CHAPTER 3 — AFFECTED ENVIRONMENT

This chapter describes existing conditions of the physical, biological, cultural, socioeconomic, and visual resources in the JIDPA and identifies associated resource-specific cumulative impact assessment areas (CIAAs). The resources and their respective CIAAs addressed in this EIS were identified during past Jonah project NEPA analyses, scoping for this project, and/or IDT reviews.

Critical elements of the human environment (BLM 1988a, 1999a), their status in the JIDPA, and their potential to be affected by the proposed project are listed in Table 3.1. Three critical elements (areas of critical environmental concern [ACECs], prime and unique farmlands, and wild and scenic rivers) are not present and would not be affected so are not addressed further. Other critical elements of the human environment may potentially be affected and are addressed. In addition to the critical elements, this EIS discusses existing conditions and potential project effects (see Chapter 4) on topography; mineral resources; geologic hazards; paleontological resources; soils; noise and odor; biological resources; socioeconomics; land use including status, livestock/grazing management, recreation, and transportation; and visual resources.

Table 3.2 lists the CIAAs for each resource, and CIAA maps are presented in specific resource sections of this EIS chapter. Existing disturbance in the JIDPA and CIAAs was estimated using existing digital geographic information system (GIS) data for roads, oil and gas wells, land cover, residential areas, surface water resources, wetlands, and watershed boundaries. Oil and gas well

Table 3.1 Critical Elements of the Human Environment, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Element[1]	Status on JIDPA	Addressed in This EIS
Air quality	Potentially affected	Yes
Areas of critical environmental concern	Not present	No
Cultural resources	Potentially affected	Yes
Environmental justice	Not affected	Yes
Farmlands (prime or unique)	Not present	No
Floodplains	Potentially affected	Yes
Native American religious concerns	Potentially affected	Yes
Noxious weeds	Potentially affected	Yes
Threatened and endangered species	Potentially affected	Yes
Wastes, hazardous or solid	Potentially affected	Yes
Water quality (surface and ground water)	Potentially affected	Yes
Wetlands/riparian zones	Potentially affected	Yes
Wild and scenic rivers	Not present	No
Wilderness	Not present	Yes

[1] Adapted from BLM (1988a, 1999a).

Table 3.2 Cumulative Impact Assessment Areas, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Resource	CIAA[1]
Air quality	Project area and nearby Class I and sensitive Class II airsheds[2]
Topography	Project-affected sixth-level watersheds
Geology	
Mineral resources	Combined Jonah, Jonah II and Jonah Infill Project areas
Geologic hazards	Combined Jonah, Jonah II and Jonah Infill Project areas
Paleontological resources	Paleontological/cultural resource CIAA
Soils	Project-affected sixth-level watersheds
Water resources	
Surface water	Project-affected sixth-level watersheds
Ground water	Project area and associated draw-down area
Odor	Project area and 2-mile buffer
Noise	Project area and 20-mile buffer
Vegetation	
General	Project-affected sixth-level watersheds
Wetlands/Riparian areas	Project-affected sixth-level watersheds
Wildlife and fisheries	
Big game	Project-affected ranges and migration corridors for the Sublette Pronghorn Antelope Herd
Greater sage-grouse	Northern portion of Upland Game Bird Management Area 7
Raptors	Raptor CIAA
Fisheries	Project-affected sixth-level watersheds
Other species	Jonah Wildlife Study Area
Wild horses	Little Colorado Herd Management Area
Threatened, endangered, candidate, proposed, and BLM-sensitive species	Entire ranges for affected species
Cultural resources	Paleontological/cultural resource CIAA
Socioeconomics	Counties (Lincoln, Sublette, and Sweetwater) and communities (LaBarge, Pinedale, Big Piney, Marbleton, Boulder, Eden, Farson, and Rock Springs) most likely to be impacted by the proposed Project
Land use	
Agricultural/rangeland	Project-affected grazing allotments
Minerals extraction	Combined Jonah, Jonah II, and Jonah Infill Project areas
Recreation	Recreation CIAA
Land status and prior rights	Project area and leases that extend beyond Project area
Visual resources	Visual resource CIAA

[1] CIAA = cumulative impact assessment area; see resource-specific sections of EIS Chapter 3 for mapped locations.

[2] Air quality emissions sources from a larger area; see Map 3.1.

and associated access road locational information was obtained from the WOGCC and BLM databases, as well as Operator-provided data. Existing development information for the JIDPA and surrounding areas was obtained from annual Jonah and Pinedale Anticline wildlife monitoring reports (TRC Mariah Associates Inc. [TRC Mariah] 2004a, 2004b) and aerial photographs of the JIDPA and surrounding areas. Big game ranges and migration routes, raptor nest and greater sage-grouse lek information, potential TEP&C and BWS species habitat information, soils, vegetation types, general wildlife observation information, wild horse management areas, and grazing allotments information were obtained from WGFD, BLM, and Wyoming Natural Diversity Database (WYNDD) digital shapefiles and associated data files and were used to assist in describing the affected environment for these resources.

3.1 PHYSICAL RESOURCES

3.1.1 Climate

The JIDPA is located in a semiarid (dry and cold) mid-continental climate regime. The area is typified by dry windy conditions, with limited rainfall and long cold winters. The nearest long-term meteorological measurement station is at LaBarge, Wyoming (1958-2003), approximately 20 miles southwest of the JIDPA at an elevation of 6,858 ft (Western Regional Climate Center [WRCC] 2004). Variations in elevation and topography across the region result in variations in site-specific climatic conditions; therefore, site-specific conditions in the JIDPA likely vary somewhat from those reported herein.

The total annual average precipitation at LaBarge is 8.0 inches, ranging from 17.8 inches (1995) to 3.4 inches (1975). Precipitation is greatest from mid-spring to early fall, tapering off during the winter months. An average of 30.5 inches of snow falls during the year (annual high 43.6 inches in 1987). Table 3.3 shows the average monthly temperature ranges and precipitation.

Table 3.3 Mean Monthly Temperature Ranges and Total Precipitation at LaBarge.[1]

Month	Average Monthly Low and High Temperatures (°F)	Average Precipitation (inches)
January	-1.7 - 30.9	0.31
February	1.0 - 34.6	0.34
March	13.7 - 43.1	0.38
April	23.4 - 54.0	0.81
May	32.0 - 64.8	1.31
June	38.9 - 73.6	1.03
July	43.9 - 83.4	0.67
August	42.3 - 81.6	0.88
September	33.2 -70.8	0.77
October	22.4 - 59.2	0.57
November	10.5 - 41.4	0.47
December	-0.9 - 31.0	0.46
Annual Average	21.6 - 55.7	8.0

[1] Source: (WRCC 2004).

The region has cool temperatures, with average daily temperature (in degrees Fahrenheit [ºF]) ranging between -1.7ºF and 30.9ºF in January to between 43.9ºF and 83.4ºF in July. Extreme temperatures have ranged from -52ºF (1990) to 96ºF (2002). The frost-free period generally occurs from mid-May to mid-September.

The region is subject to strong and gusty winds, reflecting channeling and mountain valley flows due to complex terrain. During the winter months, strong winds are often accompanied by snow, producing blizzard conditions. The closest comprehensive wind measurements are collected in the JIDPA at a meteorological station operated by BP America from 1999 through 2003. A wind rose for the JIDPA for years 1999 through 2002 is provided in Figure 3.1 and shows the frequency distribution of wind speed and direction. Table 3.4 provides the wind direction distribution in a tabular format. From this information, it is evident that winds in the JIDPA originate from the west to northwest approximately 40% of the time. The annual mean wind speed is 11.3 mph.

Table 3.5 shows the frequency distribution of wind speeds in the JIDPA, and Table 3.6 shows the atmospheric stability class. The atmospheric stability class is the measure of atmospheric turbulence, which directly affects pollutant dispersion. The stability classes are divided into six categories designated "A" (unstable) through "F" (very stable). The "D" (neutral) stability class occurs more than half of the time.

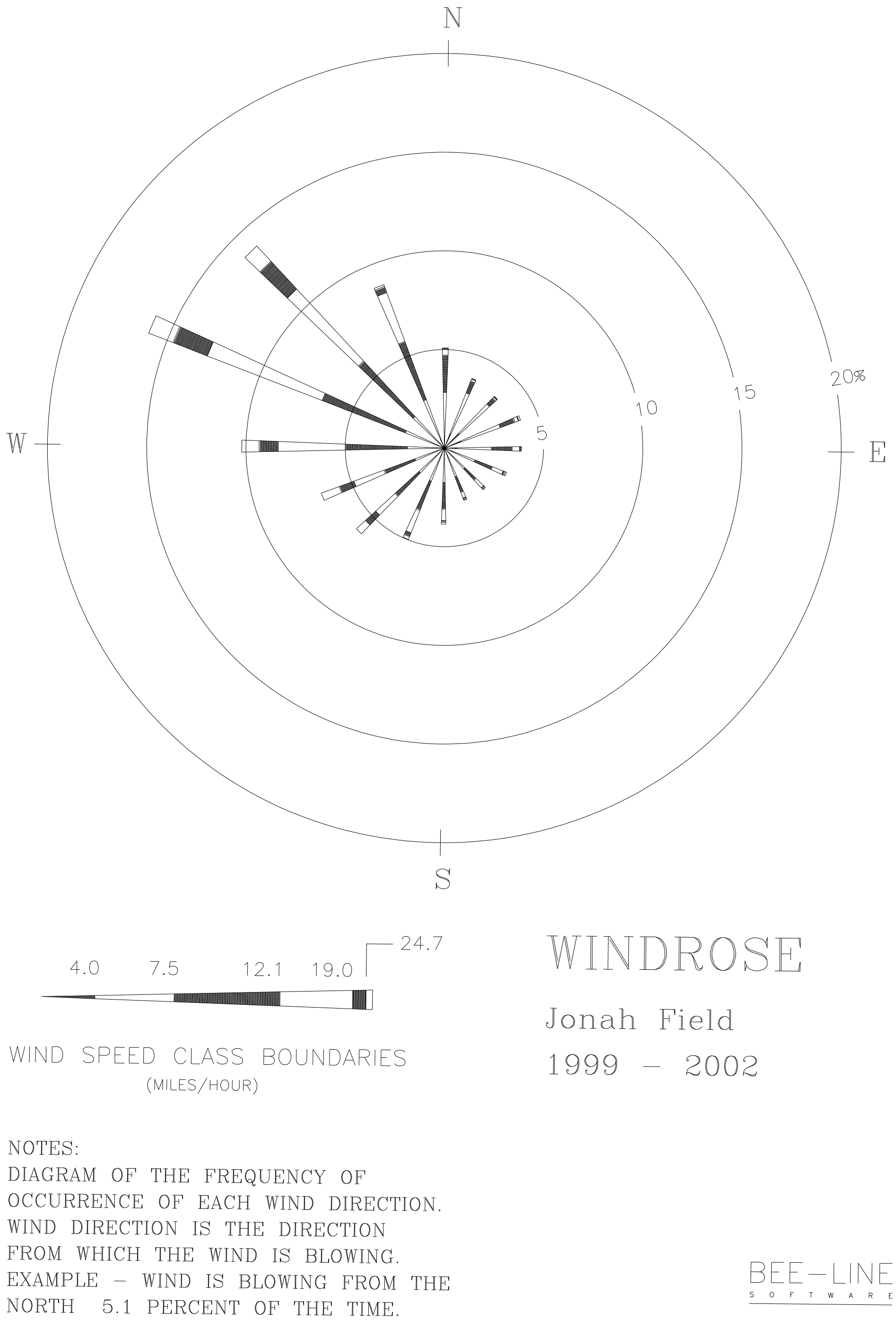
The frequency and strength of winds greatly affect the dispersion and transport of air pollutants. Because of the strong winds in the region, the potential for atmospheric dispersion is relatively high (although nighttime cooling enhances stable air, inhibiting air pollutant mixing and transport).

An assessment of project impacts to climate is beyond the scope of this analysis and is therefore not discussed further in this EIS.

3.1.2 Air Quality

The Wyoming Ambient Air Quality Standards (WAAQS) and National Ambient Air Quality Standards (NAAQS) are health-based criteria for the maximum acceptable concentrations of specific air pollutants at locations to which the public has access. Although specific air quality monitoring has not been conducted within the JIDPA, air quality monitoring for the most relevant pollutants has been conducted and determined to be representative of the CIAA (Map 3.1). Air pollutants measured for which ambient air quality standards exist include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns in effective diameter (PM_{10}), particulate matter less than 2.5 microns in effective diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). Background concentrations for these pollutants are compared to the WAAQS and NAAQS and PSD Class I and II Increments in Table 3.7.

As shown in Table 3.7, regional background values are below established standards, and all areas within the CIAA are designated as attainment for all criteria pollutants. Background air quality concentrations can be combined with modeled Project-related emissions for the same averaging time periods so that total predicted pollutant concentrations can be compared to applicable air quality standards.



Source: BP America (2004).

Figure 3.1 Wind Rose, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.

Table 3.4 Wind Direction Frequency Distribution, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.[1]

Wind Direction	Occurrence (%)
N	5.1
NNE	3.8
NE	3.6
ENE	4.1
E	3.9
ESE	3.4
SE	2.9
SSE	2.8
S	3.9
SSW	5.0
SW	6.0
WSW	6.6
W	10.2
WNW	16.0
NW	13.9
NNW	8.8

1 Source: BP America (2004).

Table 3.5 Wind Speed Distribution, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.[1]

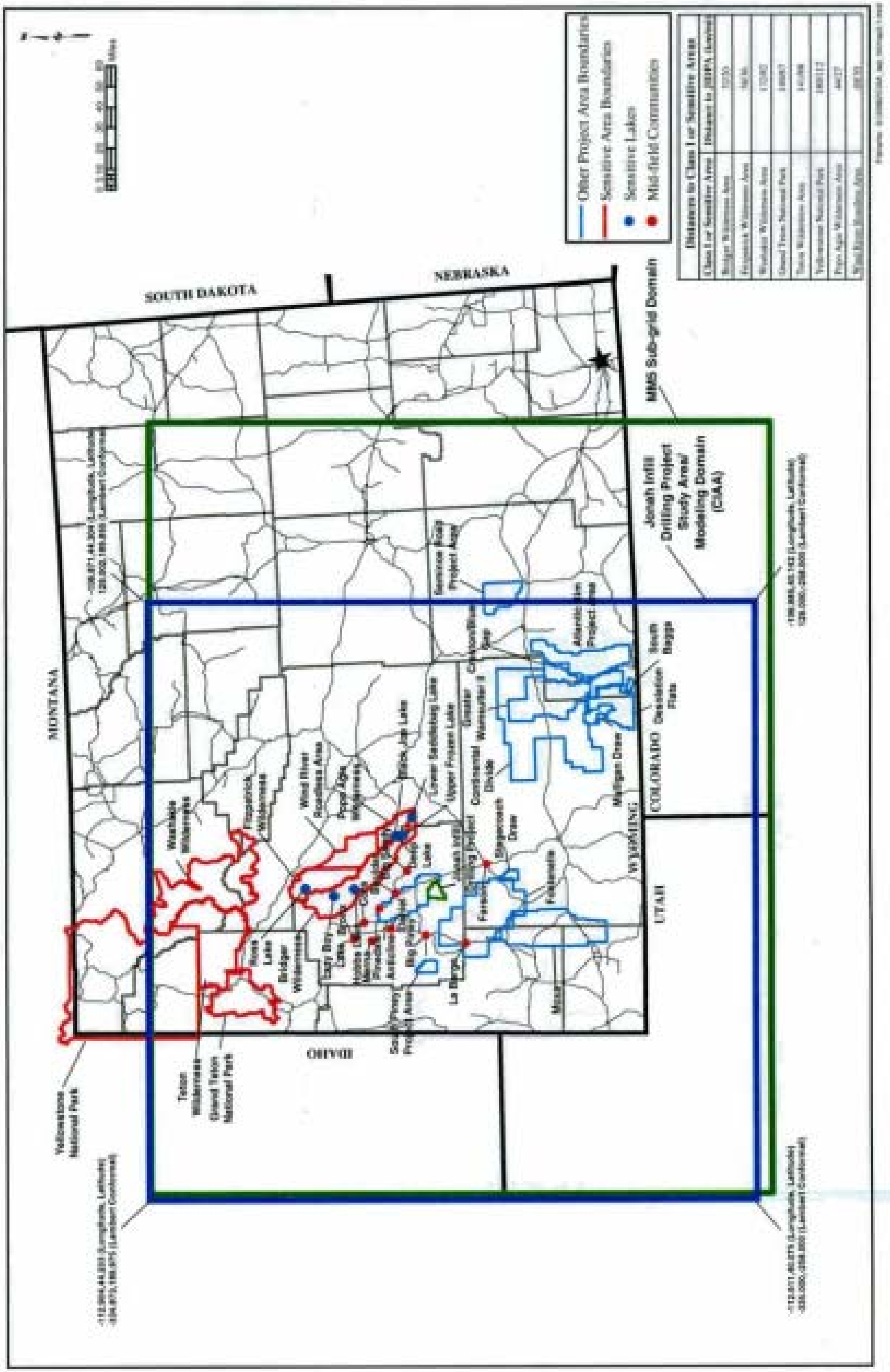
Wind Speed (mph)	Occurrence (%)
0 – 4.0	8.9
4.0 – 7.5	25.8
7.5 – 12.1	28.1
12.1 – 19.0	24.4
19.0 – 24.7	7.4
Greater than 24.7	5.4

1 Source: BP America (2004).

Table 3.6 Atmospheric Stability Class Distribution, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.[1]

Class[2]	Frequency (%)
A	2.3
B	5.9
C	12.0
D	60.8
E	15.2
F	3.7

1 Source: BP America (2004).
2 A = unstable; B = neutral; F = very stable.



Map 3.1 Air Quality Modeling Domain (Cumulative Impact Assessment Area) Depicting Class I and Other Sensitive Areas and Lakes, Jonah Infill Drilling Project, 2005

Table 3.7 Air Pollutant Background Concentrations, Wyoming and National Ambient Air Quality Standards, and Prevention of Significant Deterioration (PSD) Increments ($\mu g/m^3$).

Pollutant/ Averaging Time	Measured Background Concentration	Wyoming and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline[1]	
			PSD Class I	PSD Class II
Carbon monoxide (CO)[2]				
1-hour	3,336	40,000	n/a	n/a
8-hour	1,381	10,000	n/a	n/a
Nitrogen dioxide (NO_2)[3]				
Annual	3.4	100	2.5	25
Ozone[4]				
1-hour	169	235	n/a	n/a
8-hour	147	157		
Particulate matter				
(PM_{10})[5]	33	150	8	30
24-hour	16	50	4	17
Annual				
Particulate matter				
($PM_{2.5}$)[5]	13	65	n/a	n/a
24-hour	5	15	n/a	n/a
Annual				
Sulfur dioxide (SO_2)[6]				
3-hour (National)	132	1,300	25	512
24-hour (National)	43	365	5	91
24-hour (Wyoming)	43	260	5	91
Annual (National)	9	80	2	20
Annual (Wyoming)	9	60	2	20

1 n/a = not applicable.

2 Background data collected by Amoco at Ryckman Creek for an 8-month period during 1978-1979, summarized for the Riley Ridge project (BLM 1983).

3 Background data collected at Green River Basin Visibility Study site, Green River, Wyoming, during period January-December 2001 (Air Resource Specialists [ARS] 2002).

4 Background data collected at Green River Basin Visibility Study site, Green River, Wyoming, during period June 10, 1998, through December 31, 2001 (ARS 2002).

5 Background data collected by WDEQ/AQD at the Emerson Building, Cheyenne, Wyoming, in 2001. These data have been determined by WDEQ/AQD to be the most representative co-located PM_{10} and $PM_{2.5}$ data available.

6 Background data collected at the LaBarge Study Area/Northwest Pipeline Craven Creek site in 1982-1983.

Federal air quality regulations adopted and enforced by WDEQ/AQD limit incremental emission increases to specific levels defined by the classification of air quality in an area. The PSD Program is designed to limit the incremental increase of specific air pollutant concentrations above a legally defined baseline level. The incremental increase depends upon an area's classification. Six PSD Class I areas are identified as sensitive areas within the CIAA: the Bridger, Fitzpatrick, Teton, and Washakie Wilderness Areas and Grand Teton and Yellowstone National Parks (see Map 3.1). Strict limitations on the additional amount of air pollution allowed from major emitting facilities in PSD Class I areas are applied. For Class I areas, potential cumulative concentrations are compared to applicable PSD increments, and potential Project concentrations are compared to proposed PSD significance levels. The remainder of the CIAA is classified PSD Class II, where similar but less-stringent incremental air quality limits apply. The Popo Agie Wilderness Area and the Wind River Roadless Area are PSD Class II areas that have been identified as additional sensitive areas occurring within the CIAA for air quality. PSD Class I and Class II areas are shown in Map 3.1. Regional background pollutant concentrations, NAAQS, and WAAQS, as well as PSD Class II increments are presented in Table 3.7.

The 1977 *Clean Air Act* amendments established visibility as an Air Quality-Related Value (AQRV) which federal land managers must consider. The 1990 *Clean Air Act* amendments contain a goal of improving visibility within PSD Class I areas. Residents of the Pinedale area consider visibility impairment to be a major concern.

There are two types of visible impairment caused by emission sources--plume impairment and regional haze. Plume impairment occurs when a section of the atmosphere becomes visible due to the contrast or color difference between a discrete pollutant plume and a viewed background such as a landscape feature. Short-duration (usually less than 1-2 days) visual plumes occasionally occur from the JIDPA as a result of upset conditions occurring during flaring operations. Regional haze occurs when pollutants from more diffuse emission sources become well mixed in the atmosphere, causing a general alteration in the appearance of landscape features, changing the color or contrast between landscape features, or causing features of a view to disappear.

Visibility impairment is measured in terms of change in light extinction or change in deciview (dv). A dv change of 1 to 2 (equivalent to a 10% to 20% change in extinction) represents a small but perceptible change in visibility. Visual range, referred to as standard visual range (SVR), is the farthest distance at which an observer can just see a black object viewed against the horizon sky. The larger the SVR, the cleaner the air. Visibility within the JIDPA air quality CIAA is considered very good, with an average SVR of over 93.2 miles (150.0 km) (Malm 2000).

Visibility impacts within Class II areas such as the Sublette County towns of Merna, Pinedale, and Boulder are categorized in this analysis as the mid-field area of study. Visibility or other AQRV impacts within these Class II areas are neither monitored nor regulated by state or federal agencies. Visibility and acid deposition monitoring is conducted within Class I areas. In 1985, the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring program was initiated to establish current visibility conditions, to track visibility changes, to establish long-term trends, and to determine the causal mechanisms of visibility impairment in Class I areas.

The Bridger Wilderness Area, North Absaroka Wilderness Area, and Yellowstone National Park IMPROVE sites are the closest such sites to the JIDPA. Data have been collected near the Bridger Wilderness Area and Yellowstone National Park sites since 1989, and at the North

Absaroka Wilderness Area since 2000. Figures 3.2, 3.3, and 3.4 present summaries of visibility conditions at the IMPROVE sites for the cleanest days (20th percentile best visibility days), for average conditions; and for the haziest days (20th percentile haziest visibility days), respectively (Cooperative Institute for Research in the Atmosphere [CIRA] 2003). These data are presented in SVR and were reconstructed from monitored aerosol (suspended liquid or solid particles) data.

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and it is reported as the mass of material deposited on an area per year (kg/ha-yr). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of pollutants). Background wet and dry atmospheric acid deposition impacts have been monitored at the National Acid Deposition Program (NADP) National Trends Network (NTN) (wet deposition) and Clean Air Status and Trends Network (CASTNET) (dry deposition) station near Pinedale, Wyoming. Total annual deposition (wet and dry) reported as total nitrogen and total sulfur deposition for this site for the monitoring period of record are provided in Figure 3.5 and 3.6, respectively.

Total deposition levels of concern (LOC) have been estimated for several areas, including the Bridger Wilderness Area (USFS 1989). The "red line" LOC represents an estimate of the total pollutant loadings that each wilderness can tolerate. Total loadings above these values suggest that the land manager recommend a reduction of emissions from new sources unless data are available to indicate that no AQRVs in the Class I area are unlikely to be adversely affected. The "green line" LOC represents the total pollution loadings (current plus proposed new source contribution) below which a land manager can recommend a permit be issued for a new source, unless data are available that indicate otherwise. The USFS has indicated that the current green line values are set too high (personal communication, December 2004, with Susan Caplan, BLM Air Quality Specialist). Cumulative impacts plus background are compared to these LOCs. The Bridger Wilderness nitrogen deposition red line LOC is 10 kg/ha-yr and nitrogen deposition green line LOC is 3-5 kg/ha-yr. The Bridger Wilderness sulfur deposition red line LOC is 20 kg/ha-yr and sulfur deposition green line is 5 kg/ha-yr. For comparison with reported deposition values, these LOCs are shown on Figures 3.5 and 3.6.

The Wyoming Air Resources Monitoring System (WARMS) has measured concentrations of nitric acid, particulate nitrate, total nitrate, particulate ammonium, sulfur dioxide, and sulfate at a station near Pinedale, Wyoming since 1999. Figures 3.7 and 3.8 present the weekly concentrations of nitrogen compounds (nitrate and ammonium) and Figures 3.9 and 3.10 present concentrations of sulfur compounds (sulfur dioxide and sulfate) near Pinedale. These data are provided as an additional measure of the nitrogen and sulfur levels near the Bridger Wilderness. WARMS data from the network start-up period from 1999 and 2000 may be unreliable, however, they are provided for comparison purposes.

Site-specific lake chemistry background data (pH, acid-neutralizing capacity [ANC], elemental concentrations, etc.) have been collected by the USFS in several high mountain lakes in the nearby Wilderness Areas. Lakes for which background data were collected are shown on Map 3.1. Lake acidification is measured in terms of change in ANC, which is the lake's buffering capacity to resist acidification from atmospheric deposition of acid compounds such as sulfates and nitrates. Measured baseline ANC data for sensitive lakes within the cumulative study domain are provided in Table 3.8.

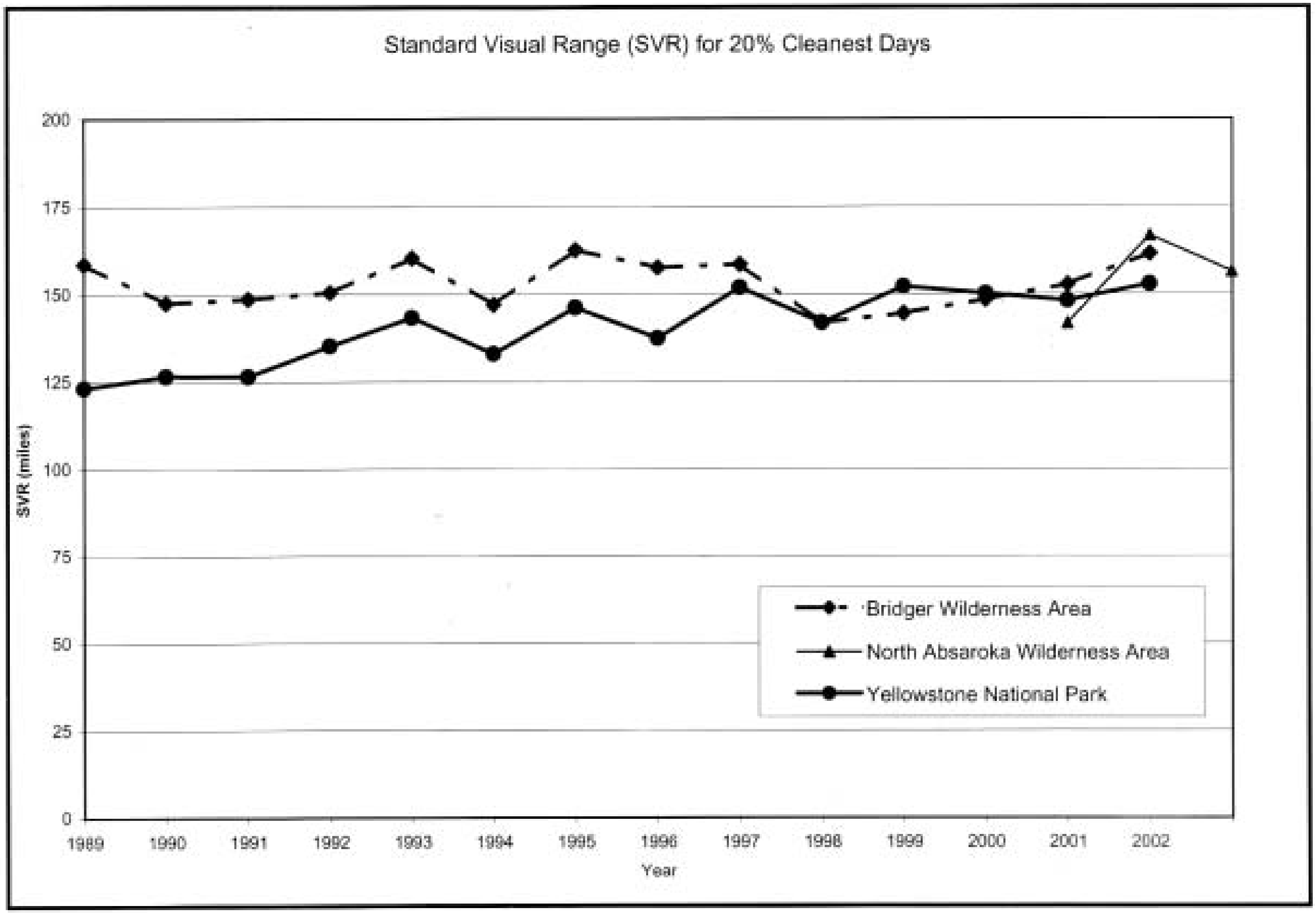


Figure 3.2 Standard Visual Range for 20th% Cleanest Days, Jonah Infill Drilling Project Area, Sublette County, Wyoming (CIRA 2003).

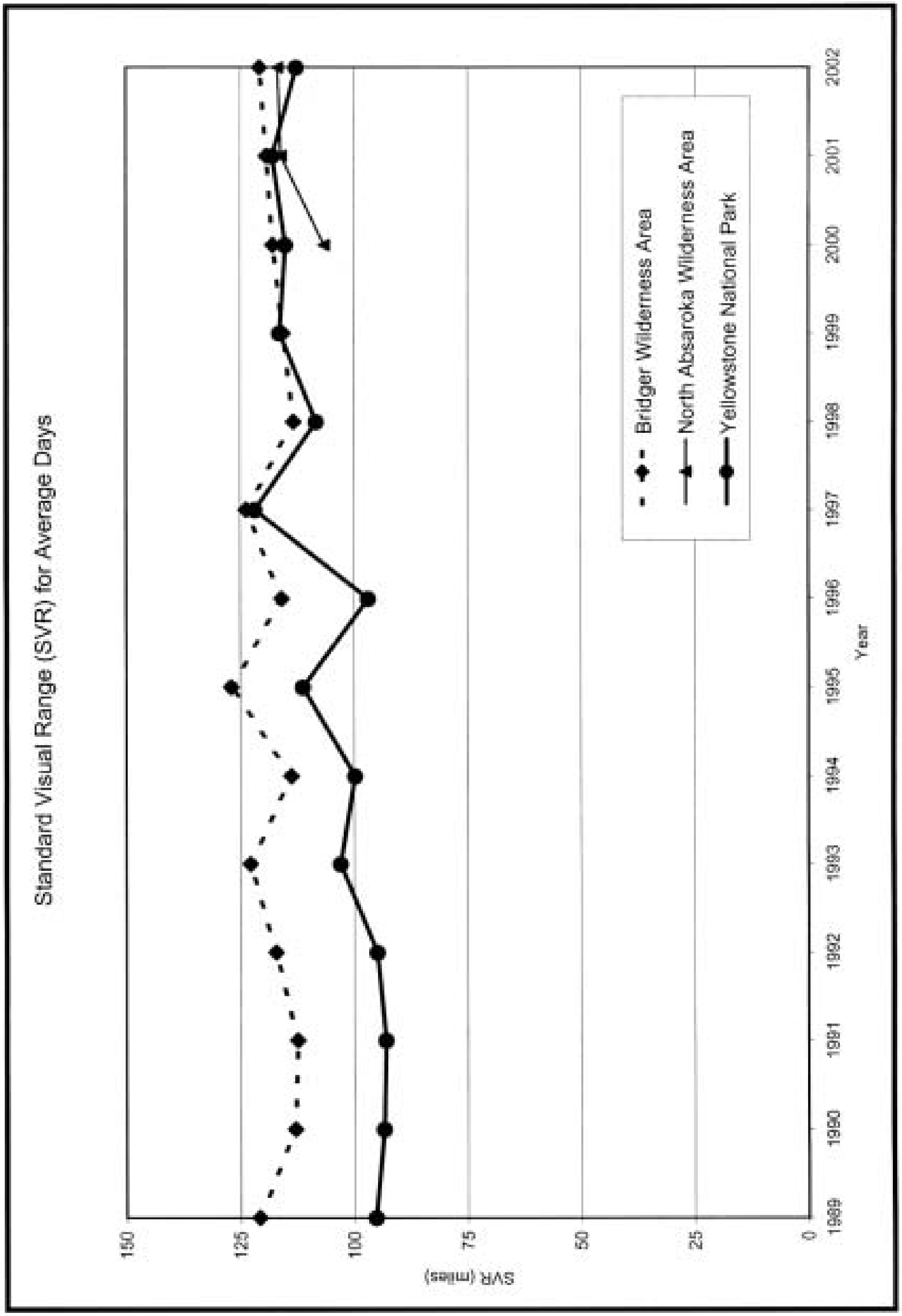


Figure 3.3 Standard Visual Range for Average Days, Jonah Infill Drilling Project Area, Sublette County, Wyoming (CIRA 2003).

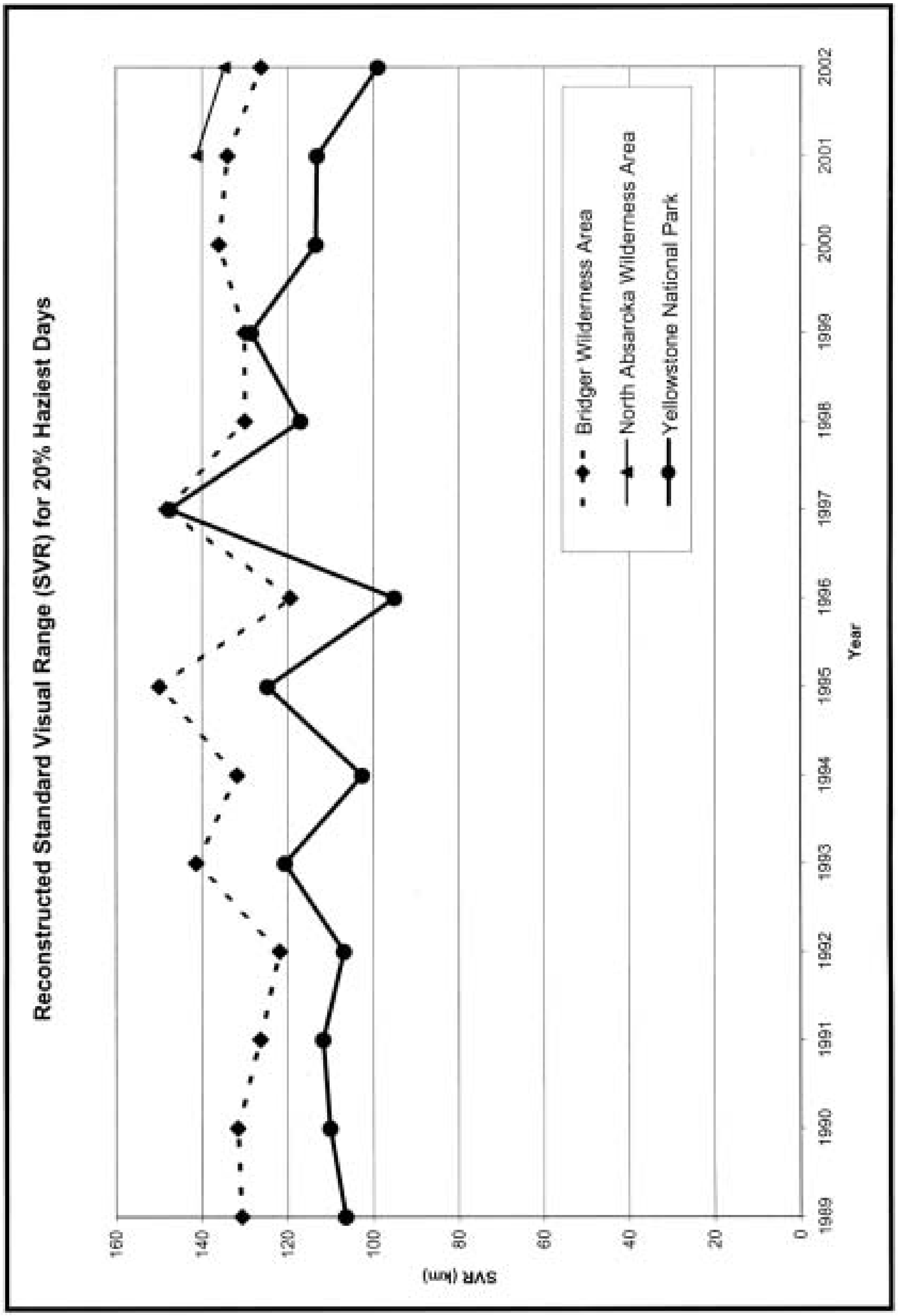


Figure 3.4 Standard Visual Range for 20th% Haziest Days, Jonah Infill Drilling Project Area, Sublette County, Wyoming (CIRA (2003).

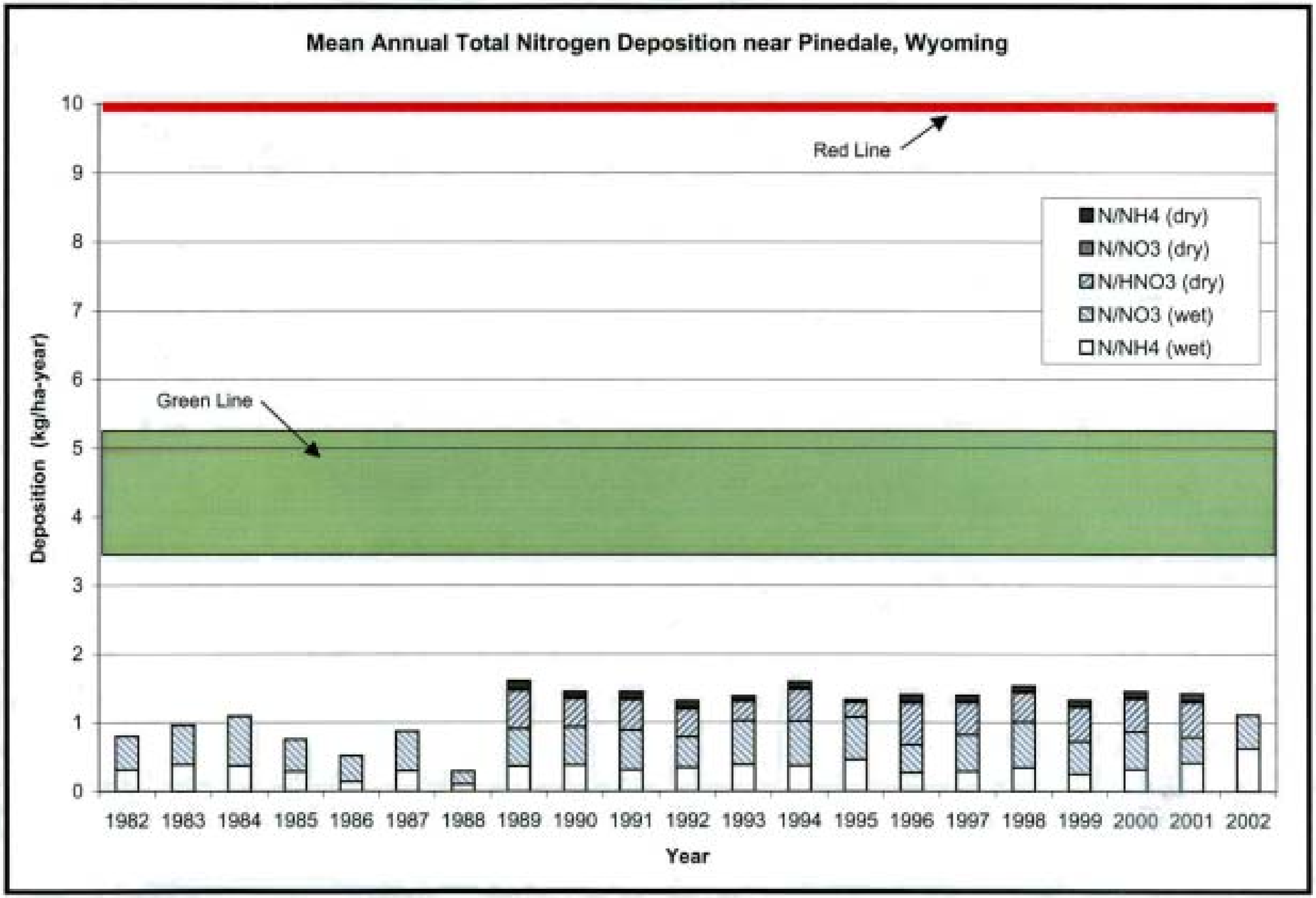


Figure 3.5 Mean Annual Total Nitrogen Deposition Near Pinedale, Wyoming (NADP [WY06] and CASTNET [PND165]).

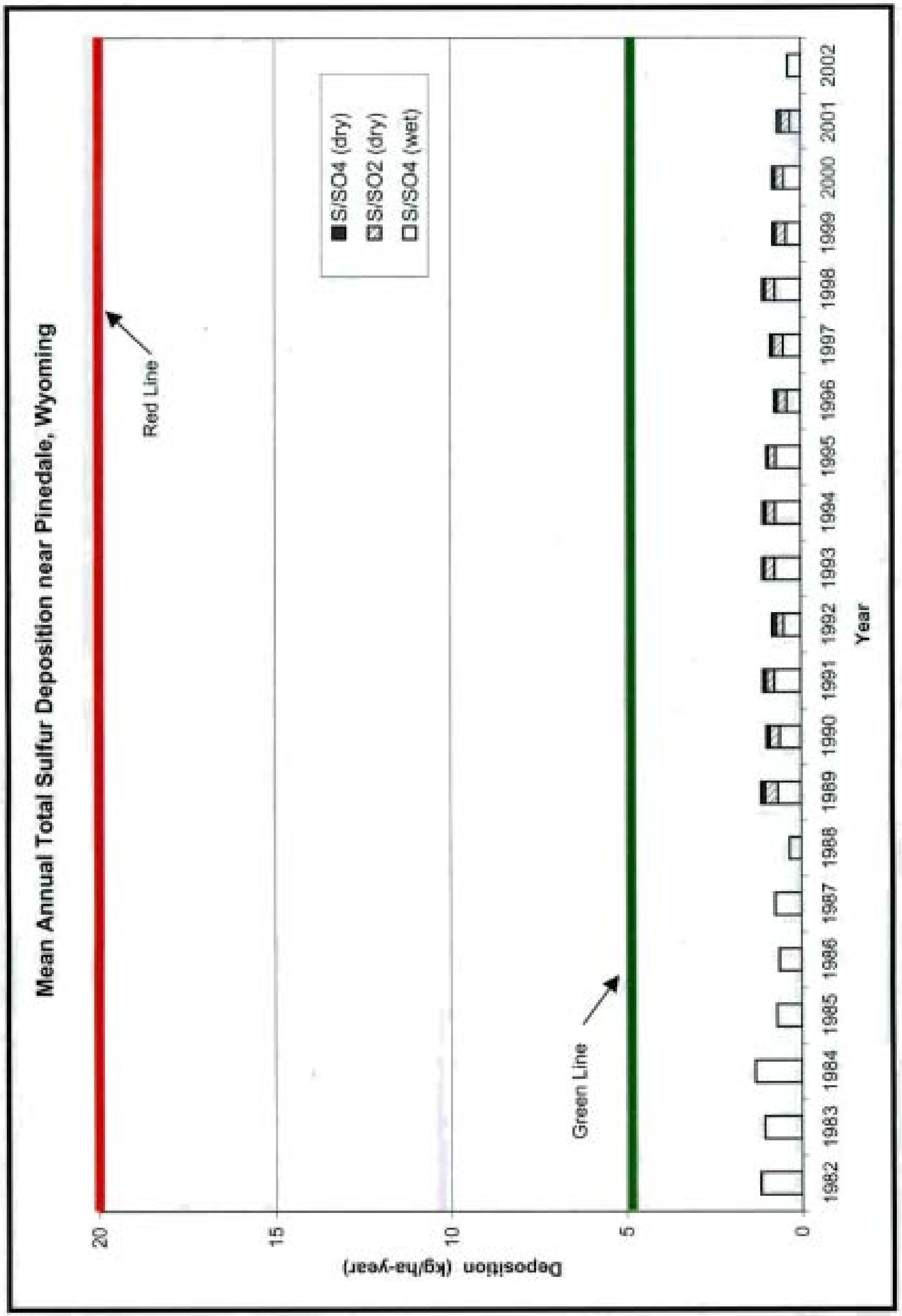


Figure 3.6 Mean Annual Total Sulfur Deposition Near Pinedale, Wyoming (NADP [WY06] and CASTNET [PND165]).

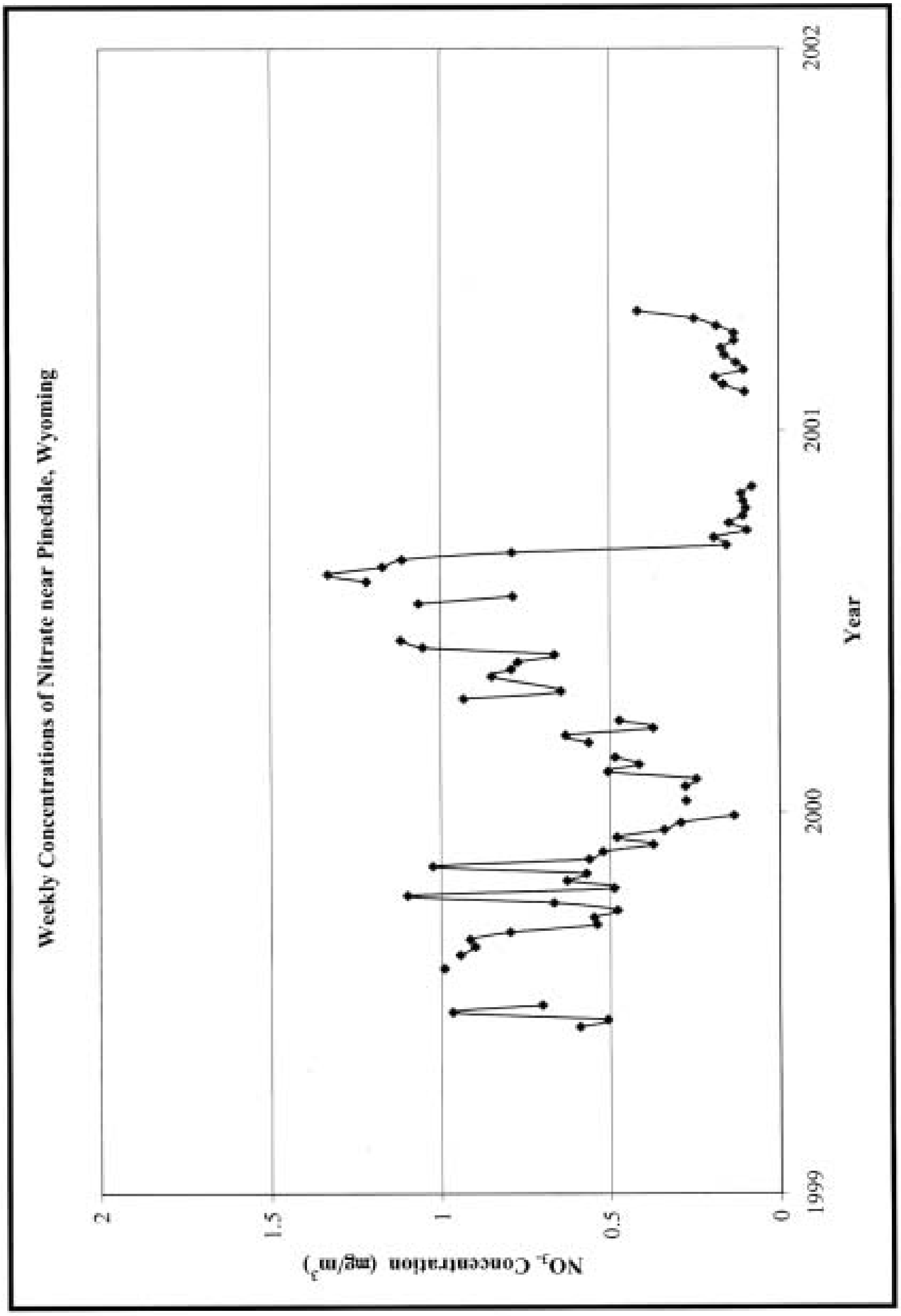


Figure 3.7 Weekly Concentrations of Nitrate Near Pinedale, Wyoming (WARMS, Pinedale).

