CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this EIS for the proposed Desolation Flats natural gas development project discusses environmental, social, and economic factors as they currently exist within the DFPA. The material presented here has been guided by management issues identified by the BLM, Rawlins and Rock Springs field offices; 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 1988b). The critical elements of the human environment, their status in the DFPA and their potential to be affected by the proposed project are listed in Table 3-1.

Table 3-1. Critical Elements of the Human Environment[1].

Element	Status on the DFPA	Addressed in text of EIS
Air quality	Potentially affected	Yes
Areas of critical environmental concern	Potentially affected	Yes
Cultural resources	Potentially affected	Yes
Environmental justice	None present	No
Prime or unique farmlands	None present	No
Floodplains	None present	No
Native American religious concerns	Potentially affected	Yes
Invasive, non-native species	Potentially affected	Yes
Threatened and endangered species	Potentially affected	Yes
Hazardous or solid wastes	Potentially affected	Yes
Water quality (surface and ground water)	Potentially affected	Yes
Wetlands/riparian zones	Potentially affected	Yes
Wild and scenic rivers	None present	No
Wilderness	None present	No

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

3.1 GEOLOGY/MINERALS/PALEONTOLOGY

3.1.1 Geology

3.1.1.1 Regional Geologic Overview

The DFPA lies within the Washakie Basin, the easternmost subbasin of the Greater Green River Basin. Part of the Wyoming Basin Physiographic Province, the Washakie Basin is a structural basin bounded by mountain or arch uplifts. It is bounded to the east by the Sierra Madre, to the north by the Wamsutter Arch, to the west by the Rock Springs Uplift, and to the south by Cherokee Ridge. The basin is approximately 42 miles north to south and 54 miles west to east and includes an area of roughly 2,200 mi^2. Surface elevations in the basin range from about 6,100 to 8,700 feet and average about 7,000 feet.

The Washakie Basin began developing as a structural basin about 70 million years ago during the late Cretaceous Period. Its axis trends northeast-southwest and Cretaceous rocks dip inward at approximately 8 degrees along its eastern flank and about 15 degrees along its western flank (Love 1970). During the late Cretaceous and early Tertiary the basin filled with sediments eroded from surrounding highlands and mountains. Cretaceous and Tertiary sedimentary rocks comprise a great thickness in the basin. Depth to Late Cretaceous rocks in the basin central exceeds 16,000 feet and Precambrian basement rocks lie at depths greater than 32,000 feet.

The DFPA is underlain by Phanerozoic sedimentary rocks, that with the exception of lacking Silurian and Ordovician age deposits, range in age from Quaternary to Cambrian. These sediments are underlain by Precambrian metamorphic bedrock that comprise part of the ancient North American cratonic shield and probably exceeds 2 billion years in age. A geologic map of the DFPA is shown in Figure 3-1. Information on the geologic units preserved beneath the project area is provided in Table 3-2. Stratigraphic relationships of post Frontier Cretaceous units are quite complicated and rock names used vary across the area and this complexity is reflected in the table.

Geologic mapping by the USGS and Wyoming Geologic Survey (Bradley 1964, Love 1970, Love and Christiansen 1985, Love et al. 1993, and Roehler 1973, 1977, 1985) document that sedimentary deposits of Quaternary and Tertiary age crop out in the project area. More detailed information on these deposits is provided below and in Table 3-3.

Quaternary Deposits

A variety of unconsolidated or semi-consolidated sediments of Quaternary age occur at the surface of the project area. These sediments include: alluvium, colluvium, terrace gravel, wind blown sand, and loess.

Tertiary Deposits

Early Tertiary deposits exposed at the surface in the project area consist chiefly of rocks that accumulated in terrestrial and lake environments that dominated the Washakie Basin during the Eocene (Bradley 1964, Love 1970, Roehler 1973, 1987, 1991 a-b, 1992 a-c, 1993, Roehler et al. 1988). These deposits comprise, from oldest to youngest, the Wasatch Formation, Green River Formation, and Washakie Formation. The Green River Formation includes the Godiva Rim and Laney (Hart Cabin, Sand Butte and LaClede beds) Members. Younger Tertiary rocks, those of the

Browns Park Formation (Miocene), occur in the southwestern and southeastern extreme of T13N: R96W, the southern margin of the project area.

Sediments of the Wasatch Formation (Cathedral Bluffs Member) accumulated in upland flood-plain and alluvial fan environments during restriction of Lake Gosuite in late early Eocene time. Overlying deposits of the Green River (Laney Shale Member) accumulated following renewed expansion of the lake. Sediments of the Washakie Formation (Kinney Rim and overlying Adobe Town Members) accumulated flood-plain environments during the final filling of Lake Gosiute in middle Eocene (Bridgerian and early Uintan) with substantial input of volcanic material from the Absaroka's in northwestern Wyoming. Deposits of the Brown's Park accumulated in upland environments during Miocene time.

3.1.1.2 Mineral Resources

Major mineral resources within the project area include petroleum, coal, and potentially coal gas. Petroleum was first discovered in the vicinity of the DFPA in 1948 in the Wamsutter Field where production was encountered in the Almond Formation (Upper Cretaceous). The 1970s saw the discovery of oil and gas in the DFPA in Cretaceous rocks in the Haystack (T14N:R96W), McPherson Springs (T13N:R94W), Triton (T13N:R95W) and Windmill Draw (T15N:R94W) fields. Additional discoveries were made in the 1980s in the Cedar Breaks (T13-14N:R95W), Desert Rose (T14N:R96W), N.T. (T15N:R96W), Dripping Rock (T14N:R94W), Rim Unit (T14N:R95W), and Shallow Creek (T16N:R94W) fields (Table 3-4). Mineral resources also include locatable (i.e. uranium) and salable (i.e. sand and gravel, clinker - locally called "scoria") and leasable minerals, specifically, coal. Coal resources are not currently economically minable, but potential exists for coalbed methane development.

Oil, but primarily gas production, in these fields is derived from upper Cretaceous rocks ranging in depth from slightly more than 9,000 feet to more than 16,000 feet. Producing formations include with increasing age and depth the: (1) Lance Formation, (2) Fox Hills Sandstone, (3) Lewis Shale, and (4) Mesaverde Group, including chiefly the Almond Sandstone. The best producers thus far have been lenticular sandstones in the Lewis and Mesaverde Group (including the Almond Sandstone). These and other Cretaceous rocks in the Washakie Basin have been studied extensively in outcrop and in the subsurface and much of this work has been published (Pyles and Slatt 1999, Reeves et al. 1998, Brynes 1997, Carroll and Bohacs 1997, Cluff and Murphy 1997, Dunn et al. 1997, Martinsen 1997, Martinsen and Olson 1997, Tyler et al. 1997, Garcia and Surdam 1997, Smith and Surdam 1997, Surdam 1997, Surdam et al. 1997, Garcia and Surdam 1995, Hendricks 1996, Garcia et al. 1996, Yin and Surdam 1996, Christiansen 1996, Hendricks 1995, Liu 1994, Martinsen et al. 1995, Tyler et al. 1995, Surdam et al. 1995, Garcia et al. 1993, Mullen and Doelger 1993, McPeek 1981).

Considerable gas reserves may be contained in the deeper parts of the Washakie Basin in tight sands of Cretaceous and early Tertiary age generated from coals and carbonaceous shales in the Fort Union, Lance, and Mesaverde Group and perhaps the Lewis and Cody Shales. At depths greater than 8,000 feet along the basin margin and 10,000 feet in the basin center these rocks are over pressured (McPeek 1981, Surdam et al. 1995) with bottom hole pressure gradients in the 0.83 and 0.86 psi/ft for the Mesaverde at Haystack and Adobe Town, and 0.55 to 0.6 psi/ft range for younger Lance and Fort Union gas pay zones. According to McPeek (1981) there is considerable additional potential for oil and gas reserves in these units deeper in the Washakie Basin because of the abnormally high pressure gradients. These gradients result because the Lewis Shale

Table 3-2. Subsurface Geologic Deposits - Desolation Flats Project Area (Love and Christiansen 1985, Love et al. 1993).

Geologic Deposit		Geologic Age	Environment/Lithology
Fort Union Formation		Paleocene	Terrestrial/paludal, chiefly somber colored sandstones, mudstones, carbonaceous shales and coals
Lance Formation (or equivalent)		Late Cretaceous	Terrestrial/marine, brown and gray sandstone , shale and mudstone, coals, and carbonaceous shales.
Fox Hills Sandstone		Late Cretaceous	Marine/shoreline, light-colored sandstone and gray sandy shale
Lewis Shale		Late Cretaceous	Marine, gray shale containing gray, brown sandstones
Mesaverde Group	Almond Formation	Late Cretaceous	Marine/deltaic/terrestrial, white and brown sandstone, sandy shale, coal, carbonaceous shale
	Ericson Sandstone	Late Cretaceous	Marine/estuarine/nonmarine, white sandstone, lenticular conglomerate
	Rock Springs or Allen Ridge Formation	Late Cretaceous	Marine, white to brown sandstone, shale, mudstone, coal
	Blair or Haystack Mountain Formation	Late Cretaceous	
Baxter, Cody, Mancos, Steele Shales		Late Cretaceous	Marine, gray shale, with numerous bentonites, sandstone
Niobrara Formation		Late Cretaceous	Marine, light-colored limestone, gray limey shale
Frontier Formation		Late Cretaceous	Marine/deltaic, gray sandstone and sandy shale
Mowry Shale		Late Cretaceous	Marine, silver-gray, hard siliceous shale, with abundant fish scales and bentonites
Muddy Sandstone		Early Cretaceous	Marine/deltaic, gray to brown sandstone, conglomeratic
Thermopolis Shale		Early Cretaceous	Marine, black, soft, fissile shale
Cloverly Formation		Early Cretaceous	Terrestrial, variegated mudstone, bentonitic, conglomeratic sandstone
Morrison Formation		Jurassic	Terrestrial, varicolored mudstones, white sandstone, bentonite
Sundance Formation		Jurassic	Marine, green-gray glauconitic sandstone and shale, underlain by red and gray non-glauconitic shale and sandstone

Table 3-2. Continued.

Geologic Deposit	Geologic Age	Environment/Lithology
Nugget Sandstone	Triassic to Jurassic	Eolian, gray to red, massive to cross-bedded sandstone
Chugwater Formation	Triassic	Terrestrial/mud flat, red shale and siltstone, sandstone
Dinwoody Formation/Goose Egg Formation	Permian to Triassic	Marine, gray to olive dolomitic siltstone (Dinwoody); red sandstone and siltstone, gypsum, halite, purple to white dolomite and limestone (Goose Egg)
Phosphoria Formation/Goose Egg Formation	Permian	Marine, dark to light gray, green to black, glauconitic shale and sandstone, phosphatic sandstone and dolomite (Phosphoria)
Tensleep Sandstone	Pennsylvanian	Marine, white to gray sandstone with limestone and dolomite
Amsden Formation	Mississippian to Pennsylvanian	Marine, red and green shale and dolomite, persistent red to brown sandstone at base
Madison Limestone	Mississippian	Marine, glue-gray massive limestone and dolomite
Flathead Sandstone	Cambrian	Marine/shoreline, red, banded, quartzose sandstone
unnamed metamorphic rocks	Precambrian	Igneous/metamorphic, granitic and/or intrusive

Table 3-3. Summary of Surface Geologic Deposits and Paleontologic Resources - Desolation Flats Project Area.

Geologic Deposit	Geologic Age	Type of Deposit/ Environment of Deposition	Fossil Resources	BLM Paleontologic Class	Area Present
Alluvial sediments (including alluvium and colluvium)	Holocene	Unconsolidated silts, sands of valleys and plains. Terrestrial-fluvial.	None	2	Widespread
Terrace deposits	Pleistocene	Gravels, silts and sands that predate current erosional cycle. Terrestrial-fluvial.	None	2	Scattered along modern river and stream drainages
Browns Park Formation	Miocene	White sandy tuff and tuffaceous sandstone and mudstone, basal conglomerate. Terrestrial, fluvial, volcanic.	vertebrates, plants	2	Extreme SW and SE T13N-R96W
Washakie Formation	middle Eocene (Bridgerian to Uintan)	Tuffaceous sandstone and bentonitic mudstone, limestone. Terrestrial-fluvial, flood-plain, accumulated after drying up of Lake Gosiute.	vertebrates, invertebrates, plants, trace fossils	5	Widespread in central Washakie Basin
Green River Formation Laney Shale Member Hart Cabin Bed	middle Eocene	Drab-colored sandstone, siltstone, mudstone. Terrestrial-fluvial, accumulated during drying up of Lake Gosiute	vertebrates, invertebrates	5	East flank and south Washakie Basin
Green River Formation Sand Butte Bed	middle Eocene	Tuffaceous siltstone, and sandstone interbedded with brown oil shale and gray limestone, as well as tuff. Lacustrine.	vertebrates, invertebrates	5	East flank and south Washakie Basin
Green River Formation Laney Shale Member LaClede Bed	middle Eocene	Chiefly oil shale, lesser algal limestone, sandstone, claystone and tuff. Lacustrine, accumulated during renewed expansion of Lake Gosiute.	vertebrates, invertebrates, trace fossils	5	Northeast flank Washakie Basin
Green River Formation unnamed basal tongue (=Godiva Rim Member?)	middle Eocene	Interbedded gray, fine-grained sandstone, brown oil shale, green mudstone, gray-green shale, and gray ostracodal, oolitic, and algal limestone. Lacustrine to fluvial	vertebrates, invertebrates, trace fossils	5	East flank and south Washakie Basin
Wasatch Formation Cathedral Bluffs Member	early Eocene	Varicolored, chiefly red sandstone and mudstone. Terrestrial, fluvial, flood plain, accumulated lateral to Lake Gosiute along basin margin.	vertebrates, plants	5	Northeast flank Washakie Basin

Table 3-4. Oil and Gas Fields in the Desolation Flats Project Area.

Field Name	Location	Year Discovered	Producing Formation-Age	Producing Depth Approx (Ft)	Cumulative Oil/ Gas since 1976	Comments
Cedar Breaks	13-14N-95W	1983	Fox Hills-Cretaceous Almond-Cretaceous	10,524 12,650	12 BO/283,583 MCFG	Producing, last report 9/2000
Desert Rose	14N-96W	1986	Lewis-Cretaceous	13,546	0 BO/68,004 MCFG	Abandoned 1987
Dripping Rock	14N-94W	1984	Lance-Cretaceous Lewis-Cretaceous Almond-Cretaceous	12,580	46,390BO/93,494,737134,465 MCFG	Producing, last report 9/2000
Haystack	14N-96W	1978	Lance-Cretaceous Almond-Cretaceous	16,100	0 B0/115,136 MCFG	Abandoned 1985
McPherson Springs	13N-94W	1979	Lewis-Cretaceous Mesaverde-Cretaceous	10,219 11,680	638 BO/489,047 MCFG	Producing, last report 7/2000
N.T.	15N-96W	1982	Lewis-Cretaceous Mesaverde-Cretaceous	12,908 14,796	0 BO/0 MCFG	Shut-in since 11/82
Rim Unit	14N-95W	1988	Lewis-Cretaceous	13,258	12 B/283,583 MCFG	Producing, last report 7/2000
Shallow Creek	16N-94W	1981	Lance-Cretaceous	9,029	10,811 BO/308,134 MCFG	Abandoned 1996
Triton	13N-95W	1979	Lewis-Cretaceous	13,276	3,077 BO/5,429,973 MCFG	Producing, last report 8/2000
Windmill Draw	15N-94W	1977	Almond-Cretaceous Ericson-Cretaceous		1,987 BO/8000,494 MCFG	Producing, last report 7/2000

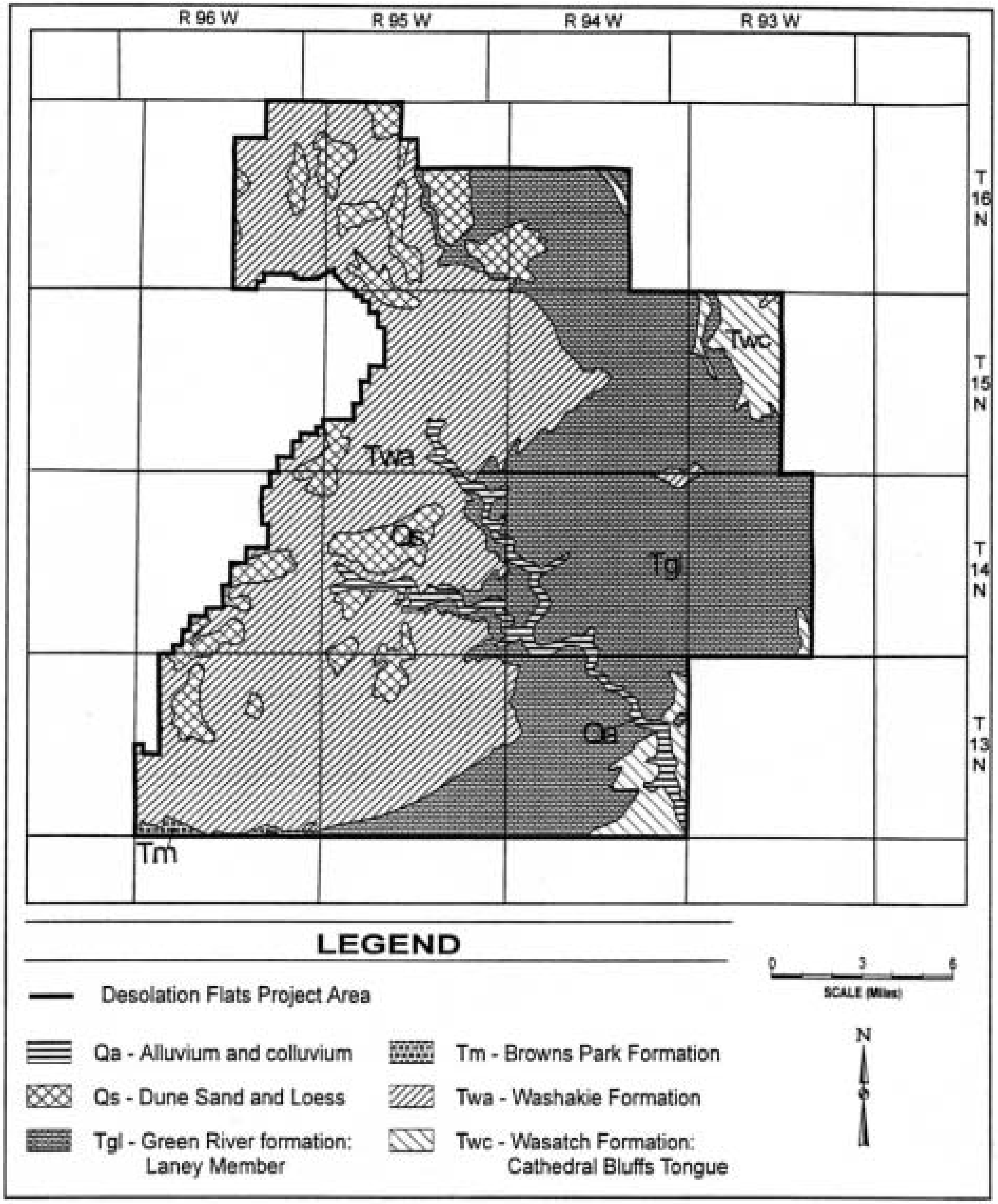


Figure 3-1. Geologic Formations within the Desolation Flats Project Area.

apparently acts as a very good seal for gas generated in the Mesaverde as it has a calculated sealing capacity of greater than 5,000 feet of gas in some areas (Surdam et al. 1995).

Deeper parts of the eastern Green River Basin (including the Washakie Basin) remain sparsely explored, but sandstones in the Lewis and Almond formations, as well as younger ones in the overlying Lance and Fort Union formations, might prove to contain large reserves (>20Tcf) of natural gas. Thermal and maturation modeling (Surdam et al. 1995) show that Almond Formation shale and coal in the central parts of the basin had generated significant amounts of liquid hydrocarbons by 40 million years ago and that gas generation from oil to gas reaction had progressed significantly by 30 million years ago. McPeek (1981) estimated 15-17 BCF per well recoverable, whereas Tyler et al. (1995) estimated that between 10 and 50 BCF of gas/mi^2 for Almond Formation and 2 to 8 BCF gas for the Fort Union Formation may underlie the DFPA. Coal resources are not currently economically minable, but the potential exists for coalbed methane development.

The only additional mineral resources documented by the Geological Survey of Wyoming (Harris et al. 1985, Harris and Meyer 1986) include includes construction materials that occur at widely spaced locations in the DFPA. Construction grade wind blown sand deposits occur over large areas of the central Washakie Basin (T13-16N:R96W; T13-14N:R95W; and T16N:R95 W). Alluvial sands and gravels occur in the drainage of Sand Creek in T14-15N:R94-95W and T13N:R94W.

3.1.1.3 Geologic Hazards

Potential geologic hazards include landslides, subsidence, and active or suspected active faults. Landslide potential is greatest in areas where steep slopes occur, particularly where geologic dip on rock formations is steep and parallel to slope or where erosional undercutting may occur. A few landslides have been mapped within the DFPA in T14N:R93W (Case et al. 1991), but these are of limited extent. Areas with unstable soils may also be susceptible to slumping, sliding, and soil creep.

No earthquake epicenters have been noted in the area. Several NW-SE trending faults have been mapped in the southern part of the DFPA (T13-14N:R93-96W). These faults, associated with the Cherokee Arch, do not show evidence of Quaternary activity (Glaze 1973, Case et al.1994, www.wrds.uwyo.edu/wrds/wsgs/hazards/quakes/quake).

3.1.2 Paleontology

3.1.2.1 Paleontologic Overview

Paleontologic resources within sedimentary deposits in the project area record the history of animal and plant life in Wyoming during the early part of the Cenozoic Era. The record represented by Cenozoic age deposits spans about 25 million years and includes parts of the Tertiary and Quaternary Periods.

Mapping documents four geologic deposits that are exposed at the surface in the DFPA. These include, from youngest to oldest: (1) unnamed deposits of late Holocene age including unconsolidated eolian sands, playa lake sediments, stream gravels, alluvium, and colluvium; (2) Browns Park Formation of Miocene age; (3) Washakie Formation of middle Eocene age including the Adobe Town and Kinney Rim members; (4) Green River Formation of middle Eocene age including the Laney and Godiva Rim members; (5) Wasatch Formation of early Eocene age, including the Cathedral Bluffs members.

With the exception of the Holocene deposits that are probably too young to contain fossils, all the listed sedimentary rock units have the potential to produce scientifically significant fossil resources. Recent published reports of the vertebrate paleontology of the Wasatch, Green River, and Washakie formations include reports by McCarroll and Turnbull (1996), McCarroll (1994, 1996a-b), McGee (1993), Townsend and Harrisville (1993), Turnbull (1978, 1993), Burke (1993), and Covert (1993).

3.1.2.2 BLM Paleontology Classes

BLM paleontology classifications are the basis for establishing the paleontologic potential of surface geologic formations and for determining the need for additional consideration of an area. These categories were originally developed by the Paleontology Center of Excellence and the Region 2 (USFS) Paleo Initiative, modified by Dale Hanson (Regional Paleontologist, Wyoming BLM, 2002) and are defined for each formation listed in Table 3-3. They include the following:

Class 1

Igneous and metamorphic geologic units or units representing heavily disturbed preservational environments that are not likely to contain recognizable fossil remains (tuffs are excluded from this category). Fossils of any kind not known to occur except in the rarest of circumstances. Soils are of igneous or metamorphic origin, landslides and glacial deposits. Land managers' concern for paleoresources on Class 1 areas is negligible. Ground-disturbing activities will not require mitigation except in rare circumstances.

Class 2

Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically important nonvertebrate fossils. Vertebrate fossils known to occur very rarely or not at all. Age greater than Devonian or younger than 10,000 years before present. Soils of deep marine or aeolian origin. Diagenetic alterations are great enough to have destroyed fossils. Land managers' concern for paleoresources on Class 2 areas is low. Ground-disturbing activities are not likely to require mitigation.

Class 3

Fossiliferous sedimentary geologic units contain fossil deposits and vary in importance, abundance and predictable occurrence. Also includes sedimentary units of unknown fossil potential, including geologic units with sporadic known occurrences of vertebrate fossils. The vertebrate fossils and important nonvertebrate fossils known to occur sporadically; predictability of fossil occurrence known to be low. This class poorly studied and/or poorly documented, and potential fossil yield cannot be assigned without ground reconnaissance.

Land managers' concern for paleoresources on Class 3 areas may extend across the entire range of management. Ground-disturbing activities would require sufficient mitigation to determine whether important paleoresources occur in the area of a proposed action. Mitigation beyond initial findings could range from no mitigation being necessary, to full and continuous monitoring of significant localities during the action.

Class 4

Class 4 geologic units are Class 5 units (see below) that have lower risk of human-caused adverse impacts and/or lower risk of natural degradation. Because of substantial soil/vegetative cover, outcrop is not likely to be impacted. In addition, these units have areas of exposed outcrop that are smaller than 2 contiguous acres, and may form cliffs of sufficient height and slope that most deposits are out of reach by normal means or have other characteristics that lower the vulnerability of both known and unidentified fossil sites. Land managers' concerns for paleoresources on Class 4 areas are toward management and away from unregulated access. Proposed ground-disturbing activities would require assessment to determine whether significant paleoresources occur in the area of a proposed action and whether the action would impact the paleoresources. Mitigation beyond initial findings would range from no mitigation to full and continuous monitoring of significant localities during the action. This classification often may not be applied until after on-the-ground assessments are made.

Class 5

These units are highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically important nonvertebrate fossils. These units are generally at risk of natural degradation and/or human-caused adverse impacts. Vertebrate fossils and/or scientifically important nonvertebrate fossils are known and documented to occur consistently, predictably, and/or abundantly in these units. Units are generally exposed having little or no soil/vegetative cover. Outcrop areas are extensive, and discontinuous areas are larger than 2 contiguous areas. These units erode readily to form badlands. These units are generally contiguous with extensive outcrop or other characteristics that increase the sensitivity of both known and unidentified fossil sites. Land managers' highest concern for paleoresources should focus on Class 5 areas. These areas are likely to be poached. Mitigation of ground disturbing activities is required and may be intense. Areas of special interest and concern should be designated and intensely managed.

3.2 CLIMATE AND AIR QUALITY

3.2.1 Climate

The climatic conditions for the DFPA are classified as a semiarid mid-continental regime. The climate is typified by dry, windy conditions with limited precipitation and long cold winters. The nearest meteorological measurements were recorded at Baggs, Wyoming for the dates September 1979 through July 2000. The Baggs meteorological station is located approximately 14 miles east of the project area at an elevation of 6,239 feet. Due to the wide variation in elevation and topography within the project area, site specific climatic conditions may vary considerably from the conditions recorded at the Baggs station.

The recorded temperatures at the Baggs station are typically cool, with average daily temperatures ranging between 7°F and 34°F in midwinter and 45°F to 83°F during midsummer. Extreme temperatures have ranged from -50°F (January 14, 1984) to 100°F (August 18, 1984).

The annual average total precipitation is slightly greater than 11 inches. Over 68% of the average annual precipitation occurs between May and October. The annual average snowfall totals 40.5 inches, with December and January being the snowiest months at 9.6 and 8.4 inches respectively. Table 3-5 presents the average temperature range, average total precipitation and average total snowfall by month, while figures 3-2 through 3-4 present the average climatic conditions graphically.

Table 3-5. Mean Monthly Temperature Range, Total Precipitation and Snowfall.

Month	Average Temperature Range (°Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
January	5.1 - 32.9	0.49	8.4
February	8.6 - 36.6	0.45	5.7
March	19.9 - 47.3	0.44	5.2
April	27.4 - 58.3	0.88	2.5
May	34.2 - 67.7	1.64	0.2
June	41.2 - 79.0	0.98	0.0
July	47.6 - 85.6	1.46	0.0
August	46.1 - 83.7	0.97	0.0
September	37.7 - 74.2	1.15	0.0
October	26.8 - 61.0	1.46	2.0
November	16.6 - 43.5	0.71	6.9
December	6.5 - 33.8	0.55	9.6
Annual Average	26.5 - 58.6	11.19	40.5

Source: (High Plains Regional Climate Center, undated)

The project area is subject to strong gusty winds, often accompanied by snow during the winter months, producing blizzard conditions and drifting snow. The nearest comprehensive wind data were collected at the Rawlins, Wyoming airport, approximately 60 miles from the project area. However, hourly wind data for the period December 1994 through November 1995 were collected near Baggs, Wyoming as part of the Mount Zirkel Wilderness Area Visibility Study. The close proximity of the Baggs station to the project area suggests that these data, rather than the more distant Rawlins data, best represent the wind conditions occurring within the project area. Figure 3-5 presents a wind rose generated from the Baggs data for the period December 1, 1994 through November 30, 1995. The wind rose depicts the relative directional frequency of the winds and the speed class. As indicated, the winds are predominately from the south to southwest approximately 37 percent of the time. The annual mean wind speed is 10.4 miles per hour (4.64 meters/second). Note that the meteorological data set used to generate the wind rose was processed with calm wind measurements set to a speed of one meter per hour. Therefore, the wind rose shows essentially no calms.

The direction and strength of the wind directly affects the dispersion and transport of pollutants emitted to the atmosphere. The strong winds typically present within the project area enhance the potential for the mixing and transport of the pollutants. Table 3-6 presents the wind speed frequency distribution while Table 3-7 summarizes the wind direction frequency.

The Proposed Action and alternatives are not expected to have any adverse effect on the local or regional climate. Therefore, climate is not further discussed in this document.

Table 3-6. Wind Speed Frequency Distribution.

