CHAPTER 3- AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The purpose of this chapter is to fully describe the existing condition (affected environment) in the Project Area and to describe the environmental consequences of implementing any of the alternatives presented in Chapter 2. It also presents the scientific and analytical basis for the comparison of those alternatives.

For the purpose of readability, this chapter is divided among resource areas with the following sub-headings described in detail under each resource:

Affected Environment includes all resources known to be present in the Project Area, and those that could be affected. Where the resource being affected could not be limited to the Project Area, the scope of analysis is expanded to fully describe the affected environment for that resource, why the area of analysis was expanded, and how the expansion could affect or otherwise impact other resources or values. If resources are present in the Project Area but are determined to be unaffected in any way by any of the alternatives, they will be mentioned briefly with a description of why they are not fully described and/or affected, or other reasons will be given as to why they were screened out of the analysis process. Some resources were identified in response to issues and concerns raised during the scoping process; however, if they are either not present or not affected by the Proposed Action or alternatives, they are also discussed briefly. The affected environment is identified within the first part of this chapter, including all of the resources present.

Regulatory Environment provides a listing of some, though not all, of the laws and regulations which are designed to regulate development of and provide protection to a given environmental resource.

Regulatory Status discusses the currently applicable resource management plans which guide development of resources in the vicinity of the Project Area.

Environmental Consequences summarizes the physical, biological, social and economic environments of the affected Project Area and the potential changes due to implementation of any of the alternatives analyzed in this document. It also presents the scientific and analytical basis for the comparison of the alternatives. The consequences are detailed for each resource known to be present in the area and which would be affected. Alternative-specific mitigation measures have also been combined into this section to directly address effects sustained by each resource under each alternative.

Mitigation Measures are measures that can be implemented to lessen the impacts to resources given an action. Mitigation can include:

- avoidance of the impact altogether by not taking the action or parts of the action;
- minimizing impacts by limiting the degree or magnitude of the action;
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

- reducing or eliminating the impact over time by preservation and maintenance operations; and
- compensating for the impact by replacement or substitution of a resource or environment.

3.1 INTRODUCTION

3.1.1 Climate

The Project Area is located in southern Campbell County and northern Converse County, a part of the Northern Great Plains. Vegetation is primarily sagebrush and mixed grass prairie. The climate is semi-arid, with an average annual precipitation at Wright, approximately 14 miles northwest of the center of the Project Area, of just over 11 inches. May and June are the wettest months, averaging 2.04 and 2.35 inches, respectively. February is the driest month averaging 0.29 inches. Snowfall averages 25.1 inches per year, with most snow occurring in March (5.0 inches) and December (4.5 inches). Potential evapotranspiration, at approximately 31 inches (NOAA, 1979), exceeds annual precipitation. The average daily mean temperature is 44.2°F. The highest recorded temperature was 103°F and the lowest was -34°F. July is the warmest month, with a mean daily temperature of 70°F, and January is the coldest month (20.5°F). The frost-free period is 100 to 125 days (BLM, 2003, FEIS p. 3-291) (BLM, 2003b, FEIS pp. 3-1 to 3-3).

The regional wind speeds average from 9 to 13 mph with local variations in speed and direction due to differences in topography. Wind speeds are highest in the winter and spring and are predominantly from the northwest or southeast. Wind velocity tends to increase during the day and decrease during the night. Winter gusts often reach 30 to 40 mph. During periods of strong wind, dust may negatively impact air quality across the region. There is an average of 15 air-stagnation events annually in the Powder River Basin with an average duration of two days each (BLM, 2003, FEIS pp. 3-1 to 3-3).

3.1.2 Physiography and Topography

The Powder River Basin is bounded by the Black Hills on the east; the Big Horn Mountains on the west; the Hartville Uplift, Casper Arch, and Laramie mountains on the south; and the Miles City Arch on the north. Elevations in the Powder River Basin range from 2,500 feet to greater than 6,000 feet above mean sea level. The major river valleys have flat floors and broad floodplains (BLM, 2003, FEIS pp. 3-56 to 3-57).

The Project Area lies within that portion of the TBNG designated by the USFS as the Hilight Bill Geographic Area, comprising approximately 100,000 acres. Elevations range between 4,700 and 5,300 feet above sea level (USFS, 2001, p. 2-21). The Project Area is a high plains area within the eastern portion of the Powder River Basin. Landforms consist of a dissected rolling upland plain with low relief, broken by low red-capped buttes, mesas, hills, and ridges. Slopes of less than 15 percent are characteristic. Playas are common in the area, as are buttes and hills capped by clinker or sandstone. The drainages in the Project Area are incised, ephemeral or intermittent, and do not provide year-round water sources. The Project Area is principally drained by

Porcupine Creek which flows to Antelope Creek, a tributary of the Cheyenne River (BLM, 2000, EA p. 3-2) (BLM, 2003, FEIS pp. 3-56 to 3-57).

3.2 GEOLOGY, GEOHAZARDS, MINERAL RESOURCES, AND PALEONTOLOGY

3.2.1 Affected Environment

3.2.1.1 General Geology

The Project Area is located along the eastern edge of the Powder River Basin. The Powder River Basin is a northwest-southeast trending assymetric structural basin filled with Cenozoic sediments of continental origin that were derived from surrounding uplifted areas (Brown, 1993). The basin was formed during the Laramide Orogeny (mountain building era) about 60 million years ago (Glass and Blackstone, 1999, pp. 1-12). The basin exhibits steeply dipping beds on the western flank and a broad area of more gently dipping strata on the eastern flank. The deeply buried synclinal structure of the Powder River Basin is not directly reflected in the landscape of Campbell and Converse counties. The individual topographic features are the result of: (1) differences in the erosional characteristics of the flat-lying Tertiary bedrock layers, (2) downward and lateral cutting by streams through rocks of uniform erosional character, and (3) minor subsidence associated with the natural burning of coal seams. The latter phenomenon also has produced many hard, resistant baked rock (scoria) layers and mounds, which have strongly influenced the topography of the county (Breckenridge et al., 1974, Topography and Climate Map).

Basin sediments were derived from the Bighorn Mountains to the west, the Laramie Mountains and Hartville Uplift to the south, and the Black Hills to the east. The early Tertiary basin fill sediments (Wasatch and Fort Union formations) attain a maximum thickness of more than 6,500 feet along the basin axis (Brown, 1993). Along drainages, a thin veneer of Quaternary alluvial deposits overlies the Tertiary geologic formations. A stratigraphic column, indicating both near-surface rock units and deeper formations productive of coal, oil, and natural gas, is illustrated in **Figure 3-1**.

Geologic formations exposed at the surface in southern Campbell County and northern Converse County are, from youngest to oldest, alluvial deposits (Holocene and Pleistocene), Wasatch Formation (Eocene), and Fort Union Formation (Paleocene) Tongue River and Lebo Members. The lowest portion of the Fort Union, the Tullock Member, does not crop out in the Project Area. The alluvial deposits consist of unconsolidated and poorly consolidated clay, silt, sand, and gravel, mainly in floodplains and terraces. The Wasatch Formation contains buff arkosic sandstone, lenticular conglomerates, drab siltstone, carbonaceous shale, and many coal beds. Thickness in the Project Area ranges from zero to 2,000 feet. The upper part (Tongue River) of the Fort Union Formation is fine-grained drab to gray sandstone, finely conglomeratic in places, interbedded with drab siltstone, claystone, and shale. There are thick coal beds near the top. The middle part (Lebo) of the Fort Union Formation is gray shale and claystone. The thickness of the Fort Union ranges from zero to 2,500 feet (Love et al., 1987, map).

Figure 3-1 Stratigraphic Column

Era	Period		Powder River Basin East		Project Area Production
Cenozoic	Tertiary	Eocene	Wasatch		
		Paleocene	Fort Union	Tongue River	
				Lebo	
				Tullock	
Mesozoic	Cretaceous	Upper	Lance		
			Fox Hills		
			Pierre		
				Teapot	
				Parkman	
				Sussex	
			Niobrara		
			Carlile	Sage Breaks	
				Turner Sd	
			Greenhorn		
			Belle Fourche		
		Lower	Mowry		
				Newcastle - Muddy	
				Skull Creek	
			Inyan Kara Group	Fall River - Dakota	
				Fuson	
				Lakota	
	Jurassic	Upper	Morrison		
			Sundance	Upper Sundance	
				Lower Sundance	
		Middle	Gypsum Spring		
		Lower			
	Triassic				
			Spearfish		
Paleozic	Permian		Goose Egg		
			Minnekahta		
			Opeche		
	Pennsylvanian		Minnelusa		
	Mississippian		Bell		
			Pahasapa		
	Devonian	Upper	Englewood		
		Middle			
		Lower			
	Silurian				
	Ordovician	Upper	Whitewood		
		Middle	Roughlock- Ice Box - Aladdin		
		Lower			
	Cambrian	Upper	Deadwood		
		Middle			
		Lower			

Modified from Kinnison, P. T., 1970, Future Petroleum Potential of Powder River Basin, Southeastern Montana and Northeastern Wyoming, in Future Petroleum Provinces of the United States, a summary; National Petroleum Council's Committee on Possible Future Petroleum Provinces of the U.S., Washington, D.C.

3.2.1.2 Minerals

Coal Resources

The Powder River Basin contains some of the largest accumulations of low sulfur sub-bituminous coal in the world. Thick coal deposits occur at or near the surface all along eastern Campbell and Converse counties. Coal from the basin is valued for its low sulfur content and clean-burning properties. There are 15 coal mines along a north-south line that parallels Highway 59, starting north of Gillette, Wyoming and extending south for approximately 75 miles. The mines are located where the Wyodak coal outcrops (BLM, FEIS, 2003a, pp. 3-66 to 68). These large surface mines supply the nation with approximately one-third of its steam coal needs and result in Wyoming ranking as the number one coal producing state (Lyman and Volkmer, 2001, p. 1).

The U.S. Geological Survey refers to the thick mineable coals in the Gillette coal field as the Wyodak-Anderson coal zone of the Tongue River member of the Fort Union Formation. Locally these beds are referred to as Wyodak, Wyodak-Anderson, Anderson, and Canyon. The number of mineable coal seams varies from tract to tract, and the nomenclature varies amongst the mine operators. The Fort Union coal seams are sub-bituminous and are generally low-sulfur, low-ash coals. Typically, coal in the Project Area has a higher heating value and lower sulfur content than its equivalent in the Gillette area (BLM, 2003, FEIS pp. 3-66 to 3-68).

The two closest coal mines to the Project Area are the North Rochelle Mine to the east and the North Antelope/Rochelle Mine complex to the south. The Antelope Coal Mine produced 22,971,230 short tons of coal in 2000 (EIA, 2003, online data). North Antelope Coal Mine opened in 1983. It is a surface mine which operates with a truck and shovel procedure. Rochelle Coal Mine began operating in 1985. This mine is a truck and shovel operation (PRCC, 2003). In 2000, the combined operation produced 70,769,071 short tons of coal and was ranked first in the United States by production (EIA, 2003, online data). In 2000, Campbell County coal mines produced around 88.4 percent of Wyoming's overall coal production; a total of 299,650,294 tons of coal (CCEDC, 2003, online data).

Oil and Gas Resources

Conventional oil and gas exploration and production have occurred for many years within Campbell and Converse counties, pre-dating the current interest in CBM development. The first commercial production in Campbell County was discovered at Adon Field in 1948 (Breckenridge et al., 1974). Wyoming's annual oil production increased during the 1950s and 1960s, peaking at nearly 160 million barrels in the early 1970s. Production of oil has been declining since, while gas production has continued to increase. Wyoming ranks seventh among states nationally in oil production and fourth for gas production, accounting for 2.8 percent and 3.5 percent of national production, respectively (BLM, 2002, figs. 6, 10). During 2002, Wyoming produced 55,472,802 barrels of oil and 1,765 billion cubic feet (BCF) of gas.

Production of Wyoming CBM natural gas had reached monthly rates of nearly 30 BCF by January 2003. Powder River Basin CBM natural gas represented 18.5 percent of total Wyoming gas production in 2002 (WOGCC, 2003, online data).

Conventional oil and gas production in the Project Area comes from a variety of Cretaceous strata. Principal reservoirs are formed by stratigraphic traps in sandstones of the Lower Cretaceous Muddy and Dakota formations, and by stratigraphic traps in the Upper Cretaceous Turner, Parkman, Sussex and Teapot sandstones and by sandstone lenses within the Niobrara Shale (Breckenridge et al., 1974).

Campbell County is a major contributor to Wyoming's petroleum production. According to 2000 WOGCC production statistics, Campbell County is the state's leading oil producer, accounting for 22.3 percent of total Wyoming production. The county ranks fourth in gas production, at 12.3 percent of state totals. As a result of the recent CBM development boom, the county is also the leading area for drilling activity in Wyoming and the nation, recording 4,877 approved APDs during 2000, far ahead of the second place county (Sheridan, at 837 approved APDs). Approved APDs from Campbell County accounted for 66 percent of Wyoming approvals in 2000. The vast majority of these permits were for CBM wells (BLM, 2002, figs. 62, 68). As of January, 2003, Wyoming recorded 10,945 producing and 3,296 shut in CBM wells. Roughly 80 percent of these wells are located within Campbell County. CBM development is occurring rapidly on State of Wyoming and private acreage in the immediate vicinity of the Project Area. In addition to the high levels of CBM drilling, WOGCC received APD applications from the county for 69 conventional oil and gas wells.

Converse County exhibits much less petroleum activity than does Campbell County. During 2002, WOGCC received 19 APD applications from the county. Only one application was for a CBM well, the remainder for conventional oil and gas operations.

Western and central parts of the Project Area contain large portions of the conventional Porcupine Field. The field is composed of 90 active oil or gas wells, including approximately 35 within the Project Area. The field was discovered in 1969. Cumulative production through February 2003 was 4.3 million barrels of oil and 76.7 BCF of gas. Production in December 2002 was 4,984 barrels of oil and 114 million cubic feet of gas. The field produces from 10 Upper and Lower Cretaceous reservoirs.

Extreme eastern parts of the Project Area overlap portions of the Payne Field. Discovered in 1969, the field contains 20 active wells, including two located within the Project Area. Cumulative production through January 2003 was 3.1 million barrels of oil and 7 BCF of gas. Production in December 2002 was 1,755 barrels of oil and 3 million cubic feet of gas. The field produces from five Upper and Lower Cretaceous reservoirs.

The Fenton Field, discovered in 1972, is located southeast of the Project Area within the confines of the NARC surface coal mine. Cumulative production through January 2003 was 440,032 barrels oil and 4.8 BCF of gas. Production in December 2002 was 217 barrels of oil and 1.7 million cubic feet of gas. The field is productive from the Muddy and Turner formations (WOGCC, 2003, online data).

Saleable Minerals

Sand and gravel deposits, consisting of alluvium and colluvium, may be found in alluvial fans or terrace deposits in the Project Area (BLM, 2000, p. 3-3). Construction aggregate is the fourth most important mineral product (by value) produced in Wyoming (WSGS, 2002, p.2). The Wasatch Formation is a known source of scoria (clinker) deposits that have been mined at numerous locations throughout Campbell County. Scoria deposits are present in the southern portion of the Project Area, and small quarries have been mined in the past (Harris, 1996, map). Sand and gravel are produced from terrace and alluvial deposits occurring near rivers and larger tributary streams. Clay occurring in association with coal in the Fort Union Formation is suitable for use in brick and tile manufacturing and has been mined in the past. No estimate of existing disturbance from past and present quarrying activities is available for aggregate and construction materials. Federal minerals such as sand, gravel, and rock are governed by the *Materials Act of 1947*, as amended (30 *United States Code* [U.S.C.] 601 et seq.) and promulgating regulations found in 43 CFR 3610 and 36 CFR 228.40. These regulations authorize the BLM to sell federal mineral materials at fair market value.

Locatable Minerals

The *General Mining Law of 1872* makes federal minerals available by location except for those minerals specifically available through lease or sale (such as coal, oil & gas, and oil shale). No locatable minerals (such as iron, copper, asbestos, gold, and jade) are known to occur within the Project Area (Hausel, 1990, map); therefore, locatable minerals are not discussed further in this EA.

3.2.1.3 Geologic Hazards

Faults

No known or suspected active faults occur in the Project Area.

Earthquake Damage

Very little damage has been attributed to earthquakes in the Powder River Basin area (Case, 1997, p. 17). The U.S. Geological Survey has placed the Project Area within seismic risk zone 0, indicating very low probability of earthquake damage (Reagor et al., 1985). There are no known liquefaction-prone areas in the Project Area (Case, 1986, map).

Landslide Hazards

Landslides are the slow or rapid down slope movement of rock and surficial materials. Conditions that contribute to landslides include steep slopes; exposure of shales or clays; exposure of brittle sandstones; and sandy, permeable materials on slopes underlain by clayey layers. No landslide hazards have been documented in the Project Area. Minor landslide areas have been mapped approximately six miles east of the Project Area, along the eastern portions of T41N and T42N, R69W. The nearest major landslide hazard areas are located on buttes approximately 35 miles northwest of the center of the Project Area (Larsen et al., 1991, map).

Flood Hazards

In the Project Area, most surface water flows in response to storm events, snowmelt, or surface discharges of CBM produced water. Potential flood hazards can be associated with weather conditions such as intense local storm events or rapid snowmelt. Discharge of produced water into low capacity stream channels and the failure of engineered drainage or impoundment structures can also present flood hazards. The estimated maximum amounts of produced discharge are small in comparison to typical storm flows (Independent Production Company, 2002, Appendix G). Flood hazard maps are not available for the Project Area.