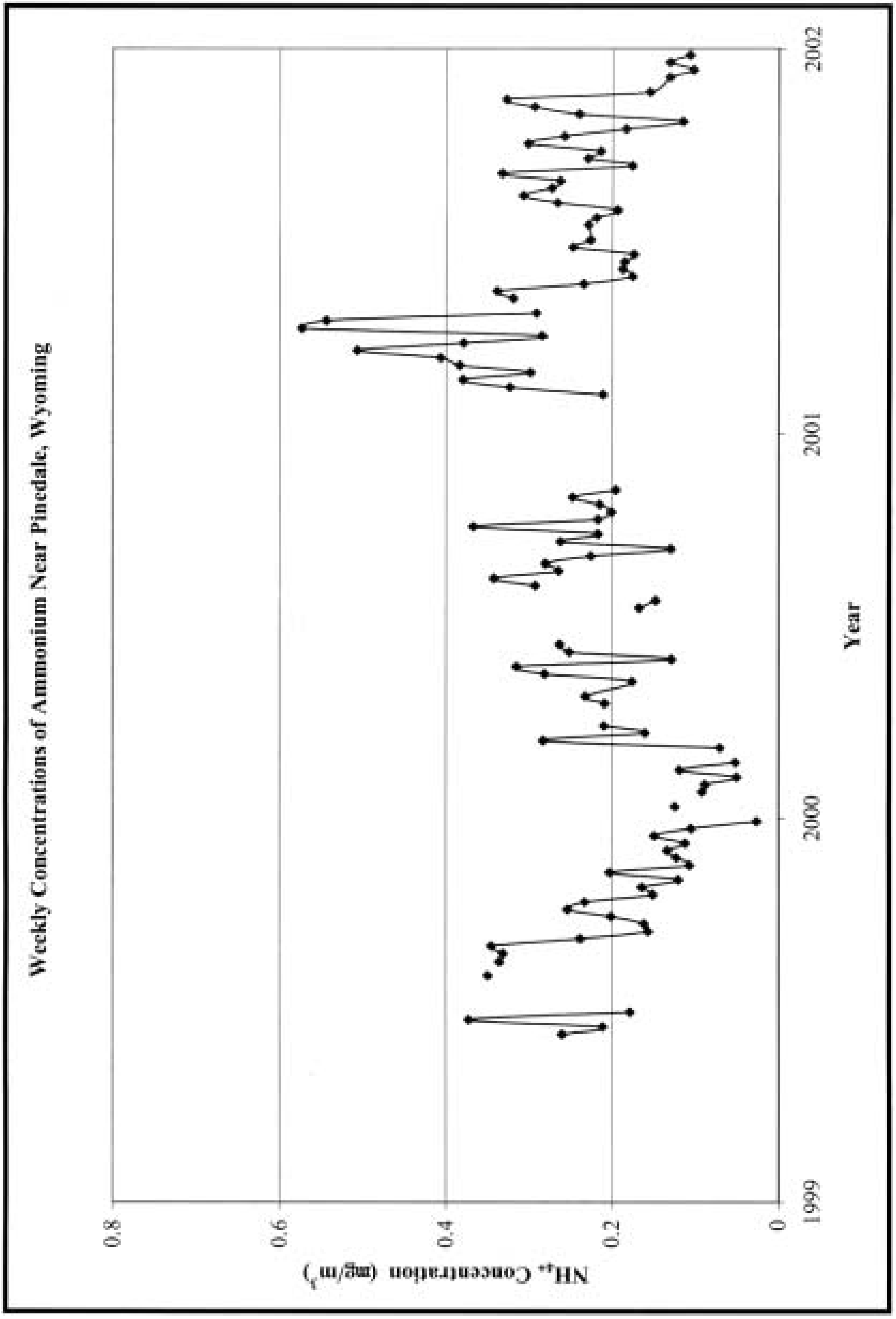


Figure 3.8 Weekly Concentrations of Ammonium Near Pinedale, Wyoming (WARMS, Pinedale).

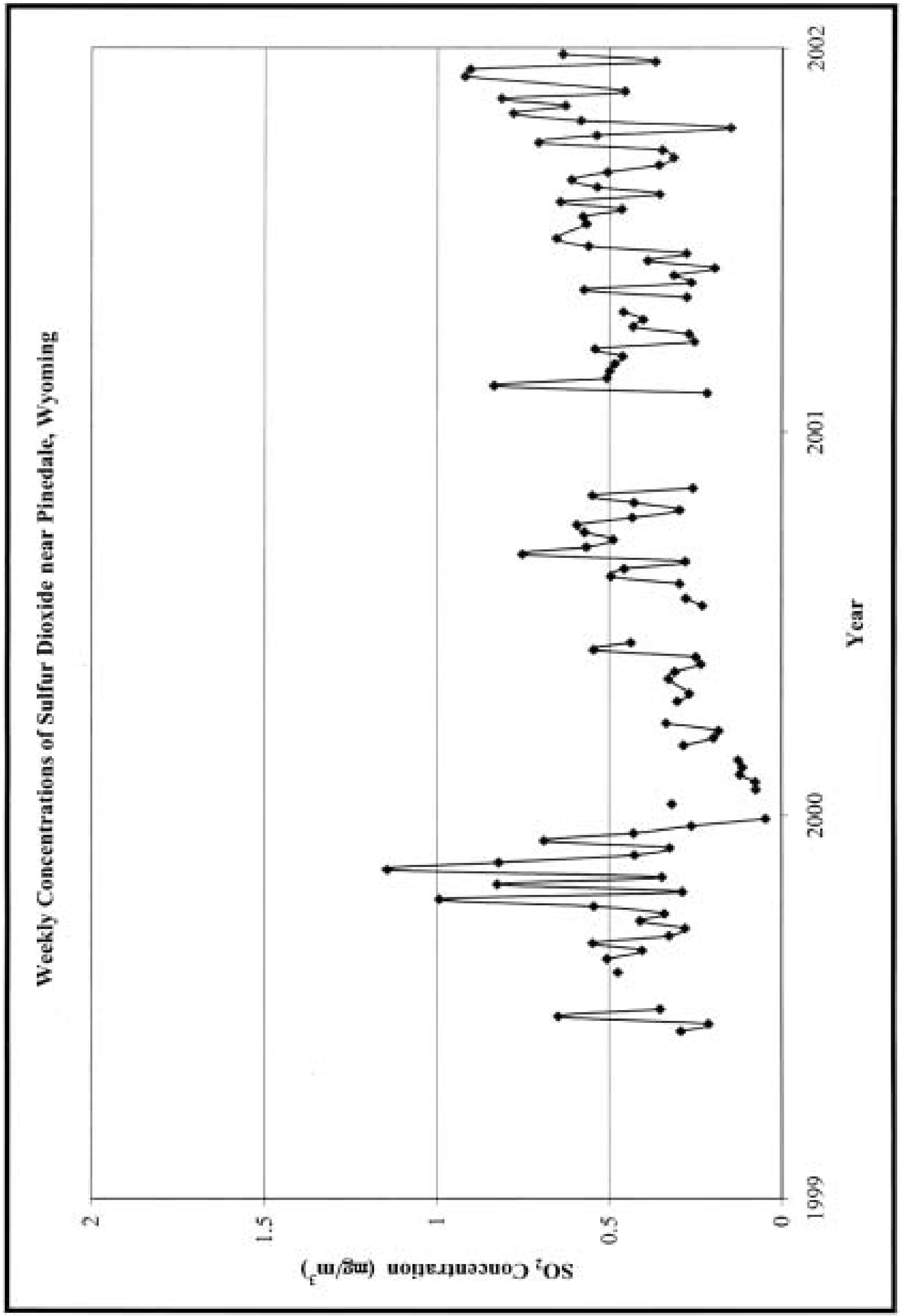


Figure 3.9 Weekly Concentrations of Sulfur Dioxide Near Pinedale, Wyoming (WARMS, Pinedale).

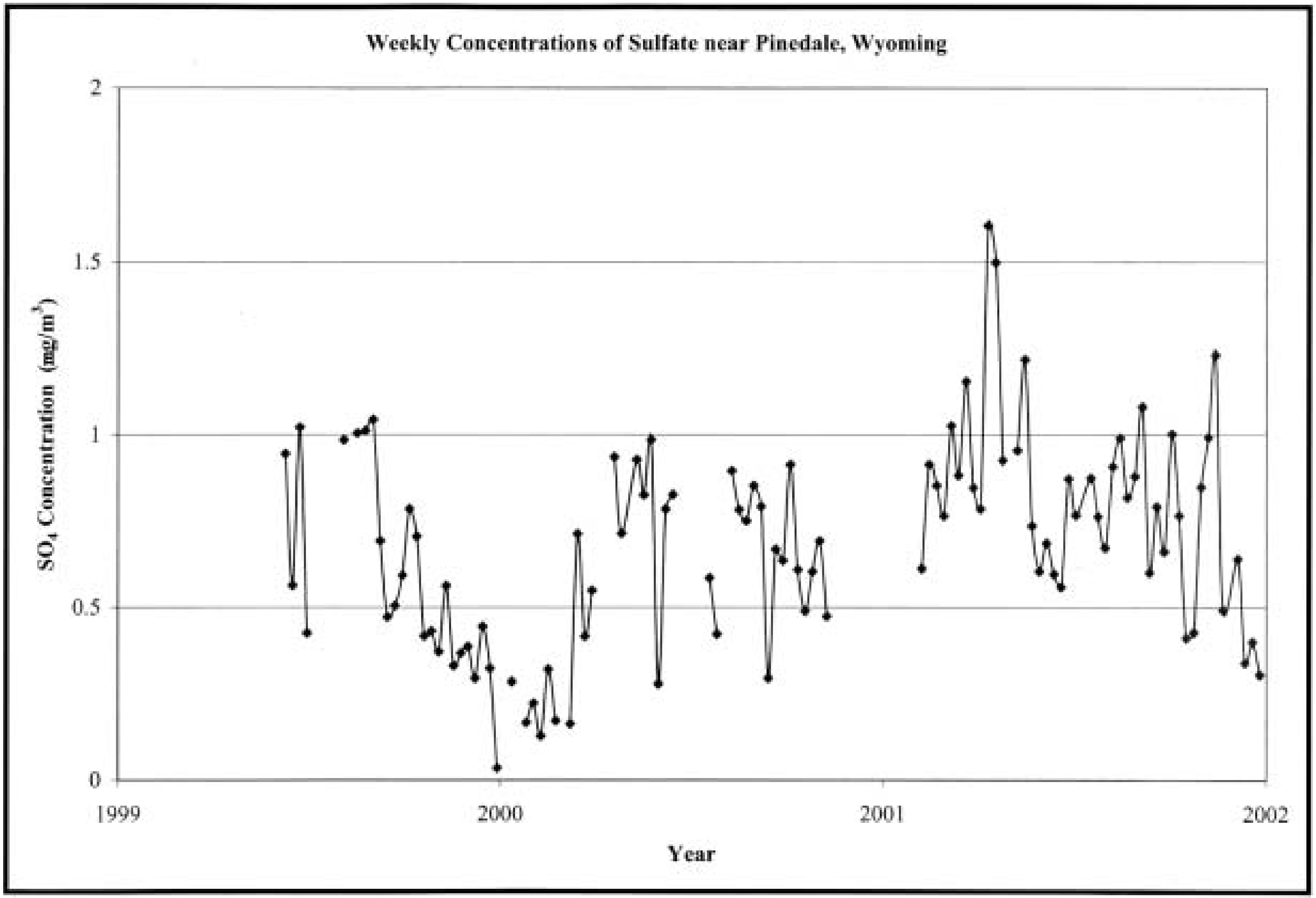


Figure 3.10 Weekly Concentrations of Sulfate Near Pinedale, Wyoming (WARMS, Pinedale).

Table 3.8 Monitored Background Conditions at Sensitive Lakes.[1]

Sensitive Lake	Lake Location	Background ANC (µeq/l)[2]	Number of Samples	Period of Monitoring
Black Joe Lake	Bridger Wilderness Area	67.0	61	1984-2003
Deep Lake	Popo Agie Wilderness Area	59.9	58	1984-2003
Hobbs Lake	Bridger Wilderness Area	69.9	65	1984-2003
Lazy Boy Lake	Bridger Wilderness Area	18.8	1	1997
Upper Frozen Lake	Bridger Wilderness Area	5.0	6	1997-2003
Ross Lake	Fitzpatrick Wilderness Area	53.5	44	1988-2003
Lower Saddlebag Lake	Popo Agie Wilderness Area	55.5	43	1989-2003

1 From USFS (2003).
2 10th Percentile Lowest ANC Values reported.

Lakes with ANC values ranging from 25 to 100 microequivalents per liter (µeq/l) are considered to be sensitive to atmospheric deposition, lakes with ANC values ranging from 10 to 25 µeq/l are considered very sensitive, and lakes with ANC values less than 10 µeq/l are considered extremely sensitive (personal communication, January 2005, with Terry Svalberg, USFS).

The USFS has identified specific AQRV "Level of Acceptable Change" (LAC) values which are used to evaluate potential air quality impacts from deposition within their wilderness areas (USFS 2000). The USFS has identified a LAC of no greater than 1 µeq/l change in ANC (from human causes) for lakes with existing ANC levels less than 25 µeq/l. A limit of 10 percent change in ANC reduction was adopted for lakes with existing ANC greater than 25 µeq/l.

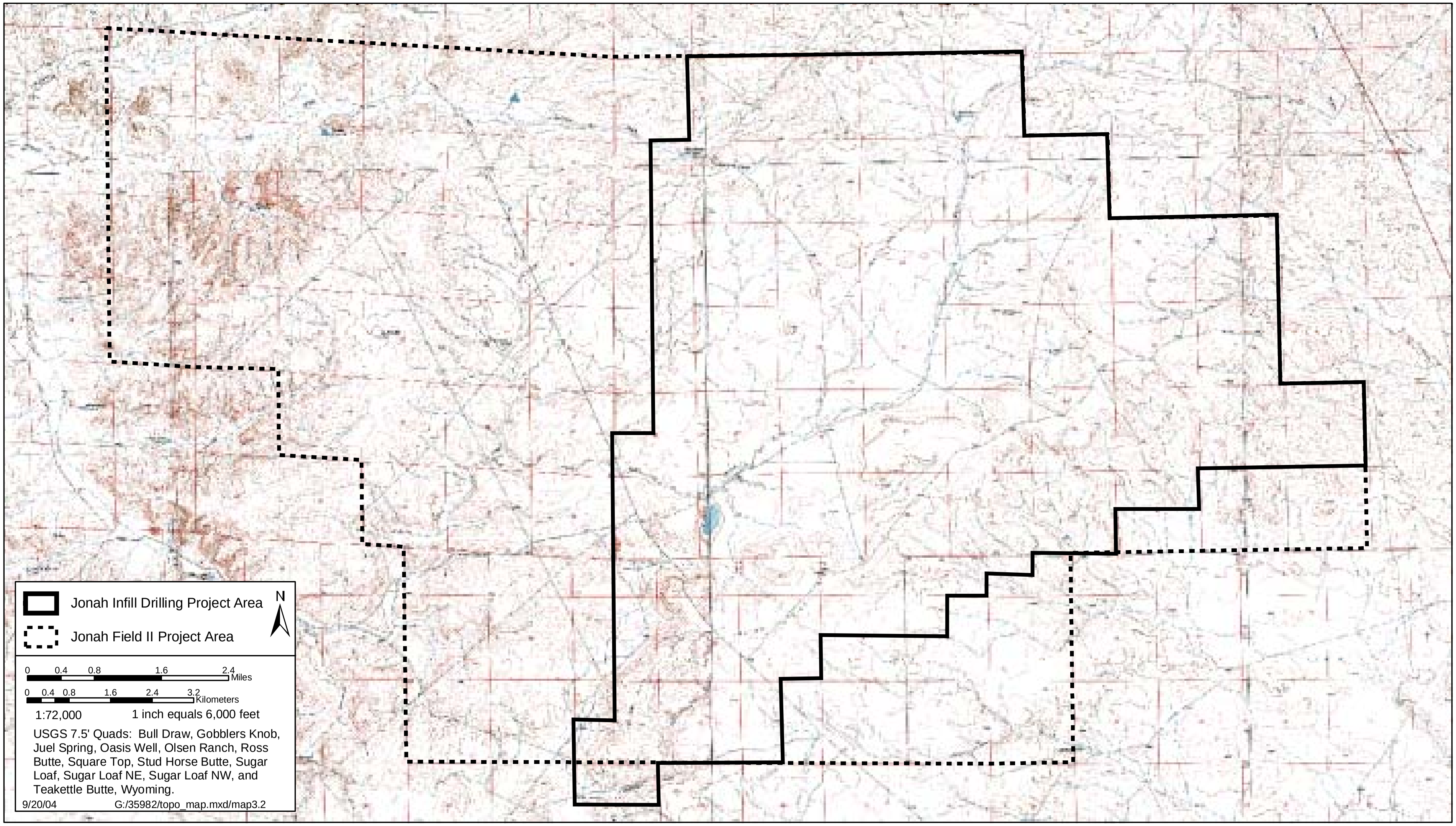
3.1.3 Topography

The JIDPA is located in the northern portion of the Green River Basin. Topography is generally gently rolling, with elevations ranging from approximately 7,400 ft on top of area buttes to about 7,000 ft on the JIDPA's southern boundary (Map 3.2). Topographic relief areas (butte slopes) typically range in height from 50 to 150 ft. Sand Draw, the major drainage in the JIDPA, bisects the area, flowing northeast to southwest into Alkali Creek (a tributary to the Green River). All drainages in the JIDPA are ephemeral, flowing only in response to snowmelt and rain storms. Drainage is predominantly to the southwest in Sand Draw and to Alkali Creek, to the west into Granite Draw, and to the southeast into Jonah Gulch (to a closed basin) and Long Draw and Bull Draw (to the Big Sandy River).

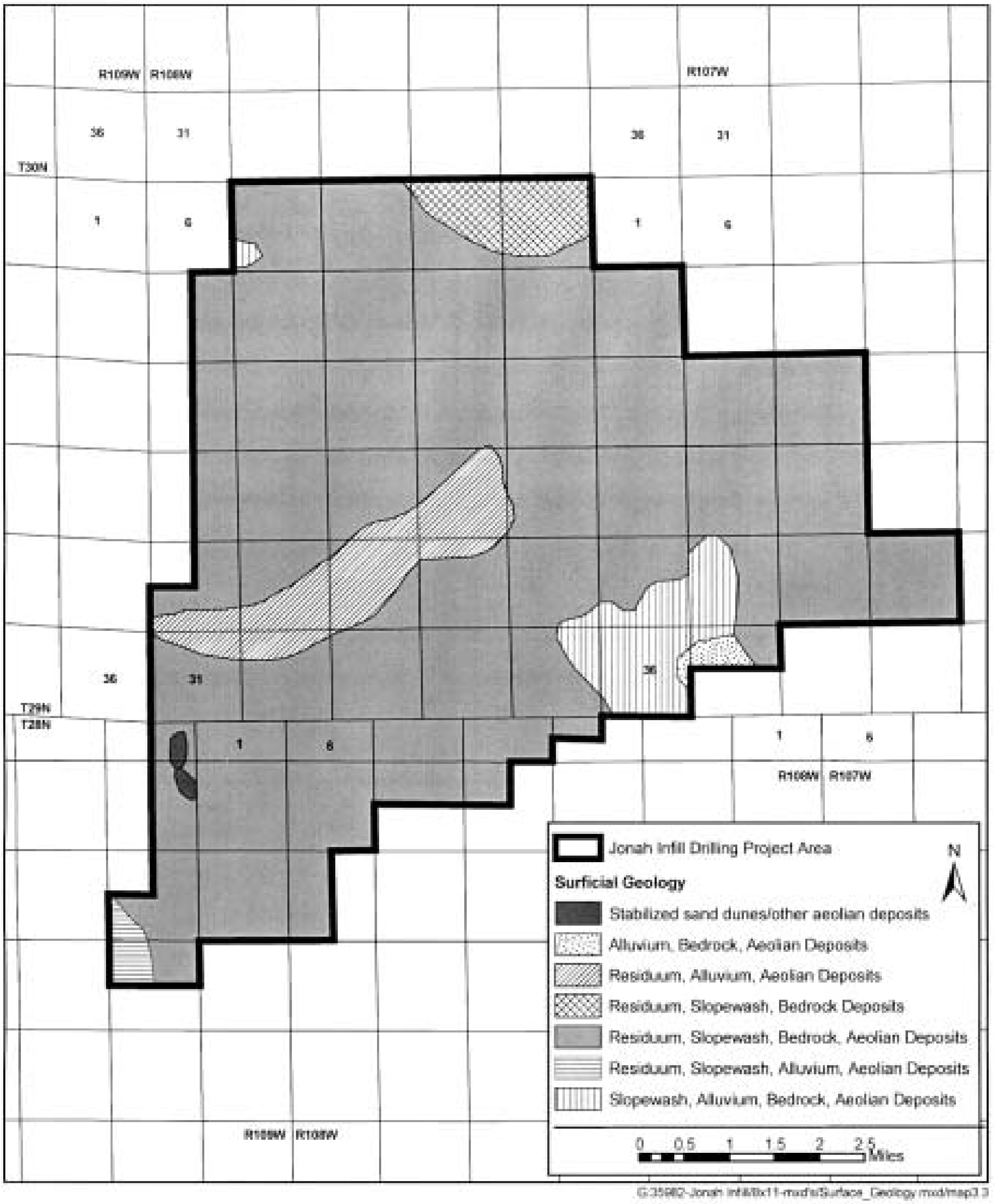
Natural gas development in the JIDPA now dominates the landscape, with over 500 wells and associated roads and pipelines. The CIAA for topography is the Project-affected JIDPA watershed areas described in detail in Sections 3.1.5 (Soils) and 3.2.1 (Vegetation).

3.1.4 Geology

The JIDPA is located on the northeastern flank of the northern Green River Basin--a structural and topographical basin located between the Overthrust Belt to the west and the Wind River Mountains to the east. The Pinedale Anticline, a large structural feature, is located immediately north and east of the JIDPA.



Map 3.2 Area Topography, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.



Map 3.3 Surface Geology, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.

Surface geology in the JIDPA is composed primarily of residuum mixed with alluvium, aeolian material, slopewash, grus, and/or bedrock outcrops. Also present are areas of slopewash and colluvium mixed with scattered deposits of residuum, grus, glacial and periglacial alluvium, aeolian deposits, and/or bedrock outcrops; shallow alluvium mixed with scattered bedrock outcrops; and an area with stabilized sand dunes (Wyoming Geographic Information Science Center [WyGISC] 2003a) (Map 3.3).

Bedrock geology in the JIDPA is dominated by the Laney Member of the Green River Formation (Tgl) and the New Fork Tongue of the Wasatch Formation (Twg) (WyGISC 2003a) (Map 3.4). An area of the Wilkins Peak Member of the Green River Formation (Tgw) occurs in the west-central portion of the area. The Laney Member is composed of oil shale and marlstone; the New Fork Tongue consists of mudstone, sandstone, and thin limestone beds; and the Wilkins Peak Member is composed of tuffaceous sandstone.

The JIDPA is underlain, in descending order, by the Green River, the Wasatch Formation, the Fort Union Formation, an unnamed Tertiary bed, the Lance Formation, the Mesaverde Group (i.e., the Almond Formation, Ericson Sandstone, Rock Springs Formation, and the Blair Formation), the Baxter/Hilliard Shale, and Lower Cretaceous (Frontier Formation), Jurassic, Triassic, Upper Paleozoic, Lower Paleozoic (Madison Formation), and Precambrian rocks. (Figure 3.11). The Lance and the upper portions of the Mesa Verde Group (together referred to as the Lance Pool) is the primary target for gas production for the Project.

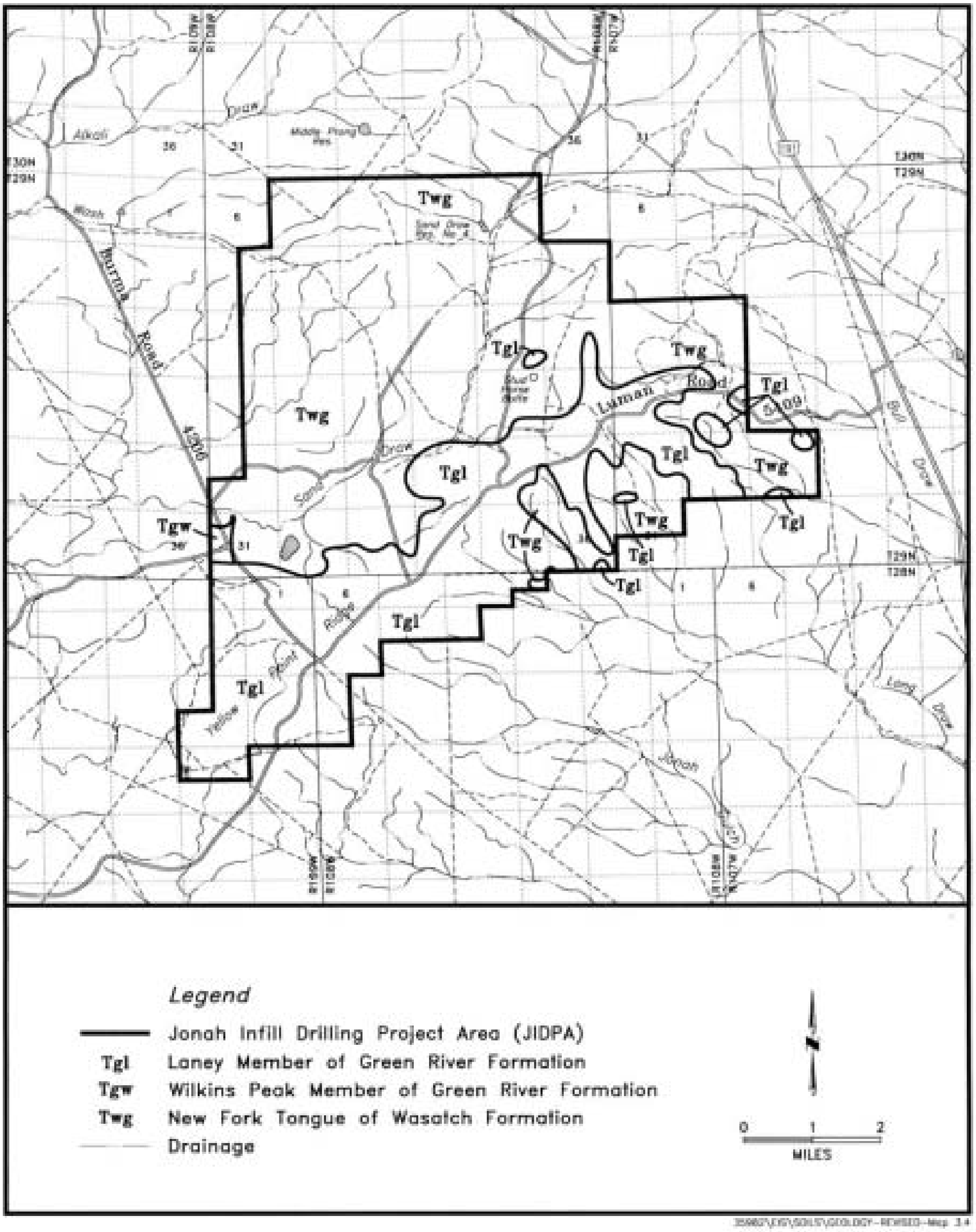
Other than the Green River and Wasatch Formations, which occur at the surface, the geological formations underlying the JIDPA would not be adversely affected by the proposed Project and, therefore, are not discussed further in this EIS. Surface geology is considered under Topography (see Section 3.1.3).

3.1.4.1 Mineral Resources

The mineral resources CIAA covers approximately 66,400 acres (103.8 square miles) on and surrounding the JIDPA and is defined as the combined Jonah EA, Jonah Field II EIS, and JIDPA areas (Map 3.5). Mineral resources within this area are generally as described below for the JIDPA; however, recovery of the natural gas resources in the CIAA area outside the JIDPA is currently considered uneconomic. Additional information on minerals industry earnings, labor, and revenues is provided in Section 3.4.

The Jonah Field is a highly productive natural gas field that produces both natural gas and condensate (oil contained in the natural gas stream). The estimated volume of natural gas in place in the field is 10,500 billion cubic ft (BCF), with recoverable volumes estimated to range between 3,400 and 8,200 BCF; 1 BCF of natural gas is the average annual amount used by 13,700 Wyoming households (2002 use rates) (Energy Information Administration 2004). Through August 2004, approximately 1,121 BCF of gas and 11 million barrels of oil (MBO) had been produced from the field from over 500 wells (WOGCC 2004).

The Lance Formation (from which natural gas would be obtained) is a sedimentary formation, formed by fluvial processes, whereby sediments were deposited in complex, discontinuous bodies by braided flowing streams. Figure 3.12 provides a photograph of a typical braided stream. The gas-bearing sediments of the Lance Formation occur in numerous discontinuous lenses (see Appendix G).



Map 3.4 Bedrock Geology, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.

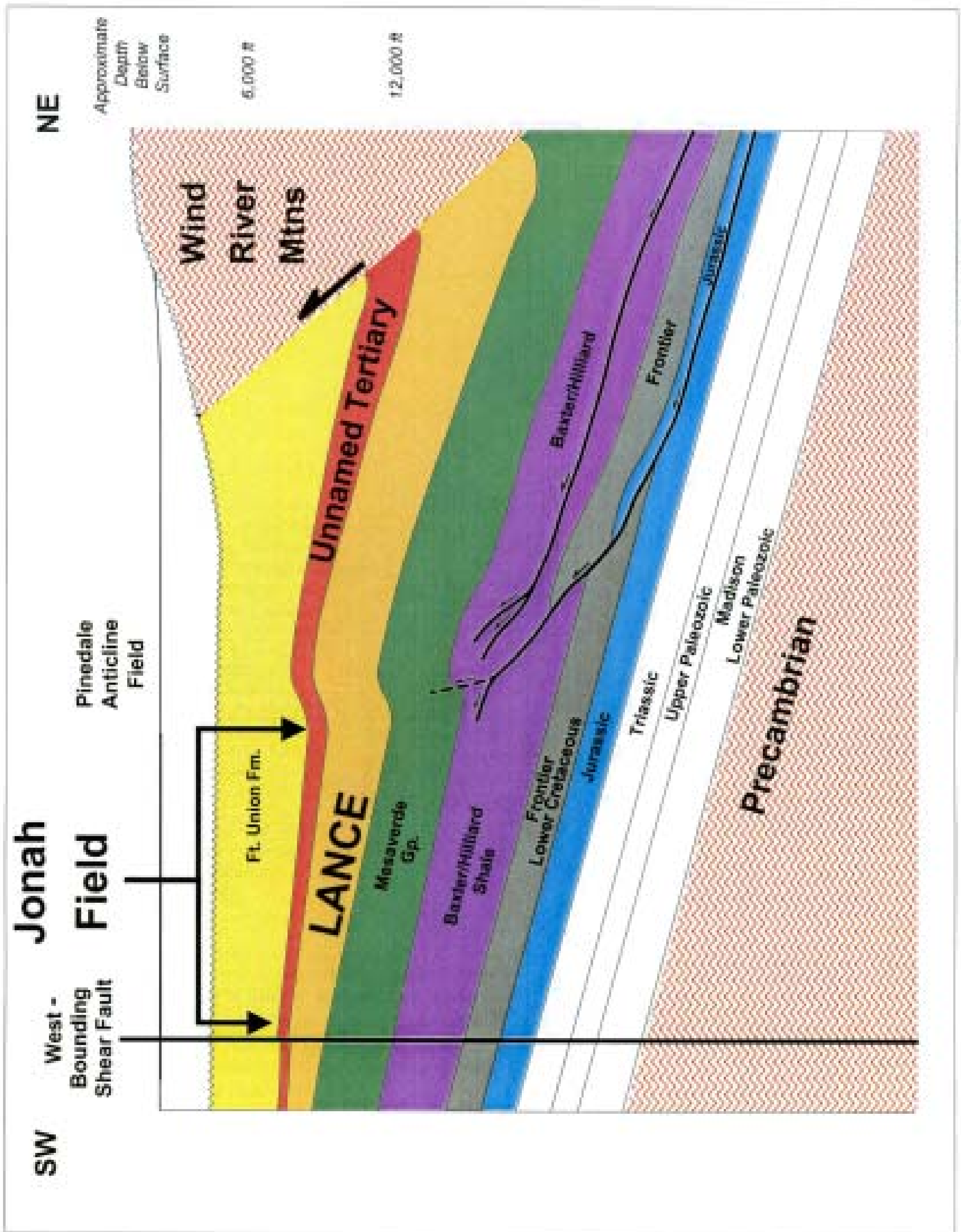


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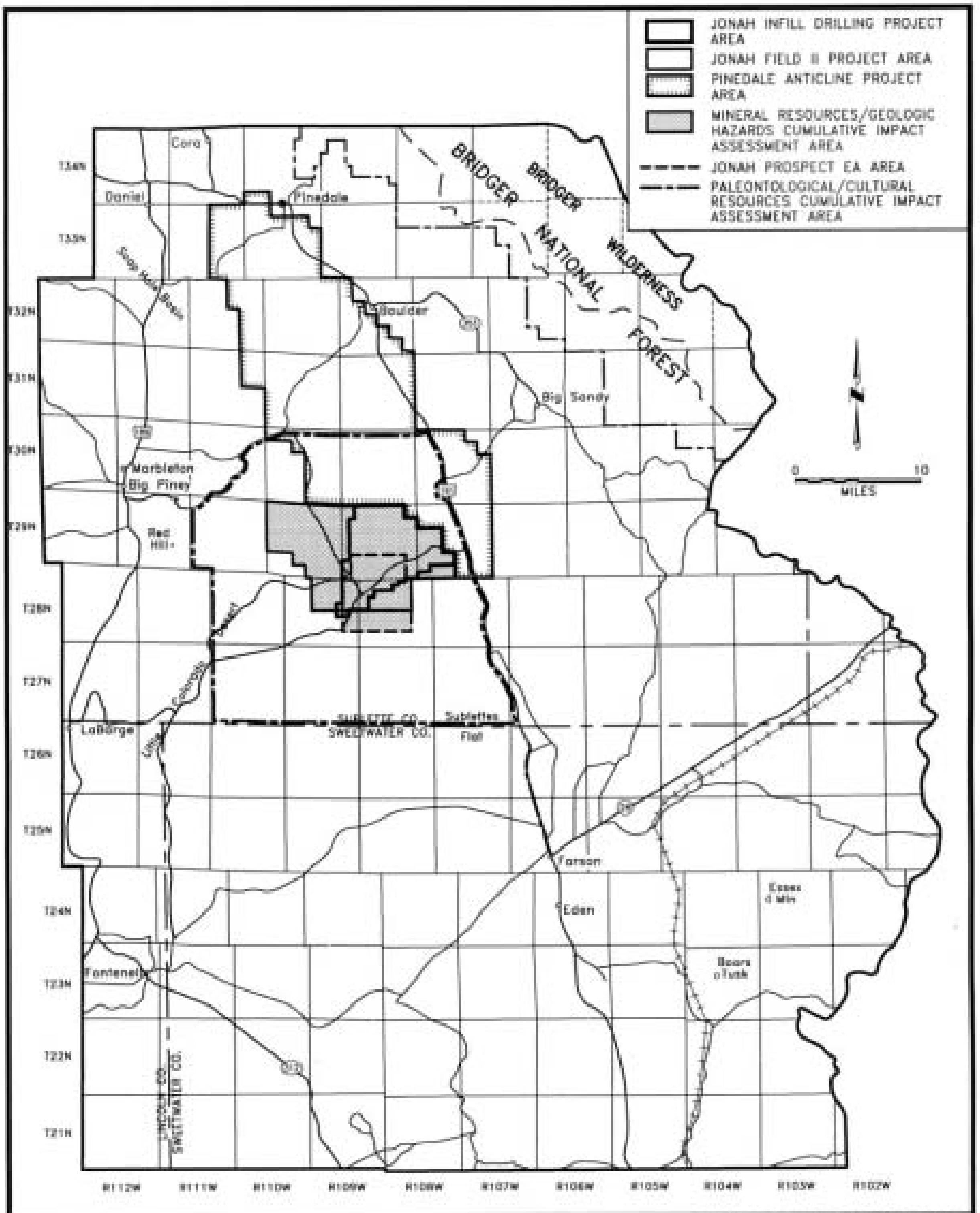
Figure 3.11 Formations Underlying the Jonah Infill Drilling Project Area, Sublette Country, Wyoming, 2005.



Map 3.5 Mineral Resources/Geologic Hazards and Paleontological/Cultural Resources Cumulative Impact Assessment Areas, Jonah Infill Drilling Project, Sublette County, Wyoming, 2004.

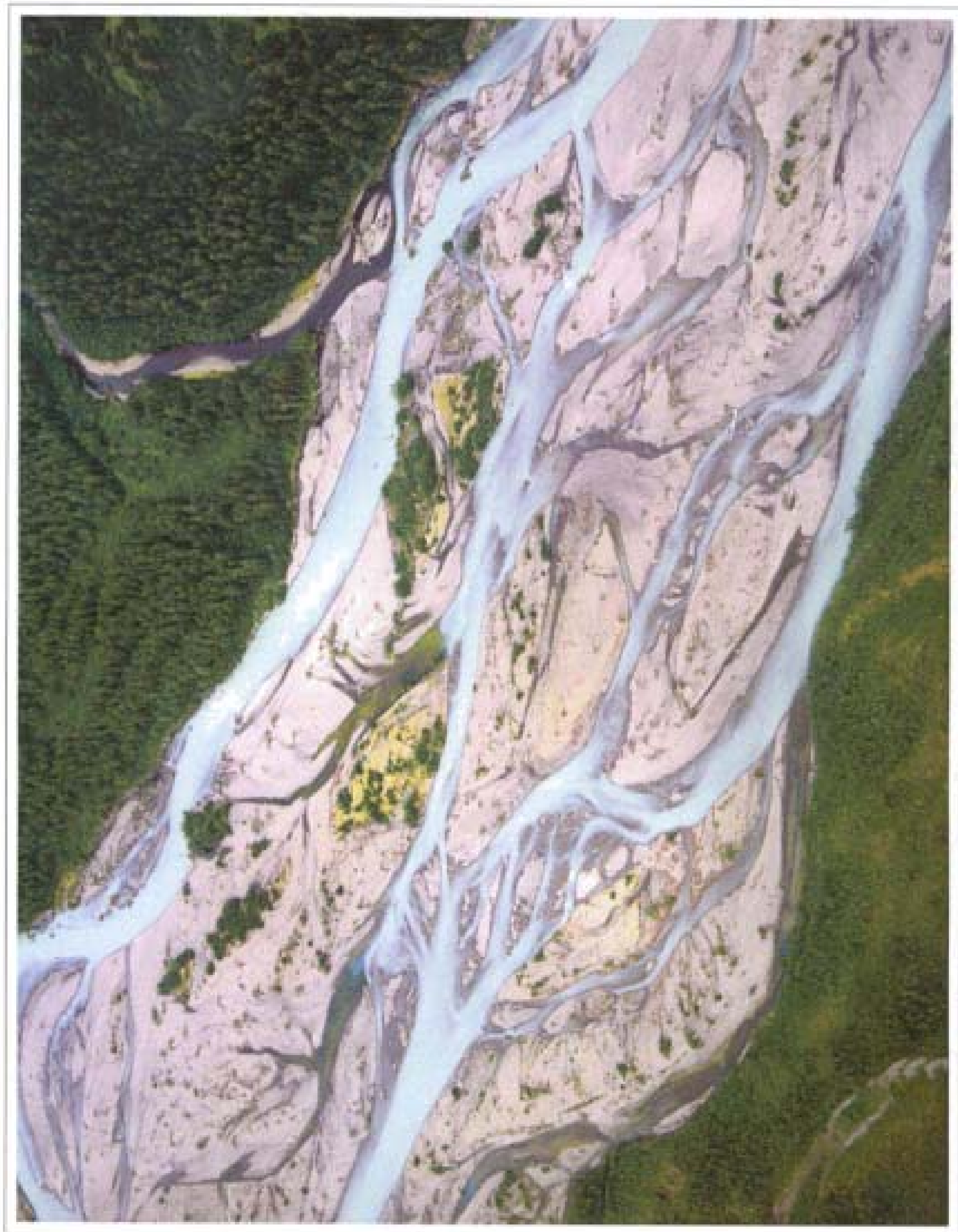


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Figure 3.12 Typical Braided Stream.

Other mineral resources in the area include coal and sand and gravel. The JIDPA is located within the Green River Basin Coal Field (Jones 1991) and is underlain by coal-bearing rocks. However, the potential for coal development is low because coal beds are thin and too deep to be economically mined. Limited sand and gravel resources occur in the JIDPA, and these resources have been used for existing area developments (e.g., roads). No other minerals are known to occur in the JIDPA (Harris 1996, 1997; Hausel 1997).

3.1.4.2 Geologic Hazards

The geologic hazards CIAA covers the same 66,400 acres (103.8 square miles) as the mineral resources CIAA (see Map 3.5). Geologic hazards within the CIAA are generally as described below for the JIDPA.

All of Wyoming is seismically active, and the western quarter of the state is more active than the eastern three-quarters (Case 1997). The JIDPA is within an area where an earthquake could have an estimated peak acceleration of 16-20% gravity and an estimated 2,500-year recurrence interval. Earthquakes with acceleration of 16-20% gravity are equivalent to earthquakes with intensities of VII to VIII on the modified Mercali scale, which cause negligible to slight damage in well-designed buildings, slight to considerable damage in ordinary structures, and considerable to great damage in poorly built structures. In the western quarter of Wyoming, an intensity V earthquake (less intense than VII; windows broken, plaster cracked, objects overturned) can be expected to occur about every 1.5 years (Case 1997).

Numerous earthquakes have occurred in a north/south-trending belt between Big Piney and Evanston in recent years. An earthquake with a 3.3 magnitude (Richter scale) occurred within the area in 1978 (Case et al. 1995). The epicenter was located in the northern portion of T29N, R108W. The Continental Fault System and the Leckie Fault occur approximately 10 miles northeast of the JIDPA (Case 1997). It is not known whether these faults have been active in Quaternary times.

No landslides or active sand dunes are known to occur in the JIDPA (WyGISC 2003a), nor are there any known areas of subsidence (personal communication, October 1996, with Jim Case, Wyoming Geological Survey).

3.1.4.3 Paleontological Resources

The CIAA for paleontologic resources covers approximately 484.4 square miles (310,000 acres) on and surrounding the JIDPA (see Map 3.5). Approximately 3,331 acres of the CIAA have been disturbed primarily from existing oil and gas developments and associated road and pipeline networks. Forty-two percent of this disturbance (1,409 acres) occurs within the JIDPA, 1,388 acres are due to roads outside the JIDPA, 468 acres are due to well pads outside the JIDPA, and 66 acres are due to agricultural lands. Paleontologic resources within the CIAA are generally the same as described for the JIDPA, and 26 fossil localities are known from the CIAA (Erathem-Vanir Geological Consultants 1997). Vertebrate fossils, including mammalian species, are known from some of these localities. The localities occur on the Green River, Wasatch, and Bridger Formations.

The important fossil record of the Green River Basin is well known (BLM 1992; Grande 1984). Table 3.9 provides information on the various geologic formations present on and in the vicinity of the JIDPA and their paleontologic potential.

Table 3.9 Surface Geologic Formations Present on the Jonah Infill Drilling Project Area and Their Paleontologic Potential, Sublette County, Wyoming, 2005.[1]

Deposit[2]	Geologic Age	Type of Deposit/ Environment of Deposition	Thickness	Fossil Resources	Fossil Potential
Alluvial sediments	Holocene	Unconsolidated silts, sands of valleys and plains; terrestrial	<20 ft	None	Low
Terrace deposits	Pleistocene/ Holocene	Gravels, silts, and sands that predate current erosional cycle; terrestrial-fluvial	<40 ft	Pleistocene mammals	Moderate
Green River Fm Laney Mbr LaClede Bed	Middle Eocene	Chiefly oil shale, lesser algal limestone, sandstone, claystone, and tuff; lacustrine, accumulated during renewed expansion of Lake Gosiute	<100 ft	Vertebrates, invertebrates, trace fossils	High
Green River Fm Wilkins Peak Mbr (upper part)	Early-Middle Eocene	Chiefly brown or black oil shale interbedded with gray or green mudstone, evaporitic; lacustrine, deposited during re-expansion of Lake Gosiute (upper)	<150 ft	Vertebrates, invertebrates, plants	High
Wasatch Fm Alkali Creek or New Fork Tongue	Early Eocene	Interbedded brown, green, and gray sandstone, siltstone, mudstone, and shale, locally conglomeratic; chiefly terrestrial-fluvial to floodplain, some lacustrine	<100 ft	Vertebrates, invertebrates, plants	High

1 Adapted from Erathem-Vanir Geological Consultants (1997).
2 Fm = formation; Mbr = member; Ss = sandstone.

The Green River and Wasatch Formations contain fossils from each of the five biological kingdoms and is well-known for its abundant fish fossils (Grande 1984). The Laney Member of the Green River Formation is especially fossiliferous. Terrestrial mammalian fossils are not common because the Green River Formation was formed predominantly from lake deposits; however, reptile (crocodile, alligator, snake, lizard), amphibian (frog, salamander), bird (pelican, grouse, shorebird, and small perching bird), and insect and other invertebrate fossils have been recorded. Although uncommon, mammalian fossils, including marsupials, insectivores, primates, rodents, carnivores, and ungulates, have been recovered.

The fossil flora of the Laney Member is not well studied but includes sycamore, horsetail, and lily pads. Other members of the Green River Formation, however, include a diverse mixture of trees, shrubs, and flowers, suggesting that the fossil flora of the Laney Member may be more diverse than is now known. Insects and other invertebrates (gastropods, arthropods), algae, fungi, flagellates, and bacteria also have been recovered from the Green River Formation. A review of museum and university records and literature (Erathem-Vanir Geological Consultants 1997) indicated no known significant localities within the JIDPA, although two localities occur within 1.0 mile of the area. However, during past JIDPA developments, a few fossils of a Pleistocene horse (tentative identification) were discovered in JIDPA terrace deposits during construction of a well pad. It is likely that important fossils (including both Eocene and Pleistocene materials), are located in the JIDPA.

3.1.5 Soils

The CIAA for soil resources is the combined area of the 10 watersheds that drain the JIDPA (see Section 3.1.6). This CIAA covers approximately 328.6 square miles (210,300 acres) (Table 3.10, Map 3.6). Estimates of the types of soils most likely to be disturbed are based on coarse-scale Wyoming Gap Analysis soil information (Munn and Arneson 1999a, 1999b). Extant soils information for the CIAA (coarsely mapped) indicates that soil map units SU03 and SU05 are the predominant soil types in the area (see Table 3.10). Approximately 1.6% of the CIAA (3,354.7 acres) has been disturbed primarily by oil and gas developments and roads (Table 3.11) and approximately 42% of this disturbance (1,409 acres) exists as long-term disturbance in the JIDPA; no crop lands or residential areas are known to occur within the CIAA. The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance (991.5 acres), 4.2% of the watershed, and most of this disturbance (664.9 acres) is from existing natural gas developments in the JIDPA (see Table 3.11).

Seventeen soil mapping units (fine resolution mapping) occur within the JIDPA (Map 3.7 and Table 3.12) (ERO Resources Corporation 1988; Munn and Arneson 1999a, 1999b; BKS Environmental Associates, Inc. 2003; Natural Resources Conservation Service [NRCS] 2003). Table 3.12 lists the fine-scale soil map units, their JIDPA acreage, and soil use limitations and management considerations. Many of the soils within the JIDPA have characteristics that limit their suitability for road construction and may inhibit successful reclamation. The primary factors limiting soils use for road construction are shallow depth to rock, low strength, shrink-swell potential, frost action, flooding, and steep slopes. Reclamation potential is limited by alkalinity and salinity; excess stones, sand, clay, and/or lime; shallow depths; and steep slopes.

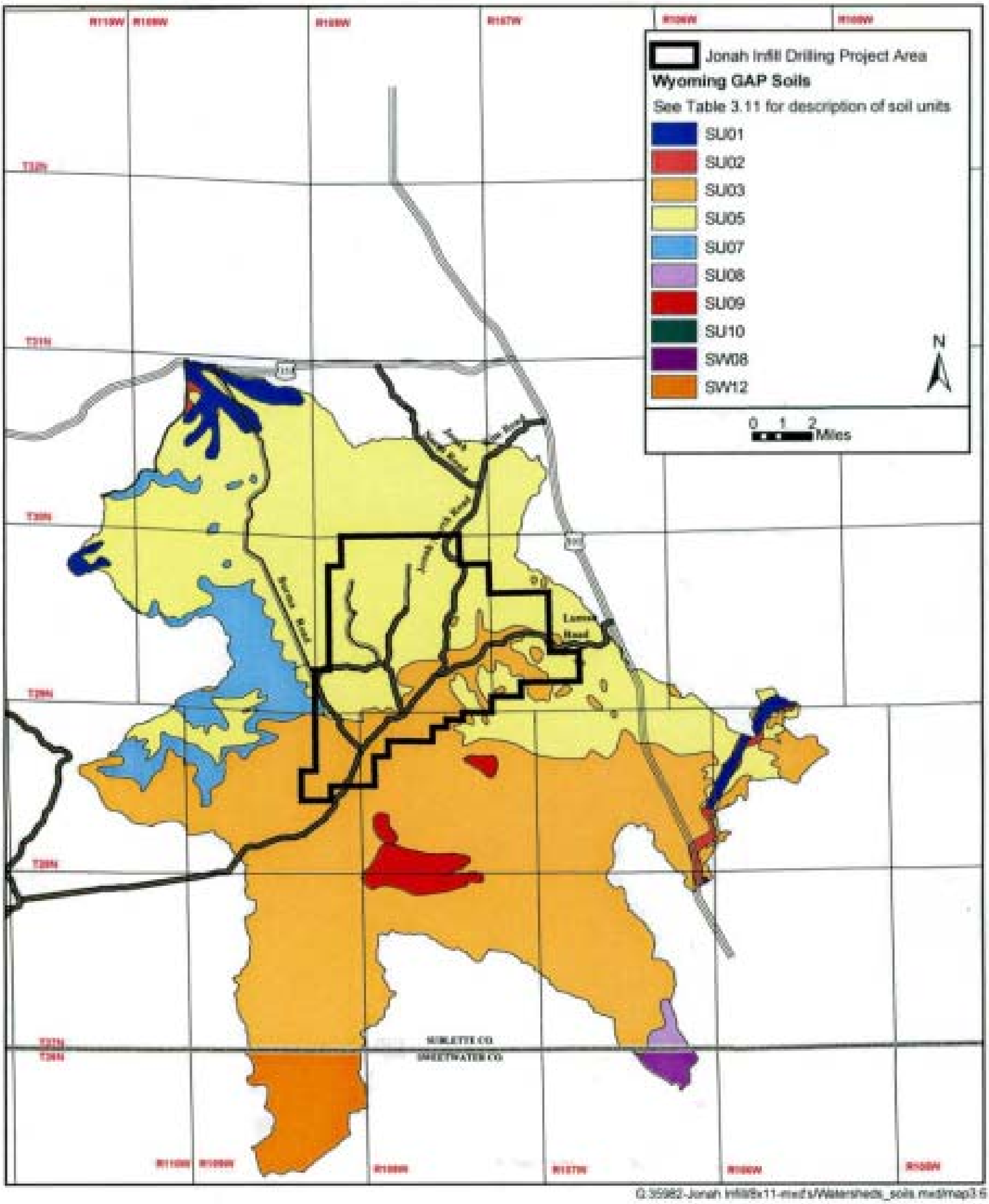
One known area of stabilized sand dunes and other aeolian (windblown) deposits occurs in the JIDPA (see Map 3.3) (Case and Boyd 1987), and it is likely that smaller areas of sand dunes or windblown deposits also occur in the area. The Spool Variant-Ouard Variant-San Arcacio Variant soil series (map unit 123) and Garsid-Terada-Langspring Variant complex (map unit 121) contain these features (Table 3.12; Maps 3.3 and 3.6). Stabilized dunes and other windblown deposits are usually very sandy and are highly susceptible to wind erosion. However, these soil types and/or known stabilized dunes are not common within the JIDPA and, where they do occur, they are limited in size and areal extent.