Wind Speed (miles per hour)	Percentage of Occurrence
0.0 to 4.0	6.6
4.0 to 7.5	33.2
7.5 to 12.1	29.6
12.1 to 19.0	21.8
19.0 to 24.7	5.8
Greater than 24.7	3.1

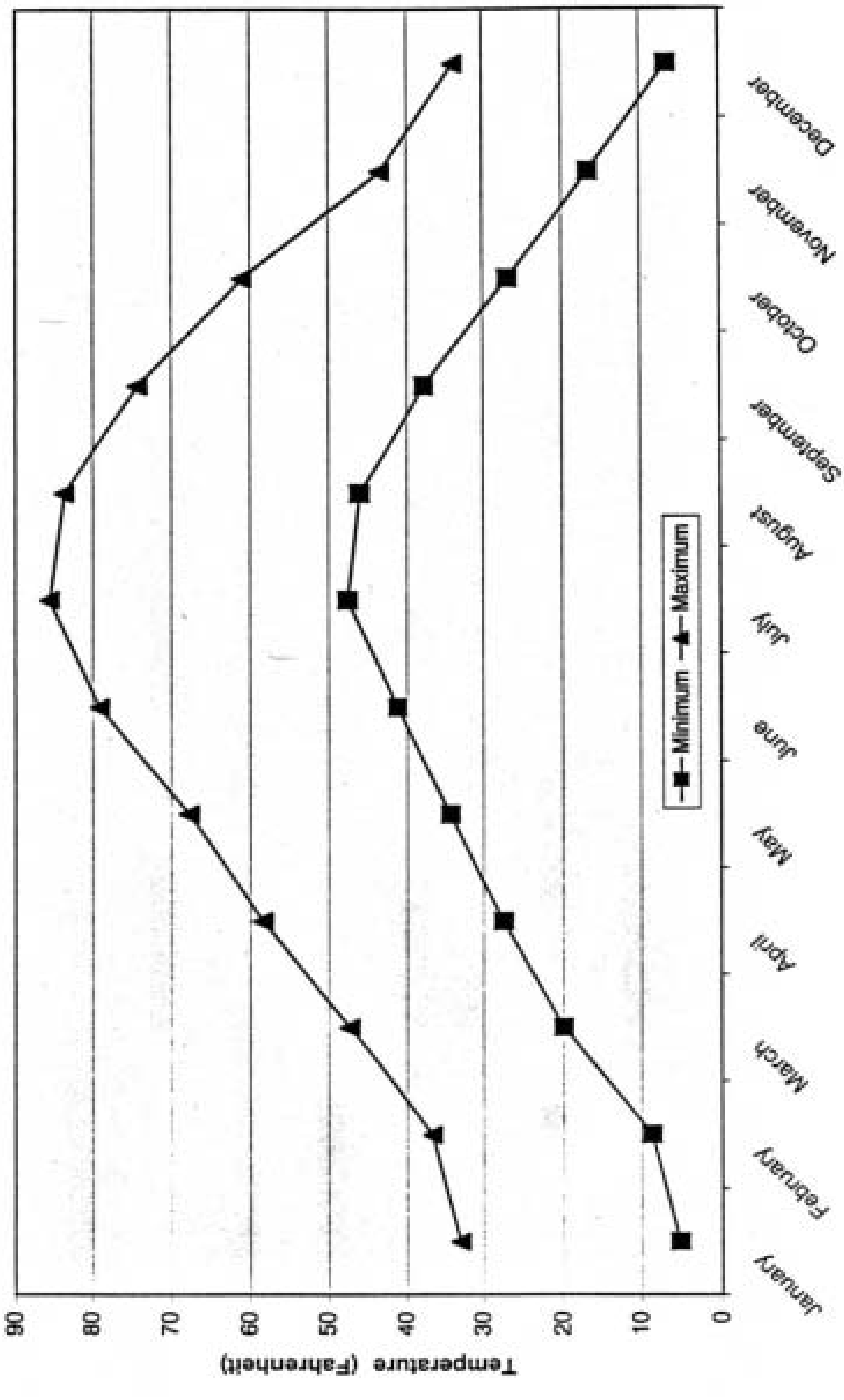


Figure 3-2 Mean Monthly Average Temperature at Baggs, Wyoming (1979 - 2000)

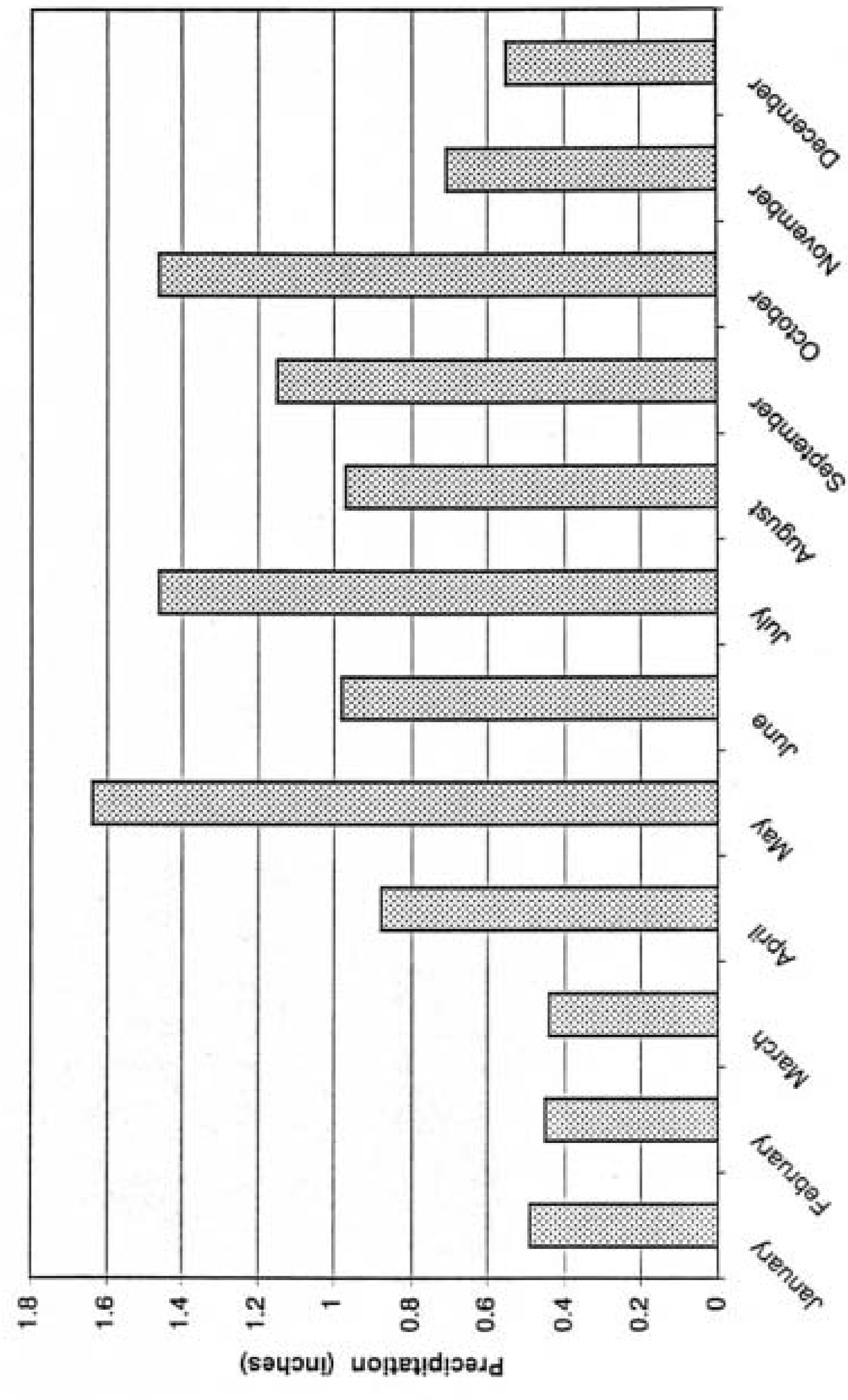


Figure 3-3 Mean Monthly Average Precipitation in Baggs, Wyoming (1979 - 2000)

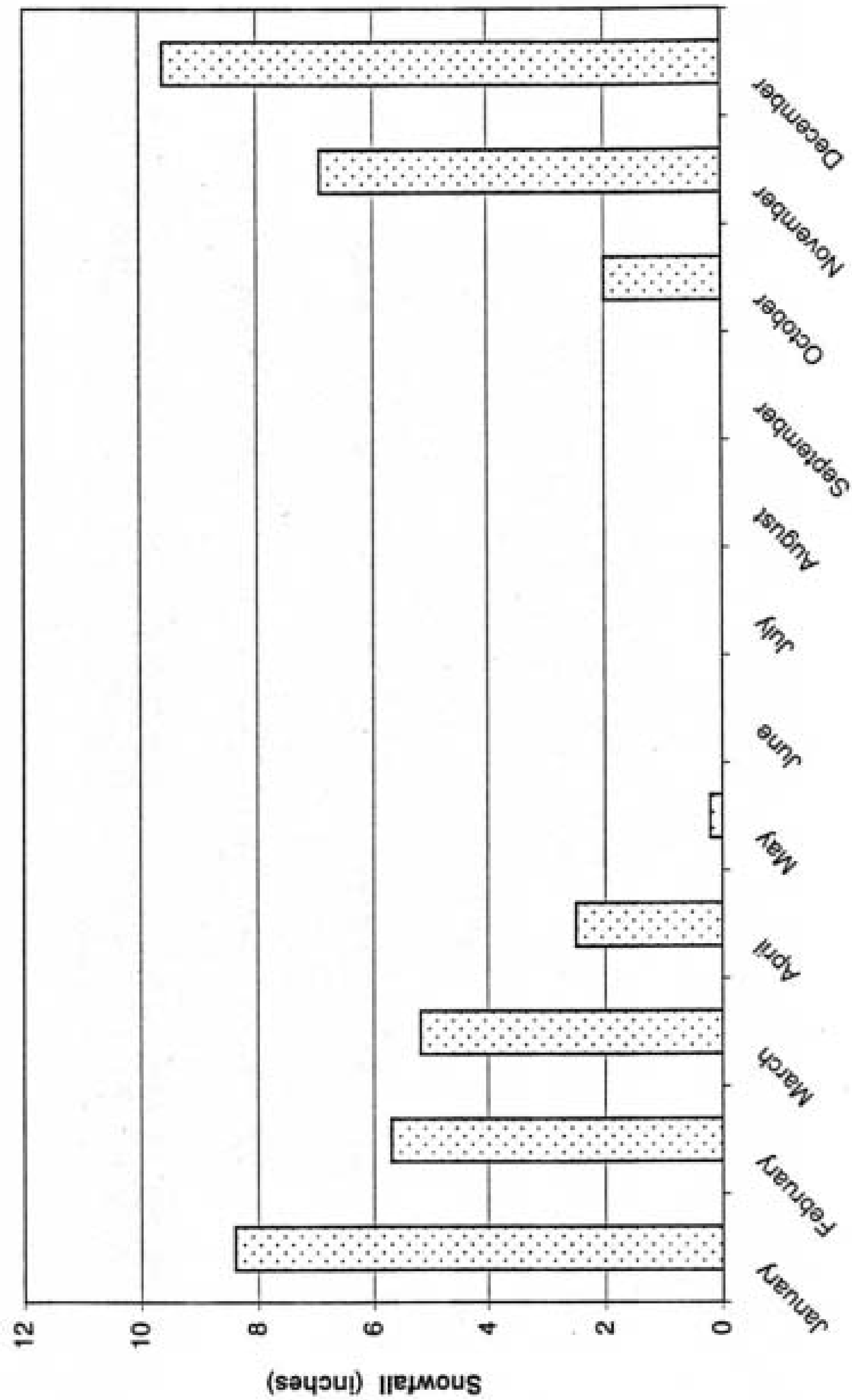


Figure 3-4 Mean Monthly Average Snowfall at Baggs, Wyoming (1979 - 2000)

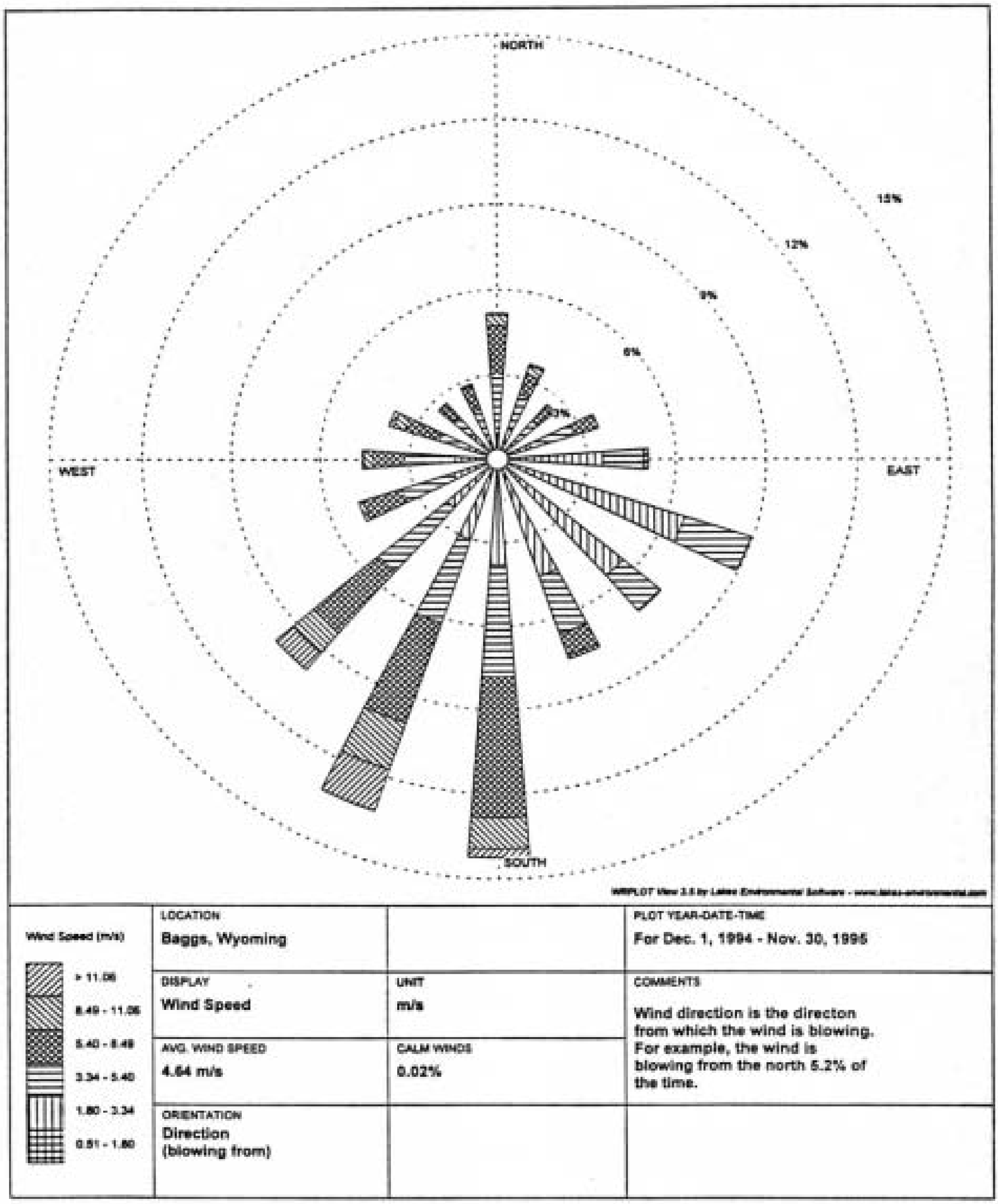


Figure 3-5. Wind Rose Generated from Baggs Data for December 1, 1994 through November 30, 1995.

Table 3-7. Wind Direction Frequency.

Direction From Which Wind Is Blowing	Percentage of Occurrence
North	5.2
North Northeast	3.6
Northeast	2.6
East Northeast	3.6
East	5.0
East Southeast	9.0
Southeast	7.2
South Southeast	7.5
South	14.2
South Southwest	13.2
Southwest	10.0
West Southwest	4.9
West	4.5
West Northwest	3.9
Northwest	2.7
North Northwest	2.8

3.2.2 Air Quality

National and state ambient air quality standards set acceptable limits for criteria air pollutant concentrations. Although specific air quality monitoring has not been conducted within the project area, criteria pollutant background concentrations measured in the region are in attainment with the National, Wyoming and Colorado ambient air quality standards, indicating that the local air quality is good. Table 3-8 presents the measured background concentrations and the ambient air quality standards.

Incremental increases in the ambient concentration of criteria pollutants are regulated under the Prevention of Significant Deterioration (PSD) program. The project and the majority of the surrounding region is classified as PSD Class II. However, five PSD Class I areas identified as sensitive receptors exist within the study area: Bridger Wilderness, Fitzpatrick Wilderness, Savage Run Wilderness, Mount Zirkel Wilderness, and Rawah Wilderness. In addition, three PSD Class II sensitive receptor areas were analyzed: Wind River Roadless Area, Popo Agie Wilderness Area and Dinosaur National Monument. As shown in Table 3-8, the limitations on the incremental increases in pollutant concentrations are very restrictive for PSD Class I areas as compared to Class II areas. Figure 3-6 presents a map of the air quality study area and indicates the location of the DFPA and the identified sensitive PSD Class I and Class II areas.

Table 3-8. Background Concentrations and Ambient Air Quality Standards ($\mu g/m^3$).

Pollutant and Averaging Time	Background Concentration	Wyoming Ambient Air Quality Standards	Colorado Ambient Air Quality Standards	National Ambient Air Quality Standards	PSD Class I Increment	PSD Class II Increment
Carbon Monoxide (CO)						
CO 1-hr	2,299 [a]	40,000	40,000	40,000	None	None
CO 8-hr	1,148 [a]	10,000	10,000	10,000	None	None
Nitrogen Dioxide (NO_2)						
NO_2 Annual	10 [b]	100	100	100	2.5	25
Ozone (O_3)						
O_3 1-hr	144 [d]	None	None	235	None	None
O_3 8-hr	139 [d]	157	157	157	None	None
Particulate Matter less than 10 microns (PM_{10})						
PM_{10} 24-hr	20 [c]	150	150	150	8	30
PM_{10} Annual	12 [c]	50	50	50	4	17
Particulate Matter less than 2.5 microns ($PM_{2.5}$)						
$PM_{2.5}$ 24-hr	10 [e]	None	None	65	None	None
$PM_{2.5}$ Annual	6 [e]	None	None	15	None	None
Sulfur Dioxide (SO_2)						
SO_2 3-hr	29 [f]	1,300	700	1,300	25	512
SO_2 24-hr	18 [f]	260	365	365	5	91
SO_2 Annual	5 [f]	60	80	80	2	20

Note: Effective February 27, 2001 the U.S. Supreme Court upheld the EPA's position on the proposed national 8-hr ozone and PM2.5 standards. Implementation of these standards is pending.

The ozone 1-hour background concentration represents the 90[th] percentile of the annual maximum daily 1-hour concentrations for the months April through August.

The 8-hour ozone background concentration represents the average annual 4[th] highest daily maximum 8-hour average.

Other short-term background concentrations represent the second highest measured value.

Sources:

a. CDPHE, 1996 - Data collected at Rifle and Mack, Colorado in conjunction with proposed oil shale development during early 1980s.
b. BLM 1996b - To supplement monitored NO_2 data, a separate NO_2 modeling analysis was performed which included many NO_x emission sources.
c. WDEQ, 1997 data collected for the Carbon County UCG Project, data collected 9 miles west of Rawlins, WY, June 1994-November, 1994
d. Clean Air Status and Trends Network, n.d. - Data collected at Pinedale, Wyoming (1997 - 1999).
e. Background $PM_{2.5}$ concentrations estimated at one-half of PM_{10} values based upon EPA literature.
f. CDPHE-APCD, 1996 - Data collected at the Craig Power Plant site and at Colorado Oil Shale areas from 1980 to 1984.

It should be noted that any comparisons made to the PSD Class I and II increments during this analysis are intended to evaluate an "impact threshold" and do not represent a regulatory PSD increment consumption analysis. The determination of PSD increment consumption is a state air quality regulatory agency responsibility with oversight from the Environmental Protection Agency (EPA). A PSD increment consumption analysis is part of the major New Source Review process and may also be performed by a state regulatory agency or EPA in order to determine minor source increment consumption.

In addition to ambient air quality standards and PSD increments, Air Quality Related Values (AQRV's), which include the potential air pollution effects on visibility and the acidification of surface water bodies, is a concern for the sensitive PSD Class I and Class II receptors. Visibility is often referred to in terms of atmospheric light extinction or visual range, that is the furthest distance a person can see a landscape feature. Visibility also involves how well scenic landscapes can be seen and appreciated. When visibility is impaired by air pollution, people perceive a loss of color, contrast and detail.

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 Forest Service (FS) has identified specific "Level of Acceptable Change" (LAC) values which they use to evaluate potential air quality impacts within their wilderness areas (USDA-FS 1993). For visibility impacts, the FS utilizes a LAC of 0.5 deciview, or "one-half of a just noticeable change."

Continuous visibility related background data collected as part of the Interagency Monitoring of PROtected Visual Environments (IMPROVE) program are available for two sensitive receptors within the study area: Bridger Wilderness and Mt. Zirkel. The Bridger data best represent existing conditions at the Bridger, Fitzpatrick, and Popo Agie wilderness areas and the Wind River Roadless Area, while the Mt. Zirkel data best represent existing conditions for Dinosaur National Monument and the Mt. Zirkel, Savage Run, and Rawah wilderness areas.

Table 3-9 summarizes the seasonal visibility conditions recorded at Bridger Wilderness. As shown, visibility in the region is very good, with an annual average visual range of 175 miles. Figure 3-7 presents a five year rolling average of the 20% cleanest, 20% haziest and the mid-range 40% to 60% visibility conditions monitored at Bridger Wilderness between 1988 and 1999 (IMPROVE 2001). As shown, monitored visibility conditions at Bridger Wilderness have been stable over the period. Visibility conditions for Mt. Zirkel are similar to Bridger Wilderness.

Acid deposition and the acidification of surface water bodies is a concern for sensitive lakes located within wilderness areas. Atmospheric acid deposition is monitored as part of the National Acid Deposition Program / National Trends Network near Pinedale, Wyoming. Although the monitored deposition values are well below those considered to damage vegetation (USDI-BLM 1996b), even low levels of acid deposition may exceed the acid neutralizing capacity (ANC) of sensitive high mountain lakes (USDI-BLM 1996b). Baseline ANC levels for monitored mountain lakes within the study area are provided in Table 3-10.

To evaluate potential acid deposition impacts, the FS utilizes an LAC of no greater than 1 microequivalent/liter (eq/l) change in ANC for sensitive water bodies with existing ANC levels less than 25 eq/l. A 10 percent change in ANC is considered significant for lakes with existing ANC levels over 25 eq/l.

Table 3-9. Baseline Standard Visual Range for the Bridger Wilderness Area.

Season	Standard Visual Range (kilometers)	Deciview (Unitless)
Annual	175	8.1
Spring	165	8.6
Summer	162	8.8
Autumn	169	8.4
Winter	218	5.9

Note: Data is aggregated over the three year period between March 1996 and February 1999 (IMPROVE 2000).

Table 3-10. Background Acid Neutralizing Capacity (ANC) for Monitored Lakes.

Wilderness Area	Water Body	Background ANC (µeq/l)
Bridger	Black Joe Lake	69.0 [a]
	Deep Lake	61.0 [a]
	Hobbs Lake	68.0 [a]
	Upper Frozen Lake	5.7 [b]
Fitzpatrick	Ross Lake	61.4 [a]
Popo Agie	Lower Saddlebag Lake	55.5 [a]
Mount Zirkel	Pothole A-8	16.0 [d]
	Seven Lakes	35.5 [d]
	Upper Slide Lake	24.7 [d]
Medicine Bow	West Glacier	26.1 [c]
Rawah	Island Lake	64.6 [a]
	Rawah #4 Lake	41.2 [a]

Note: The basis for ANC data is the 10th percentile of measurements at the lake outlet when greater than 5 years of data exist. When 5 or less years of data are available, average values are used.

Sources:
a. D. Haddow, USDA-FS, 2001.
b. T. Svalberg, USDA-FS, 2000.
c. R. Musselman, USDA-FS, 2001.
d. A. Mast, USGS, 2001.

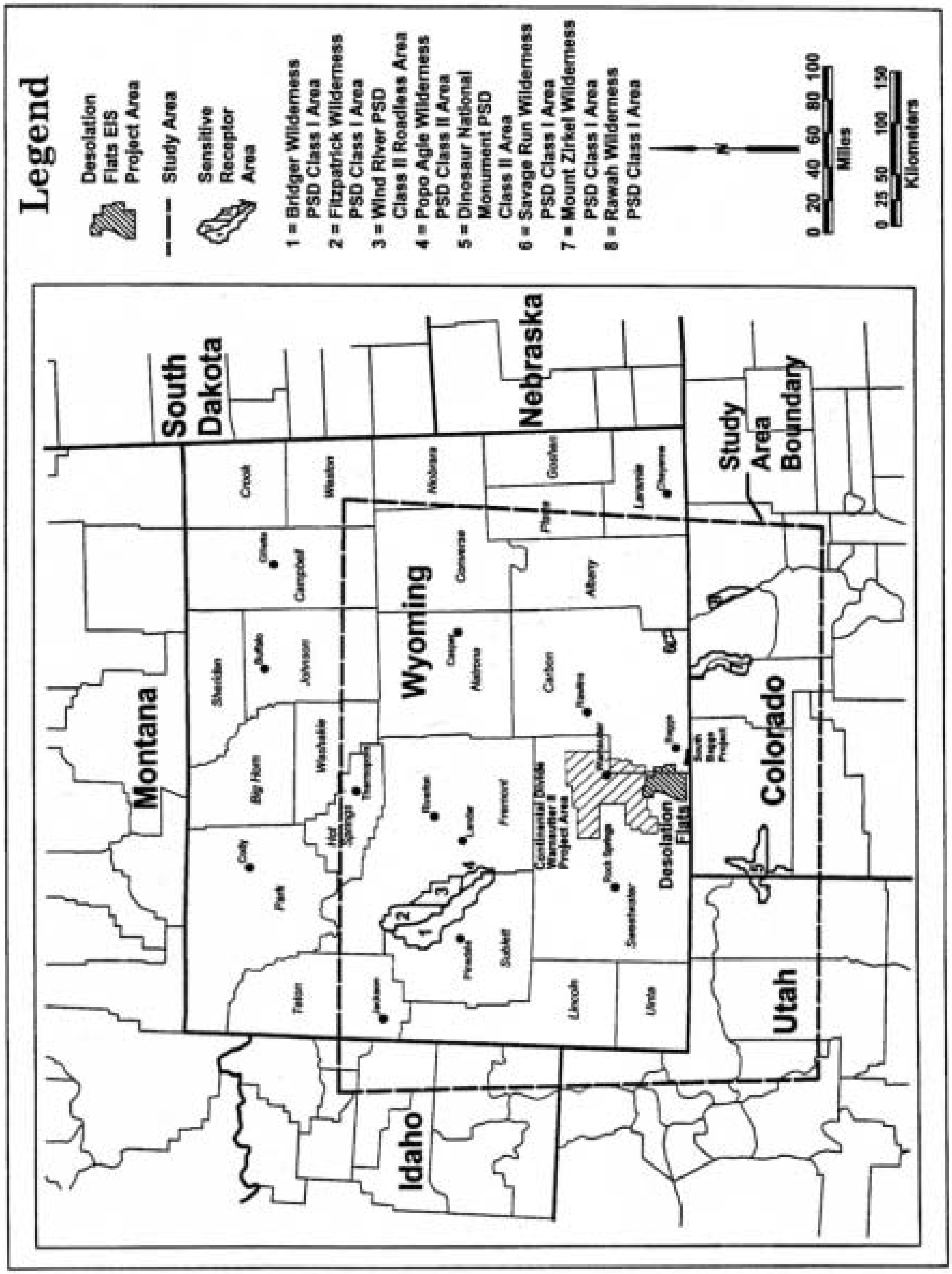


Figure 3-6. Air Quality Impact Assessment Area

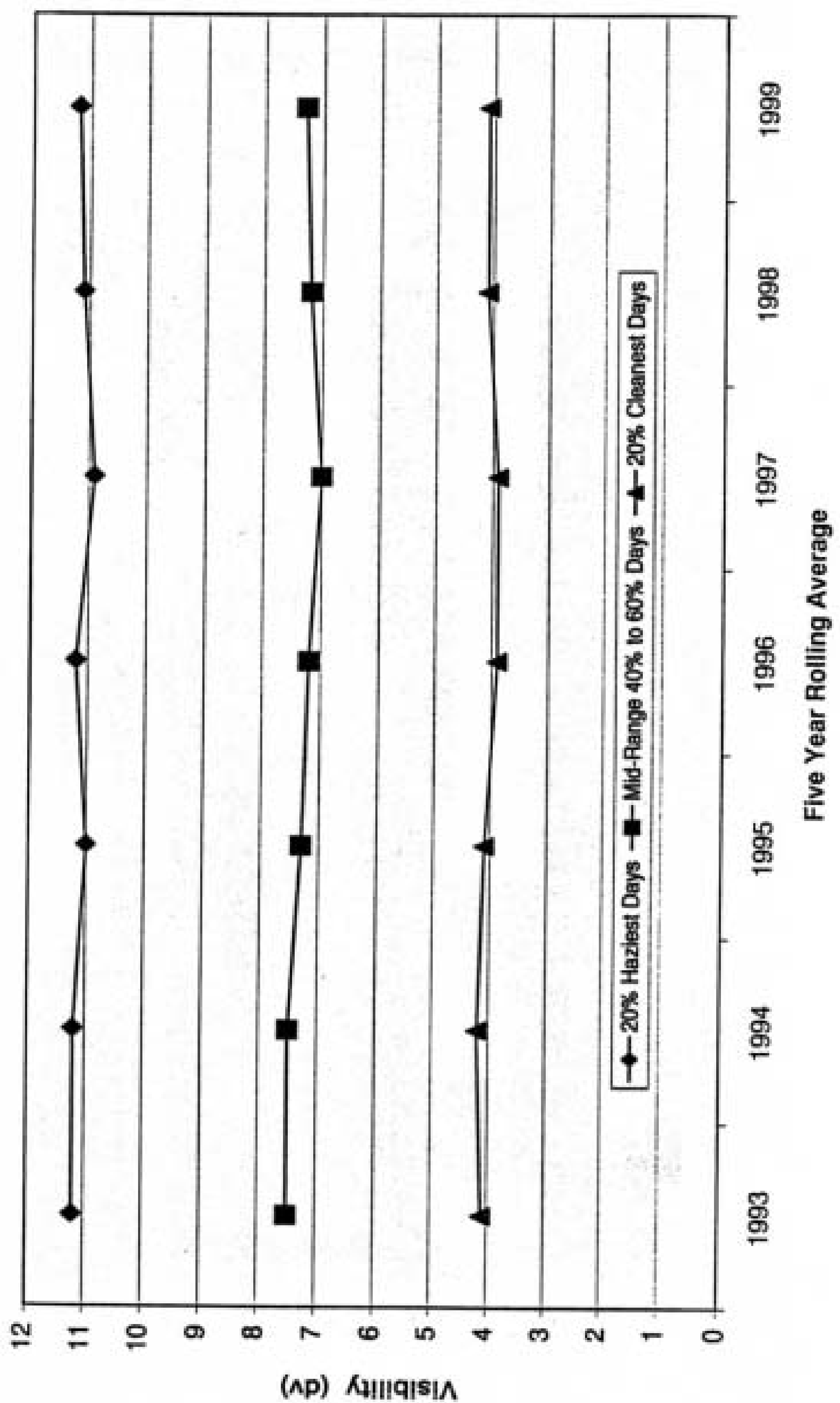


Figure 3-7 Visibility In Bridger Wilderness

3.3 SOILS

3.3.1 Topography

The range of topography within the DFPA is quite variable. There are nearly level to gently sloping floodplains and alluvial terraces; alluvial fans as well as moderately sloping terraces; and rolling, undulating residual upland hills and terraces. These are broken by steep escarpments and badlands. Maximum elevation is approximately 2,300 meters and occurs near the southern project boundary on Powder Rim. Minimum elevation is approximately 1,880 meters occurring in the extreme southeastern corner of the project area near the confluence of Sand Creek with the Little Snake River.

3.3.2 Soils

Soils within the project area are distributed according to primary differences in parent material (both residual and depositional), elevation, moisture, and topographic slope and position. Baseline soils information was extracted from two existing BLM soil surveys (USDI-BLM 1981).

In addition, field investigation was utilized to gather site-specific information on soil characteristics, verify existing information, assess existing soil disturbance, and develop field-wide reclamation recommendations. Approximately 13 percent of the project area does not have information available through the soil surveys mentioned earlier.

3.3.2.1 General Soil Characteristics

The DFPA is considered part of the Washakie Basin. Upper Eocene and Quaternary make up the majority of the major geologic units in the area and have a distinct impact on the subsequent development of the soils and their distribution. The dominant Upper Eocene formation is the Washakie Formation and its associated Adobe Town Member. Textures in this member are various and range from sandstone, siltstone, mudstone, silty limestone, silty dolomite, tuff and conglomerate. Upper Tertiary formations are located on the southern end of the project area at Powder Rim and primarily include the Browns Park Formation; textures vary from sandstone, siltstone and mudstone. Lower Eocene formations are located on the eastern border of the project area. The dominant formation is the Green River Formation (Hartt Cabin Bed of Laney Member); textures vary from sandstone, siltstone, mudstone, oil shale, limestone, and dolomite. Pockets of Quaternary sands are scattered throughout the central portion of the project area; resulting soils are distinctly sandy and almost appear dune-like.

Soils are primarily included in the Torriorthents-Camborthids-Haplargids association with areas along the Little Snake River in the Torrifluvents-Fluvaquents-Haplaquepts association. Such soils 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 and river courses. Residual soils formed from the many types of bedrock exposed at the surface, as well as from wind and flowing water deposits. Principle parent materials of soils in the project area are shales, siltstones, sandstones, and alluvium.

Two "Order 3" soil surveys have been completed for the project area, one by Texas Resource Consultants and one by Soil and Land Use Technology, Inc. Much of the information utilized for this project was derived from the second survey mentioned above. 108 soil map units have been delineated within the project area by the BLM (USDI-BLM 1981). The series contained within these map units are included in the twenty soil taxonomic classes listed in Table 3-11 (USDA-NRCS 2000):

Table 3-11. Soil Taxonomic Classes.

Taxonomic Class	Number of Soil Series in Project Area
Aquandic Endoaquoll	1
Aquic Hapludult	1
Aridic Calciustept	1
Leptic Haplogypsid	1
Lithic Calciustept	1
Pachic Haploxeroll	1
Leptic Torrertic Natrustalf	1
Typic Fluvaquent	1
Typic Haplocalcid	1
Typic Natriargid	4
Typic Torrifluvent	2
Typic Torriorthent	7
Typic Torripsamment	2
Ustertic Haplocambid	1
Ustic Calciargid	3
Ustic Haplargid	5
Ustic Haplocalcid	6
Ustic Haplocambid	1
Ustic Natriargid	3
Ustic Torriorthent	5
TOTAL	48

Of the 233,542 acres of land within the project area, most (154,104.2 acres or 66 percent) are considered sensitive for topsoil or roads or are susceptible to runoff, wind erosion, or water erosion. The balance (79,437.8 acres or 34 percent) are non-sensitive soils. Table 3-12 provides an approximate breakdown of sensitivity by category, nature of sensitivity, and area.