Pumping Induced Settlement

The Fort Union Formation is a consolidated rock unit and is not being substantially dewatered during the CBM recovery process.

It appears that minor aquifer compression up to ½ inch may occur in the coal beds that are being developed for CBM in the Gillette area. The entire amount of that compression, however, may not be transmitted to the surface. To date, no surface subsidence has been associated with significant municipal water withdrawals in the Gillette area (Case et al., 2000, p. 3; Edgar and Case, 2000, p. 8). The compressibility of an aquifer decreases with increasing depth. This is why most regional settlement problems occur in situations with shallow aquifers in sedimentary deposits close to the ground surface (Edgar and Case, 2000, p.8).

Coal Seam Fires

Coal outcrops are potential locations of surface coal seam fires ignited by spontaneous combustion, range fires, or lightning strikes. In the vicinity of the Project Area, particularly to the east and south, "clinker" deposits resulting from rock baking associated with ancient coal fires are fairly common. Typically, surface coal fires burn back into the subsurface until lack of oxygen inhibits combustion (BLM, 2003, pgs. 3-76 to 3-77). Exposed coal seams are not present in the Project Area with the exception of the extreme southern portion of the area and, therefore, coal fires represent a minimal hazard.

Wind Blown Deposits

Wind blown deposits present a potential hazard because they are subject to continuing migration unless they are stabilized by a good vegetative cover. No wind blown deposits are known to exist in the Project Area (Case and Boyd, 1987, map).

No other known geologic hazards occur within the Project Area.

Abandoned Underground Mines

Abandoned underground mines have not been located in the vicinity of the Proposed Action.

3.2.1.4 Paleontology

Paleontological or fossil resources would be found, if present, in the Project Area where bedrock occurs at or near the surface. The Wasatch and Fort Union formations are the only formations that are exposed in the Project Area. The surface bedrock in the Project Area consists primarily of exposures of the Wasatch Formation (Eocene), but bedrock in the southern extremity of the Project Area consists of the Fort Union Formation (Paleocene). A review of the available literature and of unpublished data obtained from surveys conducted by the adjacent coal mines indicate no known vertebrate fossil localities within the Wasatch or Fort Union formations in the Project Area (Erathem-Vanir Geological, 2003, pp. 4, 5). Within the TBNG, occurrences of scientifically significant fossils have been sporadic, consisting principally of reptilian remains (Erathem-Vanir Geological, 2003, p.5; Winterfeld, 2003, personal communication).

Within the Project Area, the Wasatch Formation is covered in most places by up to 80 inches of Quaternary wind-blown silts, sands, colluvium and alluvial deposits, and residual soils. The Wasatch consists of buff-colored arkosic sandstones, lenticular conglomerates, drab colored siltstones, carbonaceous shales, and numerous coal beds (Erathem-Vanir Geological, 2003, p. 4). Exposures of bedrock are extremely limited. Most of the significant fossils recovered from the Wasatch Formation in the Powder River Basin have been found at a location approximately 50 miles to the northwest of the Project Area where the lithology differs (Delson, 1971, pp. 307-364; Robinson, 1994, pp. 85-90; Robinson and Ivy, 1994, pp. 91-116.). In the area where fossils were found, the formation consists of well exposed badlands of candy-striped terrestrial, fluvial, and paleosol deposits.

Exposures of the Fort Union occur where erosional cuts through the overlying Wasatch have resulted in more rugged terrain. Exposures are more limited in extent than exposures of the Wasatch. The Fort Union Formation in the Project Area consists of fine grained drab to gray sandstone, finely conglomeratic at individual sandstone bases or interbedded with drab siltstones, claystone, shale, some limestone, and coals. The lithologic similarity of the Wasatch and Fort Union formations renders their discrimination difficult. Abundant fossil vertebrates have been recovered from Paleocene strata in Wyoming, including the Fort Union Formation; however, few, if any, fossil vertebrates have been recovered from the Fort Union in the Powder River Basin (Winterfeld, 1982, pp. 73-111; Lillegraven, 1993, pp. 414-477).

The USFS Rocky Mountain Region is cooperating with the BLM and the University of Wyoming in an experimental program to classify geological formations according to their probability of containing vertebrate fossil resources. The classification system is being developed by the Paleontology Center for Excellence and is being introduced in the Northern Great Plains Planning Area, which includes the TBNG and the Project Area. The paleontological classification system is designed to provide USFS management with a way to prioritize protection of paleontological resources. The program has resulted in the development of the Probable Fossil Yield Classification (PFYC) system. The objective of the program is to develop a predictive model that will better focus agency management activities and budgets for protection of paleontological resources. Under this system, surficial formations are classified on a scale of 1 (lowest) to 5 (highest) to reflect the likelihood of containing vertebrate fossils. Numeric classifications have been developed for both geological formations and individual localities; however, formation rankings determine what formations are investigated in detail.

Locality or site rankings provide an indication of the presence of fossils in exposures of a given formation at a specified site.

The formation ranking determines specific management activities, leading to a five-step evaluation and action process. For formations classified at levels 3 to 5, a pedestrian survey by a USFS-approved vertebrate paleontologist of potentially productive portions of a project area is required. Depending upon the results of the survey, monitoring and mitigation plans may be developed, as specified within the 2001 RMP. The system is discussed in detail in the 2001 RMP, Appendix J (USFS, 2001, Appendix J).

Under the PFYC classification system, the Wasatch Formation is ranked as PFYC Class 5. The USFS PFYC ranking applies to the formation throughout its extent despite an absence of significant fossil discoveries in or near the immediate Project Area. The Fort Union is ranked PFYC Class 3.

In response to the PFYC rankings, the Company conducted a pedestrian survey using a USFS-approved vertebrate paleontologist. The results of the survey are documented in a report prepared for the USFS (Erathem-Vanir Geological, 2003). Fossils of scientific significance were not located within the Wasatch Formation. The report suggests that in the Project Area the Wasatch Formation potential yield ranking may be excessive and that a ranking of 3 or 4 may be more appropriate. Fossil rodent teeth of potential scientific significance were discovered within the Fort Union Formation; however, the discovery location was in an area not proposed for Project activities and at a stratigraphic horizon more than 30 feet below that planned for Project surface disturbance.

3.2.2 Regulatory Environment

Among the numerous laws regulating development of mineral resources in the vicinity of the Project Area are included:

- Mineral Leasing Act of 1920, as amended (30 USC 181-263; 43 CFS 3160, 3400)
- Mineral Leasing Act for Acquired Lands of 1947, as amended(30 USC 351-359)
- Multiple Mineral Development Act of 1954 (30 USC. 521-531 et seq.)
- Mining and Minerals Policy Act of 1970 (30 USC 21)
- Federal Land Policy and Management Act of 1976 (43 USC. 1701 et seq.)
- Federal Coal Leasing Amendments Act of 1976, as amended (90 Stat. 1083-1092)
- Surface Mining Control and Reclamation Act of 1977 (30 USC. 1201 et seq.)
- National Materials and Minerals Policy Research and Development Act of 1980 (30 USC 1601 et seq.)
- Federal Oil and Gas Royalty Management Act of 1982 (30 USC. 1701)
- Federal Onshore Oil and Gas Leasing Reform Act of 1987 (30 USC 195, 226-3)

3.2.3 Regulatory Status

Management of mineral resources within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement

(USFS, 2001) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a).

Recommended monitoring and mitigation measures relating to development of mineral resources are also discussed in the Powder River Basin Oil and Gas FEIS (BLM, 2003, pp. 4-395 to 4-404) and in the South Powder River Basin Coal DEIS (BLM, 2003b, Table 4-16).

3.2.4 Environmental Consequences

Scoping revealed several potential concerns related to CBM development impacts affecting geological hazards and mineral development, including:

- The possibility of increased risk of underground coal fires in areas of CBM production;
- The possibility that removal of groundwater during CBM dewatering could lead to surface subsidence and associated structural damage; and
- Concerns related to possible effects of infiltrated water on coal mine safety.

3.2.4.1 The Proposed Action

Physiography and Topography

Impacts to topography and physiography may occur if the natural environment is altered in such a way that the beauty of natural vistas are permanently impaired or if drainages are permanently altered with adverse impacts on the natural watercourses.

Impacts to topography and physiography from the Proposed Action would occur from the alteration of existing landscape features and potentially increased erosion as a result of the construction of well locations, facilities, and pipelines. However, the operator would minimize disturbance in sensitive areas, such as drainages and steep slopes. The operator would also reclaim all disturbed lands to approximate the original conditions upon completion of activities. Approximately 685 acres of federal land would be disturbed initially, and about 108 acres of federal land would be disturbed for the life of the project.

Minerals and Geologic Hazards

Adverse impacts to minerals or an increase in geologic hazards could occur if federal and/or state construction regulations and standards were violated, or other prohibited actions were to occur that would result in the loss of potentially recoverable mineral resources.

The Proposed Action would lead to the extraction and use of the CBM resource and could possibly lead to the temporary loss of access to gravel or other potential mineral resources in the Project Area. The purpose of the Project is to develop the natural gas present in the coals and to put it to beneficial use, so no mitigation measures would need to be applied.

Coal Seam Fires

Underground coal fires have occurred in the Powder River Basin and spontaneous combustion of fines at the bases of surface mine highwalls occasionally occurs. Underground coal fires could potentially lead to surface fires and land subsidence. However, conditions for spontaneous combustion associated with CBM development is highly unlikely for a number of reasons:

- CBM production results in reduction of oxygen necessary for spontaneous combustion within the coal. Any airflow is directed out of the coal seam, rather than into it. CBM well design results in heat being vented away from the coal seam, reducing the possibility of combustion.
- Wetting of dried coal increases the risk of combustion (heat of wetting effect), but very seldom are CBM target coals dewatered. Water is removed from the rocks above the coals only sufficiently to reduce hydrostatic pressure on the coal seam.
- The small particle sizes most commonly associated with spontaneous coal combustion are not present in CBM wells.

The Wyoming State Geological Survey rates the risk of increased probability of CBM development-associated underground coal fires as "extremely remote" (Lyman and Volkmer, 2001, p. 10).

Land Subsidence

Water withdrawal-induced subsidence has been observed to occur in certain areas (Case et al., 2000, p. 1). However, the Powder River Basin Fort Union coal strata differ from those in subsidence areas:

- The Fort Union Formation is compacted and consolidated, in contrast to the unconsolidated sands and clays found in subsidence areas. The rocks provide a rigid supporting framework independent of internal water pressure.
- Porosities in the Fort Union Formation are considerably less than in sediments in subsidence areas, meaning a lesser fraction of the rock contains water.

The coal seams themselves are not dewatered during production. Based upon known rock parameters in the Powder River Basin, modeling by the WSGS suggests that the maximum subsidence associated with CBM production would be less than 1/2 inch. Even this small amount would unlikely be fully transmitted to the surface (Case et al., 2000, p. 3).

Surface coal mining requires preliminary complete dewatering of the coal seam. Produced CBM water would be released to ephemeral tributaries of Porcupine Creek and/or to storage reservoirs constructed by the NARC mine (Independent Production Company, 2002, pp. 11 to 14). Infiltrated flow in these alluvial aquifers would follow the drainages and be captured, in part, by the existing system of mine reservoirs. Underflow not caught by the reservoirs would be removed by the mine's system of dewatering wells. Produced CBM water would be used by the NARC mine for dust suppression and various other industrial purposes.

Earthquake Hazard

The proposed action would not contribute to increased risk of seismic activities. Earthquake induced ground movement may result in damage to aboveground structures; however, buried structures, such as well casing and pipelines, would only be affected if the seismic event resulted in ground failure. Facility and infrastructure construction techniques would minimize the chance of damage from potential earthquakes, although complete protection is not possible.

Landslides and Wind Erosion

Erosion control and reclamation procedures utilized in the Project Area would ensure that no excessive erosion of potential wind-blown deposits would occur and that the chance of landslides would not be increased.

Flooding

Floodplains and flooding would not be directly impacted by construction, operation, or maintenance activities during project development or operation. Because the estimated maximum amounts of produced discharge are small in comparison to typical storm flows (Independent Production Company, 2002, Appendix G), implementation of the Proposed Action is not expected to increase the potential for flood hazards. Precautions would be taken to avoid increased sediment transport downstream during potential flood events. Reservoirs which will receive discharged water would be constructed to standards compatible with Wyoming dam safety regulations and will be permitted through the WSEO. Water discharge outfalls would be located and designed to avoid destabilization of receiving channels in compliance with mitigation measures indicated in the PRB FEIS ROD (Bennett, 2003, pg. A-30).

As discussed previously, produced water would be ultimately stored in one or more flood control reservoirs constructed by the NARC surface coal mine. The reservoirs have been built in compliance with Wyoming dam safety regulations and permitted through the WSEO. The existing reservoirs have storage capacity of 145 acre-feet in excess of that required by the State of Wyoming for flood control purposes (Independent Production Company, 2002, pg. 12). The additional storage capacity would be used for CBM produced water. In the event that the amount of stored CBM water were to approach 145 acre-feet, the NARC mine would notify the Company and the Company would reduce pumping its wells until storage capacity was restored.

Paleontology

Project excavation activities may result in discoveries of potentially important vertebrate fossils. Impacts to paleontological resources could occur if scientifically significant fossils were destroyed during project activities, were discovered but not properly curated, or were lost through vandalism.

Under the Proposed Action, impacts would be minimized due to the co-location of buried pipelines and electrical lines in narrow utility corridors. Possible exposures of potentially fossiliferous rock units would only occur where backhoe excavation or pit construction activities were located in areas of thin soil bedrock cover.

The 2001 TBNG RMP requires mitigation and monitoring of activities which may disturb Class 5 formations, such as the Wasatch (USFS, 2001a, Appendix J). Excavation of reserve pits in areas of shallow soils and use of backhoe trenching in pipeline construction could expose potentially fossiliferous bedrock. A pilot program would be conducted to monitor approximately 12 reserve pit excavations dispersed geographically and stratigraphically within the area underlain by the Wasatch Formation. A USFS-certified paleontologist would monitor the excavation of these pits. In the event significant vertebrate fossil materials were not discovered, no further monitoring would be recommended unless observations of trenching or pits by a USFS monitor identified vertebrate fossils within the excavations or spoil piles. If, during subsequent construction, vertebrate fossils were uncovered, the Company would cease operations pending review and recommendations by a USFS-certified paleontologist. This mitigation/monitoring plan is discussed in detail in the paleontological resources report prepared for this EA (Erathem-Vanir Geological, 2003, pp. 11 to 12).

3.2.4.2 The No Action Alternative

Under the No Action Alternative, no additional impacts to topography and physiography would occur from effects of the Proposed Action, although development would continue on private and State of Wyoming surface. Topography and physiography would continue to be modified by natural processes and may be otherwise impacted by other activities.

Natural gas reserves on federal lands in the project area would not be developed and thus would not be available to meet national energy demands. Development of adjacent private and state leases, however, would continue and would result in the incidental drainage and loss of federal natural gas reserves. The federal government would not benefit from royalties and taxes from the adjacent activities, although state and local governments would. Project-related economic activity, employment, and income would be reduced by about 76 percent (a total of 63 wells, rather than 265) from that activity described for the Proposed Action. Also, the operator's rights to develop their leases would be infringed, which would be a significant adverse impact that would violate the contractual agreements between the government and the leaseholders.

Development of existing surface coal mines immediately adjacent to the Project Area would continue. Expansion of these coal mines into much of the Project Area is very likely and is discussed in more detail in Section 4.2.1, below. Such expansion would have major impacts to most resources within the Project Area.

Impacts from geologic hazards would be similar to those described for the Proposed Action.

Impacts from flooding would be similar to those described for the Proposed Action but reduced due to less surface use. Floodplains would not be impacted.

Paleontological resources would not be affected. However, the ongoing advance of surface coal mining in the Project Area would mean that over a probable period of approximately 20 years, potentially fossiliferous rocks would be completely excavated. Any scientifically significant fossils would be destroyed during the mining process.

3.3 WATER RESOURCES

This section includes information taken from the Water Management Plan, Big Porcupine CBM Project, Campbell County, Wyoming (Independent Production Company, 2002), developed by the Company in preparation for implementation of the Proposed Action. This document details information concerning the water resources of the Project Area and the Company's plans for water disposition.

3.3.1 Affected Environment

3.3.1.1 Surface Water

Hydrology

The Project Area is largely contained within the drainage of Porcupine Creek, although the extreme southern part of the Project Area lies in the Horse Creek drainage basin and the northern part lies in the Trussler Creek – Thunder Creek drainage. With respect to analyses cited from the Powder River Basin Oil and Gas FEIS (BLM, 2003), the Project Area is largely contained within the Antelope Creek watershed, whereas the northeastern portions are contained within the Upper Cheyenne watershed. All of the produced CBM water from the project is expected to be discharged within the Porcupine Creek watershed. **Figure 1-1** shows the Project Area in relation to the Porcupine Creek drainage basin.