Major soils within the JIDPA include the Vermillion Variant-Seedskadee-Fraddle complex on 0-3% slopes (map unit 127); the Monte-Leckman complex on 1-6% slopes (map unit 106); the Fraddle-Ouard-San Arcacio Variant complex on 3-8% slopes (map unit 124); the Ouard-Ouard Variant-Boltus complex on 1-8% slopes (map unit 114); the Garsid-Monte Association on 1-6% slopes (map unit 119); the San Arcacio-Saguache association on 0-3% slopes (map unit 125); the Huguston-Horsley-Terada complex on 6-30% slopes (map unit 116); and the Haterton-Garsid complex on 1-8% slopes (map unit 113) (Table 3.12). These mapping units collectively cover approximately 78% of the JIDPA. The Cowestglen sand loam on 0-2% slopes (map unit 951/106) and the Monte-Leckman complex (map unit 106) on 1-6% slopes occur adjacent to drainage channels and on terraces and alluvial fans.

Table 3.10 Soil Types in the Soil Resources Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Wyoming, 2005.

Soil Map Unit[1]	Soil Type Description[1]	Total Acres	% of CIAA	Acres in JIDPA
SU01	Typic Torrifluvents, fine-silty and fine, mixed (calcareous), frigid-Typic Haplaquepts, fine-loamy and fine loamy over sandy or sandy-skeletal, mixed (calcareous), frigid	4,495	2.1	0
SU02	Aquic Haplustolls, coarse-loamy, mixed, frigid-Ustic Torriorthents, fine-loamy, mixed (calcareous), frigid-Typic Fluvaquents, fine-loamy, mixed (calcareous) frigid	899	0.4	0
SU03	Rock Outcrop-Typic Torriorthents, loamy, mixed (calcareous) frigid, shallow-Lithic Typic Torriorthents, loamy-skeletal, mixed (calcareous), frigid-Typic Natrargids, fine-loamy, mixed, frigid	93,700	44.6	9,913
SU05	Typic Torriorthents, loamy, mixed (calcareous) frigid, shallow-Typic Haplocalcids, coarse-loamy, mixed, frigid-Lithic Torriorthents, loamy-skeletal, mixed (calcareous), frigid	68,323	32.5	20,496
SU07	Ustic Torriorthents, fine loamy, mixed (calcareous), frigid-Ustic Torriorthents loamy, mixed (calcareous), frigid, shallow-Typic Haplocalcids, fine-loamy, mixed, frigid	20,229	9.6	91
SU08	Typic Haplosalids, fine, mixed, frigid-Typic Haplocambids, fine-silty, mixed, frigid	10,249	4.9	0
SU09	Typic and Lithic Torripsamments, mixed, frigid-Typic Torriorthents, loamy-skeletal, mixed, frigid-Rock Outcrop-Typic Haplocambids, loamy-skeletal, mixed, frigid	3,596	1.7	0
SW08	Typic Haplosalids, fine, mixed, frigid and Typic Haplocambids, fine-silty, mixed, frigid	1,079	0.5	0
SW12	Ustic Haplargids, fine-loamy and coarse-loamy, mixed, frigid-Ustic Haplocambids, sandy, mixed, frigid	7,730	3.7	0
Total		210,300	100.0	30,500

[1] Based on Munn and Arneson (1999a, 1999b).

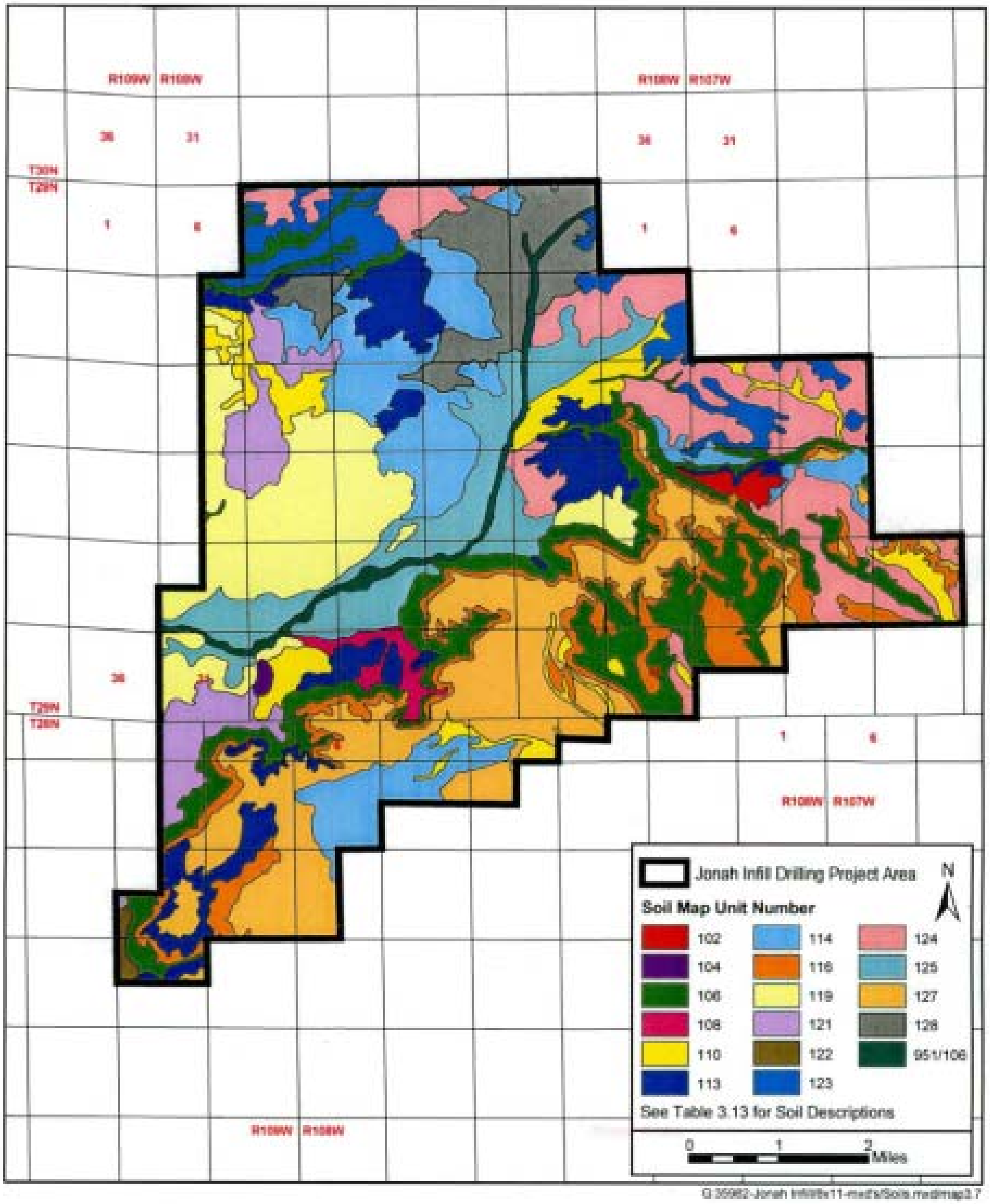


Map 3.6 Soil Types (Coarse-Scale) Within the Soils Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Wyoming, 2005.

Table 3.11 Existing Watershed Disturbance Acreage, Jonah Infill Drilling Project, Cumulative Impact Assessment Area, Wyoming, 2005.[1]

	Watersheds										
Type	Expanded Sand Draw-Alkali Creek	Granite Wash	Reduced Upper Alkali Creek-Green River	Upper Eighteenmile Canyon	Southeast New Fork River-Blue Ridge	North Alkali Draw	Big Sandy River-Bull Draw	Long Draw	Jonah Gulch	140401-040603	Total
Watershed Acreage	23,373	12,212	26,355	35,212	11,746	15,911	19,760	18,521	22,652	24,558	210,300
Disturbance in the JIDPA[2]											
	664.9	0.0	114.1	132.6	0.0	0.0	43.7	390.3	24.0	39.4	1,409.0
Disturbance Outside the JIDPA											
Wells [3]	4.0	0.0	8.0	56.0	0.0	12.0	0.0	8.0	12.0	12.0	112.0
Roads[4]											
Connecting road	0.0	1.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	4.4
Jeep trail	6.5	0.0	8.3	9.1	0.0	0.8	0.0	0.0	24.7	24.6	74.0
Neighbor-hood road	146.2	34.6	141.7	170.2	19.8	85.0	128.5	88.0	84.6	84.8	986.4
State highway	0.0	0.0	0.0	0.0	0.0	0.0	58.2	83.6	0.0	0.0	141.8
Other (new oil and gas roads)	169.9	0.4	80.6	241.8	0.0	0.0	30.2	101.6	5.6	0.0	630.1
Subtotal	322.6	36.0	230.6	421.1	23.2	85.8	216.9	273.2	114.9	109.4	1,833.7
Total Disturbance	991.5	36.0	352.7	609.7	23.2	97.8	260.6	671.5	150.9	160.8	3,354.7
% of Watershed Disturbed	4.2	0.3	1.3	1.7	0.2	0.6	1.3	3.6	0.7	0.7	1.6

1 Data gathered from WyGISC (2003b), WOGCC (2003), TRC Mariah (2004a, 2004b), and unpublished BLM aerial photography.
2 See Table 2.3.
3 Assumes 4 acres per well pad.
4 Road acreage based on 20-ft width for connecting roads, jeep trails, and neighborhood roads; 29-ft width for other roads; and 150-ft width for state highways.



Map 3.7 Soils Types (Fine-Scale) Within the Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Table 3.12 Soil Types[1], Soil Use, and Management Considerations for Soils, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Map Unit No.	Map Unit Name	Use and Management Considerations	Acres
102	Langspring Variant-Langspring complex, 1-10% slopes	Gently sloping to nearly level mesa tops and uplands. Loamy uplands. Generally suitable for road construction. Rehabilitation limited due to excess lime and small stones.	149
104	Chrisman silty clay, 0 to 2% slopes	Saline upland sites, in closed basins. Construction activities limited due to severe shrink-swell properties. Rehabilitation potential limited by moderately alkaline soils.	42
106	Monte-Leckman complex, 1-6% slopes	Gently sloping alluvial fans and drainageways. Loamy, saline uplands. Mostly suitable for road construction. Rehab limited by excess sands or small stones.	3,488
108	Dines-Clowers-Quealman complex, 0-3% slopes	Nearly level to gently sloping drainageways and alluvial terraces. Loamy sites, saline uplands. Limited for road construction due to low strength. Rehabilitation potential limited by excess salt, sand, and small stones.	268
110	Fraddle-Tresano complex, 1-8% slopes	Rolling uplands, upper dissected fans, and valley-filling slopes. Loamy uplands. Limited for construction activities and reclamation due to thin soils.	1,541
113	Haterton-Garsid complex, 1-8% slopes	Nearly level to gently sloping uplands and sideslopes. Shallow loamy and loamy sites. Construction limited by shallow depth to bedrock, slope, and low strength. Rehabilitation limited by shallow depth to bedrock and steep slopes.	2,102
114	Ouard-Ouard Variant-Boltus complex, 1-8% slopes	Nearly level to gently sloping uplands. Shallow loamy, shallow clayey, and shaley sites. Limited due to low strength and shallow depth to bedrock. Rehabilitation limited due to thin soils.	3,132
116	Huguston-Horsley-Terada complex, 6-30% slopes	Gently sloping to moderately steep sideslopes and rolling uplands. Shaley and loamy sites. Limited due to shallow depth to bedrock, low strength, and steep slopes. Rehabilitation limited by shallow depths and slopes.	2,109
119	Garsid-Monte association, 1-6% slopes	Gently undulating uplands. Loamy sites. Construction limited by thin soils, low strength, and steep slopes. Rehabilitation limited by steep slopes.	3,087
121	Garsid-Terada-Langspring Variant complex, 1-6% slopes	Undulating uplands. Loamy sites. Construction limited due to thin soils, low strength, and steep slopes. Rehabilitation limited by steep slopes, small stones, and excess lime.	1,261
122	Baston-Boltus-Chrisman association, 0-6% slopes	Undulating and dominantly concave uplands. Clayey, shaley, and saline upland sites. Construction limited by low strength, shrink-swell potential, thin soils, and steep slopes. Rehabilitation limited by thin soils, clayey textures, excess salt and steep slopes.	85
123	Spool Variant-Ouard Variant-San Arcacio Variant complex, 4-25% slopes	Gently sloping to steep sideslopes and rolling uplands. Shallow sandy, shallow clayey and loamy sites. Construction limited by shallow depth to bedrock and low strength. Rehabilitation limited by shallow depths, small stones, sandy or clayey textures, or steep slopes.	1,260
124	Fraddle-Ouard-San Arcacio Variant complex, 3-8% slopes	Rolling uplands. Loamy and shallow loamy sites. Construction limited by thin soils and low strength. Rehabilitation limited by thin soils, clayey textures, or small stones.	3,194
125	San Arcacio-Saguache association, 0-3% slopes	Old floodplains, fans, and terraces. Loamy and sandy sites. Generally suitable for road construction. Rehabilitation limited by small stones.	2,304
127	Vermillion Variant-Seedskadee-Fraddle complex, 0-3% slopes	Nearly level uplands and mesas. Shallow loamy and loamy sites. Limited for construction due to shallow depth to bedrock, low strength, and thin soils. Rehabilitation limited by stoniness, excess lime, and thin soils.	4,427
128	Fraddle-Ouard-San Arcacio Variant complex, 0-3% slopes	Nearly level upland surfaces. Loamy and shallow loamy sites. Construction limited by low strength and shallow depth to bedrock. Rehabilitation limited by thin soils and small stones.	1,645
951/106	Cowestglen sandy loam, 0-2% slopes/see also Map Unit 106, above	Nearly level drainage ways. Road construction potentially limited by moderate frost action and flooding. See also Map Unit 106, above.	406
Total			30,500

[1] Adapted from: ERO Resources Corporation (1988) and BKS Environmental Associates Inc. (2003).

Several soils (i.e., Monte-Leckman [map unit 106], Fraddle-Tresano [map unit 110], Garsid-Monte [map unit 119], and Baston-Boltus-Chrisman [map unit 122] complexes/associations) may be good sources for topsoil (ERO Resources Corporation 1988) (see also Appendix G). The Spool Variant-Ouard Variant-San Arcacio Variant (map unit 123), the Fraddle-Ouard-San Arcacio Variant (map unit 124), and the San Arcacio-Saguache (map unit 125) complexes/associations may be good gravel sources. The San Arcacio soils are also considered to be archaeologically sensitive in that they contain intact buried cultural resources.

The Chrisman silty clay soil (map unit 104) is typically fine-textured and formed in thick clayey local alluvium in closed basins and is susceptible to high shrink-swell potential that may limit road construction activities (ERO Resources Corporation 1988).The extent of erosion in the JIDPA is currently undefined. However, the relatively flat nature of the area, desert-like precipitation patterns, and BLM's requirements for the use of BMPs to limit erosion are assumed to limit the extent of erosion in the area. Nonetheless, the BLM has determined that additional erosion/soil loss modeling will be performed for the JIDPA. The results of this modeling will be available in the Final EIS for this Project.

The Transportation and Reclamation Plans (Appendix G) contain further information on soil characteristics, suitability for road construction and reclamation, use and management considerations, and criteria for establishing soil suitability for various uses.

3.1.6 Water Resources

3.1.6.1 Surface Water

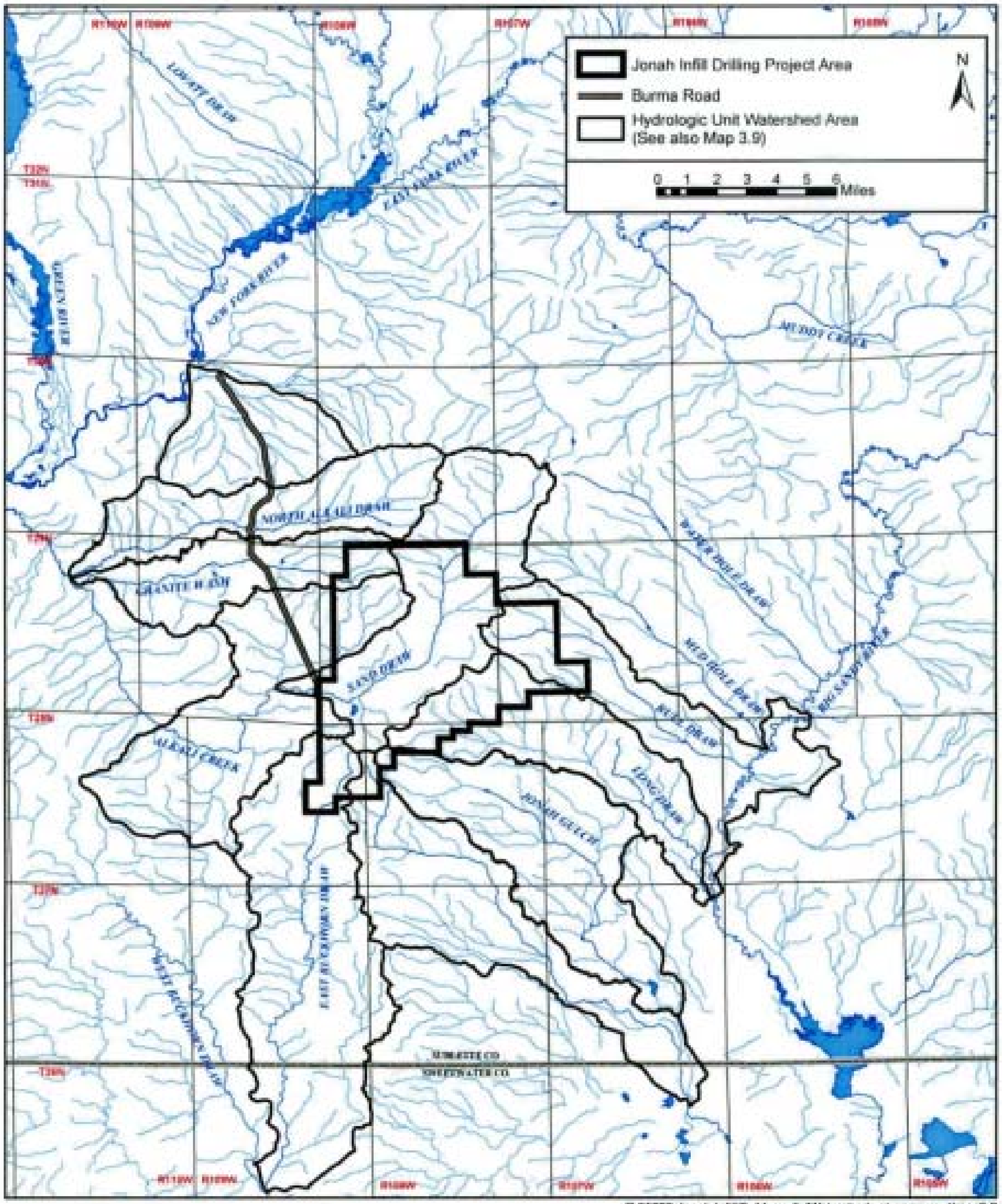
The CIAA for surface water resources is the combined area of the 10 watersheds that drain the JIDPA, which encompass approximately 328.6 miles (210,300 acres) (see Table 3.13 and Maps 3.8 and 3.9). Approximately 1.6% of the CIAA (3,354.7 acres) has been disturbed primarily by oil and gas developments and roads (see Table 3.11). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance--4.2% of the watershed (991.5 acres)--and most of this disturbance (664.9 acres) is from existing natural gas developments in the JIDPA (see Table 3.11).

The JIDPA lies within the Upper Green River Basin and is part of the Colorado River drainage system. The entire JIDPA is drained by intermittent and ephemeral streams; there are no perennial streams or springs in the area. However, there are two playas and several reservoirs and stockponds constructed in ephemeral washes that may contain water for all or a part of some years. The nearest flowing perennial water bodies to the JIDPA are the Big Sandy, New Fork, and Green Rivers (see Map 3.8).

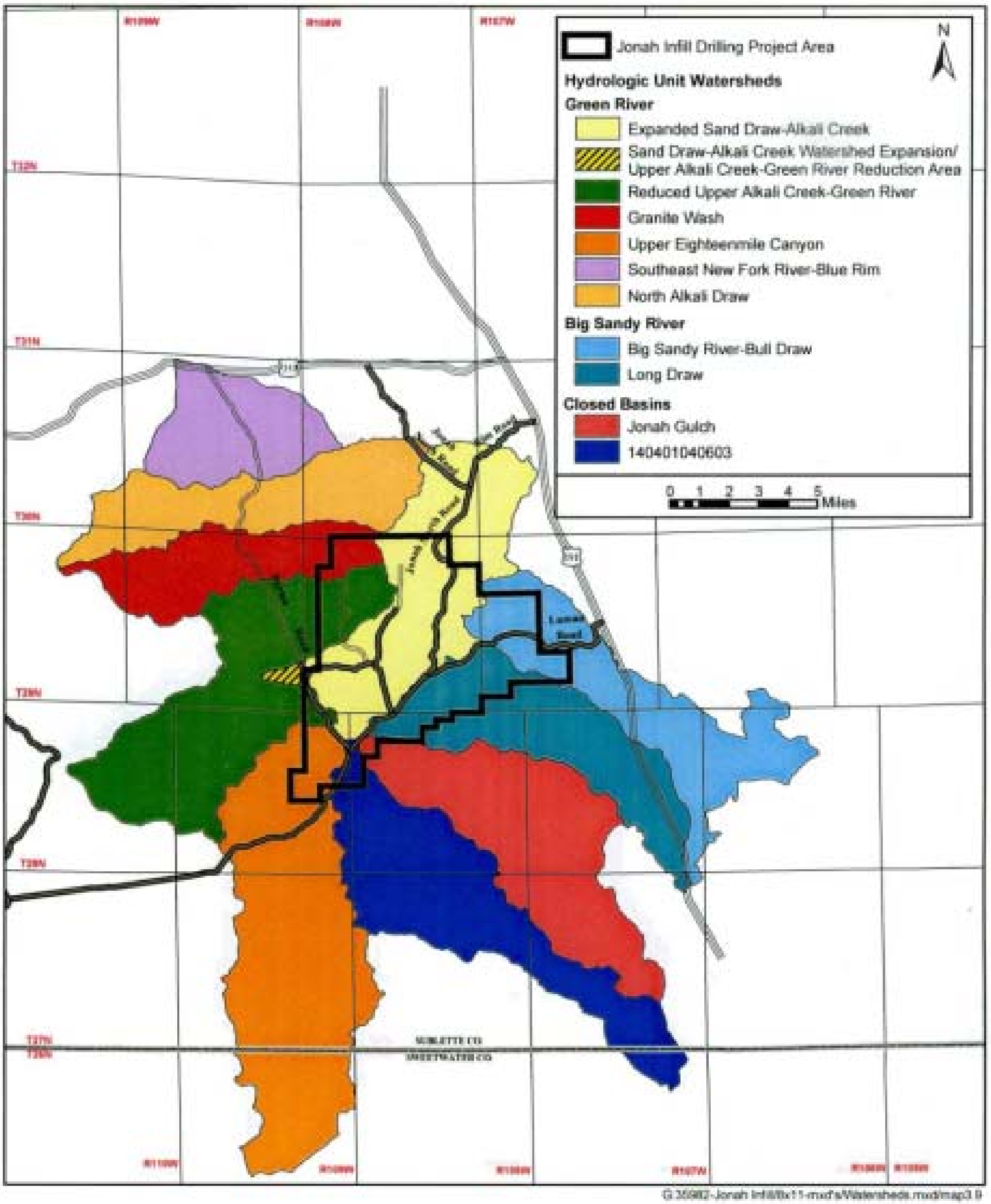
The Colorado River Basin Salinity Control Forum is a cooperative effort between federal agencies and seven states (Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming) to address the problem of increasing salinity in the lower reaches of the Colorado River. Salinity has long been recognized as one of the major problems of the river. Salts contained within sedimentary rocks throughout the basin are easily eroded, dissolved, and transported into the river system, with salt-loading resulting from natural processes (i.e., saline springs, groundwater discharge into the river system, erosion and the concentrating effects of evaporation and transpiration) and human-caused processes (i.e., irrigation return waters, reservoir evaporation, municipal and industrial discharges) (Colorado River Basin Salinity Control Forum 2002).

Table 3.13 Watershed Acreages, Jonah Infill Drilling Project, Wyoming, 2005.

Major Drainage/Watershed	Total Acreage of Watershed	Acres within JIDPA	Percent of JIDPA in Watershed	Percent of Watershed in JIDPA	Watershed Acreage Along Burma Road (Outside JIDPA)
Green River/New Fork River					
Expanded Sand Draw-Alkali Creek	23,373	13,724	45.0	58.7	2
Granite Wash	12,212	1,312	4.3	10.7	5
Reduced Upper Alkali Creek-Green River	26,355	3,782	12.4	14.4	9
Upper Eighteenmile Canyon	35,212	1,958	6.4	5.6	0
Southeast New Fork River-Blue Rim	11,746	--	--	--	13
North Alkali Draw	15,911	--	--	--	6
Subtotal	124,809	20,776	68.1	16.6	35
Big Sandy River					
Big Sandy River-Bull Draw	19,760	3,630	11.9	18.4	0
Long Draw	18,521	5,028	16.5	27.1	0
Subtotal	38,281	8,658	28.4	22.6	0
Closed Basin					
Jonah Gulch	22,652	318	1.0	1.4	0
140401040603	24,558	748	2.5	3.0	0
Subtotal	47,210	1,066	3.5	2.3	0
Total	210,300	30,500	100.0	14.5	35



Map 3.8 Surface Water Resources in the Jonah Infill Drilling Project and Associated Cumulative Impact Assessment Areas (Project-affected Watersheds), Jonah Infill Drilling Project, Wyoming, 2005.



Map 3.9 Cumulative Impact Assessment Area (Project-affected Watersheds) for Surface Water, Soils, Vegetation, and Fisheries, Jonah Infill Drilling Project, Wyoming, 2005.

The purpose of the Colorado River Basin Salinity Control Forum is to provide information necessary to comply with Section 303(a) and (b) of the *Clean Water Act* and to meet national, international, and state water quality objectives (Colorado River Basin Salinity Control Forum 2002). The following measures have been identified to reduce salt loading in the Colorado River Basin:

- implementation of management practices that minimize soil disturbances, repair disturbed surface environments, and protect water quality;
- prevention of nonpoint-source salt mobilization through land-use planning, permit stipulations, land-use authorizations, best management practices, watershed protection strategies, and ecological restoration;
- control of point sources such as saline springs and seeps and abandoned flowing wells (i.e., well plugging) that yield saline water;
- implementation of water quality monitoring and analysis to assess the effectiveness of management practices;
- implementation of vegetation management practices that improve vegetative cover (i.e., control burns, reclamation, revegetation), control noxious weed infestations, and improve or repair riparian areas thereby decreasing the amount of runoff and soil erosion and the potential amount of salt leaving an area; and
- implementation of construction and maintenance activities such as road and trail maintenance and closures, protective fencing and access control, development of springs and water sources to improve livestock distributions, and erosion control and sediment-trapping structures (Colorado River Basin Salinity Control Forum 2002).

Portions of 10 watersheds occur within the JIDPA and/or along the Burma Road--Expanded Sand Draw-Alkali Creek, Granite Wash, Reduced Upper Alkali Creek-Green River, Big Sandy River-Bull Draw, Long Draw, Upper Eighteenmile Canyon, Jonah Gulch, 140401040603, North Alkali Draw, and Southeast New Fork River-Blue Rim (Map 3.9 and Table 3.13) (WyGISC 2003). The Sand Draw-Alkali Creek and Upper Alkali Creek-Green River watershed boundaries were modified and renamed to reflect more accurate hydrologic boundaries, and the New Fork River-Blue Rim watershed was reduced in size and renamed to the Southeast New Fork River-Blue Rim watershed for this project to eliminate drainage areas north of the New Fork River. The Expanded Sand Draw-Alkali Creek, Granite Wash, Reduced Upper Alkali Creek-Green River, and North Alkali Draw watersheds drain to the Green River (below the confluence with the New Fork River), approximately 12 miles west of the JIDPA. The Upper Eighteenmile watershed also drains into the Green River approximately 35 miles south of the JIDPA. The Southeast New Fork River-Blue Rim watershed drains north to the New Fork River. The Big Sandy-Bull Draw and Long Draw watersheds drain to the Big Sandy River located approximately 5 miles southeast of the JIDPA. The Jonah Gulch and 140401040603 watersheds drain to a closed basin approximately 15 miles southeast of the JIDPA.

Approximately 45% of the JIDPA is drained by the Expanded Sand Draw-Alkali Creek watershed (13,724 acres in the JIDPA), which includes Sand Draw and many other small ephemeral washes (see Maps 3.8 and 3.9 and Table 3.13). The northwest portion of the JIDPA is drained by the Granite Wash watershed (1,312 acres in the JIDPA), which includes Granite Wash, small ephemeral washes, and Wild Horse Reservoir. The Reduced Upper Alkali Creek-Green River watershed drains approximately 3,782 acres of western portions of the JIDPA. The southern portion of the JIDPA is drained by three watersheds--Upper Eighteenmile Canyon, 140401040603, and Jonah Gulch. The Upper Eighteenmile Canyon watershed (1,958 acres in the

JIDPA) includes the south side of Yellow Point Ridge and East Buckhorn Draw. The portions of the Jonah Gulch (318 acres) and 140401040603 (748 acres) watersheds contained in the JIDPA consist of small ephemeral channels. Eastern portions of the JIDPA are drained by the Long Draw (5,028 acres) and Big Sandy River-Bull Draw (3,630 acres) watersheds (see Table 3.13). The 12 miles of the Burma Road outside the JIDPA crosses approximately 0.6 mile of the Expanded Sand Draw-Alkali Creek watershed (2 acres); 3.1 miles of Reduced Upper Alkali Creek-Green River watershed (9 acres); 1.9 miles of the Granite Wash watershed (5 acres); 2.0 miles of the North Alkali Draw watershed (6 acres); and 4.4 miles of the Southeast New Fork River-Blue Rim watershed (13 acres) (see Table 3.13).

The current PFO RMP indicates that Sand Draw and Alkali Creek are prone to flooding (BLM 1987a, 1987b). However, flooding may occur in any of the ephemeral draws within the JIDPA after rainstorms. Drainages within the JIDPA flow only periodically in response to rain and snowmelt events, having extended periods of no flow (most of the year).

<u>Surface Water Quality</u>

Alkali Creek, Sand Draw, Granite Wash, and all other named and unnamed streams in the JIDPA are Class 3B surface waters (WDEQ/WQD 2001). Class 3B waters are tributary waters including adjacent wetlands that are not known to support fish populations or drinking water supplies. They are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna. Uses designated on Class 3B waters are for aquatic life (other than fish), recreation, wildlife, industry, agriculture, and scenic value.

Down-channel of the JIDPA, the Big Sandy and New Fork Rivers are Class 2AB waters (i.e., waters known to support game fish populations and where a game fishery and drinking water use is attainable) (WDEQ/WQD 2001). Uses designated for Class 2AB waters include those listed above for Class 3B plus drinking water, game and non-game fish, and fish consumption, and these waters are protected for all these uses. The Green River, downstream from the New Fork River is also Class 2AB.

Section 303(d) of the *Clean Water Act* requires states to identify waters that are not supporting their designated uses and/or that need to have a total maximum daily load established to support their uses. There are no streams within the JIDPA or CIAA that are on the State of Wyoming's 2004 Section 303(d) list or included in the 2004 305(b) Report (WDEQ 2004).

The quantity of sediment and associated salt loads within ephemeral flows from the JIDPA is unknown. However, Alkali Creek and several associated watersheds have been listed as salinity concerns under the designation of “Long Island Watershed.” Stream surveys of Alkali Creek down stream from the JIDPA have noted drops in the channel base level (headcuts) that, while not within the immediate area of the JIDPA, have the potential to be affected and eventually affect the channels within the JIDPA as well as the salt and sediment loads coming from the affected watersheds. Efforts are underway to address the headcuts and their effects.

Due to the extent of proposed surface disturbance and topographic modification in the JIDPA for the LOP, BLM has determined that runoff condition modeling, including sediment and salt loading, will be performed for the JIDPA, and the results of this modeling will be available in the Final EIS for this project.

Surface Water Use

Five adjudicated and numerous unadjudicated surface water rights occur in the JIDPA (State Engineer's Office 2004). The major surface water uses in the JIDPA are for livestock and wildlife watering. Numerous impoundments and playas (internally drained, closed basins that periodically hold water) occur throughout the area. Several reservoirs (e.g., Warden, Lumen, Granite, Wild Horse, Sand Draw No. 4) have been constructed along drainages and may semipermanently, seasonally, or temporarily hold water. There are approximately 22 stock ponds scattered throughout the area. One large playa is located on private surface in Section 32, T29N, R108W. Other smaller playas or depressions occur throughout the JIDPA. No irrigation occurs on the JIDPA.

3.1.6.2 Ground Water

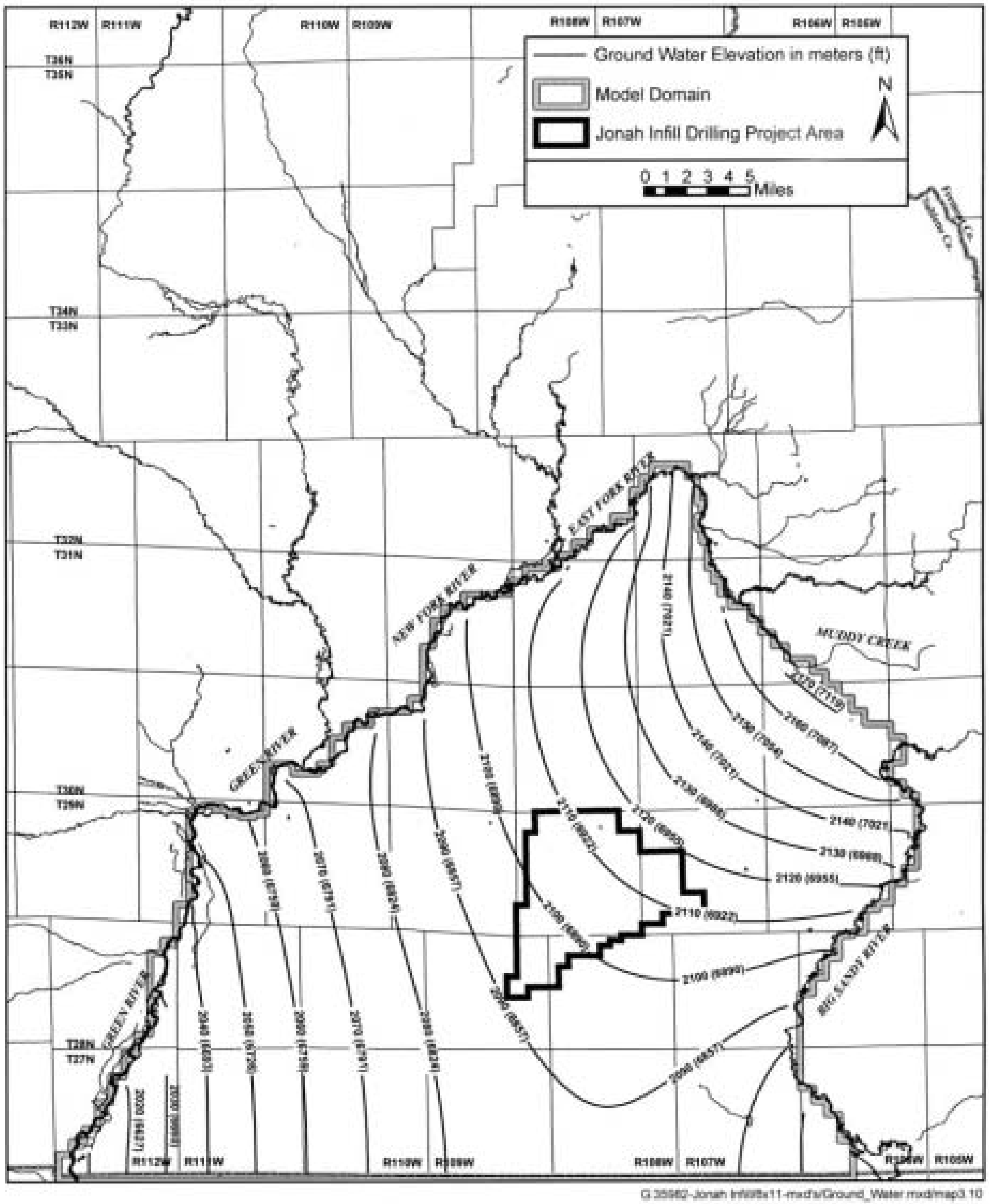
The JIDPA and associated ground water CIAA (i.e., the JIDPA and adjacent potential draw-down areas) are underlain, in descending order, by the Laney and Wilkins Peak Members of the Green River Formation or the Wasatch Formation, the Fort Union Formation, an unnamed Tertiary bed, and the Lance Formation (Dynamac Corporation 2002) (see Figure 3.11). The Laney and Wilkins Peak Members of the Green River Formation contain small quantities of water (Welder 1968; Ahern et al. 1981). The Wasatch and Fort Union Formations underlying the JIDPA and the surrounding region are known to contain significant amounts of water. Unconfined aquifers occur within about 300 ft of the surface and include the upper portions of Tertiary sedimentary rocks. Confined aquifers include the lower portions of Tertiary rocks (below about 300 ft) and all underlying strata (Welder 1968). Lenses of impermeable rock occur throughout these formations, creating perched aquifers and localized aquitards (areas with restricted flows) (personal communication, November 2003, with Dennis Doncaster, BLM).

The JIDPA and ground water CIAA are located on a recharge area for the Tertiary formations, and the main sources of recharge are precipitation and seepage from streams and reservoirs (Dynamac Corporation 2002). Ground water discharge occurs through transpiration, seepage into streams, and pumping. Ground water flow is predominantly from north to south, with a minor westerly component (Dynamac Corporation 2002); HydroGeo, Inc. (2004) indicates a northeast to southwest ground water flow. Estimated steady-state ground water levels (i.e., with no pumping), show that ground water levels slope gently from 7,100 ft in elevation in the northeast to 6,600 ft in elevation in the southwest (Map 3.10) (HydroGeo, Inc. 2004).

The Laney Member has good potential for ground water production (1-75 gallons per minute [gpm]), and well yields from the Wasatch Formation aquifer range from 1 to 3,000 gpm but typically less than 500 gpm (Ahern et al. 1981). The Fort Union Formation is deeply buried in the JIDPA so well yield data are not available. The Lance Formation produces non-potable water as a byproduct of hydrocarbon production (referred to as produced water).

Ground Water Quality

The standard for total dissolved solids (TDS) in drinking water is 500 mg/l (WDEQ 1990), and much of the ground water in the area exceeds this standard. TDS is used as a general measurement of ground water condition, but does not cover all aspects of water quality. Sandstones in the Green River and Wasatch Formations contain fresh to brackish water, with TDS concentrations of 500 to 100,000 mg/l. Ground water tends to become more mineralized with increasing depth below the surface. Ground water in the Laney Member of the Green River



Map 3.10 Estimated Steady-State Ground Water Levels (Potentiometric Surface), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Formation contains 2,000-7,000 mg/l TDS. Sodium and sulfate are the main salts, and calcium concentrations are high. Water quality in the Wilkins Peak Member is typically poor, with TDS concentrations of 7,000-100,000 mg/l. Sodium bicarbonate and sodium carbonate are the dominant ions (Welder 1968; Ahern et al. 1981). Ground water quality in the Wasatch aquifer is highly variable and tends to decline with distance from recharge areas. These waters are predominantly a calcium-bicarbonate type where, toward the basin center, sodium and chloride replace calcium (Bruce 1993). To a depth of about 2,300 ft, ground water in the Wasatch Formation has a TDS content of about 640 mg/l. At a depth of 5,000 ft, TDS concentrations are about 21,000 mg/l; this disparity suggests that these waters occur in different aquifers within the Wasatch Formation (personal communication, November 2003, with Frank Bain, BLM).

Natural gas well logs from existing wells in the JIDPA indicate that the Fort Union and Lance Formations contain discrete water-bearing sandstones, with water quality ranging from brackish to saline and TDS typically averaging 2,000-5,000 mg/l, within the range of 1,722 to 28,476 mg/l (Table 3.14). The ground water standards for TDS are 500 mg/l for domestic use, 2,000 mg/l for agricultural use, and 5,000 mg/l for livestock use, so untreated produced water is not suitable for domestic use, is only marginally suited for agricultural, but is suitable for livestock use.

Chloride concentrations in produced waters exceeded state ground water standards for domestic and agricultural use and for livestock use in three of the wells tested. Chloride concentrations range from 290 to 18,300 mg/l (see Table 3.14), whereas the standard for domestic use is 250 mg/l, for agricultural use is 100 mg/l, and for livestock use is 2,000 mg/l.

Iron concentrations also exceeded standards for domestic use (0.3 mg/l) and agricultural use (5.0 mg/l) in at least 18 and 13 of the wells sampled, respectively.

<u>Ground Water Use</u>

Ground water in the JIDPA and CIAA contributes only a small fraction (less than 2.5%) of the water used in the Green River Basin (Ahern et al. 1981). Ground water in the JIDPA and CIAA primarily is used for oil and gas development and stock and wildlife watering. More than 130 recognized ground water wells/ground water permits occur in the JIDPA, the majority of which are for existing oil and gas development use (State Engineer's Office 2004). The location of ground water wells is provided in Chapter 4 (see Map 4.1). No ground water irrigation occurs in the JIDPA or CIAA.

3.1.7 Noise and Odor

The noise CIAA includes the JIDPA and surrounding 20-mile area. Noise levels depend on the loudness and pitch of the source, the listener's distance from the source, air temperature, humidity, turbulence, wind gradient, and the screening effects of terrain. Existing natural gas development activities in the JIDPA generate noise through wellpad, road, and pipeline construction; flaring, drilling, and facility operations; vehicle traffic; and site reclamation. Drilling rig and well testing (fracturing and flaring) operations produce noise levels of up to 115 A-weighted decibels (dBA) (constant exposure endangers hearing), with a noise level of 55 dBA (which is considered quiet) at 3,500 ft (0.66 mile) from the source (BLM 1991b). Typical natural gas development noise levels are provided in Figure 3.13, and Table 3.15 provides example noise levels for commonly heard sounds. Flaring (one component of completion operations) tends to be the loudest noise event; however, with the use of flowback separators, noise from completion operations is reduced to approximately 64 dBA at the source.

Table 3.14 Produced Water Quality, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.[1]

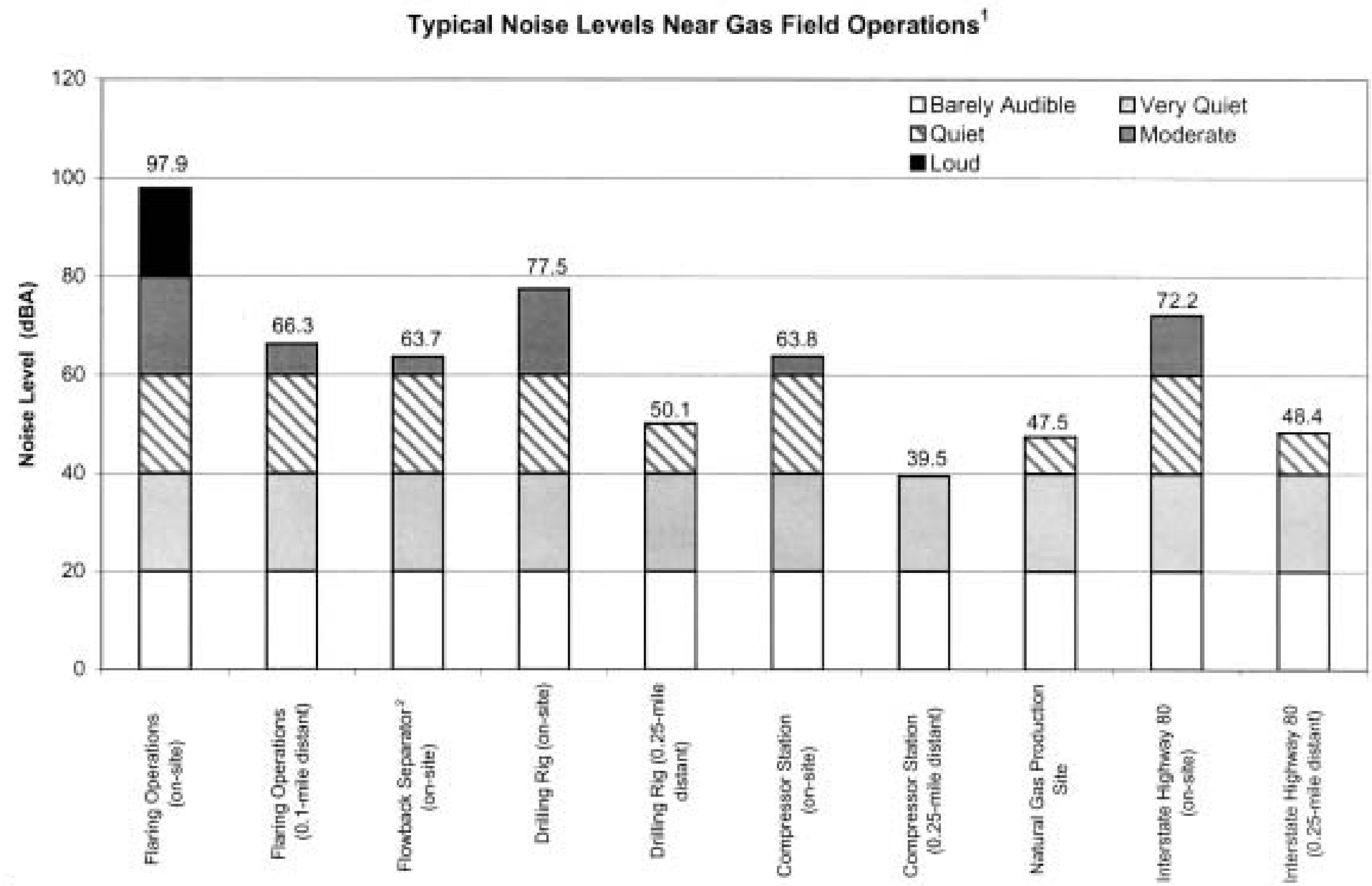
Constituent	Evaporation Pond	Well No.												
		SHB 3-34	JF 1-5X	YP 2-1	JF 2-8X	CAB 2-25	SHB 2-33	YP 4-24	SHB 4-34	JF 5-4	SHB 7-35	JF 4-18	SHB 5-34	YP 8-13
pH	7.80	6.50	7.72	7.81	7.06	7.63	7.71	7.45	7.81	7.94	7.48	7.91	7.79	8.05
Chloride	2,153	18,300	520	470	480	970	460	2,329	470	430	1,520	430	710	350
Sulfate	51	5.00	99	12	11	58	29	128	33	30	29	45	58	18
TDS	4,752	28,476	3,004	3,208	2,694	3,656	2,486	6,434	3,200	2,752	3,746	2,634	3,126	2,462
Carbonate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicarbonate	747	139	1,148	1,441	934	961	907	1,121	1,308	1,148	552	1,201	1,121	1,174
Conductivity	6,950	39,100	3,850	4,060	3,350	4,690	3,200	7,770	4,170	3,650	5,710	3,450	4,210	3,250
Sodium	1,051	3,190	964	1,040	839	1,090	801	1,180	1,025	900	1,050	878	992	793
Potassium	83.0	7,304	41.3	17.9	28.5	32	20.7	81.5	43.2	17.7	35.1	12.0	61.1	7.80
Calcium	651	6,850	22.5	11.9	12.2	11.6	12.3	9.31	17.6	9.45	22.0	6.92	17.9	6.50
Magnesium	6.02	18.1	4.23	2.04	1.4	1.25	1.13	1.92	2.64	1.69	3.88	0.6	2.81	1.06
Iron	<2.09	58.5	43.5	4.97	54.4	60.3	15.5	9.48	<0.68	<0.68	<0.68	9.48	4.7	<0.68
Barium	6.01	6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	2.67	--	--	--	--	--	--	--	--	--	--	--	--	--

[1] Data provided by EnCana. See also Appendix G.

Table 3.14 (continued)

	Well No.												
Constituent	YP 9-12	YP 10-11	CSHB 10-31	JF 11-7	SHB 11-20	SHB 11-28	CAB 12-19	SHB 12-27	SHB 13-17	SHB 13-32	CAB 14-30	SHB 16-26	SHB 31-36
pH	6.38	7.87	8.00	8.00	7.97	7.90	7.95	7.94	8.07	7.78	7.52	8.05	8.07
Chloride	1,500	290	600	340	1,300	1,150	910	450	2,100	950	390	790	960
Sulfate	15	23	34	29	48	63	45	34	24	16	49	7	30
TDS	2,848	2,154	3,552	2,192	4,740	4,260	2,996	2,850	5,084	2,088	1,722	2,954	4,062
Carbonate	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicarbonate	214	854	1,521	881	1,575	1,201	827	1,041	623	240	534	694	1,201
Conductivity	4,850	2,670	4,640	2,890	6,620	5,860	4,500	3,600	5,530	2,760	2,420	4,010	5,100
Sodium	884	640	1,160	654	1,540	1,280	993	854	1,470	630	535	868	1,120
Potassium	15.9	8.64	28.6	10.2	2,108	67.0	21.3	13.1	14.2	58.4	18.3	12.3	32.5
Calcium	37.0	17.5	15.3	6.16	1,208	29.5	13.8	14.1	37.8	18.1	5.8	10.1	8.55
Magnesium	6.25	1.07	4.18	1.15	2.38	4.38	3.45	2.06	6.88	2.90	1.18	1.36	1.20
Iron	56.0	<0.68	<0.68	0.86	8.39	<0.68	3.56	1.56	10.5	<0.68	45.4	26.7	43.0
Barium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	--	--	--	--	--	--	--	--	--	--	--	--	--

[1] Data provided by EnCana. See also Appendix G.



1 Adapted from BLM (1999c).

2 Data collected at JIDPA (Jonah Federal 5-7) on September 28, 2003.

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Figure 3.13 Typical Natural Gas Field Noise Levels, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Table 3.15 Comparison of Measured Noise Levels with Commonly Heard Sounds, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.[1]

Source	dBA[2]	Description
Normal breathing	10	Barely audible
Rustling leaves	20	
Soft whisper (at 16 ft [5 m])	30	Very quiet
Library	40	
Quiet office	50	Quiet
Normal conversation (at 3 ft [1 m])	60	
Busy traffic	70	Moderately noisy
Noisy office with machines; factory	80	
Heavy truck (at 49 ft [15 m])	90	Loud

1 Adapted from Tipler (1991).
2 dBA = A-weighted decibels.

Noise levels at the Luman compressor station, just south of the JIDPA, are about 69-86 dBA at the compressor station, 58-75 dBA about 1.0 mile to the southeast, and 54 dBA about 1.25 miles to the southeast (TRC Mariah 2003a). Noise levels at the Falcon compressor station, just north of the JIDPA, are about 77 dBA at the compressor station and about 65 dBA about 1.0 mile east. Noise levels associated with construction activities range from 70 dBA (similar to busy traffic) to over 90 dBA within 50 ft of the activity; however, these noise levels attenuate with distance with a reduction of approximately 6 dBA with each doubling of distance (Thuman and Miller 1996). While it is likely that noise from existing natural gas operations in the JIDPA during certain weather conditions (low winds) may be heard 20 or more miles from the area (outside the CIAA), noise levels at this distance are expected to be very quiet to barely audible (see Table 3.15). Background noise levels in the JIDPA are between 29 and 38 dBA (TRC Mariah 2001a, 2003a) but may be higher depending on wind conditions.