Soil Texture and Slope. A large portion of the soils in the DFPA was derived from shales, which produce medium- to fine-textured soils. Soil textures primarily consist of variations of loam (e.g., sandy loam, loam, clay loam, silt loam, silty clay loam, channery loam, etc.) and occur on all topographic positions. Heavier soils (e.g., silty clay or clay textures) occur in alkali bottomlands and badland breaks and slopes. Stratified sands and gravels are present in riverwash associated with streambeds and floodplains, and numerous stabilized sand dunes occur in hilly upland areas. Badlands and rock outcrops are formed from shale and sandstone and have little or no soil development due to their predominant erosive feature. Slopes within the project area are generally level to undulating (0 to 10 percent) and broken by areas of steeper slopes (10 to 40 percent). Nine textural families are represented on the project area and include: fine (smectitic); fine-loamy; loamy; clayey; loamy skeletal; coarse-loamy; fine-silty; mixed; and sandy. Fine-loamy, loamy, and coarse-loamy are the major textural families.

Table 3-12. Area of Sensitive and Non-Sensitive Soils within the DFPA.[1]

Category	Nature of Sensitivity	Acres[2]	Percent of Total Area[2]
Sensitive			
Topsoil	Poor suitability: too clayey, too sandy, excess salt/sodium, small stones, slope, and/or wetness/flooding	104,441.1	44.7
Roads	Severe limitations: low strength, slope, depth to rock, too sandy, and/or wetness	54,810.3	23.5
Surface Water Erosion	High (Rapid or very rapid)	26,380.9	11.3
Wind Erosion	High-Very High, High (Severe to High)	34,834.2	14.9
Runoff (based on Hydrologic Groups)	Severe (Hydrologic Group D)	66,713.4	28.6
Unavailable	Unavailable	31,131.1	13.3
Cumulative Category		**Acres**	**Percent Total**
Sensitive		154,104.2	66
Non-Sensitive		79,437.8	34
TOTAL		**233,542.0**	**100**

[1] Source: BLM soil map unit descriptions.
[2] Acres overlap for different sensitivity categories; therefore, they do not total the DFPA of 233,542 acres. Likewise, the percent of total area does not equal 100 due to overlap.

Soil Depth. Soils are deep (>40 inches) on alluvial fans, basins, and valley alluvium. Shallow soils (<20 inches) occur on plains and ravines underlain by sandstone, siltstone, and shale bedrock as well as in areas with steeper topography. Moderately deep soils are those considered between 20 and 40 inches; these soils generally lie on residual upland plains and relatively gentle sideslopes.

The effective rooting depth approximates the total soil depth or is slightly shallower. The depth to bedrock, however, presents some limitations in the suitability of soil map units for placement of roads or reclamation.

Soil Permeability. The majority of the soils within the area have moderate permeability. Areas with sandy soil textures, however, have moderately rapid to rapid permeability. Soils with heavier textures have moderately slow to slow permeability. If compacted, soils become less permeable.

Soil crusting also reduces infiltration rates. Most soils in the project area are likely to form a surface crust, particularly if vegetative cover deteriorates.

Bedrock underlying the soils is often fractured, which makes it highly permeable. Soils with a high clay content are subject to cracking upon wetting and drying; tubular cavities can develop as water flows through these cracks. Soils adjacent to major drainages tend to be stratified with repeating layers of finer and coarser soil material which allows for differential lateral flow within these layers.

Soil Productivity and Salinity. Soil productivity is naturally low for a portion of the project area due to high clay content, excess sand content, shallow depth, and/or salt content; most of the project area has an intermediate productivity baseline. Soils typically have adequate potassium for plant growth, while nitrogen and phosphorus may be limiting. Precipitation is the chief controlling factor of productivity. Lower precipitation produces less vegetative cover and, consequently, less organic matter for the soil. Soil crusting affects soil productivity by reducing infiltration rates. Salinity would affect osmotic potential in soils and eventual water uptake by plant roots, which would make whatever precipitation that is available less effective.

Available Water Capacity. Shallow soils have a lower water-holding capacity than deeper soils due to lack of depth and ultimate volume. From a physical standpoint, medium-textured soils have a higher available water capacity than heavy soils or coarse textured soils. The average available water capacity for the soils in the project area is low to moderate.

Seasonal High Water Table. In general, the water table within the project area is greater than six feet below the soil surface. Floodplains, alluvial terraces, seep areas, streambeds, and bottomlands have an average water table depth less than six feet. Flooding is rare, typically brief, and generally associated with spring runoff and summer storm events. Wetness and/or flooding affects the suitability of soils for use as topsoil and roads in portions of the project area near major drainages, including the confluence of Sand Creek with the Little Snake River in the southeast portion of the project area.

Erosion. Soil erodibility due to water and wind varies with soil texture. Silts and silt loams are most susceptible to water erosion. In contrast, fine sands, loamy sands, and coarse sandy loams are most susceptible to wind erosion. Water erosion primarily occurs during spring snowmelt and summer thunderstorms that cause intensive runoff and flash flooding. Many streams in the area have deep, incised channels. These channels continually erode as channel banks cave in and through upstream gully migration. Upland erosion simultaneously occurs due to sheet and rill erosion. The sparse vegetative cover exposes more soil to raindrop impact. Within the DFPA, soil susceptibility to water erosion is generally moderate in the surface topsoil horizon and moderate to severe in the subsoil horizons due to low permeability or non-cohesive soils, as well as steep slopes. However, the central portion of the project area has overall slight water erosion susceptibility in the Quaternary sands. Runoff potential is highly variable ranging from low to high, but with a central tendency of moderate to high. Overall wind erosion potential is moderate, but ranges from slight to severe.

Most areas are undergoing moderate natural rates of erosion. Accelerated erosion occurs in localized areas. The highest rate of natural, geologic erosion from water occurs in areas with naturally low vegetative cover, soil crusting, low organic matter content, and soft shales. In areas high in sodium where clays have dispersed, overall soil particles are more easily detached by wind and water. Scattered areas of sand dunes are easily eroded by wind when vegetation is removed. Areas with greater amounts of vegetative cover and organic matter content and/or lower sodium content have a lower natural rate of erosion by water. In addition, areas with harder rock fragments associated on or near the surface have less erosion from either water or wind. Areas with unstable soils on the surface or at depth are susceptible to slumping, sliding, and soil creep. Across the DFPA, natural re-vegetation and stabilization will occur, in time, if eroded sediment is retained and allowed to vegetate.

Soil Strength. Soils throughout the area have low strength upon wetting; deformation under a load is a problem. Compaction may be a possible tool to increase strength and to keep deformation under a load to a minimum. As Table 3-12 indicates, low soil strength presents severe limitations for placement of roads on nearly one quarter of the project area.

Reclamation Potential. Salinity, alkalinity, steep slopes, high clay content, sandy soils, small stones, wetness/flooding (i.e., prolonged saturation due to a high water table and/or surface flooding), shallow soils, and low precipitation are all factors that have potential to limit reclamation success. These factors affect the ability to effectively use heavy equipment in reclaiming a disturbed area, the species selected for revegetation, and/or reclamation techniques employed (e.g., mulching, scarification, etc.). Reclamation techniques on surface-disturbed areas are critical for providing adequate nutrients to allow for successful revegetation.

Reclamation potential is generally poor to moderate within the DFPA, with some limited areas of good potential. Potential or general suitability were determined from existing BLM soils mapping and field verification. No samples were gathered for laboratory analyses. In general, surface textures were loam, sandy loam, clay loam, silt loam, silty clay loam, and channery loam. Soils on saline flats and badlands had salt and sodium levels that would affect reclamation potential. In such soils, special measures are typically needed to reduce sodium levels and achieve adequate revegetation. Due to low organic matter in the soil and lack of geologic material that would enhance fertility, all soils are assumed to be deficient in nitrogen. Potassium is assumed to be adequate. Based on actual field sampling in the adjacent South Baggs surveyed area, phosphorus is likely limiting, as well, and that most pH’s, with the exception of areas high in sodium, are from 7.4 to 8.4, which is considered mildly to moderately alkaline. The presence of lime was predominantly adequate/normal.

Selenium Content. Historical site specific locations of selenium rich soils are present, but cover small areas within this landtype. The Wyoming State Geological Survey (WSGS 2000) referred to a 1959 University of Wyoming bulletin by O.A. Beath that indicated selenium concentrations as high as 112 ppm have been historically documented in the Poison Basin near Baggs (T12N: R93W). Beath (1959) indicated selenium in this general portion of Wyoming ranging from .32 to 3.1% but it is not clear how this value would translate to ppm in the soil; much of this earlier work was in conjunction with uranium exploration. It is possible that exposed bedrock and residual soils, especially derived from the Browns Park Formation of the Miocene age, could be potential sources of selenium in the project area (Case and Cannia 1988).

3.3.2.2 Site-Specific Soil Characterization

Site-specific field investigation into the character of soils in the project area was accomplished in October 2000. As indicated previously, existing soil information was verified in the field but no samples were collected for laboratory analysis throughout the project area. Soil characteristics such as texture, structure, horizonation, color, permeability, and drainage were recorded at each soil verification point, as well as an inventory of major plant species. Four relatively homogeneous soil landtypes were identified during this sampling and include the following: (1) residual slopes and flats, (2) ridgelines, (3) alluvial bottomlands, and (4) badland breaks, and are described subsequently.

Residual Slopes and Flats

This landtype covers the largest portion of the project area, 81.1 percent or 189,403 acres. This landtype correlates with the primary vegetatal cover types of mixed grass prairie, Wyoming big sagebrush, and saltbush and with the secondary cover type of greasewood, as described in the Vegetation Section. Slope gradients range from flat to moderately sloping (0 to 40 percent) with some areas on steeper slopes (40 to 80 percent). Soils in this landtype are generally moderately deep to deep over a shale or sandstone parent material. Dominant soil texture ranges from sandy loam and silty fine sand at the surface, to silty medium sand, to silty coarse sand and sandy clay loam at depth.

Soil colors are typically dark brown and dark yellowish brown at the surface and yellowish brown to light olive brown below. Soil permeability is generally moderate to moderately rapid, runoff potential moderate to moderately high, and wind and water erosion potential moderately high and moderate, respectively. The soils are well drained and do not have a water table within 6 feet of the soil surface. Soil pH is neutral to slightly basic and the soils have relatively low natural fertility levels in terms of phosphorus, potassium, and nitrate nitrogen. Sodium contents are generally low; however, in some areas with predominantly clay texture, poor drainage, and heavy clay parent materials, sodium content may be high. Most of the soil within this landtype has a fair to good reclamation potential with coarse fragment content (gravel and sand), high erodibility, droughtiness, and shallow topsoil depths providing the greatest impediment to reclamation success.

Badlands

This landtype covers the second largest portion of the project area, 11.4 percent or 26,624 acres. This landtype correlates with the desert shrub and basin exposed rock/soil primary vegetal cover types described in the Vegetation Section. There is a general lack of either woody or herbaceous plant growth associated with these soils. Slope gradients range from flat to moderately sloping to strongly sloping (20 to 100 percent). Soils in this landtype are very shallow over a shale parent material. Dominant soil texture ranges from silty clay to clay. Soil colors are typically vivid and range from reddish brown to strong brown to olive gray. Soil permeability is very slow, runoff potential very high, and wind and water erosion potential low and moderate, respectively. The soils are moderately-well drained and do not have a water table within 6 feet of the soil surface. Soil pH is slightly basic and the soils have very low natural fertility levels in terms of phosphorus, potassium, and nitrate nitrogen. Sodium contents are generally high. Soils within this landtype have a very poor reclamation potential with high clay content, droughtiness, and shallow topsoil depths providing the greatest impediment to reclamation success.

Ridgelines

This landtype covers the third largest portion of the project area, 6.7 percent or 15,647 acres. This landtype correlates with the juniper woodland primary vegetal cover type described in the Vegetation Section. Slope gradients range from flat to slightly sloping (0 to 10 percent). Soils in this landtype are generally shallow over a shale or sandstone parent material. Dominant soil texture ranges from fine sandy loam to silty clay loam at the surface to sandy clay at depth. Soil colors are typically olive brown at the surface and olive yellow below. Soil permeability is generally slow to moderate, runoff potential moderately high, and wind and water erosion potential moderate and moderately high, respectively. The soils are moderately-well drained and do not have a water table within 6 feet of the soil surface. Soil pH is slightly basic and the soils have relatively low natural fertility levels in terms of phosphorus, potassium, and nitrate nitrogen. Sodium contents are generally low. Most of the soil within this landtype has a poor to fair reclamation potential with coarse fragment content, clay content, droughtiness, and extreme shallow topsoil depths providing the greatest impediment to reclamation success.

Alluvial Bottomlands

This landtype covers the smallest portion of the project area, 0.8 percent or 1,868 acres. This landtype correlates with the shrub dominated riparian primary vegetal cover types described in the Vegetation Section. Slope gradients are generally flat to slightly sloping (0 to 10 percent). Soils in this landtype are generally deep and were derived from alluvial deposits along streams. Dominant soil texture ranges from fine sandy loam to silty clay loam at the surface to sandy clay loam and sandy clay at depth. Soil colors are typically very dark brown to dark yellowish brown at the surface and dark yellowish brown to light olive brown below. Soil permeability is generally moderate to moderately rapid, runoff potential low to moderate, and wind and water erosion potential low and moderate, respectively. The soils are moderate to moderately-well drained and, depending on location, may have a water table within 6 feet of the soil surface. Soil pH is neutral to slightly basic, and the soils have relatively low natural fertility levels in terms of phosphorus and potassium, but nitrogen levels are generally adequate due to high productivity rates associated with more favorable water relations. Sodium contents are generally low, but may be elevated in areas of clay deposits. Most of the soil within this landtype has fair to good reclamation potential with clay content and saturation providing the greatest impediment to reclamation success. These soils correlate with natural drainage ways and floodways of perennial and intermittent streams, primarily Sand Creek within the project area.

3.3.2.3 Existing Soil Disturbances

Existing disturbance includes: 126.1 mi of primary roads (611.1 ac); 132.9 mi of secondary roads (322.3 ac); 402 mi of 2-track roads (194.5 ac); 82.2 mi pipeline (39.9 ac) and 338.6 acres of other disturbed areas. Therefore, total existing disturbance within the DFPA is 1,506.4 acres, or 0.6% of the total project area. Disturbed land consists of: (1) off-road vehicle tracks created by past livestock management activities and recreationists; (2) mineral exploration activities; (3) developed roads for oil and gas development, as well as actual pads and facilities; and (4) Carbon County Road 700. The total acreage of disturbance has not been broken out by vegetation type; however, most of this disturbance has occurred in the major landscapes of Residual Slopes and Flats and Badlands. These areas have altered vegetative structure and composition and, in some areas, are actively eroding.

Chapter 2 discusses the amount and nature of existing disturbances within the DFPA. Review of aerial photographs (dated 2000), topographic quadrangle maps, as well as field inspection was used to estimate the area of existing disturbance in the project area.

Water Erosion. Although the total area of disturbance is in varying stages of reclamation and revegetation, such disturbance has contributed to accelerated erosion in the project area. Erosion cannot be accurately quantified due to the highly dynamic factors involved (e.g., slope gradients, reclamation, soil type, vegetal cover, transient nature of revegetation, etc.). The Revised Unified Soil Loss Equation (RUSLE) could be used to estimate general magnitudes of erosion resulting from the existing disturbance but, based on discussion with Richard Warner, University of Kentucky (personal communication), use of the equation to determine concurrent rates of erosion off areas with varying soil slopes is not an appropriate use. Therefore, susceptibility risk of the surface soils to water erosion is based on the K factor of the soil series within the project area and is outlined in Figure 3-8. The K factor represents, according to Toy and Foster (1998): (1) susceptibility of soil or surface material to erosion, (2) transportability of the sediment, and (3) the amount and rate of runoff given a particular rainfall input, as measured under a standard condition. NRCS has outlined twelve values to be used, i.e., .1, .15, .17, .2, .24, .28, .32, .37, .43, .49, .55, and .64. The following generalized categories can be estimated for the K factor: low - .1 to .24; moderate - .28 to .32; and high - .37 to .64. Utilizing these categories, Table 3-13 outlines the number of soil map units that would fall into each risk factor for the surface soils.

Erosion rates in the South Baggs natural gas project area (located to the east of the DFPA) were estimated at 1.5 tons/acre/year (t/ac/yr) (USDI-BLM 1999c). According to the 1981 BLM Soil Inventory of the Overland Area, most soils within the Resource Area have a T factor of T-2 t/ac/yr which represents the soil loss tolerance or the amount of soil that a soil can lose through erosion without affecting soil productivity. Based on an erosion rate of 1.5 t/ac/yr, the total natural erosion loss from the project area is 350,313 tons/year (t/y). Assuming incomplete revegetation, accelerated erosion from existing disturbances (1,506.4 acres) is approximately 5 tons per acre per year (USDI-BLM 1999c) or 7,532 t/y. This represents an approximate increase in erosion of 2.2 percent over baseline or natural conditions. This represents a worse-case estimate; the true natural baseline erosion rates are likely less than the value presented here. Most of the eroded soil is contained on-site and is not transported off-site to streams due to low overland flow transport efficiencies. The cumulative effect of existing disturbance combined with proposed and future disturbance is discussed in greater detail in Chapter 4.

Table 3-13. Risk Category for the K Factor.

Risk Category for K	Number of Map Units	Acreage
Low	11	21,912.2
Moderate	21	46,030.6
Moderate-High	24	108,086.2
High	14	26,381.9
Unavailable Information	5	31,131.1

Livestock grazing has contributed to the level of disturbance described above through removal of vegetal cover and soil compaction. These factors contribute to increased erosion above the natural baseline rate. Not enough is known about the intensity of grazing experienced by the project area to predict an increase in soil erosion. However, erosion increases attributable to livestock grazing are well below the estimate provided above.

Wind Erosion. Regarding wind erodibility, NRCS has outlined eight categories to be used, i.e., 1, 2, 3, 4, 4L, 5, 6, 7, and 8. In general, the sandier the soil, the more likely it will move as a result of wind energy. The following generalized risk categories can be estimated for the following WEG designations: no risk - 6, 7, and 8; low - 5; moderate-low - 4 and 5; moderate-high - 3; and high - 1 and 2. Utilizing these categories, Table 3-14 is derived that outlines the number of soil map units that would fall into each risk factor.

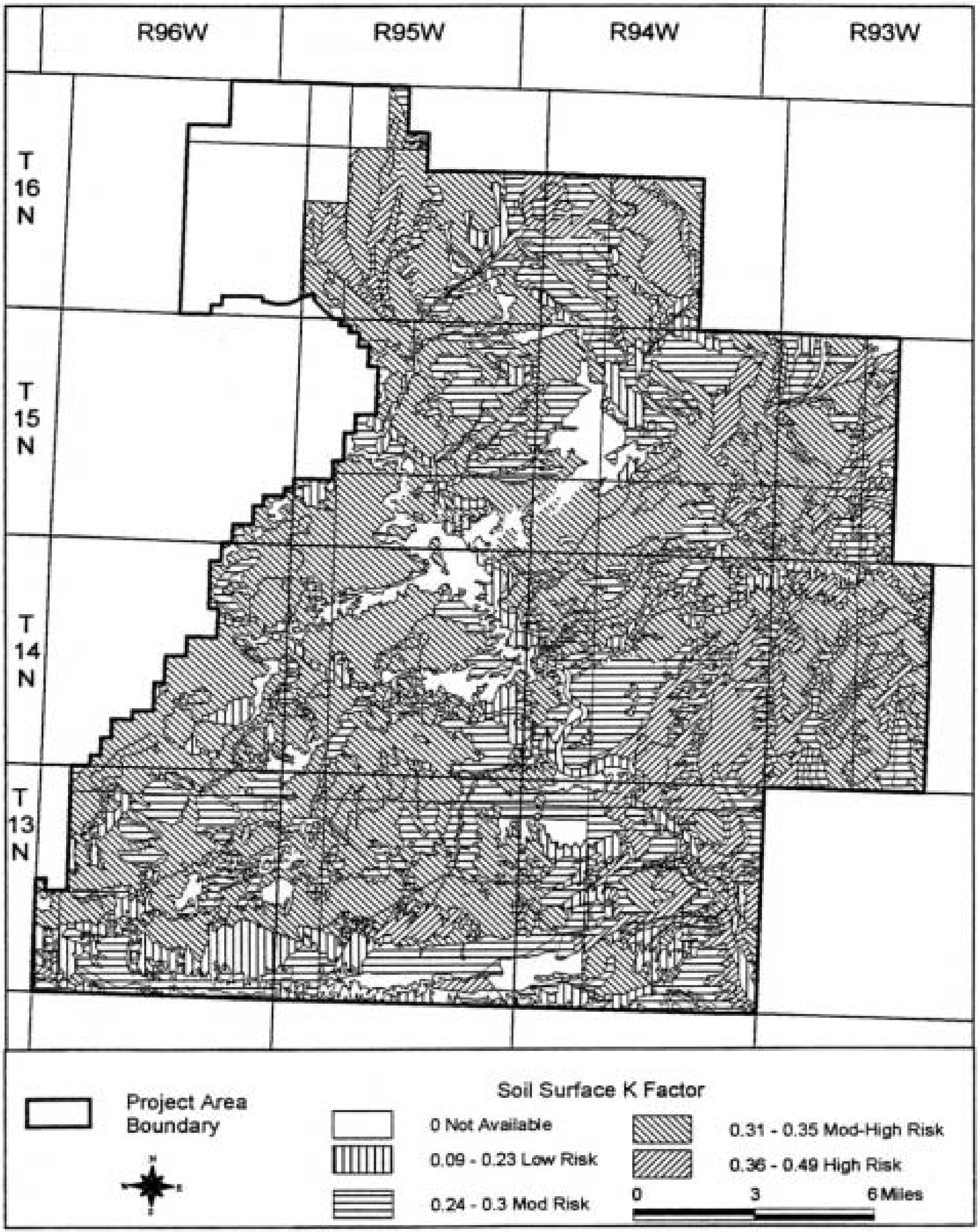


Figure 3-8. Susceptibility Risk (K Factor) of the Surface Soils to Water Erosion within the Desolation Flats Project Area.

Table 3-14. Number of Soil Map Units Falling into each Risk Factor.

WEG	Risk Category	Number of Map Units	Acreage
6, 7, and 8	None	2	478.7
5	Low	9	5,979.5
4	Low-Moderate	24	74,846.4
3	Moderate-High	21	86,272.2
2	High	9	24,094.7
1	High-Very High	5	10,739.4
	Unavailable Information	5	31,131.1

3.4 WATER RESOURCES

Water resources in the project area include both surface water and groundwater. Surface waters include the ephemeral Sand Creek, its named ephemeral tributaries including Red Wash, Hangout Wash, Hartt Cabin Draw, Willow Creek, Haystack Wash, Skull Creek, Grindstone Wash, Redder Cabin Draw and Cedar Breaks Draw, as well as its unnamed ephemeral tributaries. Some of the unnamed and named ephemeral tributaries of Barrel Springs Draw (i.e., Windmill Draw and South Barrel Springs) also occur within the northeastern portion of the project area. There are a small number of named and unnamed seeps and springs, as well as numerous man-made ephemeral and intermittent livestock reservoirs and ponds. The perennial Little Snake River is the most important surface water resource in the general vicinity, but falls immediately outside of the southern and eastern boundary of 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 and Climate

Climatological data from the Rawlins (No. 487533) and Baggs (No. 480484) weather stations are most relevant to the characterization of water resources in the DFPA. The closest comprehensive recording weather station is in Rawlins, approximately 50 miles to the northeast, and is maintained by the USDT FAA. Climatological data are also gathered at Baggs, approximately 10 miles to the east.

<u>Climate</u>. The project area occurs in a continental dry, cold-temperature-boreal climate (Trewartha 1968). This climate is primarily characterized by a deficiency of precipitation (i.e., evaporation exceeds precipitation), and generally has cold temperatures where fewer than eight months of the year have an average temperature greater than 50 F with hot summer days and cool summer nights, but bitterly cold winters.

<u>Temperature</u>. The average annual temperature is 42.2 F at Rawlins and 42 F at Baggs. At Baggs, the average monthly low and high temperatures for January are 5.1 F and 32.9 F, respectively. In contrast, the average monthly low and high temperatures for July are 47.6 F and 85.6 F, respectively (WRCC 2000). In Rawlins, the average number of days per year with a minimum temperature at or below 32 F is 225 (Martner 1986).

Precipitation. Mean annual precipitation is expected to be approximately 11 inches in the project area, with Rawlins and Baggs having an annual average of 9.31 inches and 11.19 inches, respectively. Precipitation is somewhat evenly distributed throughout the year with a peak in May. In Baggs, the average monthly precipitation for the month of May is 1.64 inches (WRCC 2000). The majority of precipitation falls as rain from frontal systems and thunderstorms. In regard to intensity of rainfall events, the 50-year, 24-hour precipitation rate is 2.2 inches (Miller et al. 1973). Average total snowfall depth for the year at Baggs is approximately 41 inches, with the greatest snowfall occurring in December and January (WRCC 2000). Due to the effect of ablation and snow drifting, a discontinuous snow cover is usually present during the winter.

Other Climate Characteristics. Mean annual evaporation ranges from 55 inches (lake) to 75 inches (pan) and potential annual evapotranspiration is roughly 20 inches (Martner 1986). Compared to the average annual precipitation of 11 inches, this gives an average annual deficit of approximately 9 inches. The prevailing wind is from the west and southwest at an average of 14.3 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 in general 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

Surface water is relatively rare or infrequent within the project area. The project area is predominantly drained by Sand Creek, a tributary of the Little Snake River. Tributaries of the Barrel Springs Draw watershed that discharges into the Muddy Creek drainage, which is also a tributary of the Little Snake River, drain the northeastern portion of the study area. As shown on Figure 3-9, numerous stream channels occur within the DFPA but the vast majority of the channels, named and unnamed, are ephemeral (i.e., carry water only in direct response to snow melt and precipitation events). Typically under this regime, streamflow will last for only a short period of time after the runoff-producing event. The drainage area of Sand Creek is 584.57 mi^2 with 314.47 mi^2 (53.80%) percent in the project area. The Barrel Springs drainage area is 337.16 mi^2 with 45.8 mi^2 (13.49%) in the project area.

The project area falls entirely within the Little Snake River drainage basin (USGS Basin #14050003). There are no internally drained areas in the project area. The Little Snake River drains the largest basin in the Yampa River basin (Driver et al. 1984). It joins the Yampa River in northwest Colorado. The Yampa River flows southwest to its confluence with the Green River in Utah. The Green River drains to the Colorado River, which ultimately flows to the Pacific Ocean.

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). Streams receive little to no support from groundwater discharge to sustain flow; consequently, there are extended periods of time when drainages are dry. A few named and unnamed springs are located at higher elevations near the headwaters of some of the tributaries to Sand Creek, although infiltration and evapotranspiration quickly exceed the discharge rates and intermittent streamflow is sustained only for short distances downstream. Active stream channels in the project area exhibit ephemeral flow only during snowmelt and high-intensity, short-duration summer thunderstorms.

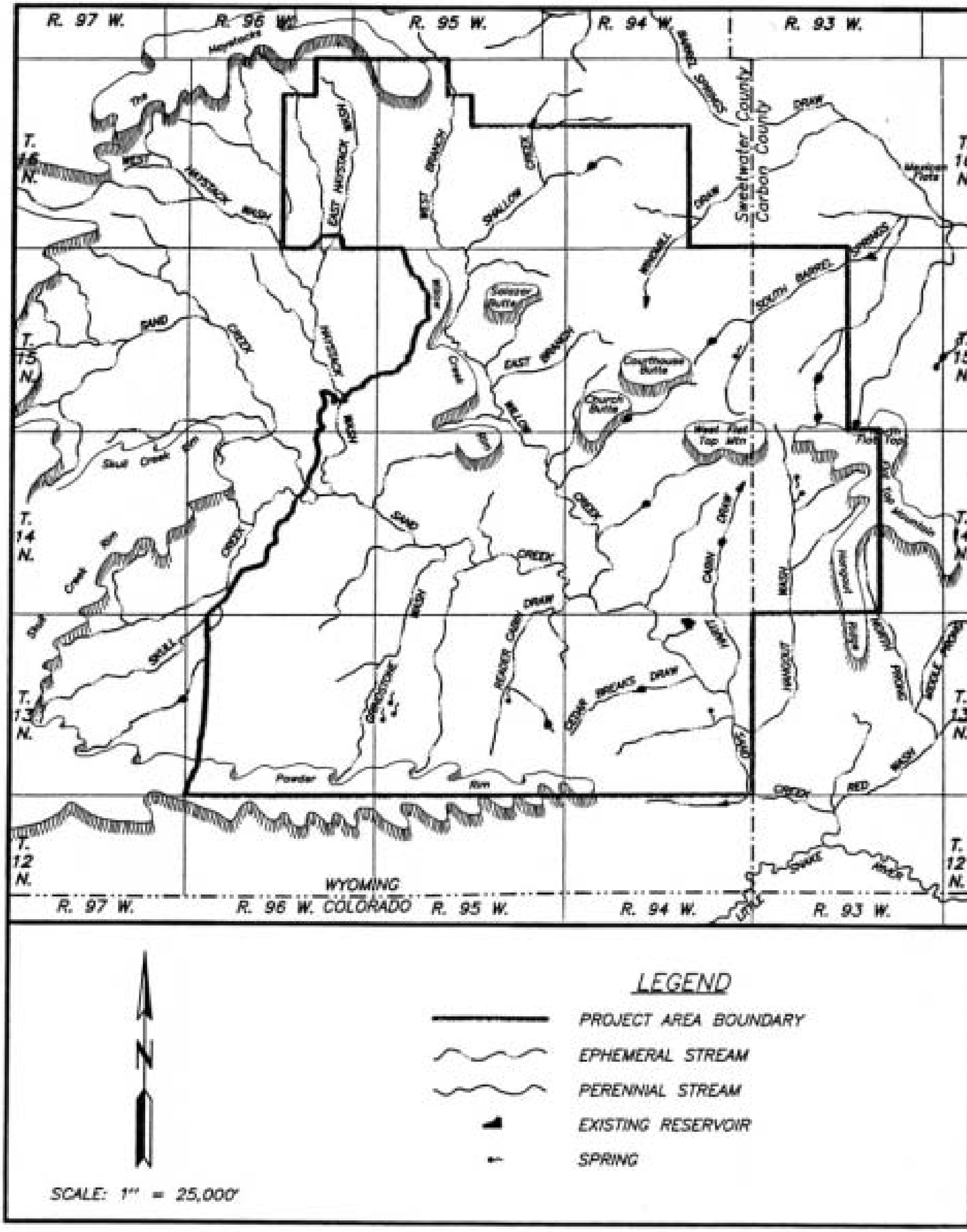


Figure 3-9. Surface Water Features in the Desolation Flats Project Area.

The surficial geology of the project area, which is within the structural Washakie Basin, is characterized by the predominance of Tertiary age rocks of the Uinta, Bridger, Green River and Wasatch Formations. These sediments contain an interbedded mixture of marlstones (calcareous clays), siltstones, mudstones, shales, and fine-grained sandstones characteristic of mixed fluvial and lacustrine deposition (Welder and McGreevy 1966). The type of sediments that accumulated in the structural basin during the Early Tertiary Period are related to their distances from the mountain front source areas and the periodic oscillation of the level of the ancient Green River Lakes that covered the basin. This resulted in a complex interfingering relationship between lake sediments and their laterally equivalent river-deposited sediments. Rocks that accumulated in the river systems along the margins of the basin during the early Eocene comprise the Wasatch Formation (i.e., Cathedral Bluffs Member). Rocks that accumulated in the Green River Lakes system comprise the Green River Formation (i.e., Laney Shale Member). During the middle to late Eocene Epoch, the last Green River Lake filled with chemically precipitated rocks, intermittent volcanic ash falls, and fine-grained sediments of the Uinta and Bridger Formations (which together are also called the Washakie Formation). The DFPA lies roughly at the center of the basin; therefore, bedrock sediments on the surface tend to be fine-grained, typical of those that accumulated in flood plain and lacustrine environments.