The Porcupine Creek drainage basin extends from its headwaters in the southeastern portion of T43N, R73W in Campbell County, 46.6 stream miles to the southeast to its confluence with Antelope Creek in the southeastern portion of T41N, R70W in northern Converse County. The Porcupine Creek watershed is 118.92 square miles (76,109 acres) in area and contains a number of existing stock ponds and reservoirs. Porcupine Creek elevations range from 5,200 feet in the upper basin reaches to 4,500 feet at the confluence with Antelope Creek. The channel is well-defined and extensively vegetated over most of its reach. Episodic floods have excavated scour features, closed depressions below grade level, within the channel floor. The configuration of the channel varies from fairly straight to highly sinuous. The channel has been periodically dammed, and its lower reaches have been extensively modified by surface coal mining activities. The 330 acre-feet Porcupine Reservoir (Murphree, 2002, p. 2) is located approximately one mile upstream from the confluence of Porcupine Creek with Antelope Creek and downstream of the NARC surface coal mine (Independent Production Company, 2002, p. 3).

The average annual precipitation for this area is approximately 11.5 inches (Independent Production Company, 2002, p. 3). Porcupine Creek is an ephemeral stream throughout its length, flowing only in response to storm or snow melt runoff. Existing CBM and mine dewatering wells in the area have contributed to the natural flow. During the period 1978 to 2001, mean flows in Porcupine Creek downstream from the Project Area were 0.52 cubic feet per second (cfs) (NARC, 2002a). Surrounding land is typically flat to gently rolling with established short grasses and sage cover. Longer tributaries are well-defined and similar to Porcupine Creek, whereas shorter tributaries may be less well-defined and may be heavily grass or sage-covered.

Antelope Creek joins the Dry Fork of the Cheyenne River in the western portion of T40N, R68W in Converse County, together forming the Cheyenne River. The Cheyenne River is ephemeral in this area, with spring snowmelt, summer thunderstorms, and groundwater contributing to variable flows. Between 1977 and 1987, average flow in the Cheyenne River near Bill, Wyoming (approximately 28 miles upstream of the Antelope Creek confluence) was 1.73 cfs, but ranged from 0.0 to 870 cfs (WRDS, 2003, online data).

Surface Water Quality

Big Porcupine Creek and Antelope Creek and their tributaries are Class 3B waters (WDEQ, 2003, Chapter 1, Section 4). Wyoming Water Quality Standards are presented in Appendix I. Class 3 waters are waters, other than those designated as Class 1, that are intermittent, ephemeral, or isolated waters and because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning or certain perennial waters which lack the natural water quality to support fish (e.g., geothermal areas). Class 3 waters provide support for invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage of their life cycles. Uses designated on Class 3 waters include aquatic life other than fish, recreation, wildlife, industry, agriculture, and scenic value. Generally, waters suitable for this classification have wetland characteristics. There are three subcategories of Class 3 waters.

Class 3B waters are tributary waters including adjacent wetlands that are not known to support fish populations or drinking water supplies and where those uses are not attainable. Class 3B waters 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 which inhabit waters of the state at some stage of their life cycles. In general, 3B waters are characterized by frequent linear wetland occurrences or impoundments within or adjacent to the stream channel over its entire length.

The Cheyenne River is classified as 2AB ww water (WDEQ, 2003, Chapter 1, Section 4). Class 2 waters are waters, other than those designated as Class 1, that are known to support fish or drinking water supplies or where those uses are attainable. Class 2 waters may be perennial, intermittent, or ephemeral and are protected for the uses indicated in each subcategory. There are four subcategories of Class 2 waters.

Class 2AB waters are those known to support warm water game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable. Unless it is shown otherwise, these waters are presumed to have sufficient water quality and quantity to support drinking water supplies and are protected for that use. Class 2AB waters are also protected for nongame fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture, and scenic value uses.

The key water quality parameters for predicting the potential effects of CBM development on irrigated agriculture are sodicity (as measured by the sodium adsorption ratio, SAR) and salinity (as measured by electrical conductivity, EC). Wyoming's current permitting process incorporates the numeric water quality standards for SAR (10) and EC (2,000) considered protective of water bodies downstream in South Dakota (BLM, 2003, pp. 4-70 to 4-73).

Furthermore, WDEQ applies its anti-degradation policy to all CBM discharges. This policy results in effluent limitations in National Pollution Discharge Elimination System (NPDES) permits for discharges of CBM produced water that equate to 20 percent of the available increment between low-flow pollutant concentrations and the relevant standards (assimilative capacity) for critical constituents. A separate basin-specific anti-degradation policy for barium is also applied to CBM discharges.

Water quality data for the period between 1977 and 2001 were obtained for Porcupine Creek and Antelope Creek, and are presented in **Table 3-1**. These data indicate that these streams have very low flows and that the water is an alkaline, sodium-calcium bicarbonate type. The SAR and EC are both typically less than the standards noted above. Water quality in most surface streams in the vicinity of the Project Area varies inversely with streamflow, as higher flows tend to dilute most dissolved constituents.

3.3.1.2 Groundwater

Aquifers

Groundwater resources in the Project Area exist within non-regional, Quaternary alluvial aquifers adjacent to creeks, and aquifers within the Eocene Wasatch and Paleocene Fort Union formations. These units represent the majority of the significant water-bearing strata; however, there are a few wells completed in formations that are generally considered as aquitards.

Alluvial Aquifers. Alluvial aquifers consist of very permeable unconsolidated sand, silt, and gravel that underlie floodplains and the adjacent stream terraces. Thicknesses are usually less than 50 feet. The only alluvial aquifer located within the Project Area is associated with Porcupine Creek (BLM, 2003, p. 3-32). Recharge results from surface infiltration and discharge from underlying strata. Local groundwater movement dominates these systems, and movement is along the drainage in a downstream direction. The groundwater resources contained in alluvial aquifers are under unconfined conditions. Water yields of about 5 to 1,000 gpm have been reported from PRB alluvial aquifers (BLM, 2000a, p. 3-29).

Wasatch Aquifer. The Wasatch aquifer consists primarily of discontinuous lenticular sandstone beds surrounded by fine-grained sedimentary rocks with low permeability, such as siltstone, claystone, mudstone, carbonaceous shale, and limestone. Coal beds may be locally important if present (Bartos and Ogle, 2003, p. 18). The discontinuous, lenticular sandstone beds are the primary geologic materials that yield water to wells and comprise the aquifer. Fine-grained sedimentary rocks in the Wasatch Formation do not yield sufficient quantities of water to be considered an aquifer, even though they may be saturated. The aquifer thickness increases from east to west. The hydraulic connection between sandstone lenses is tenuous due to intervening shale aquitards; therefore, vertical groundwater movement through the Wasatch Formation is limited.

Table 3-1 Surface Water Quality Data[1]

Parameter	Porcupine Creek WY005 GS-5, 1978-2001[2]			Porcupine Creek WY005 GS-7, 1979-2001[3]			Antelope Creek, 1975-1978[4]			Dry Fork Cheyenne River, 1977-1987[5]		
	Mean	Standard Deviation	n5	Mean	Standard Deviation	n5	Mean	Standard Deviation	n5	Mean	Standard Deviation	n5
Flow (cfs)	0.52	2.0	5216	0	0	11				1.73	5.36	14
pH (s.u.)	7.96	0.66	171	8.62	1.18	143	7.99	0.25	14	7.6	1.23	12
Sodium (mg/L)	227.28	429.55	172	151.90	112.30	127	186.67	64.26	12	71.4	21.19	12
Potassium (mg/L)	19.80	11.30	172	16.56	7.95	127	8.09	1.19	12	13.34	3.47	11
Calcium (mg/L)	155.56	79.34	3	84.50	61.05	127	145.18	53.57	11	203.93	62.10	12
Magnesium (mg/L)	89.34	149.34	171	58.25	47.24	127	58.58	18.76	12	100.28	33.61	12
Chloride (mg/L)	19.3	45.18	172	15.30	13.77	127	19.32	5.95	12	16.99	11.51	12
Sulfate (mg/L)	897.69	1501.59	171	631.15	538.75	126	737.50	225.09	12	708.78	289.15	4
Total alkalinity (mg/L)							232	44.05	4	302.72	79.47	12
TDS (mg/L)	1645.42	2,374.85	168	1088.31	828.66	126	1343.077	389.70	12	1375.43	417.89	
Sodium adsorption ratio (SAR)	3.23	0.86	123	3.0	1.21	12	3.7	1.03	12	0.98	0.25	12

[1] Sources: WRDS (2003); NARC (2002a).
[2] Downstream from NARC Mine, Section 21, T41N, R70W.
[3] Downstream from NARC Mine, Section 27, T41N, R70W.
[4] Source: WRDS (2003).
[5] Number of samples.

The sandstone and thin coal stringers, where saturated, will yield water to wells, and this water is primarily used for stock watering. The yield of wells completed in the Wasatch aquifer is directly related to the number and thickness of sandstone lenses or beds penetrated by the well. Wells can yield as much as 500 gpm, although smaller rates are more typical. Unconfined and confined conditions can exist in the Wasatch aquifer, although the sandstone beds comprising the aquifer are generally confined. Artesian conditions are common away from the outcrop, particularly in deeper isolated sands, and flowing wells occur in the Project Area (BLM, 1999, p. 3-2). The hydraulic conductivity of the Wasatch aquifer ranges from 0.2 to 0.3 foot per day. Recharge of the Wasatch aquifer is through surface infiltration of precipitation and lateral movement of water from adjacent clinker, spoil, and alluvium. Groundwater flow in the Wasatch aquifer is suspected to be primarily local and related to topography. Investigators differ on whether regional groundwater flow in the Wasatch aquifer occurs, and the relationship between local groundwater flow and possible intermediate and regional groundwater flow is unclear. If regional groundwater flow in the Wasatch aquifer does occur, flow would be to the north (Bartas and Ogle, 2002, p. 18). Any such regional flow would have a small volume and slow flow rate because of the low permeability of many of the rocks in the Wasatch Formation.

Fort Union Aquifers. The upper part of the Tongue River Member, the uppermost division of the Fort Union Formation, contains as many as 11 coal beds (Flores et al., 1999, p. PF-3) and many discontinuous, lenticular sandstone layers. The Wyodak coal occurs at the top of the Fort Union sequence and is the most continuous hydrogeologic unit in the Project Area. The Wyodak aquifer consists of the Wyodak and associated coals, which split and separate into multiple seams, interbedded sandstones, and clinker beds. The coal aquifer is anisotropic, and groundwater flow occurs primarily through fractures (cleats) in the coal bed. Flow direction in this aquifer may change where the coal bed splits into other beds and is interbedded with other lithological units and where differences in the distribution and density of the cleats in the coal occur. Hydraulic conductivity is estimated to range from 0.5 to 0.9 foot per day (Bartos and Ogle, 2002, pp. 13, 16). Recharge occurs primarily along clinker outcrop areas (see below) with a small amount of leakage from the overlying Wasatch aquifer. Recharge into the coal could also come from spoil and alluvial aquifers and from localities where coal underlies valley fill deposits. As more operating mines are reclaimed, reclaimed mine areas may become recharge areas for adjacent, undisturbed Wyodak coal.

Regional flow is to the north and northwest and away from the recharge areas (Bartos and Ogle, 2002, p. 16). Regional groundwater flow is to the north, moving toward local discharge areas where Antelope and Porcupine creeks cross coal outcrops. Local flow patterns may differ from regional flow. Water in the coal aquifers is typically unconfined near the outcrop along the eastern margin of the Powder River Basin, but becomes confined to the west, away from the outcrop and downdip. The gas present within the coal beds or associated geologic materials (for example, sandstone lenses above or below the coal bed) can contribute significantly to hydraulic head in wells and may cause water levels to rise higher than would be the case if only artesian pressure were present. Artesian conditions can exist (Bartos and Ogle, 2002, p. 13). Water yields from the Fort Union aquifers range from 3 to 160 gpm (BLM, 2003, p. 3-29).

The underlying Lebo Member aquifer consists of sandstones grading to mudstone with depth. Wells in the Lebo unit may yield as much as 10 gpm of water for domestic and livestock use if a

sufficient thickness of saturated sandstone is penetrated. As with other Fort Union aquifers, recharge is primarily from inflow at outcrop areas. Groundwater generally flows north (BLM, 1999, p. 3-6).

The basal Ft. Union Formation Tullock Member aquifer consists of fine- to medium-grained sandstone layers and thin coal seams interbedded with siltstone, shale, and carbonaceous shale. Sandstone channel deposits comprise about one-third of the section; fine-grained overbank sediments make up the remaining two-thirds. The Tullock was deposited in river systems that flowed to the east and is 500 to 1,500 feet thick in the Project Area. The Tullock is separated from the overlying members of the Fort Union Formation by a leaky confining layer (Lebo Member). Fine-grained sandstones and jointed coal beds may yield as much as 40 gpm, but yields of 15 gpm are more common. Where the aquifer is confined, wells generally flow less than 10 gpm. Recharge to the Tullock results from leakage through overlying strata and infiltration along the outcrop areas (BLM, 1999, p.3-7).

Clinker aquifers consist of highly fractured rocks formed by the natural burning of coal beds. Clinker aquifers can store large amounts of water from rainfall and snowmelt and protect it from evaporation. Although no clinker deposits crop out in the Project Area, large areas of clinker crop out east and southeast of the Project Area. Recharge of the clinker occurs from precipitation, from streams that cross the clinker, and from lateral inflow from clinker or unburned coal and overburden updip. Recharge rates to the clinker are very high compared to surrounding geologic units. However, the rate of recharge from the clinker units to the coal is often limited by a relatively low-permeability, clay-rich zone that typically occurs at the contact between the clinker and the coal. Transmissivities of the clinker are very high, ranging from 10,000 to more than 1,000,000 feet squared per day. The stored water is slowly discharged to springs, streams and coal aquifers downdip, helping to maintain perennial streams during dry periods. Springs which emerge from the base of clinker form the headwaters of several perennial streams and provide wetland habitat for many species. Clinker may function locally as an confined aquifer, although it is normally unconfined. Yields as great as 500 gpm may be possible from clinker deposits (BLM, 2000a, p. 3-29).

Deeper Aquifers. Deeper, underlying regional aquifers include the Upper Cretaceous Lance/Fox Hills, the Lower Cretaceous Dakota, and the Paleozoic Madison formations. These aquifers are hydrologically removed from project-related activities and are not considered further in this discussion.

Springs

Springs and seeps occur where groundwater is discharged to the surface. They are most numerous where topographic relief is great and stratigraphic units are discontinuous. In addition, springs and seeps also emerge at the base of clinker deposits, along the contact between the permeable clinker and impermeable layers below. The primary source of recharge to springs and seeps within the Project Area is likely infiltration of precipitation and seepage from streams and rivers. A search of the Wyoming State Engineer Office (WSEO, 2002, online data) database for permitted springs did not reveal any springs in the Project Area.

Wells

Groundwater levels in the area depend on the aquifer in which the well is completed and well depth. The Wasatch and Fort Union aquifers are the most important local sources of groundwater in the PRB (BLM, 1999, p. 3-7). They are developed extensively for shallow domestic and livestock wells. Domestic and livestock wells usually are low-yield (less than 25 gpm), intermittent producers. Water suitable for domestic and livestock uses typically can be found less than 1,000 feet below the surface. Industrial water wells are used primarily to obtain water for use in subsurface injection that promotes secondary recovery of petroleum. At coal mines, these industrial use wells are used for drinking water and dust abatement.

Sixty nine stock and/or domestic water well permits have been issued in the Project Area and within a one-mile radius of the project boundary. Completion depths range from 7 to 805 feet below ground level. Static groundwater depths measured from wells in the vicinity range from 1 foot to 290 feet below surface grade. Several wells potentially flow at the surface. A list of permitted stock and domestic wells is presented in **Appendix J.**

Groundwater Quality

Alluvial Aquifers. Water quality in alluvium within the PRB is variable (BLM, 2003, p. 3-8). Concentrations of TDS in alluvial aquifers ranged from 106 to 6,610 mg/L and averaged 2,128 mg/L for 38 samples. Water from surficial deposits that contains less than 600 mg/L TDS is either a calcium magnesium carbonate type or a calcium magnesium sulfate type. Waters containing greater than 600 mg/L TDS are generally the result of increases in sodium and sulfate.

Wasatch Aquifer. Data reported by Bartos and Ogle (2002, p. 2B) from the central portion of the PRB CBM fairway indicate that dissolved solids concentrations in the Wasatch aquifer range from 263 to 4,020 mg/L with a median concentration of 1,010 mg/L. The dominant cation is sodium, which ranges from 97 to 480 mg/L with a median concentration of 225 mg/L. Bicarbonate is the dominant anion, with a range of 157 to 1,244 mg/L and a median concentration of 461 mg/L. Hardness ranges from 22 to 2,500 mg/L, with a median concentration of 97.5, making the water moderately hard to very hard (typically moderately hard). From the standpoint of suitability for irrigation, the median SAR and median sodium concentration place this water in the category of medium sodium hazard. A medium sodium water will present an appreciable sodium hazard in fine-textured soils having high cation-exchange-capacity, especially under low-leaching conditions, unless gypsum is present in the soil. This water may be used on coarse-textured or organic soils with good permeability (U.S. Department of Agriculture, 1954, p. 81). The maximum concentrations reported by Bartos and Ogle (2002, p. 28) for several water quality parameters exceed one or more Wyoming groundwater standards (pH – livestock standard; sulfate – agriculture standard; TDS – domestic, agriculture, fish and aquatic life standards). Water quality data from the Wasatch aquifer is summarized in **Table 3-2**.