Outside development areas, noise levels can be characterized as rural or natural. Wind, thunderstorms, livestock, and wildlife (primarily passerine birds) are the primary noise sources, except for the occasional vehicle or aircraft.

Noise-sensitive areas in the JIDPA include greater sage-grouse leks during the breeding season and occupied greater sage-grouse and raptor nests. No residences occur in or immediately adjacent to the area.

No specific data on odors are available from the JIDPA or the surrounding 2-mile CIAA area; however, odors present in the area, other than the natural odors of vegetation and wildlife, include those from vehicle emissions along roads, natural gas development, activities at well sites, compressor stations, other ancillary facility sites, and livestock. Odors are likely to be quickly dispersed by the wind.

3.2 BIOLOGICAL RESOURCES

3.2.1 Vegetation

3.2.1.1 Plant Communities

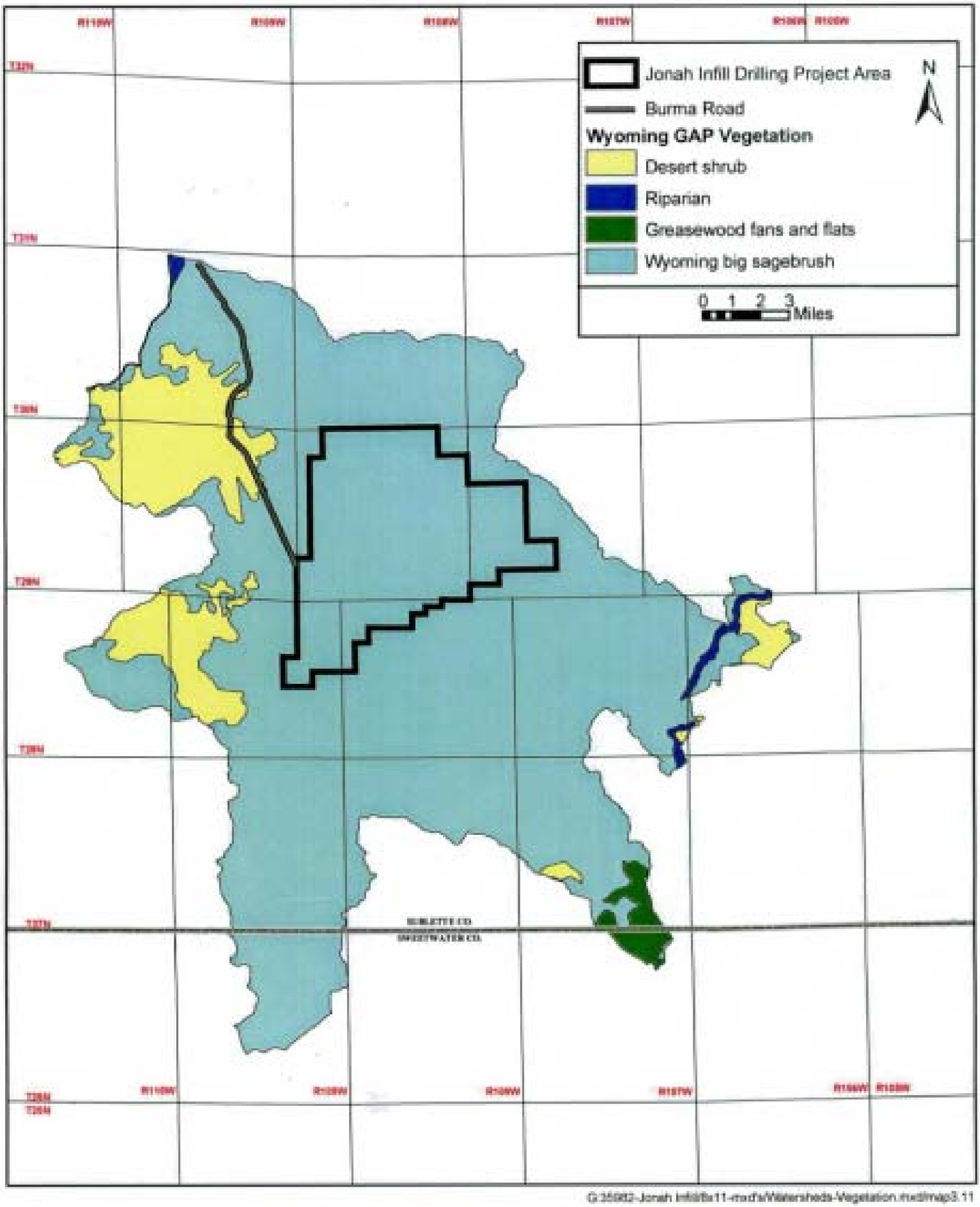
Vegetation in the JIDPA and CIAA (the same CIAA as for soils and other surface water; see Sections 3.1 and 3.16) is dominated by Wyoming big sagebrush grasslands communities with inclusion of saltbush and cushionplant communities (BLM 1987b; Intermountain Ecosystems LC 1996; TRC Mariah 2001a; WyGISC 2003) (Map 3.11, Table 3.16). Important plants in the Wyoming big sagebrush grasslands include Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), western wheatgrass (*Elymus smithii*), thickspike wheatgrass (*Elymus lanceolatus*), Sandberg bluegrass (*Poa secunda* var. *secunda*), winterfat (*Kraschenninikovia lanata*), granite prickly gilia (*Leptodactylon pungens*), Hood's phlox (*Phlox hoodsii*), stemless goldenweed (*Haplopappus acaulis*), and rabbitbrush (*Chrysothamnus* spp.) (Fertig 1993). Needle-and-thread (*Stipa comata*) and Indian ricegrass (*Oryzopsis hymenoides*) are major species on sandy soils (TRC Mariah 2001a).

The CIAA for vegetation resources is the 10 watersheds that drain the JIDPA, which encompasses approximately 210,300 acres (see Map 3.9). Wyoming big sagebrush is the predominant vegetation type based on 1:100,000 scale mapping information of the CIAA (WyGISC 2003) (see Table 3.16). Based upon WyGISC digital data and aerial photographs of the CIAA, approximately 1.6% (3,355 acres) of the area has been disturbed by well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residences (i.e., ranches) (see Table 3.11). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance 4.2% (992 acres), the majority of which is from natural gas development in the JIDPA (665 acres).

Habitat mapping (TRC Mariah 2001a) in the JIDPA delineated the Wyoming big sagebrush communities into three sagebrush habitat types in an effort to define optimal greater sage-grouse nesting and brood-rearing areas (Table 3.17, Map 3.12). Moderate-density sagebrush (formerly referred to as dense sagebrush) was the most common habitat type, occupying approximately 87.2% (26,601 acres) of the JIDPA. This habitat type generally occurs on flat to rolling terrain and generally exhibits sagebrush cover of >20% (n = 15).

The low-density sagebrush (formerly referred to as moderate-density sagebrush) type occupies approximately 8.9% (2,721 acres) of the JIDPA (Table 3.17). This habitat type primarily occupies slopes in the southeastern portion of the project area. Sagebrush cover in this type is approximately 6-8% of the total vegetative cover (n = 15) (TRC Mariah 2001a). Grass and forb species composition is generally similar to species growing in the dense sagebrush habitat type; however, Gardner's saltbush (*Atriplex gardneri*), winterfat, and spiny hopsage (*Grayia spinosa*) are more common.

The scattered/no sagebrush habitat type (2.5% of the JIDPA, 750 acres) contains saltbush and cushionplant communities. The saltbush communities support Gardner's saltbush, shadscale (*Atriplex confertifolia*), bud sagebrush (*Artemisia spinescens*), winterfat, and western wheatgrass and generally occur on level lowland topographic locations or are associated with playas. The cushionplant communities--which are characterized by the near absence of big sagebrush and low overall vegetative cover--generally occupy rocky outcrops, ridgetops, or steep slopes. Dominant



Map 3.11 Vegetation Communities (Course-Scale) in the Jonah Infill Drilling Project Area and Cumulative Impact Assessment Area, Sublette and Sweetwater Counties, Wyoming, 2005.

Table 3.16 Acreages of Vegetation Communities in the CIAA and Vegetation Types in the JIDPA, Sublette and Sweetwater Counties, Wyoming, 2005.

	Hydrologic Unit Watersheds										
	Expanded Sand Draw-Alkali Creek	Granite Wash	Reduced Upper Alkali Creek-Green River	Upper Eighteenmile Canyon	Southeast New Fork River-Blue Rim	North Alkali Draw	Big Sandy River-Bull Draw	Long Draw	Jonah Gulch	140401-040603	Total
CIAA Vegetation Communities[1]											
JIDPA											
Wyoming big sagebrush	13,724	1,312	3,781	1,957	0	0	3,632	5,028	317	748	30,500
Outside JIDPA											
Wyoming big sagebrush	9,648	3,081	14,681	32,532	10,678	10,289	13,207	13,492	22,179	20,943	150,730
Desert shrub	0	7,819	7,892	722	843	5,623	1,805	0	0	369	25,073
Greasewood fans and flats	0	0	0	0	0	0	0	0	155	2,497	2,652
Riparian (shrub and forest)	0	0	0	0	225	0	1,119	1	0	0	1,345
Subtotal	9,648	10,900	22,573	33,254	11,746	15,912	16,131	13,493	22,334	23,809	179,800
Total	23,372	12,213	26,354	35,211	11,746	15,912	19,763	18,521	22,651	24,557	210,300
JIDPA Vegetation Types[2]											
Scattered/ no sagebrush	170	21	110	15	0	0	61	371	2	0	750
Low density sagebrush	404	76	223	118	0	0	320	1,566	8	6	2,721
Moderate density sagebrush	13,053	1,211	3,448	1,504	0	0	3,247	3,089	307	742	26,601
Basin big sagebrush	47	0	0	0	0	0	0	0	0	0	47
Wetlands	42	1	0	0	0	0	2	2	0	0	47
Ephemeral stockponds	8	3	0	0	0	0	2	0	0	0	13
Unmapped vegetation	0	0	0	320	0	0	0	0	0	0	320
Total	13,724	1,312	3,781	1,957	0	0	3,632	5,028	317	748	30,500

[1] Vegetation types based on Wyoming GAP Analysis land cover for Wyoming (WyGISC 2003).
[2] Vegetation types based on TRC Mariah (2001a).

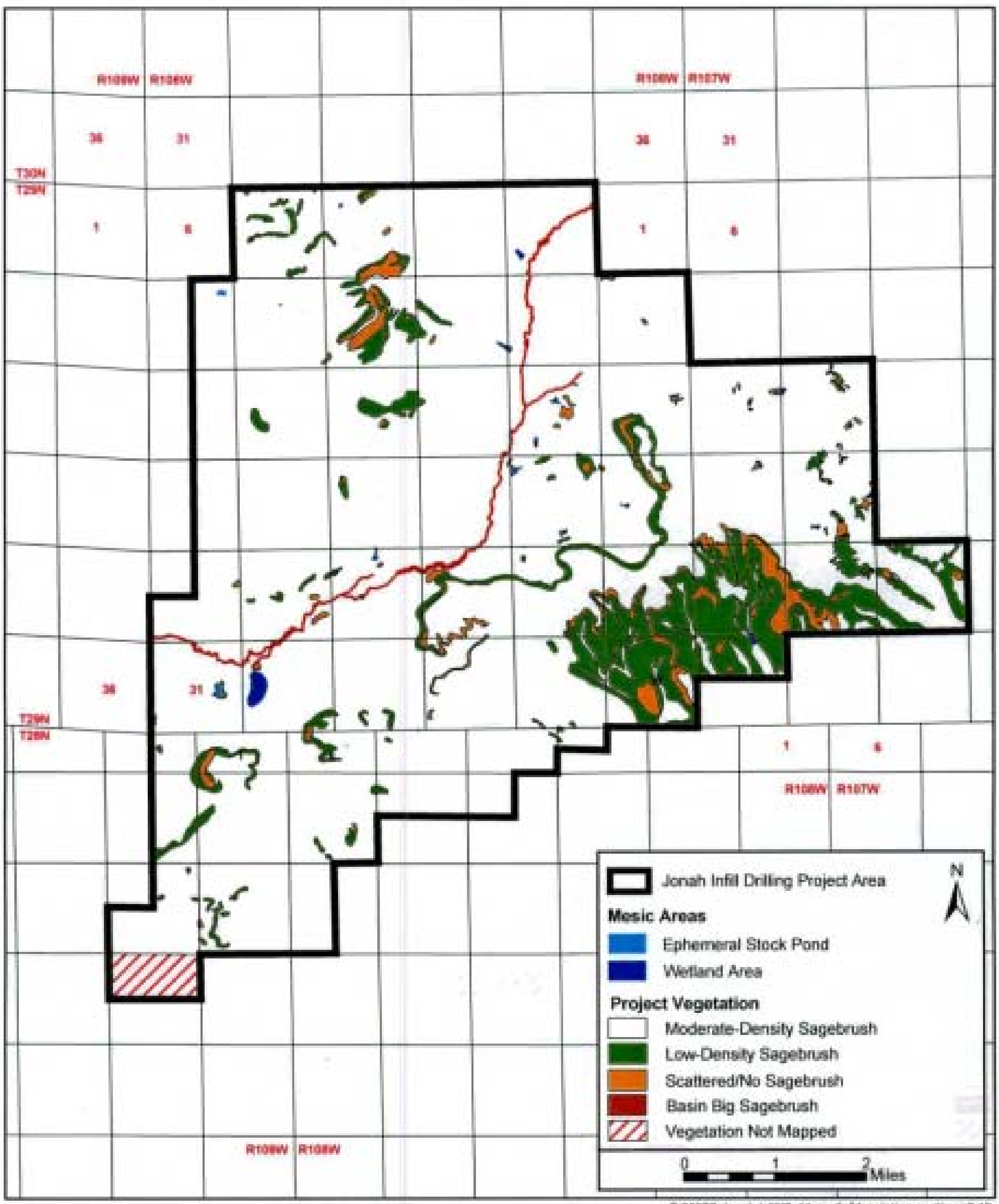
Table 3.17 Vegetation Data, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.[1]

	Vegetation Type[2]		
Parameter	Moderate Density Sagebrush (n=15)	Low Density Sagebrush (n=15)	Basin Sagebrush (n=5)
Sagebrush height (inches)	9.8	7.9	31.0
Percent sagebrush cover			
Daubenmire	21.7	6.5	30.8
Line intercept	24.5 (99%)	7.9 (89%)	36.7 (79%)
Percent total shrub cover			
Daubenmire	22.0	6.8	31.4
Line intercept	24.7 (99%)	8.1 (92%)	38.0 (80%)
Grass/forb height (inches)	5.6	6.5	6.5
Percent grass and forb cover	10.6 (89%)	15.1 (96%)	20.1 (65%)
Residual grass height (inches)[3]	6.3	6.1	6.5
Percent residual grass cover	8.5	10.9	20.1
Sagebrush plants/acre	7,260 (99%)	2,636 (92%)	4,494 (86%)
Total shrubs/acre	7,665 (99%)	2,951 (96%)	5,088 (91%)

1 Adapted from TRC Mariah 2001a. Data on file at TRC Mariah, Laramie, Wyoming. Measurements recorded in late summer 2000.

2 See map 3.12 for type locations. Numbers in parentheses are the confidence level achieved with 80% precision using the appropriate z statistic.

3 Excludes pre-2000 litter.



Map 3.12 Project Area Vegetation Types (Finely Mapped), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

species in the cushionplant community include fringed sagebrush (*Artemisia frigida*), squarestem phlox (*Phlox muscoides*), spoonleaf milkvetch (*Astragalus spatulatus*), goldenweed (*Haplopappus* spp.), Hooker sandwort (*Arenaria hookeri*), cutleaf daisy (*Erigeron compositus*), mat beardtongue (*Penstemon caespitosus*), and silky locoweed (*Oxytropus sericea*). This habitat type also includes barren side slopes and fans derived from clay and shale substrates.

The basin big sagebrush (*Artemisia tridentata tridentata*) type occupies less than 0.1% (47 acres) of the JIDPA. Sagebrush canopy cover in this type is approximately 30-38% (n = 5) (Table 3.17). This type occurs as a narrow strip from less than 5 ft wide to approximately 150 ft wide along the Sand Draw drainage, where basin big sagebrush is the dominant species. The understory is relatively sparse, with scattered rabbitbrush, western and thickspike wheatgrasses, Sandberg bluegrass, and Great Basin wildrye (*Elymus cinereus*).

Approximately 4,200 acres of the JIDPA have been disturbed by existing oil and gas development (see Table 2.3). Approximately 1,400 acres of this disturbance is anticipated to remain for another 40 to 60 years; however, approximately 2,800 acres of disturbance are in various stages of reclamation.

3.2.1.2 Riparian and Wetlands Areas

Riparian areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent water bodies (rivers, streams, lakes, or drainageways) and are usually transitional between wetland and upland communities. Riparian areas generally exhibit distinctly different vegetative species than adjacent areas and/or vegetative species similar to adjacent areas but exhibiting more vigorous or robust growth forms (USFWS 1997). Based on this definition, no riparian communities occur within the JIDPA. However, riparian communities are present in the CIAA along the New Fork and Big Sandy Rivers.

Wetlands are protected under Section 404 of the *Clean Water Act* (33 C.F.R. 1251 et seq.) and *EO 11990* and are considered sensitive and valuable resources. The current regulatory definition of wetlands for administrating the *Clean Water Act* Section 404 permit program for dredge and fill activities is "areas inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and [which] under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (U.S. Army Corps of Engineers [COE] 1987; Wetlands Training Institute, Inc. 1995). A wetland must possess the following three general diagnostic characteristics:

- Hydrophytic vegetation - The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in the wetland definition above. That is, they are adapted to actively grow in saturated soils.
- Hydric soil - Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing (often saturated) soil conditions.
- Hydrology - The area is inundated either permanently or periodically at mean water depths less than or equal to 6.6 ft, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.

In 2003, field investigations were conducted to verify the wetland designations indicated on existing USFWS National Wetland Inventory (NWI) maps of the JIDPA. The maps generally proved to be accurate in the classification and location of wetlands; however, many of the mapped NWI sites may not be subject to regulation under Section 404 due to a lack of the three general diagnostic environmental characteristic described above. While some of the NWI-identified wetlands lack one or more or the regulatory requirements (i.e., hydric soils, dominance of hydrophytic vegetation, or wetland hydrology), these areas provide unique habitats for wildlife, as well as water for both wildlife and livestock, throughout all or part of the year. Approximately 13 acres of the NWI-identified wetland areas within the JIDPA are ephemeral stockponds (see Table 3.16, Map 3.11). Approximately 47 acres (<0.1% of the JIDPA) of potentially jurisdictional wetlands (i.e., regulated under Section 404) occur within the JIDPA (see Map 3.11). These areas are generally classified as palustrine emergent seasonally or semipermanently flooded wetlands on the NWI maps and are primarily associated with stockponds and reservoirs. These wetlands generally range in size from 0.1 acre to 2.1 acres. The largest reservoirs in the area (e.g., Sand Draw No. 4 and Wild Horse) are classified as temporarily, seasonally, or semipermanently flooded and are 5 to 10 acres in size. A large playa located on private surface in Section 32, T29N, R108W, is classified as temporarily or seasonally flooded and occupies approximately 36 acres. There are also several small depressions or playas less than an acre in size and classified as palustrine unconsolidated shore, temporarily, seasonally, or semipermanently flooded wetlands in the area.

Waters of the U.S. (WUS) have an active channel that exhibits relatively stable characteristics; the criterion for a WUS is the presence of a defined bed and bank. The boundary of a WUS extends to the ordinary high-water mark or to the boundaries of adjacent wetlands. Intermittent and ephemeral streams that exhibit a defined bed and bank qualify as WUS, as do reservoirs constructed on these streams.

Numerous ephemeral channels (WUS) classified as riverine intermittent streambed temporarily flooded on the NWI maps occur in the JIDPA (see Map 3.8). Bed channel widths range from 1 ft to over 30 ft along Sand Draw, the largest ephemeral drainage in the JIDPA.

3.2.1.3 Noxious Non-Native, and Invasive Plant Species

The Wyoming State Legislature enacted the *Wyoming Weed and Pest Control Act* in 1973 for the purpose of controlling designated weeds and pests. *EO 13112 "Invasive Species"* was signed by President Clinton on February 3, 1999, to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause. Potential invader species (which include noxious weeds) identified by the Sublette County Weed and Pest Control for the JIDPA and vicinity include black henbane (*Hyoscyamus niger*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), Dyer's woad (*Isatis tinctoria*), spotted knapweed (*Centaurea maculosa*), hoary cress (*Cardaria draba* and *C. pubescens*), perennial pepperweed (*Lepidium latifolium*), Russian knapweed (*Centaurea repens*), and perennial sow thistle (*Sonchus arvensis*). Sources of invasion include gravel obtained from outside the JIDPA and soil carried to the area on vehicles and drilling and construction equipment.

A reconnaissance of JIDPA in 2003 found Russian thistle (*Salsola kali*) and halogeton *(Halogeton glomeratus*) establishment on reclaimed areas (i.e., well pads, pipeline and road ROWs) reseeded from 1992 through 2002. Though Russian thistle and halogeton are not identified as noxious weeds by Sublette County Weed and Pest Control, they are generally considered undesirable for livestock and wildlife forage (Stubbendieck et al. 1997).

3.2.2 Wildlife and Fisheries

3.2.2.1 Big Game/Other Mammals

Pronghorn antelope is the only big game species that regularly inhabits the JIDPA. Occasionally, mule deer have been observed in the area (TRC Mariah 2004a), but no range designation for mule deer has been delineated on the JIDPA by the WGFD, so mule deer are not discussed further.

The WGFD determines range classifications for big game species and is in the process of revising big game ranges across the state. This revision is not complete for the big game herds in the JIDPA; therefore, the range designations that have been in place for the last several years are used in this EIS.

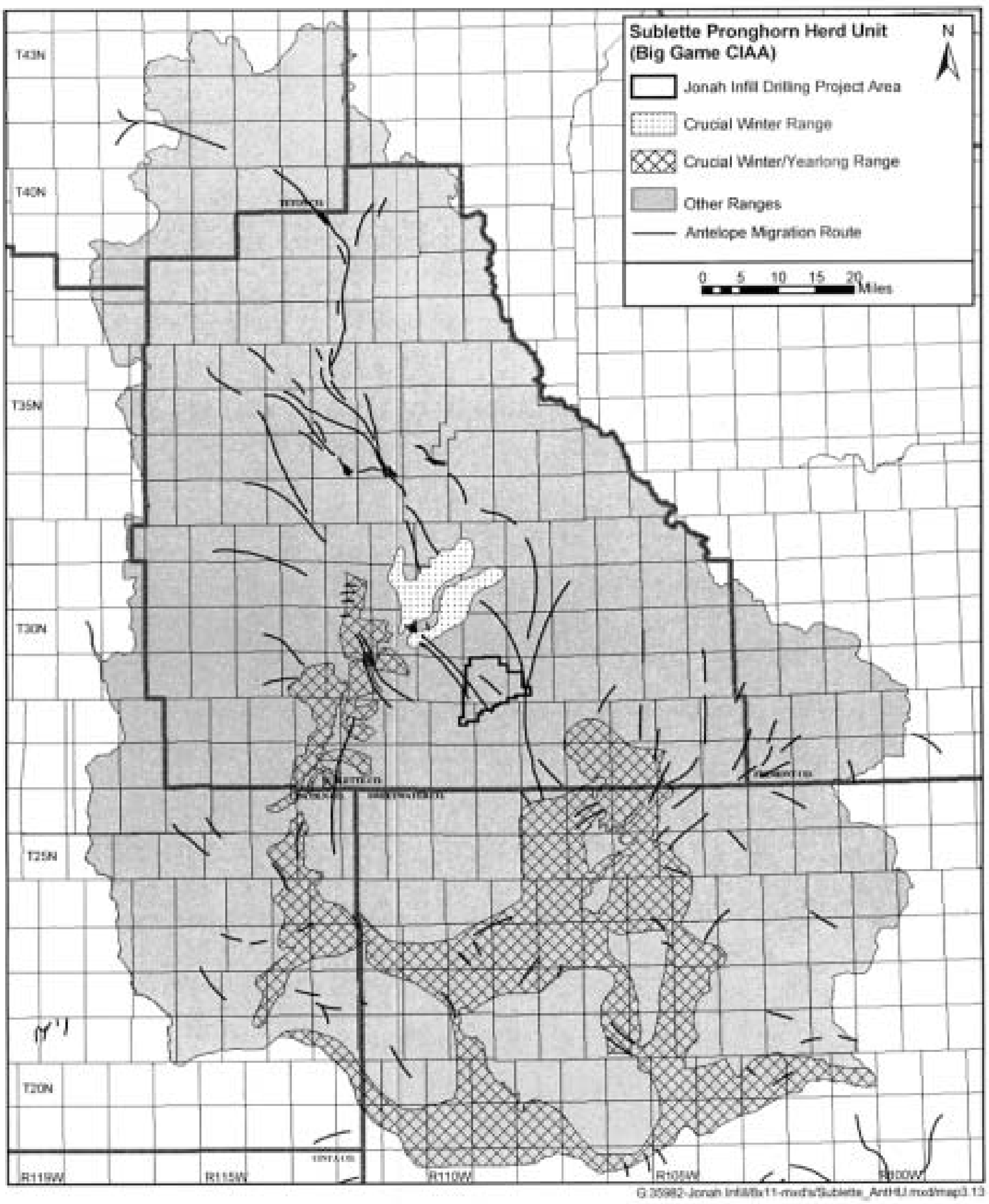
<u>Pronghorn Antelope</u>

The entire JIDPA is within spring/summer/fall range of the Sublette Pronghorn Antelope Herd Unit (the CIAA). This herd unit occupies approximately 10,546 square miles and includes most of the Green River drainage north of Interstate 80, exclusive of the Black's Fork and Ham's Fork drainages (Map 3.13). Approximately 3,006,000 acres (4,697 square miles) of the Sublette Herd Unit CIAA is designated as spring/summer/fall habitat. Limited portions of other drainages, including the Gros Ventre/Hoback River area near Jackson Hole are also included in the Sublette Herd Unit. Within these boundaries, the Sublette Herd Unit pronghorn migrate farther between seasonal ranges than any other pronghorn in Wyoming, with documented movements of as much as 150 miles between several ranges (WGFD 2001). WGFD has documented migration corridor occurrence within and adjacent to the JIDPA (Map 3.13).

Total existing disturbance (from roads, wells, towns) within the Herd Unit CIAA is approximately 87,200 acres (136 square miles) or 1.3% of the total herd unit. Though no pronghorn crucial range occurs within the JIDPA, approximately 27,200 acres (2.5%) of pronghorn crucial range in the Sublette Herd Unit have been disturbed. BLM is responsible for the majority of surface management in the Sublette Herd Unit. Other surface management entities include the USFS, the Bureau of Reclamation, the State of Wyoming, and private entities.

The WGFD population objective for the Sublette Herd Unit is 48,000 pronghorn antelope. The 2002 population was estimated at 44,700 (93% of the current objective), and the estimated population averaged 44,080 from 1997 to 2001 (WGFD 2002). Because of its large size, the Sublette Herd Unit has been divided into three sub-units. The JIDPA is within the North sub-unit, which has a population objective of 22,000 and an estimated 2001 population of 18,600 (84.5% of objective). The population trend in the North sub-unit has been relatively stable in recent years, ranging from 17,900 head in 1998 to 19,700 in 1994 (WGFD 2001).

Reproductive success of the Sublette North sub-unit from 1985 to 2001 has been highly variable, ranging from 45 fawns/100 does in 1993 to 90 fawns/100 does in 1987. Fawn/doe ratios in 2000 and 2001 were toward the low end of the range at 53/100 and 55/100, respectively (WGFD 2001). Drought conditions from 2000 to 2003 have reduced forage production and available water throughout the Sublette Herd Unit. Low summer precipitation typically results in poor body condition and subsequently, poor fawning rates and overwinter fawn survival (WGFD 2001).



Map 3.13 Sublette Herd Unit and Pronghorn Migration Routes, Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Other Mammals

The CIAA for other mammal species and general wildlife encompasses approximately 188,888 acres (295 square miles) (Map 3.14). Existing disturbance within the CIAA includes approximately 2,729 acres (4.3 square miles), or 1.4% of the CIAA, and results primarily from road and pipeline ROWs (44%) and existing long-term disturbance in the JIDPA (52%).

Other mammals known or likely to occur in the JIDPA based on observations and range and habitat preference (Clark and Stromberg 1987; WGFD 1999; WYNDD 2003) include: dwarf shrew, 10 bat species (California myotis, small-footed myotis, Yuma myotis, little brown myotis, long-legged myotis, silver-haired bat, big brown bat, hoary bat, Townsend's big-eared bat, and pallid bat); four species of hares and rabbits (pygmy rabbit, Nuttall's cottontail, desert cottontail, and white-tailed jackrabbit); five squirrel species (least chipmunk, Uinta ground squirrel, Wyoming ground squirrel, thirteen-lined ground squirrel, and white-tailed prairie dog); northern and Idaho pocket gophers; six species of new world rats and mice (Ord's kangaroo rat, deer mouse, grasshopper mouse, bushy-tailed woodrat, sagebrush vole, and long-tailed vole); coyote and red fox; four mustelid species (long-tailed weasel, badger, western spotted skunk, and striped skunk); and bobcat. Porcupines have been observed in the vicinity of the project area but are uncommon and not likely to be residents.

All identified prairie dog colonies on the JIDPA have been mapped. Colonies vary from 6 to 893 acres in size (Map 3.15) and are visited annually during wildlife surveys conducted for the Jonah wildlife studies project (TRC Mariah 2004a). During these studies, newly observed colonies are mapped, and regular updates to colony boundaries are made.

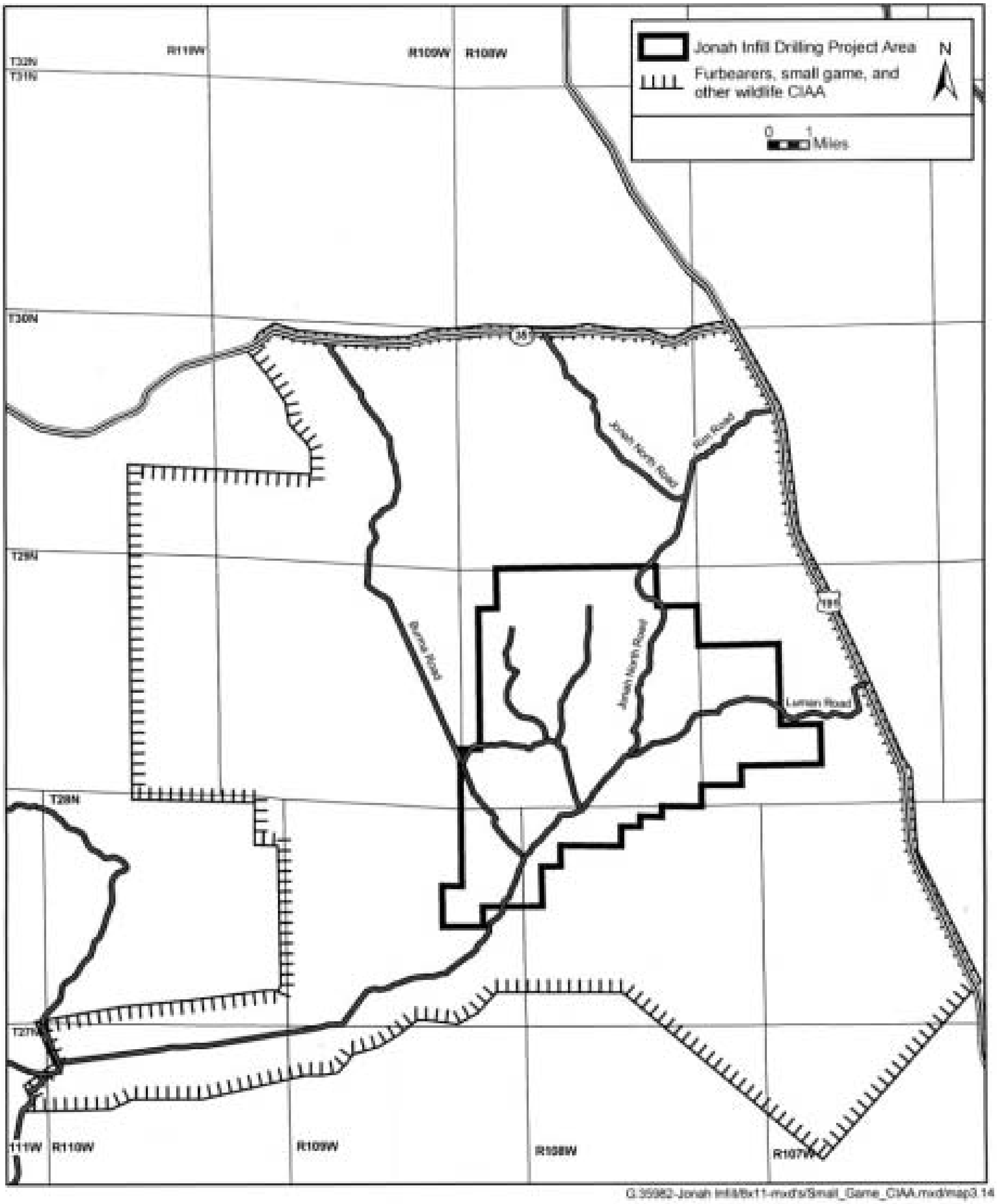
3.2.2.2 Birds

Raptors

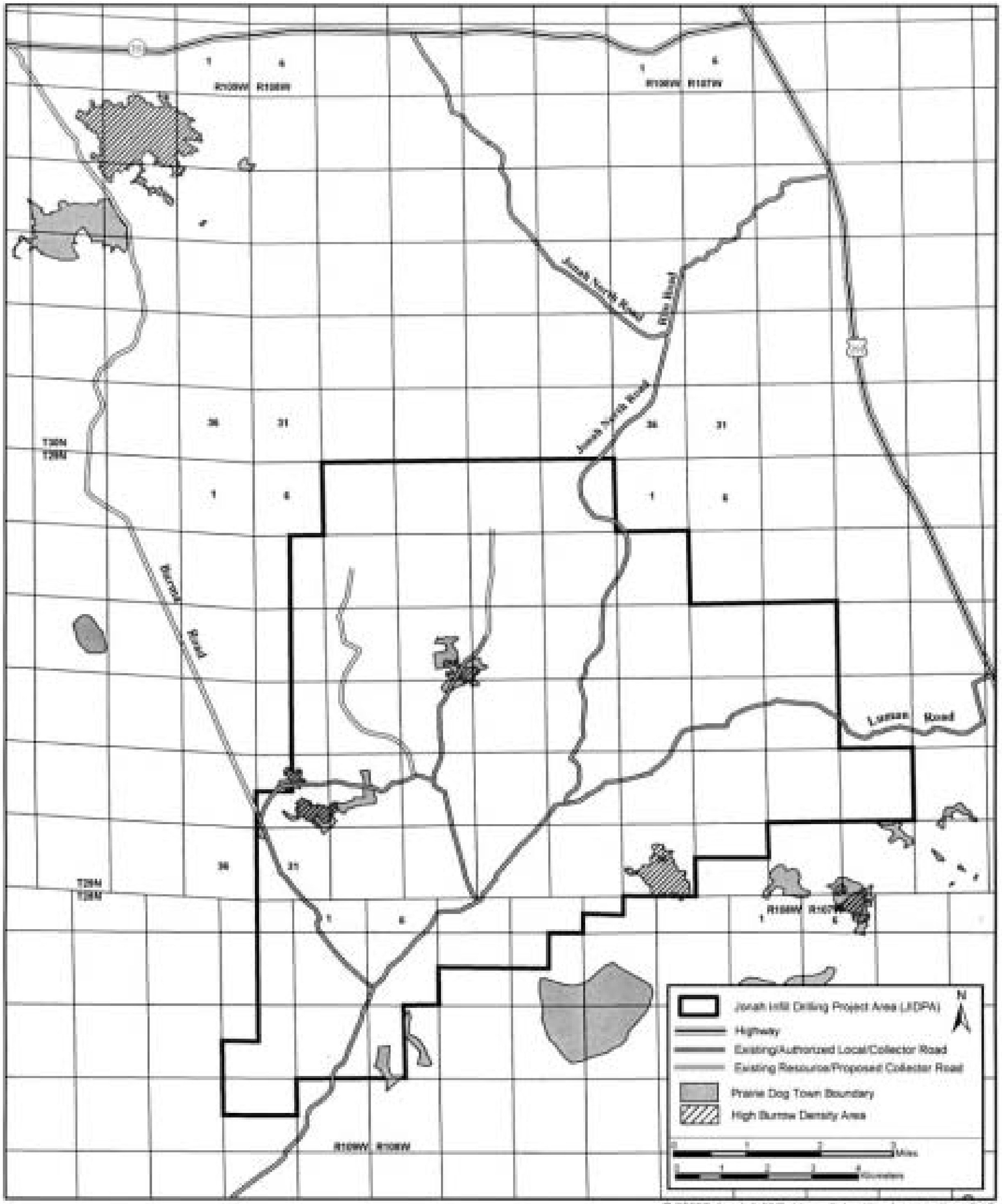
The CIAA for raptors encompasses approximately 1,184,443 acres (1,850 square miles) (Map 3.16). Existing disturbance within this CIAA is approximately 113,092 acres (176 square miles), or 9.5% of the area. This disturbance is primarily from agriculture (88%) and road and pipeline ROWs (8%).

Based on geographic range and habitat preferences, a variety of raptor species may occur within the JIDPA (Dorn and Dorn 1999; WGFD 1999). Raptor nest surveys are conducted annually on the JIDPA and within the greater Jonah wildlife study area in association with Jonah wildlife studies (TRC Mariah 2004a). All known raptor nests/nest sites are inventoried, and other suitable nesting habitat is observed to determine if there are new nests in the area (Map 3.17). These inventories have revealed declines in the number of active ferruginous hawk nests on and adjacent to the JIDPA over the last 8 years.

Approximately 35 raptor nests are known to occur within the JIDPA, and in 2004, seven were occupied, including five American kestrel nests, one ferruginous hawk nest, and one burrowing owl nest. In addition to the seven occupied nests, nine other nests on the JIDPA are considered active (i.e., occupied at least once during the last three years or having an unknown status) for management purposes. These include four ferruginous hawk, one American kestrel, and one burrowing owl nest. Approximately 19 known nests within the JIDPA have had no recent activity or use. A detailed analysis of raptor nesting history in the area is provided in *2003 Wildlife Studies, Jonah Field II Natural Gas Development Project* (TRC Mariah 2004a).



Map 3.14 General Wildlife Species Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.



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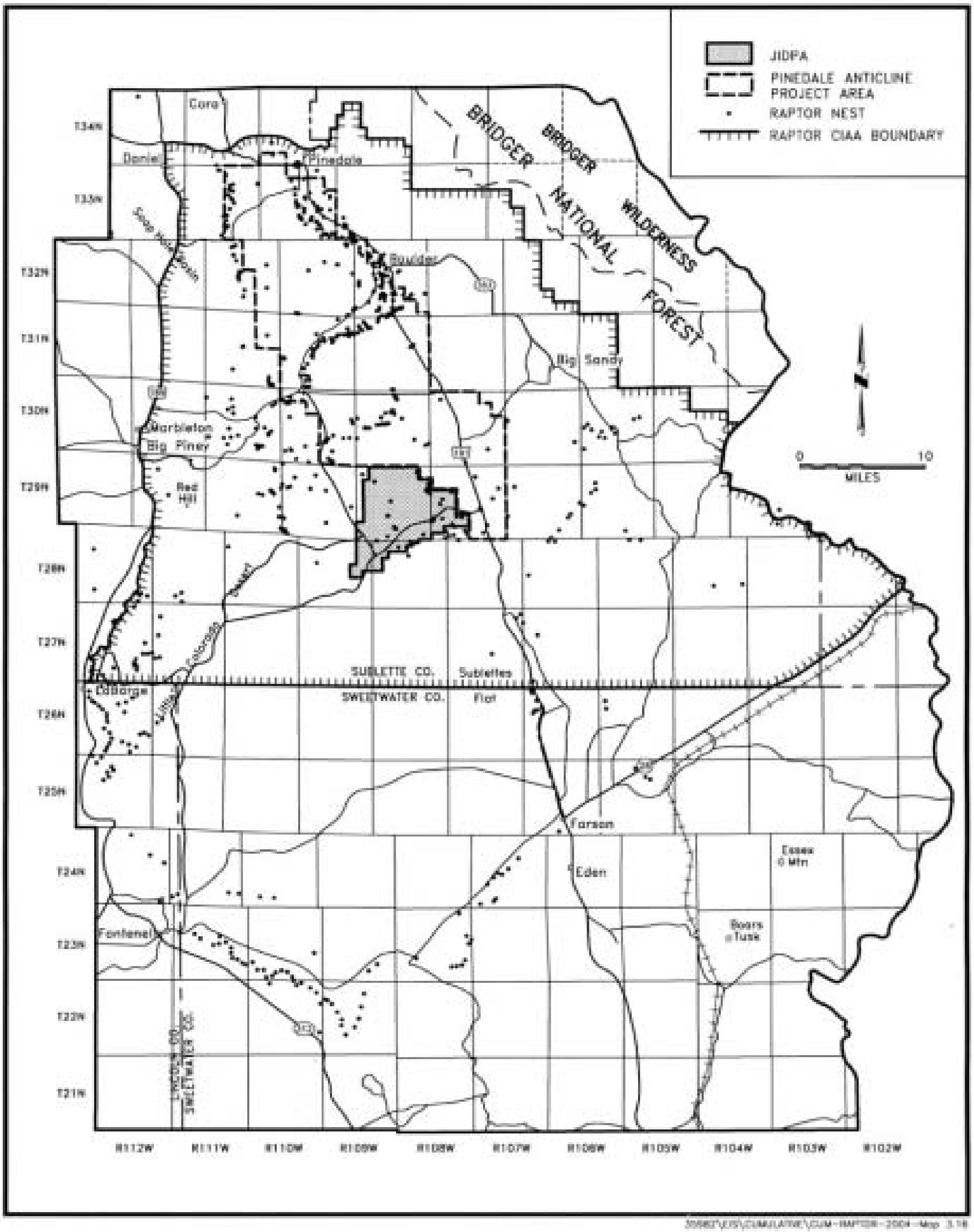
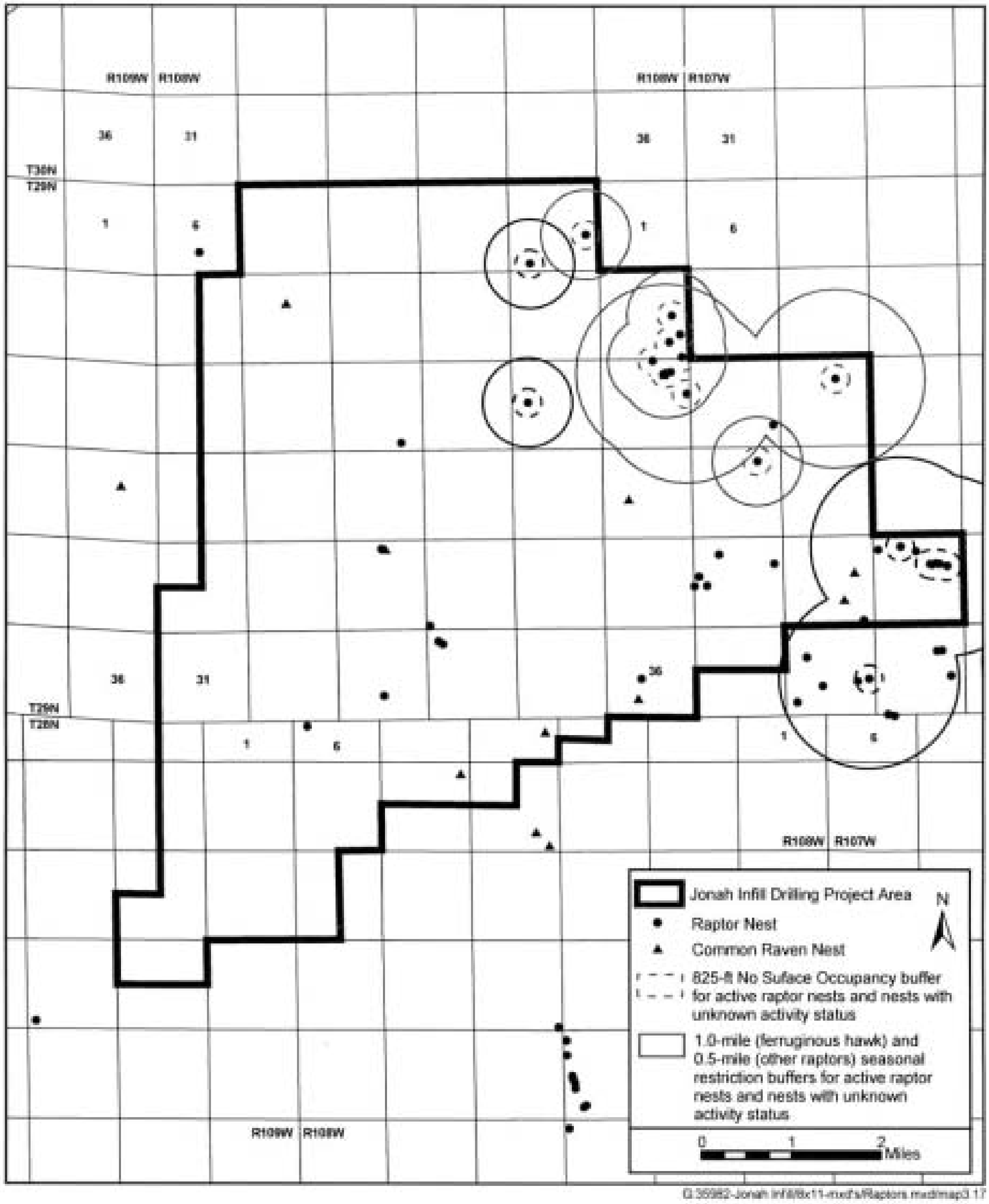
Map 3.15 Prairie Dog Colonies, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.



Map 3.16 Raptor Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.



Map 3.17 Raptor Nests On or Adjacent to the Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Game Birds

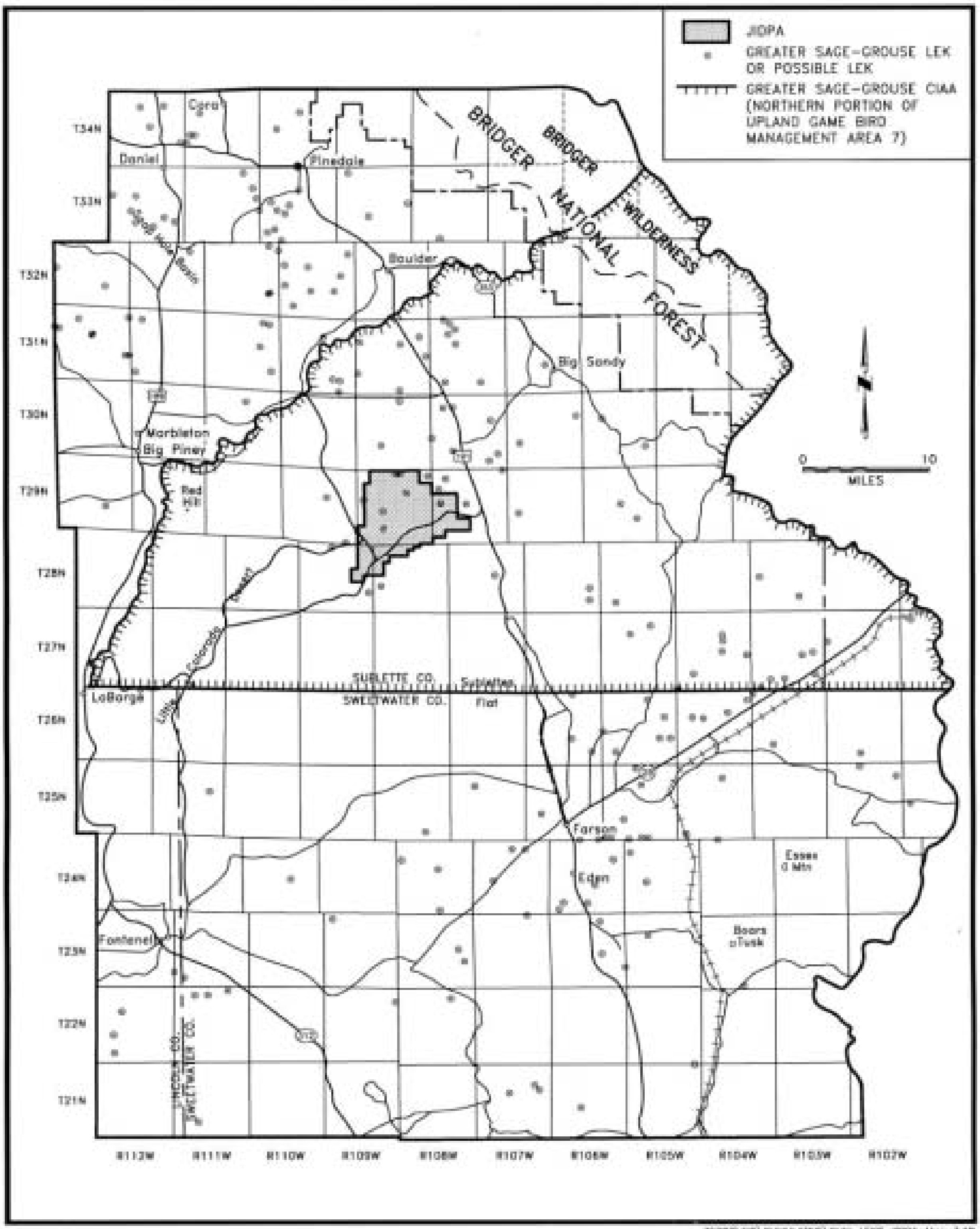
The principal upland game bird inhabiting the JIDPA is greater sage-grouse. A detailed summary of known greater sage-grouse lek activity on the JIDPA is provided in *2003 Wildlife Studies, Jonah Field II Natural Gas Project* (TRC Mariah 2004a). The CIAA for greater sage-grouse encompasses 1,061,805 acres (1,659 square miles) (Map 3.18). Existing disturbance within this CIAA includes approximately 28,767 acres (45 square miles), or 2.7% of the CIAA, and results primarily from agriculture (70%) and road and pipeline ROWs (21%).