The types of particles that comprise the sedimentary bedrock largely determine the texture of the soil that develops from that deposit. Therefore, most of the soils within the project area generally have a heavy clay texture with low infiltration and permeability rates. In addition, a high rate of natural or geologic erosion is evidenced by the badland-type topography, which predominates much of the project area’s landscape. Badlands and rock outcrops have very little to no soil development upon their steep surfaces. Soil and bedrock susceptibility to water erosion can be severe due to low permeability, and the area’s sparse vegetative cover exposes more surface to raindrop impact erosion. As a result of the project area’s slow infiltration rates, steeply sloping surfaces and sparse vegetal cover, runoff potential is very high.

Precipitation events are highly erratic, both temporally and areally, within the project area. Thunderstorms can produce rapid, brief, stream flows and high-intensity thunderstorms can cause equally intensive runoff and flash flooding. The surface erosion and sediment deposition that result from such intense storms in this arid to semi-arid environment have resulted in the formation of stream channels having the fluviogeomorphic characteristics of arroyos (i.e., vertical walled and flat floored). The larger, higher-ordered stream channels in the flat terrain areas are broad and somewhat indistinct. The fine silts and clays in these channels are carried away, leaving behind channel deposits of braided sand-sized materials. Conversely, surface runoff generation may be insufficient in some of the lower-ordered subwatersheds to produce enough streamflow to maintain active channels having fluviogeomorphic characteristics such as channel banks, beds, bars, etc. Some stream courses identified on USGS topographic maps may grade between active channels and vegetated swales along their length.

There are no USGS surface water gaging stations in the project area. The closest USGS gages are located on Muddy Creek near Baggs and on the Little Snake River near Dixon. The USDI-BLM (1994b) has collected some surface flow data for Barrel Springs and Barrel Springs Draw, both of which are located north and east of the project area boundary. Barrel Springs has an average flow of less than 0.1 cfs and Barrel Springs Draw has been measured to have an average flow of less than 1.0 cfs. Muddy Creek, which exhibits an intermittent to perennial flow regime, has an average discharge of 8.0 cfs. Maximum instantaneous and minimum daily recorded flows on Muddy Creek are 738 cfs and no flow, respectively. Given the relatively dry 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 inches per year, or about five percent of the total annual precipitation (Wyoming Water Research Center 1990).

There are no naturally occurring lakes or ponds in the project area. Some drainages have been diked to impound water for livestock use and some small ponds have been constructed to contain water produced from existing gas wells. There are over fifty small man-made reservoirs and ponds distributed throughout the project area, most of which are not readily identifiable on 7.5 minute USGS topographic maps. The records of the Wyoming SEO were used for this inventory, as these small reservoirs are difficult to locate either by field inspection or on recent aerial photographs. Water levels in impoundments on the ephemeral channels are erratic and fluctuate in response to the frequency of runoff events. The two largest reservoirs, each estimated to be less than 20 acres in surface area when full, are located in T15N:R94W and are on Windmill and South Barrel Springs Draws. The source of water for these reservoirs appears to be primarily from surface runoff as there are no springs located upstream.

A small number of named and unnamed springs and seeps occur in the project area. Most naturally occurring springs in the project area have been developed for livestock use and small detention reservoirs are generally associated with them. Some springs can contribute a small amount of inflow to drainages. Typically, due to evaporation, transpiration, seepage and freeze-up, flow from these springs will extend for only a short distance downstream from the spring face. The major named springs that are shown on USGS topographic maps and listed as sources of surface water rights with the SEO are Rotten Spring, Sand Spring, Doby Spring and Chimney Spring (located in T13N:R95W), Dripping Rock Spring and Hangout Spring (located in T14N:R93W), McPherson Spring (located in T13N:R94W), and South Barrel Spring (located in T15N:R94W). Oil and gas development has also created a few flowing wells that are allowed to discharge water perennially for livestock. These wells usually support small detention reservoirs. Springs and flowing wells are important sources of water for wildlife as well as livestock.

Based upon a recent (December 2000) review of the SEO records, there are approximately 60 currently active surface water rights in the project area. These surface water rights are all associated with livestock watering facilities (i.e., ponds, reservoirs, and improvements such as ditches, pipelines and enlargements), with the exception of two rights that are for irrigation use. Roughly two-thirds of these permits are unadjudicated and the other third are adjudicated. These permit rights total approximately 325 acre-feet per year.

3.4.2.2 Surface Water Quality

Surface water quality in semiarid regions is seasonal and dependent on the magnitude and frequency of discharge events, although typically somewhat high in dissolved solids concentration. 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 will commonly decrease after the initial flushing of salts has taken place. During less intense, low-flow events the dissolved solids concentration may increase in the downstream reaches. 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 highly erosive nature of the area, relatively high suspended sediment concentrations are expected.

As indicated in the previous section, there are no USGS streamflow gaging stations within the project area, nor does the USGS have any established surface water quality stations in the project area. The USDI-BLM and USGS have collected a small number of miscellaneous surface water grab samples (approximately 12) for partial chemical analyses within the project area (WRDS 2000). Water quality information from this small data set is too brief to be conclusive. The USDI-BLM (1994b) has accumulated all available surface water quality data in the general vicinity of the project area, and a general synopsis and discussion of these data are included in the Draft EIS South Baggs Area Natural Gas Development Project (USDI-BLM 1999c). Based upon that discontinuous data set, the following surface water quality conditions can be expected in the general vicinity of the project area: water temperature is relatively high (>20 F); dissolved oxygen is moderate to high (9 mg/l); conductivity is high (>2,000 to 5,000 mhos/cm); pH is neutral to alkaline (7 to 10); turbidity is low to moderate (10 to 900 NTU); sodium is the predominant cation and bicarbonate and sulfate are the predominant anions; total hardness is moderate to high (40 to 990 mg/l); total alkalinity is moderate to high (100 to 2,890 mg/l); and total dissolved solids are high (as much as 12,800 mg/l). Miscellaneous grab samples that were analyzed for total iron indicate moderate to high concentrations (1 to 100 mg/l). Information on other constituents such as selenium, fluoride, boron and other various trace metals is not available. 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 livestock and industrial uses. In general, surface water, when present in the DFPA, is expected to be poor to very poor quality due primarily to high turbidity, suspended solids and dissolved solids concentrations.

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 DFPA is located in the Colorado River Basin and, as such, is subject to review by the Colorado River Basin Salinity Control Forum. As one of the seven member states of the forum, Wyoming reviews point and nonpoint sources of salinity in the Wyoming portion of the Colorado River Basin through a watershed protection program administered by the Water Quality Division of the WDEQ (CRBSCF 1999).

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

<u>Class 1</u>. 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 significant quantities of developable water and other values of present and future benefit to the people.

<u>Class 2</u>. Those surface waters other than Class 1, determined to be presently supporting game fish, have the hydrologic and natural water quality potential to support game fish, or include nursery areas or food sources for game fish.

<u>Class 3</u>. Those surface waters, other than those classified as Class 1, which are determined to be presently supporting nongame fish only, have the hydrologic and natural water quality potential to support nongame fish only, or include nursery areas or food sources for nongame fish only.

<u>Class 4</u>. Those surface waters, other than those classified as Class 1, which are determined to not have the hydrologic or natural water quality potential to support fish and include all intermittent and ephemeral streams. Class 4 waters shall receive protection for agricultural uses and wildlife

watering.

Sand Creek, Windmill Draw and the North Prong Red Wash have all been classified as Class 4 streams. Red Wash has been classified as a Class 3 Stream. All other streams in the project area are undesignated and by default take on the classification of the first stream they run in to. The Little Snake River has been designated a Class 2 stream. The portion of the Little Snake River below Baggs has been further classified as a secondary contact recreation water which adds fecal coliform restriction normally reserved for Class 1 surface water bodies.

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 project area are Class 5 streams (incapable of supporting fish) (WGFD 1991). Muddy Creek, located just east of the project area is a Class 4 stream (low production trout waters/fisheries frequently of local importance, but generally incapable of sustaining substantial fishing pressure). The Little Snake River below Dixon is also a Class 4 stream.

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 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 Clean Water Act (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

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); or the Great Divide and Washakie basins by Collentine et al. (1981) and Welder and McGreevy (1966). Groundwater resources include deep and shallow, confined and unconfined aquifers. Site-specific groundwater data for the project area is limited. Existing information comes primarily from oil and gas well records from the WOGCC, water well records from the Wyoming SEO and from the USGS (Weigel 1987). Regional aquifer systems pertinent to the project area are discussed by Heath (1984), Freethey (1987), Driver et al. (1984), and Lowham et al. (1985). Basin-wide evaluations of hydrogeology specific to the project area have been investigated by Collentine et al. (1981). The most relevant hydrogeologic study specific to the project area is by Welder and McGreevy (1966).

3.4.3.1 Location and Quantity

Several rock units can be classified as water-bearing zones (aquifers) within the Washakie and Great Divide structural basins of Wyoming. As described in Table 3-15, these aquifers vary in thickness, potential yields, and water quality. Not all of the geologic formations listed in Table 3-2 are encountered within the DFPA (Geology Section 3.1). Those occurring in the project area include Quaternary deposits; the Tertiary Washakie (Uinta and Bridger), Laney Shale Member of the Green River, Wasatch, and Fort Union formations; the Upper Cretaceous Lance, Fox Hills, Mesaverde, and Frontier formations; the Lower Cretaceous Cloverly Formation; the Jurassic Sundance Formation and Nugget Sandstone; and the Paleozoic rocks. As indicated in Table 3-15, these aquifers are all separated by confining layers and the expected yields and permeabilities are generally low.

Quaternary aquifers in the Washakie Basin are comprised of alluvial deposits along the major drainages and isolated windblown deposits. Groundwater flow within the sandy Quaternary aquifers is typically downward toward an underlying permeable Tertiary strata (Collentine et al. 1981), or downslope as determined by the topography. 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. The Mesaverde Formation is also a major aquifer throughout the two basins, 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. Groundwater withdrawals by the oil and gas industry are principally a by-product of oil and gas production and consist of water derived from Paleozoic rocks (Collentine et al. 1981).

Welder and McGreevy (1966) found that sandstone is the principle water-bearing strata of the Washakie Basin. Individual sandstones vary greatly in distribution and character. In the Great Divide Basin, sandstone aquifers of the Wasatch Formation are probably the most significant in terms of areal distribution, shallow depth and general availability of groundwater for beneficial use (i.e., livestock water). The Wasatch and older aquifers in the Washakie Basin though are generally deeper and less accessible to wells than in the Great Divide Basin. Relatively impermeable beds of marlstone, claystone, siltstone and shale in the Green River and Washakie formations overlie the Wasatch Formation throughout most of the Washakie Basin (Welder and McGreevy 1966).

As stated previously, the project area is located near the center of the Washakie Basin. The shape of the basin is nearly symmetrical and the strata in the basin dip toward the center at 2 to 12 degrees. The total thickness of sedimentary rocks near the center of the structural basin may exceed 25,000 feet. 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 movement of groundwater in the surficial Eocene strata (i.e., Laney Shale Member of the Green River Formation and the Washakie Formation) is probably controlled by the topography of the basin and likely moves out of the basin beneath surface drainages. Welder and McGreevy (1966) suggest that the direction of groundwater movement in the deeper formations is downdip toward the center of the structural basin, and upward into the overlying formations. Recharge to the water-bearing strata of the Washakie Basin is principally from the infiltration of precipitation (direct rainfall,

Table 3-15. 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 Mtns 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

Table 3-15. Continued.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
Cenozoic	Tertiary	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
		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

Table 3-15. Continued.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
Mesozoic	Upper Cretaceous	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/ft² • Transmissivity ranges from 0.03 to 50 gpd/ft
		Mesaverde Formation (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)
		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)

Table 3-15. Continued.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
Mesozoic	Upper Jurassic	Morrison Formation	170-450+	• Confining unit • Well and spring data not available
		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
	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

1 - Adapted from Collentine et al. (1981); additional sources include Lowham et al. (1985), Heath (1984), and Freethey (1987)

Overland flow and snow melt). 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 drainageways. Discharge via water wells and transpiration by plants is not significant (Welder and McGreevy 1966).

A recent (December 2000) SEO records review revealed 33 currently active groundwater permits in the project area. They are apportioned as follows: 17 stock, 14 miscellaneous, 1 industrial, and 1 domestic. The USDI-BLM is the applicant for all 17 permits designated for stock use. Of these 17 permits, 5 are springs that yield from 1.25 gpm to 20 gpm, 1 is a flowing well that yields 25 gpm, and the other 11 are wells that yield 5 to 10 gpm via windmills. The reported completion depths of these 12 stock-use water wells range from 3 feet to 1,300 feet, and the static water level depths range from ground surface (if flowing) to 135 feet below ground level. All 15 of the permits designated for miscellaneous and industrial use are associated with the oil and gas industry. These groundwater permits are for water wells that are supplying water for drilling deep oil and/or gas wells. The reported completion depths of these 15 wells (6 of which have no information) range from 700 to 1,440 feet, the static water level depths range from 50 to 580 feet, and the yields range from 40 to 105 gpm. The one permit designated for domestic use is located in the NE1/4NE1/4 of Section 15, T16N:R96W. The reported completion depth of this well is 420 feet, the static water level depth is 148 feet, and the yield is 12 gpm. There are also over 120 cancelled and/or abandoned groundwater rights within the project area, essentially all of which were for well permits associated with the drilling of oil and gas wells.

The majority of the groundwater in the vicinity of the DFPA is obtained from Tertiary units. Total estimated use in the Washakie Basin is between 80,000 and 89,000 acre-feet per year (Collentine et al. 1981). Regional development of groundwater resources has been negligible.

3.4.3.2 Groundwater Quality

Groundwater quality is largely related to the depth of the aquifer and the rock type. The quality of water in the various geologic formations underlying the Washakie Basin ranges from poor to good (Welder and McGreevy 1966). The total dissolved solids (TDS) concentration is an indication of salinity. TDS concentrations ranging from less than 1,000 mg/l (considered fresh) to roughly 2,000 mg/l (slightly saline to saline) is typically found within Quaternary aquifers, shallow members of the Tertiary aquifer system, and near the outcrop areas of the Mesaverde Formation and older aquifers. The total dissolved solids concentration is usually higher when the aquifer is interbedded with lake deposits that contain evaporite minerals (i.e., Washakie Formation). The predominant ions of these low-TDS waters are typically sodium, calcium, bicarbonate and/or sulfate. Shallow groundwater (<1,500 feet) from all members of the Tertiary aquifer system generally have <3,000 mg/l TDS. Limited data from the deeper parts of this system indicate TDS concentrations in excess of 10,000 mg/l, which exceeds Wyoming DEQ groundwater standards for livestock. Salinity increases rapidly away from the outcrop.

Concentrations of several constituents are likely to exceed the WDEQ/LQD domestic water quality standards (Collentine et al. 1981). For example, fluoride concentration in a sample from a well completed in the Laney Shale Member of the Green River Formation southwest of Wamsutter was 2.3 mg/l. Fluoride concentrations in samples from the Quaternary alluvium, Wasatch Formation, and the Mesaverde Group ranged from 2.3 to 7.9 mg/l (Collentine et al. 1981). Driver et al. (1984) indicated that trace elements are generally below standards for drinking water within the Washakie

Basin. Selenium problems are local in nature. Groundwater quality in the project area is generally sufficient for oil and gas well drilling.

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 be a potential source of contamination between aquifers.

3.5 VEGETATION AND WETLANDS

3.5.1 General Vegetation

Vegetation in the DFPA is typical of the semi-arid Wyoming Basin floristic region, where precipitation and soil parent material are controlling factors for plant composition. Vegetation often appears sparse.

Most of the DFPA is vegetated with a mix of types typical of the basins of south-central Wyoming. Wyoming big sagebrush steppe (grassland with a canopy of *Artemisia tridentata* ssp. *wyomingensis*) and desert shrub vegetation (a shrub type of shadscale [*Atriplex confertifolia*], greasewood [*Sarcobatus vermiculatus*], and Gardner saltbush [*Atriplex gardneri*]) form a mosaic that covers most of the area. Sparsely vegetated rock and soil also cover substantial parts of this mosaic. Smaller areas of grassland with little sagebrush (the Mixed Grass Prairie cover-type) also are included.

The eastern third of the area contains a band of greasewood mixed with flats and fans dominated by low-growing Gardner saltbush. Stands of juniper woodland mixed with Wyoming big sage steppe grow in a band along the southern edge of the project area. Utah juniper (*Juniperus osteosperma*) is the common species in the basins in southern Wyoming. Narrowleaf cottonwood (*Populus angustifolia*) woodland grows along the Little Snake River between irrigated hay meadows south of the project area. Riparian shrublands grow along tributaries flowing southeast through the eastern part of the DFPA. The species composition in these shrublands is unknown, but basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and greasewood are likely to be important in this part of the state.

According to large-scale map information from the Spatial Data Visualization Center (SDVC) based on WY-GAP Analysis (Merrill et al. 1996), seven primary cover types are present in the project area: Mixed grass prairie; Wyoming big sagebrush; desert shrub; Saltbush fans and flats; Juniper woodland; Non-vegetated channel; and Basin exposed rock/soil. Non-vegetated channel is a modification of WY-GAP Analysis classification, determined by BLM personnel to more accurately reflect site-specific conditions. Five of these seven cover types are also present in various polygons as secondary cover types e.g., Powder Rim contains the primary cover type Juniper woodland but also has the secondary cover type of Wyoming big sagebrush. In addition, small wetland areas associated with spring development, open water, and disturbed areas are present. Verification of these map unit descriptions of the vegetation resources in the project area is based on field reconnaissance accomplished in October 2000. Land cover types for the project area are summarized in Table 3-16.

Wyoming big sagebrush primary cover type covers the largest portion of the project area, 74.4 percent or 173,755.3 acres. This cover type has a generally dense cover of Wyoming big sagebrush and other drought-tolerant shrubs over an herbaceous groundcover of forbs and grasses.

Desert shrub is the second most common primary cover type in the project area comprising approximately 8.6 percent or 20,084.6 acres. This cover type has a sparse to dense cover of drought-tolerant shrubs over an herbaceous groundcover of forbs and grasses. Cryptogamic crusts are also present on the surface of the soil. Sagebrush-dominated areas are the most common phase of this cover type. Common herbaceous groundcover species include western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass (*A. spicatum*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*), needlegrass (*Stipa* spp.), common yarrow (*Achillea millefolium*), Indian paintbrush (*Castilleja* spp.), buckwheat (*Eriogonum* spp.), lupine (*Lupinus* spp.), and phlox (*Phlox* spp.).

Table 3-16. Land Cover Types within the DFPA.

Land Cover Type	Primary Acreage	%	Secondary Acreage
Mixed grass prairie	10,509.4	4.5	
Wyoming big sagebrush	173,755.3	74.4	40,440.6
Desert shrub	20,084.6	8.6	61,628.2
Saltbush fans and flats	5,137.9	2.2	
Juniper woodland	15,647.3	6.7	17,178.3
Non-vegetated channel**	1,868.3	0.8	
Basin exposed rock/soil	6,539.2	2.8	113,782.9
Disturbed*	1,506.4*	0.6*	
TOTAL	233,542.0	100.0	

*Existing disturbance of 1,506.4 acres has not been broken out by vegetation type.
**WY-GAP Analysis information modified by BLM personnel (Otto 2002) to reflect site-specific conditions.

A portion of this cover type resembles the “badlands” type described for the adjacent South Baggs area in which there was a very sparse vegetal cover consisting of saltbush (*Atriplex spp.*), Indian ricegrass, greasewood, stemless goldenweed (*Haplopappus acaulis*), and foliose lichens. The following description is from WY-Gap Analysis (Merrill et al. 1996), which provided the map units for cover.

Juniper woodland is the third most common cover type in the project area comprising approximately 6.7 percent or 15,647.3 acres. This cover type is very similar to the desert shrub, but has a sparse to moderate cover of small juniper (*Juniperus* spp.) trees over the typical desert shrub vegetation.

Mixed grass prairie is the fourth most common primary cover type in the project area comprising approximately 4.5 percent or 10,509.4 acres. It is found primarily in the northeastern corner of the project area.

Basin exposed rock/soil is the fifth most common primary cover type in the project area comprising approximately 2.8 percent or 6,539.2 acres. It is found primarily in the northwestern corner of the project area.

Saltbush is the sixth largest primary cover type in the project area comprising approximately 2.2 percent or 5,137.9 acres. It is primarily found in the northeastern portion of the project area.

Non-vegetated channel (Otto 2002) is the last primary land cover unit and comprises approximately 0.8 percent or 1,868.3 acres of the project area. It is located exclusively along Sand Creek in the southeastern corner of the project area. The sandy channel is non-vegetated over long stretches, supporting only isolated patches of shrubs, as well as rushes and sedges associated with tiny, scattered spring/seep sites which lie along the banks and edges of the creek. The springs/seeps produce water (but no flow) throughout and/or at various times during the year. Isolated trees (*Populus* spp.), including scattered shrub willow (*Salix* spp.) were observed near the confluence of Sand Creek and the Little Snake River during fieldwork. Often the transition to upland areas from stream channels is abrupt and precludes development of wetland hydrology or hydric soils.

The total existing disturbance within the DFPA is 1,506.4 acres or 0.6% of the total project area. The total acreage of disturbance has not been broken out by vegetation type; however, most of this disturbance has occurred in the primary cover types of Wyoming big sagebrush, desert shrub, and basin exposed rock/soil cover types. These areas have altered vegetative structure and composition and, in some areas, are actively eroding.

Sand Creek is classified as a riverine intermittent system which covers approximately 1,793.1 acres, or 0.8 percent of the DFPA. Small portions of this area are potential jurisdictional wetlands. Much smaller wetland areas occur at developed or undeveloped springs as subirrigated wet meadow and marsh but they have not been included in the acreage picture. The wet meadow areas are covered by such species as Baltic rush (*Juncus balticus*), foxtail barley (*Hordeum jubatum*), alkali cordgrass (*Spartina* spp.), redtop (*Agrostis stolonifera*), and American licorice (*Glycorrhiza lepidota*). Soils are saturated to their surface for a portion of the growing season but are not inundated for long periods. The marsh cover type is quite limited and occurs in discrete patches within the wet meadow cover type and is dominated by saltmarsh bulrush (*Scirpus maritimus*), creeping spikerush (*Eleocharis palustris*), and common reed (*Phragmites australis*). Marsh areas are inundated for a large portion of the growing season and have saturated soils throughout the growing season. Several springs outlined on the BLM maps for the project area, i.e., Kinney Rim and Baggs, were observed and photographed during October 2000. It is assumed that those springs that were not specifically observed and photographed are similar to the ones that were. It is assumed that, at a minimum, the named springs below are developed; the unnamed spring in Section 18, T13N:R95W was also developed. Those springs identified on the Baggs and Kinney Rim 1:100,000 scale BLM maps are generally concentrated on the north side of Powder Rim and are described in Appendix E. McPherson Spring, Rotten Springs, Carson Springs and an unnamed spring in Section 18, T13N:R95W were viewed in October 2000. Carson Springs is on State Trust, but contains a BLM marker in the field identifying the water body.

Except for the lower reaches of Sand Creek, stream channels in the project area are ephemeral and do not provide sufficient hydrology for wetlands to develop. Wetland vegetation may develop around the margin of water impoundments but are generally not jurisdictional pursuant to the CWA. Existing pond development is generally limited to the northeastern corner of the project area, as depicted on the Baggs and Kinney Rim 1:100,000 scale BLM maps and verified in the field.

Based on field reconnaissance, weed invasion and establishment is minimal within the project area along roads and pipelines as well as at well sites and other areas of disturbance. The State of Wyoming has identified 22 species as noxious (Table 3-17); however, not all may occur in every county. In addition to these species, Carbon County includes Geyer larkspur (*Delphinium geyeri*) (Carbon County Weed & Pest District 2000) and Sweetwater County includes Foxtail Barley (*Hordeum jubatum*). Noxious species known to be present within the DFPA include whitetop (*Cardaria draba*), houndstongue (*Cynoglossum officinale*), Russian knapweed (*Centaurea repens*), and saltcedar (*Tarask spp.*). Most disturbances have exotic species present (i.e., cheatgrass [*Bromus tectorum*]), but few are considered noxious. Hartman and Nelson (2000) identified 428 invasive, exotic (non-native to the state) vascular plants in Wyoming. An undetermined number of these species occur in the DFPA. Areas away from disturbances were observed to have native assemblages of plants.

Several common native and exotic poisonous plants that occur within the project area are halogeton (*Halogeton glomeratus*), milkvetch (*Astragalus* spp.) and locoweed (*Oxytropis* spp.). Other poisonous plants include larkspur (*Delphinium* spp.), horsebrush, greasewood, deathcamas (*Zigadenus* spp.), arrowgrass (*Triglochin maritimum*), tansy mustard (*Descurainia pinnata*), and cocklebur (*Xanthium* spp.). Most of these plants occur in the desert shrub cover type; some occur in wet sites.

Table 3-17. Designated Noxious Weeds in Wyoming.

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

NOTE - *Delphinium geyeri*, Plains larkspur, and *Hordeum jubatum*, Foxtail barley, are considered “County Declared Pest” species in Carbon and Sweetwater Counties, respectively.

3.5.2 Waters of the United States, Including Wetlands

Waters of the United States, including special aquatic sites and wetlands, represent unique and important resources within the project area, although they cover less than one percent of the DFPA. The COE, through the CWA Section 404(b)(1) guidelines and permitting process, has the administrative authority to regulate activities that involve excavation of or discharge of dredge/fill material into waters of the U.S. To be subject to regulation (i.e., jurisdiction) under the federal program, a wetland must have hydrophytic plants, hydric soils, and surface or subsurface water to support such plants and soils. Other administrative directives that involve wetlands protection on federally administered land include the 1977 Executive Orders 11990 (wetland protection) and 11988 (floodplain protection).

Potential wetland areas were initially identified using SDVC data layer derived from National Wetlands Inventory (NWI) maps produced by the FWS. Except for the riverine intermittent nature of the alluvial bottomlands of Sand Creek in the southeastern portion of the project area, most identified areas were small and scattered widely throughout the project area. Based on a review of the 1:24,000 scale NWI maps, classification of the surface drainages and reservoirs/springs are located in Appendix E. Some of the springs identified on the BLM maps do not contain a designation on the NWI maps, i.e., McPherson Springs.

The NWI maps only indicate the potential occurrence and distribution of jurisdictional wetlands because (1) the scale of resolution is small (i.e., 1:24,000); (2) a different method was used to identify wetlands for the NWI maps than for the 1987 COE manual (Environmental Laboratory 1987); and (3) very little ground truth verification of the NWI maps occurred. Wetland investigations were performed in support of, but do not replace, site-specific jurisdictional wetland inventories necessary for CWA 404(b)(1) compliance. Five potential aquatic habitats exist within the project area: marsh, subirrigated wet meadow, riparian scrub, open water, and riverine. The wide channel within the lower reaches of Sand Creek is considered riverine intermittent. Table 3-18 classifies each aquatic habitat according to size and the permanence of water. Within the project area, the condition of these aquatic habitats is highly variable.

Wyoming General Permit 98-08 was developed by the COE to be used statewide for all types of oil and gas activities related to both exploration and production (Johnson 2001). BLM has the authority under this permit (but is not required) to determine if the permit is applicable to activities that are under their jurisdiction. In some cases, GP 98-08 is more restrictive than Nationwide Permits 12 and 14 (e.g., advance notification required for any crossing that impacts more than 0.10 acre). BLM is allowed to approve any activity up to the full limit of GP 98-08. However, the permittee must send a Statement of Compliance to the COE documenting what was done within 30 days after completion for activities that impact over 0.10 acre.

Wetlands have gained considerable recognition for their value in maintaining biological, physical, and socioeconomic systems. The functions wetlands perform include groundwater discharge and recharge, flood storage and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support, wildlife and fish habitat, and heritage values including active and passive recreation and socioeconomic qualities (Adamus and Stockwell 1983).

Professional judgement for determining the functional values of wetlands within the project area was guided by Adamus (1983), Adamus and Stockwell (1983), and Adamus et al. (1987). Values were assigned for each special aquatic site cover type (Table 3-19). Values inherently incorporate differences created by the dissimilarity in cover type vegetation height, condition, and hydroperiod.

Table 3-18. Classification of Aquatic Habitats within the DFPA.[1]

Aquatic Habitat	Cowardin Classification[1]
Marsh	Palustrine Emergent Persistent Semipermanently Flooded
Subirrigated Wet Meadow	Palustrine Emergent Persistent Seasonally/ Temporarily Flooded; Palustrine Unconsolidated Shore Temporarily/Seasonally/Semipermanently Flooded
Riparian Forest	Palustrine Forested Broad-leaved Deciduous Temporarily Flooded/Saturated
Riparian Scrub	Palustrine Scrub-Shrub Broad-leaved Deciduous Temporarily Flooded/Saturated
Open Water	Palustrine Unconsolidated Shore Seasonally/Semipermanently Flooded; Palustrine Unconsolidated Bottom Temporarily/Semipermanently Flooded; Lacustrine Littoral Unconsolidated Shore Temporarily Flooded
Riverine	Riverine Intermittent Streambed Temporarily Flooded

[1]Source: Cowardin et al. (1979).

Table 3-19. Estimated Functional Values for Aquatic Habitats within the DFPA.

Aquatic Habitat	Function[1]								
	GWR	GWD	FSD	SAD	SED	NRR	FCS	HAB	REC
Marsh	x	x	x	x	x	+	+	+	x
Subirri. Wet Meadow	o	x	x	x	x	x	x	x	o
Riparian Forest	o	x	x	x	x	o	x	x	o
Riparian Scrub	o	x	x	x	x	o	x	x	o
Open Water	+	x	x	o	x	x	+	+	x
Riverine	x	x	o	o	o	o	x	x	o

+ - major functional value
x - minor functional value
o - no or minimal functional value
[1] - Wetland and Special Aquatic Site Functions Adamus and Stockwell (1983):
GWR = groundwater recharge
GWD = groundwater discharge
FSD = flood storage and desynchronization
SAD = shoreline anchoring and dissipation of erosive forces
SED = sediment trapping
NRR = nutrient retention and removal
FCS = food chain support
HAB = wildlife and fish habitat
REC = active and passive recreation and heritage value

In the project area, the aquatic habitat with the most positive functional characteristics is Marsh; however, the extent of this type is very limited. The aquatic habitat with the least functional value is Riverine. However, it must be noted that the wide, sandy floodplain of Sand Creek, which is the only riverine type in the project area, plays a large role in flood storage and groundwater recharge.

3.6 RANGE RESOURCES AND OTHER LAND USES

3.6.1 Range Resources

The DFPA would occur on land that is within 13 BLM grazing allotments. Eleven of the allotments extend beyond the boundaries of the DFPA and only two are located wholly within the project boundaries. Twelve of the allotments are administered by BLM's RFO and one allotment is administered by the RSFO.

The 12 RFO grazing allotments total over 386,000 acres, including land outside the project area. Of this amount, 87 percent is in federal ownership, 12 percent is private land, and less than one percent is state-owned land. Currently there are over 31,000 animal unit months (AUMs) permitted for cattle, sheep and a small number of horses in these allotments. Calculated acreage per AUM in these allotments averages just over 12 acres. About 89 percent of the allotments have been issued for sheep and 11 percent issued for cattle. The season of use varies for each allotment. Range condition varies from excellent to poor in these allotments, although the vast majority is in the good category. Poor condition rangeland is relatively rare (Otto 2000).

A small portion of the RSFO-administered Rock Springs Grazing Allotment is located in the northwest corner of the DFPA. The portion of this allotment within the project area supports about 57 AUM's of cattle, although it receives little or no use because of lack of water and logistical concerns; the area is difficult to access from the west and north due to topography. The season of use for the allotment is from December through April, and the range condition is considered fair to good with the majority in good condition (Stephenson 2000).

3.6.2 Other Land Uses

The project area encompasses approximately 233,542 acres of mixed federal, state, and private lands. Over 96 percent of the land within the DFPA is in federal ownership (see Tables 1-2 and 1-3 for information on surface and mineral ownership within the project area). The project area is located with in the RFO and RSFO administrative areas, and federal lands within the project area are administered in accordance with the Green River and Great Divide RMP's.

In addition to grazing, other land uses within and adjacent to the DFPA include wildlife habitat, oil and natural gas exploration, development and transmission and dispersed outdoor recreation. No developed recreation facilities exist within or adjacent to the project area. For more information on recreational resources in the project area, see Section 3-9.

BLM ROW and lease data for the sections contained in the DFPA were reviewed for this analysis. Existing ROW's and leases within the project area are numerous and predominately related to oil and gas exploration, production and transmission.