Table 3-2 Water Quality Data for the Wasatch Aquifer and Fort Union Coal Aquifers

Water Quality Parameter	Wasatch Aquifer (median of 7-8 samples)	Fort Union Coal Aquifers (median of 13 samples)
pH (s.u.)	7.8	7.2
Sodium (mg/L)	225	210
Potassium (mg/L)	9.4	12
Calcium (mg/L)	15.5	36
Magnesium (mg/L)	15.4	15
Chloride (mg/L)	9.6	9.1
Sulfate (mg/L)	130	<0.3-1.8
Fluoride (mg/L)	0.85	ND1.2
Bicarbonate (mg/L)	461	712
Silica (mg/L)	10	10
Specific conductance (uS/cm)	1,382	1,070
Total dissolved solids (mg/L)	1,010	644
Sodium absorption ratio	9	7

Source: Bartos and Ogle (2002, pp. 28-29)

Fort Union Aquifers. TDS concentrations in the Fort Union coal aquifers range from 382 to 2,720 mg/L, with a median concentration of 644 mg/L (**Table 3-2**). The dominant cation is sodium, which ranges from 120 to 1,000 mg/L and has a median concentration of 210 mg/L. The dominant anion is bicarbonate, which has a range of 422 to 3,134 mg/L and a median concentration of 712 mg/L. Hardness ranges from 74 to 446 mg/L, making the water moderately hard to very hard (typically hard). The median SAR and SC indicate that the water has a medium sodium hazard. The maximum TDS concentration reported by Bartos and Ogle (2002, p. 29) exceeds the Wyoming groundwater standards for domestic, agriculture, and fish and aquatic life.

Analyses of Fort Union produced water indicate that concentrations of most constituents are generally less than the most restrictive Wyoming groundwater quality standards (BLM, 2003, pp. 3-12 to 3-13). However, maximum concentrations of barium, fluoride, iron and manganese exceed the domestic standard; SAR exceeds the agriculture standard; mercury exceeds the livestock standard; and copper, iron, mercury and zinc exceed the fish and aquatic life standard.

Within the clinker aquifers, water quality appears better in well-drained areas where soluble materials in the clinker have dissolved away, and on clinker-capped plateaus where burning has removed most or all of the coal. These areas are generally updip and further away from the burn line, and contain younger water. Quality is poorer where water in clinker has ponded along a contact (burn line) with unburned coal downdip. TDS values range from 200 to 10,000 mg/L. Major cations include calcium, magnesium, and sodium. Dominant anions vary from sulfate in clinker next to a burn line to bicarbonate in clinker downdip from coal or in clinker plateaus

where little or no coal remains. Clinker springs on these plateaus commonly have calcium bicarbonate type water with TDS values under 400 mg/L.

Within the vicinity of the Project Area, water from the Wyodak coal aquifer is of good quality. Analyses were obtained of samples from the NARC mine in Section 36, T42N, R71W, and from a Merit Energy CBM well in Section 16, T42N, R71W. These sources are located on the southeast and northwest sides of the Project Area, respectively. Average SAR values from these wells is 5.8, with a range of 5.2 to 6.4, making the water suitable for agriculture. Average TDS values range from 435 mg/L to 812 mg/L, with an average of 569 mg/L (NARC, 2002a; Merit Energy, 2003; Independent Production Company, 2003). The lower TDS value makes the water suitable for domestic use while the higher value makes it suitable for agricultural use.

3.3.2 Regulatory Environment

Laws and regulations dealing with management and protection of surface and groundwater :

- Clean Water Act of 1948 (33 USC Chap. 26, 33 USC 1344, 33 CFR 323, 40 CFR Parts 112 et seq., 404-471)
- Safe Drinking Water Act of 1974, as amended (42 USC 300f-300j, 40 CFR Parts 141-149)
- Federal Land Policy and Management Act of 1976 (FLPMA), (43 USC 1701 et seq., 43 CFR 3809)
- National Forest Management Act of 1976, as amended (16 USC 1600 et seq., 36 CFR 219.6)
- Executive Order 11988 (1977) Protection of Floodplains
- Wyoming Statutes (35-11-103, 35-11-301 et seq., WDEQ Program, Chapters 1, 2, 7, 8, 18)
- USFS Manual 2500

3.3.3 Regulatory Status

Management of surface water and groundwater resources within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement (USFS, 2001) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a).

Recommended mitigation measures relating to water resources are also discussed in the Powder River Basin Oil and Gas FEIS (BLM, 2003, pp. 4-392 to 4-393). These would be applied by the Company as appropriate or as required by the USFS.

3.3.4 Environmental Consequences

Surface water issues identified from scoping include:

- Effects of surface discharge of produced water containing high salinity and high SAR values and consequential effects on irrigation, sodification of soils, plant toxicity, and degradation of waters entering South Dakota;
- Effects of high volumes of discharged water with respect to increased sedimentation, channel erosion, stream temperature, and potential loss of floodplain diversity;
- Restriction of spring recharge of downstream wetland/riparian areas and evaporative concentration of salts resulting from storage of produced water in impoundments;
- Necessity for mandatory water and soil testing at discharge points, along ephemeral drainages, and along receiving perennial streams; and
- Potential deleterious effects of discharge of produced water with selenium concentrations exceeding 2 µg/L.

Groundwater issues identified from scoping include:

- Possible deleterious effects of infiltration from impoundments of saline water on near surface aquifers;
- Potential depression of the water table in near-surface aquifers resulting from dewatering of coals; and
- Potential methane contamination of shallow aquifers from seepage accompanying coal dewatering or contamination of other aquifers by produced water.

3.3.4.1 The Proposed Action

Distribution of Produced Water

Water resources in the Project Area would be affected to varying degrees by the production of CBM and the discharge of CBM produced water to the surface. This section describes an overview of the proposed disposition of CBM produced water and the effects on surface and groundwater.

Produced water from CBM wells would be beneficially used for ,livestock watering, wildlife, and wildlife habitats. Produced water would be available for industrial purposes by the NARC mine and for dust suppression on access roads to wells under WOGCC guidelines.

Water generated from the proposed CBM wells would be piped and pumped to 14 discharge locations identified on **Figure 2-2**. Information obtained from the NARC coal mine and nearby CBM operators indicates that initial water production would be approximately 100 barrels per day (bpd) (0.006 cfs) per well for wells in the northeastern and eastern portions of the Project Area, 1,000 bpd (0.0649 cfs) per well near the northwestern portion of the Project Area, and 750 bpd (0.049 cfs) per well along the southwestern boundary. CBM water production is expected to decline approximately 50 percent per year (Independent Production Company, 2002, p. 6).

Once discharged, the conveyance of CBM produced water flows in stream channels would be reduced through infiltration into the subsurface and through evapotranspiration. Of the total conveyance loss, approximately 82% would result from infiltration and 18% from evapotranspiration (BLM, 2003, pgs. 4-3 to 4-4). Estimated CBM water conveyance losses are

summarized in **Table 3-3**. These data indicate that the average conveyance loss in ephemeral drainages is approximately 30 percent per mile. Meyer (2000, p. 6) in a six-year study of CBM produced water conveyance losses in the Belle Fourche watershed has noted that such have losses have been persistently underestimated.

Table 3-3 Ephemeral Stream Conveyance Loss Estimates

Ephemeral Stream	Length Analyzed (miles)	Conveyance Loss (percent)	Amount Lost (cfs)	Amount Lost (bwpd)	Conveyance Loss/Mile (percent)
Caballo Creek	14.0	100	4.97	76,500	>28
Pumpkin Creek	11.3	99	1.88 (?)	29,000	33
Spotted Horse Creek	3.8	62	0.626	9,600	22
Wildcat Creek	2.8	76	0.41	6,300	40
Average					>31

Source: Applied Hydrology Associates (2001).

Water released into ephemeral stream channels would ultimately drain to an existing impoundment operated and owned by the NARC coal mine located in Section 36, T42N, R70W, as illustrated on **Figure 2-2**. From this facility, discharge water would be pumped to three existing reservoirs constructed by PRCC in the northeastern portion of the Project Area. Several of the discharge points would produce water to drainages directly tributary to these reservoirs.

Mine reservoirs would permit storage of up to 145 acre-feet of Project produced water. Most produced water would be used for industrial purposes within the mine. A water balance under typical and estimated maximum flow cases illustrating net CBM water (after conveyance losses) reaching the mine reservoirs is indicated in **Figure 3-2**. For this water balance, the typical flow case indicates water production buildup from randomly located wells. The maximum flow case indicates the scenario in which those wells with the highest water production potential are preferentially brought on production first. Daily mine use refers to all industrial uses of produced water within the NARC mine. The water balance indicates that the NARC coal mine has the capacity to accept the maximum anticipated produced water volumes.

The Company computed peak flows in the various Porcupine Creek sub-watersheds for 2-year, 10-year, 25-year, 50-year, and 100-year storm events and has included detailed hydrological analyses in its Water Management Plan (Independent Production Company, 2002, pp. 23-31). In the main stem of Porcupine Creek from the confluence of Cripple Creek in Section 18, T42N, R72W downstream to the north edge of Section 21, T41N, R70W, the peak discharges would range from 684 cfs (2-year storm) to 6,720 cfs (100-year storm).

Surface Water

Potential effects to surface water resources may include changes to both the downstream hydrologic regime and to water quality.

Hydrology

Potential effects from discharges of CBM produced water to surface drainages within the Project Area include alteration of flow regimes, channel erosion, and channel sedimentation. Conveyance losses caused by evapotranspiration and infiltration would reduce the volume of discharged CBM produced water reaching downstream surface drainages, as indicated by **Table 3-3** and **Figure 3-2**. However, drainages that previously were ephemeral could become perennial due to the increased volume of channelized flow and recharge saturation of alluvial aquifers. Conveyance losses would be reduced when CBM produced water is discharged into perennial waterways and during prolonged cold winters. Channel alluvium of creeks and draws receiving surface discharge of CBM produced water would become more saturated, and runoff rates would likely increase.

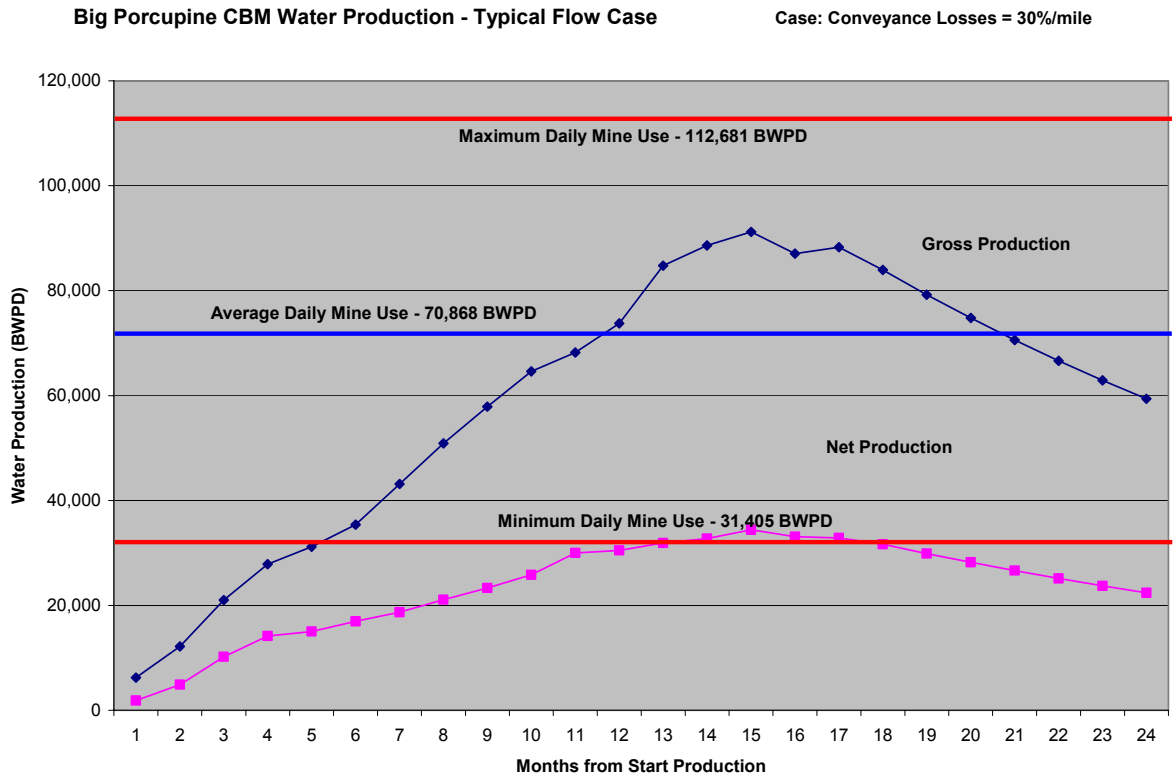
The increase in flow would not likely cause significant adverse downstream impacts because the flow attributable to CBM produced water is small, relative to storm flows in the Porcupine Creek basin. Maximum net flow, including CBM produced water, anticipated to reach mine reservoirs would be approximately 1.51 cfs. This compares to estimated Porcupine Creek storm flows of 12.43 cfs, 27.86 cfs, and 47.44 cfs for 2-, 5-, and 10-year storm events, respectively. These storm discharge figures represent only natural precipitation contributions within the Project Area. Actual flows, which would likely include contributions from drainages upstream of the Project Area, would probably be greater. Specifics relating to the level and frequency of storm flows are contained in Appendix G of the Project Water Management Plan (Independent Production Company, 2003).

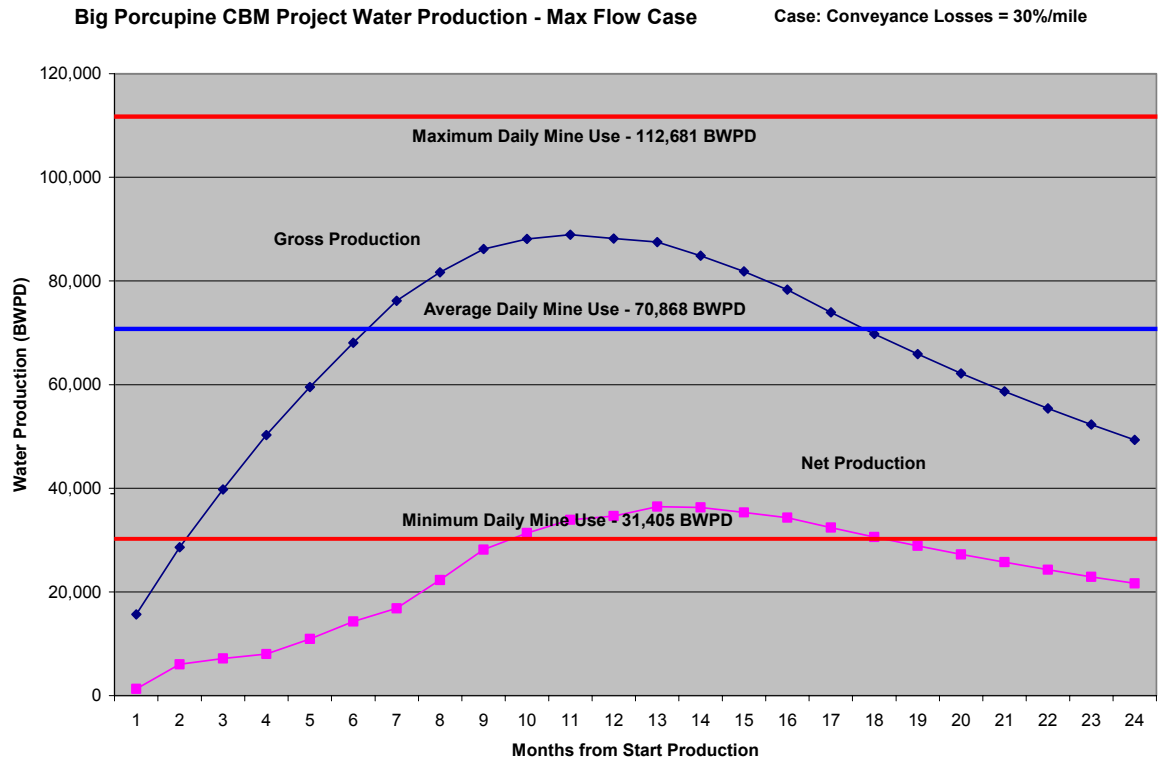
The discharge of CBM water would result in minimal additional downstream sediment transport because the low base flow associated with CBM discharges would not be highly erosive and storm flows, as noted above, would not be significantly increased by the relatively small CBM discharge flows. Conveyance losses within ephemeral drainages would significantly reduce flow volumes, particularly within the first few years of production when flows would be greatest.

Because impoundments used to manage produced water would be designed as flow-through structures and would be permitted by WSEO, there would be no expected effects to existing surface water rights.

One of the issues identified in scoping related to potential effects of surface discharge on wetland and riparian communities. These effects are discussed in Section 3.6.

Fig. 3-2 CBM Net Produced Water Balance (after Conveyance Losses), NARC Coal Mine





West Nile Virus

The surface discharge of produced CBM water and resultant increase in quantities of water in streams and impoundments in the Powder River Basin has raised concerns about a possible increase in the incidence of West Nile Virus, a mosquito-borne disease (BLM, 2003c, pgs. 17-18). Mosquito larvae may develop in shallow, stagnant waters which may be associated with CBM produced water discharge facilities. Mosquito host transmission of several viral diseases makes control of mosquito populations a concern. The principal host is the *Culex tarsalis* mosquito a subgenus of the genus *Culex*, distributed throughout North America, most abundantly in western agroecosystems and wetlands. Larval habitats vary widely from domestic supplies to flooded pasture, but are restricted to stagnant water of less than 18-inch depth. Mosquito larvae are not found in moving water (Benjamin, 2003, personal communication). Mosquito-borne viruses include western equine encephalitis, St. Louis encephelatis, California encephalitis, and West Nile virus. Mosquitoes feeding on infected birds pass the infection to successor prey. Animals at risk of infection include horses, birds, especially corvids, and humans (Colorado Department of Public Health and Environment, 2002).