Greater sage-grouse have been extirpated from two states and populations over the remainder of its range have notably declined (Connelly and Braun 1997; Braun 1998; Connelly et al. 2004). Conservative estimates suggest that only 56% of the pre-European settlement area occupied by greater sage-grouse is still occupied or capable of supporting the species on an annual basis (Braun et al. 1976; Braun 1995; Connelly et al. 2004). Eleven of 13 states have shown significant declines. Historically, Wyoming supported more greater sage-grouse than any other state due to the presence of extensive sagebrush habitats (Patterson 1952). The areas in central and western Wyoming, where sagebrush-dominated landscapes and greater sage-grouse populations remain relatively contiguous and intact, cumulatively represent one of the species' last strongholds (Braun 1998). The number of male sage-grouse counted per lek in Wyoming decreased 17% between 1985 and 1995 (Connelly and Braun 1997), and regional declines as high as 73% between 1988 and 1999 have been recorded. The average decline in male attendance on leks in Wyoming from 1965 -2003 is 49% and lek size has also significantly decreased (Connelly et al. 2004). Changes in the sagebrush-dominated areas where birds typically reside are thought to be one of the principal factors for population declines (Braun 1998). Factors include fire, plant invasions, land conversions, urbanization, livestock grazing, energy development, noise, and others.

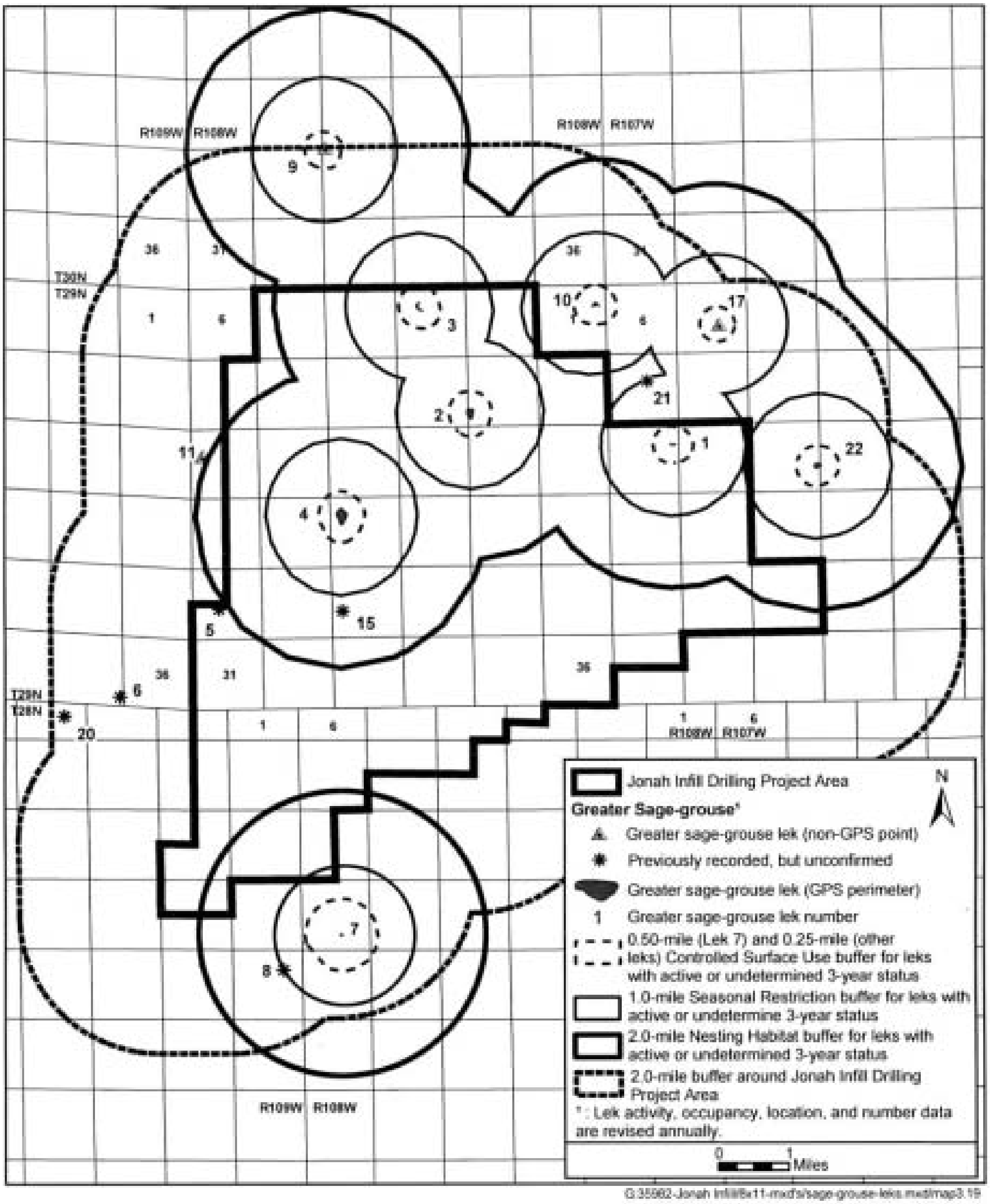
Greater sage-grouse lek monitoring is conducted annually on the JIDPA and surrounding areas. The WGFD, BLM, University of Wyoming Cooperative Fish and Wildlife Research Unit, and TRC Mariah are responsible for the lek activity status monitoring in the area (TRC Mariah 2004a). Ten active leks have been identified on or within a 2-mile buffer of the JIDPA (Map 3.19 and Table 3.18). In addition, six formerly identified leks occur in the area; however these areas are no longer classified as leks (Table 3.18). Data from the JIDPA and for the entire Upper Green River Basin show declines in male greater sage-grouse attendance at leks. Additionally, declines appear to be occurring at a faster rate in areas with oil and gas development (WGFD unpublished data; personal communication, December 2004, with Dean Clause, WGFD Biologist). Declines in lek attendance likely indicate a reduction in the regional population.

Site-specific surveys of the JIDPA conducted over the last few years indicate that while the area is still used for nesting and summer and winter foraging, use of the area by greater sage-grouse continues to decline. This decline is likely due in part to the increased loss of habitat resulting from oil and gas development. Habitat vegetation conditions in the JIDPA are described in Section 3.2.1.

To maintain or move PFO greater sage-grouse habitat toward RMP goals, existing PFO area-wide and statewide stipulations on leases and COAs on APDs and ROWs apply a Controlled Surface Use restriction within 0.25 mile of an occupied lek. There are also timing stipulations protecting breeding activities, nesting and brood-rearing females, and wintering grouse, but these stipulations do not preclude exploration and development from occurring in nesting and wintering



Map 3.18 Greater Sage-grouse Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.



Map 3.19 Greater Sage-grouse Leks, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Table 3.18 Greater Sage-Grouse Lek Attendance Trends, Jonah Infill Drilling Project, Sublette County, Wyoming, 1992-2004.[1]

Lek No.[2]	Most Recent Activity	History[3]												
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	2004	NS	NS	9	NS	26	6	31	25	22	12	10	14	13
2	2004	NS	NS	2	NS	2	17	12	7	14	16	NS	6	7
3[4]	2004	NS	NS	NS	NS	16	0?	36	26	22	27	17	23	15
4	2003	NS	NS	16	NS	15	4	4	0	1	1	0	1	0
5[5]	1996[6]	NS	NS	NS	NS	1	0?	0	0	NS	NS	NS	0	NS
6[5]	1996[6]	NS	NS	NS	NS	3	0?	0	0	0	NS	NS	0	0
7	2004	NS	NS	36	NS	0	16	17	11	9	6	NS	3+	2
8[5]	1996[6]	NS	NS	NS	NS	2	0?	0	0?	0	NS	0	0	0?
9	2004	NS	NS	NS	NS	NS	-50	26	62	47	45	46	36	13
10	2004	NS	NS	NS	NS	NS	60	53	79	64	62	47	25	16
11[5]	UNK	NS	NS	UNK	NS	UNK	NS	0	0	0	NS	NS	0	0?
15[5]	1996[6]	NS	NS	NS	NS	1	0?	0	0	0	NS	NS	0	0
17	2001[6]	NS	NS	NS	NS	NS	NS	NS	5	3	3	0	0?	0
20[5]	UNK	NS	NS	0	NS	0	NS	NS	NS	NS	NS	NS	0	0
21[5]	2000[6]	NS	NS	NS	NS	NS	NS	NS	NS	10	NS	NS	NL	0
22	2000	NS	NS	NS	NS	NS	NS	NS	NS	9	0	0	0	0

[1] Further detail is provided in TRC Mariah 2004a.
[2] See Map 3.19 for locations; lek numbering is consistent with TRC Mariah 2004a.
[3] Numbers refer to maximum male attendance observed; NS = not surveyed; NL = not located- survey was attempted but no birds were observed and exact location of lek could not be confirmed; UNK = unknown; + = unclassified birds observed but not included; ? = no males were observed on the lek, but the lek was visited less than three times during that breeding season.
[4] This lek/lek location may be revised to accommodate two leks.
[5] WGFD in consultation with BLM has removed these locations from consideration as leks because they may never have met WGFD lek criteria and/or they may represent areas where birds were observed after departure from an established lek.
[6] The lek may have been active more recently than indicated because data are lacking for at least one year since the last known activity.

habitat outside of the timing restriction dates, and therefore, habitat is not protected from development. Given the noted decline in greater sage-grouse use of the JIDPA, existing protection measures within the JIDPA appear to be inadequate.

Sand Draw and adjacent areas have been identified as containing important greater sage-grouse habitat (particularly for nesting and wintering); therefore, past BLM decisions for the Jonah Field identified specific measures for the protection of this drainage (BLM 1998b, 2000b). These measures include no well construction within 300 ft of the edge of Sand Draw and the basin big sagebrush-dominated areas associated with this drainage channel. Roads and pipelines that must cross these draws would be constructed perpendicular to drainage channels, and engineering designs would specifically address each road/pipeline crossing in an effort to minimize disturbance.

Greater sage-grouse breeding habitats are sagebrush-dominated rangelands, typically consisting of large, relatively contiguous sagebrush stands, which are critical for the survival of greater sage-grouse populations (Connelly et al. 2000). Since grouse populations typically inhabit large interconnected expanses of sagebrush, they have been characterized as a landscape-scale species (Patterson 1952; Wakkinen 1990). Therefore, conserving landscapes with suitable winter habitat also may be important for species conservation (Eng and Schladweiler 1972). Total shrub canopy cover, residual grass cover, non-food forb cover, and litter cover are the best predictors of greater sage-grouse nesting habitat (Holloran 1999; Lyon 2000). Typically greater sage-grouse nests are located in habitat with >20% sagebrush canopy cover (Holloran 1999; Lyon 2000). Braun et al. (1976) indicated that most hens nest within 3.2 km (2.0 miles) of a lek, but more recent studies suggest many hens nest further away. The average distance moved by hens from undisturbed leks to nests in western Wyoming was 2.1 km (1.3 miles), whereas the average distance traveled from disturbed leks to nests was 4.1 km (2.5 miles) (Lyon and Anderson 2003). Nest initiation rate was also higher for hens captured on undisturbed leks than those captured on disturbed leks (Lyon and Anderson 2003), and the presence of vehicle traffic also appears to lower nest initiation rates. The chance of successfully hatching chicks (nest success) increases by 30% if there is at least 20% cover that includes both sagebrush and herbaceous vegetation and if the vegetation is at least 15 cm in height (Holloran 1999). Greater sage-grouse nest success ranges from 12% to 86% and is relatively low compared to other prairie grouse species (Connelly et al. 2000). While sage-grouse have used highly fragmented habitats in some oil fields and reclaimed areas, population levels in these areas are below pre-disturbance numbers (Connelly et al. 2004).

Important greater sage-grouse wintering habitat within the Jonah and Anticline Fields and surrounding areas currently is being identified by the BLM in cooperation with WGFD. Identification of sage-grouse wintering areas will be based, at least in part, on aerial winter sage-grouse surveys.

The other game bird likely to occur on the JIDPA is the mourning dove. The mourning dove is a common summer resident that prefers open land with scattered vegetation and requires trees or some other type of structure for nesting. Mourning doves that frequent the JIDPA likely utilize the shrub-covered areas along Sand Draw that provide suitable cover for nesting and roosting.

Other Birds

The CIAA for other birds is the same as that for other general wildlife (see Map 3.14). Based on observations and range and habitat preference (WGFD 1999; Dorn and Dorn 1999; TRC Mariah 2001a, 2001b, 2002, 2004a), other bird species known or likely to occur on the area include common raven, horned lark, lark bunting, loggerhead shrike, sage sparrow, sage thrasher, Brewer's sparrow, cliff swallow, barn swallow, mountain bluebird, western kingbird, grasshopper sparrow, killdeer, common nighthawk, black-billed magpie, American crow, canyon wren, western meadowlark, Brewer's blackbird, common grackle, and brown-headed cowbird. Several species of wading/shore birds and waterfowl also may occur around reservoirs. Wading/shore birds include black-necked stilt, willet, Wilson's phalarope, common snipe, great blue heron, snowy egret, long-billed dowitcher, and black-crowned night-heron. Waterfowl include pied-billed grebe, eared grebe, western grebe, green-winged teal, blue-winged teal, cinnamon teal, mallard, northern pintail, northern shoveler, gadwall, American wigeon, and ruddy duck.

3.2.2.3 Amphibians and Reptiles

The CIAA for amphibians and reptiles is the same as that for other general wildlife (see Map 3.14). Based on range and habitat preference (Baxter and Stone 1980), two amphibian and four reptile species are likely to occur on the JIDPA. Amphibians include the Great Basin spadefoot and northern leopard frog, and reptiles include the northern sagebrush lizard, eastern short-horned lizard, bullsnake, and wandering garter snake.

3.2.2.4 Fisheries

The fisheries CIAA is the combined area of project-affected watersheds (see Map 3.8). There are no perennial streams on the JIDPA, and no fish are known to occur in the area. The nearest perennial streams with significant fishery resources are the Big Sandy, New Fork, and Green Rivers (see Section 3.1.6.1 and Map 3.8). The Big Sandy River is approximately 5 miles east of the JIDPA, the New Fork River is approximately 7 miles northwest of the area, and the Green River is approximately 12 miles west of the area.

3.2.3 Threatened, Endangered, Proposed, and Candidate Species and BLM Wyoming Sensitive Species

The *Endangered Species Act* (16 *United States Code* [U.S.C.] 1531-1543) protects listed threatened and endangered plant and animal species and their critical habitats. To ensure compliance with this act, a biological assessment (BA) would be prepared and USFWS concurrence of effects determinations for the TEP&C species potentially occurring in the JIDPA would be obtained prior to project authorization.

A list of TEP&C species that potentially occur on or in the vicinity of the JIDPA was compiled from several sources, including a written communication from the Wyoming State Supervisor's Office of the USFWS and the WYNDD (Table 3.19). Seven federally listed TEP&C plant and animal species potentially occur in the vicinity of the JIDPA or could otherwise be potentially affected by the proposed project, including the black-footed ferret, bald eagle, four Colorado River endangered fish species--Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub--and one plant species--Ute ladies'-tresses.

3.2.3.1 Black-footed Ferret

Black-footed ferret, a federally endangered species (endangered species are those that are in danger of extinction throughout all or a significant portion of their range), was once distributed throughout the high plains of the Rocky Mountain and western Great Plains regions (Forrest et al. 1985). Prairie dogs are the main food of black-footed ferrets (Sheets et al. 1972), and few

Table 3.19 Federal Threatened, Endangered, Proposed, and Candidate Species and Their Potential Occurrence on the Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.

Species[1]			
Common Name	Scientific Name	Federal Status[2]	Potential Occurrence on JIDPA[3]
Mammals			
Black-footed ferret	*Mustela nigripes*	E	X
Birds[4]			
Bald eagle[5]	*Haliaeetus leucocephalus*	T	U
Fish			
Bonytail chub	*Gila elegans*	E	X
Colorado pikeminnow	*Ptychocheilus lucius*	E	X
Humpback chub	*Gila cypha*	E	X
Razorback sucker	*Xyrauchen texanus*	E	X
Plants			
Ute ladies'-tresses	*Spiranthes diluvialis*	T	X

1 List of species provided by USFWS (2003).

2 Federal status:
- E = Listed as federally endangered.
- T = Listed as federally threatened.

3 Potential occurrence:
- U = Uncommon; species may be present in the JIDPA but in such low numbers or in such small and widely scattered populations that an encounter during field development and operation is unlikely; the species could be present for a significant part of the year (e.g., breeding season, summer resident) or the entire year.
- X = Unlikely; there has been no recent historical record of the species' occurrence in the JIDPA; probability of encountering the species during field development and operation is very unlikely.

4 The mountain plover was previously included as proposed for listing as federally threatened by the USFWS, but the decision not to list the species has since been published (*Federal Register*, September 9, 2003, 68[174]: 53083-53101).

5 Proposed for removal from federal listing.

black-footed ferrets have been collected away from prairie dog towns (Forrest et al. 1985). The *Black-footed Ferret Survey Guidelines for Compliance with the Endangered Species Act* (USFWS 1989) defines potential black-footed ferret habitat as any white-tailed prairie dog towns or complexes greater than 200 acres in size with a burrow density greater than 20 active burrows per hectare (8 active burrows per acre). The USFWS Wyoming Field Office has block-cleared large portions of Wyoming for black-footed ferrets, including all lands within the JIDPA (USFWS 2004). USFWS considers block-cleared areas unlikely to be inhabited by black-footed ferrets, and surveys for ferrets in these areas are not required. However, block-clearance of an area "does not provide insight into an area's value for survival and recovery of the species through future reintroduction efforts"; thus, prairie dog towns in the JIDPA (see Map 3.15) may still provide important habitat for the species. Therefore, BLM continues to evaluate actions in these areas to determine if actions could adversely affect the value of prairie dog towns as future black-footed ferret reintroduction sites.

3.2.3.2 Bald Eagle

Protection for bald eagles was initially provided through the passage of the *Bald Eagle Protection Act of 1940* (16 U.S.C. 668-668dd) and the *Migratory Bird Treaty Act* (16 U.S.C. 701-715). In 1973, the bald eagle was listed as endangered under the ESA (43 C.F.R. 6233).

Bald eagle population estimates have increased in Wyoming since the species was listed as endangered. This increase is due, in part, to population growth, to significant reduction of environmental contaminants, and to the initiation of intensive nesting surveys (Greater Yellowstone Winter Wildlife Working Group 1999). On July 12, 1995, a final rule to downlist the bald eagle from endangered to threatened in the lower 48 states was published in the *Federal Register* and on July 6, 1999, the USFWS proposed delisting the bald eagle.

The JIDPA is outside of any major bald eagle nesting or roosting areas. Bald eagles generally require cliffs, large trees, or sheltered canyons associated with concentrated food sources (e.g., fisheries or waterfowl concentration areas) for nesting and/or roosting areas (Edwards 1969; Snow 1973; Call 1978; Steenhof 1978; Peterson 1986). Bald eagle winter habitat generally is associated with areas of open water where fish and/or waterfowl congregate (Stahlmaster 1987; Greater Yellowstone Winter Wildlife Working Group 1999). Wintering bald eagles frequent unfrozen portions of lakes and free-flowing rivers and may occupy upland areas where ungulate carrion, game birds, and lagomorphs (rabbits and hares) are available (Swenson et al. 1986). Additionally, bald eagles forage over wide areas during the non-nesting season (i.e., fall and winter) and scavenge on animal carcasses such as pronghorn, deer, and elk; they may therefore potentially forage in the JIDPA.

No bald eagle nests or winter roosts are known to occur in the JIDPA, and the lack of suitable nesting areas or winter roosting habitats within the JIDPA precludes its use for such activities by bald eagles. Fourteen bald eagle sightings (10 adults, two juveniles, and two unclassified) have been recorded within and adjacent to the JIDPA (WGFD 1996), although no bald eagles have been documented in the area since 1984. A WYNDD search revealed no records of bald eagle in the vicinity of the JIDPA (WYNDD 2003), and they have not been observed during annual wildlife investigations conducted on the JIDPA and surrounding wildlife study area (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). Bald eagles are known to nest and roost along the New Fork and Green Rivers north of the JIDPA (TRC Mariah 2003c), and they also have been observed in the Farson-Eden area south of the JIDPA (BLM 1994).

3.2.3.3 Colorado River Endangered Fish Species

Four endangered Colorado River fish species--Colorado pikeminnow, razorback sucker, bonytail chub, and humpback chub--occur downstream from the JIDPA in the Green and Colorado Rivers. Water depletions from tributary waters within the Colorado River drainage jeopardize the continued existence of these fish and require formal consultation with the USFWS.

3.2.3.4 Ute Ladies'-Tresses

Ute ladies'-tresses is a perennial member of the orchid family that inhabits moist stream banks, wet meadows, and abandoned stream channels at elevations of 4,500-6,800 ft (Fertig 1994; Spackman et al. 1997). Where this plant occurs in ephemeral drainages, the soil typically is saturated within approximately 18 inches of the ground surface (USFWS 1992). Based on elevational range and lack of suitable habitat within the JIDPA, Ute ladies'-tresses is unlikely to occur in the area.

3.2.3.5 BLM Wyoming Sensitive Species

The BLM PFO identifies 27 BWS animal and 25 BWS plant species that may occur in the JIDPA. These species and their preferred habitats are listed in Table 3.20. Management efforts for these species primarily involve habitat maintenance.

Based on habitat preference and geographic location, three mammal and eight bird BWS species of the 27 BWS animal species potentially occur in the JIDPA (see Table 3.20). BWS animal species recorded recently in the JIDPA include Idaho pocket gopher, white-tailed prairie dog, pygmy rabbit, Brewer's sparrow, sage sparrow, loggerhead shrike, long billed curlew, mountain plover, greater sage-grouse, sage thrasher, burrowing owl, and ferruginous hawk (WYNDD 2003; TRC Mariah 2004a).

Based on habitat preference and geographic location (Hallsten et al. 1987; Dorn 1992), five of the 25 BWS plant species--bastard draba milkvetch, Trelease's milkvetch, Cedar Rim thistle, large-fruited bladderpod, and tufted twinpod--have the potential to occur in the vicinity of the JIDPA, and all five species have been recorded in the area (WYNDD 2003). The scattered/no sagebrush vegetation type (see Section 3.2.1.1 and Map 3.12) provides potential habitat for these species within the JIDPA.

3.2.4 Wild Horses

Spanish explorers originally introduced wild horses, also known as the American feral horse or mustang, to the western United States. Over the years, wild horses have become a mix of numerous breeds that have escaped or been released by the U.S. cavalry, farmers, ranchers, and miners. That portion of the JIDPA contained in the RSFO area is included in the Little Colorado Herd Management Area (LCHMA) (Map 3.20). The LCHMA encompasses 519,541 acres (of which 6,310 acres [1.2%] are in the JIDPA). The estimated wild horse population was 240 in 2001; the appropriate management level (AML) for this herd area is 69 to 100 horses (BLM 2001). The entire LCHMA is the wild horse CIAA for this Project. The portion of the JIDPA within the LCHMA does not receive a high level of wild horse use due to the limited availability of water. No managed wild horse herds occur in the PFO portion of the JIDPA and a fence separating the RSFO and the PFO areas restricts wild horse movement into the PFO area.

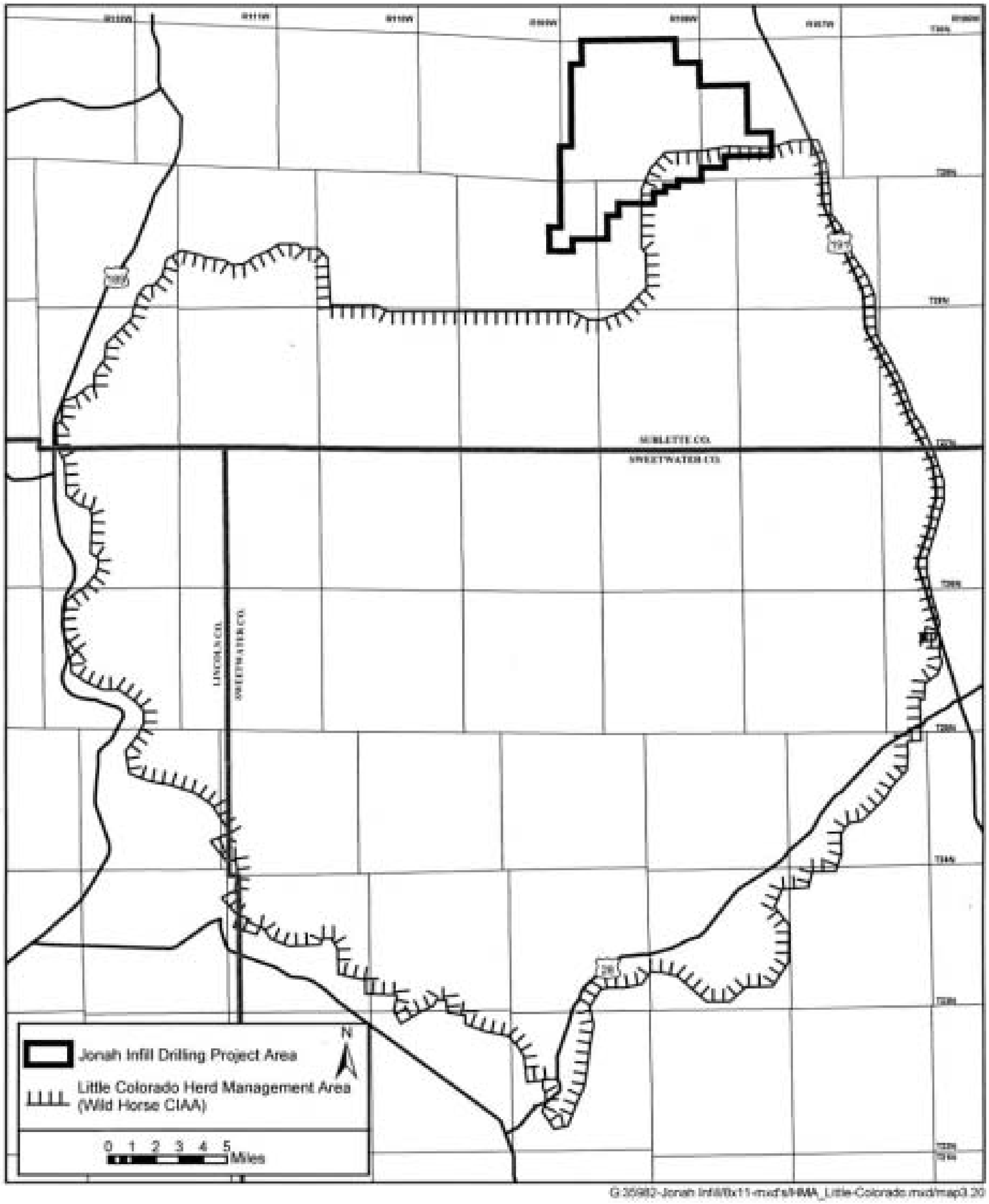
Table 3.20 BLM Pinedale Field Office Sensitive Animal and Plant Species and Potential Occurrence in the Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.[1]

Common Name	Habitat Preference[2]	Recorded Occurrence[3]
MAMMALS		
Long-eared myotis	Conifer and deciduous forests, caves, and mines	
White-tailed prairie dog	Basin-prairie shrub, grasslands	X
Idaho pocket gopher	Shallow stony soils	X
Pygmy rabbit	Basin-prairie and riparian shrub	X
BIRDS		
White-faced ibis	Marshes, wet meadows	
Trumpeter swan	Lakes, ponds, rivers	
Northern goshawk	Conifer and deciduous forests	
Ferruginous hawk	Basin-prairie shrub, grassland, rock outcrops	X
Peregrine falcon	Tall cliffs	
Greater sage-grouse	Basin-prairie shrub, mountain-foothill shrub	X
Long-billed curlew	Grasslands, plains, foothills, wet meadows	X
Mountain plover	Cushionplant communities; low sparse vegetation	X
Yellow-billed cuckoo	Open woodlands, streamside willow and alder groves	
Burrowing owl	Grasslands, basin-prairie shrub	X
Sage thrasher	Basin-prairie shrub, mountain-foothill shrub	X
Loggerhead shrike	Basin-prairie shrub, mountain-foothill shrub	X
Brewer's sparrow	Basin-prairie shrub	X
Sage sparrow	Basin-prairie shrub, mountain-foothill shrub	X
FISH		
Roundtail chub	Colorado River drainage, mostly large rivers, also streams and lakes	
Leatherside chub	Bear, Snake, and Green River drainages, clear cool streams and pools	
Bluehead sucker	Bear, Snake, and Green River drainages, all waters	
Flannelmouth sucker	Colorado River drainage, large rivers, streams, and lakes	
Yellowstone cutthroat trout	Yellowstone drainage, small mountain streams, and large rivers	
Colorado River cutthroat trout	Colorado River drainage, clear mountain streams	
Fine-spotted Snake River cutthroat trout	Snake River drainage, clear fast water	
AMPHIBIANS		
Northern leopard frog	Beaver ponds, permanent water in plains and foothills	
Boreal toad (Northern Rocky Mountain population)	Pond margins, wet meadows, riparian areas	
Spotted frog	Ponds, sloughs, small streams	
PLANTS		
Pink agoseris	Mountain meadows	
Meadow pussytoes	Subirrigated meadows within broad stream channels	
Soft aster	Mountain parks and meadows	
Meadow milkvetch	Moist alkali meadows and swales in sagebrush valleys, 4,400-6,300 ft in elevation	

Table 3.20 (continued)

Common Name	Habitat Preference[2]	Recorded Occurrence[3]
Bastard draba milkvetch	Rocky areas with low cover within sagebrush and cushionplant communities on sandstone, stony clay, badlands, and barren clay slopes and ridges, 6,900-7,200 ft in elevation	X
Payson's astragalus	Clear cuts, burns, and blow-down areas in the Wyoming Range, 6,700-9,600 ft in elevation	
Trelease's milkvetch	Sparsely vegetated sagebrush communities on shale or limestone outcrops and barren clay slopes at 6,500-8,200 ft in elevation	X
Seaside sedge	Alpine and subalpine meadows	
Black and purple sedge (F)	High mountain slopes and meadows	
Cedar Rim thistle	Barren, chalky hills, gravelly slopes, and fine textured, sandy-shaley draws, 6,700-7,200 ft in elevation	X
Boreal draba	Volcanic slopes; cliffs and riparian areas with loamy alluvium, and mossy mats, 6,200-8,550 ft in elevation	
Rockcress draba	Rocky ridges and slopes in mountains	
Giant helleborine	Wet areas in Grand Teton and Yellowstone Parks	
Wooly fleabane	Talus steep alpine slopes or rims, 10,800-11,000 ft in elevation	
Narrowleaf goldenweed	Semi-barren clay flats and slopes, gravel bars and sandy lake shores, northwest and central Wyoming	
Keeled bladderpod	Sparsely vegetated outcrops on slopes and ridge crests, Teton County	
Large-fruited bladderpod	Gypsum-clay hills and benches, clay flats, and barren hills, 6,800-7,700 ft in elevation	X
Payson's bladderpod	Windswept gravelly ridge crests, semi-open slopes, and talus slopes in mountain sagebrush/grassland communities and conifer clearings, 5,500-10,600 ft in elevation	
Marsh muhly	Bogs, springs, peaty or calcareous meadows, floating mats, and stream edges, 4,700-6,600 ft in elevation	
Contracted Indian ricegrass	Plains and hills, basin areas, northwest-central, northeast, east-central, southwest and south-central Wyoming	
Naked-stemmed parrya	Steep talus slopes in alpine or upper subalpine zones, 9,600-12,240 ft in elevation	
Beaver Rim phlox	Sparsely vegetated slopes, Wind River Basin, Fremont County, 6,000-7,400 ft in elevation	
Tufted twinpod	Sparsely vegetated shale slopes and ridges 6,500-7,000 ft in elevation	X
Creeping twinpod	Barren, rocky, calcareous hills and slopes in mountainous areas, 6,500-8,600 ft in elevation	
Greenland primrose	Wet meadows and calcareous montane bogs, 6,600-8,000 ft in elevation	

1 Based on BLM (2003b).
2 Plant habitat preference based on Hallsten et al. (1987), Dorn (1992), and Keinath et al. (2003).
3 Recorded occurrences on or in the vicinity of the JIDPA (WYNDD 2003; TRC Mariah 2001a, 2001b, 2002, 2004a).



Map 3.20 Little Colorado Wild Horse Herd Management Area (CIAA), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

However, horses from the LCHMA have entered the PFO area and the JIDPA (often through gates being left open); and are subsequently herded back to the RSFO and LCHMA.

3.3 CULTURAL AND HISTORIC RESOURCES

The following sections discuss the cultural resources within the JIDPA. An historic overview was provided in the Jonah II EIS (BLM 1997a, 1998a) and is not repeated in this EIS.

3.3.1 Introduction

Cultural resources, which are managed pursuant to the *National Historic Preservation Act of 1966* and the *Archaeological Resources Protection Act of 1979* and other statutes, are the nonrenewable remains of past human activity. The CIAA for cultural resources includes the JIDPA and surrounding area as depicted on Map 3.5. The archaeological record of the JIDPA has been created and identified through Class III cultural resource inventories (100% coverage pedestrian surveys), informal surveys, construction monitors, test excavations, salvage excavations, formal data recovery excavations, examination of ethnographic materials used to determine ethnic origin, local informant interviews, consultation with modern Native American people, archival sources, and the historic record. Continued development since 1997 and at an accelerated pace has steadily increased the number of cultural resource inventories performed (estimated at approximately 1,500), and the number of known sites has increased accordingly (estimated at between 1,000 and 2,000 sites).

3.3.2 Site Types

The JIDPA is rich in prehistoric resources but contains few historic period sites. The historic period sites predominately relate to open-range ranching, stock grazing, and wagon road passage. Most historic sites consist of nonsignificant debris scatters.

An informal search of the SHPO cultural records database indicated that (as of November 2003) there are over 1,000 known cultural properties within the JIDPA, the majority of which are prehistoric archaeological sites. Extrapolating from the results of seismic inventories that have provided broad systematic survey coverage of the area, roughly one site per 17 acres occurs within the JIDPA (an average of 38 sites per section). Actual site density is probably even higher due to frequently encountered buried archaeological sites that lack surface manifestations.

Known prehistoric site types within or near the JIDPA include open campsites, lithic scatters, housepits, rock alignments, kill/butchering sites, rockshelters, floral processing locales, sacred or respected sites, extensive lithic procurement locales (see Archaeological Landscapes, Appendix F-1.5 of the Jonah II EIS [BLM 1997a, 1998a]), limited activity sites, Traditional Cultural Properties, and sacred or respected places. A "Traditional Cultural Property" can generally be defined as a property that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that are rooted in the community’s history and are important in maintaining the continuing cultural identity of the community. The Traditional Cultural Properties in the JIDPA also are considered sacred or respected places (areas that local Native American tribes consider sensitive, important for current uses [e.g., plant collection], and/or of religious importance pursuant to *EO 13007*. These properties include rock alignment sites, visionquest locales, stone circle sites such as tipi rings, and cairns. No drivelines are currently known, but they may be present in the area. No petroglyph or pictograph sites are presently known, even though the geology of the area (i.e., the presence of numerous rock outcrops) is conducive to the presence of these site types. One prehistoric human burial has been encountered. Prehistoric sites between 4,000 and 7,000 years old are common, many of which are completely buried with few (if any) surface manifestations.

A considerable amount of inventory, testing, monitoring, and salvage excavation has been completed in the JIDPA, especially since the mid-1990s (estimated at over 1,500 actions). It has resulted in the identification and recording of a large number of prehistoric cultural properties (estimated at over 1,000), most notably those discovered during construction. Larger-scale data recovery excavations are becoming more common as discoveries continue to be made and adverse effects are mitigated.

3.3.3 Native American Sensitive Sites and Traditional Cultural Properties

In the late nineteenth century, the JIDPA was used predominantly by the Shoshone Tribe, though Bannock, Ute, and other Tribes frequented the Upper Green River. Sites relating to prehistoric tribal use exist, but identifying specific tribal affiliation to these remains is difficult. Some prehistoric sites, as well as some of the more modern Native American use sites, may be considered respected areas or sensitive sites by modern Native Americans and may be formally considered Traditional Cultural Properties.

Sites and properties within this class are protected by numerous laws, such as the *Native American Graves Protection and Repatriation Act* (NAGPRA), the *American Indian Religious Freedom Act* (AIRFA), and by various executive orders (e.g., *EO 13007*). Human burials, rock alignment sites, petroglyphs, steatite procurement locales, and modern-day Native American use, extraction, or religious sites are considered sensitive or sacred to modern Native Americans. Several such sites have been identified in the area. Consultation with potentially affected Native American Tribes concerning the identification and management of specific Traditional Cultural Properties and other sensitive sites began in 1998, and this consultation resulted in several recommendations concerning the management of sensitive/sacred/respected sites, disturbance buffers, holistic management approaches and guidelines, and how Native American traditional practitioners want BLM to manage sensitive areas. The general theme of the consultation has been to leave these sensitive areas undisturbed.

Representatives of the Shoshone and Ute Tribes have visited the Jonah area during the period of 1997 through 2001. Consultation particularly focused on the site 48SU4000 Archaeological District. Additionally, in 2002, formal NAGPRA consultation with the Shoshone Business Council took place concerning the 7,300-year-old human remains encountered during construction of a well pad. Consultation among the BLM, Shoshone Tribe, and possibly other tribes would continue throughout Project development.

3.3.4 Culture Historic Context and Chronology

The prehistory of the Green River Basin, which encompasses the JIDPA, is typically considered in relationship to the prehistory of the larger western Wyoming Basin, which also includes the Great Divide and Washakie Basins and the Rock Springs and Rawlins Uplifts. The prehistory of the western Wyoming Basin is typically discussed in terms of a series of periods and phases originally defined specifically for the region by Metcalf (1987) (Table 3.21). The breakdown of periods and phases is based on such characteristics as artifact assemblages, house and pit forms, shifts in settlement or resource procurement patterns, and peaks and valleys in the frequencies of radiocarbon dates (Wheeler et al. 1986; Metcalf 1987; McNees et al. 1992; Thompson and Pastor 1995; Vlcek 1997). At the broader level, the prehistory of the region is broken down into the Paleoindian, Early Archaic, Late Archaic, Late Prehistoric, and Protohistoric periods. The Early Archaic, Late Archaic, and Late Prehistoric periods are typically further subdivided into the Great Divide and Opal phases, the Pine Spring and Deadman Wash phases, and the Uinta and Firehole phases, respectively. Though most researchers agree on the general nature and sequence of the phases, some disagreement exists on their beginning and ending dates. Table 3.21 uses the dating modified from McNees et al. (1992) and Vlcek (1997).

Evidence indicates that the JIDPA has been occupied almost continuously since at least the Folsom stage of the Paleoindian period about 10,900 years before present (B.P.). Occupation of the area apparently intensified after approximately 8,500 years B.P. and especially after 7,200 years B.P.

The Paleoindian period in Wyoming is typically discussed in terms of the sequence of "classic" Paleoindian point types initially established on the basis of data from the Hell Gap site in eastern Wyoming and subsequently amplified and refined. In the Wyoming Basin, it is typically represented by the Clovis, Goshen, Folsom, Agate Basin, and Hell Gap points. Alberta, Alberta-Cody, and Cody cultural complexes are also commonly represented but appear to be more transitional to the lifeways represented in the subsequent Archaic period. The Paleoindian period was characterized by a large-animal hunting-oriented economy that was specialized even in contrast to later bison-hunting groups on the plains.

Initially, that strategy focused on the procurement of mammoth and/or other megafauna, but then it shifted to bison and apparently incorporated an increasingly broader spectrum of smaller animal and plant resources.

Occasional surface finds of fluted projectile points of the Clovis and Folsom traditions indicate that, at a minimum, human beings have lived in the Green River Basin since the end of the Pleistocene geologic epoch. However, evidence of the big game foraging tradition, which has defined the early Paleoindian adaptation, is rare. Evidence most commonly consists of surface finds of Paleoindian points.

Table 3.21 Prehistoric Cultural Chronology for the JIDPA and Southwestern Wyoming.[1]

Period	Phase	Age (Years Before Present [B.P.])
Paleoindian	--	11,500-8,500
Early Archaic	Great Divide	8,500-6,000
	Opal	6,000-3,600
Late Archaic	Pine Spring	3,600-2,900
	Deadman Wash	2,900-1,800
Late Prehistoric	Uinta	1,800-1,000
	Firehole	1,000-250
Protohistoric	--	250-0

[1] Metcalf 1987; McNees et al. 1992; Vlcek 1997.

Few sites containing classic Paleoindian points have been discovered in the area, although such sites are known. For example, the site complex containing Sites 48SU389, 48SU907, 48SU908, and 48SU909 just south of the JIDPA has produced artifacts from the Folsom, Hell Gap, Agate Basin, Scottsbluff, and Cody complexes spanning a time period from 12,000 to 8,000 years B.P. (Frison 1991). Folsom points have been found at three localities in the JIDPA (two along Sand Draw and one in the 48SU4000 Archaeological District). At least 16 sites or locations have produced surface Paleoindian projectile points in the Jonah area. Site 48SU1421, situated adjacent to an ancient playa, contained several projectile points that tentatively date two components at the site from 9,000 to 8,500 years B.P. Another site (Site 48SU2980) encountered during pipeline construction has been dated to 8,600 years B.P. and has a possible Paleoindian connection, and sites/site complexes that include Sites 48SU2662, 48SU3087, and 48SU3090 have also produced Paleoindian material. A Hell Gap point was discovered eroding out of a low sand sheet in the northern Jonah field, and Scottsbluff complex artifacts have been recorded in various portions of the field, including within the Site 48SU4000 Archaeological District (see Section 3.3.7). Additionally, three Early Archaic period JIDPA sites (48SU2094, 48SU2324, and 48SU4479) dating from 4,590 to 8,210 years B.P. were recently excavated (McKern and Harrell 2004).

The lifeways defining the Early Archaic period in the western Wyoming Basin may have begun as early as the middle Paleoindian period, possibly as a result of a "settling-in" process (McNees 1998:36). These lifeways apparently were characterized by the more-intensive use of the landscape by groups pursuing an increasingly broad-spectrum hunting and gathering lifestyle. Specific characteristics of those lifeways are believed to have included a settlement and subsistence strategy oriented to specific geographic areas on a year-round basis, including especially a reliance on a broader range of plant and animal food resources. This more "place-oriented" lifeway resulted in the apparent elaboration of house and cooking pit forms represented in the archaeological record.

In the western Wyoming Basin in general, the archaeological record contains a gradually increasing number of dated components through the time period beginning around 8,500 years B.P., with a more significant increase after 6,000 years B.P. The number of radiocarbon-dated sites then generally declines again across the region throughout the Late Archaic period. Cultural remains dating to the Late Archaic period become more complex and more diverse through time. The earlier part of the Early Archaic period corresponding to the Great Divide phase is typically characterized by sites containing limited remains, typically a simple firepit or two, a few flaked stone artifacts, and bone scraps, most commonly from rabbits and occasionally pronghorn. Artifacts associated with Early Archaic period sites in the area tend to be limited in number and type. The Great Divide phase tends to be characterized by large side-notched points, which give way to more-diverse, less-distinctive, and less-frequent collections of side- and corner-notched projectile points of the Opal phase. After about 6,500 years B.P., housepits become a prominent trait of the period, as do slab-lined cylindrical baking pits and deep unlined baking pits after about 6,000 years B.P. The coalescence of those traits is judged to represent the transition to the Opal phase around 6,500 to 6,000 years B.P. The Opal phase appears to have been a time of a significant increase in the number of sites and population compared with the preceding and subsequent phases in the western Wyoming Basin in general (Smith 2003). Small mammals, especially rabbits probably opportunistically captured near the camps, are the most commonly identified animals from the housepit bone assemblages. However, pronghorn bone is also relatively common, and the Trapper's Point site to the north of the JIDPA evidences relatively intensive pronghorn procurement. The deep baking pits suggest the relatively widespread use of roots, most likely biscuitroot and onion.

One of the most distinctive aspects of the archaeological record of the JIDPA and its immediate surroundings is the abundance of archaeological sites dating to the later Great Divide phase, in contrast to the rest of the western Wyoming Basin (TRC Mariah 2001c). The archaeological record indicates that occupation of the JIDPA began to intensify after approximately 8,500 years B.P. as elsewhere in the region. However, the major increase in occupation apparently began around 7,200 years B.P. The appearance of the remains of house structures in and around the JIDPA likewise pre-dates that in the rest of the region. Figure 3.14 illustrates the excavation of a typical housepit. Most of the houses have yielded radiocarbon dates between 7,110 and 6,000 years B.P. A post mold associated with a house at Site 48SU3835 yielded an age estimate of 8,240 years B.P. (Nelson and Richard 2004) and one associated with a house at the J. David Love site (Site 48SU4479) yielded an age estimate of 8,210 years B.P. (McKern and Current 2004), the two earliest dates for house structures recorded in the region. Only a few structures in the project area have yielded dates of less than 6,000 years B.P. By contrast, only one housepit out of 41 fully excavated housepits from 21 sites in Wyoming listed by Smith (2003) and a list of excavated housepits from the Green River Basin and immediately adjacent areas compiled by Thompson and Pastor (1995) yielded a date of 6,000 years B.P. or older, and it was dated at 6,000 years B.P. Therefore, it is clear that the house remains in the Jonah area represent a distinctive temporal phenomenon in the archaeological record of the region.

The house structures excavated in the JIDPA are distinctive in other ways as well. They include both "classic" housepits characterized by large, circular stains that are basin-shaped in cross section, as well as circular or semicircular areas delineated by apparent post molds around the perimeter of clusters of hearth-type basins. The latter type appears to be distinctive to the Jonah area.

The transition from the Early Archaic period to the Late Archaic period is marked by a decrease in radiocarbon-dated sites in the western Wyoming Basin at about 3,600 years B.P. Despite minor regional peaks from 3,200 to 3,000 years B.P., 2,900 to 2,700 years B.P., and 2,000 to 1,800 years B.P., the frequencies of radiocarbon-dated sites remain depressed into the early Late Prehistoric period. Because of the limited number of investigated sites dating to the Late Archaic period, it remains poorly understood. The period was apparently marked by the decreased use of the area by interior basin-adapted groups, possibly reflecting a decline in population and/or a shift in settlement and subsistence strategies (McNees 1992).

Some investigators in the region have placed the end of the Opal phase Early Archaic period and the start of the Pine Spring phase Late Archaic period around 4,400 years ago to coincide with the full time span of McKean complex dart points in the region. However, sites containing McKean complex points appear to represent a different cultural phenomenon than the abundance of sites displaying more typical Opal phase traits such as housepits, slab-lined cylindrical pits, deep baking pits, and side- and corner-notched projectile points. Only after the cultural complex exhibiting these latter traits becomes attenuated around 3,600 years B.P. do sites containing McKean complex points become dominant as a result of the vacuum created by the absence of the more typical Opal phase sites.

The Pine Spring phase of the Late Archaic period is typically defined by the prevalence of McKean complex dart points. McKean complex stemmed and lanceolate dart points occur at sites in the western Wyoming Basin beginning as early as 4,900 years B.P. (McNees 1992). They appear to be most common at sites dated between 4,400 and 3,000 years B.P. Surface finds of McKean complex dart points are common within and around the JIDPA. McKean complex points

Figure 3.14 Typical Housepit Excavation, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

have been reported for Site 48SU1754 in the Bull Draw drainage, Site 48SU1328 on a bench above Sand Draw, and Site 48SU3090 at the Sand Draw playa complex. The McKean complex point at Site 48SU3090 is consistent with age estimates obtained from features in the complex, including estimates of 3,580 and 3,900 years B.P. from a cobble-lined and a bell-shaped basin, respectively, suggesting the presence of intact McKean complex components in the area (Plastino 1999). Based upon radiocarbon dating, a McKean concentration has been found in the JIDPA. The presence of Pine Spring phase sites in the JIDPA is also indicated by firepits radiocarbon dated to that time period.

The transition from the Pine Spring phase to the Deadman Wash phase is typically placed around 3,000 or 2,900 years B.P. to correspond with the transition from the use of McKean complex dart points to the use of corner-notched dart points. Evidence for Deadman Wash phase use of the JIDPA area is even more limited than for Pine Spring phase use. Corner-notched dart points diagnostic of the phase are not as distinctive or definitive as McKean complex points, making them less effective as an indicator of occupation of the area during that time period. Likewise, fewer features have been dated to this phase, which suggests that the phase may be poorly represented in the area.

The Uinta phase of the Late Prehistoric period exhibits a peak in the number of radiocarbon-dated components in the western Wyoming Basin, specifically between 1,500 and 1,000 years B.P. In many aspects, this phase of the Prehistoric period more closely resembles the Early Archaic period than the immediately preceding Late Archaic period or the subsequent Firehole phase. The Uinta phase is generally considered to coincide with the introduction or general adoption of bow and arrow technology. Pottery also first appears in the archaeological record of the region during this period, although it apparently only became an integral element of the indigenous inhabitants of the region after approximately 900 years B.P.

The Uinta phase is characterized by repeated occupation of the same site localities and the use of deep cylindrical basins, small circular habitation structures, more common ornamental artifacts (e.g., bone tubes and bone disks), and a broad spectrum of large and small animals and plant resources, including pronghorn, occasionally bison, and seeds from weedy annuals. Uinta phase sites and components are often much more artifact- and data-rich than sites from other periods. Classic Uinta phase sites contain Rose Spring arrow points but lack pottery. Interestingly, radiocarbon-dated Uinta phase sites or sites with Rose Spring points are relatively uncommon in the JIDPA.

Following the Uinta phase is the Firehole phase. In most of the western Wyoming Basin, Firehole phase sites are rare in comparison to Uinta phase sites. McNees (1992) argues the Firehole phase represents a return to a lifeway that relied more heavily on hunting large game animals, including bison, similar to that of the Pine Spring and Deadman Wash phases, with less reliance on more intensive use of smaller animals and plants. The Firehole phase is characterized by the predominance of side-notched, tri-notched, and unnotched points; by quartz sand-tempered (Intermountain Ware) pottery; and by the abrupt disappearance of typical Uinta phase traits between 1,000 and 950 years B.P. The historic Shoshone inhabitants of the region likely first arrived during the Firehole phase.

In contrast to much of the western Wyoming Basin, the JIDPA and surrounding area contain a large number of sites dating to the Firehole phase. Site 48SU4000 Archaeological District appears to be dominated by Firehole phase materials (Miner 2001). The phase is associated with an extensive and distinct area of interior basin sandstone outcrops and includes numerous rockshelter alcoves and stone circles. Associated artifacts include side-notched and unnotched points and ceramics from five distinct localities. Ceramics recovered from 48SU4000 have been subject to thin sectioning analysis, and local manufacture is indicated. These ceramics show similarities to those found at the Wardell Buffalo Trap (Frison 1993). This ceramic assemblage (two sites with 500 sherds each) represents the highest known concentration of prehistoric ceramics anywhere in southwestern Wyoming. Ceramics have also been recovered from other sites in the area, including Sites 48SU1443, 28SU2261, and 48SU3017.

3.3.5 Geomorphology

Geomorphological studies that examine the relationship among geology, soils, topography, and vegetation are important to archaeologists because most significant prehistoric sites are located within specific soil matrices (i.e., the history of which contributes to the integrity of the site, the integrity of cultural deposits, and the post-depositional history of the site). These factors are critical for understanding the nature, integrity, and preservation potential of the archeological resources in the JIDPA.