3.6.3 Conformance with Local Land Use Plans

As outlined in Chapter 1, the Sweetwater county portion of the DFPA would be located in an agriculture zone where oil and gas is a permitted use, although certain county permits may be required (see Section 1.4.3.1) (Kot 2000). In Carbon County, the project would be located in an area that has been designated as suitable for oil and gas development by the county land use plan (Pederson Planning Consultants 1998). The Carbon County Land Use Plan contains the following recommendations relevant to the project:

- The Plan recommends that all lands (public and private) within the county suitable for agriculture should be used for future agricultural use, unless existing land uses now preclude agricultural activities. The Plan notes that oil and gas and other mineral development can usually share land and water resources without causing any significant impact to agriculture, and the county recommends and encourages continued use of mineral resources on agricultural lands.

- The Plan states that it is important to conserve the crucial winter range of big game animals, and that the County Planning Commission desires to integrate the consideration of crucial winter range areas for big game animals in its future land management decisions.

- The Plan states that resource conservation should be balanced with the social and economic needs of Carbon County residents.

3.7 WILDLIFE

3.7.1 Introduction

The DFPA supports a rich diversity of wildlife species and wildlife habitats. For the purposes of inventory and subsequent impact analysis, the core analysis area consists of the 233,542-acre project area. Because many wildlife species are highly mobile and readily move in and out of the project area, records of current and historical wildlife species occurrence were obtained for the project area and an approximate six-mile zone surrounding it (WGFD 2000a, WYNDD 2000). A portion of the DFPA (13,285 acres or 5.7%) is located within the MVMA of the RSFO administrative area. The management objective for the MVMA is to provide protection of wildlife, geologic, cultural, watershed, scenic, and paleontological resources (USDI-BLM 1997).

Existing wildlife information for the project area was supplemented through survey data collected by Hayden-Wing Associates (HWA) biologists in 2000 and 2001 (USDI-BLM and HWA 2002, HWA 2002). These data collections consisted of aerial and ground surveys to determine: (1) occurrence of threatened, endangered, proposed, candidate, or sensitive species, and/or potential habitat that may occur on the project area (USDI-FWS 2002a, USDI-BLM 2001); (2) the occurrence, location, size, and burrow density of white-tailed prairie dog colonies; (3) the location and activity status of raptor nests within the project area and two-mile buffer zone; (4) the activity status of all leks within the project area and two-mile buffer zone and search for previously undocumented greater sage-grouse leks; (5) the location and size of critical greater sage-grouse winter habitat and document grouse use of these areas during the winter; and (6) the occurrence, location, and size of mountain plover habitat and document the presence/absence of plover within these habitats. Methods and results of these surveys are summarized in this document and detailed methods and results are included in the Biological Assessment (USDI-BLM and HWA 2002) and Wildlife Technical Report for the Desolation Flats Natural Gas Development Project (HWA 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 areas that would be physically disturbed by the drilling and construction of well pads, related roads, pipelines and production facilities, as well as the zones of influence around activity areas. Zones of influence are defined as those areas surrounding, or associated with, project activities where impacts to a given species could occur. The shape, and extent of such zones, varies considerably with species and circumstance.

The vegetation within the project area is comprised of a mix of types typical of the basins of south-central Wyoming. General vegetative species composition for each habitat type is characterized in Section 3.5.1 of this document. Except for rock outcrops and piles and exposed soil, the wildlife habitat types correspond with the general vegetation cover types described in Section 3.5.1. Wildlife habitat in the portion of the DFPA in the MVMA includes habitats such as greasewood, saltbush, sagebrush, grassland patches, rock outcrops, and badlands.

3.7.3 General Wildlife

A total of 388 species of wildlife are known, or have the potential, to occur as residents or seasonal migrants within the DFPA and surrounding six-mile buffer (Appendix F). This species list is comprised of 80 mammals, 269 birds, 7 amphibians, 11 reptiles, and 21 fish species. The presence and distribution of these wildlife species was determined from published literature, unpublished data from state and federal agencies, databases from private organizations, and on-site surveys conducted by HWA during 2000 and 2001. Although all species listed in Appendix F are important members of ecological communities, many are common and have a wide distribution within the project area, state, and region. Consequently, the relationship of most of these species to the proposed project is not discussed in the same depth as species which are threatened, endangered, rare, or are otherwise of high interest or unique value.

3.7.4 Big Game

Three big game species: pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) occur on the project area. Big game populations are managed by the Wyoming Game and Fish Department (WGFD) within areas designated as herd units and are discussed in that context. The types of big game habitat designated by WGFD (1996, 2000b) discussed in this document include winter, winter/yearlong, crucial winter/yearlong, severe winter relief and spring/summer/fall. Winter ranges are used by a substantial number of animals during winter months (December through April). 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 and 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. Severe winter relief habitat is used only during the worst of winters, approximately one in five years. These ranges are used by and allow at least a significant portion of the population to survive the occasional extremely severe winter. Spring/summer/fall ranges are used before and after winter conditions persist. Areas designated as OUT (or non-use areas) contain habitats of limited importance to the species.

Pronghorn. The DFPA is located within the southeastern quarter of the 2,915-square-mile Bitter Creek Herd Unit (Figure 3-10). The Bitter Creek Herd Unit contains Hunt Areas 57 and 58. The boundaries of this herd unit correspond with major roads on the east, west and north sides (State Highways 789 and 430 and Interstate 80) and the Wyoming/Colorado border on the south.

The 1999 post hunt population estimate for the Bitter Creek Herd Unit was 14,700 animals, which is 41.2 percent below the WGFD management objective of 25,000 animals (Table 3-20). Population objectives can change over time and are based upon WGFD management and public input. According to the WGFD (2000b), the low herd numbers can be attributed to limited fawn production during the past five years. No harvest changes were prescribed for antelope in this unit by the WGFD (2000b).

The Bitter Creek herd unit contains winter/yearlong (WYL), crucial winter/yearlong (CWYL), and severe winter relief (SWR) pronghorn habitats as shown on Figure 3-10. Pronghorn use the project area year-round. The project area encompasses 233,542 acres or 12.5 percent of the Bitter Creek Antelope Herd Unit. Approximately 13,612 acres or 5.8 percent of the antelope habitat within the project area is classified as CWYL range by the WGFD. The remainder of the project area (219,930 acres) is classified as WYL range. Pronghorn movement across the project area follows several general migration routes through the central portion of the project area (Figure 3-10).

Pronghorn habitat in the portion of the DFPA located in the MVMA includes an area of crucial winter range (5,708 acres or 41.9% of the CWYL pronghorn range on the DFPA).

Table 3-20. Population Parameters for Big Game Herd Units within the DFPA.

Species	Herd Unit	Unit No.	Hunt Area(s)	Size (mi^2)	Population Estimate (1999)[c]	Population Objective	Density Estimate Objective[a]	Fawn:Doe Ratio
Pronghorn	Bitter Creek	414	57, 58	2,915	14,700	25,000	8.58	48:100[b]
Mule Deer	Baggs	427	82,84, 85,100	3,440	18,300	18,700	5.44	56:100[c]
Elk	Petition	430	124	2,915	300	300	0.10	??:100[c]

[a] = No. Animals (WGFD Population Objective) per Square Mile of Occupied Habitat
[b] = Prehunt Classification
[c] = Posthunt Classification

<u>Mule Deer</u>. The DFPA is located within the southwest portion of the 3,440-square-mile Baggs Herd Unit (Figure 3-11). The boundaries for this herd unit correspond with the Bitter Creek Road on the west, Interstate 80 on the north, and the Wyoming/Colorado border on the south. Much of the eastern border follows the Continental Divide until it intersects Highway 71.

The 1999 post hunt population estimate for the Baggs Herd Unit was 18,300. This estimate is very close to the WGFD management objective of 18,700 (Table 3-20). Population objectives can change over time and are based upon WGFD management and public input. The project area is located within Hunt Areas 82, 84, 85 and 100, where the hunter success rate for 1999 was 56 percent. Hunt Area 82 remains the most popular in the herd unit and sustains the highest levels of hunter use (WGFD 2000b).

The Baggs Herd Unit contains WYL, CWYL, winter (WIN), and spring/summer/fall (SSF) mule deer habitats as shown on Figure 3-11. Approximately 214,112 acres or 91.7 percent of the mule deer habitat on the project area is classified as winter/yearlong range by the WGFD. The remainder of the project area (19,430 acres) is classified as CWYL range. As shown in Figure 3-11, the only

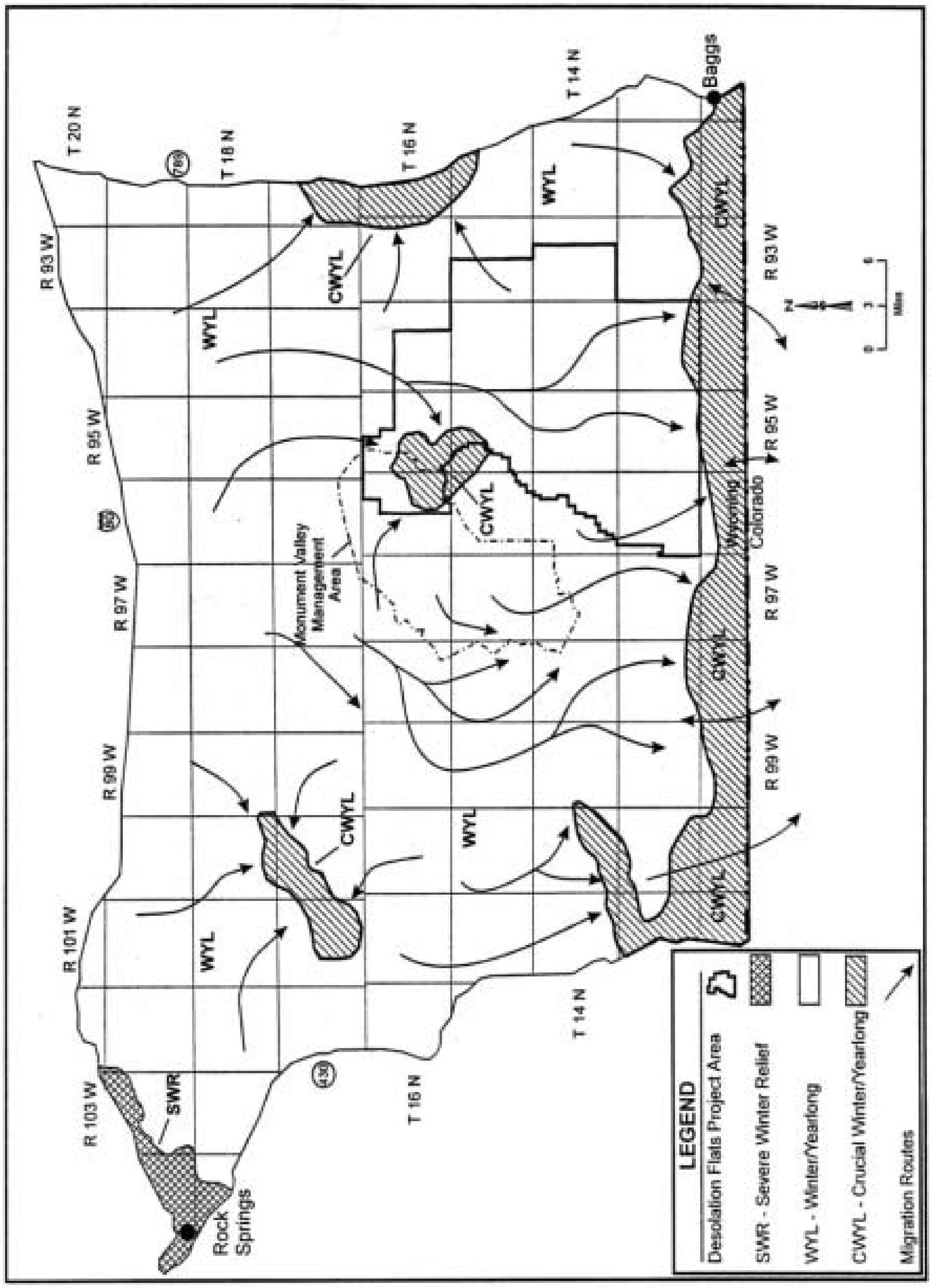


Figure 3-10. Seasonal Pronghorn Antelope Ranges for the Bitter Creek Herd Unit in Relation to the Desolation Flats Project Area.

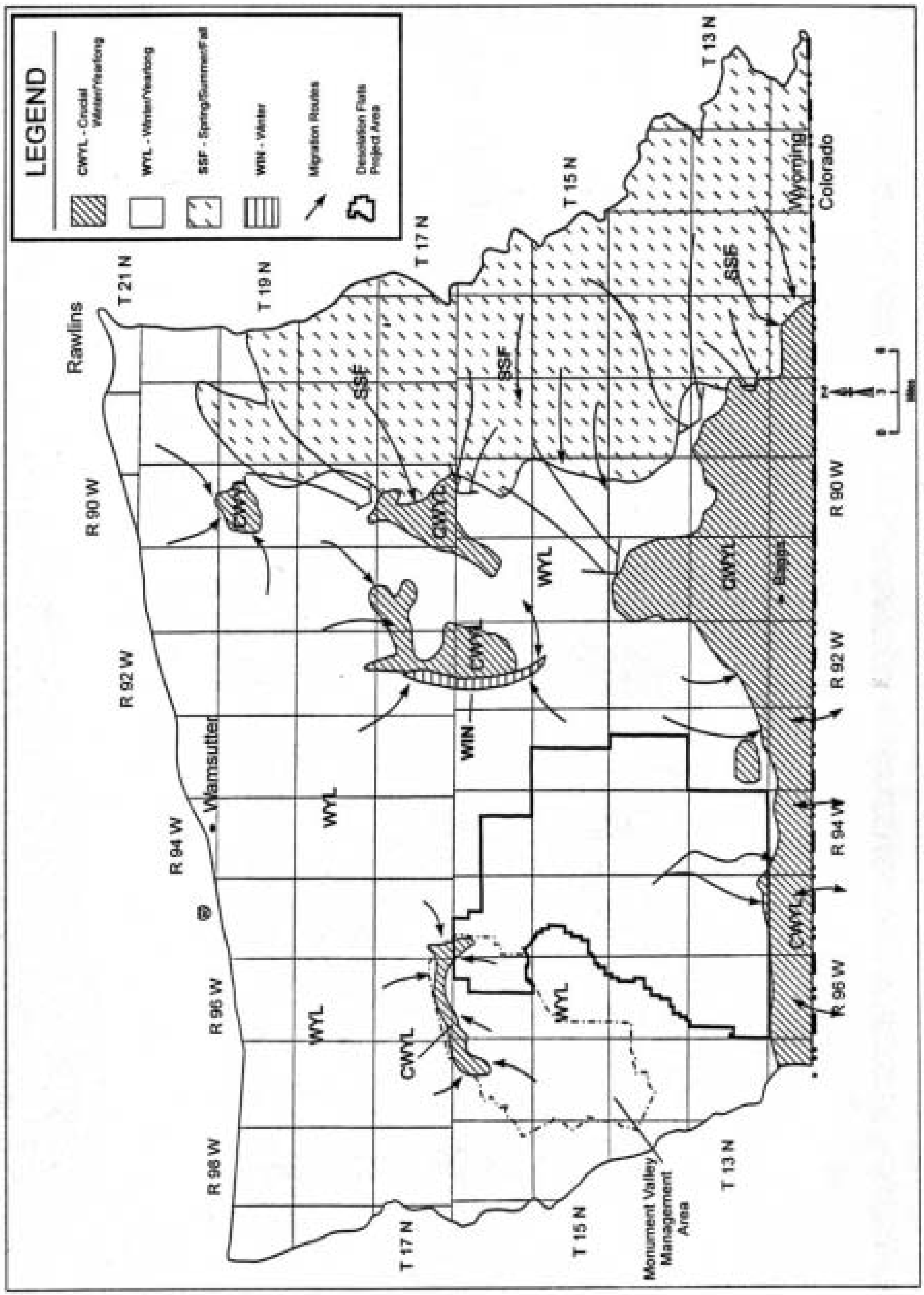


Figure 3-11. Seasonal Mule Deer Ranges for the Baggs Herd Unit in Relation to the Desolation Flats Project Area.

places this habitat type occurs on the project area are in the south-central portion along the Powder Rim and in the northwest in the Haystack range. The CWYL range near the Haystack Range (794 acres) is also located within the MVMA. Mule deer utilize several general migration routes to cross the project area and access the crucial winter ranges on Powder Rim and the Haystacks (Figure 3-11).

Elk. The DFPA is located within the southeastern quarter of the Petition Herd Unit (Figure 3-12). The Petition Elk Herd Unit is bounded by Wyoming Highway 430 on the west, Interstate 80 to the north, Wyoming Highway 789 to the east and the Colorado/Wyoming state line to the south and covers approximately 2,915 square miles.

The 1999 post hunt population estimate of 300 animals for the Petition Herd Unit (Table 3-20) is at the WGFD management objective. Since the herd has been thriving and numbers are stable, the WGFD proposed increasing the antlerless harvest and hunter opportunity for the 2000 hunting season. Population objectives can change over time and are based upon WGFD management and public input. The project area is located within Hunt Area 124, where hunter success rate for 1999 was 51.7 percent (WGFD 2000b).

The Petition Herd Unit contains yearlong (YL), WYL, and CWYL elk habitats as shown on Figure 3-12. Approximately 201,003 acres or 86.1 percent of the project area is not classified as elk habitat. Of the remaining 32,539 acres, 9,364 acres (4.0 %) are classified as YL; 21,302 acres (9.1%) are WYL; and 1,873 acres (0.8 %) are CWYL range. All of the winter range occurs in the area of the Powder Rim along the southern edge of the project area (Figure 3-12). No designated elk ranges occur on the MVMA. Elk migrate to the Powder Rim from the Sierra Madre and Elk Head Mountains (approximately 50 miles to the east) and may cross southern portions of the DFPA (Porter 1999).

White-tailed Deer. The WOS (WGFD 2000a) contains records of occurrences of white-tailed deer along the flood plain of the Little Snake River around Baggs, Wyoming. White-tailed deer habitats in the Northern Rocky Mountains can be generally characterized as dense coniferous forests, riparian areas, and croplands at elevations of 1,000 to 6,500 feet (Halls 1984). Habitats on the project area, however, are not typical of those normally inhabited by this species. White-tailed deer may occasionally traverse the project area along the riparian corridor vegetation found adjacent to dry stream beds as they move between riparian/bottomland habitats along the Little Snake River. There is only a slight possibility that white-tailed deer would occur on the DFPA. Due to the limited number of white-tailed deer within the Baggs Herd Unit, animal numbers are not managed through hunting (WGFD 2000b).

3.7.5 Wild Horses

The project area is located within portions of the RFO and RSFO administrative areas. Management direction for wild horses is outlined within the RMP's (USDI-BLM 1990a, USDI-BLM 1997). The RMP's provide for protection, management, and control of the wild horses within a number of Wild Horse Herd Management Areas (HMA). The DFPA lies within the bounds of the Adobe Town Wild Horse HMA (Figure 3-13).

Within each wild horse HMA, monitoring is conducted primarily at the allotment level and emphasizes vegetative conditions. Limited data has been gathered on the horses themselves, but

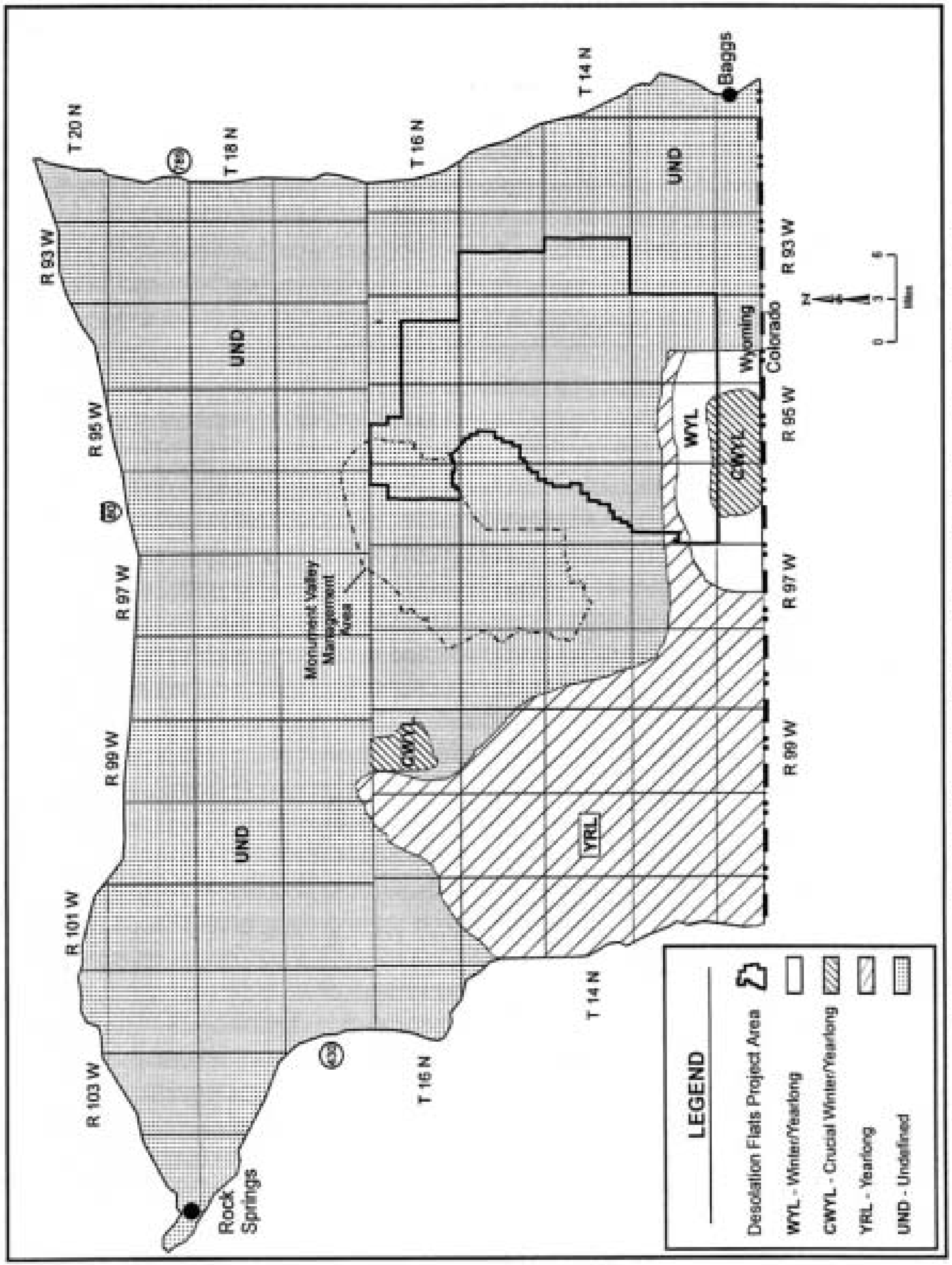


Figure 3-12. Seasonal Elk Ranges for the Petition Herd Unit in Relation to the Desolation Flats Project Area.

Plans include developing a more extensive monitoring program to evaluate herd conditions and ensure that objectives established in management plans are met (USDI-BLM 1999d).

The Adobe Town Wild Horse HMA is predominantly within the RFO administrative area and encompasses approximately 466,265 acres. The majority of the DFPA lies within the Adobe Town Wild Horse HMA (194,105 acres or 83.1%). Likewise, the majority of the MVMA is located within the Adobe Town Wild Horse HMA. The wild horse herd management target is about 700 horses, with a range of 610-800 in the Adobe Town Wild Horse HMA. The most recent BLM wild horse population estimate (2001) for the Adobe Town Wild Horse HMA was approximately 1,740 animals (Reed 2002). There is a large area of habitat currently used by a relatively small number of horses (179 in 2001) that is not located within the Adobe Town Wild Horse HMA (Figure 3-13). A small portion of the DFPA (16.3%) is located in this area. This area does not have a herd management goal, and horses in this area may be gathered and removed over time (USDI-BLM 1999d). If horses are distributed evenly across the Adobe Town Wild Horse HMA, we would expect approximately 291 horses to occur on the portion of the DFPA located within the Adobe Town Wild Horse HMA. However, horses are not likely evenly distributed because they will concentrate in areas of suitable habitat (i.e. near water sources), and will use different portions of the Wild Horse HMA during different seasons (Reed 2002).

3.7.6 Upland Game Birds

Two species of upland game birds are known to regularly use habitat within the project area: greater sage-grouse (*Centrocercus urophasianus*) and mourning dove (*Zeniada macroura*). The WGFD manages greater sage-grouse and other game birds within designated upland game management areas. The DFPA is located in the center of the southern half of the 1,758-square-mile Bitter Creek Upland Game Management Area (WGFD 2000c).

Greater Sage-grouse. Greater sage-grouse are common on the project area, and are know to inhabit the project area year-round (WGFD 2000a, HWA 2002). The entire project area occurs within the Bitter Creek Game Management Area where the grouse are managed by the WGFD. In 1999, 218 grouse, or 1.0 percent of the state wide annual harvest of 21,556 grouse, were killed within the Bitter Creek Game Management Area (WGFD 2000c).

Greater sage-grouse are listed as a state sensitive species by the BLM and may be petitioned for listing under the Endangered Species Act (ESA) because populations have been in decline over much of their range due to a wide variety of possible factors including drought, habitat loss, predation, and other causes. However, lek counts within the Green River region, which includes a portion of the DFPA, have increased during the past three years with more than twice as many males being counted on leks as were observed by WGFD during the low in the population during 1997 (Woolley 2000, personal communication).

Important habitats for these birds include strutting (leks), nesting, brood-rearing, and wintering areas, all of which occur on the project area both in contiguous blocks and in isolated patches (HWA 2002). During their spring mating season, greater sage-grouse gather on strutting grounds (leks) that typically occur in open or barren areas within a sagebrush matrix. Females usually nest within mature stands of sagebrush that provide adequate cover and protection from predators. Density of nesting greater sage-grouse tends to decrease with distance from the lek, with the majority of females nesting within 2 miles of leks (Braun et al. 1977, Hayden-Wing et al. 1986).

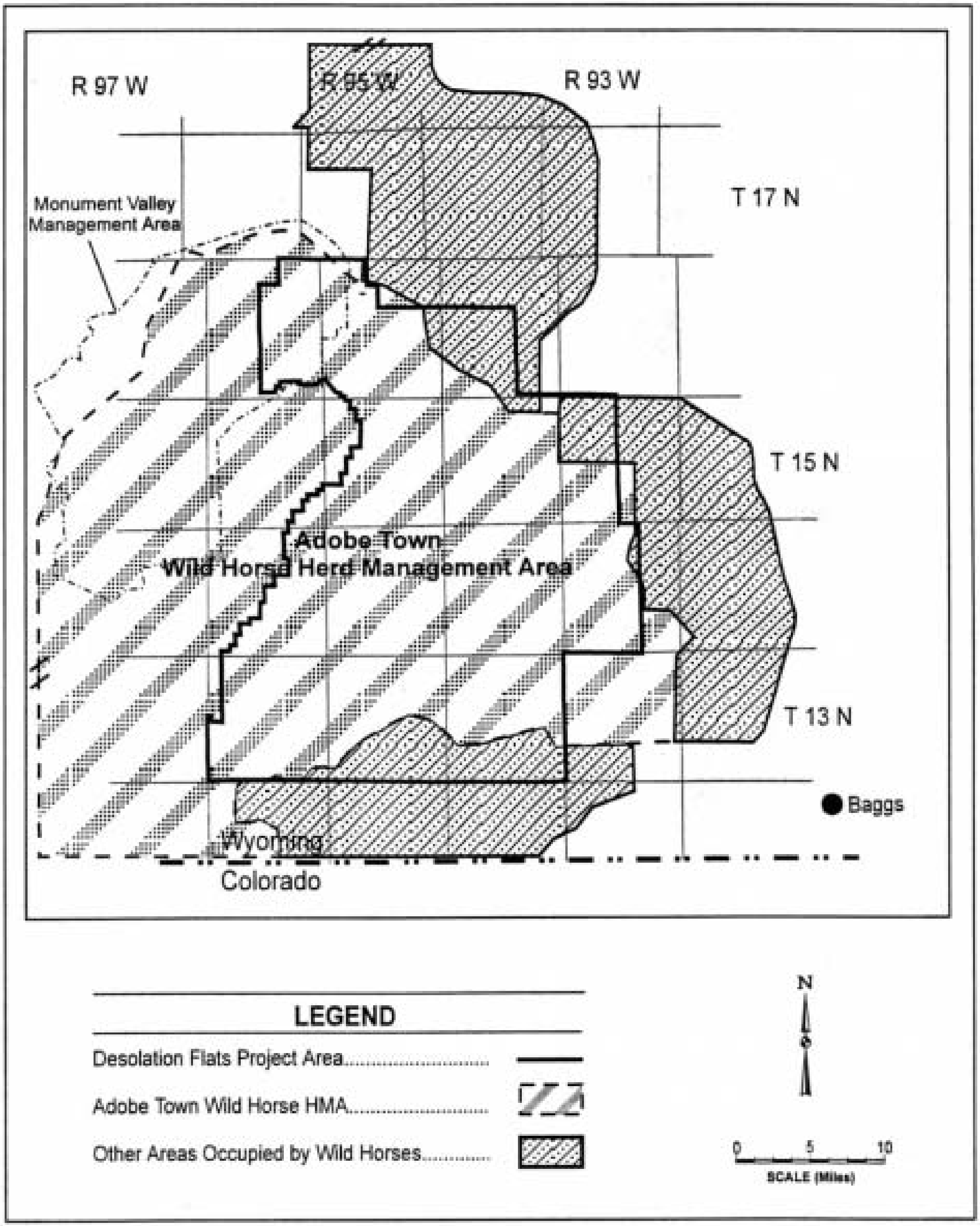


Figure 3-13. The Adobe Town Wild Horse Herd Management Area as it Relates to the Desolation Flats Area.

Therefore, habitat within 2 miles of leks is considered potential nesting habitat. Winter habitat is characterized by tall mature stands of sagebrush that remain above snow cover (HWA 2002).

Fifteen greater sage-grouse lek locations on and within two miles of the project area, were obtained through the BLM office in Rawlins, Wyoming and from District and Regional biologists with the WGFD in Baggs and Green River, Wyoming. Aerial surveys by HWA biologists were conducted in April, 2000 to check the status of known greater sage-grouse leks and document new leks on and within two-miles of the project area (HWA 2002). Locations of the four active leks found during the April, 2000 survey and two active leks that have been monitored by WGFD (Woolley, personal communication) are illustrated in Figure 3-14. In addition to the 15 leks obtained through BLM and WGFD records, one new active lek was discovered during aerial surveys, bringing the total lek count to 6 that were active during 2000 surveys and 10 that were not active. According to the WGFD, leks will not be considered historic until they have not been used for 7-10 years. It is probable that hens from the active leks use the project area for nesting and brood rearing. Greater sage-grouse leks and associated nesting habitats on the project area occur mostly within sagebrush/desert shrub vegetation type, and secondarily within the big sagebrush type (Figure 3-14). Only one greater sage-grouse lek (active or historic) was located within 2 miles of the MVMA. The winter of 2000-2001 was worse than most years on the project area and snow cover was extensive and deep. This forced greater sage-grouse to seek out habitat with sagebrush tall enough to remain above the deep snow. In order to determine the location of crucial winter habitats used by grouse during this extreme winter, HWA biologists conducted helicopter surveys during the maximum snow depth conditions that occurred in February, 2001 (HWA 2002). The areas where greater sage-grouse were found during the surveys were classified as severe winter relief habitats. Severe winter relief habitat is used only during the worst of winters, and allows at least a significant portion of the population to survive the occasional extremely severe winter. Most of the severe winter relief habitat for greater sage-grouse was found within the sagebrush/desert shrub type (Figure 3-14). The remainder was located within stands of tall big sagebrush that occur within other vegetation types. During April and May 2001, the severe winter relief habitat areas identified from the air were ground surveyed by HWA biologists to determine winter dropping densities of grouse and size of the areas used. Thirteen severe winter relief habitat patches were located on the DFPA, covering a total of 209 acres. No severe winter relief habitat patches were identified on the MVMA. Details of the protocol used in locating and describing the concentration areas are contained in the Technical Report (HWA 2002).