Effective control of mosquito larvae is achieved through application of the biological agent *Bacillus thuringiensis israelensis* (Bti). This bacterium kills by producing delta-endotoxin proteins within the digestive tract of target larval-stage insects. The insect ceases feeding and succumbs to starvation, usually within several days of infection. Bti is essentially non-toxic to humans, pets, and wildlife. Application consists of periodic use of Bti briquets to at-risk ponds (Craneshaw, 2003).

Surface Water Quality

Changes in water quality may occur as the CBM discharge flows from discharge points in stream channels toward the higher order streams or as it infiltrates to shallow groundwater systems and is discharged subsequently to surface flows.

CBM produced waters containing proportionally higher levels of sodium cation concentrations relative to magnesium and potassium cation concentrations (in excess of Wyoming Underground Water threshold SAR of 8) may result in some dispersal of soil-sized particles, particularly clay soil particles and subsequently some decrease in the permeability of bottom sediments in impoundments or channels located in clayey sediments or soils, thus decreasing the rate of infiltration. Impoundments constructed in sandy soil would be less affected by increased relative concentrations of sodium over time, and infiltration rates would likely be maintained over the life of the impoundment. Representative SAR values (samples collected and evaluated in accordance with protocols outlined in the ROD for the Powder River Basin Oil and Gas EIS) of produced Wyodak coal-seam water in the vicinity of the Project Area average 5.8 and TDS values in the vicinity of the Project Area average 569 mg/L. Both values meet WDEQ agricultural quality standards.

Irrigation application of proportionally more sodic waters can cause subsequently loss of soil permeability (reduced infiltration of moisture and oxygen) and resulting reduction in crop productivity, depending on a number of factors including soil texture, mineralogy, soil drainage

characteristics, and susceptibiloity of the crops species to sodic conditions. Irrigation does not occur in the vicinity of the Project Area and the below-threshold SAR levels of the Project Area-representative produced water would not, in any case, reduce the suitability of the area's produced water for irrigation usage. As discussed in Section 3.5, the more sodic-sensitive soils in the Project Area are not likely to be adversely affected by discharge of CBM produced water.

One of the issues identified from scoping concerns the discharge of water containing potentially high volumes of dissolved selenium. Analyses of Wyodak coal water obtained from the NARC mine indicate values of dissolved selenium of less than 5 µg/L (NARC, 2002a). The EPA Drinking Water Standard for selenium is 50 µg/L (EPA, 2003, online data). Discharge of produced water is unlikely to result in unsafe levels of selenium in local streams.

Water quality modeling conducted for the PRB Oil and Gas FEIS indicates that the annual water production in the Antelope Creek watershed would peak in 2004, when 925 wells would be producing at an average rate of 11.9 gpm (0.0265 cfs) per well (BLM, 2003, p. 4-81). Under modeled conditions, the amount of produced water assumed to reach the main stem of Antelope Creek during the peak year of CBM water production would be about 12 cfs (8,689 acre-feet/year).

The same model predicts that, following CBM development in the basin, the stream flow under low-flow conditions (12 cfs) would consist almost entirely of CBM produced water. The resultant salinity level measured as electrical conductivity (EC), in accordance with the model, would decrease to 924, whereas the SAR would increase to 7.0 (BLM, 2003, p. 4-81). The water quality in Antelope Creek near Teckla, Wyoming, during all months of the year and during low-flow conditions would be adequate to meet the limits for both EC and SAR that WDEQ has adopted to be protective of downstream irrigation. It should also be noted that samples collected since the onset of CBM production in other watersheds have not detected adverse changes in ambient stream SAR and EC concentrations of the magnitude predicted by the water quality model, and actual impacts may be less than the mass balance model predicts (BLM, 2003, p. 4-82).

Groundwater

Aquifers

Alluvial Aquifers. Almost all of the groundwater produced from Project operations would be released to surface drainages and impoundments. Alluvial infiltration rates would approach 30 percent per mile, as indicated in the discussion on distribution of produced water.

Increases in water levels in the alluvium likely would closely follow increases in the discharge and infiltration of CBM produced water. The rise in water levels in the alluvium would be constrained by the unsaturated thickness of the alluvial aquifer and by the likelihood that lateral flows would occur. A rise in alluvial groundwater levels could occur in the immediate vicinity of the impoundments within a few months of the onset of discharge. In areas with near-surface water tables, the increase in water level may cause standing water in areas not previously displaying this condition or as wetland development. Declining production of CBM water likely

would result in declining water levels in the alluvium. Water levels could return to preexisting conditions within a few months after discharge ends.

Wasatch Aquifer. Drawdown of the underlying Fort Union coal aquifer would likely cause a drawdown of the Wasatch aquifer. A significant period (typically several years) (BLM 2003a, p. 4-47) would likely pass before noticeable drawdown in the sands would be apparent because of the limited hydraulic communication between the coal zone and the overlying Wasatch sands. The drawdown effects in the overlying Wasatch aquifer are likely to be much less than in the coal aquifer, but may be noticeable for deep sand units that occur within 100 feet of a developed coal. Drawdowns in deep sands that occur within 100 feet of developed coals may be between 5 to 10 percent of the projected drawdowns in the coal and would tend to occur several years after drawdown in the coal. Drawdown in the shallow Wasatch sands is expected to occur only near mines and areas where the target coal seam for CBM development is nearer the surface. Any wells producing from the drawdown portion of the Wasatch would be affected.

Some of the groundwater released by the project to surface drainages or impoundments would result in direct recharge of shallow Wasatch sands and or indirect recharge of Wasatch sands from alluvial groundwater along creek valleys. The rate and extent of recharge would be directly related to the permeability of the Wasatch Formation subcrop under streams and ponds.

Recovery in the deep Wasatch sands would tend to occur after water levels in the coal recovered substantially and induced leakage from the deep Wasatch sands into the coal becomes minimal.

Because the Wasatch sands would continue to recharge the coal after development of CBM ceases, the recovery of water levels in the deep Wasatch sands would be slow. Modeling conducted for the PRB EIS indicates that water levels would recover to within 25 feet of pre-operation levels over a period of 20 years after CBM development ends in the area (BLM, 2003, p. 4-49). Water levels would eventually recover to within less than 20 feet of pre-operation levels over the next hundred years.

Fort Union Aquifers. The Proposed Action would cause the initial hydraulic head in the coal in the Tongue River Member to be drawn down. Initial recovery would primarily be caused by redistribution of groundwater stored in the aquifer. When the stresses of pumping are removed, the groundwater in storage outside the areas of CBM development would re-saturate and re-pressurize the areas that were partially depressurized during operations. The amount of groundwater storage within the coals and the sand units above and below the coals is quite large, and redistribution could potentially result in a rapid initial recovery of water levels in the coal. However, the amount and rate of leakage from the overlying Wasatch aquifer into the coals would be limited by the areal extent of sands within 100 feet of the coal and by variable thicknesses of claystone at the base of the Wasatch Formation.

Modeling conducted for the PRB EIS projects that the initial recovery period would occur over 25 years (BLM, 2003, p. 4-38). The rate of recovery would then slow dramatically, eventually recovering to within 20 feet or less of pre-operation conditions over the next hundred years.

Complete recovery of the water level would be a long-term process because most of the recharge would come from overlying and underlying sand and undeveloped coal units that, in turn, would be recharged from surface infiltration.

Recharge rates would increase temporarily as a result of infiltration of CBM produced water discharged to impoundments and streams. However, it would decades before these influences from surface recharge would appear in the coal.

Coal mining along the eastern subcrop would result in minimal recharge to the coal while the mines are active because of the groundwater sink caused by pit dewatering. Complete dewatering of the target coals must precede mining. As mines are reclaimed and eventually shut down, the backfilled areas would become long-term recharge zones for the coal aquifer. Infiltration through backfill areas may be substantial because the permeability of the backfill materials tends to be much higher than in the original un-mined materials. In addition, most of the creeks would be diverted over these backfilled areas, providing an important source of recharge water.

The Lebo and Tullock aquifers are partially isolated from impacts resulting from dewatering associated with mine activities and CBM production in the Wyodak coal aquifers.

Deeper Aquifers. Groundwater moves within deeper Tertiary aquifers from southeastern Johnson County toward northeastern Natrona County to replace hydrocarbons pumped from oil fields in Natrona County. This groundwater flow system is not hydraulically connected with the Tertiary coal zone aquifer, and would not be affected by CBM development.

The lower Cretaceous aquifers are recharged principally by the underlying Madison aquifer. Neither the lower Cretaceous aquifers nor the Madison aquifer are hydraulically connected to the Tertiary coal aquifers, and CBM development would not affect these deep aquifers.

Springs

Increased availability of shallow groundwater caused by the infiltration of CBM produced water could cause new springs and seeps to develop downgradient of locations where infiltration is occurring.

No decrease in flows would be anticipated where the springs result from flow along a near-surface zone of low permeability that intercepts the surface.

Wells

Impacts to individual water wells completed within the coal, and in sands above the coal, would depend on their proximity to CBM production wells, depth and completion interval of the water well, and the yield required to maintain the well as a usable source.

Impacts to well yield or availability are likely to be an issue only if the drawdown exceeds 20 to 30 percent of available drawdown at any location (BLM, 2003, p. 4-50). The decreased head the

well pump operates against may cause the pump discharge to decrease. However, yield may be restored by installing a larger pump if sufficient available drawdown remains in the well. In cases where the drawdown causes the water level in a well to drop below the intake, the pump may have to be lowered in the well.

Changes in water levels in wells are not expected to be as significant in the aquifers above or below the coal because of the presence of low-permeability claystone aquitard layers, although the integrity of the confining layer may be compromised locally by water supply wells that are screened through both the coal and the overlying sands, by deteriorating well casings, or by poorly plugged oil and gas wells or exploratory drill holes.

The effects on flowing artesian wells would depend on whether the wells tap shallow local groundwater or deeper groundwater within the coal zone aquifer. Wells completed in shallow aquifers that flow locally would not likely be affected by drawdown of the coal zone aquifer during CBM development. Flows in these wells would likely be increased, however, by the increased availability of shallow groundwater where the CBM produced water is infiltrating.

Deep flowing artesian wells completed in the coal zone aquifer or sandstone layers in hydraulic connection with the coal zone aquifer likely would be affected by drawdown of the coal zone aquifer during CBM development. Decreased flows or no flow would be the likely effects on wells completed in deep aquifers.

Concerns have been expressed by the USFS and other entities, including private landowners and range permittees, regarding the potential decline or loss of well productivity resulting from aquifer depletion associated with CBM development. Research conducted in support of this EA examined this issue. Evidence which would document the link between CBM development and loss of well productivity has not been identified in discussions with the USFS hydrologist (Gloss, 2003c) or in a review of Gillette newspaper stories since January 2002. A complicating factor is that much of the West has undergone a sustained drought in recent years resulting in water table declines even in areas lacking CBM development. It is therefore possible that attributing well productivity declines to CBM production could be an erroneous conclusion. A BLM-required mitigation for possible well productivity declines in areas of CBM production is a mitigation agreement between the Company and nearby well owners. In the event an agreement can not be reached, the Company must certify that it will mitigate impacts of a CBM well in accordance with Wyoming State Water Laws (BLM, 2003, p. 21). The Company has certified that it has obtained such agreements or will meet its obligations where such agreements have not yet been obtained (Independent Production Company, 2002).

Groundwater Quality

Leakage. Some groundwater contained in Wasatch sandstones that directly overlie coal zones likely would leak into the Fort Union coal aquifer during development of CBM. The depth of the leakage should be directly related to both the extent of reduction in hydraulic head and the permeability of the coal. Groundwater in Wasatch sandstones and coals varies somewhat from the Fort Union coal aquifer, with a slightly higher median pH, higher concentrations of TDS, sulfate, and manganese, but lower concentrations of barium (**Table 3-2**). Resulting changes in

water quality in the Fort Union coal aquifer would be a function of the relative volumes of mixed water and concentrations of the various water quality parameters in the two waters.

Leakage and mixing between aquifers with differing water quality could also occur where aquifer zones are not isolated during well completion or abandonment because of a lack of mechanical integrity, including inadequate casing, cementing, or plugging. Procedures for drilling and completing CBM wells are strictly controlled by WOGCC and BLM requirements that ensure each formation remains as isolated as it is under natural conditions and that the integrity of the well bore remains intact. Development in accordance with these requirements is not likely to allow any additional mixing of groundwater by improperly drilled or completed wells.

Infiltration. CBM produced water that is exposed at the surface typically undergoes immediate changes in chemical composition that are the result of introducing oxygen to the water. When oxygen is introduced at the surface, iron and manganese oxidize and precipitate, as evidenced by iron stains commonly associated with CBM discharge outfalls.

CBM produced water that has infiltrated unsaturated alluvial materials resembles naturally-occurring alluvial water quality very near the surface (BLM, 2003, p. 4-54). This is likely the result of dissolution of gypsum (hydrous calcium sulfate) in the unsaturated zone very near the surface by infiltrating CBM produced waters. Gypsum occurs abundantly in environments characterized by considerable evaporation, such as ephemeral drainages.

Issues identified from scoping include concerns relating to infiltration of saline waters and concentration of salts from evaporation in impoundments. As noted previously, local Wyodak coal water is low in both sodium and salinity values and meets WDEQ agricultural standards. The Company has no plans to develop off-channel evaporation/infiltration impoundments. Storage of produced water within the large NARC mine reservoirs would be temporary pending usage within the mine for industrial purposes.

CBM Drilling Fluids. Drilling fluids do not contain constituents that would contaminate the formations surrounding the well bore of a CBM well. They are generally a mixture of water, commonly obtained from a nearby producing CBM well, native mud, and bentonite. Small amounts of biodegradable polymer additives or potassium chloride salts may be added to the mud to clean the hole and stabilize the clay.

The drilling fluids are in contact with the well bore for only a short time, generally one to three days while the well is being drilled and before it is cased. The well bore is then isolated from surrounding formations by casing cemented into place. The well bore is flushed with water before drilling continues. The coal zone is then drilled using water or air only. The finished hole may be flushed with water to remove coal fines.

Emissions of Methane. Gas migration and seepage are naturally occurring processes where coal beds are extremely close to the surface and can be enhanced during CBM development. Gas migration and seepage would be most likely to occur near production areas along the coal outcrop and within or near CBM production areas.

Production of gas from CBM wells may help prevent or limit seepage. Production of CBM removes methane from the coal zone aquifer, thus making less methane available to migrate through underground faults, fractures, or sandstone layers or escape at the surface in seeps. Completion procedures for CBM wells are designed to direct methane toward the well bore and would not induce methane to migrate away from the well bore and toward existing water wells. Production of CBM is strictly controlled within casing that is cemented and is not likely to cause any release of methane into the groundwater. However, some older conventional oil and gas wells may be inadequately cased or plugged, allowing methane, if present, to migrate.

Methane could emerge from stock or domestic water wells near CBM production areas, affecting usage. Water wells frequently are screened over multiple aquifer zones, which would facilitate methane migration through the well bore between individual aquifer zones.

Other areas with potential for migration or seepage include areas where faults, fractures, or sandstone layers occur in an orientation that provides a conduit for methane movement. The migration of methane could be enhanced where sandstone layers are in contact with the coal zone, or faults and fractures extend from the coal zone into surrounding rocks.

Monitoring

One of the issues identified in scoping related to a need for extensive testing of produced water at discharge points and testing of associated soils. Representative produeced water sample analyses obtained for this EA indicate that the quality of produced water meets state agricultural standards (average SAR of 5.8 and average TDS value of 569 mg/L) and chemical characteristics are similar over the vicinity of the Project Area. The water quality is suitable for existing uses for livestock, wildlife, coal mine dust suppression and mining operations and meets WDEQ discharge limits. Discharge monitoring is required by the terms of NPDES permits issued by WDEQ. Even sodic-sensitive soils are unlikely to be affected by water produced from the Project, as indicated in Section 3.5 Additional monitoring is not recommended.

Groundwater Use

Where CBM wells are drilled in close proximity to existing water wells, water quality in existing water wells may be temporarily affected immediately after the CBM wells are drilled and completed. The WSEO has received reports of increased sediment, fines, and odor in wells where water is being produced from a zone shallower than the target coal. These effects would likely be temporary (BLM, 2003, p. 4-55).

Mitigation

Each discharge point will be monitored on a monthly basis and all dam outlets (spillways and low-level pipe outlets) culverts, and low water crossings will be checked quarterly and after major storm events. In addition, the channel section below each reservoir will be inspected for signs of overtopping and/or seepage. Inspectors will note the condition of all reservoirs and discharge points, check for evidence or erosion or failure. As conditions are identified that

require repair, the appropriate remedial work required will be scheduled and performed. If erosion is noted, it will be mitigated with erosion control measures, modification of discharge structures or locations, and if necessary diversion of discharges to other locations. After the first year of operation, inspections will only occur annually unless site specific concerns are identified. Culverts and low water crossings will be inspected after major storm events. Debris will be removed to prevent culvert blockage and repairs will be made as necessary.

Headcuts located on private surface where the landowner has denied permission to mitigate will be monitored. For each identified headcut, a five foot length of 3/8 inch rebar will be pounded three feet into the ground at a measured location six feet upstream of the most upstream portion of the headcut. During the first year after onset of production of CBM water, headcuts will be monitored by Company personnel on a monthly basis, and semi-annually in subsequent years. Monitoring will also be performed after major storm events. Monitoring will also be conducted semi-annually by Forest Service personnel.