Of particular interest in the JIDPA is the San Arcacio-Saguache soils complex (soil map unit 125), which occurs along the lower and middle reaches of Sand Draw. The San Arcacio soils form on geomorphically stable surfaces at less than 3% slopes, mainly on level or uniformly sloping surfaces with deposits of uniform depth. They typically exhibit a sandy clay loam horizon with oxidized colors and clay enrichment over coarse sand (Eckerle and Taddie 1997) and occur on old floodplains, fans, and terraces. The soils are typically sandy and have formed in coarse sandy alluvium (ERO Resources Corporation 1988:49). Plastino (Plastino and Randolph 2000:4) describes the soils as "sandy loam above coarse sand with an increasing gravel content with increasing depth." According to Eckerle and Taddie (1997:8), "The [San Arcacio] soil is formed into a coarse, moderately well-sorted, subangular to subrounded, nonfrosted sand, [the] exact genesis of which is not presently known." They argue that the source material of the sand does not appear to be local. The depth of the sand deposit exceeds 4 m in at least one location.

Eckerle and Taddie (1997) state that the San Arcacio soils compare well to the Vonalee-Hiland soil/paleosol documented in other parts of the Wyoming Basin on aeolian deposits that have been stable since the middle Holocene, except that they are slightly older. They suggest that occupation occurred on a sheet deposit intermittently active from sometime before 7,000 years B.P. until approximately 3,700 years B.P., after which the surface stabilized, and the San Arcacio soils began to form. The San Arcacio soils remain the modern surface.

Buried cultural features have frequently been encountered in San Arcacio soils during construction in the Sand Draw area. Those features typically range in age from approximately 4,000 years B.P. to greater than 7,000 years B.P. The tops of the features typically occur at depths of only 15 to 20 cm below the ground surface, yet the locales frequently lack any surface manifestation or topographic relief to differentiate them from other portions of the surrounding landscape. The features typically include hemispherical basins with and without rock, as well as housepits and other house remains. They are typically encapsulated within the aforementioned sandy clay loam soil horizon and exhibit remarkable preservation.

3.3.6 Discovered Sites

In recent years, discoveries have occurred in a number of management contexts. Those contexts include discoveries at previously recorded sites at which subsurface components were not expected or detected (sometimes despite extensive testing and/or magnetometer surveys), previously unidentified sites with (often very sparse) surface expressions, and previously unidentified sites lacking any surface expression. The latter are by far the most prevalent and the most problematic because there is no favorable or adequate current methodology to identify them in a cost- and time-effective manner prior to construction. Discoveries have occurred in a number of different construction contexts, including well pad stripping and leveling, access road construction, and pipeline trench construction. The sites include locales with housepits or other structural remains and basins with low to moderate densities of artifacts, locales with stained layers and basin features with moderate densities of associated flaked stone artifacts and bone, locales consisting primarily of basin features with few associated artifacts, and locales with a single hearth or cultural stain. In portions of the JIDPA (i.e., Stud Horse Butte, Corona, and Cabrito units), nearly one in six projects have yielded discoveries (TRC Mariah 2001c).

As of August 2004, one prehistoric human burial has been encountered within a discovery scenario, although the actual human remains were found during salvage excavations. The majority of the discoveries to date have occurred at a relatively shallow depth (15 to 30 cm) in sheet deposits. The best known of those deposits are the San Arcacio soils of the Sand Draw area. Other sediment types in the JIDPA, away from the Sand Draw terraces, have yielded discoveries in often geomorphologically complex contexts that have also proven difficult to identify by surface analysis and preconstruction testing. These discoveries have generally not been as significant or as time-consuming to mitigate as the structural remains that are mostly found in the San Arcacio soil contexts along Sand Draw.

House remains initially identified during well pad or access road construction have been partially or completely excavated at a minimum of seven sites in the JIDPA to date. They include the remains of 17 housepits or surface structures excavated at the McKeva Ryka site (Site 48SU2094), Jonah's House site (Site 48SU2324), and J. David Love site (Site 48SU4479), and Sites 48SU3835, 48SU2317, 48SU3291, and 48SU3519. The houses generally had interior firepits, but few flaked stone artifacts, bone fragments, or other remains were associated with most of the houses. Fossils, tentatively identified as Pleistocene horse bones, a very rare occurrence in Wyoming, have also been discovered and a human burial dated at 7,290 years B.P. was encountered in a shallow circular pit at the J. David Love site (McKern and Current 2004). This burial represents the earliest known human remains from Wyoming and is one of the earliest known burials from the entire Rocky Mountain region.

3.3.7 Highly Sensitive Archaeological Locales

The following section discusses the most highly sensitive and threatened archaeological locales in the JIDPA. Development and implementation of specific activity plans may be necessary to ensure that these valuable resource areas are adequately protected from impacts directly or indirectly related to energy development.

3.3.7.1 Sand Draw/Bull Draw Divide

The Sand Draw/Bull Draw Divide upland is one of the most sensitive and complex locales currently known for the JIDPA. During 2000-2001, it was the subject of an intensive block inventory followed by formal site recordations and evaluations (Miner 2001). The site complex has been designated the "Site 48SU4000 Archaeological District" and is also known as the "Vlcek Archaeological District." This is the first Archaeological District established within the PFO.

The site complex is characterized by sandstone outcrops containing vertical rock faces, overhangs, nooks, and boulders bordering and enclosing sand-filled openings and pockets. A nearly continuous scatter of cultural material is present across that area. Identified archaeological remains include numerous rockshelters and alcoves containing cultural deposits, stone circles, buried hearths, areas of culturally stained sediment, numerous projectile points and point fragments, abundant bifaces and other flaked stone tools, ceramics, abundant obsidian artifacts, groundstone, at least one sandstone abrader, abundant burned bone, and mussel shell, among other things. Rock art is conspicuously absent from the cultural remains noted to date, despite the presence of suitable rock faces. Prehistoric human burials or interments have also not been identified to date, although their occurrence somewhere within or around the rock outcrops is likely.

Much of the described cultural remains apparently date to the Late Prehistoric period (primarily to the Firehole phase) but all other temporal periods are represented as well. Projectile points and point fragments typically include small side-notched points. Small triangular points and at least one base-notched point have also been recovered. Potsherds were recovered from at least five loci within the locale, some of which apparently closely resemble the ceramics from the Wardell Bison Kill site. Small- and medium-sized corner-notched points and point fragments are also present. A Folsom point was also reportedly collected from one locale within the site complex. Numerous clusters of artifacts were thought to be collectors' piles and indicators of extensive vandalism. Miner (2001) refutes this, however, making a strong argument that most of the piles are the result of packrat activity.

The Site 48SU4000 Archaeological District is an exceedingly significant set of properties unique to the region. The area is also considered highly sensitive by Native Americans. The types, density, and diversity of the remains all contrast sharply with the remains typically encountered in the JIDPA and the region. The District contains numerous areas of apparently intact deposits containing dense, well-preserved remains with rich data potential. Moreover, it appears to have significant, and perhaps unique potential to provide insight into some of the more distinctive and prominent cultural manifestations known in the region, especially during the Late Prehistoric period, including potentially the poorly understood but distinctive cultural manifestation represented at the nearby Wardell Bison Kill site. There is also a possibility of relict Folsom and other Paleoindian deposits in isolated nooks or pockets.

3.3.7.2 Sand Draw Playa Complex

The Sand Draw playa is situated toward the lower (western) end of Sand Draw approximately 700 ft south of the stream channel. It is encircled by a low rim around its western, southern, and eastern sides but opens north toward Sand Draw. It has been modified by historic ranching activity by way of a ditch into Sand Draw. The playa area is privately owned. Another large enclosed depression is located slightly less than 1 mile to the north, and a smaller enclosed depression is located just over 0.5 mile to the north-northwest, north of Sand Draw. Both of these depressions are on BLM surface. Neither of these depressions are presently mapped as playas, but both may have been playas in the past and they suggest that a complex of playas may have once been present in the area.

The playa complex area may have served as a focus for Paleoindian period occupations. A similar playa complex in the Jonah Gulch site complex (including Sites 48SU389, 48SU907, 48SU908, and 48SU909), located approximately 12 miles to the southeast, contains extensive Paleoindian components. To date, no significant intact Paleoindian components have been identified in the vicinity of the Sand Draw playa complex. However, both a Folsom point and a point tentatively identified as Goshen or Dalton have been recovered as surface finds, suggesting that such components may be present.

The Sand Draw playa complex, due to its capture of more moisture than other JIDPA locations, may preserve archaeologically important paleoclimatic data. Specifically, pollen, which usually is not preserved or recovered from archaeological deposits in other JIDPA locations, may be well preserved in the playa complex. These data are critical for establishing baseline information concerning the paleoenvironmental reconstruction of the JIDPA.

Plastino (1999) noted two soil types within the playa complex area during testing at Site 48SU3090 in a sheltered backslope context with colluvial and aeolian deposits, and in a lower slope/drainage bottom context characterized by slopewash deposits. Testing and monitoring have indicated the presence of intact subsurface deposits of both types, including a basin well out into and under modern playa deposits at a depth of 25 cm below the ground surface at Site 48SU3089 at the northern tip of the playa. A stain of possible cultural origin was also noted at a greater depth of 51 cm.

Three sites adjacent to the Sand Draw playa were tested as part of a testing program associated with a geophysical project (Kohler et al. 2003). The sites (Sites 48SU2662, 48SU3087, and 48SU3090) were selected because of their abundant surface artifacts and potential to contain buried Paleoindian cultural remains. These sites have usually been avoided by development projects, and little subsurface testing has been performed. The limited testing program revealed few, if any, cultural remains at the three sites, and no intact cultural components were identified. The tested areas generally exhibited colluvial/slopewash deposits and did not contain San Arcacio soils.

Discoveries made during testing and monitoring indicate that the Sand Draw playa area is characterized by a large proportion of basin types not commonly represented in other parts of the JIDPA. They include cobble-lined and cobble-filled basins, bell-shaped basins, and U-shaped basins (e.g., at Sites 48SU3049, 48SU3850, and 48SU3089). Point types noted in the area include a McKean complex point, a point described as a "Pelican Lake or Rose Spring" point, and a Rose Spring point. The apparent McKean point is consistent with age estimates obtained from features in the complex, including estimates of 3,580 and 3,900 years B.P. from a cobble-lined basin and a bell-shaped basin, respectively, which suggest the presence of intact McKean complex components in the area.

These patterns suggest that the playa complex may have been a locus of different procurement/processing activities and/or of more concentrated occupation by different groups and/or at different times than other portions of the JIDPA. Therefore, sites in the area have the potential to provide distinct and important information concerning prehistoric land use patterns in the JIDPA and the region.

3.3.7.3 Central Sand Draw

Terraces along the central part of Sand Draw contain a concentrated locus of early to mid-Holocene housepits and other structural remains and contemporaneous basins, as was discussed above with regard to the Sand Draw/Bull Draw Divide. This segment of Sand Draw lies below and to the west of Stud Horse Butte at its upper end and above the Sand Draw playa at its lower end. The housepit occupations may have been intentionally positioned in proximity to the playa complex.

Plastino (1999) describes a series of at least three terraces above Sand Draw. He estimates the three terraces occur at 2 m, 4 m, and >4 m above the modern Sand Draw channel. He describes two of the terraces as strath terraces with nearly level trends. Sediments across the lower terraces are classified as San Arcacio soils.

As part of the geophysical project mentioned above, four sites were selected for testing along Sand Draw to investigate areas of interest that are usually avoided during development projects (Kohler et al. 2003). Sites in the testing program along Sand Draw included Sites 48SU1779, 48SU2246, 48SU3088, and 48SU4011. Most of the testing was conducted in San Arcacio sediments, and the majority of cultural material was recovered from San Arcacio strata. Two San Arcacio strata were identified: San Arcacio "A" stratum was interpreted as post-dating 3,000 years B.P., and San Arcacio "B" stratum was the lower, older layer dating between 3,000 and 7,000 years B.P. Site 48SU2246 was the only site tested that did not contain San Arcacio soils. Ceramic and obsidian artifacts were found on the surface of this site, and additional pieces of pottery were recovered from the test unit. Site 48SU2246 appears to date to the Late Prehistoric period based on the ceramic assemblage, while the remaining sites appear to date to the Archaic period based on their presence in San Arcacio soils. Only a few features were identified in the 67 m^2 of excavation, none were structural, and none were radiocarbon dated. Few of the test units yielded more than a small number of artifacts or other types of cultural remains.
Recent notable housepit/structure data recovery excavations along Sand Draw have occurred at the McKeva Ryka site (Site 48SU2094), Jonah's House site (Site 48SU2324), the J. David Love site (Site 48SU4479), Site 48SU3835, and Site 48SU3519. These sites are all located on the Sand Draw terraces in San Arcacio sediments, and all were excavated to mitigate impacts to features encountered during well pad or access road construction.

The McKeva Ryka site contained two housepits with postholes and interior and exterior features (McKern and Current 2002). Artifacts included a light scatter of flaked stone and bone. The housepits were radiocarbon dated to between 5,990 and 6,880 years B.P. The housepits appear to represent short-term habitations that were revisited seasonally over hundreds of years.

The Jonah's House site is similar to the McKeva Ryka site in setting, cultural remains, and apparent function. It contained two housepits with postholes and a sparse scatter of artifacts and bone (McKern and Current 2003). It was radiocarbon dated to between 6,590 and 7,070 years B.P. and also is interpreted as representing short-term, repeated habitations.

The J. David Love site is rich in structural remains, containing six housepits and three surface structures dating between 4,590 and 8,210 years B.P. (McKern and Current 2004). A pit feature in one of the housepits contained human burial remains dating to 7,290 years B.P. The burial represents the remains of an elderly woman, and it is suggested that the structure was constructed specifically for the burial. Artifacts at this site were sparse but did include fragments of red ochre.

Site 48SU3835 included a single, flat-floored surface structure with 26 postholes, six internal features, and an intact roof layer (Nelson and Richard 2004). A sparse scatter of lithic artifacts was present on the site surface, but a magnetometer survey of the area conducted prior to well pad blading did not yield evidence of buried cultural remains. Radiocarbon dates from the discovery ranged from 5,600 to 8,240 years B.P. Of particular interest was the presence of about 300 pieces of microdebitage (small discarded materials such as flakes) and about 1,000 small bone fragments recovered from feature fill. The recovery of this quantity of artifacts from a single structure is uncommon.

Site 48SU3519 was not identified during the Class III inventory that included magnetometer survey, but well pad construction revealed a cluster of 10 basin features and 11 scattered basin features (Sines and Roufs 2001). Twenty-five flakes and approximately 802 small pieces of bone were recovered from the heavy fraction of flotation fill samples. A series of possible post molds associated with the feature cluster suggests that this site also contained a shelter. Six age estimates ranging from 4,050 to 7,110 years B.P. were obtained from the features.

The housepits and other features in the central Sand Draw area provide excellent potential to contain cultural material from a time period that is crucial for understanding North American prehistory, particularly the Paleoindian-Archaic lifeway transition and hunter-gatherer adaptation to the severe climatic conditions of the Altithermal climatic episode. Intact buried components dating to that time period are uncommon, as are concentrations of housepit loci. The combination of the two in central Sand Draw would be unparalleled anywhere in the western United States.

3.4 SOCIOECONOMICS

Unless otherwise cited, the socioeconomic information that follows has been summarized from the Socioeconomic Analysis Technical Support Document for the Jonah Infill Drilling and South Piney Projects Environmental Impact Statements (BLM 2005). This document is available from the BLM PFO. Please refer to that document for more detailed socioeconomic information and analysis. Additional information has been taken from the socioeconomic profile (BLM 2003d) prepared for inclusion in the new Pinedale RMP (now in preparation). Unless otherwise stated, all dollar amounts are presented in year 2000 dollars, adjusted for inflation. Formulas used to make the calculations presented herein (e.g., change, average annual change) are illustrated and explained in detail in BLM (2005).

3.4.1 Study Area

The economic study area (i.e., the CIAA) includes the counties and communities most likely to be impacted by the proposed project, including LaBarge in Lincoln County; Pinedale, Big Piney, Marbleton, and Boulder in Sublette County; and Eden, Farson, and Rock Springs in Sweetwater County. Rock Springs is a hub of natural gas development activity and likely will be home to some of the workers. Wyoming and the United States are also included in the profile and impact analyses (see Section 4.4) where information is available and pertinent. The three-county area and the listed communities also comprise the CIAA.

3.4.2 Demography

3.4.2.1 Population Dynamics and Census Data

Population data were obtained from the U.S. Census Bureau (2000a, 2000b, 2000c, 2000d), Taylor and Lieske (2002), and the Wyoming Department of Administration and Information (WDAI) (2001a, 2001b, 2002a, 2002b, 2003a) (Tables 3.22 and 3.23). Sonoran Institute Economic Profile System (EPS) reports, charts, and raw data are on file TRC Mariah's Laramie, Wyoming, office.

Table 3.22 Historic and Projected Population.

Location	Population[1]			Total Change in Population[1]			Projected Population[1]				
	1980[2]	1990[2]	2000[2]	1980-1990	1990-2000	1980-2000	2002[3]	2010[4]	2015[4]	2020[4]	2025[4]
United States	226,542,199	248,709,873	281,421,906	9.8%	13.2%	24.2%	288,368,698	297,716,000	310,133,000	322,742,000	335,050,000
State of Wyoming	469,557	453,588	493,782	-3.4%	8.9%	5.2%	498,703	607,000	641,000	670,000	694,000
Lincoln County	12,177	12,625	14,573	3.7%	15.4%	19.7%	14,890	15,520	NP	NP	NP
LaBarge	302	493	431	63.2%	-12.6%	42.7%	NR	NR	NP	NP	NP
Sublette County	4,548	4,843	5,920	6.4%	22.2%	30.2%	6,240	6,690	NP	NP	NP
Big Piney	530	454	408	-10.1%	-1.3%	-23.0%	NR	461	NP	NP	NP
Bondurant	NR	NR	155	--	--	--	NR	NR	NP	NP	NP
Boulder	NR	NR	30	--	--	--	NR	NR	NP	NP	NP
Cora	NR	NR	76	--	--	--	NR	NR	NP	NP	NP
Daniel	NR	NR	89	--	--	--	NR	NR	NP	NP	NP
Marbleton	537	634	720	18.0%	16.9%	34.1%	NR	814	NP	NP	NP
Pinedale	1,066	1,181	1,412	10.7%	20.3%	32.5%	NR	1,596	NP	NP	NP
Sweetwater County	41,723	38,823	37,613	-6.9%	-3.1%	-9.9%	37,194	35,400	NP	NP	NP
Eden	NR	NR	388	--	--	--	NR	NR	NP	NP	NP
Farson	NR	NR	242	--	--	--	NR	NR	NP	NP	NP
Rock Springs	19,458	19,050	18,708	-2.1%	-1.7%	-3.9%	NR	17,607	NP	NP	NP

1 NR = not reported; -- = not calculated due to lack of information; NP = no projection available at this geographic level.
2 WDAI (2001a). Information for Bondurant, Boulder, Cora, Daniel, Eden, and Farson was not collected until the 2000 census. U.S. Census Bureau information was not collected for LaBarge until the 1990 census; however, WDAI reported 1980 estimates (WDAI 2001a).
3 Estimate as of July 2002. WDAI (2003a).
4 U.S. (Campbell 1997) and Wyoming (WDAI 2002b) projections.

Table 3.23 Urban and Rural Population and Density, 2000.

	Population[1]				
		Rural			
Location	Urban	Total	Farm[2]	Non-Farm[2]	Density per Square Mile
United States					
No. of People	222,358,309	59,063,597	2,987,531	56,076,066	79.6
Percent	79%	21%	5%	95%	NA
State of Wyoming					
No. of People	322,073	171,709	15,150	156,559	5.1
Percent	65%	35%	9%	91%	NA
Lincoln County					
No. of People	2,958	11,653	718	10,897	3.6
Percent	20%	80%	6%	94%	NA
Sublette County					
No. of People	--[3]	5,920	477	5,443	1.2
Percent	--	100%	8%	92%	NA
Sweetwater County					
No. of People	33,512	4,101	416	3,685	3.6
Percent	89%	3%	10%	90%	NA

[1] U.S. Census Bureau (2000a).
[2] Total rural residents living on farms and not living on farms.
[3] Sublette County has no urban population as defined by the U.S. Census Bureau.

Lincoln County

The Lincoln County population increased 3.7% between 1980 (12,177) and 1990 (12,625); however, by 2000, the population rose to 14,573, a 15.4% increase from 1990 (U.S. Census Bureau 2000a, 2000b) (see Table 3.22). Thus, the Lincoln County population increased by 2,396 (19.7%) during the 20-year study period. The majority of Lincoln County residents (11,653, 80.0%) live in rural areas (see Table 3.23). Of these, 93.5% (10,897) are nonfarm residents (U.S. Census Bureau 2000d). Lincoln County has a population density of 3.6 people/square mile (U.S. Census Bureau 2000a).

LaBarge is the community in Lincoln County that is most likely to be affected by the proposed project. Unlike Lincoln County as a whole, the population of LaBarge rose from 302 in 1980 to 493 in 1990 (63.2% increase) then fell to 431 in 2000 (-12.6%), for a net increase of 129 (42.7%) during the 20-year study period (see Table 3.22).

Sublette County

The Sublette County population in 2000 was 5,920, up from 4,843 (22.2%) in 1990 and up from 4,548 (30.2% overall) in 1980 (U.S. Census Bureau 2000a, 2000b) (see Table 3.22). Sublette

County has no urban areas as defined by the U.S. Census Bureau. Therefore, the entire population is considered rural, but of that number, 477 (8.1%) are farm residents, while 5,443 (91.9%) are nonfarm residents (U.S. Census Bureau 2000d) (see Table 3.23). Sublette County has a population density 1.2 people/square mile (U.S. Census Bureau 2000c).

Pinedale, Big Piney, Marbleton, and Boulder in Sublette County are the communities most likely to be affected by the proposed project. Bondurant, Cora, and Daniel may also be affected. Census data for Bondurant, Boulder, Cora, and Daniel were not collected until the 2000 census. In 2000, Pinedale had the largest population in Sublette County (1,412), while Boulder had the smallest population in the entire study area (30) (see Table 3.22).

According to local officials, populations have changed in the Sublette County area since the census was conducted. Pinedale has grown, although the growth has not been quantified (personal communication, May 20, 2004, with Patti Raisch, Pinedale Town Clerk); Marbleton has increased to possibly 750 residents (personal communication, May 21, 2004, with Alice Griggs, Marbleton Town Clerk), and Big Piney has remained stable or declined (personal communication, May 20, 2004, with Vickie Brown, Big Piney Town Clerk).

Sweetwater County

The Sweetwater County population in 2000 was 37,613, down from 38,823 (-3.1%) in 1990 and from 41,723 in 1980, thus the decrease over the 20-year study period was 9.9% (-4,110) (U.S. Census Bureau 2000a, 2000b) (see Table 3.22). Sweetwater County has a population density of 3.6 people/square mile; however, unlike Sublette County, 89.1% (33,512) of the Sweetwater County population lives in urban clusters (U.S. Census Bureau 2000d) (see Table 3.22). Of the 4,101 rural residents, only 416 (10.1% of rural residents; 1.1% of county residents) reside on farms.

Rock Springs is the community most likely to be affected in Sweetwater County; however, Eden and Farson may also be affected. No census data were collected for Eden and Farson until 2000. Rock Springs reflected Sweetwater County's trend, declining 1.7% from 19,458 in 1980, to 19,050 (-2.1%) in 1990, to 18,708 (-3.9% from 1980) in 2000. In 2000, Rock Springs had the largest population in the entire study area (18,708) (see Table 3.22). In the affected portion of Sweetwater County, Farson had the smallest population (242) (U.S. Census Bureau 2000a, 2000b).

3.4.2.2 Income, Poverty, and Unemployment

Income, poverty, and unemployment data are presented in Table 3.24. Households throughout the United States experienced increased income over the 20-year study period, although poverty levels remained relatively static and unemployment decreased. Overall, for the 20-year study period there was no change in poverty levels in the United States (U.S. Census Bureau 1981, 1990, 2000a). The national unemployment rate dropped throughout the 20-year study period from 7.1% to 4.0% from 1980 to 2000 (Bureau of Labor Statistics 2003). Both median household income and personal per capita income increased throughout the United States over the course of the 20-year study period--19.3% and 38.5%, respectively.

In contrast, the median household income throughout Wyoming fell by 9.3% over the course of the 20-year study period, although personal per capita income increased by 11.4% (only 0.5%

Table 3.24 Income, Poverty, and Unemployment.

Location	Median Household Income[1,2] ($)			Personal Per Capita Income[1,2] ($)			Poverty Rate[1] (%)			Unemployment Rate[1] (%)		
	1980[3]	1990[4]	2000[5]	1980[3,6]	1990[4,6]	2000[5,6]	1979[3]	1989[7]	1999[5]	1980[8,9]	1990[9,10]	2000[10,11]
United States	35,194	39,599	41,994	21,280	25,787	29,469	12.4	11.8	12.4	7.1	5.6	4.0
State of Wyoming	41,784	35,700	37,892	24,561	23,696	27,372	7.9	11.2	11.4	4.0	5.5	3.9
Lincoln County	37,627	37,534	40,794	19,602	19,071	20,980	11.5	11.1	9.0	6.0	6.6	5.2
LaBarge	NR	12,142	18,837	NR	6,995	18,837	NR	24.5	12.3	NR	NR	NR
Sublette County	36,425	35,343	39,044	25,201	24,746	26,927	9.7	8.8	9.7	2.7	2.9	3.8
Big Piney	NR	15,418	17,647	NR	8,882	17,647	NR	6.2	11.5	NR	NR	NR
Bondurant	NR	NR	19,432	NR	NR	19,432	NR	NR	19.2	NR	NR	NR
Boulder	NR	NR	12,500	NR	NR	NR	NR	NR	33.3	NR	NR	NR
Cora	NR	NR	20,831	NR	NR	20,831	NR	NR	7.9	NR	NR	NR
Daniel	NR	NR	21,213	NR	NR	21,213	NR	NR	24.4	NR	NR	NR
Marbleton	NR	15,125	18,446	NR	8,713	18,446	NR	10.1	4.2	NR	NR	NR
Pinedale	NR	17,030	20,441	NR	9,811	20,441	NR	12.9	8.9	NR	NR	NR
Sweetwater County	50,394	47,707	46,357	10,955	16,810	28,037	5.2	7.4	7.8	3.7	5.5	4.8
Eden	NR	NR	52,625	NR	NR	18,392	NR	NR	17.6	NR	NR	NR
Farson	NR	NR	44,545	NR	NR	16,140	NR	NR	0.0	NR	NR	NR
Rock Springs	19,525	19,456	51,539	4,471	11,208	19,396	5.8	8.5	9.4	NR	NR	NR

1 NR = not reported.
2 All national, state, and local area dollar estimates are in year 2000 dollars adjusted for inflation based on U.S. average consumer price index (for urban consumers). EPS uses the urban consumer base; therefore, it was also applied to inflation adjustments for this technical report to maintain consistency.
3 U.S. Census Bureau (1981) (based on 1979 income); median household income for all geographic units; personal per capita for towns and cities. Poverty rate is the percent of people in poverty.
4 U.S. Census Bureau (1990) (based on 1989 income); median household income for all geographic units; personal per capita for towns and cities. Poverty rate is the percent of people in poverty.
5 U.S. Census Bureau (2000c) (based on 1999 income); median household income for all geographic units; personal per capita for towns and cities.
6 Bureau of Economic Analysis (BEA) (2003a); EPS (2003) for nation, state, and counties.
7 WDAI (2001b). Poverty rate is the percent of people in poverty.
8 Wyoming Department of Employment, Research, and Planning (WDERP) (2002a). Unemployment rate is the percentage of people actively seeking work but unemployed.
9 Bureau of Labor Statistics (BLS) (2003a). Unemployment rate is the percentage of people actively seeking work but unemployed.
10 WDERP (2002b). Unemployment rate is the percentage of people actively seeking work but unemployed.
11 WDERP (2002c). Unemployment rate is the percentage of people actively seeking work but unemployed.

average annual growth) over the 20-year study period (see Table 3.24). Over the 20-year study period, the median household income in Lincoln County increased 8.4%, Sublette County increased 7.2%, and Sweetwater County fell 8.0%.

Personal per capita income in 2000 in Wyoming was $27,372, whereas personal per capita income in the study area ranged from $28,037 in Sweetwater County to $20,980 in Lincoln County (see Table 3.24). The poverty rate in Wyoming was 11.4% in 2000, while poverty rates in the study area ranged from 33.3% in Boulder (Sublette County) to 0.0% in Farson (Sweetwater County) (U.S. Census Bureau 2000a).

In distinct contrast to national increases, Wyoming's personal per capita income fell by 3.5% from 1980 to 1990 but experienced a recovery of 15.5% from 1990 to 2000, for an overall increase of 11.4% (only 0.5% average annual growth) over the 20-year study period (see Table 3.24). From 1980 to 2000, personal per capita income in Lincoln County increased 7.0% but only slightly exceeded the poverty level ($18,244), Sublette County increased by 6.8%, and Sweetwater County increased 155.9%.

The poverty rate in Wyoming increased over the 20-year study period from 7.9% in 1979 to 11.4% in 1999 (U.S. Census Bureau 1981, 1990, 2000a), while the unemployment rate for Wyoming rose between 1980 (4.0%) and 1990 (5.5%) then decreased to 3.9% by 2000 (see Table 3.24) (Wyoming Department of Employment, Research, and Planning [WDERP] 2002a, 2002b, 2002c). In Lincoln County, the poverty rate decreased slightly from 1979 (11.5%) to 1989 (11.1%) and decreased again to 9.0% by 1999. In Sublette County, it decreased from 9.7% in 1979 to 8.8% in 1989 but, despite the gains in personal income, increased back to 9.7% by 1999. In Sweetwater County, the poverty rate increased from 5.2% in 1979 to 7.4% in 1989 but only slightly increased to 7.8% between 1989 and 1999.

Generally throughout the study area, unemployment rates have increased, ranging from 5.2% in Lincoln County to 3.8% in Sublette County (see Table 3.24).

Data were not collected for LaBarge until the 1990 census. LaBarge has experienced trends similar to the state, with median household income increasing by approximately 55.1% (4% average annual growth [see BLM 2005 for formula used to calculate average annual growth]) from 1990 to 2000 (see Table 3.24). Personal per capita income increased more than 169.3% (10% average annual growth) between 1990 and 2000. Despite the dramatic increase, the per capita income of LaBarge barely exceeds the poverty level (set at $18,244). The poverty rate has significantly decreased--from 24.5% in 1989 to 12.3% in 1999; however, it still exceeds the poverty rate in both the state and county, as well as the other counties in the study area.

Complete information for the potentially affected communities in Sublette County is not available for all study years. Big Piney, Marbleton, and Pinedale have experienced increases in both median household income and personal per capita income since 1980 (see Table 3.24). Marbleton had the highest increase in median household income (22.0%; 2.2% average annual growth) and personal per capita income (111.7%; 8% average annual growth). Despite the increase, the per capita income of Marbleton barely exceeds the poverty level. No personal per capita income is reported for Boulder. The median household income in Boulder in 2000 was only $12,500--68.5% of the poverty level (set at $18,244). The highest reported poverty rates in the three-county study area in 2000 were in Sublette County--Boulder (33.3%), Daniel (24.4%), and Bondurant (19.2%). Although poverty in Sublette County has remained relatively stable, the poverty rates in Marbleton and Pinedale have decreased since 1989.

Rock Springs experienced a decline in median household income (-0.4%) from 1980 to 1990 but experienced an increase (164.9%) from 1990 to 2000, for an overall increase of 164.9% (5.0% average annual growth) over the 20-year study period (see Table 3.24). Personal per capita income increased (150.7%) from 1980 to 1990 and again from 1990 to 2000 (73.1%), for an overall increase of 333.8% (8% average annual growth) over the course of the 20-year study period. Despite the increase in personal income, the poverty level increased from 5.8% in 1979 to 8.5% in 1989 and continued to rise to 9.4% by 1999 in Rock Springs.

Information for Eden and Farson in Sweetwater County was not collected until the 2000 census. However, the median household income in Eden was the highest in the three-county study area ($52,625), and Farson had the lowest poverty level in the three-county study area in 1999 (0.0%) (see Table 3.24).

3.4.2.3 Workforce Age, Gender, and Disabilities

Workforce information was obtained from the U.S. Census Bureau (2000e, 2000f). For the purposes of this report, the civilian labor force is defined as all persons between 16 and 66 years of age (retirement age is 67) in the civilian non-institutional population who either had a job or were looking for a job in the last 12 months and who did not have an employment disability. For the purposes of the last census, employment disability was defined as a condition lasting for 6 months or more that:

- limited the kind or amount of work that he or she could do at a job,
- prevented him or her from working at a job,
- made it difficult to go outside the home alone (for example, to shop or visit a doctor's office), and
- made it difficult to take care of his or her own personal needs such as bathing, dressing, or getting around inside the home.

Based on the age of residents, employment disability information, and unemployment rates in each county, there is a civilian labor force of approximately 1,719 unemployed working-age residents available for employment in the study area (Table 3.25). However, there may be some disconnect between published data and actual available labor. A labor shortage has been reported in all sectors in Sweetwater County, with as many as 600 job vacancies existing in November 2004 (Mast 2004). Additionally, a new Halliburton facility in Rock Springs has reported having difficulty filling the 100 new jobs created by its facility (Mast 2004). Smaller operators are also reported to have difficulties hiring and maintaining crews (personal communication, December 2004, with Roy Allen, Economist, BLM Wyoming State Office, Cheyenne and with Marilyn Filkins, Sublette County Attorney, Pinedale).

3.4.3 Housing

Historic information on housing was obtained from the WDAI (2002a), and projected data were obtained from the Wyoming Business Council (2002d) (Table 3.26). Rental rates and cost as compared to the state were obtained from WDAI (2003b) (Table 3.27). The habitability of vacant residences is unknown, and the acceptability of any individual housing unit is not quantifiable and is subjective for each individual tenant.

Table 3.25 Population and Workforce, 2000.[1]

			County		
Sex and Age	United States	Wyoming	Lincoln	Sublette	Sweetwater
Male					
0-15 years	32,919,334	57,604	1,985	680	4,727
16-66 years	92,539,411	168,540	4,627	2,080	13,168
67 years and over	12,594,818	22,109	763	281	1,072
Total males	138,053,563	248,253	7,375	3,041	18,967
Female					
0-15 years	31,353,445	54,266	1,901	663	4,515
16-66 years	93,508,194	162,400	4,455	1,926	12,533
67 years and over	18,506,704	28,863	842	290	1,598
Total females	143,368,343	245,529	7,198	2,879	18,646
Total all ages	281,421,906	493,782	14,573	5,920	37,613
Total working age	186,047,605	330,940	9,082	4,006	25,701
Persons with disabilities[2]	57,890,659	30,952	633	325	1,942
Total potential workforce	128,156,046	299,988	8,449	3,681	23,759
Unemployment rate	4.0%	3.9%	5.2%	3.8%	4.8%
Number of Persons Available for Employment	5,126,241	11,699	439	139	1,140

[1] U.S. Census Bureau (2000e).
[2] U.S. Census Bureau (2000f).

Table 3.26 Historic and Projected Housing Availability.

	Wyoming						Lincoln						Sublette						Sweetwater					
					Projected		Historic				Projected		Historic				Projected		Historic				Projected	
Housing Item	1980	1990	2000	2002	2007	2012	1980	1990	2000	2002	2007	2012	1980	1990	2000	2002	2007	2012	1980	1990	2000	2002	2007	2012
Type of Housing[1,2]																								
Vacant	N/A	34,572	30,246	38,804	38,706	39,582	N/A	1,272	1,565	1,349	1,389	1,430	N/A	1,077	1,181	1,155	1,177	1,201	N/A	1,828	1,816	2,075	2,063	2,107
Owner-occupied	N/A	114,544	135,514	139,391	149,399	159,413	N/A	3,310	4,280	4,461	4,869	5,282	N/A	1,281	1,737	1,820	2,055	2,289	N/A	9,552	10,586	10,722	10,960	11,154
Renter-occupied	N/A	54,295	58,094	58,736	60,422	62,098	N/A	826	986	1,024	1,072	1,116	N/A	553	634	652	692	733	N/A	4,065	3,519	3,420	3,168	2,926
Total housing units	188,217	203,411	223,854	236,931	248,527	261,093	4,671	5,408	6,831	6,834	7,330	7,828	2,393	2,911	3,552	3,627	3,924	4,223	15,116	15,445	15,921	16,217	16,191	16,187
Percent of Housing[1]																								
Vacant	N/A	17.0	13.5	16.4	15.6	15.2	N/A	23.5	22.9	19.7	18.9	18.3	N/A	37.0	33.2	31.8	30.0	28.4	N/A	11.8	11.4	12.8	12.7	13.0
Owner-occupied	N/A	56.3	60.5	58.8	60.1	61.1	N/A	61.2	62.7	65.3	66.4	67.5	N/A	44.0	48.9	50.2	52.4	54.2	N/A	61.8	66.5	66.1	67.7	68.9
Renter-occupied	N/A	26.7	26.0	24.8	24.3	23.8	N/A	15.3	14.4	15.0	14.6	14.30	N/A	19.0	17.9	18.0	17.6	17.4	N/A	26.3	22.1	21.1	19.6	18.1
No. of Building Permits[2]	3,845	692	1,582	2,045	--	--	30	3	145	204	--	--	82	37	54	88	--	--	801	56	41	48	--	--

1 Historic data from WDAI (2002a); projected data from Wyoming Business Council (2002d). Reported average availability may not accurately reflect actual availability within particular communities (e.g., Pinedale) that have already been impacted by other projects (e.g., Pinedale/Anticline Project) in the area.

2 Total residential units (i.e., single family units, duplex units, tri- and four-plex units, and multi-family units) (Wyoming Housing Database Partnership 2003).

Table 3.27 Average Rental Rates.[1]

Location	Apartment[2]			House[3]			Mobile Home[4]			Mobile Home Lot[5]		
	Fourth Quarter			Fourth Quarter			Fourth Quarter			Fourth Quarter		
	2001 ($)	2002 ($)	Percent Change	2001 ($)	2002 ($)	Percent Change	2001 ($)	2002 ($)	Percent Change	2001 ($)	2002 ($)	Percent Change
Lincoln	292	332	13.7	400	388	-3.1	315	304	-3.4	158	163	3.2
Sublette	441	534	21.1	613	655	7.0	350	457	30.6	175	165	-5.7
Sweetwater	390	392	0.5	533	516	-3.2	422	422	0.0	201	197	-2.2
Wyoming average	430	443	3.0	599	617	3.0	436	448	2.8	178	183	3.1

1 WDAI (2003b). Reported average rental rates may not accurately reflect actual rental rates within particular communities (e.g., Pinedale) that have already been impacted by other projects (e.g., Pinedale/Anticline Project) in the area.
2 Two-bedroom, unfurnished, excluding gas and electric.
3 Two or three-bedroom, single family, excluding gas and electric.
4 This price reflects total monthly rental expense, including lot rent.
5 Single-wide, including water.

According to the Wyoming Housing Database Partnership [WHDP] (2003), there were 4,579 vacant units available for housing in the study area in 2003, with the vacancy rate ranging from 12.8% in Sweetwater County to 31.8% in Sublette County. Average contract rent ranged from $362/$363 in Lincoln/Sweetwater Counties to $413 in Sublette County. Median monthly mortgage payments were lowest in Sublette County ($847/month) and highest in Sweetwater County ($953/month), although the median house value was lowest in Lincoln County ($95,300) and highest in Sublette County ($112,000) (WHDP 2003).

However, individuals have reported that it was difficult to rent or purchase adequate housing in Sublette County and a surplus apparently does not exist (personal communication, Bill Lanning, BLM, PFO). Blevins et al. (2004) also reported an affordable housing shortage exists in the Pinedale community. No housing is available in Pinedale, Big Piney, or Marbleton (personal communication, May 20, 2004, with Patti Raisch, Pinedale Town Clerk; Vicky Brown, Big Piney Town Clerk; Alice Griggs, Marbleton Town Clerk; and Mary Langford, Sublette County Clerk). According to Ms. Langford, most of the housing impact in the town of Pinedale originates from administrators associated with oil and gas field development, rather than oil and gas field workers. However, according to Sheriff Hank Ruland, up to 40% of the demand on his office results from the in-migration of dislocated Teton County residents who cannot find adequate housing in Jackson Hole (personal communication, May 21, 2004, with Sheriff Hank Ruland, Sublette County Sheriff's Department). Therefore, a large percentage of the housing demand may result from dislocated Teton County residents rather than oil and gas workers.

This view is shared by Cyd Goodrich. Ms. Goodrich stipulates that there is no low-income housing available in the Pinedale community. She holds the opinion that much of the pressure is from higher-middle to lower-upper income families moving out of Teton County and she has never heard anyone express a lack of interest in moving to Pinedale because of oil and gas development. However, most of the affected individuals who encounter difficulty obtaining housing are native residents of Pinedale, especially young or newly married, under-employed couples who simply cannot afford the high rental rates and are not in a position to purchase.

The vacancy rate for rentals/hotels/motels in summer (April-November) is estimated to be 0%, while it is less than 10% the rest of the year and declining (personal communication, December 2004, with Cyd Goodrich, Realtor, Pinedale Properties). Much of the seasonal pressure on housing comes from seasonal, often migrant workers from Canada, who come on work visas. Landlords offer only one-year leases and do not allow subletting, so, although the houses are only used during the drilling season by workers in areas without year-round operations and sit vacant the rest of the year, other workers who are involved in year-round operations have difficulty finding adequate housing. Housing pressures are less in the southern part of the county, because there are no direct roads to the oil and gas fields (personal communication, December 2004, with Cyd Goodrich, Realtor, Pinedale Properties). Additionally, the demand for new housing apparently exceeds the rate of building. A total of 88 new residential building permits were issued in Sublette County in 2002 (WHDP 2003).

In 2004, rent for single family homes ranges from $1,000-$1,500/month, while small apartments in multi-unit facilities range from $850-$1,000/month (personal communication, December 2004, with Cyd Goodrich, Realtor, Pinedale Properties).

3.4.4 Social Traditions

The study area's general heritage is based on ranching and mineral extraction and remains one of least populated and most undeveloped areas in the lower United States, with a population density ranging from 1.2 people/square mile in Sublette County to 3.6 people/square mile in Sweetwater County (see Table 3.23). Landownership is largely public (80% of Sublette County, 79% of Lincoln County, and 72% of Sweetwater County). Oil and gas has played a significant role in the regional economy since the 1920s. Historically, most of the oil and gas activity was limited to the LaBarge area in southwestern Sublette County and neighboring Lincoln County but it now extends over much of the southern portion of the county.

The social characteristics throughout the study area are similar to other small rural western communities and are strongly tied to traditional natural resource-based industries such as agriculture and extractive industries. In addition, study area residents recognize the importance of public lands in providing a natural resource base for economic activities, as well as supporting a particular way of life. Public lands often provide scenic beauty, wildlife habitat, and recreational opportunities. Because public lands comprise 76% of all land within the study area, management decisions can affect lifestyles, as well as the economic base.

Agriculture has provided the historical basis for community development for much of the nineteenth century, and ranching and grazing are viewed as a viable economic activity that provides open space, protection of natural resources, and support of cultural and ecological diversity. Although agricultural activities have become much less important economically in recent years (providing 0.7% of industry income and 4.7% of employment in the study area in 2000), the industry is important for its historic and cultural influence. Moreover, agricultural is viewed as a guardian of resources and an underpinning of cultural resources in the area. Because management decisions made by the federal land managers affect ranching operations beyond public land boundaries, communities are concerned about the social influences these decisions have on local communities.

The oil and gas industry has also played a vital role in the social character of Sublette County and has been an important part of the tax base for Sublette, Sweetwater, and Lincoln Counties for nearly 50 years. In 2000, the oil and gas industry provided 12.8% of industry income and 12.5% of employment in the study area. The area has experienced several boom and bust cycles throughout its history and has realized an increased population tied to this industry. Individuals working in this industry are now active members of local communities and are directly affected by federal land manager decisions.

In spite of the traditional social characteristics, there are indications that the views and beliefs of residents in the study area are changing. Some areas have seen an increase in population, including a combination of retirees and others attracted to this region for the abundance of high-quality air, water, and land resources that offer a rich quality of life and reflect a western wilderness heritage. This new population is not tied to traditional natural resource industries and is more likely to support a conservation-oriented public land management policy.

3.4.5 Quality of Living

Data on quality of living and infrastructure for each county in the study area were obtained from the Wyoming Business Council (2002b, 2002c, 2002d), WDAI (2002b), and personal communications. Due to the remote and unique area encompassed by the JIDPA, the United States in not included in the quality of life analysis, with the exception of crime statistics.

3.4.5.1 Crime

The crime indexes are "100" based, meaning that a value of 100 for a particular level of geography is the average national value. For example, a value of 150 indicates that the area has one and a half times the average risk level. A value of 50 indicates that the area is at half the average risk level.

Wyoming had a low crime index compared to the national average, with the index for personal crimes at 49--about half the national index--and property crimes at 71--about three-fourths the national index. The highest individual crime index for personal crime in Wyoming is for rape (80), which is higher than the index for any of the counties in the study area. The highest crime index for crimes against property is larceny (115)--15% greater than the national average (Wyoming Business Council 2002b).

The overall personal crime index in the study area is less than the national average (ranging from 30 to 60), although murder (133 in Sublette County) exceeds the national average. The crimes against property index is generally lower than the national average (ranging from 33 to 76), with the exception of larceny (155 in Sweetwater County).

Sublette County has implemented an enhanced 911 system as part of community policing efforts and to promote citizen's health and safety (Sublette County Sheriff's Department 2002). A 911 System Health Questionnaire identifies health concerns for local area citizens, which is included as part of a computer system used to assist medical, fire, or law enforcement in meeting the needs of victims in the event of an emergency. Additionally, Sublette County has implemented an innovative Ranch Watch program; child identification and fingerprinting; McGruff (child safety); D.A.R.E.; citizens' academy; county fair dance; Halloween dance; stay-out-of-jail free card (rides home); seminars on drug awareness, shoplifting, and check fraud; and a vacation watch program to aid in the prevention of crime in this largely rural area.

The Sublette County Sheriff's Department staff includes a sheriff, undersheriff, lieutenant, emergency management coordinator, two patrol sergeants, three detectives, a probation/resource officer, a seasonal forest patrol deputy, five patrol deputies for Big Piney/Marbleton, five patrol deputies for Pinedale, four patrol deputies for the county, a detention sergeant and five detention deputies, a communication sergeant and five communication deputies, an office manager, and three secretaries/clerks (Sublette County Sheriff's Department 2002).

The Sublette County Sheriff's office services all of Sublette County and the affected towns within the Sublette County Project-affected area. While calls for service have increased in recent years (from 3,000 in 1995 to 7,000 in 2003), approximately 40% of the increased demand is a result of displaced Jackson Hole residents who have in-migrated to Sublette County in an attempt to find housing; the remaining 60% of the increase results from a combination of Jonah Field workers and tourists (ranging from 11,000 to 14,000 visitors per day during the summer) (personal communication, May 2004, Sheriff Hank Ruland, Sublette County Sheriff's Department, Pinedale, Wyoming). The budget has increased from $1.0 million in 1995 to more than $4.5 million in 2004. The majority of calls for service resulting from Jonah Field development are medical emergencies not involved with criminal action, although some increase in speeding violations can be attributed to Jonah Field workers. According to Sheriff Ruland, oil and gas workers are welcome and contributing members of the community who show that they genuinely care about the community by participating in such activities as community clean-up days. Additionally, recent improvements in the county legal system (new jail, courthouse, equipment, competitive wages, increased staffing [up from 12 officers in 1995 to 26 sheriff's deputies and 21 jail officers in 2003], and vehicles) are a direct result of the tax revenues resulting from natural gas activities in the Jonah Field.

The Sheriff's department and Sublette County would not have been able to sufficiently expand to keep up with the increased demand for services without those revenues (personal communication, May 2004, Sheriff Hank Ruland, Sublette County Sheriff's Department, Pinedale, Wyoming). However, service calls increased from 4,032 in 1995 to 7,347 in 2003 (Royster 2004). According to Sheriff Ruland, the biggest crime problem in Sublette County is methamphetamine. Drug use also leads to increases in domestic violence and bar fights--particularly within the temporary worker demographic. Although there has been an increase in drug use in Sublette County, Ruland does not equate that increase to oil and gas workers--it is a state-wide problem (Royster 2004). Additionally, Ruland recognizes that any increase in population--including visiting hunters and other tourists--result in an increase in drug and alcohol-related calls (Royster 2004).

The majority of law enforcement calls in Sublette County still involve traffic--people speeding or running stop signs. One study indicates that transient workers pose challenges to law enforcement primarily in the form of highway safety and increased substance abuse (Blevins et al. 2204.) However, it is estimated that crime in Sublette and Sweetwater County has increased by 80% since 2000, largely as a result of oil and gas development (personal communication, December 2004, Marilyn Filkins, Sublette County Attorney [formerly Sweetwater Deputy County Attorney], Pinedale). At the end of 2004, the Sublette County Attorney's office had 1,200 open cases and had hired an assistant county attorney to handle only criminal cases. Additionally, she indicated that in 2000-2001, there were one or fewer felony arrests in Sublette County, in 2004 the average is approximately one felony arrest per week and many of those are egregious aggravated assaults. Ms. Filkins also reports gang-like behavior from various drilling and pipeline crews. Increases in felonies and drug-related calls have been reported by the Sweetwater County Sheriff and the Chief of Police in Rock Springs, and these were primarily attributed to oil and gas workers (crime report to Pinedale/Anticline Working Group (PAWG) presented by Jana Weber). Ms. Filkins holds the opinion that Sweetwater County has a higher incident of crime related to methamphetamine than Sublette County.

It should be noted that both Questar (a local oil and gas producer) and EnCana require random drug testing for employees and subcontractors. Additionally, EnCana sponsors training sessions for emergency response personnel and Questar donates money to family violence organizations (Royster 2004). However, one of the smaller local operators is reported to have delayed drug-testing for a year and a half, and when a random drug test was performed, 16 of 18 workers on a drill rig tested positive and were fired (personal communication, December 2004, Marilyn Filkins, Sublette County Attorney [formerly Sweetwater Deputy County Attorney], Pinedale).

3.4.5.2 Infrastructure

County and community profile information was primarily obtained from BLM (1997b) as well as local community websites and other extant information.

Lincoln County

In Lincoln County, LaBarge is the only potentially affected community. It was incorporated in 1973 and is located in Lincoln County on U.S. Highway 189 approximately 75 miles north of Green River and 21 miles south of Big Piney. The town has a mayor/council, one full-time and one part-time policeman, 911 emergency telephone service, and a 15-member volunteer fire department. There is a 6,000-volume library, one day care center, one senior center, four churches, one motel with 36 rooms, and a recreational vehicle (RV) park with six spaces. Medical services are provided by a weekly clinic and by ambulance service, and communications include a weekly newspaper, cable TV, and a post office. Recreational facilities include one ice skating rink, two baseball fields, bike paths, two parks, and a small airport.