Mourning Dove. Both migratory and nesting populations of mourning doves have been recorded within the region and it is likely that they occur on the project area (WGFD 2000c). Mourning doves are frequently associated with sagebrush-steppe, mountain shrub, and riparian habitats. Brood production of the species is tied closely to spring and summer precipitation because increased productivity of mourning doves depends on the availability of sufficient seed and water supplies. Thus, mourning doves would be expected to concentrate along the riparian habitats within the project area.

The estimated 1999 dove harvest for the Bitter Creek Upland Game Management Area (Area 10) was 127 birds (WGFD 2000c) and accounted for about 0.4 percent of the statewide annual harvest of mourning doves (32,702) in 1999. The average harvest rate within Area 10 was 0.07 birds per square mile (WGFD 2000c). According to this average harvest rate, approximately 26 doves would theoretically have been harvested within the 365-square-mile project area during 1999.

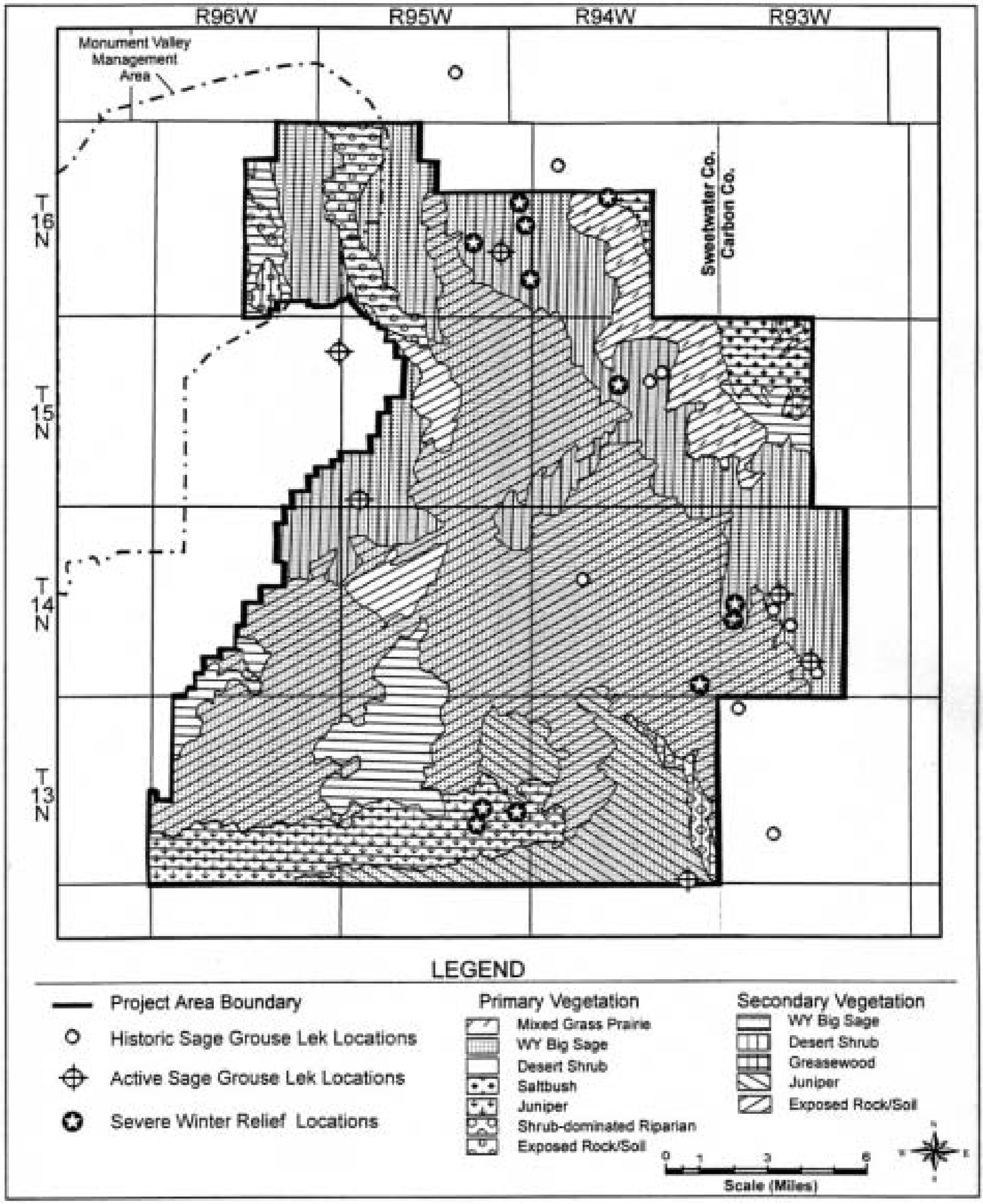


Figure 3-14. Greater Sage-Grouse Lek Locations, and Severe Winter Relief Areas in Relation to the Vegetative Cover of the Desolation Flats Project Area.

3.7.7 Raptors

Existing records of the WGFD and BLM, and recent research results from a raptor study conducted by Ayers and Anderson (1996), show that 17 species of raptors have been observed on the project area since 1977. The golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (*Buteo jamaicensis*), ferruginous hawk (*Buteo regalis*), Cooper's hawk (*Accipiter cooperii*), Swainson's hawk (*Buteo swainsoni*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), burrowing owl (*Athene cunicularia*), and turkey vulture (*Carthartes aura*) are the most commonly reported raptors. Other raptor species which have been documented as occurring on the project area include: great horned owl (*Bubo virginianus*), long-eared owl (*Asio otus*), short-eared owl (*Asio flammeus*), rough-legged hawk (*Buteo lagopus*), sharp-shinned hawk (*Accipiter striatus*), and northern goshawk (*Accipiter gentilis*).
Helicopter surveys of raptor nests on and around the project area were conducted by HWA during early May 2000 (HWA 2002). A total of 204 raptor nest sites was identified within a one-mile buffer of the DFPA between the May 2000 survey and BLM historic records (HWA 2002). Only nine of the nest sites were active. The active nest sites belonged to three raptor species: red-tailed hawk (3), ferruginous hawk (2), and golden eagle (4). Historic raptor nest locations within 1 mile of the DFPA (111 nests) were also obtained from the BLM. Only 8 raptor nest sites were located within the MVMA. Inactive raptor nest sites may be used in subsequent years, therefore, all nests have the potential to be active in any given year. The topography of the DFPA includes numerous low bluffs and cliffs that provide suitable sites for raptor nesting. The entire project area contains suitable habitat for raptor hunting or foraging.

3.8 SPECIAL STATUS PLANT, WILDLIFE, AND FISH SPECIES

Special status species include: (1) threatened, endangered, species proposed for listing by the FWS (Under the ESA of 1973 as amended); and (2) candidate species and sensitive species identified by the BLM Wyoming State Sensitive Species List (USDI-BLM 2001).

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

The FWS has determined that four wildlife, four fish, and one plant species listed as either threatened, endangered or proposed under the ESA may potentially be found 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 3-21. More detailed information on threatened, endangered, and proposed species is presented in the Biological Assessment (BA) for the DFPA (USDI-BLM and HWA 2002).

3.8.1.1 Wildlife Species

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. 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).

Fifty-nine areas containing prairie dog burrows (Figure 3-15) were documented during aerial surveys conducted over the DFPA, plus the two-mile buffer, in April, 2000 (USDI-BLM and HWA

Table 3-21. Threatened, Endangered, and Proposed Wildlife, Fish, and Plant Species Potentially Present in the DFPA.[1]

Species	Scientific Name	Status
Mammals		
Black-footed ferret	*Mustela nigripes*	Endangered
Canada lynx	*Lynx canadensis*	Threatened
Birds		
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Mountain plover	*Charadrus montanus*	Proposed
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

[1] Source: (USDI-FWS 2002a)

2002). Prairie dog towns occurring within the project area and the 2-mile buffer were mapped from the ground in their entirety. One prairie dog colony extended beyond the 2-mile buffer zone. Collectively, a total of 9,967 acres of white-tailed prairie dog colonies were identified (2.6 % of the surveyed area). A large portion of these colonies, 4,229 acres, was located outside of the DFPA. These colonies form 2 complexes (Figure 3-15) that may have the potential to support black-footed ferrets, according to habitat requirements identified in Biggins et al. (1989). Complex 1 encompasses 54 colonies and 9,450 acres and extends just beyond the 2-mile buffer of the project area. Complex 2 encompasses 5 colonies and 517 acres. Of the 59 colonies identified by air and surveyed on the ground, 9 colonies had active burrow densities less than 8 per acre and 43 colonies had active burrow densities greater than or equal to 8 per acre (USDI-BLM and HWA 2002). Black-footed ferret surveys would be necessary prior to ground disturbing activities within prairie dog towns in both complexes that meet FWS requirements for black-footed ferret surveys (USDI-FWS 1989). Portions of 4 colonies in complex 2 were located within the western portion of the MVMA located within the DFPA. Aerial mapping and ground surveys indicated that the area and density of active prairie dog colonies may be sufficient to support black-footed ferrets and that the species could theoretically be present within the DFPA.

No black-footed ferret sightings within the project area have been reported in the Wildlife Observation System (WOS), WYNDD, or records of the BLM (WGFD 2000a, WYNDD 2000, and Jim Dunder, Wildlife Biologist, Rock Springs Field Office, personal communication). The WGFD atlas does, however, indicate that historic sightings of black-footed ferrets have been made within the project area (WGFD 1999) and an unconfirmed sighting of a black-footed ferret southwest of Monument Valley was reported in 1992 (Jim Dunder, personal communication).

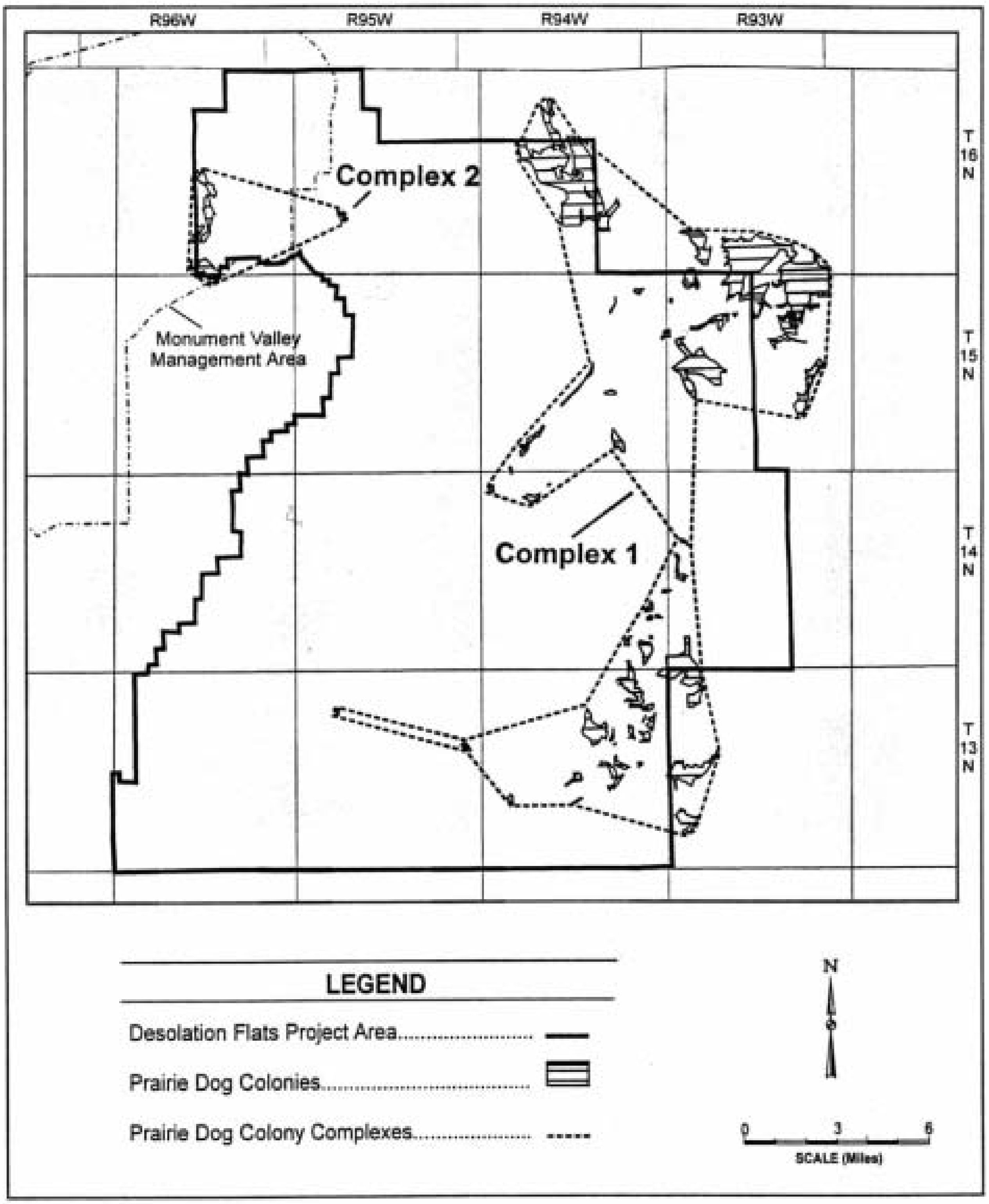


Figure 3-15. White-tailed Prairie Dog Colonies and Complexes in Relation to the Desolation Flats Project Area.

Canada Lynx. The Canada lynx is one of three major species of wildcats found in North America. Although Wyoming comprises part of the species' historic geographical range, no lynx sightings have been documented in the project area or within a six-mile buffer (WGFD 2000a). In a collaborative effort, the BLM, FWS, and FS recently completed a map of lynx habitat in the State of Wyoming; according to the habitat map, lands within the DFPA do not provide lynx habitat (McKelvey et al. 1999), but lynx could potentially travel across the DFPA.

Due to the facts that: (1) the project area does not include high elevation lodgepole pine/spruce-fir habitat types preferred by this species, (2) the project area does not support a population of snowshoe hares (WGFD 2000a), (3) there are no recorded lynx sightings within a six-mile buffer in either the WOS (WGFD 2000a) or the WYNDD (2000), and (4) the closest potential habitat is more than 20 miles to the east in the Sierra Madre Mountains, it is unlikely that lynx occur on or near the project area.

Bald Eagle. As of the July 12, 1995 Federal Register, the bald eagle is no longer classified as endangered and has been downlisted by the FWS to the status of threatened in the lower 48 states. Bald eagles typically build stick nests in the tops of coniferous or deciduous trees along streams, rivers or lakes; they may also select cliffs and ledges as nest substrates (Call 1978). Selection of nest trees appears to depend, in part, on food availability early in the nesting season (Swenson et al. 1986). Primary wintering areas are typically associated with concentrations of food sources along major rivers that remain unfrozen where fish and waterfowl are available and near ungulate winter ranges that provide carrion (Montana Bald Eagle Working Group 1990). Wintering bald eagles are also known to roost in forests with large, open conifers and snags protected from winds by ridges, often near concentrations of domestic sheep and big game (Anderson and Patterson 1988).

Bald eagles winter and nest in proximity to the project area along the Little Snake River, and numerous observations, both on and proximal to the project area, are listed in the WOS (WGFD 2000a). A large number of incidental bald eagle sightings (70) have been recorded within a six-mile buffer of the project area (WGFD 2000a). Most observations (91 %) were documented between November and March, indicating that the area is primarily used as wintering habitat.

Several ecological factors probably allow for seasonal and/or year-round use by bald eagles along the Little Snake River: (1) water remains open on the river year-round providing an adequate supply of fish and waterfowl, (2) the river is adjacent to crucial ungulate winter range, (3) domestic sheep production is present, and (4) the riparian zone has many large cottonwood trees for roosting and nesting. This habitat located along the Little Snake River is located outside of the 1-mile buffer of the DFPA. Upland habitat use by bald eagles within the project area would probably be limited to winter scavenging forays. Very few, if any, trees large enough for eagle roosting or nesting exist on the project area.

Inspection of BLM and WGFD raptor nest records and results of aerial and ground raptor nest surveys (HWA 2002) revealed that no active bald eagle nests occurred within the DFPA.

Mountain Plover. The mountain plover nests across much of Wyoming, but preferred habitat is limited throughout its range (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 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).

The DFPA was surveyed for mountain plovers and mountain plover habitat in June, 2000 (USDI-BLM and HWA 2002). Plover habitat evaluations were conducted in accordance with the protocol outlined in the *Final Biological and Conference Opinions for the Proposed Continental Divide/Wamsutter II Natural Gas Project* (USDI-FWS 2000). Potential plover habitats defined during 2000 were again surveyed for plovers in 2001. The project area provides approximately 25,415 acres (10.9 % of the project area) of potential plover habitat (USDI-BLM and HWA 2002). Approximately 4,825 acres of this potential mountain plover habitat was located within the MVMA. Some "islands" of non-habitat such as dense sagebrush are included within the greater polygons of designated plover habitat, however plover are capable of utilizing relatively small habitat patches within a sagebrush matrix.

Mountain plovers were observed in numerous locations in the northern half of the DFPA, including the MVMA. There are also recorded sightings of mountain plovers within a six-mile buffer of the project area (WGFD 2000a, WYNDD 2000). During 2000 and 2001 surveys, mountain plovers were observed within 9,202 acres (3.9% of the project area) of the designated potential mountain plover habitat polygons; none were observed in the remaining 16,213 acres of designated potential mountain plover habitat (Figure 3-16). Plovers with young were found on one site (Section 4, T15N:R93W) during the 2001 production survey.

3.8.1.2 Fish Species

The DFPA drains intermittent/ephemeral runoff generated by spring snowmelt and summer thunderstorm events directly into the Little Snake River, a tributary to the Colorado River. Surface water is scarce and perennial streams within the DFPA are limited to the most downstream portion of the Sand Creek drainage during wet years (see Section 3.4.2.1). All of the streams in the project area are classified as Class 5 streams by the WGFD (1991).

Four federally endangered fish species may occur as downstream residents of the Colorado River system: bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), and razorback sucker (*Xyrauchen texanus*) (USDI-FWS 2002a). The bonytail, Colorado pikeminnow, humpback chub, and razorback sucker share similar habitat requirements and historically have occupied the same rivers. None of these fish species are likely to be found in streams within the DFPA, nor has critical habitat been established in Wyoming for any of these species (Upper Colorado River Endangered Fish Recovery Program 1999). However, the potential for project-related impacts to waters (see section 4.4) that feed into the Little Snake River warrant their inclusion in this NEPA document.

Colorado Pikeminnow. The Colorado pikeminnow is the largest member of the minnow family and occurs in swift, warm waters of Colorado Basin rivers. 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. It was also known to occur historically in the Green River of Wyoming at least as far north as the City of Green River. In 1990, one adult was collected from the Little Snake River in Carbon County, Wyoming (Baxter and Stone 1995).

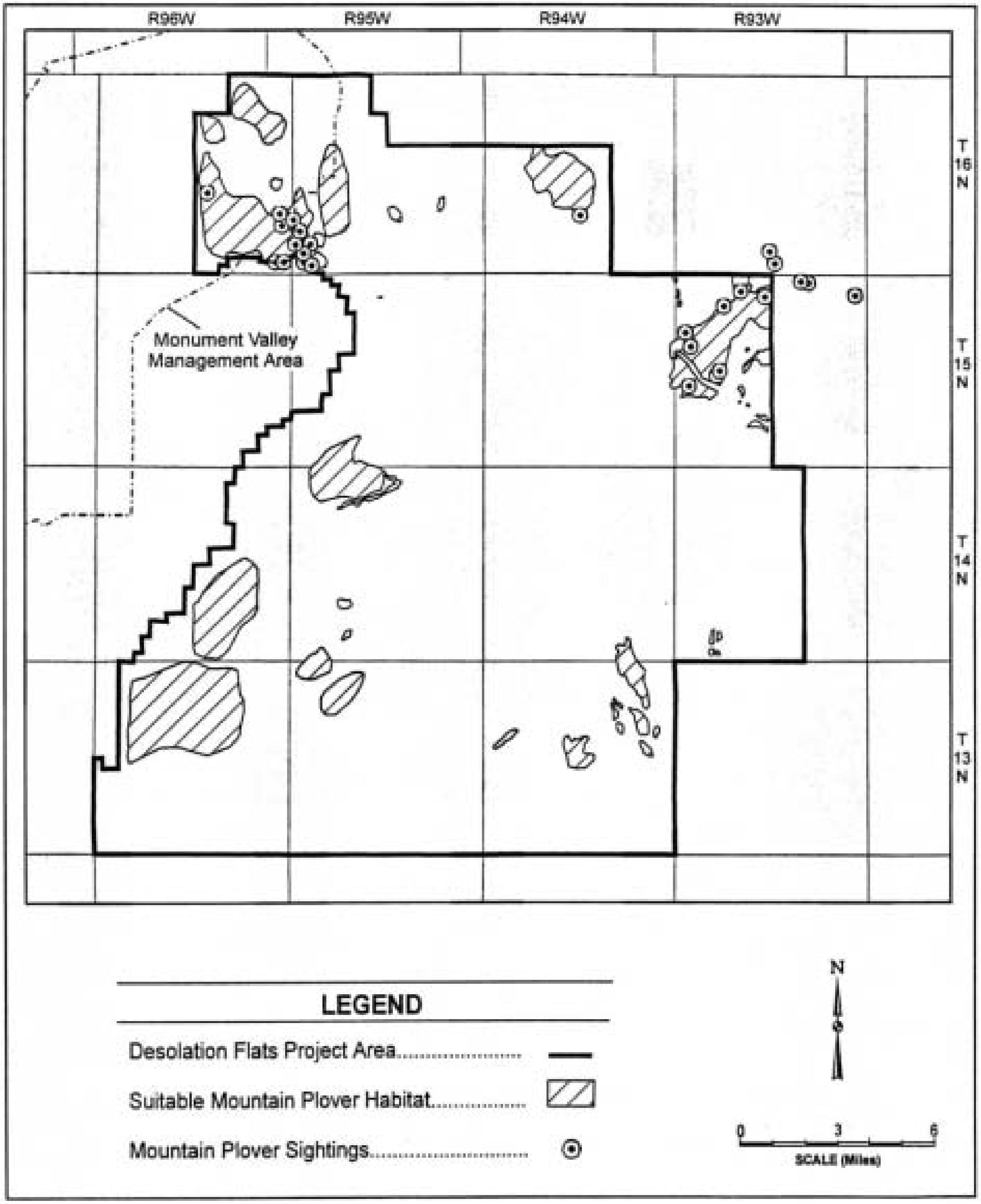


Figure 3-16. Areas Identified as Potential Mountain Plover Habitat and Mountain Plover Sightings on and proximal to the Desolation Flats Project Area.

Subsequent survey attempts to collect Colorado pikeminnow from this area of the Little Snake River by WGFD personnel failed to yield any other specimens.

Bonytail. Habitat of the bonytail is primarily limited to narrow, deep, canyon-bound rivers with swift currents and white water areas. With no known reproducing populations in the wild today, 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, in the Colorado River at the Colorado/Utah border and in Cataract Canyon (Upper Colorado River Endangered Fish Recovery Program 1999).

Humpback Chub. Habitat of the humpback chub is also 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 1999). The humpback chub was historically found throughout the Colorado River, and its tributaries, which are used for spawning (Valdez et al. 2000). It is estimated that the humpback chub currently occupies 68% of its original distribution, in five independent populations that are thought to be stable (Valdez et al. 2000).

Razorback Sucker. The razorback sucker, an omnivorous bottom feeder, is one of the largest fishes in the sucker family. Adult razorback sucker habitat use varies depending on season and location. 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 (Upper Colorado River Endangered Fish Recovery Program 1999).

3.8.1.3 Plant Species

Ute ladies'-tresses. The Ute ladies'-tresses 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. Recent discoveries of orchid colonies in Wyoming and Montana indicate that surveys for and inventories of orchid occurrences continue to be an important part of orchid recovery planning and implementation (USDI-FWS 2002a). This species has been located in Converse, Goshen, Laramie, and Niobrara counties in Wyoming (Fertig 2000).

3.8.2 Sensitive Plant, Wildlife, and Fish 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 2001). 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 2001). The BLM's order of priority for the management of all special status species is: First - listed T&E species; Second - proposed T&E species; Third - candidate T&E species; Fourth - BLM sensitive species; and, Fifth - State listed species (USDI-BLM 2001). 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 3-22. A summary discussion of these species follows and detailed species accounts and discussion for wildlife and fish species are included in the Wildlife and Fisheries Technical Report (HWA 2002). The potential for occurrence of the following sensitive species in the MVMA portion of the DFPA is expected to be the same as for the remainder of the DFPA.

Plants. Twenty-one BLM Wyoming state sensitive plant species are found in either the BLM Rawlins Field Office or Rock Springs Field Office (USDI-BLM 2001). These include: meadow pussytoes, Laramie columbine, small rock cress, mystery wormwood, Nelson's milkvetch, precocious milkvetch, Cedar Rim thistle, Ownbey's thistle, Wyoming tansymustard, Weber's scarlet gilia, large-fruited bladderpod, stemless beardtongue, Gibbens' beardtongue, Beaver Rim phlox, tufted twinpod, persistent sepal yellowcress, pale blue-eyed grass, Laramie false sagebrush, Green River greenthread, Uinta greenthread, and Cedar Mountain Easter daisy. One of these, Gibbens' beardtongue (Penstemon gibbensii), is known to occur in the eastern portion of the DFPA (WYNDD 2002). The occurrence and distribution of these species will require specific consideration in the planning of the proposed project as discussed in Chapter 4. A summary of status and habitat associations for these sensitive species is given in Table 3-22.

Mammals. Ten sensitive mammal species may potentially be found on the DFPA. These include: dwarf shrew, 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. Only one of these species, the white-tailed prairie dog is known to occur on the DFPA. The dwarf shrew, Wyoming pocket gopher, and swift fox are likely to occur on the DFPA. The Idaho pocket gopher is unlikely to occur and the remaining species: pygmy rabbit, spotted bat, fringed myotis, long-eared myotis, and Townsend's big-eared bat, have a slight potential to occur on the DFPA.

Birds. Fifteen sensitive bird species may potentially be found on the DFPA. These include: Baird's sparrow, sage sparrow, Brewer's sparrow, long-billed curlew, sage thrasher, western burrowing owl, yellow-billed cuckoo, loggerhead shrike, Columbian sharp-tailed grouse, greater sage-grouse, white-faced ibis, trumpeter swan, peregrine falcon, ferruginous hawk, and northern goshawk. The western subspecies of yellow-billed cuckoo is considered a FWS candidate for listing as endangered. Nine of these species are known to be present on the DFPA and include: sage sparrow, Brewer's sparrow, sage thrasher, western burrowing owl, Scott's oriole (not likely to nest on the DFPA, though), loggerhead shrike, greater sage-grouse (see Section 3.7.6), ferruginous hawk, and northern goshawk (not likely to nest on the DFPA, though). Seven species, snowy plover, Baird's sparrow, long-billed curlew, yellow-billed cuckoo, black tern, white-faced ibis, and trumpeter swan, are unlikely to occur. The Columbian sharp-tailed grouse and peregrine falcon have a slight potential to occur in the DFPA.

Reptiles. The midget-faded rattlesnake may potentially be found on the DFPA, but the likelihood is very low.

Amphibians. Four sensitive amphibian species may potentially be found on the DFPA. These include: boreal toad, Great Basin spadefoot toad, northern leopard frog, and spotted frog. The boreal toad and spotted frog are unlikely to occur on the DFPA, the Great Basin spadefoot toad has a slight potential to occur, and the northern leopard frog is likely to occur in areas with perennial water.

Table 3-22. Sensitive Plant, Wildlife, and Fish Species Potentially Present in the DFPA.[1]

Plant Species				
Common Name	**Scientific Name**	**Sensitivity**	**Habitat**	**Occurrence Potential[3]**
Meadow pussytoes	*Antennaria arcuata*	GS/S2	Moist, hummocky meadows, seeps or springs surrounded by sage/grasslands 4,950-7,900'	unlikely
Laramie columbine	*Aquilegia laramiensis*	G2/S2, FSR2	Crevices of granite boulders and cliffs, 6,400-8,000'	unlikely
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'	unlikely
Mystery wormwood	*Artemisia biennis var. diffusa*	G5T1/S1	Clay flats and playas 6,500'	possible
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'	possible
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.	unlikely
Cedar Rim thistle	*Cirsium aridum*	G2Q/S2	Barren, chalky hills, gravelly slopes and fine textured, sandy-shaley draws 6,700-7.200'	possible
Ownbe's thistle	*Cirsium ownbeyi*	G3/S2	Sparsely vegetated shaley slopes in sage and juniper communities 6,440-8,400;	possible
Wyoming tanseymustard	*Descurania torulosa*	G1/S1	Sparsely vegetated sandy slopes at base of cliffs of volcanic breccia or sandstone 8,300-10,000'	possible
Weber's scarlet gilia	*Ipomopsis aggregata ssp. weberi*	G5T1T2Q/S1,FSR2	Openings in coniferous forests and scrub oak woodlands 8,500-9,600'	unlikely
Large-fruited bladderpod	*Lesquerella macrocarpa*	G2/S2	Gypsum-clay hills and benches, clay flats, and barren hills 7,200-7,700'	possible
Stemless beardtongue	*Penstemon acaulis var. acaulis*	G3T2/S1	Cushion plant or Black sage grassland communities on semi-barren rocky ridges, knolls, and slopes at 5,900-8,200'	possible
Gibbens' beardtongue	*Penstemon gibbensii*	G1, S1, BLM	Sandy or shaley (often Green River Shale) bluffs and slopes, 5,500-7,500 ft. Associated vegetation: *Juniperus* spp., *Cirsium* spp., *Eriogonum* spp., *Elymus* spp., *Amelanchier alnifolia*, *Chrysothamnus* spp., *Thermopsis* spp., *Arenaria* spp., and *Astragalus* spp.	certain, within eastern portion of project
Beaver Rim phlox	*Phlox pungens*	G2/S2	Sparsely vegetated slopes on sandstone, siltstone, or limestone substrates 6,000-7,400'	unlikely
Tufted twinpod	*Physaria condensata*	G2/S2	Sparsely vegetated shale slopes and ridges 6,500-7,000''	unlikely
Persistent sepal yellowcress	*Rorippa calycina*	G3/S2S3	Riverbanks and shorelines, usually on sand soils near high water line	unlikely
pale blue-eyed grass	*Sisyrinchium pallidum*	G2G3/S2S3	Wet meadows, stream banks, roadside ditches, and irrigated meadows, 7,000-7,900'	unlikely

Table 3-22. Continued.

Laramie false sagebrush	*Sphaeromeria simplex*	G2/S2	Cushion plant communities on rocky limestone ridges and gentle slopes 7,500 - 8600'	unlikely
Green River greenthread	*Thelesperma caespitosum*	G1/S1	White shale slopes and ridges of Green River Formation 6,300'	possible
Uinta greenthread	*Thelesperma pubescens*	G1/S1	Sparsely vegetated benches and ridges on course, cobbly soils of Bishop Conglomerate 8,200-8,900''	possible
Cedar Mountain Easter daisy	*Townsendia mircrocephala*	G1/S1	Rocky slopes of Bishop Conglomerate 8,500'	possible

Wildlife Species

Common Name	Scientific Name	Sensitivity Status[2]	Occurrence Potential[3]
Mammals			
Dwarf shrew	*Sorex nanus*	G4/S2S3, R2, NSS3	Likely
Idaho pocket gopher	*Thomomys idahoensis*	G4/S2?, NSS5	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, NSS7	Present
Swift fox	*Vulpes velox*	R2, G2/S2S3, NSS3	Likely
Spotted bat	*Euderma maculatum*	R2/R4,G4/S1B, SZ?N, NSS2	Possible
Fringed myotis	*Myotis thysanodes*	R2, G5/S1B, S1N, NSS2	Possible
Long-eared myotis	*Myotis evotis*	G5/S1B, S1?N, NSS2	Possible
Townsend's big-eared bat	*Corynorhinus townsendii*	R2/R4, G4/S1B, S2N, NSS2	Possible
Birds			
Baird's sparrow	*Ammodramus bairdii*	G4/S1B, SZN, R2, NSS4	Unlikely
Sage sparrow	*Amphispiza belli*	G5/S3B, SZN	Present
Brewer's sparrow	*Spizella breweri*	G5/S3B, SZN	Present
Long-billed curlew	*Numenius americanus*	G5/S3B, SZNR2, NSS3	Unlikely
Sage thrasher	*Oreoscoptes montanus*	G5/S3B, SZN	Present
Western burrowing owl	*Athene cunicularia*	R2, G4/S3B, SZN, NSS4	Present
Yellow-billed cuckoo	*Coccyzus americanus*	G5/S2B, SZN, R2, NSS2	Unlikely
Loggerhead shrike	*Lanius ludovicianus*	G5/S4B, SZN, R2	Present
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	R2/R4, G4T3/S1	Possible
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	Possible
Ferruginous hawk	*Buteo regalis*	R2, G5/S23B, S4N, NSS3	Present
Northern goshawk	*Accipiter gentilis*	R2/R4, G5/S23B, S4N, NSS4	Present
Reptiles			
Midget-faded rattlesnake	*Crotalus viridis concolor*	G5T3/S1S2	Possible
Amphibians			
Boreal toad	*Bufo boreas boreas*	G4T4/S2, R2, R4, NSS1	Unlikely
Great Basin spadefoot toad	*Spea intermontanus*	G5/S4, NSS4	Possible
Northern leopard frog	*Rana pipiens*	G5/S3, R2, NSS4	Likely
Spotted frog	*Rana pretiosa*	G4/S2S3, R2, R4, NSS4	Unlikely
Fish			
Leatherside chub	*Gila copei*	G3G4/S2, NSS1	Unlikely
Roundtail chub	*Gila robusta*	G3G4/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 3-22. Continued.