As indicated in Chapter 2 (Section 2.1.1.7), the Proposed Action would result in the upgrading of two small existing stock reservoirs located on private surface and one wildlife and stock reservoir on USFS surface. The USFS would consult with the Campbell County Weed and Pest Control District regarding concerns relating to West Nile virus. At the direction of this agency, the USFS would request that the BLM apply a Condition of Approval to control for mosquitoes where CBM discharge waters become stagnant for any federal wells discharging to the private surface reservoirs. The reservoir located on USFS surface would receive discharge at the request of the USFS and the USFS would assume all responsibility for that reservoir. No other bodies of shallow, standing water would be created by development of the Proposed Action and no other mitigation is considered to be necessary.

Long term mitigation of the project area will be addressed by the local surface coal mines. The majority of the project area is likely to be consumed by the coal mines within twenty years if current mining rates remain constant (5 years per mile or 100 million tons annually). Portions of the project site will be mined much earlier (five to eight years), as the coal mine is less than two miles from the proposed production area. Once the coal is removed from these areas they will be reclaimed and rehabilitated.

3.3.4.2 The No Action Alternative

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action Alternative, no negative impacts to water resources additional to existing impacts would occur. Conventional oil and gas development would continue within the Project Area, and CBM development would continue on state and private lands near the Project Area. Many effects to both surface and groundwater resources occur in the area of existing surface coal mines. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future, with resultant impacts to the coal aquifer and streams in the vicinity of the mines.

3.4 AIR QUALITY

3.4.1 Affected Environment

Detailed information describing the existing and projected air quality status of the Powder River Basin, within which the Big Porcupine project would be completed, is contained in the Powder River Basin Oil and Gas Final environmental Impact Statement (BLM, 2003) and the Air Quality Impact Assessment (Argonne, 2002).

3.4.1.1 Climate

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is strongly affected by regional and local topography.

Most of the area is classified as a semi-arid cool steppe, where evaporation exceeds precipitation, with relatively short warm summers and longer cold winters. On the plains, average daily temperatures typically range between 5 to 10 (low) and 30 to 35 (high) degrees Fahrenheit (°F) in mid-winter and between 55 to 60 (low) and 80 to 85 (high) °F in mid-summer. The frost-free period generally occurs for 120 days between late May and mid-September. The annual average total precipitation is nearly 12 to 16 inches, with 36 to 60 inches of total annual snowfall.

Prevailing winds occur mainly from the southeast and northwest, but local wind conditions reflect channeling due to complex terrain, resulting in mountain and valley flows. Nighttime cooling enhances stable air, inhibiting air pollutant mixing and transport along the valley drainages (BLM 2003, p. 291). Wind directions are graphically illustrated using a wind rose diagram in **Figure 3-1**. Wind data are based upon information supplied by WDAQ from the Hampshire monitoring station, located approximately 26 miles to the east of the Project Area. Data from the station are used by WDAQ for permitting purposes. Average wind speed is approximately 6.8 meters/second (approximately 15 miles/hour) (Rairigh, 2003).

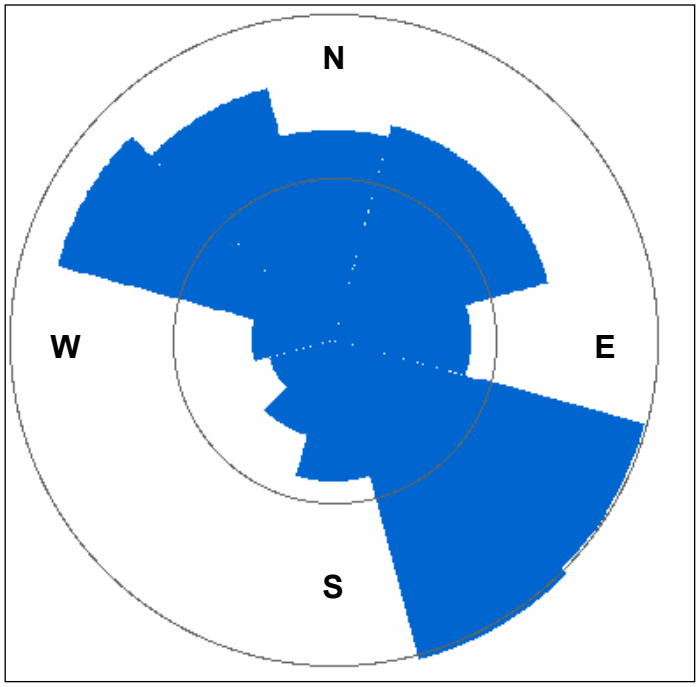
3.4.1.2 Air Quality

Air quality in rural areas is generally very good to excellent. Rural areas lack concentrations of industrial sources and lack emissions associated with concentrations of residences. The Project Area is located in a Class II PSD area and is considered to be in attainment for all criteria pollutants.

Air quality in a given location is defined by pollutant concentrations in the atmosphere and is generally expressed in units of parts per million or micrograms per cubic meter. The level of impacts can be determined by comparing a pollutant's concentration to national or state ambient air quality standards. The WDAQ maintains an extensive network of air quality monitors throughout the state to detect changes in air quality and anticipate issues related to air quality. Some monitors are located to assess ambient air quality while others are located to measure impacts from specific sources. The data are used to determine air quality trends, provide sufficient information to arrest or reverse air quality degradation, and to monitor compliance.

Air quality monitors located near the Project Area are found near Sheridan, Gillette, Arvada, Wright, and 14 miles west of Buffalo. Other monitoring stations are located nearer to the Project Area and are generally source-oriented and are located near coal mining activity (EPA AirData, 2002).

Figure 3-3 Wind Direction Data, Project Area



Regional ambient air quality levels for northeastern Wyoming were estimated for the Powder River Basin Oil and Gas EIS using monitoring data in northeastern Wyoming and southeastern Montana. Estimated background air pollutant concentrations fell well below national and state ambient air quality standards (BLM, 2003, pp. 3-293, 3-294)(see **Table 3-4)**.

Particulate matter, occurring as fugitive dust originating from natural sources, unpaved roads, surface disturbance associated with construction, recreation, and livestock grazing, can be a primary pollutant in rural areas. PM_{10} monitoring data collected near and south of Gillette, north of the Project Area, have exceeded both the WAAQS and the available PSD Class II increment causing concern to EPA Region 8 staff (BLM, 2003, p. 3-298). Sheridan, Wyoming, located approximately 100 miles to the northwest of the Project Area, is considered to be nonattainment for particulate matter (EPA AirData, 2002a). Two PM_{10} monitoring locations, North Rochelle E and the North Rochelle 1, are located approximately one mile east and three miles southeast of the Project Area, respectively, and accumulate PM data reflecting coal mining operations. Data obtained from EPA AirData in March, 2003 indicated that the 24-hour standard for PM_{10} was exceeded nine times during 2002 at these two stations. Subsequent searches of the EPA database (December, 2003) indicate that 24-hour PM_{10} standards were exceeded only three times in

Campbell County, once at the North Rochelle 1 station and twice at the Thunder Basin Coal Black Thunder Mine station (EPA AirData, 2003a).

Table 3-4 Estimated Background Air Pollutant Concentrations and Applicable Ambient Air Quality Standards (µg/m^3)

Pollutant	Averaging Time	Background Concent.	Primary NAAQS [2]	Secondary NAAQS [2]	Wyoming Standards	PSD Increments	
						Class I	Class II
Carbon monoxide	1-hour	3,500 [3]	40,000	40,000	40,000		
	8-hour	1,500	10,000	10,000	10,000		
Nitrogen dioxide	Annual	16.5 [4]	100	100	100	2.5	25
Ozone	1-hour	82 [5]	235	235	235		
	8-hour	130 [5]	157	157	157		
PM_{10}	24-hour	42 [7]	150	150	150	8	30
	Annual	17 [7]	50	50	50	4	17
$PM_{2.5}$	24-hour	19 [7]	65	65	65		
	Annual	7.6 [7]	15	15	15		
Sulfur dioxide	3-hour	8 [6]	--	1,300	1,300	25	512
	24-hour	8 [6]	365	--	260	5	91
	Annual	3 [6]	80	--	60	2	20

Source: Adapted from BLM 2003, p. 3-294
Notes:
[1]Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
[2]Primary standards are designed to protect public health; secondary standards are designed to protect public welfare.
[3]Per Riley Ridge EIS (BLM, 1983)
[4]Data collected in Gillette, WY (1996 - 1997)
[5]Data collected in Pinedale, WY (1992 - 1994)
[6]Data collected at Devil's Tower, WY (1983)
[7]Data collected in Gillette, Wyoming (1999)
Source: (Argonne 2002, p. 4-9)

Despite the discrepancy in the data reported by the EPA, it is apparent that PM_{10} values are sometimes exceeded in the vicinity of coal mines near the Project Area. These exceedances are the results of the operations the stations are intended to monitor, i.e., coal mining operations. CBM operators are aware, however, that construction operations for CBM wells would temporarily add to the PM levels. In order to mitigate adverse impacts of excessive PM emissions, a group of coal mines and CBM operators in the Powder River Basin initiated a program to control dust by developing a dust control plan for the Basin (PAW, 2003). Measures taken by operators include the application of diverse products, including tank bottom crude hydrocarbons, to area roads, and most products have proven to be successful in reducing fugitive dust levels. Results of their efforts are being tracked in a cooperative effort with the WDAQ and US EPA in order to refine and improve area dust control measures.

Formaldehyde emissions in Campbell County were estimated for the year 1996 using state and local HAP inventories, toxic release inventory data, EPA estimate of mobile source emissions, and EPA databases related to its program to reduce HAP emissions. The data indicate that approximately 21 percent of formaldehyde emissions in the county result from the operation of non-road sources, while 75 percent were on-road emissions (EPA AirData, 2002b).

3.4.1.3 Existing Emissions Sources

Pollutant emissions within the region, including the Big Porcupine Project Area, result primarily from conventional oil and gas, CBM, and coal mining operations. These emissions consist primarily of the following:

- Exhaust emissions, CO and NO_x from natural gas fired compressor engines used in production of natural gas and coal bed methane;
- Gasoline and diesel vehicle tailpipe emissions of combustion pollutants, including volatile organic compounds (VOCs), CO, NO_x, PM_{10}, $PM_{2.5}$, and sulfur dioxide SO_2;
- Particulate matter, or dust, generated by vehicle travel on unpaved roads, windblown dust, road sanding during the winter months, and earth-moving activities associated with construction operations;
- Transport of air pollutants from emission sources located outside the region; and
- Particulate matter from coal mines (BLM 2003, p. 3-293).

There are fifteen coal mines along a north-south line that parallels Highway 59, starting north of Gillette, Wyoming and extending south for approximately 75 miles. The two closest coal mines to the project area are the Antelope mine to the southwest and the North Rochelle mine complex to the northeast. Emissions associated with coal mining operations include NO_x, PM_{10}, SO_2, CO and VOCs, emanating from equipment operation and surface disturbance activities.

Currently operating conventional and CBM oil and gas productions facilities emit pollutants in and near the Project Area. Fugitive dust and tailpipe exhaust emissions are generated during operation and maintenance activities. Compressors and dehydration units emit criteria pollutants. Compressor engines also emit formaldehyde.

3.4.1.4 Receptors

The Big Porcupine CBM Project Area is rural and sparsely populated. The Project Area is surrounded by coal mines to the northeast, southeast, and southwest. Potential air receptors in the Big Porcupine Project Area include residences, personnel associated with CBM operations, coal mining personnel, and hunters. The residences in the Project Area include the town of Teckla located in Section 2, T41N, R71W and the Wilkenson Ranch located in Section 26, T42N, R71W. Hunters are temporary and transient users of the area. The nearest PSD Class I and Class II receptor to the Big Porcupine Project Area is the Devils Tower National Monument located approximately 65 miles to the northeast (BLM 2003, p. 296). No air quality monitors are located near the monument (EPA AirData, 2002a).

3.4.2 Regulatory Environment

The Clean Air Act (CAA) in Wyoming is administered by the Wyoming Department of Environmental Quality, Air Quality Division (WDAQ) through the Wyoming Air Quality Standards and Regulations, last updated February 7, 2003.

Ambient air quality standards for the criteria pollutants have been established by the EPA to protect public health and welfare. These standards are the national Ambient Air Quality Standards (NAAQS). Criteria pollutants consist of carbon monoxide (CO), nitrogen oxides (NO_X), sulfur dioxide (SO_2), particulate matter of 10 microns in effective diameter or less (PM_{10}), particulate matter of 2.5 microns in effective diameter or less ($PM_{2.5}$), and ozone. The NAAQS have been adopted by the state of Wyoming, and Wyoming ambient air quality standards are identical to the national standards. They are known as the Wyoming Ambient Air Quality Standards (WAAQS). Wyoming Ambient Air Quality Standards (WAAQSD) and National Ambient Air Quality Standards (NAAQS) are health-based criteria for the maximum acceptable concentrations of air pollutants at all locations to which the public has access.

Ambient air quality in a given location is characterized by comparing the concentration of various pollutants in the atmosphere to the standards set by federal and state agencies. The purpose of these standards is to allow an adequate margin of safety for the protection of public health and welfare from adverse effects resulting from pollutants in the ambient air. The primary pollutants of concern for which federal and state ambient air quality standards have been established include criteria pollutants, hazardous air pollutants (HAPs), and toxic air pollutants. Emissions of criteria pollutants, HAPs and air toxics are regulated by the WDAQ with permits regulating individual emissions sources.

A geographic area that meets or exceeds the limit for a particular pollutant is called a "nonattainment" area. Areas where pollutants are measured below the limits are called "attainment" areas.

Prevention of Significant Deterioration (PSD) regulations limit emissions of pollutants from new sources in attainment areas. In order to implement its policy of non-degradation, the EPA designated types of areas in which certain types of increments of additional pollution would be allowed. Facilities that have the potential to emit more than 100 tons per year, if it is a new source on a federally defined list of 28 source types, or 250 tons per year, if it is a new source not on the list, of any criteria pollutant are subject to the PSD requirements and would be required to undergo a regulatory PSD Increment Consumption analysis under the federal New Source Review permitting regulations.

The National Emission Standards for Hazardous Air Pollutants (NESHAPs) are designed to protect human health and the environment by reducing toxic air emissions. The underlying authority for NESHAP is Title III of the Clean Air Act Amendments of 1990 (CAAA-90), which established a listing of HAPs. Title III of the CAAA-90 specified requirements for the EPA to identify those source categories that emit, or have the potential to emit, one or more HAPs. For each source category identified, EPA was directed to promulgate NESHAPs using standards that are modeled on the best practices and most effective emission reduction methodologies in use at the affected facilities. Threshold quantities determine application of various requirements or exemption from those requirements. The WDAQ has yet to establish HAPs standards (BLM, 2003, p. 4-380). Gas-fired engines associated with compressor operations emit formaldehyde, a toxic air pollutant.

Air Quality Related Values (AQRVs), including the potential air pollutant effects on visibility and the acidification of lakes and streams, are applied to PSD Class I and sensitive Class II areas. The land management agency responsible for the Class I area sets a level of acceptable change for each AQRV. The AQRVs reflect the land management agency's policy and are not legally enforceable standards. Class I areas include federal lands such as national parks, national wilderness areas, and national monuments. These areas are granted special air quality protections under Section 162(a) of the federal CAA. Class II areas generally allow additional, well-controlled growth except where otherwise restricted, as in the case of a Class II wilderness area.

Visibility can be defined as the distance one can see and the ability to perceive color, contrast, and detail. Fine particulate matter ($PM_{2.5}$) is the main cause of visibility impairment. Materials produced from combustion processes or secondary formation in the atmosphere, by photochemical processes, tend to make up the majority of $PM_{2.5}$ samples. Visual range, one of several ways to express visibility, is the furthest distance a person can see a landscape feature. Maximum visual range in the western United States is about 140 miles.

3.4.3 Environmental Consequences

Air quality impacts from the implementation of the Big Porcupine CBM Proposed Action would occur during construction and CBM production. Actual air quality impacts depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions such as wind speed and direction, precipitation, relative humidity, etc. (BLM 2003, page 379).

Impacts to air quality are limited by state and federal regulations, standards, and implementation plans established under the CAA and administered by the WDAQ. Air quality regulations require proposed new air pollutant emissions sources, including CBM compression facilities, to undergo a permitting review before their construction can begin. Thus, the WDAQ would have the primary authority and responsibility to review permit applications and require emissions permits, fees, and control devices prior to construction and/or operation. Under the CAA, federal agencies cannot authorize any activity that does not comply with applicable local, state, and federal air quality laws, statutes, regulations, standards, and implementation plans. The significance criteria for potential air quality impacts include these legal requirements, which are enforced to ensure air pollutant concentrations will remain within specific allowable levels. Where legal limits have not been established, federal agencies use the best available scientific information to identify thresholds of impacts.

3.4.3.1 The Proposed Action

Impacts to air quality are discussed in the following sections in terms of emissions that are most commonly generated during construction activities and operation and maintenance activities.

Construction Impacts

Impacts to air quality resulting from construction consist primarily of PM and exhaust emissions. Construction emissions would also result from well drilling, well completion, and testing. During well completion testing, natural gas may be flared and exhausted. Since the burned natural gas is "sweet" (does not contain sulfur compounds), no objectionable odors are likely to occur. Maximum air pollutant emissions from each well would be temporary (i.e., occurring during a limited construction period) and would not interact with emissions from adjacent well locations.