Sublette County

Sublette County has three airports; 26 churches; three libraries; five medical facilities (however, the nearest hospitals are in Jackson and Rock Springs, Wyoming); two museums; two newspapers; nine post offices (Big Piney, Bondurant, Boulder, Cora, Daniel, Farson, LaBarge, Marbleton, and Pinedale); and two school districts including three elementary schools, two middle schools, two high schools, and a private school, with higher education available from Western Community College's distance learning program; and utilities/services are provided by one telephone company, two garbage/refuse services, one cable television provider, three natural gas suppliers, one electricity supplier, and one coal company. Citizen organizations are important to Sublette County's infrastructure and include volunteer fire departments, a search-and-rescue organization, and a citizen's recycling program (Sublette.Com 2001; Pinedale Online 2002).

Pinedale

Located approximately 100 miles northwest of Rock Springs and 32 miles north of the JIDPA on U.S. Highway 191, Pinedale is the county seat of Sublette County. The town has a mayor/council government, 911 emergency service, and a volunteer fire department. Police protection for the town is provided through contract with the Sublette County Sheriff's Office. There is a 37,000-volume library, one day care center, one senior center, nine churches, 11 hotels/motels with a total of 162 rooms, and an RV park with 44 spaces. Medical services include a clinic, two doctors, a physician's assistant, one dentist, ambulance service, and a nursing home with 107 rooms. Communications include a weekly newspaper, cable TV, and a post office. There is one golf course, one ice skating rink, bike paths, two parks, and a recreation center, as well as a small airport. It has been reported that there is a shortage of health-care providers in Sublette County (Royster 2004). Some health-care providers may work shifts up to 52 hours straight. The Pinedale Medical Clinic serviced approximately 12,000 patients in 2003--mostly oil and gas workers.

Pinedale has a variety of establishments for overnight lodging. A Best Western and Super 8 are located on the west end of town and offer the most rooms. Several smaller motels are located in the downtown area. The surrounding area has several bed and breakfasts, guest ranches and lodges, and individual cabins available for rent. Tourism in and around Pinedale and in Sublette County in general, is a major business with the primary attraction being the natural resources in the area and the many outdoor activities associated with them, including hunting, fishing, camping, backpacking and hiking, wilderness escapes, horseback riding, mountain biking, golf, wildlife viewing, downhill skiing, cross-country skiing, and snowmobiling. Plans are underway to build another motel in town and several mancamps are currently under discussion by area operators for permitting to alleviate some of the pressures on housing. Several housing developments are also being planned.

Big Piney

Big Piney is located on U.S. Highway 189 about 95 miles north of Green River and 35 miles southwest of Pinedale. The town has a mayor/council government, 911 emergency service, and a voluntary fire department. Police protection is provided by the Sublette County Sheriff's Office. There is a 40,000-volume library, one day care center, six churches, and three motels. Medical services include two doctors, one dentist, and ambulance service. Communications include a weekly newspaper, cable TV, and a post office. There is one ice skating rink, one bike path, three parks, three baseball fields, one swimming pool, and a small airport. Major employers include the oil and gas industry, agriculture, and retail trade and services.

Marbleton

Marbleton is located on U.S. Highway 189 1 mile north of Big Piney. Marbleton has an RV park and picnic grounds, two motels, a coffee shop and restaurant, gas stations, retail shops, a movie theater, a medical clinic, and an airport. Major industries include ranching, oil and gas, and recreation.

Boulder

Boulder is an unincorporated community located on U.S. Highway 191 12 miles south of Pinedale and 85 miles north of Rock Springs. Boulder has a post office and the Boulder Store, which includes a store, gas station, RV park (nine spaces), motel (nine rooms), restaurant, and bar.

Sweetwater County

Sweetwater County is located in the southwestern part of Wyoming with 60 miles of its border touching the states of Utah and Colorado. The county consists of 10,497 square miles. The two largest cities in the county are Rock Springs and Green River.

Rock Springs

Established in 1888 as a mining town, the cultural tradition in Rock Springs emphasizes natural resources as the driving force behind its economy (Rock Springs Chamber of Commerce 2004). Rock Springs is located along Interstate 80 in west-central Sweetwater County and serves as the economic hub of the area. Law enforcement and fire protection services are available, as well as a 911 emergency number. Public education is provided by 11 elementary schools, two junior high schools, one high school, and Western Wyoming Community College (2-year junior college). Community services consist of two libraries (107,000 total volumes), eight day care centers, and 32 churches. Commercial services include two shopping centers, five convention facilities (with a total capacity of 4,660 persons), 31 hotels/motels (1,680 total rooms), an RV park (50 spaces), and several mobile home parks. Medical care is provided by a hospital (100 beds), a nursing home (100 rooms), 33 doctors, 24 dentists, and an ambulance service. Communications consist of two local newspapers (one published in Rock Springs and one in Green River), cable TV, two AM and three FM radio stations, and two post offices.

Recreation resources include 17 baseball fields, 24 tennis courts, six swimming pools, eight soccer fields, a golf course, one ice skating rink, two recreation centers, and 24 parks. Outdoor recreation opportunities available within 30 miles of the city include Flaming Gorge National Recreation Area and various opportunities on BLM-administered lands, including Boar's Tusk, sand dunes, petroglyphs, and the Oregon/California Trails.

Cultural/entertainment attractions include the Red Desert Rodeo, Wild Horse Days, the Sweetwater County Museum, the historical Rock Springs City Hall Museum, the Fine Arts Center, and the Western Wyoming Community College Dinosaur Collection.

Rock Springs is serviced by two commercial airlines providing flights to and from the Rock Springs Airport, two bus lines, four car rental services, and two taxi services.

Eden/Farson

Eden and Farson are two unincorporated communities located on U.S. Highway 191 about 40 miles northwest of Rock Springs and 28 miles southeast of the JIDPA. The communities are governed by Sweetwater County and have a resident sheriff's officer and highway patrolman, a 26-member volunteer fire department, ambulance service, and 911 emergency phone service. There are four churches, two gas stations, two cafes, two bars, and a convenience store. Recreational facilities include a youth center and a county park.

Eden and Farson are not serviced by a doctor, nurse, or dentist, although there is an emergency medical technician service. The nearest medical facility is in Rock Springs. There is one elementary and one secondary school. Bridger Valley Electric supplies energy and three vendors supply propane for heating. Residents have individual wells and septic systems, and solid waste disposal facilities are available. Housing is limited, with ranch homes being the primary type of housing.

3.4.5.3 Cost of Living and Inflation

Cost of living and inflation information was obtained from the Wyoming Cost of Living Index for the fourth quarter of 2002 (WDAI 2003b) (Table 3.28). The Wyoming Cost of Living Index is a summary of price data collected from 27 cities and towns throughout Wyoming over the period of January 8, 9, and 10, 2003. The price data collected are used to build a comparative index and to estimate inflation rates for Wyoming and the five regions of the state.

During this period, Lincoln County ranked 18th in the state with an all items cost of living index of 91, while Sweetwater County was ranked ninth (see Table 3.28). Sublette County was the third most expensive county in the state and had the highest cost of living in the study area with an all items ranking of 105.

Table 3.28 Comparative Cost of Living Index.[1]

Rank	County	All Items	Food	Housing	Apparel	Transportation	Medical	Recreation and Personal Care
1	Teton	139	105	174	121	104	110	111
2	Sheridan	106	107	107	120	100	107	104
3	Sublette	105	96	107	123	101	97	110
4	Campbell	105	100	111	87	99	101	102
5	Laramie	104	107	109	94	98	100	97
6	Johnson	103	105	100	132	100	99	106
7	Albany	102	94	107	103	101	99	96
8	Natrona	99	105	98	103	100	98	96
9	Sweetwater	98	100	95	94	100	99	103
10	Park	97	99	92	107	101	102	101
11	Carbon	94	105	85	91	102	96	107
12	Converse	94	95	90	89	100	98	98
13	Fremont	93	89	91	87	101	99	100
14	Hot Springs	93	98	83	102	102	104	103
15	Uinta	93	92	89	87	100	105	98
16	Goshen	91	93	85	99	99	97	99
17	Platte	91	100	80	107	100	95	100
18	Lincoln	91	90	84	102	100	92	99
19	Big Horn	89	96	77	117	100	95	99
20	Washakie	89	92	78	112	99	101	98
21	Niobrara	88	90	74	104	101	103	106
22	Crook	87	93	76	98	100	93	101
23	Weston	87	89	76	93	101	109	100

[1] Fourth quarter 2002. Prices as of January 8, 9, and 10, 2003 (statewide average = 100) (WDAI 2003b).

Table 3.29 Annual Inflation Rates for the U.S., Wyoming, and Regions.[1]

			Region[2] (All Items %)				
Quarter[3]	U.S. Consumer Price Index (%)	Wyoming (All Items %)	Southeast	Southwest	Central	Northeast	Northwest
4Q96	3.3	4.8	5.2	4.0	5.0	4.2	4.9
2Q97	2.3	2.8	3.6	2.8	3.1	1.0	2.6
4Q97	1.7	2.9	3.3	4.0	1.9	3.0	2.2
2Q98	1.7	1.5	1.3	2.6	0.3	2.1	2.5
4Q98	1.6	2.2	2.7	2.8	1.4	2.0	2.4
2Q99	2.0	2.6	3.8	3.4	1.5	2.6	0.9
4Q99	2.7	3.1	3.6	2.6	2.8	3.4	3.0
2Q00	3.7	4.3	3.9	2.3	4.4	7.4	4.0
4Q00	3.4	3.2	2.8	2.6	3.4	6.9	3.8
2Q01	3.2	4.3	4.1	3.1	5.0	4.8	4.6
4Q01	1.6	3.5	4.9	2.3	2.9	4.0	2.6
2Q02	1.1	2.5	2.6	1.4	2.8	3.1	2.2
4Q02	2.4	3.7	3.0	2.5	5.1	5.1	2.7

1 Source: WDAI (2003b). Note: The 2Q99 inflation calculations mark the first time the WCLI used all 23 counties to calculate the inflation rates. Previously, only 15 counties were used.

2 Regional Composition for Inflation Estimate:
- Southeast: Albany, Carbon, Goshen, Laramie, Niobrara, and Platte Counties.
- Southwest: Lincoln, Sublette, Sweetwater, and Uinta Counties.
- Central: Converse, Fremont, and Natrona Counties.
- Northeast: Campbell, Crook, Johnson, Sheridan, and Weston Counties.
- Northwest: Big Horn, Hot Springs, Park, Teton, and Washakie Counties.

3 4Q96 = fourth quarter (October, November, December) 1996. Fourth quarter represents the December to December and 2nd Quarter represents the June to June percent change.

The inflation rate represents the percent change in the price level of a standard basket of selected consumer items priced this quarter, compared with the price level of the same goods recorded one year ago. WDAI (2003b) weighted the data by population to more accurately represent the price changes experienced by the majority of consumers in Wyoming (Table 3.29). Nationally, the inflation rate from December 2001 to December 2002 was 2.4% (consumer price index for urban consumers), as reported by the Bureau of Labor Statistics (BLS). Inflation is reported only at the regional level within Wyoming. The study area is in the southwest region.

The Wyoming annual all-items inflation rate for the fourth quarter of 2002 was 3.7% (see Table 3.29), with the medical category experiencing the highest inflation rate for the third consecutive period, increasing 6.0% over the previous period. The southwest region, which includes the study area, had the lowest inflation rate (2.5%) in the state for the fourth quarter of 2002. Because the regional inflation rates are calculated using a smaller sample size than the state-wide all items rate, they may be more volatile over time. Thus, when using the regional inflation rates, it must be noted that they can vary significantly from quarter to quarter.

3.4.5.4 Education

Detailed information on education statistics in the study area is provided in BLM (2005).

3.4.6 Personal Income Trends

The Bureau of Economic Analysis (BEA) reports data adjusted to current dollars using the Consumer Price Index (CPI). CPI data were obtained from the BLS (2003). CPI is a measure of the average change in prices over time in a market basket of goods and services. The estimate for 2003 was based on the change in the CPI from fourth quarter 2001 to fourth quarter 2002, and the base year was chained (i.e., three years were averaged to obtain a base year for the calculation of the CPI; e.g., 1982-1984 = 100). The BLS uses the following formula to make the calculation.

Inflation Factor = (Current Year CPI / Year "X" CPI)

Current Year Dollars = Year "X" Dollars x Inflation Factor

The CPI values and inflation factors used by EPS are listed in Table 3.30. Average wage information was obtained from BEA (2003a) and is summarized in Table 3.31. Personal income trend data were obtained from the BEA (2003b). Table 3.32 shows the components of personal income for 1980, 1990, and 2000 for the counties in the study area and Wyoming. A detailed analysis of personal income trend data is presented in BLM (2005).

3.4.7 Industry and Economy

3.4.7.1 Overview

Gross state product (GSP) is the value added to production by the labor and property located in a state (BEA 2003f). The BEA calculates GSP for a state as the sum of gross state product originating by industry of all industries. This measure of GSP is the state counterpart of the nation's gross domestic product by industry from the national income and product accounts (BEA 2003f). Further detail is provided in BLM (2005).

Table 3.30 CPI and Inflation Factors, 1980-2003.[1]

Year	CPI	Inflation Factor[2]	Year	CPI	Inflation Factor[2]
1980	82.4	2.09	1992	140.3	1.23
1981	90.9	1.89	1993	144.5	1.19
1982	96.5	1.78	1994	148.2	1.16
1983	99.6	1.73	1995	152.4	1.13
1984	103.9	1.66	1996	156.9	1.10
1985	107.6	1.60	1997	160.5	1.07
1986	109.6	1.57	1998	163.0	1.06
1987	113.6	1.52	1999	166.6	1.03
1988	118.3	1.46	2000[3]	172.2	1.00
1989	124.0	1.39	2001	177.1	0.97
1990	130.7	1.32	2002	179.9	0.96
1991	136.2	1.26	2003[4]	184.5	0.93

[1] Obtained from BLS (2003).
[2] Inflation Factor = CPI current year/year "X" CPI.
[3] 2000 is the current year (base year) for the purposes of this analysis (i.e., inflation factor = 1.00--the year when $1 is worth $1).
[4] November 2003 CPI.

Table 3.31 Wages and Job Numbers.

	Average Wage ($)[1,2]			Number of Jobs[3]		
Area	1980	1990	2000	1980	1990	2000
United States	29,254	30,738	34,647	114,231,200	139,426,900	167,283,800
Wyoming	32,004	26,146	26,549	279,650	272,471	328,532
Lincoln	31,618	26,545	25,050	6,591	6,873	8,125
Sublette	27,816	23,260	24,783	2,812	3,076	3,965
Sweetwater	39,568	33,759	33,748	25,503	22,856	24,281

[1] The employment estimates used to compute the average wage are a job, not person, count. People holding more than one job are counted in the employment estimates for each job they hold. Source: BEA (2003a).
[2] All national, state, and local area dollar estimates are in year 2000 dollars, adjusted for inflation.
[3] BEA (2003d).

Table 3.32 Personal Income by Major Source.[1]

							County								
	United States			Wyoming			Lincoln			Sublette			Sweetwater		
Income Item	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
Income Source															
Labor Income (earnings from work)	3,615,178	4,622,364	6,088,880	9,482	7,531	9,006	211	177	187	83	73	87	1,079	834	883
Less: Personal contributions for social insurance[2]	160,890	267,370	357,843	(435)	(444)	(538)	(10)	(11)	(11)	(3)	(4)	(5)	(57)	(57)	(58)
Plus/minus: Adjustment for residence[3]	(949)	(971)	(1,060)	(160)	(16)	(33)	(21)	(7)	(1)	1	3	5	(68)	(77)	(50)
Equals: Net earnings by place of residence	3,453,339	4,354,024	5,729,977	8,887	7,071	8,434	181	159	174	81	72	86	954	700	775
Plus: Dividends, interest, and rent[4]	797,599	1,299,148	1,598,302	1,941	2,513	3,771	42	56	94	29	37	62	110	140	238
Plus: Transfer payments	584,707	783,610	1,070,592	818	1,166	1,600	21	27	40	7	12	17	62	83	104
Total personal income	4,835,646	6,436,782	8,398,871	11,647	10,750	13,805	243	242	308	116	121	165	1,126	923	1,117
Per capita personal income[5]	21,280	25,787	29,760	24,561	23,696	27,941	19,602	19,071	21,041	25,201	24,864	27,741	12,749	18,058	29,811

1 Source: BEA (2003b). All rows except per capita personal income are in millions of year 2000 dollars adjusted for inflation unless otherwise noted. All national, state, and local estimates are in current dollars adjusted for inflation based on U.S. average consumer price index (for urban consumers).

2 Personal contributions for social insurance (e.g., Medicare) are included in earnings by type and industry but they are excluded from personal income.

3 The adjustment for residence is the net inflow/outflow of the earnings of inter-area commuters (i.e., live in Sweetwater County, work in Sublette County, net inflow to Sublette County and net outflow to Sweetwater County).

4 Rental income of persons includes the capital consumption adjustment.

5 Year 2000 dollars, per capita personal income as calculated by the BEA is not the same as personal per capita income reported by the census.

3.4.7.2 Wyoming Industry and Industry Employment

The BEA calculates income and gross state product information at the Standard Industrial Classification (SIC) two-digit level. The data for GSP (Table 3.33) are presented at the simplified one-digit SIC code level for the purposes of this report, with the exceptions of mining (coal, metal, and non-mineral) separated from oil and gas and government separated into federal civilian, federal military, and state and local. Table 3.34 provides employee compensation data in order to make a comparison of state-wide income growth in relation to GSP changes. Detailed analysis of Wyoming industry is presented in BLM (2005).

3.4.7.3 Industry Employment

Data were obtained from BEA regarding total annual employment by industry for the study area and for Wyoming for 1980, 1990, and 2000 to examine trends over the 20-year study period. These data are presented in Table 3.35. More detailed industry employment information for the counties as well as an analysis of industry employment for the State of Wyoming is presented in BLM (2005).

<u>Lincoln County</u>

All employment categories in Lincoln County added 1,534 jobs from 1980 to 2000, an increase of 23.3% (1% average annual growth) (see Table 3.35). Agriculture services, forestry, and fisheries experienced the greatest percentage of job growth (365.6%; 8% average annual growth) during the 20-year study period. The greatest number (-842) and highest percentage (-62.0%; -5% average annual loss) of job losses occurred in mining from 1980 to 2000. The average weekly wages in the private and government sectors in Lincoln County in the first quarter of 2003 were $660 and $495, respectively. Heavy and civil engineering construction had the highest average weekly wage at $1,439, followed by oil and gas at $1,243 and utilities at $1,051 (WDERP 2003a).

<u>Sublette County</u>

Industry employment in Sublette County added 1,153 new jobs from 1980 to 2000, an increase of 41.0% (2% average annual growth) (see Table 3.35). Agriculture services, forestry, and fisheries experienced the greatest percentage of growth (388.9%; 8% average annual growth) during the 20-year study period. The greatest number (-68) and highest percentage (-38.6%; -2% average annual loss) of job losses occurred in transportation, communication, and public utilities from 1980 to 2000. The average weekly wages in the private and government sectors in Sublette County in the first quarter of 2003 were $559 and $529, respectively. Oil and gas had the highest average weekly wage at $1,846, followed by finance/insurance at $964 and federal government at $719 (WDERP 2003a).

<u>Sweetwater County</u>

Industry employment in Sweetwater County lost 1,222 jobs from 1980 to 2000, a decrease of 4.8% (0.2% average annual decrease) (see Table 3.35). Agriculture services, forestry, and fisheries experienced the greatest percentage of growth (291.7%; 7.1% average annual growth) during the 20-year study period. The greatest number (-3,601) and highest percentage of job losses (49.2%; 3.3% average annual loss) occurred in mining from 1980 to 2000. The average

Table 3.33 Wyoming Gross State Product (Millions of Year 2000 Dollars).[1]

	Gross State Product (GSP)						Growth (%)		
			1990		2000				
Industry	GSP	% of GSP	GSP	% of GSP	GSP	% of GSP	1980-1990	1990-2000	1980-2000
Agriculture	619	2.7	510	2.9	468	2.4	-17.6	-8.2	-24.3
Mining (metal, coal, non-metallic)	3,162	14.0	1,920	10.9	1,437	7.5	-39.3	-25.1	-54.6
Oil and gas	6,499	28.8	4,215	23.8	3,089	16.2	-35.2	-26.7	-52.5
Construction	1,601	7.1	573	3.2	1,015	5.3	-64.2	77.1	-36.6
Manufacturing	917	4.1	779	4.4	1,335	7.0	-15.1	71.4	45.5
Transportation, communication, and public utilities	2,236	9.9	2,661	15.0	2,510	13.1	19.0	-5.7	12.2
1980 Wholesale trade	802	3.6	505	2.9	773	4.0	-37.1	53.2	-3.7
Retail trade	1,273	5.6	1,053	6.0	1,403	7.3	-17.3	33.3	10.2
Finance, insurance, and real estate	2,023	9.0	1,648	9.3	2,285	12.0	-18.5	38.6	13.0
Services	1,500	6.7	1,505	8.5	2,202	11.5	0.3	46.4	46.8
Government									
Federal civilian	391	1.7	427	2.4	501	2.6	9.2	17.4	28.2
Federal military	196	0.9	246	1.4	277	1.4	25.4	12.4	41.0
State and local	1,312	5.8	1,650	9.3	1,817	9.5	25.7	10.2	38.4
Total Gross State Product	22,532	100.0	17,690	100.0	19,112	100.0	-21.5	8.0	-15.2

[1] BEA (2003e), millions of year 2000 dollars, adjusted for inflation.

Table 3.34 Compensation of Employees (Millions of Year 2000 Dollars).[1]

	Compensation Paid to Employees from Gross State Product (GSP)[1]								
	1980		1990		2000		Growth (%)		
Industry	Paid	% of Total Paid	Paid	% of Total Paid	Paid	% of Total Paid	1980-1990	1990-2000	1980-2000
Agriculture	148	1.7	100	1.5	132	1.6	-32.5	31.8	-12.4
Mining (metal, coal, non-metallic)	1,220	14.0	655	9.6	518	6.4	-46.3	-20.9	-135.6
Oil and gas	1,014	11.6	426	6.3	580	7.2	-58.0	36.3	-74.8
Construction	997	11.4	402	5.9	642	7.9	-59.7	59.8	-55.3
Manufacturing	422	4.8	364	5.3	461	5.7	-13.9	26.8	8.4
Transportation, communication, and public utilities	932	10.7	780	11.5	762	9.4	-16.3	-2.3	-22.3
Wholesale trade	416	4.8	250	3.7	299	3.7	-39.8	19.4	-39.1
Retail trade	775	8.9	622	9.1	799	9.9	-19.8	28.5	3.0
Finance, insurance, and real estate	255	2.9	237	3.5	308	3.8	-7.0	29.9	17.2
Services	832	9.5	895	13.2	1,393	17.2	7.6	55.7	40.3
Government									
Federal civilian	380	4.4	398	5.9	443	5.5	4.6	11.3	14.1
Federal military	173	2.0	217	3.2	226	2.8	25.3	4.0	23.3
State and local	1,166	13.4	1,455	21.4	1,547	19.1	24.7	6.4	24.6
Total Gross State Product	8,731	100.0	6,798	100.0	8,108	100.0	-22.1	19.3	-7.7

[1] BEA (2003f), millions of year 2000 dollars adjusted for inflation.

Table 3.35 Employment by Industry.[1]

	Number of Jobs											
				Sublette			Sweetwater			Wyoming		
Industry	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
Farm employment	851	733	698	429	402	412	266	220	205	14,504	12,476	12,624
Agriculture services, forestry, fishing, and other	32	77	149	27	83	132	48	81	188	2,016	3,353	5,769
Mining (coal, metal, nonmetal, oil and gas)	1,359	667	517	276	315	325	7,318	4,989	3,717	38,523	20,840	19,387
Construction	575	444	863	388	261	427	3,282	1,533	1,509	25,805	15,782	24,879
Manufacturing	467	614	530	31	(D)[2]	91	494	745	1,649	10,512	11,203	13,583
Transportation, communication, and public utilities	503	568	582	176	145	108	2,208	1,987	1,785	19,169	16,583	17,084
Wholesale trade	196	80	133	25	(D)	55	773	648	615	10,055	7,633	8,812
Lincoln												
Retail trade	821	1,083	1,389	499	409	603	3,743	3,739	4,447	43,998	47,252	57,824
Finance, insurance, and real estate	287	307	471	147	184	228	693	1,125	1,127	16,334	17,167	21,303
Services	576	1,040	1,278	395	599	905	3,605	3,760	4,749	48,437	61,294	83,161
Federal, civilian	117	146	110	62	91	96	304	262	266	7,539	7,589	7,400
Federal, military	63	75	84	39	28	41	214	228	215	6,335	6,311	6,204
State government	109	136	126	54	74	72	203	278	269	10,988	13,150	13,820
Local government	635	903	1,195	264	364	470	2,352	3,261	3,540	25,435	31,838	36,682
Total full-time and part-time employment	6,591	6,873	8,125	2,812	2,955	3,965	25,503	22,856	24,281	279,650	272,471	328,532

1 BEA (2003b).
2 (D) = not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals. BEA does not provide this information.

weekly wages in the private and government sectors in Sweetwater County in the first quarter of 2003 were $744 and $580, respectively (WDERP 2003a). Mining provided 20.0% of total income generated in Sweetwater County and local government provided 14.7% in the first quarter of 2003 (WDERP 2003a).

3.4.7.4 Industry Earnings

<u>Wyoming</u>

Wyoming experienced a loss in total gross earnings for all industries (private non-farm, farm, and government) of 5.0% from 1980 to 2000.

In 1980, total mineral extraction was the largest source of industry earnings in Wyoming (25.0%), and government (federal civilian, military, state, and local government) provided 17.4% of income. Mining (metal, coal, nonmetallic) led the individual categories (13.4% of all income) in 1980, followed by services (12.5%), construction (11.9%), oil and gas extraction (11.6%), and transportation, communication, and public utilities (9.8%) (Table 3.36).

Wyoming's mining and minerals sector contributes more to GSP than any other sector of the economy (Foulke et al. 2001). Minerals (including oil and gas) accounted for 23.7% of Wyoming's GSP, or over $4.5 billion in 2000 (see Table 3.33), and supported approximately 19,387 full-time wage earners, or 5.9% of Wyoming's employment base (see Table 3.35) (BEA 2003e).

In 2000, government led industry income, providing 23.4% of income, followed by services (20.0%), retail trade (9.3%), construction (8.5%), and transportation, communication, and public utilities (8.3%).

In real terms, for the 20-year study period, Wyoming industry income fell in farm; mining; oil and gas; construction; transportation, communication, and public utilities; wholesale trade; and retail trade. The most industry income growth occurred in non-farm agricultural services (156.4%; 4.8% average annual growth) and government (27.5%; 1.2% average annual growth).

<u>Lincoln County</u>

In 1980, total mineral extraction was the greatest source of industry income (36.4% of all income) in Lincoln County (see Table 3.36). In 2000, total government led industry income (23.4%). Total mineral extractions provided 14.2% of industry income. Over the 20-year study period (1980-2000), non-farm agricultural services led industry growth (188.1%; 5.4% average annual growth). Losses occurred in total mineral extraction (-65.4%), and farm income (-60.0%).

<u>Sublette County</u>

In 1980, total mineral extraction provided 20.0% (oil and gas provided 20.0%, mining provided less than 0.1%) of Sublette County industry earnings (see Table 3.36). In 2000, total government provided the most industry income to Sublette County (24.0%). Industry income in Sublette County grew during the 20-year study period from 1980 to 2000 by 4.3% (0.2% annual average growth). Mining (metal, coal, nonmetallic) in Sublette County demonstrated a boom/bust cycle, going from an average annual growth rate of 50.8% from 1980 to 1990 to a declining average

Table 3.36 Earnings by Industry.[1]

				County								
	Wyoming ($)			Lincoln ($)			Sublette ($)			Sweetwater ($)		
Income Item	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
Farm[2]	179,991	191,042	95,760	6,685	5,559	2,675	5,935	8,228	1,969	1,229	1,785	292
Nonfarm agricultural services, forestry, fishing, and other[3]	30,425	50,777	77,999	403	513	1,165	357	677	892	713	726	1,665
Mining (metal, coal, nonmetallic)[4]	1,265,969	637,410	589,053	56,356	28,946	15,921	50	3,043	1,720	322,982	262,370	151,984
Oil and gas extraction[5]	1,102,210	673,330	750,850	20,493	5,747	10,688	16,551	10,934	13,919	116,820	83,967	124,438
Construction	1,131,352	498,755	768,822	23,211	15,296	25,949	15,425	7,686	11,937	177,174	59,118	56,754
Manufacturing[5]	433,727	365,436	478,173	12,825	17,514	12,887	610	1,481	1,135	21,824	34,714	106,835
Transportation and public utilities	924,125	740,282	751,189	24,867	29,076	29,519	8,071	5,503	3,245	109,418	99,300	91,285
Wholesale trade[5]	414,417	250,765	302,921	6,654	2,038	2,289	1,003	773	913	32,990	22,068	20,396
Retail trade	875,953	695,019	840,999	16,725	15,501	16,062	9,143	5,823	8,061	77,068	57,889	66,061
Finance, insurance, and real estate	290,903	247,437	446,611	5,124	4,182	6,131	1,989	1,457	3,932	15,076	13,448	25,631
Services	1,180,316	1,206,898	1,796,451	11,832	14,783	19,792	11,245	10,601	18,032	109,094	73,273	105,933
Federal government, civilian	374,702	382,042	421,904	4,942	6,000	5,538	2,610	4,126	5,566	16,261	14,954	15,720
Military	164,959	206,034	215,018	508	925	1,178	792	357	904	1,735	2,834	3,016
State government	372,796	437,358	435,192	4,017	4,556	4,183	2,102	2,486	2,362	7,881	9,560	9,058
Local government	740,096	947,968	1,035,117	16,685	26,319	32,837	7,057	9,478	11,944	69,143	97,879	104,199
Total Earnings	9,481,940	7,530,552	9,006,059	211,327	176,954	186,814	82,942	70,402	86,531	1,079,406	833,885	883,267

Table 3.36 (continued)

				County								
	Wyoming (%)			Lincoln (%)			Sublette (%)			Sweetwater (%)		
Income Item	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
Farm[2]	1.90	2.54	1.06	3.16	3.14	1.43	7.16	11.69	2.28	0.11	0.21	0.03
Nonfarm agricultural services, forestry, fishing and other[3]	0.32	0.67	0.87	0.19	0.29	0.62	0.43	0.96	1.03	0.07	0.09	0.19
Mining (metal, coal, nonmetallic)[4]	13.35	8.46	6.54	26.67	16.36	8.52	0.06	4.32	1.99	29.92	31.46	17.21
Oil and gas extraction[5]	11.62	8.94	8.34	9.70	3.25	5.72	19.95	15.53	16.09	10.82	10.07	14.09
Construction	11.93	6.62	8.54	10.98	8.64	13.89	18.60	10.92	13.80	16.41	7.09	6.43
Manufacturing[5]	4.57	4.85	5.31	6.07	9.90	6.90	0.74	2.10	1.31	2.02	4.16	12.10
Transportation and public utilities	9.75	9.83	8.34	11.77	16.43	15.80	9.73	7.82	3.75	10.14	11.91	10.33
Wholesale trade[5]	4.37	3.33	3.36	3.15	1.15	1.23	1.21	1.10	1.06	3.06	2.65	2.31
Retail trade	9.24	9.23	9.34	7.91	8.76	8.60	11.02	8.27	9.32	7.14	6.94	7.48
Finance, insurance, and real estate	3.07	3.29	4.96	2.42	2.36	3.28	2.40	2.07	4.54	1.40	1.61	2.90
Services	12.45	16.03	19.95	5.60	8.35	10.59	13.56	15.06	20.84	10.11	8.79	11.99
Federal government, civilian	3.95	5.07	4.68	2.34	3.39	2.96	3.15	5.86	6.43	1.51	1.79	1.78
Military	1.74	2.74	2.39	0.24	0.52	0.63	0.95	0.51	1.04	0.16	0.34	0.34
State government	3.93	5.81	4.83	1.90	2.57	2.24	2.53	3.53	2.73	0.73	1.15	1.03
Local government	7.81	12.59	11.49	7.90	14.87	17.58	8.51	13.46	13.80	6.41	11.74	11.80
Total Earnings	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

1 Source: BEA (2003b). Thousands of 2000 dollars unless otherwise noted. All state and local area dollar estimates are in current dollars, adjusted for inflation.
2 Farm income consists of proprietors' income; the cash wages, pay-in-kind, and other labor income of hired farm workers; and the salaries of officers of corporate farms.
3 "Other" consists of wage and salary disbursements to U.S. residents employed by international organizations and foreign embassies and consulates in the United States.
4 Calculated by subtracting oil and gas extraction from total mining.
5 Oil and gas extraction for Sublette County in the year 2000 was not disclosed. Therefore, the value shown was estimated for the year 2000 using the constant share of total method based on the average of the shares for 1980 and 1990 and is likely underestimated for 2000 given known increases in this sector during that period. The same method was used to estimate manufacturing and wholesale in Sublette County in 1990 based on the average of the shares for 1980 and 2000.

annual rate of 5.5% from 1990 to 2000; thus, while the industry overall grew by 3,340.0% (19.3% annual average growth) over the 20-year study period, it provided only 2.0% of all Sublette County industry earnings in 2000. Overall, mineral extraction provided a total of 18.1% of all Sublette County industry earnings in 2000 compared to 20.0% in 1980--an average annual loss of 0.3%.

Sweetwater County

In 1980, total mineral extraction provided 40.7% (mining provided 29.9% and oil and gas provided 10.8%) of Sweetwater County industry earnings (see Table 3.36). In 2000, total mineral extraction provided 31.3% (oil and gas provided 14.1% and mining provided 17.2%) of Sweetwater County industry earnings. Total earnings in Sweetwater County fell 18.2% (1.0% annual average loss) over the 20-year study period.

3.4.8 Taxes and Revenues

The minerals industry accounts for a substantial share of revenues to the state and to local governments in Wyoming. Revenues that contributed to the general fund, including those from the minerals industry, from 1980 to 2000 are listed in Table 3.37.

Produced minerals are classified as personal property, and mineral producers pay two types of taxes: (1) the county property (ad valorem) tax on production and (2) the state severance tax. Producers pay county property (ad valorem) taxes on plants, refineries, mining and well head equipment, pipelines, and other facilities used in the mineral production and transportation operations. Mill levies applied against mineral facilities and structures are the same as those applied against all other property in the taxing jurisdiction. Property associated with mineral production is classified as industrial property and thus has a higher assessment ratio than commercial, agricultural, or residential property.

Mineral producers also pay royalties, bonuses, rentals, and fees to the owner of the mineral for the right to obtain a lease and produce the mineral. For minerals owned by the federal government, the federal government receives a share of the revenues from the mineral production, or annual rentals are paid on mineral leases that are not producing. The same is true for minerals owned by the state government. Additionally, the state receives a share of federal royalty payments for federal minerals through a federal revenue-sharing provision.

To obtain a mineral lease from the state or federal government, the lessee must pay a bonus. This "bonus" is the amount that the successful winner of the lease (i.e., highest bidder) pays to acquire the lease. The state retains the entire bonus bid to acquire state leases. One-half of the federal lease bonus proceeds for federal land leases are returned to the state.

A severance tax is an excise tax imposed on the present and continuing privilege of removing, extracting, severing, or producing any mineral in Wyoming. Severance taxes are distributed according to *Wyoming Statute* (W.S.) 39-14-801. Severance distributions to all Wyoming counties and cities and to those counties and cities in the study area are summarized in Table 3.38. Further detail is provided in BLM (2005).

The Permanent Wyoming Mineral Trust Fund (PWMTF) is a fund that holds 25% of all severance taxes currently received by the state, functioning like a savings account for the state.

Table 3.37 Wyoming General Fund Revenues, Fiscal Year Collections by Source.[1]

Fiscal Year	Ad Valorem (Production)	Severance Tax	Sales & Use Tax	PWMTF Income	Pooled Income[2]	Charges-Sales and Services	Franchise Tax	Revenue from Others[3]	Penalties[4]	Federal Aid and Grants	All Other[5,6]	Total[7]
1980	12,907,248	79,282	245,683	25,061	30,410	31,495	15,746	10,131	1,491	9,464	21,444	13,377,455
1981	15,367,554	90,952	267,396	34,650	29,553	31,587	16,067	7,943	2,056	9,826	20,182	15,877,767
1982	14,162,407	201,201	293,965	46,613	37,622	17,129	10,296	13,356	2,304	2,806	21,938	14,809,638
1983	13,737,084	190,796	224,897	78,946	53,131	16,971	15,007	16,229	2,788	442	40,612	14,376,904
1984	13,903,877	181,963	200,116	93,578	48,802	15,005	14,169	13,363	1,976	3,840	29,000	14,505,689
1985	12,532,055	182,560	196,486	108,030	52,254	13,681	14,484	18,681	2,501	3,858	42,055	13,166,647
1986	9,384,099	169,940	196,322	113,788	57,582	17,242	18,627	14,206	1,273	707	26,932	10,000,718
1987	8,934,607	104,407	154,576	112,297	36,053	15,142	30,329	21,040	1,432	1,273	31,046	9,442,200
1988	8,340,254	96,495	150,859	105,738	25,878	14,398	15,197	11,271	1,181	756	22,310	8,784,337
1989	8,435,621	90,777	138,466	98,671	21,377	15,829	14,580	13,149	1,691	1,406	20,005	8,851,573
1990	8,415,025	97,318	134,719	113,515	67,982	13,997	14,336	9,724	3,642	977	22,153	8,893,390
1991	7,653,645	99,741	140,803	119,046	50,717	13,195	16,843	10,913	4,386	3,244	22,080	8,134,614
1992	7,579,071	83,109	142,873	113,807	66,214	16,555	15,162	14,060	5,093	5,504	14,362	8,055,810
1993	7,497,211	78,431	149,419	105,277	31,049	17,424	15,267	10,088	3,938	8,781	12,857	7,929,742
1994	7,240,946	75,800	217,771	99,976	26,045	17,785	14,739	16,551	5,381	9,062	38,561	7,762,616
1995	7,257,937	63,816	236,956	96,731	30,693	18,128	15,593	4,600	10,779	11,944	13,641	7,760,818
1996	7,842,694	67,661	229,365	94,964	29,839	18,286	13,759	4,389	2,203	12,194	15,166	8,330,520
1997	7,983,933	76,075	230,870	98,944	25,997	19,093	14,439	5,577	6,010	12,731	13,225	8,486,894
1998	7,422,008	73,484	247,974	106,994	24,687	19,197	14,073	6,317	7,148	11,153	17,499	7,950,534
1999	8,162,297	60,905	242,616	110,437	26,174	21,017	11,823	7,245	6,070	10,639	20,143	8,679,364
2000	10,542,096	83,616	262,339	117,485	26,192	18,799	13,629	14,830	5,809	8,189	64,712	11,157,696
Total Growth (%) (1980-2000)	-18.32	5.47	6.78	368.79	-13.87	-40.31	-13.45	46.39	289.74	-13.48	201.77	-16.59
Average Annual Growth Rate (%) (1980-2000)	-1.01	0.27	0.33	8.03	-0.74	-2.55	-0.72	1.92	7.04	-0.72	5.68	-0.90

1 Source: Consensus Revenue Estimating Group (2003). In thousands of 2000 dollars, adjusted for inflation.
2 Pooled income revenues earned on water development funds were no longer distributed to the General Fund beginning in FY93.
3 In FY94, this category received an additional $2.9 million in interest on severance tax protests. The rest of the difference in this series between FY94 and FY95 is primarily because revenues from Workers' Compensation ($6.8 million in FY94) and the Retirement System Board's Trust and Agency Fund ($0.8 million in FY94) no longer flowed into the General Fund beginning in FY95. However, the expenditure responsibilities were also shifted away from the General Fund at that time. Consequently, there was no net loss in actual General Fund revenues as a result of these changes.
4 Total revenues in this category in FY95 included $4.1 million in severance tax penalty and interest and interest received during the Generally Accepted Accounting Principals transition period and an additional $2.8 million from an oil audit settlement.
5 This category includes all 1200 series tax revenue except sales and use taxes, inheritance tax (revenue code 1401), license and permit fees (2000 revenue series), property and money use fees (4000 revenue series, excluding investment income), and non-revenue receipts (9000 revenue series). The inheritance tax total for FY94 included $21.0 million in revenue from a single estate settlement, and in FY00 it totaled $45.1 million.
6 Inheritance taxes will provide revenue to the general fund at diminishing rates through FY05. Due to federal legislation, the tax will be completely phased out by FY06.

Table 3.38 Summary of Mineral Severance Taxes Received by Wyoming and Directly Distributed to All Wyoming Counties and Cities and Project-Affected Counties and Cities in the Study Area.

	Distributions (Thousands of $)[1]				
Tax and Distribution Entity	1980	1990	2000	2001	2002
Total Received by Wyoming[2]	219,889	331,196	275,123	434,534	287,457
Amount Distributed to All Counties[2]	--	8,628	8,559	15,171	6,081
Lincoln County[3]	--	--	159	405	231
Sublette County[3]	--	--	61	159	94
Sweetwater County[3]	--	--	489	1,175	595
Amount Distributed to All Cities[2]	--	25,885	21,506	32,136	14,498
LaBarge[4]	--	--	27	53	22
Big Piney[4]	--	--	25	49	21
Marbleton[4]	--	--	35	74	37
Pinedale[4]	--	--	65	140	72
Rock Springs[4]	--	--	1,056	2,121	959

1 In thousands of year 2000 dollars, adjusted for inflation; -- = data not available.
2 Consensus Revenue Estimating Group (2003). Total direct disbursements to cities and counties, not including capital construction or other funds.
3 Lummis et al. (2000, 2001, 2002, 2003). Distributions to counties. Total distributions reported by Lummis et al. do not add to the total reported as revenue received in Consensus Revenue Estimating Group (2003).
4 Lummis et al. (2000, 2001, 2002, 2003). Distributions to towns and cities. Total distributions reported by Lummis et al. do not add to the total reported as revenue received in Consensus Revenue Estimating Group (2003).

The fund balance was $1.9 billion in June 2002 (Lummis et al. 2002). As reported by Lummis et al. during the previous fiscal year, over $74 million in severance taxes were added to the fund. Natural gas alone contributed 46.8% of severance taxes or more than $34.7 million to the PWMTF. Gas, oil, and associated products contributed more than $45.5 million (61.4%) of all severance added to the PWMTF. The principal of the PWMTF is inviolate but may be loaned to political subdivisions. The interest on the PWMTF goes to the state's general fund for the legislature to allocate to current programs.

Royalties

A mineral royalty is the amount of money the owner of the mineral resource receives as a payment or royalty from the mineral producer. Wyoming receives a base royalty of 16.7% of the value of production from state-owned minerals. The federal government receives a royalty of 12.5% of the value of production for minerals produced on federal lands. Fifty percent of federal mineral royalties are returned to the state, and a portion of that is then distributed to counties and cities. Unlike severance taxes, royalties are based on the value of production and byproducts. Gas and oil prices skyrocketed in 2000, bringing with them significant increases in all forms of mineral revenue along with increasing natural gas revenues, which include coalbed methane production. Natural gas prices rose in 2000 due to tighter supplies, lower storage stocks, and market perceptions (Energy Information Administration 2001). In the late 1990s, these sources of income were declining as prices for gas and oil were depressed. With renewed market pressure in late 1999, the value of production increased, as did corresponding taxes. Federal royalties are distributed by the State of Wyoming according to W.S. 9-4-601. Federal royalty distributions to all counties and cities, and those cities in the project-affected area are shown in Table 3.39. State mineral royalties received are presented in Table 3.40.

Payments in Lieu of Taxes (PILT)

The federal government owns and manages 49% of Wyoming lands. Federal lands are not subject to property taxes that support county governments and education. In 1976, Congress authorized federal land management agencies to share income with states and counties and provided a payment in lieu of taxes (PILT) program to help offset lost tax revenue (31 U.S.C. 6901-6907 [*Public Law* 103-397, October 22, 1994; *Public Law* 104-333, November 12, 1996; and *Public Law* 105-83, November 14, 1997]; 43 C.F.R. Part 1880 [65 *Federal Register* 51229-51234, August 23, 2000, effective September 22, 2000]). PILT payments are federal payments to local governments that help offset losses in property taxes due to nontaxable federal lands within their boundaries. PILT payments are administered by the BLM (Coupal et al. 2003).

PILT payments are based on three factors:

eligible federal acres in the county,

federal revenue-sharing going to the county the prior year, and

county population up to the pre-determined ceiling.

Since 1998, PILT payments received by Wyoming have increased by 63.9% (Table 3.41). The three-county study area has experienced a similar increase.

Lincoln County PILT payments increased 74.2%, Sublette County payments increased 58.9%, and Sweetwater County PILT payments increased 58.0% over the past 6 years.

Property Taxes (Ad Valorem Taxes)

The taxable valuation of all mineral production in Wyoming fell 18% from $12.9 billion in 1980 to $10.5 billion in 2000 (-1.1% average annual decline) (Wyoming Department of Revenue 2002). Foulke et al. (2001) believe that mineral revenues will continue to rise and that gas production, particularly, will drive future revenues higher for the foreseeable future. Assessed production values are presented in Table 3.42.

Wyoming Department of Revenue reports indicate that in 2002, natural gas production contributed the greatest proportion of taxable value to the state (34.8%), followed by residential land and improvements (18.5%), mining production (15.9%), and oil production (9.7%) (Table 3.43).

Table 3.39 Summary of Federal Mineral Royalties Received by Wyoming and Directly Distributed to All Counties and Cities and Project-Affected Counties and Cities.[1]

	Royalties Distributions (Thousands of $)[2]				
Tax and Distribution Entity	1980	1990	2000	2001	2002
Total Received by Wyoming[3]	198,742	222,188	309,093	434,676	334,703
Amount Distributed to Counties[3,4]	n/d	1,389	n/d	n/d	n/d
Amount Distributed to Cities[3,4]	--	20,830	19,588	21,678	20,007
LaBarge[5]	--	--	61	60	55
Big Piney[5]	--	--	66	64	55
Marbleton[5]	--	--	86	88	86
Pinedale[5]	--	--	147	152	154
Rock Springs[5]	--	--	1,010	1,002	994

1 Includes coal lease bonuses. FY98 coal revenues include $8.0 million in protest severance taxes that were from prior production years.
2 In thousands of year 2000 dollars, adjusted for inflation; -- = data not available; n/d = no distribution.
3 Consensus Revenue Estimating Group (Consensus Revenue Estimating Group) (2003).
4 Total direct disbursements to cities and counties, not including capital construction or other funds.
5 Lummis et al. (2000, 2001, 2002, 2003). Total distributions reported by Lummis et al. do not add to the total reported as revenue received in Consensus Revenue Estimating Group (2003).

Table 3.40 Summary of State of Wyoming Mineral Royalties.

Fiscal Year	Thousands of $[1]
1980	--
1990	--
2000	27,721
2001	34,099
2002	56,021

1 Historical data for state-owned mineral royalties are not readily available and are generally not included in socioeconomic analyses prepared by Wyoming state agencies. WDAI (2002a).

Table 3.41 Total PILT Payments and Total Acres.[1]

	PILT Payments/Acres					
Location	1998	1999	2000	2001	2002	2003
Wyoming						
Payment ($)	8,118,173	8,208,280	8,318,110	11,828,099	12,392,400	13,304,416
Acres	29,917,112	29,893,541	29,885,632	29,884,922	29,889,764	29,877,970
Lincoln County						
Payment ($)	384,723	406,667	418,646	598,093	617,577	670,171
Acres	1,946,836	1,946,805	1,946,765	1,946,631	1,947,558	1,947,558
Sublette County						
Payment ($)	258,703	247,508	256,483	360,764	376,237	411,150
Acres	2,432,160	2,432,000	2,431,960	2,431,960	2,431,305	2,431,305
Sweetwater County						
Payment ($)	910,456	929,377	949,649	1,281,416	1,333,882	1,438,845
Acres	4,609,862	4,606,891	4,606,891	4,606,888	4,606,888	4,606,799

[1] Coupal et al. (2003) and BLM (2003c), in year 2000 dollars, adjusted for inflation.

Table 3.42 Total State-Assessed Mineral Production Valuations.[1]

	Taxable Valuation (Thousands of $)		
Mineral Type	1980	1990	2000
Oil	4,847,711	2,561,672	1,438,976
Natural Gas	1,402,442	1,057,631	3,365,841
Coal	1,616,744	1,487,154	1,336,116
Trona	290,327	236,359	206,219
All Other Minerals	256,679	52,660	59,909
Total Mineral Taxable Valuation	8,413,904	5,395,476	6,407,060
Other Property	4,493,344	3,019,549	4,135,036
Grand total	12,907,248	8,415,025	10,542,096

[1] Consensus Revenue Estimating Group (2003), thousands of year 2000 dollars, adjusted for inflation.

Table 3.43 Proportionate Taxable Valuation of Various Classes of Property in Wyoming, 1998-2002.

	Proportion of Taxable Value[1] (Ranked Highest to Lowest According to 2002 Proportions)				
Property	1998	1999	2000	2001	2002
Natural gas production	19.2%	18.6%	20.6%	31.9%	34.8%
Residential lands and improvements	19.9%	22.6%	22.0%	18.5%	18.5%
Mining (coal, minerals, and non-minerals)	20.0%	41.6%	19.5%	15.2%	15.9%
Oil production	14.7%	8.8%	11.5%	13.7%	9.7%
Industrial and manufacturing property	8.9%	9.8%	8.7%	7.1%	7.4%
Commercial lands and improvements	1.5%	5.6%	5.2%	4.2%	4.4%
Railroads	1.7%	2.0%	2.2%	1.7%	1.8%
Electric/gas-privately owned	2.5%	2.6%	2.3%	1.6%	1.6%
Commercial personal property	1.5%	1.7%	1.6%	1.3%	1.3%
Agricultural lands	1.9%	2.0%	1.8%	1.3%	1.3%
Natural gas pipelines	0.9%	1.1%	1.1%	0.8%	1.0%
Electric-cooperatives	1.5%	1.1%	1.0%	0.7%	0.6%
Major telecommunications	0.7%	0.7%	0.807%	0.7%	0.6%
Residential personal property	0.6%	0.6%	0.572%	0.4%	0.4%
Liquid pipelines	0.6%	0.7%	0.672%	0.4%	0.4%
Rural telecommunications	0.2%	0.3%	0.232%	0.2%	0.2%
Cellular/reseller telecommunications[2]	<0.1%	0.1%	0.162%	0.1%	0.2%
Airlines	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Electric-municipal	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

[1] Columns may not total to 100% due to rounding. Wyoming Department of Revenue (1998, 1999, 2000, 2001, 2002).