[1] - Source: Fertig et al. (1994), WYNDD (2002), Dorn (2001), USDI-BLM (2001).
[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.

<u>WGFD Native Species Status Codes - Fish and Amphibians</u>

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.

<u>WGFD Native Species Status Codes - Birds and Mammals</u>

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 and known distribution.

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

3.9 RECREATION

Recreation use of BLM, state, and private lands within the DFPA is best characterized as dispersed; there are no developed recreation sites or facilities. Most recreation activities occur during the fall hunting seasons. The area attracts small game hunters in September and October during the sage grouse season. Pronghorn hunting also occurs in September. Other hunting use occurs during the mule deer season in mid to late October and hunting for rabbits and predators later in the fall and winter. During other seasons the area attracts small numbers of recreationists engaged in rock collecting, camping and hiking, wild horse and wildlife observation, outdoor photography and picnicking. The area also accommodates a limited amount of use by off-road vehicle enthusiasts. Although statistical data on recreational visitation are not available, overall use levels are generally low (USDI-BLM 2000). Low visitation is a function of the small number of local residents, long drives from major population centers, lack of publicized natural attractions, road conditions that limit vehicle access into many back country areas, and lack of developed facilities.

MVMA and WSA

The Adobe Town WSA, Monument Valley and the Haystacks adjacent to the DFPA are destinations for a small number of wilderness-oriented recreationists_including some recreationists that are guided by a local outfitter. Approximately 23 square miles of the MVMA (14 square miles of BLM land) are within the DFPA. Oil and gas development could occur in any of the 23 sections if access through BLM lands was granted.

Management direction for the MVMA states that designation of the MVMA as an ACEC will be deferred until determination can be made that specific resources meet the ACEC relevance and importance criteria. If specific resources are identified that meet the relevance and importance criteria, the MVMA will then be considered for designation as an ACEC. Should the area be designated as an ACEC, visitation by recreationists seeking isolation and solitude may increase substantially in the MVMA.

The Adobe Town WSA, approximately 89,000 acres in size, is remote and contains some of the region's most dynamic spaces and diverse visual resources. The WSA and DFPA share a common border for approximately 21 miles along the entire eastern boundary of the WSA and a segment on the north. Lands with wilderness qualities, whether existing wilderness areas, recommended and managed as WSA's, or lands under study for wilderness consideration, typically attract recreationists in search of solitude and isolation.

3.10 VISUAL RESOURCES

The characteristic landscape is moderately undulating along the eastern border, west of Dad with occasional areas of steep topography (badland breaks and buttes) which stand out as contrasting forms. Mulligan Draw, Willow Creek, and Sand Creek are distinctive drainages with subtle changes in vegetation and topography. Numerous additional small drainages dissect the landscape adding diversity. The northern and western edges of the DFPA are typical of the more rugged sections of the Washakie Basin. The Haystacks north of Haystack Bend are a unique visual resource. Flat Top Mountain is a distinctive feature in the southeast quadrant. The combination of topography, buttes, badland breaks, and variations in vegetation subdivide the area into a number of small viewsheds. Larger views that encompass several viewsheds are available from high points within the project area.

The sky/land interface is a significant aspect of all distant views as is the sense of spaciousness within the project area. The predominant vegetation, typical of cold desert steppe, is alkali and low sage brush, mixed desert scrub, grasses and forbs with scattered patches of big sage/rabbit brush on flatter north and east facing slopes, along drainage ways and in large depressions. Small established stands of juniper exist within the DFPA as do occasional cottonwood trees. The combination of plant communities creates a subtle mosaic of textures and colors. Predominant vegetation colors in early spring are green and gray green changing to gray green and buff ochre as grasses and forbs cure in the summer and fall. Reddish brown and buff colors of the badland formations add contrast and dominate in areas of steep topography, especially the Haystacks, Flattop Mountain and the Adobe Town WSA. The Monument Valley Area has been designated part of a special management area (MVMA) by the BLM in recognition of its unique aesthetic and cultural values. Although mainly north and west of the project area, the Haystacks in MVMA comprise the most scenic visual backdrop to views from the project area.

Evidence of cultural modification in the DFPA includes improved and unimproved roads, power lines, livestock facilities, stock ponds, and some oil and gas production facilities. Lines of Russian thistle parallel roads on the shoulders and in ditches and on the disturbed edges of well pads, borrow sites and other areas of disturbance. Motorists traveling Wyoming Highway 789, the only major paved roadway in the area, would not have visual access to any of the project area because of viewing distance (3 to 6 miles) and intervening elevated topography. However, the DFPA would be visible from the eastern edge of the Adobe Town WSA and the Haystacks, and would also be visible from high points in the interior of both areas including East Fork Point.

The area receives moderate use by recreationists including big and small game hunters, rock collectors, wild horse and wildlife watchers, backpackers and ATV operators. The quality of the visual resource is an important part of the recreational experience for many of these users. The area is also an important entry portal from the east and west for recreationists accessing Adobe Town and Monument Valley. Access from the west is off Interstate 80 on Bitter Creek road (outside the project area). Access from the east is from Wamsutter on the Wamsutter-Dad road to the Eureka Headquarters road west to the Haystacks (Figure 1-2). Other non-recreational users of the area, including grazing permit holders and those working in the oil and gas industry, would also be affected by changes to the visual resources.

The intent of BLM's VRM program is to preserve scenic values in concert with resource development. BLM personnel responsible for visual resource management have classified the approximately 90% of the project area as Class 3 (Figure 3-17). The VRM describes the levels of change to the visual resource permitted in Class 3 landscapes as:

> Class 3 - *Contrasts to the basic elements caused by a management activity are evident but should remain subordinate to the existing landscape.*

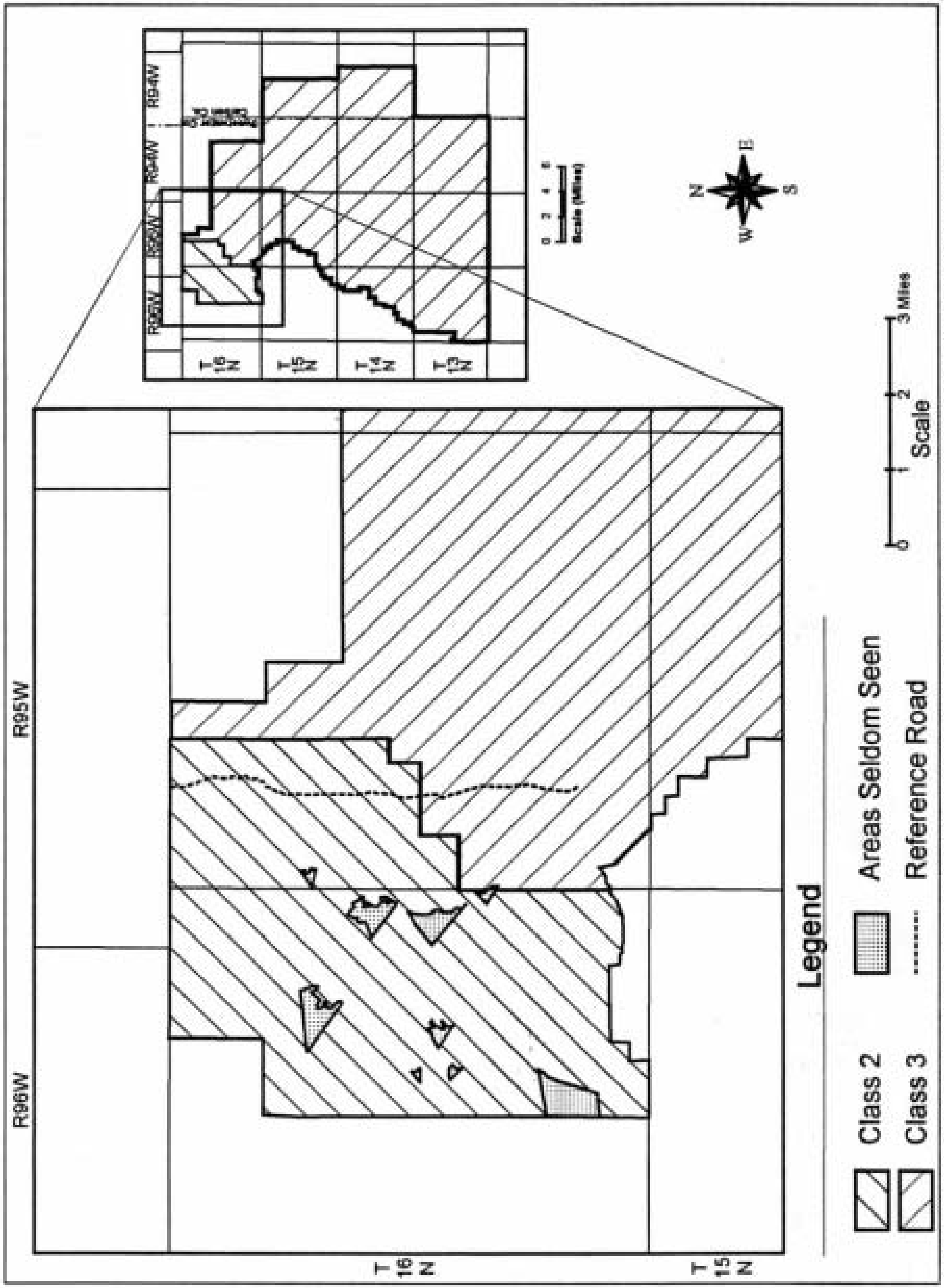


Figure 3-17. Visual Resource Management Classes and Seldom Seen Areas for the Desolation Flats Project Area

Thus for projects in Class 3 areas, project facilities, activities and site disturbance that contrast enough to attract viewer attention and are evident in the landscape are allowed, but they should be constructed in a manner that reflects the lines, forms, colors and textures of the characteristic landscape. Whenever possible, existing topography and vegetation should be utilized to screen project activities and facilities. Areas adjacent to the project areas include the Adobe Town WSA (Class 1) and the MVMA (Class 2). Portions of the DFPA abut the Adobe Town Area WSA. Approximately 23 square miles of the DFPA are in the MVMA and are thus in VRM Class 2. The VRM describes the level of change to the visual resource permitted in Class I and 2 landscape as:

> Class I - *The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be extremely low and must not attract attention.*
>
> Class 2 -*The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Surface disturbing activities will be prohibited unless or until an acceptable plan for mitigation of anticipated impacts has been agreed upon. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. Utilize existing topography to screen roads, pipeline corridors, drill rigs, well heads and production facilities from view. Mitigation may require adjustments in surface disturbance and facility locations. Above ground facilities will be painted with a nonreflective environmental color approved by Visual Resource Management specialist. Visual resource mitigation negotiation will occur prior to any development.*

<u>MVMA and WSA</u>

The MVMA objective for visual resources specifies partial protection of scenic values. For projects in a Class 2 area, project facilities, activities, and site disturbances should not be visible as contrasting with the characteristic landscape. The Green River RMP states for the MVMA that "all management actions will be designed and located to blend into the natural landscape and to not be visually apparent to the casual observer". Since all Class 2 VRM lands are in the RSFO, visual resource management decision should reflect the RMP decision as stated above. This essentially reflects VRM Class 2 standards. The WSA shares a 21-mile long common boundary with the DFPA. If any of the WSA is designated wilderness it would become VRM Class I. Existing topography and vegetation become critical features in screening facilities and activities from view.

3.11 CULTURAL RESOURCES

3.11.1 Cultural Chronology of Area

Archaeological investigations in the Washakie 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 of the Washakie Basin 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 3-23. Not all sites discussed below are located in the project area.

Table 3-23. Prehistoric chronology of the Wyoming Basin.

Period	Phase	Age (B.P.)
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

Source: Metcalf (1987), as modified by Thompson and Pastor (1995)
B.P. is before present

Paleoindian Period - The oldest period for which there is solid archaeological evidence is the Paleoindian, beginning ca. 12,000 years B.P. and ending around 8500 B.P. 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. Understanding paleoenvironmental conditions operating at the end of the Pleistocene and into the Holocene will 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 may be a major factor 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 B.P. The environmental change at the end of the Paleoindian period led to a pattern of broad spectrum resource exploitation which is reflected in the subsistence and settlement practices of the Archaic period which became more diverse. 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 were used for hunting. The presence of ground stone implements suggests a greater use pf plant resources during the Archaic. Faunal assemblages from Archaic components document increased use of small animals (Thompson and Pastor 1995). At the Yarmony site in Colorado, at least one housepit has been investigated which produced dates of ca. 6300 B.P. (Metcalf and Black 1991). The housepit is a large, semi-subterranean, two-room dwelling containing four slab-lined storage bins, interior hearths and other floor features. Large side-notched points have not been recovered from components dated to the Great Divide phase in the Wyoming Basin. The earliest dated context for side-notched points are Component I at Maxon Ranch (6400-6000 B.P.), west of the project area. Large side-notched points from the Great Basin and Colorado Plateau occur as early as 7000 years B.P.

Late Prehistoric Period - The Late Prehistoric period lies between 2000/1800 B.P. and 300/250 B.P. 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. 1050 B.P. At least two different types of structures have been identified: a more substantial, cold weather habitation present at the Nova site (Thompson 1989) and a less substantial, warm weather structure serving more as a windbreak present at the Buffalo Hump site (Harrell 1989).

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. The South Baxter Brush Shelter site (Hoefer et al. 1992) and the Firehole Basin 11 site (Metcalf and Treat 1979) are sites located west of the project area attributed to the Firehole phase.

Protohistoric Period - The Protohistoric period begins sometime after 300 years B.P. 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 including the Upper Powder Spring Hunting Complex site immediately west of the project area (Murcray 1993). Metal projectile points have been recovered from both surface and subsurface contexts in southwest Wyoming.

Historic use of the area is limited by the formidable topographic relief. Steep canyons, inadequate water supply, badlands, and escarpments make the area inhospitable for settlement with only limited ranching activities present. Some grazing occurred and is recognized by a very insignificant number of buildings and corrals depicted on the 1882 GLO maps (less than 10 in the DFPA) as well as by the few local roads. Table 3-24 represents the historic chronology of the area. Fur trapping and trading was not an important occurrence in the project area due to lack of perennial streams. The Cherokee Trail is in the extreme eastern and southern portion of the DFPA. Historic documentation indicates the Outlaw Trail trends southwest from Hole in the Wall, near Kaycee, Wyoming, to Browns Park, Colorado, located immediately southwest of the current project area. No sites have been associated with outlaw activity.

Table 3-24. Historic chronology of the Washakie Basin.

Phase	Age A.D.
Pre-Territorial	1842-1868
Territorial	1868-1890
Expansion	1890-1920
Depression	1920-1939
Modern	1939-Present

Source: Massey (1989)

3.11.2 Summary of Extant Cultural Resources

The Cultural Records Office in Laramie provided information on the previous work conducted in the DFPA and previously recorded sites. Records at Western Archaeological Services (WAS) were conducted as well as records at the RFO of the BLM. There have been 328 projects conducted resulting in the recordation of 900 sites. Of these, there are 308 Class III block and linear surveys (including 45 seismograph or geophysical surveys), 15 monitors, 3 Class II sampling surveys, 1 Cherokee Trail reconnaissance, and 1 compliance project. Limited amounts of field work have resulted in the documentation of cultural resources through survey, test excavations, examination of ethnographic records, and historic record research. Three excavations have been conducted in the DFPA. Approximately 12,263 acres (block) or ca. 5% of the project area have been inventoried for cultural resources. The project specific site density per acre cannot accurately be calculated because there are no acreage calculations for the linear projects.

The overall site density within the project area varies with the highest number of sites located along drainages and near the major topographic land forms. The Haystacks are located immediately west of the project area. Site density is high on the flanks of the Haystacks, specifically along East Haystack Wash. In the Salt Wells Resource Area Class II inventory (Treat and Tanner 1981) identified cultural resources clustered adjacent to Adobe Town Rim, the Haystacks, and Man and Boy Butte badlands. Ephemeral drainages that flow into the Washakie Basin from several escarpments such as Prehistoric Rim, Willow Creek Rim, and Powder Rim, flow into the major drainages of Skull Creek, Sand Creek, Willow Creek, Windmill Draw, Shallow Creek, and Barrel Springs Draw along with their tributaries.

Radiocarbon analysis conducted on several sites in the project area returned dates ranging from the Uinta phase at 680 ± 70 B.P. through the transition period between the Pine Springs and Opal phases at 4370 ± B.P. Twelve samples have been submitted from six sites within the project area with eight of the sites dating to the Uinta phase, one site in the transition between Uinta and Deadman Wash Phase, one site dating to the Deadman Wash phase, one site dating to the transition between Deadman Wash and Pine Spring phase, and one site dating to the transition between Pine Spring and Opal phase.

3.11.3 Site Types

Nine hundred sites have been recorded in the project area including 823 prehistoric sites, 43 historic sites, and 34 prehistoric/historic sites. Of the total site types, 91.4% are prehistoric sites, 4.8% are historic sites, and 3.8% contain both prehistoric and historic components. Of the recorded cultural resources, 24% are recommended eligible for nomination to the NRHP, 20% are recommended not eligible for nomination to the NRHP, and 56% remain unevaluated. Many of the unevaluated sites have been located during seismic inventories. Table 3-25 categorizes the sites into prehistoric open camps, prehistoric lithic debris, historic sites, and prehistoric/historic sites.

3.11.4 Prehistoric Sites

Prehistoric sites consist of camps that contain evidence of a broad range of activities including subsistence-related activities. 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.

Table 3-25. Summary of Prehistoric and Historic Sites Located in the DFPA.

Site Types	Total Number of Site Types	% of Total Sites
Habitation/hearths/FCR	329	
Open camp - ceramics	4	
Open camp - stone circles	3	
Open camp - milling/processing, groundstone	22	
Open camp - butchering/processing	5	
Total Prehistoric camps	**363**	**40.3 %**
Lithic scatters	428	
Quarry	3	
Primary procurement	7	
Secondary procurement	22	
Total Lithic debris	**460**	**51.1 %**
Cherokee Trail	1	
Cabin	1	
Mine	1	
Debris	14	
Ranching/stock herding	26	
Total Historic sites	**43**	**4.8 %**
Prehistoric camp/stone rings, ranching	1	
Prehistoric camp/historic debris	20	
Lithic scatter/historic debris	10	
Lithic scatter/stock herding	3	
Total sites (prehistoric/historic)	**34**	**3.8 %**
TOTAL SITES	**900**	**100 %**

Lithic debris scatters consist of sites containing lithic debitage or stone tools. The sites are described as representing short-term activities.

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.

Human burials, rock alignments, and rock art have been identified as sensitive or sacred to Native Americans. One human burial has been located in the project area. What is probably a flex burial in a slab-lined feature was encountered during the excavation at Site 48SW8803. The burial was not excavated (Metcalf personal communication 2000). Rock art, recognized as pictographs or petroglyphs, is unknown in the project area. However, immediately west of the DFPA, in the Upper Powder Springs sites, several panels of charcoal pictographs typical of Ute or Shoshone are located in the Upper Powder Springs complex as well as pecked trapezoidal anthropomorphic figures (Murcray 1993). Some of the pictographs were faded with time but had been painted red. It is important to be cognizant of the possibility of similar resources in the project area.

Three prehistoric stone circles were identified in the data base for the project area. The stone circles are located south and east of the Haystacks on West Willow Creek and East Haystack Wash. Four prehistoric cairns/caches are reported in the DFPA. Two of the cairns are located on Powder Rim overlooking Grindstone Wash, one is situated on a tableland between Sand and Willow creeks, and one is located on a high point on a tableland south of Barrel Springs Draw. Stone circle sites are sometimes important to the Native Americans for religious reasons.

Pottery/ceramics are rare in the project area. Four sites containing pottery have been identified. Both gray ware and brown sherds were recognized. Pottery is associated with the Uinta phase of the Late Prehistoric period.

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

3.11.5 Historic Sites

A cabin is located on Powder Rim in a stand of juniper overlooking the Cherokee Trail. Two corral/fence ranching sites have been identified in the DFPA. One is located on a finger ridge of Powder Rim, overlooking the Cherokee Creek drainage, ca. ½ mile south of the Cherokee Trail.

One corral/fence is situated between the Cherokee Trail and the Shell Creek Stock Trail on Powder Rim. The corral is a juniper branch pen structure reportedly used as a herding or hunting camp during the historic/modern period. The Shell Creek Stock Trail was used to move cattle from outlying areas north to the Union Pacific Railroad for shipping. The Shell Creek Stock Trail has yet to be investigated and recorded.

There is a building and stable/corral along the south side of Sand Creek, east of Prehistoric Rim. Inspection of the 1882 GLO maps also revealed a corral west of Prehistoric Rim and east of Skull Creek.

A "wagon" mine is located at McPearson Spring, along the Shell Creek Stock Trail. A wagon mine is a small operation consisting of one or more people or perhaps a family that mines coal for limited use such as to heat a home and to cook. "Wagon mines, literally mines serviced by wagons instead of railroads, were a common site wherever coal was available. The wagon mines developed because wood was scarce and coal was available. The coal seams were usually visible on the surface. The mines were not considered long-term ventures and the homesteaders turned part-time miners usually opened mines without obtaining legal titles to the minerals" (Gardner and Flores 1989).

The 1930 Italo Petroleum State gas well overlooks Cherokee Draw in the Cherokee Field, on Powder Rim (Wyoming Geological Association 1950). The well has not been recorded.

The Cherokee Trail has been identified in the project area. The Cherokee Trail was used in the 1850's by members of the Cherokee Tribe moving from the Oklahoma Reservation to the California gold fields. As depicted on the 1882 GLO maps, the Southern Variant of the Cherokee Trail trends south along the spine of Flat Top Mountain crossing Hangout Wash ca. two miles south of Dripping Rock Spring. It proceeds west from the Little Snake River Valley and descends into Hart Cabin Draw and follows Sand Creek south, crossing Sand Creek and descending into the Cherokee Basin. West of Cherokee Draw, the trail ascends Powder Rim trending west along the rim to Vermillion Creek. The Cherokee Trail crosses the ridge between Sage and Current creeks and continues west/northwest to the Green River.

As with any of the westward migratory trails of the mid-1800's, variants have been documented. Reasons for variations in routes include inaccessibility at certain times of year or members of the group may have traveled the route previously and found an easier or more direct avenue to water. The route of the Cherokee Trail depicted on the USGS quadrangle maps does not exactly match the route of the trail depicted on the 1882 GLO maps. As is the case with many historic linear properties, the route of the Cherokee Trail needs to be verified in the field. On the ground inspection should be supplemented by diaries of early pioneers that followed the westward migration routes. Many of the diaries include pertinent information such as distances traveled, landmarks, water sources, and feed for the stock.

Excerpts from Cherokee Trail diarist found in *Cherokee Trail Diaries* (Fletcher et al. 1999) document stops along the southern variant of the Cherokee Trail. Fletcher et al. (1999) recounts the 1850 Brown diary account at Sand Creek:

> "July 11...20 miles...Today we had very good Road for a few miles and then the rest of the way, the worst Road that we have Traveled over since we left home. No water or Grass or Timber. The Road Dry & Dusty & pached [parched]. No game, Sage Grass scarce. at Sundown we reached the dry Bed of a large Creek where we got water by digging holes. the water tasted of Salaratas, salt. Grass scarce. Made today 20 miles – Camp 60–."

On July 12, at Camp 61, Brown indicates the party was northeast of the Little Snake River, north of Cherokee Rim. The party continued over Powder Mountain to Lower Powder Spring near the Wyoming Colorado border, immediately west of the current project area. Brown:

> "July 13...25 miles...Traveled today 25 miles very Rough Road. No grass wood or water. Traveled untill sometime in the night when we came to Sulphur Springs. Not fit for man or Beast to drink. No grass -- Camp 62–."

Gardner discusses the romanticizing of the Cherokee Trail in western lore.

> "The Cherokee Trail has received a great deal of attention by writers and even the film industry. LeRoy Hafen, in his work *The Overland Mail,* contends that the pioneering efforts of the Cherokee Indians led to the eventual development of the Overland Trail. Louis L'Amour romanticized the trail in his novel *The Cherokee Trail*. And in the 1960s a television series entitled "Cherokee Trail" drew attention to this road through southern Wyoming. The net result of the combined effort of novelists, historians, and the media has been to create a highly romanticized trail that is still not well understood in terms of the people who traveled this trail and the location of the actual route of this road taken by Cherokees traveling west from Oklahoma to California in 1850" (Gardner 1999).

The Cherokee Trail (48SW3680/CR3651) is a historic linear property located in the eastern and southern portion of the DFPA. The Cherokee Trail is recommended eligible for inclusion on the NRHP. Management of historic roads and trails that are eligible for the NRHP but are not congressionally designated will generally be the same as for designated trails including a ¼ mile protective setback on either side of the trails (USDI-BLM 1997). It has been determined that a ¼ mile buffer will be established on either side of the contributing segments of the historic Cherokee Trail.

The Outlaw Trail is purported to be in or near the project area. There is no formal documentation of the trail showing its exact location. The trail was used by the outlaws to go "from Brown's Hole north to Hole-in-the-Wall in Johnson County, Wyoming" (Kelly 1959). Historic accounts of the outlaw movements place them in Rock Springs, Green River, and Powder Springs. However, the location of the trail is largely unknown and its exact locale will be very difficult to ascertain.

3.11.6 Excavation Data

Two sites have been excavated in the DFPA and several sites have been excavated in the surrounding area. Site 48SW8803 is a short-term camp with a few fire pits, small mammal procurement, and vegetable processing. The site is located in Cherokee Draw and dates to the Uinta phase of the Late Prehistoric period and the Deadman Wash phase of the Late Archaic period. A burial was encountered at the site but not excavated. It is believed to be a slab-covered flex burial (McDonald et al. 2000). Site 48SW8808 is a short-term camp with low artifact densities, several fire pits, and ground stone. The site dates to the Uinta phase of the Late Prehistoric period (O'Brien and McDonald 2000).

The Sheehan Site (48SW4114) is a multi-component site located east of the project area. Component I dates to the Archaic period and Component II dates to the Late Prehistoric period. Site data suggests both components were short-term winter camps. Game was brought to the camp for processing and local lithic sources were exploited. The chronological differences noted in the components reflect a change from atlatl to bow and arrow. Ceramics, ground stone, and bone tools were recovered from the Late Prehistoric component but not from the Archaic component. A bone juice processing area including bone tools and ground stone was identified in the Late Prehistoric component (Bower et al. 1986).

Two sites have been excavated immediately north of the project area in recent years. Site 48CR8818 is a multi-component occupation dating to the Uinta phase of the Late Prehistoric period and the Deadman Wash phase of the Late Archaic period. The site is a low intensity plant processing and hunting camp (Metcalf personal communication 2000). Site 48SW8842 is a multi-component site dating between 9360 B.P. and 1730 B.P. The prehistoric camp consists of seven stratified occupations with numerous pit features and two small house depressions dating to 3000 B.P. The site exhibits typical Archaic technology such as plant processing and small mammal procurement (Pool 2000).

3.11.7 Summary

The subsistence and settlement patterns in the project area 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 B.P. (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.

Most of the significant cultural resources are found along the major ephemeral drainages and along the lower benches of escarpments that dominate the terrain in the study area (Treat and Tanner 1981). Sensitive areas include drainages such as Sand Creek, Willow Creek, Cherokee Creek, and Windmill Draw as well as their ephemerals. Powder Rim and Prehistoric Rim contain a number of sites along the edges of the rim and in the draws. 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 limited by terrain and lack of perennial water sources. The historic Cherokee Trail bounds the eastern edge of the area. The Outlaw Trail may transverse the project area between Hole in the Wall, near Kaycee, Wyoming, to Browns Park, Colorado, located immediately southwest of the current project area. No sites have been documented to be associated with the trail although local outlaw lore places notorious bandits such as Butch Cassidy and the Sundance Kid in the area. Some grazing and limited ranching activities are identified by the historic debris scatters and historic record.

3.12 SOCIOECONOMICS

3.12.1 Introduction

Area socioeconomic conditions potentially affected by the Proposed Action and Alternatives include employment and earnings (in the oil and gas industry and other sectors of the economy), population, housing, local government facilities and services, local, state and federal fiscal conditions and local attitudes, opinions and values.

The primary area of analysis for potential socioeconomic affects includes Sweetwater and Carbon counties in Wyoming. Temporary housing resources in the Moffat County, Colorado community of Craig may also be affected.

3.12.2 Economic Conditions

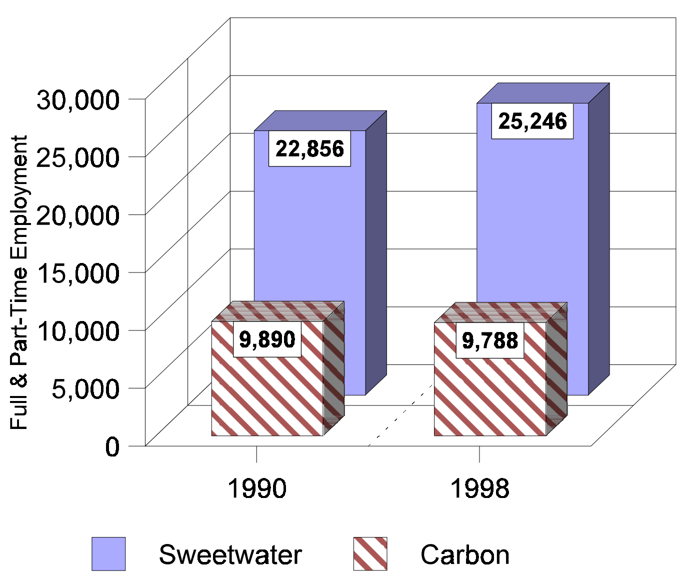
3.12.2.1 Economic Base

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. Both Sweetwater and Carbon counties have natural resource-based economies. Basic sectors in both counties include oil and gas production and processing, coal mining, electric power generation, agriculture and transportation (primarily the Union Pacific railroad). Portions of other sectors are also basic. For example, the portions of the retail and service sectors which serve visitors (tourism, travel and recreation) can be considered basic in both counties. Sweetwater County's economic base also includes trona mining and the manufacturing of soda ash and related products, and fertilizer manufacturing (Planning Information Corporation 1996, Pedersen Planning Consultants 1998).