Typical emissions associated with CBM construction activities are estimated on a per well basis in **Table 3-5**. The estimates for PM_{10} in the table below include particulate emissions from machinery operation.

Table 3-5 Typical Emissions Associated with CBM Development

Construction	Emissions (lb/well)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOCs
Well site construction						
Improved Road	18	3	NA	NA	NA	NA
Two-track Road	7.3	1	4.2	0.4	0.9	0.2
Well Site	3.6	0	6	0.8	0.2	0.6
Pipeline	7.8	1	10	0.9	3.5	0.7
Compressor Site	142	19	197	20	57	21
Pipeline	392.1	56	234.3	22.1	85.3	19.1
Drilling and completion operations						
Drilling	31	NA	453	29	98	37
Completion & Testing	100	NA	1403	93	302	114

Source: Adapted from Argonne 2002, pp.s B-76 and 77

Fugitive Dust Emissions

Air quality impacts would result from fugitive dust arising from earth work during site preparation and construction. Road and well site construction would be conducted in various locations throughout the Project Area during different time periods. Therefore, emissions of fugitive dust would not be continuous from a stationary location.

Fugitive dust emissions from vehicles on unpaved roads are calculated from the following formula, which is used in EPA emissions estimate methodology (USDI BLM 2003, Appendix F, page F11; AP-42, Section 3.13.2):

$$\left(E\left[\frac{lb}{VMT}\right]\right) = 5.9 \times k \times \left(\frac{s}{12}\right) \times \left(\frac{S}{30}\right) \times \left(\frac{W}{3}\right)^{0.7} \times \left(\frac{w}{4}\right)^{0.5} \times \left(\frac{365-p}{365}\right)$$

"E" represents emissions of PM.

VMT = Vehicle mile traveled; highest use estimated as 120 per day
k = particle size multiplier; 0.36 for PM_{10}
s = road silt content; 12 percent for a rural dirt road
S = average vehicle speed; 40 mph
W = vehicle weight; 3 tons for projected vehicles
w = number of wheels; 4 wheels for project vehicles
p = number of days with more than 0.01 inches of precipitation; 100 for the expanded project area

The expected fugitive PM emission factor would be 2.05 lbs/ VMT.

The assumptions used to estimate PM emissions associated with vehicle traffic are described below:

- Vehicle miles traveled would be greatest during the 18-month (540 days) construction period; therefore vehicle miles traveled are estimated for the highest expected use.
- To drill and complete 226 wells in 18 months, it is assumed that three drilling rigs would be required.
- Each drilling rig would require the use of eight vehicles, each making one roundtrip to the well location per day.
- To estimate the average number of miles associated with each roundtrip, the Big Porcupine project was separated into three areas based on general distance from paved roads. The distance to five locations and the longest unpaved route were measured in each section using Arcview software. The average distance in each section was weighted according to the relative number of wells to determine an average route length on unpaved roads. The average route length was determined to be 5.0 miles per roundtrip.
- Three drilling rigs, each requiring eight vehicle trips at five miles per roundtrip each, would require 120 vehicle miles per day (3x8x5=120=VMT).

The estimated average daily PM_{10} emissions from vehicles during the construction phase would be 246 pounds or 0.123 tons. These emissions would occur throughout the Project Area. Watering of roads would be required during the construction phase. Based on information in AP-42 PRB FEIS (BLM 2003, Appendix F, page F11; AP-42, Section 3.13.2), approximately 70% control efficiency would be achieved by watering the roads. After considering the emissions reductions achieved by watering roads, the expected fugitive PM emission would be approximately 74 pounds or 0.04 tons of PM_{10} per day. Assuming 540 days of construction, the total PM_{10} emissions from this phase of operation would be 19.9 tons. The results can be described as conservative because the emissions factor used in the calculations may be high. Actual vehicle speeds on unpaved roads would likely be less than the assumed 40 miles per hour, further reducing actual dust emissions.

Maximum potential near-field particulate matter emissions from traffic on unpaved roads and from well site construction were used to predict the maximum annual and 24-hour average impacts from PM_{10} during the development of the PRB O&G FEIS. Potential impacts were predicted using the EPA CALPUFF dispersion model (BLM 2003, Appendix F, page F9). The potential near-field impacts to air quality resulting from full CBM development in the PRB were

described in Table 4-89 of the PRB O&G FEIS (page 4-384). The results of the model indicate that maximum near-field direct PM_{10} concentrations are expected to be below the PSD Class I increment (BLM 2003, Appendix F, page F16). The Big Porcupine CBM Project represents an incremental amount of development within the overall scope of development modeled for the PRB O&G FEIS. Near-field impacts resulting from the development of the Proposed Big Porcupine CBM Project wells are expected to be consistent with those impacts estimated for the PRB O&G Project.

Fugitive dust generated by vehicles at a given location would be localized and short-term. Fugitive dust emissions from the proposed project are not anticipated to add to the PM_{10} values measured at nearby monitoring sites that track PM values in the area. Prevailing winds from the southeast would carry dust particles away from the monitoring stations located near the closest coal mines; however, winds from the northwest may carry some PM toward mining operations during the construction period. Fugitive dust emissions would also occur from wind blown erosion, however, these impacts would be negligible.

Exhaust Emissions

During construction, temporary and localized increases in atmospheric concentrations of NO_2, CO, SO_2, VOCs, and PM would result from exhaust emissions of worker's vehicles, heavy construction vehicles, and other machinery, equipment and tools. Diesel fueled vehicles may also emit SO_x . These emissions are expected to be so small that the impact is not quantifiable.

The EPA regulates vehicle exhaust emissions through the implementation of standards for new vehicles. States may also impose vehicle emissions testing programs for vehicles registered in their state.

Vehicle exhaust emissions can be estimated for NO_x using the equation:

$$E = \frac{\left(1.5\frac{gm}{mile}\right)\times\left(VMT\frac{miles}{day}\right)}{\left(454\frac{gm}{lb}\right)}$$

"E" represents NO_x emissions in pounds/day

The assumptions used to estimate NO_x emissions associated with vehicle traffic are described below and are consistent with the assumptions used to estimate PM emissions:

- Vehicle miles traveled would be greatest during the 18 month construction period; therefore vehicle miles traveled will be estimated for the highest expected use.
- Three drilling rigs, each requiring eight vehicle trips at five miles per roundtrip each, would require 120 vehicle miles per day (3x8x5=120=VMT).

- The NO_x emission factor of 1.5 gm NO_x per vehicle mile for project vehicles is taken from PRB FEIS (USDI BLM 2003, AP-42, Volume II, Table I.18; See also "*Wyodak CBM Project Air Quality Impact Analysis*" pages 5-14 through 5-21.)

Calculation of the emissions using EPA methodology and a NO_x emission factor of 1.5 gm NO_x per vehicle mile results in an estimated 0.4 lbs. of NO_x produced per day, or about 0.0002 tons per day. These emissions would be distributed over the Project Area. These emissions estimates represent highest expected road use days. Exhaust emissions from drill rigs and other construction equipment would be short term and localized. Mitigation measures other than compliance with federal and state vehicle emissions regulations are not needed for the small amounts estimated.

Operational Impacts

Impacts to air quality from operational activities include emissions from well production equipment, compression engine exhausts, fugitive dust emissions, and vehicle exhaust emissions. Well production equipment can result in emissions from dehydrators, emissions from generators, and flashing losses at production tanks.

PM Emissions

Road use following the construction phase would be limited to the occasional recreation user and periodic maintenance activities. Control and monitoring of well production by radio telemetry would typically result in weekly or bi-weekly visits to wells by maintenance personnel. Fugitive dust generated by vehicles at a given location would be localized, short-term, and extremely small.

Exhaust Emissions

Vehicle miles traveled would likely be much lower during the operation period than during construction. Control and monitoring of well production by radio telemetry would typically result in weekly or bi-weekly visits to wells by maintenance personnel. Exhaust emissions generated by vehicle use would be localized, short-term, and extremely small.

Generator Emissions

Project power would be supplied by an electric distribution system. Generators would not be used, and therefore, no emissions from generators would result.

Fugitive Emissions from Wells

Fugitive emissions from wells would be minimal and would only occur during construction. Fugitive emissions from wells are not regulated by WDEQ and were not quantified.

Dehydrator Emissions

Glycol dehydration units would be installed at the second and third stage compressor site. The dehydration units would be used to reduce the water in the gas stream to acceptable levels for pipeline transmission. The units would have a design flow rate that would accommodate the compression capacity of the station. Extracted water vapor would be vented. Other emissions associated with dehydrator operation include NO_x, VOCs, CO, and HAPs consisting mainly of benzene. Dehydration units would be installed after permitting requirements with the WDEQ are satisfied. Potential emissions would be based upon permitted emissions limits. Limits could include maximum pumping rate, fuel consumption, and natural gas throughput. Emissions would be quantified using the Gly-Calc estimation program with respect to specific equipment data. Emissions associated with project dehydration units were not estimated.

Flashing Losses

Flashing losses occur at a well site when hydrocarbon liquids are produced into an unpressurized stock tank. The pressure differential between that of the producing formation and that at the surface (atmospheric pressure) results in the offgassing of some of the produced liquid hydrocarbons. The amount of liquids that are volatized corresponds to the amount of the pressure differential and the volume of liquid hydrocarbons produced. Project CBM wells are not expected to produce measurable or marketable amounts of liquid hydrocarbons. Hydrocarbon separation equipment would not be installed at the well sites. No stock tanks would be located at the well sites. No pipelines would be installed to transport liquid hydrocarbons.

Compressor Emissions

The Proposed Action includes five 1st-stage compressor stations and one 2nd and 3rd stage compressor station. Each of the 1st-stage compressor stations would have between one and six 350 to 800 HP engines. The largest single emission source associated with the Proposed Action would be from the 2nd and 3rd stage compressor station. The 2nd and 3rd stage compressor station would have between one and six 1,650 HP reciprocating engines. Operation of the compressors would generate emissions of NO_x, CO, VOCs, and formaldehyde (CH_2O). Emissions of SO_2, PM_{10}, and $PM_{2.5}$ would be relatively negligible because the engines would burn natural gas. Actual emissions would vary according to the number and types of compressors installed.

Formaldehyde emissions for a 2nd and 3rd stage compressor station as discussed in the Powder River Basin Oil and Gas EIS were modeled at 11.9 $\mu g/m^3$, falling within a range (4.5 to 71 $\mu g/m^3$) of acceptable ambient concentration threshold levels established by other states (BLM, 2002, p. 4-380). The maximum formaldehyde concentration was predicted to occur at 85 meters (less than 300 feet) from a compressor station. As the distance from the station increases, the predicted concentration decreases rapidly. The incremental cancer risk for the maximum exposed individual (MEI), who was assumed to be a compressor station worker, was calculated to be 2.2×10^{-6} and was near the lower end of the 1 to 100 $\times 10^{-6}$ threshold. The MEI cancer risk

would fall below this threshold at 460 meters. Therefore, adverse impacts resulting from inhalation of formaldehyde are expected to be minimal.

Table 3-6 lists potential emissions associated with the 1st-stage compressor stations and the 2nd and 3rd stage compressor station. The calculations assumed that the maximum number of engines would be installed at each station. The compressor stations would be permitted in accordance with WDEQ regulations. Enforcement of permit requirements is assumed by the state. Emissions from the compressor stations would not trigger a major source designation.

Mitigation Measures

Several mitigation measures were identified in the Powder River Basin Oil and Gas EIS, in addition to those carried forward into that document from the Wyodak FEIS and ROD and the Wyodak Drainage EA and Decision Notice, which can be applied by the FS (BLM, 2003, pp. 4-404 to 4-405).

Watering or other dust control techniques would reduce fugitive dust emissions from traffic on un-paved roads. Watering of access roads or other dust control techniques would occur as needed or required by the Forest Service, state and/or county both during the construction and operation phases of the project. Imposing reduced speed limits on unpaved roads would also decrease fugitive dust emissions from vehicle traffic.

3.4.3.2 The No Action Alternative

Should the federal action be denied, air emissions associated with construction and operation activities associated with the Big Porcupine Project would not occur.

The air emission impacts associated with existing CBM operations, coal mines, and transportation corridors, would still be present. As indicated in the Argonne Laboratory's Air Impact Assessment (2002), the emissions from the coal mines in the project area will increase as mining activities move into and expand over the project area. Emissions of VOCs may actually increase as the coal mine migrates into the Project Area and the coal bed methane is not captured prior to surface mining. The CBM may be vented to the atmosphere if the Big Porcupine CBM Proposed Action were not implemented. Therefore, if the Big Porcupine Project were not implemented, the coal mines would continue to be air pollutant emissions sources.

Table 3-6 Potential Annual Emissions for Big Porcupine Compressor Stations

Compressor Station	# Engines	HP Rating	Yearly Hours of Operation	Emission Factor (g/HP-hr)		Emissions (tons/year)		Emission Factor (g/HP-hr)		Emissions (tons/year)	
				NO_x	CO	NO_x	CO	CH_2O	VOC	CH_2O	VOC
Single 1st-stage station	6	800	8,760	1*	0.5**	46.3	23.2	0.06***	0.5	2.8	23.2
Total of Five 1st-stage stations						231.5	116.0			14.0	116.0
2nd and 3rd stage	6	1,650	8,760	1*	0.5**	95.5	47.8	0.06***	0.5	5.7	47.8
Total Project Compressor Emissions						327.0	163.8			19.7	163.8

* The estimated maximum emission that would be allowed in the permit by Wyoming DEQ is 1 g/Hp-hr.
** The estimated maximum emission that would be allowed in the permit by Wyoming DEQ is 0.5 g/Hp-hr because the engine probably would be required to have an oxidation catalyst.
*** The estimated maximum emission that would be allowed in the permit by Wyoming DEQ is 0.06 g/Hp-hr because the engine probably would be required to have an oxidation catalyst.

3.4.3.3 Comparison of Alternatives

Table 3-7: Summary of Direct and Indirect Effects on Air Quality by Alternative

	Proposed Action	No Action
Compressors	Each 1st stage compressor station would generate 46.3 TPY NO_x, 23.2 TPY each of CO and VOCs, and 2.8 TPY CH_2O. The 2nd and 3rd stage compressor station would generate 95.5 TPY NO_x, 47.8 TPY each of CO and VOCs, and 5.7 TPY CH_2O. Total potential emissions that could be generated on an annual basis include 327 TPY NO_x, 163.8 TPY, CO and VOCs, and 19.7 TPY CH_2O.	No new compressors would be built, therefore, no additional emissions from compressors would occur
Generators	No new generators would be constructed; therefore, no additional emissions from generators would occur. Wells would utilize line power from existing infrastructure.	No new generators would be built, therefore, no additional emissions from generators would occur.
Fugitive Emissions from Wells	Fugitive emissions from wells would be minimal and would only occur during construction. Fugitive emissions from wells are not regulated by WDEQ and were not quantified.	No new fugitive emissions from wells would occur.
Fugitive Dust (PM_{10})	74 pounds (0.04 tons) of PM_{10} emissions per day are estimated to occur during the construction period from vehicle traffic on new and existing unpaved roads. This represents a conservative estimate during the highest use days. Actual emissions would definitely be lower after the construction phase is completed.	Slight increases in traffic on existing roads may occur as trends in recreation use change over the years yielding slight increases in fugitive dust emissions.
Vehicle Exhaust	0.42 pounds of NO_x (0.0002 tons) emissions per day are estimated to occur during the construction period from vehicle traffic on new and existing roads. This represents a conservative estimate during the highest use days. Actual emissions would definitely be lower after the construction phase is completed.	Slight increases in traffic on existing roads may occur as trends in recreation use change over the years yielding slight increases in vehicle exhaust emissions.
Dehydrator Emissions	Dehydrator emissions would result from dehydrators located at the 2nd and 3rd stage compressor station. Their emissions would be regulated by the WDEQ.	There would be no emissions from dehydrators.
Flashing Losses	No flashing losses are expected to occur. Liquid hydrocarbons would not be produced from project wells.	No liquid hydrocarbons would be produced. No flashing losses would occur.

3.5 SOILS

3.5.1 Affected Environment

Soils in the Project Area are developing in mostly residuum of the nearly level to gently sloping (0-6 percent) upland high plains that dominate the Project Area, and in alluvium of the gently sloping drainage bottoms (NRCS, 1998, GIS maps). Approximately 50 soil units have been mapped by the NRCS in the Project Area (NRCS, 1998, GIS maps) (**Appendix K**). The upland plains are dissected by the ephemeral Porcupine Creek and its tributaries and are broken in places with low, red-colored, clinker-capped buttes and hills. Slopes up to 45 percent are located in small areas associated with these buttes and hills and in local, more heavily dissected valley sides and stream banks. Also present in the upland plains landscape are a number of internally-drained playas. Sandstones, siltstones, mudstones, and shales of the Wasatch Formation and upper Fort Union Formation are the principal parent materials.