[2] Designated as radio-telephones in 1998.

Sales, Use, and Lodging Tax

Wyoming has had sales and use taxes since 1935. Sales taxes apply to the retail sale of personal property or services within the state. A use tax is levied on any sale of any property outside the state of Wyoming for use, storage, or consumption inside the state of Wyoming.

Wyoming counties, cities, and towns benefit from sales and use tax collections. Each month, the treasurer's office in each county sends the sales tax collections to the Wyoming Department of Revenue, which distributes the money. Currently, two-thirds of the 4% sales tax collections go to the state general fund, and one-third (minus 1% for state administrative purposes) is returned to the cities, towns, and counties. The money returned to the cities and counties is based on where the purchase occurred and the population of the city or county (which is based on the last federal census). Counties that have 1% optional sales taxes or a 1% capital facilities tax keep 100% of the additional 1% collected. The state's share of the sales tax revenue is distributed to the General Fund. Effective tax rates for the study area as of 2002 are listed in Table 3.44.

County sales tax rates can fluctuate from year to year because county option taxes originate and expire at varying times; therefore, only the total state imposed sales tax (4%) will be used for this analysis. State use tax is imposed on purchases made outside a taxing jurisdiction for first use, storage, or other consumption within that jurisdiction (Table 3.44). Thus, the use tax prevents sales tax avoidance or the payment of a lesser tax rate by making purchases outside of the taxing jurisdiction where first use, storage, or other consumption will occur. Wyoming taxing jurisdictions are the State of Wyoming and/or each Wyoming county. Use tax is a complement of sales tax. Effective January 1, 1981, the adoption of an optional sales tax required a change in the use tax rate of equal amount. State use tax is shared between state government and the county of origin on the same distribution basis as sales tax. Therefore, the revised rate and allocation, as mentioned earlier in the sales tax description, applies here as well.

Cities, towns, and counties, by voter approval, may impose a lodging excise tax of up to 4% on all sleeping accommodations for guests staying less than 30 days (see Table 3.44). This tax extends to mobile accommodations such as tents, trailers, and campers, as well. All collections

Table 3.44 Sales, Use, and Lodging Tax Rates by County (Effective April 1, 2003).[1]

Tax Rate	Lincoln	Sublette	Sweetwater
State Sales Tax Rate	4.0%	4.0%	4.0%
General Purpose Option Tax	1.0%	--	1.0%
Specific Purpose Option Tax	--	--	0.5%
Subtotal	5.0%	4.0%	5.5%
Lodging Tax	2.0%[2]	3.0%	2.0%
Total Tax Rate	7.0%	7.0%	7.5%

1 Wyoming Department of Revenue (2003).
2 Note: Lodging tax is imposed only in Afton (i.e., not in a county-wide base).

(less a 2% state administrative cost during the first year the tax is imposed and 1% thereafter) are distributed to the cities, towns, and counties of origin. At least 90% of the tax distributions must be used to promote travel and tourism within the county, city, or town imposing the tax. The amount remaining, not to exceed 10% of the total amount distributed, may be used for general revenue within the governmental entity imposing the tax.

3.4.9 Study Area Taxes and Revenues

3.4.9.1 Availability of Information

Reporting of tax and revenue information has evolved with the development of the internet and the ease of publishing large volumes of information; this evolution has led to an unavailability of certain reports and information that predate 1998 (personal communication, July 8, 2003, with Christie Yurek, Validation Supervisor, Wyoming Department of Revenue, Administrative Services Division).

Oil and gas field operations support employment in many industries. Firms whose primary activity is operating oil and gas wells, exploring for oil and gas, or providing oil and gas field services are included in SIC 13, mining--oil and gas extraction. But many employers in other industries such as wholesale trade and transportation, communications, and public utilities depend on business from oil and gas service companies (WDERP 1999). According to Bullard in WDERP (1999: Table 1 and Map 1), the Sublette and Sweetwater County economies are highly dependent on oil and natural gas extraction (15.2% and 5.8%, respectively), while Lincoln County is moderately dependent (4.2%) on the oil and gas industry.

While it is not possible to determine the proportion of funds each city and county spends on each item of infrastructure and services derived from oil and gas revenues, example budgets for Big Piney, Pinedale, and Sublette County are presented in BLM (2005). Funds received by Sublette County in recent years have been used for capital improvements, such as a new courthouse, jail, land fill, senior centers, and public clinic upgrade, and surpluses have been placed in reserve accounts to develop savings for future requirements (personal communication, May 20, 2004, with Mary Langford, Sublette County Clerk). Funds received in Big Piney in excess of normal operating have also gone to capital improvements (personal communication, May 20, 2004, with Vickie Brown, Big Piney Town Clerk).

3.4.9.2 State Royalties

In total, royalties in Wyoming arising from natural gas production on state lands increased by nearly 62.0% from 1998 to 2002 (Wyoming Office of State Lands and Investments [WOSLI] 2002). Oil royalties rose and fell, but overall grew 5.6% from 1998 to 2002.

In Lincoln County, royalties from natural gas production on state lands fell 21.5% from 1998 to 2002. Oil royalties have risen and fallen, but generally declined in Lincoln County, falling 17.3% from 1998 to 2002. The only other mineral royalty paid to Lincoln County in 2001 and 2002 from state lands was for sand and gravel (WOSLI 2002).

In contrast, Sublette County has experienced significant increases in royalties from natural gas and oil production on state lands. Royalties from natural gas increased by 81.9% from 1998 to 2002. Oil royalties increased even more dramatically (155.9%) from 1998 to 2002. The only other mineral royalty paid to Sublette County in 2001 and 2002 from state lands was for sand and gravel (WOSLI 2002).

Sweetwater County royalties from natural gas production on state lands increased by more than 17.1% from 1998 to 2002. Oil royalties also increased (20.6%; 3.8% average annual growth) in Sweetwater County from 1998 to 2002. Sweetwater County received most of its royalties from (and is the only county in Wyoming to receive royalties from) trona mining but also received royalties from coal (2000, 2001, 2002), limestone (2000), uranium (2002), and sand and gravel (2001, 2002).

3.4.9.3 Ad Valorem Valuation and Taxes Levied

Due to changes in agency reporting methods, information from 1980 and 1990 was only minimally available. Ad valorem valuations for the study area illustrating tax source and allocation are presented in BLM (2005).

3.4.9.4 Sales, Use, and Lodging Tax Collections

Sales, use, and lodging tax collection information is presented for Wyoming and the three-county study area in BLM (2005).

3.4.10 Grazing Economics

3.4.10.1 Grazing Allotments

Table 3.45 summarizes grazing allotment acreages and animal unit months (AUMs) (an AUM is the amount of forage required to sustain one cow and calf for one month) in the JIDPA (see also EIS Section 3.5.2).

3.4.10.2 Value of Grazing

The estimated value of grazing in the JIDPA is summarized in Tables 3.46-3.48. The method used to determine the value of grazing per AUM is from BLM (2003a).

The value of cattle grazing per AUM in Wyoming is shown in Table 3.46. AUM values for grazing cattle were determined from Wyoming Agricultural Statistics Service (2003) values of cattle sold in Wyoming from 1998 to 2002 (presented in Year 2000 dollars, adjusted for inflation) (see Table 3.47). Total cattle sales were divided by the number of cows that calved, which provided a value per cow. The values per cow was then divided by an AUM conversion factor (Workman 1986), resulting in an estimated nominal value per AUM for 2000. The average values of these AUMs are used in the impact analyses presented in EIS Chapter 4.

The JIDPA is entirely within Sublette County. Because there would be no impact on grazing activities in Lincoln or Sweetwater Counties as a result of the proposed project, Sublette County comprises the total study area for grazing analyses. The value of grazing associated with the JIDPA was compared to livestock sales during 1997 for Sublette County. Data on sales were obtained from the 1997 Census of Agriculture published by the National Agricultural Statistical Service (1999). Table 3.48 shows that total agricultural sales in Sublette County exceeded $29 million, more than 95% of which was associated with livestock sales. Grazing activities

Table 3.45 Grazing Allotments and AUMs, Jonah Infill Drilling Project, Sublette County, Wyoming, 2004.

	Allotment Size (acres)		AUMs		Average Acres per AUM
Allotment Name	Total	In Project Area	Total	In Project Area	
Stud Horse Common	15,590	5,490	1,730	670	8.2
Sand Draw	31,740	20,740	2,324	1,571	13.2
Boundary[1]	31,994	3,630	2,996	363	10.0
Blue Rim Desert	41,273	0[2]	2,826	--	14.6
Unalloted private lands	640	640	-- [3]	-- [3]	-- [3]
Total JIDPA[3]	121,237	30,500	9,876	2,604	11.5

1 Sheep are also approved for grazing on the Boundary allotment.
2 Approximately 35 acres of this allotment would be affected by the Burma Road upgrade.
3 Total does not include unalloted private lands; insufficient data available to calculate AUMs for these lands.

Table 3.46 Estimated Value of Cattle Grazing AUMs in Wyoming, Jonah Infill Drilling Project, Sublette County, Wyoming, 2004.

Year	Value of Cattle Production (Thousands of $)[1]	Number of Cows that have Calved (Thousands of Head)[2]	Value Per Cow[3]	AUM Conversion Factor[4]	Value of Production Per AUM[5] (Year 2000 $)
1997	474,990	870	545.97	16	34.12
1998	423,250	880	480.97	16	30.06
1999	467,253	830	562.96	16	35.18
2000	497,851	830	599.82	16	37.49
2001	527,804	850	620.95	16	38.81
2002	425,776	820	519.24	16	32.45
Average	468,387	842	556.79	--	34.80

1 Thousands of Year 2000 dollars, adjusted for inflation. Source: Wyoming Agricultural Statistics Service (2003:42).
2 Source: Wyoming Agricultural Statistics Service (2003:40).
3 Value per cow = value of cattle production ÷ number of cows that have calved.
4 Workman (1986).
5 Value of production per AUM = value per cow ÷ AUM conversion factor.

Table 3.47 Estimated Value of Grazing Activities on Project-Affected Lands[1], Jonah Infill Drilling Project, Sublette County, Wyoming, 2004.

	Value of Grazing Cattle[2] ($)	
Allotment Name	Total	Project-Affected Lands
Stud Horse Common	60,204	23,316
Sand Draw	80,875	54,671
Boundary	104,261	12,632
Blue Rim Desert	98,345	1,218 [3]
Unalloted private lands	1,636 [4]	1,636 [4]
Total JIDPA	343,685	90,619 [3,4]

1 See Table 3.45.
2 Cattle grazing was valued at $34.80/AUM (see Table 3.46). Sheep are also approved for grazing on the Boundary allotment, but currently they do not occur on the project-affected portion of the allotment and are not discussed further.
3 The JIDPA is 30,500 acres; 35 acres in the Blue Rim Desert allotment outside of the project boundary would be disturbed for the Burma Road upgrade (12 miles long x 24 ft wide = 35 acres).
4 Unalloted private lands within the Sand Draw allotment are not under federal control; therefore, they are not shown in Table 3.44, however, the AUMs (47) are estimated based on the Sand Draw allotment for the purposes of valuation in this table.

Table 3.48 Percentage of Agricultural Sales Attributed to Grazing in the Jonah Field, 1997.

Sales in Sublette County[1]	Value ($)	Percentage
Total Agricultural[2]	$29,191,000	
Value from Livestock[2]	$27,809,000	
Percent from Livestock		95.0%
Sales Attributable to Grazing on the Project Area[2,3]	$90,619	
Percent of all Sublette County Agricultural Sales arising from Grazing on the JIDPA		0.31%
Percent of All Livestock Sales in Sublette County Arising from Grazing on the JIDPA		0.33%

1 The JIDPA is entirely encompassed within Sublette County; therefore, Lincoln and Sweetwater County sales are unlikely to be affected and are not evaluated.
2 In year 2000 dollars, adjusted for inflation (National Agriculture Statistics Service 1999).
3 See Table 3.47.

attributable to the JIDPA could account for $90,619, or up to 0.31% of all agricultural sales and 0.33% of all livestock sales in Sublette County in 1997.

3.4.11 Recreation Economics

Since the JIDPA lies almost entirely within the PFO area, recreation economics are evaluated only within this area. However, some additional demand is likely in other areas (e.g., Lincoln and Sweetwater Counties). See BLM (2005) for more detailed analysis.

3.4.11.1 Nonconsumptive Recreation

Table 3.49 shows the recreational visitor days (RVDs) per activity for the PFO for a 4-year period from 1998 to 2002 (BLM 2003d). (These data are considered to be somewhat inaccurate.) During this time, over 300,000 RVDs are estimated to have occurred annually within the PFO area for a variety of activities. The most popular of these activities were float or raft trips, fishing, camping, and hiking/walking/running. Hunting is addressed separately (Section 3.4.11.2).

3.4.11.2 Hunting

Hunting is also popular within the PFO area. Much of this activity occurs on BLM-managed land since this land provides habitat for many species, including big game, small game, and upland game birds. Pronghorn is the only big game species likely to be hunted in the JIDPA; therefore, the economics of hunting other big game species are not addressed further in this EIS.

The entire JIDPA lies within the Sublette Pronghorn Antelope Herd Unit, which occupies approximately 6.7 million acres (Table 3.50). BLM is responsible for management of 64% of the surface of the Sublette Herd Unit; the USFS is responsible for management of 4% of the surface; 4% is managed by the Bureau of Reclamation; and 26% is in State of Wyoming and private ownership. Pronghorn hunting was estimated from WGFD data since WGFD regulates the sport and keeps data on hunting use by animal and by area throughout Wyoming (Table 3.51).

Furbearers, Small Game, Upland Birds, and Waterfowl

Furbearers likely occur within the JIDPA, which lies within Furbearer Management Area 7 (WGFD 2003b). Weasel, badger, skunk, coyote, red fox, and bobcat are likely to occur and may be hunted/trapped in the vicinity of the project area. WGFD has not collected hunter expenditure information for these species (WGFD 2003d); therefore, they are not addressed further herein.

The JIDPA lies within Small Game Management Area 7 (WGFD 2003b); however, due to habitat limitations, only greater sage-grouse and desert cottontail rabbit are likely to occur and be hunted on the JIDPA (Table 3.52). The WGFD has not collected hunter expenditure information for all small game species that may potentially occur and may occasionally be hunted and trapped on the JIDPA (WGFD 2003d); therefore, impact analysis is provided only for desert cottontail rabbit and greater sage-grouse.

Waterfowl Area 5B encompasses the JIDPA, and ducks and geese may be hunted in the vicinity of the project area. The WGFD has not collected hunter expenditure information for all waterfowl species that may potentially occur and may occasionally be hunted on the JIDPA (WGFD 2003d); therefore, these species are not addressed further herein.

Table 3.49 Estimated Annual Recreational Visitor Days, PFO Area.[1]

Activity	Annual Recreational Visitor Days[2]	Percent of Total Activity
Archery	760	0.24
Backpacking	4,118	1.29
Bicycling–Mountain	5,066	1.58
Bicycling–Road	16	0.01
Camping	35,168	10.99
Climbing–Mountain/Rock	458	0.14
Driving for Pleasure	4,182	1.31
Environmental Education	55	0.02
Fishing	73,227	22.89
Hiking/Walking/Running	30,581	9.56
Horseback Riding	732	0.23
Nature Study	880	0.28
Off-highway vehicles (OHVs) - All-terrain vehicles (ATVs)	1,268	0.40
OHVs – Cars/Trucks/Sport Utility Vehicles	155	0.05
Pack Trips	2,746	0.86
Photography	880	0.28
Picnicking	1,366	0.43
Power Boating	789	0.25
Row/Float/Raft	138,630	43.32
Skiing – Cross-Country	2,123	0.66
Snowmobiling	12,368	3.87
Staging/Comfort Stop	829	0.26
Swimming/Water Play	854	0.27
Viewing Wildlife	2,727	0.85
Total Recreational Visitor Days	319,978	100.00

[1] From BLM (2003d).

3.4.11.3 Value of Recreational Use

Recreational activities (nonconsumptive and hunting) have important economic value both in terms of the satisfaction provided to local residents and visitors and the economic activity it generates for the regional economy. Recreation generates additional spending in the local economy that supports jobs and income. Economic stimulus occurs as non-residents visit the area and spend money in the local economy, which in turn generates additional spending by local residents. It is assumed that if local residents were not participating in recreation, they probably would have spent their money on something else in the region's economy. Thus, expenditures by local residents are seen as a shifting of dollars from one sector to another within the local economy and not a net gain to the region. However, dollars that remain within the community when local residents have satisfactory recreational opportunities are important. Keeping dollars within the local economy helps maintain jobs, thus reducing employment and income fluctuations that may result if those dollars became an outflow from (i.e., are spent outside) the local economy.

<u>Value of Nonconsumptive Recreation</u>

The value of recreation was estimated using the methods developed for the South West Regional Economic Evaluation (University of Wyoming, Agricultural Economics Department [UWAED 1997]) and Jack Morrow Hills Coordinated Activity Plan (BLM 2003a; UWAED 2003). Nonconsumptive recreation was derived from UWAED (1997), and is presented in Year 2000 dollars adjusted for inflation. The estimated value of nonconsumptive recreation in the PFO is summarized in Table 3.53.

<u>Value of Hunting</u>

The method used to determine the value of hunting is based that used by UWAED (1997) updated with 2002 hunting and hunter expenditure data from WGFD (2003a, 2003b, 2003c) and is presented in Year 2000 dollars, adjusted for inflation. The JIDPA is fully encompassed by the Sublette Antelope Herd Unit, and for the purposes of this report it is assumed that pronghorn antelope are evenly hunted across the herd unit because it is not possible to derive from existing data exactly where any individual hunts. This method results in a conservative overestimate of the value of hunting in a particular area because in actual practice, hunting likely does not occur evenly across all areas of a hunt unit. The value of hunting pronghorn antelope on the JIDPA is presented in Tables 3.54 and 3.55.

<u>JIDPA Hunting Value</u>

Because elk, mule deer, and moose are unlikely to occur on the JIDPA, there is no value attributable to the project area for those species. Pronghorn do occur on the JIDPA, and an estimated 61.0 hunter days (0.5% of the Sublette Antelope Herd Unit hunter days) are attributed to the JIDPA. At a value of approximately $381.30/hunter day, approximately $23,244 of hunter expenditures for antelope annually is attributable to hunting on the JIDPA. Approximately 1.0% of hunting in Small Game Management Area 7 for cottontail and greater sage-grouse each are attributable to hunting on the JIDPA. Cottontail account for 26.4 hunter days for a value of approximately $4,569.84 of hunter expenditures attributable to cottontail hunting on the JIDPA. Greater sage-grouse account for 16.3 hunter days for a value of approximately $2,123.78 of hunter expenditures attributable to greater sage-grouse hunting annually on the JIDPA.

Table 3.50 Sublette Antelope Herd Unit Landownership and Management.

		Ownership/Management (acres)		
Herd Unit Name	Total Acres	Federal	State/Private	Disturbed
Sublette Antelope Herd Unit	6,749,440	4,994,586	1,754,854	85,000

Table 3.51 Summary of Pronghorn Hunters and Hunter Days in Wyoming and the Sublette Antelope Herd Unit, 2002.[1]

	Hunters[2]			Hunter Days[2,3]		
Area	Total	Resident	Non-resident	Total	Resident	Non-resident
Wyoming	33,569	15,776	17,793	101,989	51,208	50,781
Sublette Antelope Herd Unit	4,382	2,881	1,501	13,490	9,356	4,134

[1] WGFD (2002; 2003a).
[2] Calculated from Harvest, Hunting Pressure, Hunter Success By Hunt Area 2002 reports for each species. Totals may not match state-wide summary tables.
[3] WGFD defines a "hunter-day" as any day hunting occurred, regardless of actual time spent hunting. These data are based on licensed hunter survey reports.

Table 3.52 Summary of Potentially Project-Affected Small Game and Upland Bird Hunters and Hunter-Days, 2002.[1]

	Total Wyoming		Area 7[2] (Eden)	
Species	Number of Hunters	Hunter Days	Number of Hunters	Hunter Days
Desert cottontail rabbit	5,814	25,566	316	1,981
Greater sage-grouse	2,947	7,164	271	938
Totals	8,761	32,730	587	2,919

[1] WGFD (2003b).
[2] Encompasses the JIDPA in its entirety.

Table 3.53 Value of Nonconsumptive Recreation, PFO Area, 1997.[1]

Recreation Activity	Value per Visitor-Day ($)
General recreation	10.18
Developed camping	15.73
Primitive camping	19.85
Day hiking	33.01
Picnicking	14.32
Sightseeing	16.68
Gathering forest products	15.17
Wilderness recreation	14.45
Big game hunting	77.25
Trout fishing	30.04
Wildlife watching	30.04
Snowmobiling	51.50
Average value per visitor day	27.35

[1] In Year 2000 dollars, adjusted for inflation. Source: UWAED (1997).

3.4.12 Environmental Justice

Less than 5% of the Sublette County population is minority (EPA 2003) and, although 9.7% of the population of Sublette County lives below the poverty level, this is a smaller percentage than for the State of Wyoming (11.4%) (U.S. Census Bureau 2000a). Therefore, Sublette County is neither a minority community nor a low-income community.

3.5 LAND USE

3.5.1 Land Status/Prior Rights

The JIDPA consists of federal surface/federal minerals administered by the BLM (94%/28,580 acres), two sections (1,280 acres) of State of Wyoming surface/mineral, and one section (640 acres) of private surface/federal minerals (see Map 1.1). Current land use includes energy production and development (e.g., natural gas well pads, pipelines, access roads, ware yards, offices), livestock grazing, wildlife habitat, and recreation--primarily hunting. Map 2.1 shows the extent of existing natural gas development in the JIDPA.

Table 3.54 Value of Hunting of Species Potentially Occurring on the Project Area, Wyoming and Study Area, 2002.

	Wyoming					Attributable to Potentially Affected Hunt Areas					
	Hunter-Days[1,2]				Average Value/ Hunter-Day ($)	Hunter-Days[4]			Hunter Expenditures ($)		
Species	Total	Resident	Non-resident	Hunter Expenditures[3] ($)		Total	Resident	Non-resident	Total	Resident	Non-resident
Antelope	101,989	51,208	50,781	38,888,895	381.30	13,490	9,356	4,134	5,143,737	3,567,443	1,576,294
Cottontail[6]	25,566	NA	NA	4,424,464	173.06	2,516	NA	NA	435,419	--	--
Greater sage-grouse[6]	7,164	NA	NA	933,437	130.30	1,553	NA	NA	202,356	--	--
Total	134,719	51,208	50,781	44,246,796	228.22	17,559	NA	NA	5,781,512	--	--

1 WGFD (2003a, 2003b). Calculated from Harvest, Hunting Pressure, Hunter Success By Hunt Area 2002 reports for each species. Totals may not match state-wide summary tables or WGFD (2003c).
2 WGFD defines a "hunter-day" as any day hunting occurred, regardless of actual time spent hunting. This data is based on licensed hunter survey reports.
3 WGFD (2003c). In year 2000 dollars, adjusted for inflation. WGFD does not distinguish between resident and non-resident expenditures.
4 Refer to Table 3.51 and 3.52.
5 Species that may occur infrequently within the affected areas that WGFD does not manage for hunting in the project areas may include bighorn sheep, Rocky Mountain goat, black bear, and mountain lion.
6 WGFD does not separate resident and non-resident hunter days for small and upland game.

Table 3.55 Contribution of JIDPA to Hunting Revenues.[1]

Species	Unit Name	Total Acres	Hunter-Days Attributable to Unit	Average Value/ Hunter-Day ($)	Project Area (acres)	% Acres of Unit in Project Area	Hunter-Days in Project Area	Annual Value Attributable to Hunting on Project Area ($)
Antelope	Sublette Antelope Herd Unit	6,749,440	13,490	381.30	30,500	0.5%	61.0	23,244.00
Cottontail	Small Game Management Area 7	2,906,068	2,516	173.06	30,500	1.0%	26.4	4,569.84
Greater sage-grouse	Small Game Management Area 7	2,906,068	1,553	130.30	30,500	1.0%	16.3	2,123.78
Total	--	n/a[2]	n/a[2]	n/a[2]	n/a[2]	n/a[2]	103.7	29,937.63

[1] In year 2000 dollars, adjusted for inflation.
[2] n/a = column is not additive.

The CIAA for land status/prior rights includes the JIDPA and leases that extend beyond the JIDPA, and it encompasses approximately 35,634 acres (Map 3.21). All of the JIDPA and the CIAA is leased for mineral development. Land use associated with mineral development on the JIDPA is described in Section 3.1.4.1.

3.5.2 Livestock/Grazing Management

The JIDPA includes portions of three grazing allotments--Stud Horse Common, Sand Draw, and Boundary--and the Burma Road Upgrade area includes portions the Blue Rim Desert allotment (Map 3.22 and Table 3.56). Livestock grazing is allocated to two permittees each in the Stud Horse Common and Sand Draw allotments and four permittees in the Blue Rim Desert allotment (personal communication January 6, 2003, with Steve Laster, BLM PFO). The Boundary allotment is allocated to two permittees. There are also approximately 640 acres of private lands (2% of the JIDPA) not included in allotments (see Map 3.22).

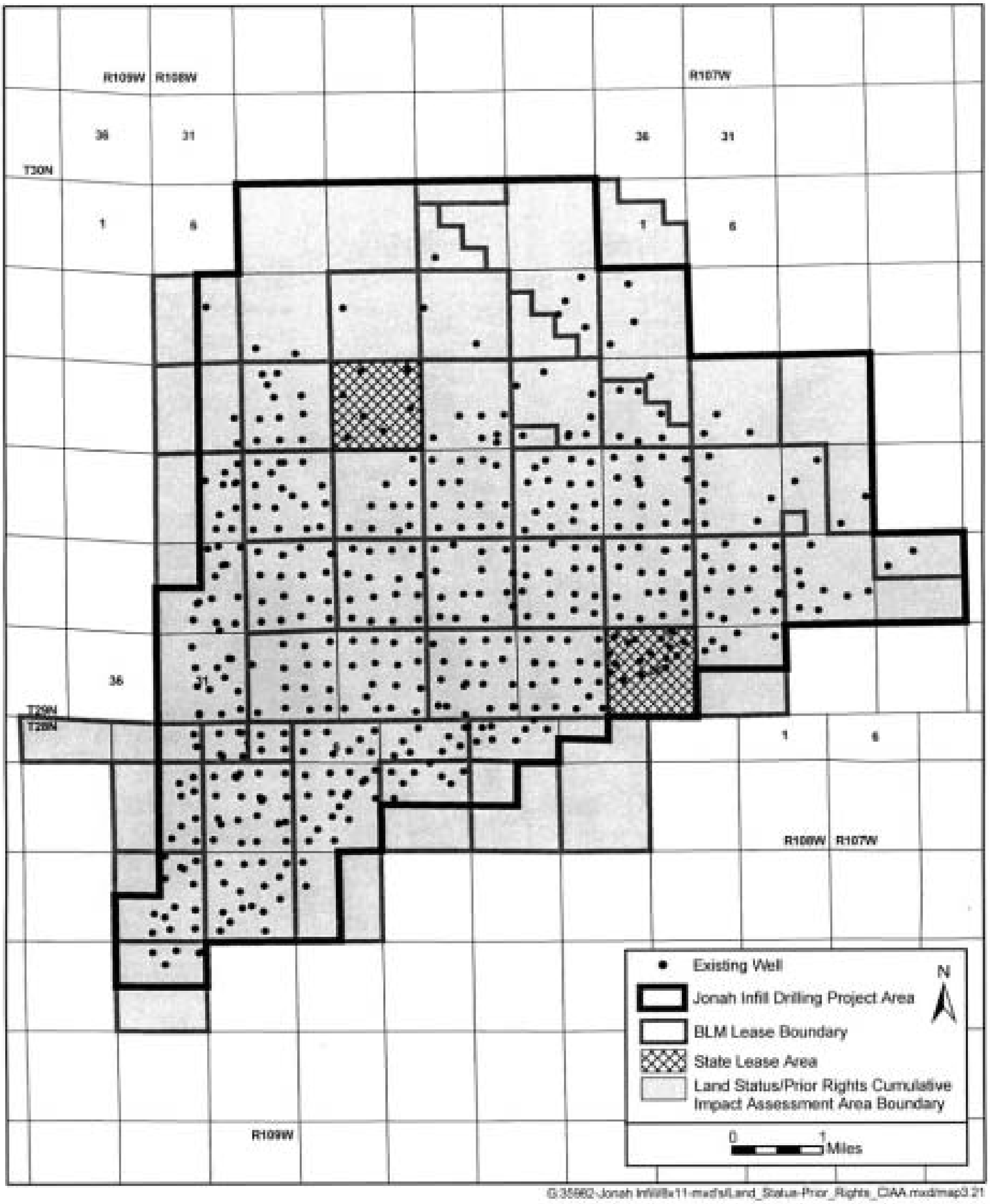
The Stud Horse Common allotment (15,590 total acres) includes 14,309 acres of BLM lands providing 1,730 AUMs (personal communication, January 6, 2003, with Steve Laster, BLM PFO) and 1,280 acres of State of Wyoming lands--an average of 8.2 acres/AUM. Cattle are grazed from May 1 to June 30. The JIDPA includes approximately 5,490 acres of the Stud Horse Common allotment providing approximately 670 AUMs (see Table 3.56).

The Sand Draw allotment (31,740 acres) includes 30,445 acres of BLM lands providing 2,324 AUMs (personal communication, November 2003, with Steve Laster, BLM PFO) and 1,295 acres of State of Wyoming lands. Cattle are grazed from May 1 to June 20 (personal communication, November 2003, with Steve Laster, BLM PFO). The JIDPA includes approximately 20,740 acres of the Sand Draw allotment providing an average of 1,571 AUMs, an average of 13.2 acres/AUM (see Table 3.56).

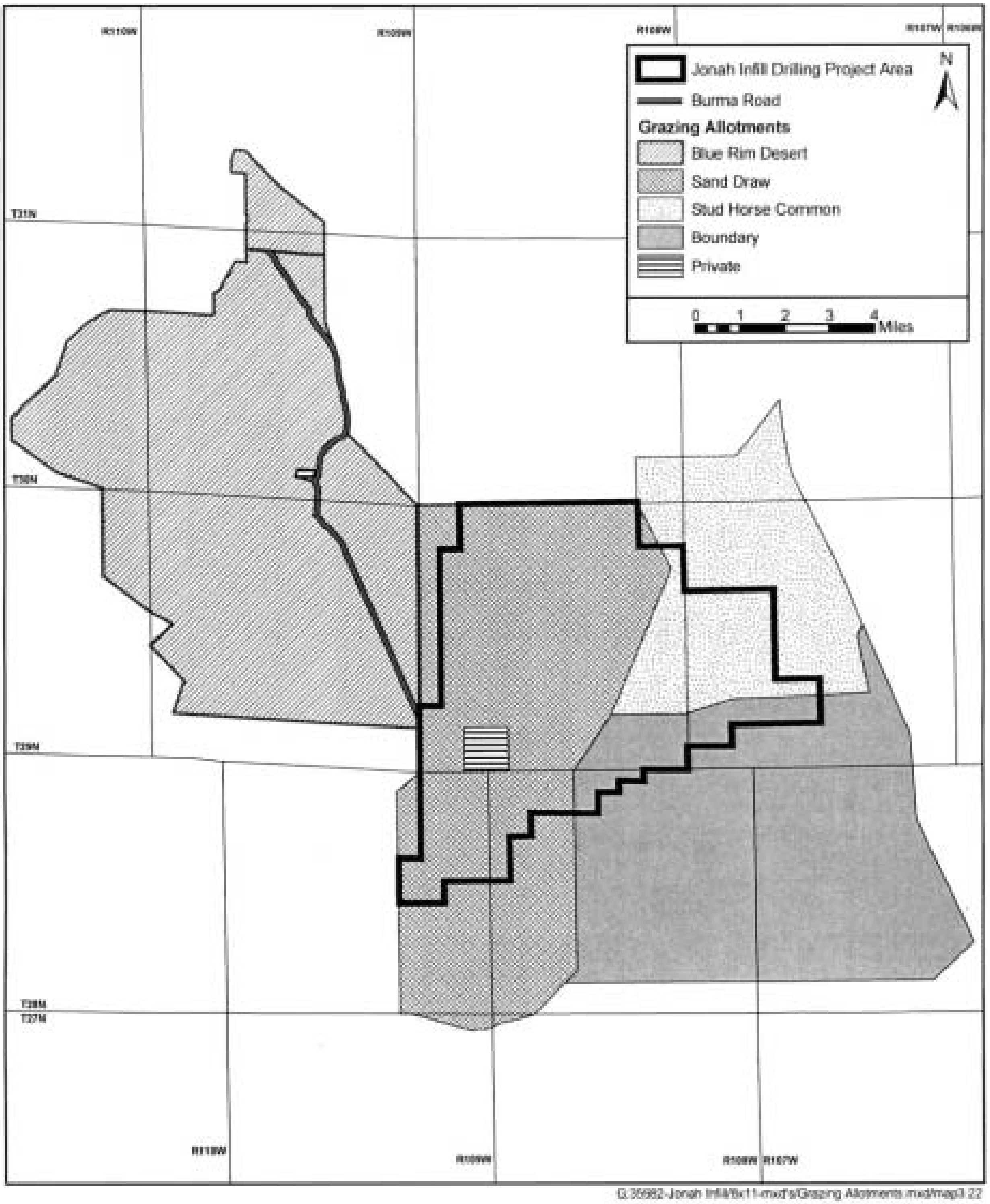
The Boundary allotment (31,994 total acres) includes 29,982 acres of BLM lands (providing 2,996 AUMs), 1,930 acres of state lands, and 82 acres of private land. The allotment is managed for three-pasture deferred rotation/short duration, low-intensity grazing and is approved for yearlong grazing. Sheep and/or cattle are grazed from May to July, with cattle remaining on the allotment until November (personal communication, January, 9, 2004, with Jay D'Ewart, BLM RSFO). The JIDPA includes approximately 3,630 acres of the Boundary allotment providing 363 AUMs, an average 10 acres/AUM (see Table 3.56). Lambing occurs in a portion of the allotment from May 15 to June 15. Sheep grazing and lambing generally do not occur in the JIDPA; therefore, sheep are not discussed further.

The Blue Rim Desert allotment (41,273 total acres) includes 39,467 acres of BLM lands providing 2,826 AUMs (personal communication, January 6, 2004, with Steve Laster, BLM PFO), 1,019 acres of state lands, and 787 acres of private land--an average of 14.6 acres/AUM (see Table 3.56). Cattle are grazed from May 1 to July 6. The proposed Burma Road Upgrade area crosses this allotment.

Economic data for JIDPA livestock grazing is provided in Section 3.4.10. The CIAA for livestock grazing is the four affected grazing allotments that encompass approximately 120,597 acres, of which the 114,203 acres of federal land provide a total of 9,876 permitted AUMs (see Table 3.56, Map 3.22). Based upon WyGISC (2002, 2003) digital data and aerial photographs, approximately 2.3% of the CIAA for livestock grazing (2,777 acres), has been disturbed by well pads, pipelines,



Map 3.21 Land Status/Prior Rights Cumulative Impact Assessment Area Boundary, Jonah Infill Drilling Project, Sublette County, Wyoming, 2004.



Map 3.22 Grazing Allotments, Jonah Infill Drilling Project Area and Cumulative Impact Assessment Area, Sublette and Sweetwater Counties, Wyoming, 2004.

Table 3.56 Livestock/Grazing Allotments in the Jonah Infill Drilling Project Area and Cumulative Impact Assessment Area, Sublette County, Wyoming, 2005.

Grazing Allotment	Allotment Size (acres)	Federal Acres in Allotment	Total AUMs	Acres of Allotment in JIDPA	AUMs in JIDPA	Existing Disturbance in Entire Allotment (acres)	Average Federal Acres/AUM
Stud Horse Common	15,590	14,309	1,730	5,490	670	782	8.2
Sand Draw	31,740	30,445	2,324	20,740	1,571	1,147	13.2
Boundary	31,994	29,982	2,996	3,630	363	461	10.0
Blue Rim Desert	41,273	39,467	2,826	n/a [1]	--	359	14.6
No Allotment (Private)	640	--	--	640	--	28	--
Total[1]	120,597	114,203	9,876	30,500	2,604	2,777	11.5[2]

1 n/a = 12 miles of the Burma Road Upgrade Area is in the Blue Rim Desert.
2 Total does not include the "No Allotment"; average federal acres/AUM are not additive.

resource roads, agricultural lands (i.e., hay meadows), and highways. The Sand Draw grazing allotment has the largest amount of existing disturbance with 1,147 acres (3.6% of the allotment) disturbed primarily from existing gas development in the Jonah Natural Gas Field.

3.5.3 Recreation

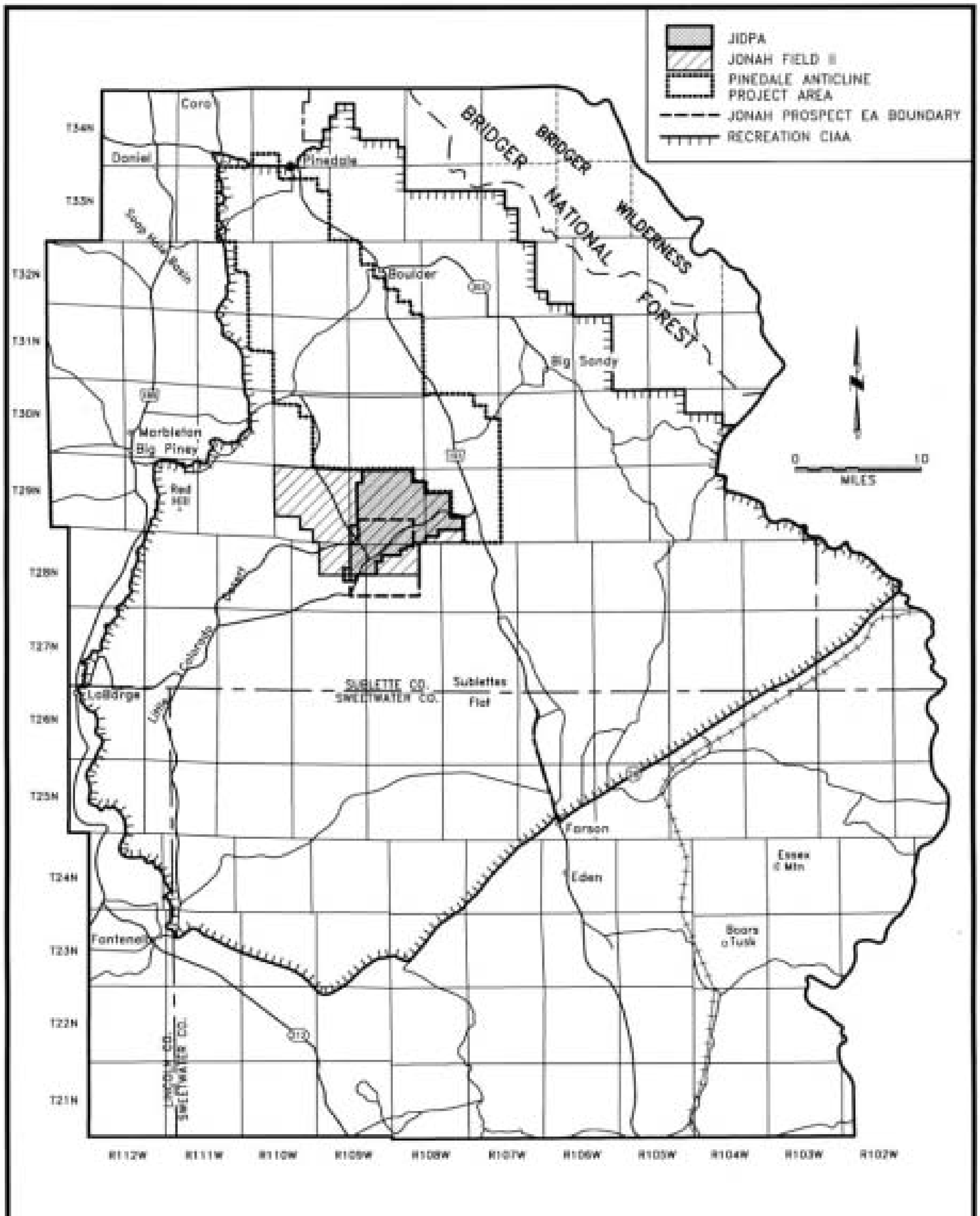
The CIAA for recreation encompasses 1,557,558 acres (2,434 square miles) (Map 3.23). Existing surface disturbance includes approximately 84,331 acres (132 square miles), or 5.4% of the CIAA, and results primarily from agriculture (79%) and road and pipeline ROWs (14%).

Detailed information on recreation and recreation revenues is provided in Section 3.4.11. The following provides some additional information on recreation types and the importance of the various recreation types in the area.

Davis-Peterson Associates, Inc. (1995) estimate that total traveler expenditures in southwestern Wyoming (Carbon, Lincoln, Sublette, Sweetwater, and Uinta Counties) were $282 million in 1994, with Sweetwater County having the most ($98 million) and Sublette County the least ($30 million). Vacationers represented 55% of total traveler expenditures in the five-county region. Data suggest that travel peaked in 1981, declined until 1988, and then grew steadily through 1993 (UWAED 1997). Southwestern Wyoming is an important recreation area for Wyoming residents (UWAED 1997). The 1990 Wyoming State Comprehensive Outdoor Recreation Plan (State of Wyoming 1990), while out of date, reported that southwestern Wyoming, with 20% of the state's population, supported more than 50% of all Wyoming resident OHV and four-wheel drive use, 49% of all resident antelope hunting, 15% of all resident sightseeing, and 17% of all historical site visits and day hiking. Relative to its population (1.1% of state), Sublette County was especially important in terms of OHVs (21.6%), antelope hunting (15.6%), backpacking (18.7%), and camping (11.9%). Statewide, the most popular recreational activities include: wildlife viewing (71%), driving for pleasure (66%), hiking or walking (64%), viewing natural features, such as scenery, flowers (64%), general/other, such as relaxing, escaping crowds, noise (64%), fishing (63%), visiting historic and/or prehistoric sites (54%), and attending fairs or festivals (50%) (Bingaman et al. 2003).

There are no developed recreation areas within the JIDPA; however, BLM-administered lands provide a variety of recreational opportunities including hunting for antelope, greater sage-grouse, and small game. Backpacking, camping, cross-country skiing, snowshoeing, snowmobiling, rock collecting, sightseeing, wildlife viewing and general photography are a few of the nonconsumptive recreational opportunities available in the region, although many of these actions likely no longer occur on the JIDPA due to existing oil and gas development. Total annual recreational visitor days (other than hunting) in the PFO from October 1, 1998, to September 30, 2002, was 319,978 (BLM 2003c). The most popular activities included boating (43%), fishing (23%), camping (11%), and hiking/walking/running (10%). Recreational use data specific to the JIDPA are not available. However, dispersed recreation related to sightseeing and OHV use does likely occur on the JIDPA since the area is designated as suitable for OHV use in the PFO RMP, and recreational hunting is likely the most important recreational activity on the JIDPA.

Since the JIDPA may have importance for recreational hunting by some individuals for the game species that occur in the area (e.g., pronghorn, cottontail rabbit, and greater sage-grouse), a conservative economic analysis of recreational hunting in the JIDPA is provided in Section 3.4.11.2.



Map 3.23 Recreational Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette and Sweetwater Counties, Wyoming, 2004.

While no wilderness or wilderness study areas occur in the JIDPA, the BLM Scab Creek Wilderness Study Area (7,636 acres south of Boulder Lake) and the Bridger Wilderness Area are approximately 20 miles northeast of the area. The Scab Creek, Bridger, Fitzpatrick, and Popo Agie Wilderness provide regional opportunities for remote recreational activities.

3.5.4 Transportation

Surface transportation in the JIDPA is provided by an extensive network of collector and resource roads (see Map 2.1 and Appendix G). The two principle roadways to the JIDPA are State Highway 191, which links the field to Rock Springs and Pinedale, Wyoming, and State Highway 351, which links the field to Big Piney and Marbleton, Wyoming.

The main access to the JIDPA is from the Luman Road, which runs east from the JIDPA to State Highway 191. The Burma and Jonah North Roads, which run north from the JIDPA to connect with State Highway 351 also provide access to the field (see Map 2.1). Further detail on the roads in the JIDPA and associated traffic is discussed in the Transportation Plan (Appendix G).

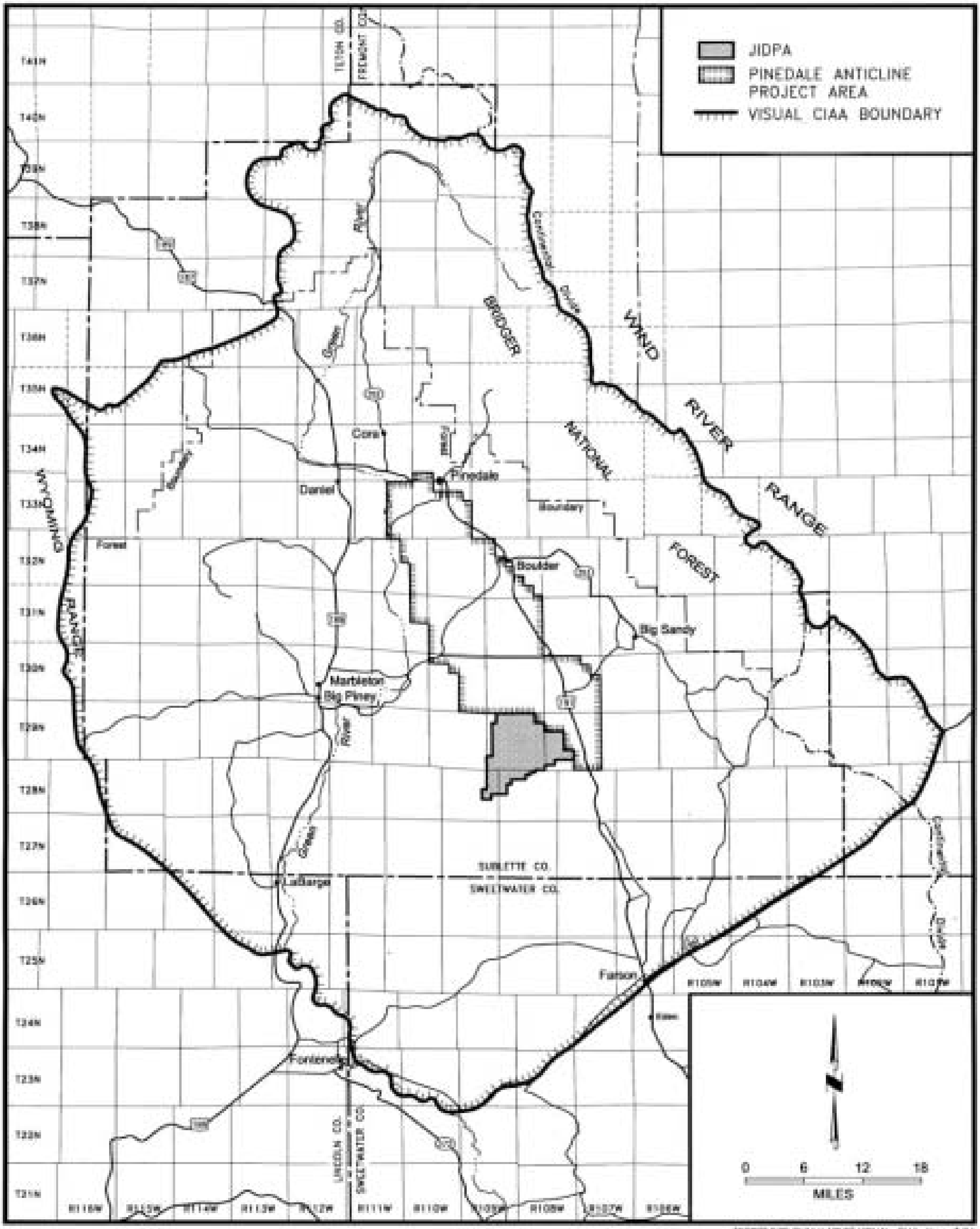
3.6 VISUAL RESOURCES

The CIAA for visual resources encompasses 2,089,363 acres (3,264 square miles) (Map 3.24). Existing surface disturbance includes approximately 138,740 acres (216 square miles) or 6.6% of the CIAA and results primarily from agriculture (83%) and road and pipeline ROWs (12%).

The Visual Resource Management (VRM) System is the basic tool used by the BLM to inventory and manage visual resources on public lands. The VRM classification combines evaluation of visual quality, visual sensitivity of the area, and view distances. The BLM's PFO was first visually inventoried and classified in 1978. VRM classes are used to identify the degree of acceptable visual change within a characteristic landscape. Classes are based on the physical and sociological characteristics of a given homogeneous area and serve as a management objective. Projects of all types within established VRM class areas will generally be required to conform with objectives and characteristics of the classification, or the project will be modified to meet the VRM class objective. Short-term modifications in portions of visual class areas may be approved if a site-specific environmental analysis determines that impacts would be acceptable.

The entire JIDPA is in a Class IV VRM area. A basic description of the landscape (high desert shrub area with flat to rolling topography containing buttes and ridges) is provided in Sections 3.1.3 (Topography) and 3.2.1 (Vegetation). The landscape today is dominated by oil and gas development features (e.g., roads, well pads). The Class IV designation provides for management activities that may generate major modifications to the existing character of the landscape. Contrasts may attract attention and be a dominant feature of the landscape in terms of scale; however, the change should repeat the basic elements (form, line, color, and texture) inherent in the characteristic landscape. A Class IV VRM designation allows for modification of the landscape to accommodate natural gas production, but also advocates that surface facilities blend with surroundings to lessen the visual impacts.

The connected actions, including the upgrade of the Burma Road and the modification of the Project area boundary to include the north half of Section 23, T28N, R109W, are also in areas designated as VRM Class IV.



Map 3.24 Visual Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Lincoln, Sublette, and Sweetwater Counties, Wyoming, 2005.

A VRM Class III area occurs as a 1-mile corridor surrounding U.S. Highway 191 just east of the JIDPA. A Class III designation provides for moderate changes to the existing landscape, although management activities associated with these changes should not dominate the view of the casual observer. For the most part, the JIDPA is not visible from U.S. Highway 191, a major corridor for tourists. However, current JIDPA developments (e.g., rig structures and production facilities) at higher elevations on Yellow Point Ridge in the southern JIDPA are visible at a distance of about 8 miles from an approximately 8- to 10-mile length of U.S. Highway 191. Additional existing oil and gas development effects visible from the highway include nighttime lights, occasional smoke plumes, and haze events. The only currently identified project feature present in the VRM Class III corridor along U.S. Highway 191 is the existing Luman Road.

3.7 HAZARDOUS MATERIALS

Hazardous materials present in the JIDPA include those used and produced in association with natural gas drilling, completion, and production, and these substances and their current management protocol are discussed in detail in the Hazardous Materials Management Summary (Appendix G).

3.8 COMPENSATORY MITIGATION

No compensatory (off-site) mitigation (CM) projects have been completed or are in progress.

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