3.12.2.2 Employment, Unemployment and Labor Force

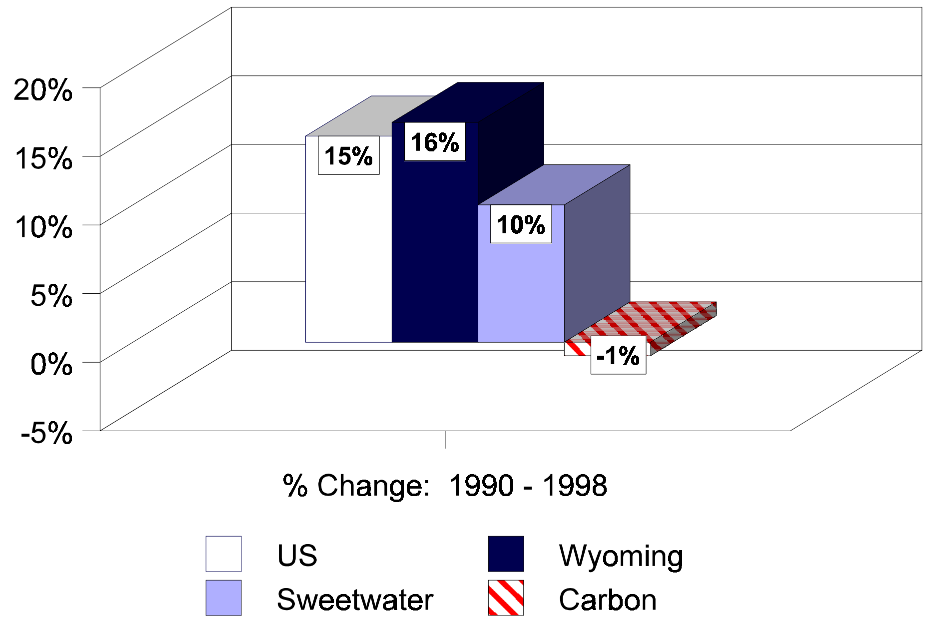
The US Bureau of Economic Analysis (BEA) collects information on the number of jobs in each county in the country. BEA employment statistics include jobs located in the county, whether they are held by a person who lives outside the county, a person who may have more than one job, a person who is a proprieter of a business, or a person who works on a farm or a ranch. Figure 3-18 displays annual average full and part-time BEA employment for Sweetwater and Carbon counties for 1990 and 1998. Figure 3-19 shows the percent change in employment for Sweetwater and Carbon counties during this period contrasted with that of the State of Wyoming and the United States as a whole. As shown in these figures, Sweetwater County employment grew by about 2,390 jobs or almost ten percent between 1990 and 1998, while Carbon County employment declined by 102 jobs or about one percent during the same period. Both counties lagged employment growth in the U.S. and Wyoming, which were about 15 and16 percent respectively during this period (WDAI 2000a).

Figure 3-18. Total Employment Sweetwater and Carbon Counties: 1990 and 1998.



Source: WDAI 2000a

Figure 3-19. Percent Change in Employment in the U.S., Wyoming, Sweetwater and Carbon Counties: 1990 and 1998



Source: WDAI 2000a

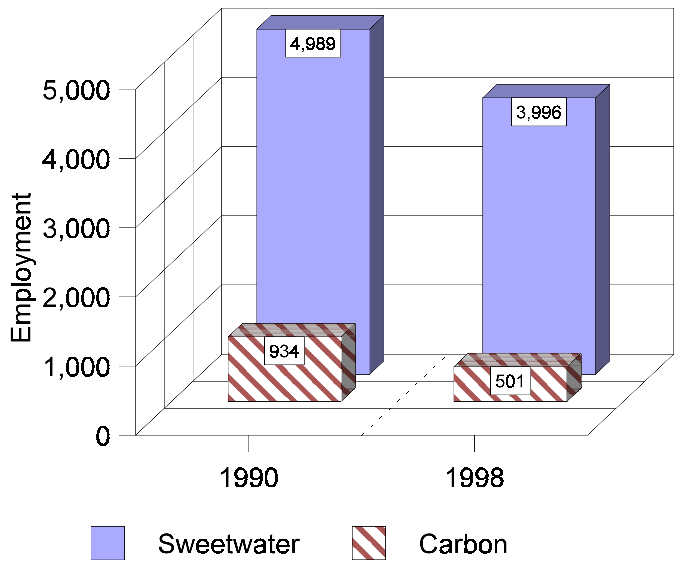
The mining sector, which includes oil and gas employment, decreased in both counties between 1990 and 1998. As shown by Figure 3-20, Sweetwater County mining employment decreased by 993 workers or about 20 percent during the period, and Carbon County mining employment decreased by 433 workers or 46 percent.

In 1993, oil and gas jobs totaled an estimated 36 percent of mining jobs and 8 percent of all jobs in Sweetwater County. In Carbon County, oil and gas jobs totaled about 12 percent of mining jobs and less than one percent of all jobs (UW 1997).

Labor force and unemployment statistics are collected by the Research and Planning Section of the Wyoming Department of Employment (WDE). These statistics reflect employees (as opposed to jobs as in the case of the BEA) and are tabulated by the employee's place of residence. The statistics include workers covered by unemployment insurance, so proprieters and agricultural workers are excluded. Also, multiple job holders are counted as one employee and workers who live outside the county under consideration are excluded. For these reasons WDE labor force totals are lower than BEA employment totals.

In both Sweetwater and Carbon counties, recent unemployment rates have remained relatively constant. Sweetwater County ten-year annual average unemployment rates have ranged from a low of 5.2 percent (1995) to a high of 6.3 percent (1992 and 1996). The 1999 unemployment rate in Sweetwater County was 6.2 percent, based on 1,293 unemployed persons out of a total labor force of 20,750. In Carbon County, ten-year unemployment rates ranged from a low of 5.2 (1997) to a high of 6.1 (1993). The 1999 Carbon County unemployment rate was 5.3, based on 446 unemployed persons out of a total labor force of 8,475 (Wyoming Department of Employment 2000).

Figure 3-20. Sweetwater and Carbon County Mining Sector Employment: 1990 and 1998



Source: WDAI 2000a

A recent Wyoming Business Council-sponsored report on the workforce of Carbon and Sweetwater counties concluded that new employers would be able to attract workers from a pool of 4,900 underemployed workers in the two counties (PFResources 2000). The report noted that an estimated 50 percent of these underemployed workers would take new jobs for salaries of $13.75 per hour or less.

Even with this relatively high number of under-employed persons, there is some indication that oil and gas companies and service firms are having difficulty attracting workers from the local workforce (Robbins 2000).

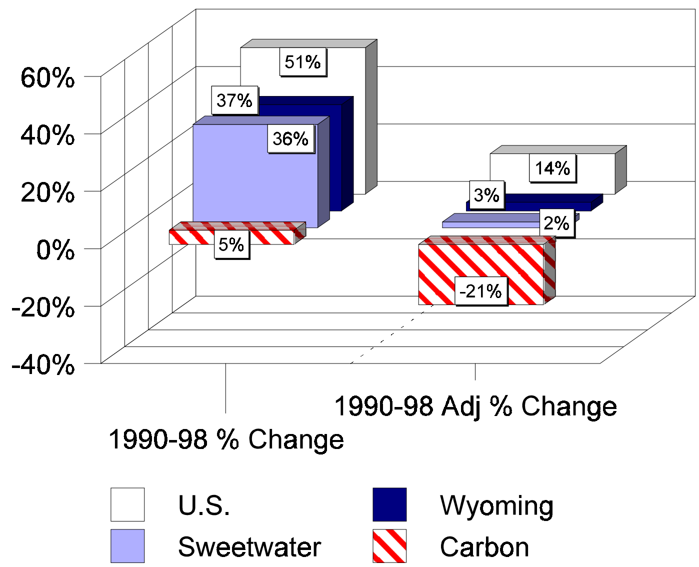
3.12.2.3 Earnings

Sweetwater County earnings by place of work increased from $633 million in 1990 to $858 million in 1998, a 36 percent increase over the 8 year period (WDAI 2000b). Carbon County earnings increased from $202 million to $211 million during this period, a 5 percent increase. These increases compare to a 37 percent increase in earnings for the State of Wyoming during this period, and a 51 percent increase for the United States as a whole (Figure 3-21). However, when adjusted for inflation, Sweetwater County earnings increased by 2 percent from 1990 to 1998, and Carbon County earnings decreased by 21 percent from their 1990 level. These inflation-adjusted earnings compare to increases of 3 percent for the State of Wyoming and 14 percent for the U.S. during this period.

Oil and gas earnings increased 81 percent in Sweetwater County between 1990 and 1998, from $63.7 million to $115 million. When adjusted for inflation, Sweetwater County oil and gas earnings increased 36 percent. Recent Carbon County oil and gas earnings are not disclosed because of the small number of companies in the industry.

Oil and gas jobs are relatively high paying. In 1993, average earnings per job for the oil and gas industry in southwest Wyoming were about 60 percent higher than average earnings for all jobs, and about twice as high as average earnings for non-mining jobs (UW 1997). However, oil and gas jobs typically pay less than other jobs in the mining sector. In 1993, oil and gas earnings were on average about 76 percent of those of the mining sector as a whole.

Figure 3-21. Change in Total Earnings 1990 - 1998: Carbon County, Sweetwater County, Wyoming and the U.S. (Current and Inflation Adjusted Dollars)



Source: WDAI 2000b; Blankenship Consulting LLC

3.12.2.4 Recent Oil and Gas Activity

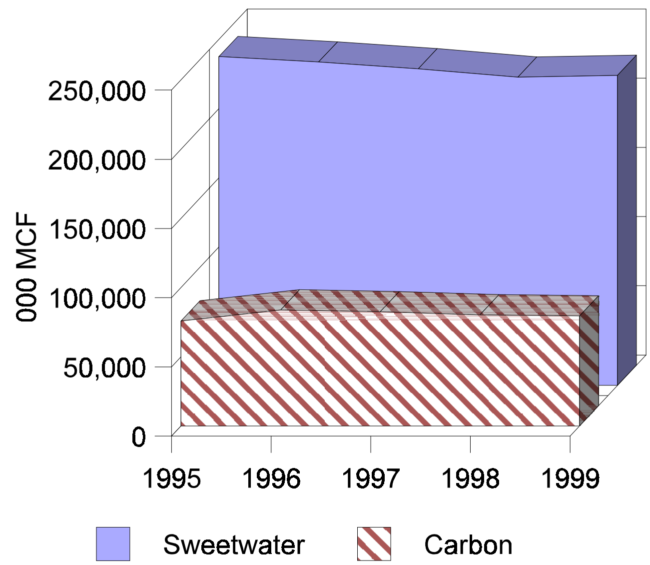
Production and approved applications for well drilling permits (APD) are two measures of oil and gas activity. As shown in Figure 3-22, annual natural gas production in Sweetwater County decreased from 238 million MCF in 1995 to 224 million MCF in 1999 (WOGCC 1995-99). In contrast, Carbon County natural gas production increased, from 76 million MCF to about 80 million MCF during the four year period.

Annual oil production in Sweetwater County decreased by about 21 percent or 1.2 million barrels during the latter part of the last decade, from 5.8 million barrels in 1995 to 4.5 million barrels in 1999. After some losses in 1996, Carbon County production ended the period within 0.2 percent of the 1995 level of 1.3 million barrels (Figure 3-23).

Approved APD's reflect 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. The annual number of APD's approved for Sweetwater County varied over the last several years, ranging from the 1997 high of 210 to the 1999 low of 123. In Carbon County, APD approvals have steadily increased during the period, from 50 in 1995 to 127 in 1999 (Figure 3-24).

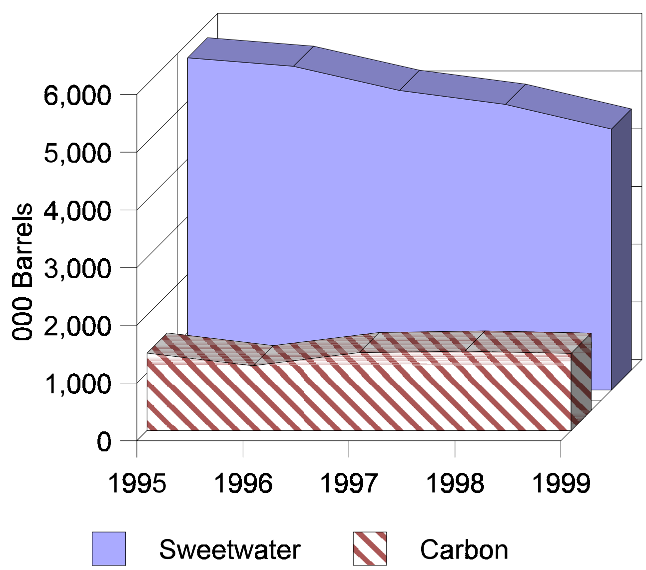
During 1999, there were a total of 1,864 producing oil and gas wells in Sweetwater County and 742 in Carbon County.

Figure 3-22. Natural Gas Production for Sweetwater and Carbon Counties, 1995 - 1999



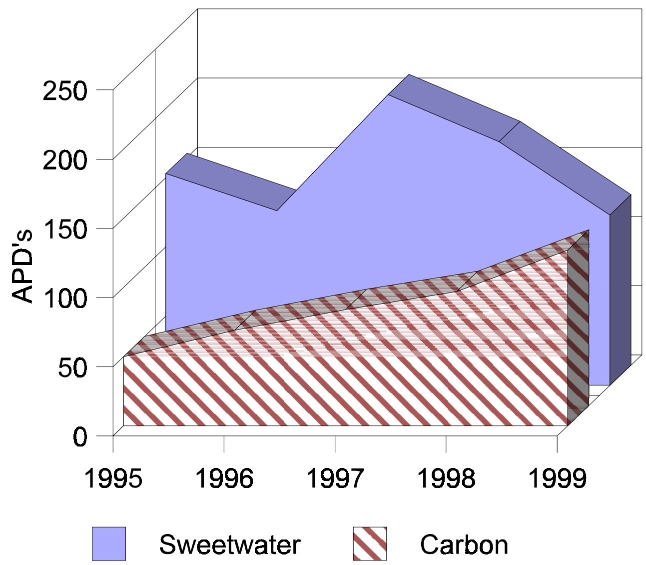
Source: WOGCC 1995-1999

Figure 3-23. Oil Production for Sweetwater and Carbon Counties: 1995 - 1999.



Source: WOGCC 1995-1999

Figure 3-24. Applications for Permit to Drill, Sweetwater and Carbon Counties: 1995- 99.



Source: WOGCC 1995-1999

3.12.2.5 Economic Activities in the Vicinity of the Proposed Action

Currently, economic activities occurring on and near the site of the DFPA include grazing (Section 3.6), low-intensity dispersed recreation (Section 3.9), and oil and gas exploration and production (Deakins 2000).

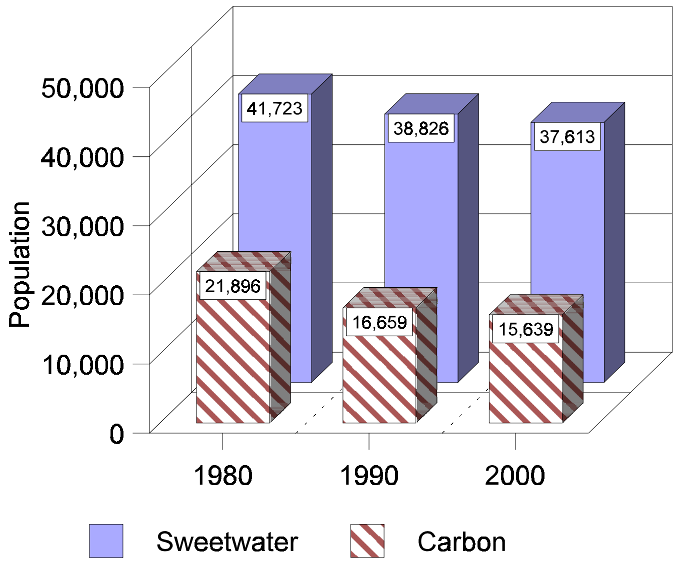
3.12.3 Population Conditions

Population levels in both Sweetwater and Carbon Counties have been volatile over the past 20 years. As shown in Figure 3-25, Sweetwater County population in 2000 was almost 10 percent lower than its 1980 level of 41,723. The 2000 Carbon County population was 29 percent lower than its 1980 level of 21,896 (WDAI 2000c, 2001).

During 1995, Sweetwater County population reached 40,635 (Table 3-26), but declined to 37,613 in 2000, about 3 percent less than its 1990 level. Population within Rock Springs, the largest community in the county, reached 19,930 in 1995, but lost almost 2 percent between 1990 and 2000. Population in the Town of Wamsutter, the closest Sweetwater County community to the DFPA, averaged about 240 to 260 persons according to state sources, but local officials believe that the current level is closer to 350 and growing, because of recent natural gas drilling activity in the area (Carnes 2000) .

According to census estimates, Carbon County population has continued to decline, losing an estimated 1,020 people or about 6.1 percent of its 1990 population over the 10 year period. Similarly, the City of Rawlins, the largest community in Carbon County, lost an estimated 374 persons, or about 4 percent of it’s 1990 population. The Town of Baggs, the closest community to the DFPA, gained 76 residents or 28 percent of its 1990 population, and the Town of Dixon, several miles east of Baggs, gained 12 persons to end the period with an estimated population of 79.

Figure 3-25. Sweetwater and Carbon County Population: 1980, 1990 and 2000.



Source: WDAI 2001

The most recent population forecasts available from the Wyoming Division of Economic analysis project that population levels in both Sweetwater and Carbon counties will remain essentially flat through 2008, although those projections were developed from higher current population levels than those presented in the 2000 Census of Population and Housing and will soon be revised. Future population levels in both counties are likely to be linked in large part to national energy demand (see Section 5.3.12).

Table 3-26. Population Estimates 1990 - 1998: Sweetwater and Carbon Counties and Selected Communities.

	1990	1995	2000
Sweetwater County	38,823	40,635	37,613
Rock Springs	19,050	19,930	18,708
Wamsutter	240	246	261
Carbon County	16,659	16,034	15,639
Rawlins	9,380	9,063	9,006
Baggs	272	258	348
Dixon	70	67	79

Source: WDAI 2001

3.12.4 Housing

The nature of the 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. The relatively few production employees are typically interested in longer-term housing resources.

There are a substantial number of both temporary housing resources (motels and RV parks) and longer-term housing resources (apartments, mobile home parks and houses for sale) available in Rock Springs and Rawlins. There are limited temporary and long-term housing resources available in Wamsutter and the Baggs area at the time of this assessment (spring 2001).

Wamsutter - Several natural gas companies have announced large, multi-year drilling programs in the Wamsutter area, which has resulted in a corresponding increase in demand for housing in the town. In February 2000, Wamsutter officials said that there was no available housing in the town to accommodate workers and their families (Rock Springs Rocket Miner 2001a). Temporary housing resources in Wamsutter include two mobile home operations; one has 26 spaces (Highland 2000, Englehart 2002), the other had 75 spaces and some pads equipped to serve RV's (Waldner 2000, 2002). There are two motels in Wamsutter. A dormant 55 space mobile home park has recently been purchased and the new owner intends to reopen it and install some rental mobile homes (Williams 2001). A local truck stop operator is considering development of an RV park (Carnes 2000).

Baggs Area - Rental housing in the Baggs area consists primarily of a mobile home park, two motels, scattered mobile home lots, one apartment building and a newly constructed rental duplex. Most temporary housing resources are fully occupied by oil and gas workers during the summer; during winter more units become vacant. The 26-space mobile home park in Baggs is equipped to accommodate RV's as well as mobile homes. Within the park there are several rental mobile homes. There is a small four-space mobile home park in Savery and a number of mobile home lots scattered throughout the Little Snake River Valley (Grieve 2000).

The two motels in Baggs have a total of 64 rooms, most of which can accommodate several guests. Both motels routinely accommodate oil and gas industry workers as well as tourists, travelers and hunters. As with mobile home parks, the motels are filled to capacity during the summer and fall and partially vacant during the winter. Most oil and gas occupants are relatively short term in nature, moving in and out of the community as work assignments are completed (Willis 2000, Hawkins 2000).

Rawlins - Rawlins has 19 motels and 4 RV parks (Hiatt 2000), and 18 mobile home parks with over 525 pads (City of Rawlins 1998). A substantial number of houses are available for purchase and there are apartments and mobile home spaces for rent (Taylor 2001).

Rock Springs - Rock Springs has ample homes for sale (Smith 2001). There are also a number of vacant rental apartments and mobile home pads. Rock Springs has 15 motels with over 1,100 rooms and 30 mobile home parks with over 1,900 pads (PIC 1997).

Craig, Colorado - The Craig area has 12 motels with a total of 472 rooms and 2 campground/RV parks with a total of 128 spaces (Moffat County Lodging Tax Panel 2000).

3.12.5 Community Facilities, Law Enforcement and Emergency Management Services

Wamsutter - Law enforcement in the Wamsutter area is provided by a town police officer, a Sweetwater County Sheriff's deputy and a Wyoming Highway Patrol officer. Emergency response services are provided by 15 volunteer emergency medical technicians operating one ambulance and 10 volunteer firefighters operating two fire trucks. The volunteer fire and ambulance services provide coverage to surrounding oil and gas operations; both services may have difficulty responding to more than one emergency at the same time. The town has submitted grant applications for new fire and ambulance vehicles and BP America, Inc. recently provided a $68,000 grant toward purchase of a new ambulance. The town has an ongoing effort to recruit new volunteers for both the fire and ambulance service.

In general, sewer, water and school facilities have capacity to serve a larger population than currently exists in Wamsutter. However, a well recently added to the system requires a water line extension to connect to the system and other improvements to pump and improve the quality of the water. The town has submitted a grant request to the Wyoming Water Development Commission for funding of these improvements. The current water and sewer system do not serve the industrial park on the south side of town and there are plans to extend service to that area. The town is developing a new library, and has identified a variety of street and infrastructure improvements, vehicles and staff that may be required to accommodate growth from the drilling programs planned for the area (Carnes 2000, Williams 2001, Rawlins Daily Times 2001).

Carbon County and the Baggs Area - Law enforcement services in the portion of Carbon County near the project site are provided by the Carbon County Sheriff's Department. Currently, coverage is provided by one full-time and one part-time deputy. The deputies provide coverage for the Town of Dixon and the community of Savery; the Town of Baggs has one police officer (Colson 2000).

Medical services in Baggs are provided at a county-owned clinic, staffed by a physician's assistant, who is supported by other medical and administrative personnel. Emergency response is provided by six volunteer emergency medical technicians (EMT) who staff two county-owned ambulances. Seriously injured patients are transported to Craig or Rawlins, depending on the location of the accident. Casper-based Flight-for-Life is also available if needed (Herold 2000).

Sewer and water services in the Town of Baggs would need expansion to accommodate population growth. Other community facilities are adequate for existing demand and have capacity to accommodate some population growth. The community is in the process of developing a community center (Terkla 2000).

Rock Springs and Rawlins - Population in both Rock Springs and Rawlins are substantially below historic high levels of the 1980's. Infrastructure in these communities has, in general, been sized to serve larger populations than currently exist.

3.12.6 Local, State and Federal Government Fiscal Conditions

Local 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) 2000 assessed valuation was over $1.1 billion, which yielded total property tax revenues of $76.6 million (WTPA 2000a). Total mill levies within Sweetwater County communities ranged from 69.6 to 75.6, including county, municipal, school and special district levies. FY 2000 assessed valuation from 1999 natural gas production totaled $337 million or about 30 percent of total assessed valuation. Assessed valuation from oil production totaled $72 million, or about 6 percent of total assessed valuation (WTPA 2000b).

Carbon County assessed valuation in FY 2000 totaled about $337 million, which yielded total property tax revenues of $21.3 million. Total mill levies within Carbon County communities ranged from 65 to 75.3. FY 2000 assessed valuation from 1999 natural gas production totaled $159 million or about 47 percent of total assessed valuation. Assessed valuation from oil production totaled 16.9 million or about 5 percent of total valuation.

3.12.6.2 Sales and Use Tax

Wyoming has a statewide four percent sales and use tax. Both Sweetwater and Carbon counties collect an additional one percent general-purpose local-option sales and use tax. Carbon County also collected an additional one percent specific-purpose local option sales and use tax, which was retired in the spring of 2001. FY 2000 sales and use tax collections in Sweetwater County totaled about $47 million and about $21 million in Carbon County (Figure 3-26).

About 28 percent (less administrative costs) of statewide 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. Collections from the specific purpose local option tax were dedicated for specific capital facilities.

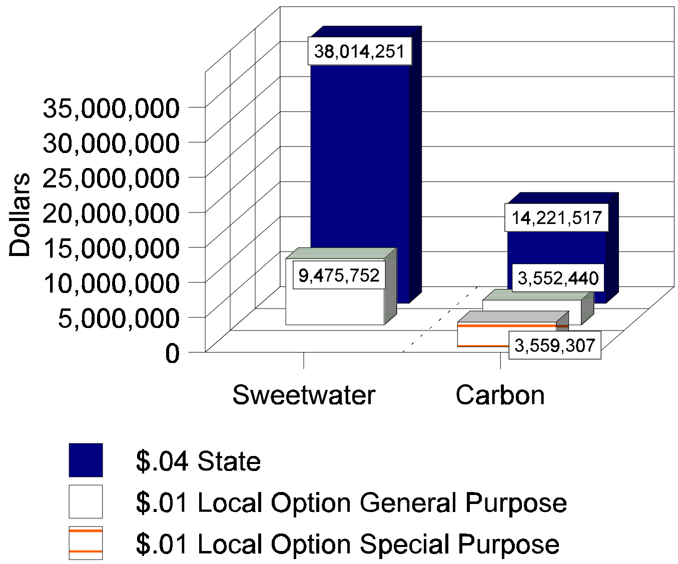
3.12.6.3 Wyoming Severance Taxes

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 2000, severance tax distributions totaled $275 million (WDAI 2000c). Of the total, 44 percent was attributable to severance taxes on natural gas and 21 percent was attributable to oil.

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, School Foundation fund, Highway fund, Legislative Royalty Impact Account, and cities, towns and counties. In FY 2000, a total of $309 million in federal mineral royalty funds were distributed to Wyoming entities (WDAI 2000d).

Figure 3-26. Sweetwater and Carbon County Sales and Use Tax* Collections: FY 2000.



Source: WDR 2000
* Includes state share of the four-percent sales and use tax and excludes lodging taxes and penalties and interest.

3.12.7 Local Attitudes and Opinions

Support for oil and gas development in Sweetwater and Carbon counties is mixed. Based on a previous NEPA assessment and a local survey, it appears that support is strongest in the communities near the proposed development, in part because many of the residents of those communities are economically tied to the oil and gas industry and/or generally believe that natural resources should be extracted from public lands. Opposition to oil and gas development comes from those whose economic interests and lifestyles may be affected, such as grazing allotment permittees and those who value the land for recreation and wildlife habitat purposes and/or believe that certain areas should be left in an undeveloped state.

The DEIS for the Greater Wamsutter Area II (USDI-BLM 1995), which is located adjacent to the DFPA, concluded the following regarding local attitudes and opinions:

> "...Overall, most (Wamsutter) area residents are likely to view this proposed development (GWA II) favorably, particularly since it would help to sustain employment opportunities, local business activity, and revenues to support public services in an area where substantial previous drilling and development activities have occurred... Despite this overall context of community acceptance, some population segments (hunters and ranchers) could potentially experience some negative effects as a result of project activities."

In Carbon County, a 1996 survey conducted in conjunction with the preparation of the Carbon County Land Use Plan provides some insight into resident attitudes and opinions regarding land use, oil and gas development, natural resource conservation and use and other topics. Just over 300 residents completed the survey (Pederson Planning Consultants 1998).

Water resource conservation and concern for government regulation of land use were the most frequent land use issues listed by respondents, followed closely by the availability of water to support future land uses, the economic viability of the ranching, timber and oil and gas industries, and the need to conserve wildlife habitat.

County-wide, 54.9 percent of survey respondents (based on a weighted average to account for respondents who marked more than one response) indicated that conservation of land, water and wildlife resources was more important than increased oil and gas production, while 36.9 percent indicated that increased oil and gas production was more important. However, among Baggs respondents, the reverse was true. About 54 percent indicated that increased oil and gas production was more important than conservation of land, water and wild life resources, while 36 percent indicated that resource conservation was more important. The land use plan attributes this difference to Baggs' greater economic dependence on future oil and gas employment.

Concerning management of federal lands, the largest number of respondents (69.5 percent) indicated that more federal lands within the county should be designated for the purpose of conserving fish and wildlife habitat and surface and groundwater resources. In addition, 60.8 percent of respondents indicated that more land should be designated for public recreation, 48.8 percent indicated more land should be leased for oil and gas industry exploration and production, 48.7 percent indicated more land should be leased for commercial mining, and 44.5 percent indicated more land should be made available to local timber companies for commercial timber harvest.

3.12.8 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).

Communities within Sweetwater and Carbon counties, entities with interests in the area, and individuals with ties to the area all may have concerns about the presence of a natural gas development within the project area. Communities potentially impacted by the presence or absence of the proposed natural gas development have been identified above in this section of the DEIS. Environmental Justice concerns are usually directly associated with impacts on the natural and physical environment but these impacts are likely to be interrelated to social and economic impacts as well.

3.13 TRANSPORTATION

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

3.13.1 Access to the Project Site

Access to the project site is provided by I-80, Wyoming State Highway 789 (WYO 789), Colorado Highway 13 (CO 13) Sweetwater County Road 23/Carbon County Road 701 (SCR 23/CCR 701), also known as the Wamsutter/Dad Road, and Carbon County Road 700 (CCR 700), which travels west from WYO 789 near Baggs. Table 3-27 displays traffic and accident 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 listed in Table 3-27 are within level of service volumes set for those highways by the Wyoming Department of Transportation (Rounds 2000). Traffic volumes on these highways could increase substantially before level of service standards would be exceeded. The ten-year average accident rates for these highways are substantially below the Wyoming average for all highways of 1.6 accidents per million vehicle miles traveled (Rounds 2000).

Table 3-27. Highway Access to the Project Site.

Route	2000 ADT*	Level of Service	Accidents*
I-80 west of Wamsutter	10,640 (58% Trucks)	A	0.9
I-80 east of Wamsutter	10,650 (57.9% Trucks)	A	0.6
WYO 789 (first 5 mi. so. of Creston Jct)	850 (18.8% Trucks)	B	0.6
WYO 789 @ Baggs	1,650 (11.5% Trucks)	B	0.9
CO 13 south of the Wyoming state line	1,320 (21% trucks)	n/a	n/a

* 10 year average per million vehicle miles traveled.
Sources: Rounds 2000; CDOT 2000

SCR 23/CCR 701 (Wamsutter/Dad Road) - The Wamsutter/Dad Road is a two-lane gravel road which connects I-80 with WYO 789 at Dad, and provides access to the oil and gas fields in southeastern Sweetwater and southwestern Carbon counties. The northernmost eight miles of the road (SCR 23) are within Sweetwater County and are maintained by a motor grader operator located in Wamsutter. Most of the Sweetwater County portion of the road has been reconstructed with gravel during the last two years. Although there are no traffic counts on the Sweetwater County portion of the road, it accommodates a large amount of oil and gas traffic. Current problems on the road include damage to cattle guards and safety hazards resulting from excessive speed (Vanvalkenburg 2000).

Seven miles of the Carbon County portion of the Wamsutter/Dad Road (CCR 701) have also been reconstructed with gravel and magnesium chloride within the past year. The road is a maintenance priority within the county because of the large amount of oil and gas traffic it accommodates. Although there are no official travel counts, unofficial observations have recorded 50 and 60 vehicles per hour during mid-day in the spring and summer of 2000. Maintenance issues on CCR 701 include damage to the road from use during periods when the road is wet from rain or snow, and damage resulting from excessive speed (Nations 2000).

CCR 700 - CCR 700 provides access to the southern portion of the project area from WYO 789 just north of the Town of Baggs. The first mile of the road, which provides access to a solid waste landfill, has a chip-sealed gravel surface. The next two miles are an improved drainage gravel road, thereafter CCR 700 has a dirt surface with some gravel on hills and slopes. CCR 700 passes through several miles of private lands, and there is a bridge on Red Creek that is not designed for commercial travel. The road is lightly used by oil and gas operators in the area (Nations 2000).

3.13.2 Access within the Project Area

Access within the proposed DFPA is provided by an existing road network developed to service prior and ongoing drilling and production and livestock grazing activities. These roads include the Barrel Springs Road, the Eureka Headquarters Road, the South Barrel Springs Road, the Standard Road and the Shell Creek Stock Trail (Figure 1-2). Including these roads, the existing DFPA transportation network contains an estimated 126.1 miles of primary roads, 132.9 miles of secondary roads and 402 miles of two-track roads.

3.14 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the DFPA include occupational hazards associated with oil and gas exploration, development and operations; industrial accidents associated with oil and gas operations (including fires, hazardous materials and hydrocarbon releases into waterways and pipeline ruptures); risk associated with vehicular travel on improved and unimproved county and BLM roads; firearms accidents during hunting season and by casual firearms use such as plinking and target shooting; illegal dumping of trash and toxic substances and low probability events such as flash floods, landslides, earthquakes and range fires.

3.15 NOISE

Other than jet aircraft overflights at high altitudes, occasional helicopter use for geophysical exploration, and localized vehicular traffic on county and BLM roads in the project area, only ongoing drilling and production operations and related traffic create even modest sound disturbances within and in the immediate vicinity of the DFPA. Wind noise is the most prevalent sound in the area.