The dominant soils of the upland plains are predominantly sandy loam to loam/clay loam surface soils or topsoils over loam to clay loam, to clay subsoils, respectively, that are moderately deep to deep, well-drained, and nearly level to gently sloping (1 to 6 percent) (**Table 3-8**) (NRCS, 1998). Soils of the dissected valley sides and upland buttes and hills are mostly sandy loams to loams over loams to clay loams to clays, respectively, exhibiting soil depths (soil thickness over bedrock) that are shallow (0-20 inches to bedrock) to moderately deep (20-40 inches to bedrock), well-drained, and gently sloping to steep (6-45 percent). The alluvial drainage bottoms of Porcupine Creek are occupied by loams to clay loams over clay loams to clay that are deep (40 to 60 inches to bedrock), well drained, and nearly level to gently sloping (0-6 percent). Soils of most of the playa bottoms within the Project Area are not differentiated from soils of the adjacent landscapes, and therefore do not necessarily elicit characteristics representative of confined evaporation conditions, such as elevated salt and sodium levels.

The potential for high/severe water erosion hazard is limited to the mostly moderately deep to shallow soils of the steeper valley sides, buttes, and hills. Approximately 290 acres of the 17,940-acre Project Area (1.6 percent) could, if disturbed and not stabilized with proper mitigation measures, be subject to accelerated rates of water erosion. Factors contributing to high water erosion hazards are slope, soil erodibility factor (k-factor), and soil permeability (rate of water infiltration) (BLM, 2003, p. 3-82; and Appendix K). The potential for severe wind erosion hazard within the Project Area following soil disturbance (BLM, 2003, p. 3-81, Appendix K) is limited to a single soil map unit of 114 acres (0.6 percent of the Project Area). The remaining 97.8 percent of the Project Area would be subject to slight to moderate potentials for accelerated water and wind erosion if disturbed.

Deep, saline and sodic soils occupy approximately 902 acres (5.0 percent of the Project Area) in alluvial bottom lands associated with Porcupine Creek and one of its tributaries in the proposed Wilkerson Reservoir area. These soils have elevated salinity and sodic (SAR) levels in subsoil horizons below the topsoil layers (Appendix K). Approximately 4,269 additional acres of heavier textured, clayey soils that are susceptible to accumulating proportionally elevated sodium levels (in comparison to calcium and magnesium levels) in the subsoil and are most likely to exhibit adverse effects on soil conditions occur in the Project Area (BLM 2003, p. 3-86).

Table 3-8 Limiting Factors[1] for Soil Mapping Units in the Project Area

Soil Mapping Unit Symbol	Mapping Unit Name	Slope Range (percent)	Acreage within Project Area	Percentage of Project Area	Depth Class	Water Erosion Hazard	Wind Erosion Hazard	Limitations for Reclamation
102	Arvada, Thick Surface-Arvada-Slickspots Complex	0-6	473	2.68	Deep			High salinity and SAR levels in subsoils
109	Bidman Loam	0-6	92	0.52	Deep			
110	Bidman Loam, Loamy Substratum	0-6	426	2.42	Deep			
111	Bidman-Parmleed Loams	0-6	25	0.14	Deep, Moderately Deep			
113	Bidman-Ulm Loams	0-6	434	2.46	Deep			
116	Cambria-Kishona-Zigweid Loams	0-6	265	1.50	Deep			
121	Cushman-Cambria Loams	0-6	86	0.49	Moderately Deep, Deep			
126	Cushman-Theedle Loams	0-6	47	0.27	Moderately Deep			
129	Decolney-Hiland Sandy Loams	0-6	3,194	18.12	Deep			
130	Decolney-Hiland Sandy Loams	6-15	2	0.01	Deep			
143	Felix Clay, Ponded	0-2	29	0.16	Deep			Clayey, low permeability, high shrink/swell potential
144	Forkwood Loam	0-6	546	3.10	Deep			
145	Forkwood-Cambria Loams	0-6	40	0.23	Deep			
146	Forkwood-Cushman Loams	0-6	33	0.19	Deep			
148	Forkwood-Ulm Loams	0-6	1,083	6.14	Deep			
151	Haverdad Loam	0-3	148	0.84	Deep			
154	Heldt Clay Loam	0-6	56	0.32	Deep			
156	Hiland Fine Sandy Loom	0-6	504	2.86	Deep			
157	Hiland-Bowbac Sandy	0-6	3,242	18.39	Deep,			

Soil Mapping Unit Symbol	Mapping Unit Name	Slope Range (percent)	Acreage within Project Area	Percentage of Project Area	Depth Class	Water Erosion Hazard	Wind Erosion Hazard	Limitations for Reclamation
	Loams				Moderately Deep			
158	Hiland-Bowbac Sandy Loams	6-15	202	1.15	Deep, Moderately Deep			
159	Hiland-Vonalee Sandy Loams	0-6	1,262	7.16	Deep			
160			80	0.45				
169	Julesburg Sandy Loam	0-6	24	0.14	Deep			
171	Keeline-Tullock-Niobrara Complex	3-30	114	0.65	Deep, Moderately Deep, Shallow		X	Slope, shallow soil, severe wind erosion hazard
172	Keyner Fine Sandy Loam	0-6	429	2.43	Deep			
177	Maysdorf Fine Sandy Loam	0-6	65	0.37	Deep			
178	Maysdorf Sandy Clay Loam	0-6	27	0.15	Deep			
179	Maysdorf-Pugsley Complex	0-6	106	0.60	Deep, Moderately Deep			
180	Maysdorf-Pugsley Sandy Loams	6-15	54	0.31	Deep, Moderately Deep			
193	Pugsley-Decolney Sandy Loams	0-6	24	0.14	Moderately Deep, Deep			
199	Renohill-Savageton Clay Loams	0-6	30	0.17	Moderately Deep			
201	Renohill-Shingle-Worf Complex	3-15	43	0.24	Moderately Deep, Shallow			Slope, shallow soils, moderate water erosion hazard, low permeability, high shrink/swell potential
205	Samday-Savageton Clay Loams	3-15	111	0.63	Shallow, Moderately Deep			Slope, shallow soils, moderate water erosion hazard, low permeability, high shrink/swell potential
206	Samday-Shingle-Rock	10-45	31	0.18	Shallow	X		Slope, shallow soils, high

Soil Mapping Unit Symbol	Mapping Unit Name	Slope Range (percent)	Acreage within Project Area	Percentage of Project Area	Depth Class	Water Erosion Hazard	Wind Erosion Hazard	Limitations for Reclamation
	Outcrop Complex							water erosion hazard, low permeability, high shrink/swell potential
208	Savageton-Silhouette Clay Loams	0-6	409	2.32	Moderately Deep, Deep			
209	Savageton-Silhouette Clay Loams	6-15	22	0.12	Moderately Deep, Deep	X		Slope, moderately deep soils, high water erosion hazard, low permeability, high shrink/swell potential
214	Theedle-Kishona Loams	0-6	220	1.25	Moderately Deep, Deep			
215	Theedle-Kishona Loams	6-20	799	4.53	Moderately Deep, Deep			
216	Theedle-Kishona-Shingle Loams	3-30	21	0.12	Moderately Deep, Deep	X		Slope, shallow soils, high water erosion hazard
217	Theedle-Shingle Loams	3-30	108	0.61	Moderately Deep, Shallow	X		Slope, shallow soils, high water erosion hazard
221	Turnercrest-Keeline-Taluce Sandy Loams	6-30	101	0.57	Moderately Deep, Deep, Shallow			Slope, shallow soils, moderate water erosion hazard
226	Ulm Loam	0-6	69	0.39	Deep			
227	Ulm Clay Loam	0-6	352	2.00	Deep			
228	Ulm-Renohill Complex	0-6	959	5.44	Deep, Moderately Deep			
233	Ustic Torriorthents, Gullied		108	0.61		X		
235	Vonalee Sandy Loam	0-10	93	0.53	Deep			
236	Vonalee-Terro Sandy Loams	2-10	940	5.33	Deep, Moderately Deep			
246	Wyarno-Ulm Clay Loams	0-6	98	0.56	Deep			
			17,626	100.00				

[1]Determination of limiting factors was based on evaluation of soils characteristics within upper 6 inches of topsoil and/or upper subsoil combination (**Appendix K**). The most restrictive value representing soil materials present in the upper 6 inches was used in characterizing the limiting factor for the soil mapping unit.

Accumulation of sodium and the elevation of SAR levels in these soils could adversely affect vegetative productivity, should high SAR waters be added over time. Clayey soils, particularly clayey soils whose clay fraction is comprised mostly of swelling, smectitic clay minerals, are also more susceptible to shrink-swell action and compaction that can affect a soil's ability to support construction and long-term operations of a facility. Compaction can adversely affect revegetation and associated reclamation potential (BLM 2003, p. 3-82).

Approximately 1,053 acres of soils exhibit individual or combinations of characteristics that may pose difficulties to successful revegetation efforts. These soils occupy the steeper buttes and hills and saline and sodic bottom lands in the Project Area. Factors which would reduce revegetation success capability include:

- Steeper slopes and higher k-factor,
- Shallower soil depths, resulting in insufficient soil material to provide physical support, nutrients, and moisture for plants,
- Higher shrink/swell potential (higher content of smectitic clay minerals),
- Higher compaction susceptibility, in which soil peds are insufficiently separated to allow air and moisture to penetrate into the soil,
- Lower permeability, and
- Elevated salinity and SAR levels in the subsoil (BLM 2003, pp. 3-82, 3-85, and 3-86).

Such conditions can prevent a disturbed soil from achieving a stable post-disturbance state. Soils which are assessed as posing potential difficulties to achieving successful revegetation are identified in **Table 3-8**.

Soils in the Project Area support vegetation/forage for livestock grazing and wildlife habitat. They have been disturbed by construction and operation of roads, railroad tracks, oil and gas wells, pipelines, electrical power lines and substations, and coal mine sediment- and water-control impoundments. Current soil productivity varies depending on local factors such as soil depth, texture, slope, topographic aspect, and permeability in combination with grazing pressure and precipitation.

3.5.2 Regulatory Environment

Laws and regulations dealing with management and protection of soils include:

- Forest and Rangeland Renewable Resources Planning Act of 1974 (16 USC 1601-1610).
- National Forest Management Act of 1976, as amended (16 USC 1600 et seq., 36 CFR 219.6).
- USFS Manual 2550.

3.5.3 Regulatory Status

Management of soil resources within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement (USFS, 2001) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a).

Recommended mitigation measures relating to soils are also discussed in the Powder River Basin Oil and Gas FEIS (BLM, 2003, pp. 4-135 to 4-149) and these measures would be applied, where appropriate or as required by the USFS.

3.5.4 Environmental Consequences

Soil-related issues raised during scoping included:

- Potential for Project implementation to accelerate rates of soil erosion.
- Potential for soils in the Project Area to be adversely affected by the discharge and disposal of high sodium water from coal bed natural gas well production.
- Potential for successful reclamation of disturbed soils/lands.

3.5.4.1 The Proposed Action

Direct and Indirect Impacts

Implementation of the Proposed Action would result in disturbance to soils from construction or roads, compressor stations, pipelines, water discharge pipelines, electrical utilities, and well sites. Anticipated impacts are:

- Clearing or mowing of protective vegetative cover at well sites and along pipeline and utilities corridors resulting in increased potential for accelerated soil erosion.
- Compaction of soils and damage to protective vegetative cover by initial and continuing use of two-track roads and well sites, and by construction of pipelines and buried and overhead electrical utility lines.
- Burial and loss of productivity beneath new compressor facilities and the all-season, graveled roads and associated parking areas adjacent to the facilities.
- Mixing of soil materials by gas pipeline, water pipeline, and electrical line underground installation, and by excavation of water reserve pits at each well site.

Total maximum, short-term soil disturbance would be approximately 938 acres (647 federal, USFS-administered surface acres, 81 State of Wyoming surface acres, and 209 acres of private surface)(**Table 2-7**). Following near-term, post-construction reclamation of those disturbed areas and soils no longer subject to continuing use and disturbance, remaining long-term surface disturbance would total approximately 114 acres (72 USFS-federal, 14State, and 28 private) (**Table 2-7**). The long-term use of roads, well sites, and compressor stations would make up over 90 percent of the remaining 114 acres of disturbance. At the end of the Project, as required

by the USFS, some Project-constructed roads that are not required for continuing USFS-management purposes would be reclaimed as part of decommissioning.

Erosion Hazard. Project implementation would disturb in the short-term approximately 938 acres of soils, including totals of approximately 8.3 (7.3 federal) and 7.8 (7.2 federal) acres of soils posing high water and severe wind erosion potentials and hazards, respectively (**Table 3-9**). These acreages of soils susceptible to water and wind erosion hazards represent 0.5 (0.6 federal) and 0.4 (0.6 federal) percent of the total disturbance acreage (647-acre total disturbance of federal surface) for the Project, respectively.

Table 3-9 Disturbance of Sensitive Soil Types by Surface Ownership, Proposed Action

Soil Sensitivity	Short-Term Disturbance (Acres)				Long-Term Disturbance (Acres)			
	Federal	State	Private	Total	Federal	State	Private	Total
High Water Erosion Hazard	7.3	0.0	1.0	8.3	1.7	0.0	0.0	1.7
Severe Wind Erosion Hazard	7.2	0.0	0.5	7.8	0.1	0.0	0.1	0.3
Potential Limiting SAR Soil Levels (Sodic Soils)	34.1	15.4	13.9	63.3	4.1	5.6	0.6	10.3
Potential Limiting Reclamation Factors	43.9	1.8	12.0	57.8	5.3	0.3	1.5	7.2

Source: NRCS SSURGO soils data. New roads include upgrades. Rounding issues may affect totals.

Application of interim reclamation measures specified in the mitigation measures listed in Chapter 2 and those measures detailed in **Appendix C** would minimize soil loss due to accelerated erosion. Completed on-site inspections for the proposed wells and ancillary road, pipeline, utilities, and compressor facilities have finalized locations for all facilities with consideration for minimizing soil loss from Project implementation.

Following successful reclamation/revegetation of those disturbed lands to be reclaimed shortly after construction, well drilling, and completion operations are complete, remaining long-term disturbance to these soils posing water and wind erosion hazards would total approximately 1.7 (1.7 federal) and 0.3 (0.1) acres, respectively (**Table 3-9**). These acreages of soils susceptible to water and wind erosion hazards represent approximately 0.1 and less than 0.1 percent of the 938-acre total disturbance (647 acres total federal disturbance) for the Project, respectively. Accelerated soil erosion beneath the long-term facilities and graveled surfaces are expected to be minimal due to the protection provided to soils by the facilities and gravel-armored surfaces. Application of mitigation measures listed in Chapter 2 and those measures detailed in **Appendix C** would minimize soil loss due to accelerated erosion at the time of Project decommissioning.

Sodic Soils (Elevated SAR Levels). Project implementation would disturb in the short-term approximately 63.3 (34.1 federal) acres of soils with elevated SAR values in the near-surface soil layer(s) (topsoil and upper subsoil) to a minimum depth of six inches (**Table 3-9**). The highest

reported salinity levels of 4 mmhos per centimeter or less, as indicated by electrical conductivity measurements, for the soils in the Project Area (**Appendix K**) is considered slightly saline (BLM, 2003, p. 3-86) and would pose little if any limitations on soil conditions or re-establishment of vegetation during reclamation. The acreage for elevated SAR levels in the near-surface soil layers represents 6.7 (5.2 federal) percent of the 938-acre total disturbance (647 acres total federal disturbance) for the Project, respectively.

SAR levels in these soils may likely be posing some limitations on soil conditions and adverse impacts to vegetative productivity. As the Proposed Action would not involve the addition of high SAR waters to these soils or to any other soils in the Project Area, including the more susceptible clayey soils (20.7 percent of the 938-acre total project disturbance) (**Appendix K**), the coal bed natural gas development would not cause any additional increases in the soils' SAR levels. The piped or channelized discharges of produced waters in the Project Area would be confined to established ephemeral stream channels. No other discharge or disposal methods or irrigation are proposed. In addition, the SAR levels of the produced water in the Project Area based on sampling in the area range from 5.2 to 6.3, as indicated in Section 3-3. These values are considered low, and if they were to be added to soils with elevated SAR levels (**Table 3-8**, **Appendix K**), the produced waters would not increase current levels.

Direct discharge of produced waters into drainages would also avoid any addition of salts present in the produced waters to upland soils. Although no impacts to sodic-affected soils are expected from the Proposed Action, treatments for affected soils exist. These involve the incorporation of soil amendments, including various sources of soluble calcium, to reduce the potential from sodium ion toxicity on plant growth. Additional effects include mitigation of the deterioration of soil structure caused by slaking and the swelling and dispersion of clays in the soils resulting from excess exchangeable sodium relative to magnesium and potassium (BLM, 2003, p. 4-148).

Following successful reclamation/revegetation of those disturbed lands to be reclaimed shortly after construction, well drilling, and completion operations are complete, remaining long-term disturbance to soils with elevated salinity and/or SAR levels would total approximately 10.3 (4.1 federal) acres (**Table 3-9**). These salt/SAR-affected soil acreages represent 1.1 (0.6 federal) percent of the 938-acre total disturbance acreage (647 acres total federal disturbance) for the Project, respectively. Application of mitigation measures listed in Chapter 2 and those measures detailed in **Appendix C** would optimize re-establishment of protective vegetation in these soils at the time of Project decommissioning.

High Shrink/Swell and Compaction-Prone Soils. Other than the 2nd and 3rd stage compressor station, significant surface facilities would not be constructed as part of this project; therefore the presence of high shrink/swell soils in the Project Area would not adversely impact Project facilities. The 2nd/3rd stage compressor station would be constructed on soils not classified as high shrink/swell (NRCS, 1998). Two of the smaller, five 1st stage compressor stations would be located on high shrink/swell potential soils in the Project): Section 17, T42N, R70W; and Section 13, T42N, R71W. Additional mitigative construction measures may be required at these locations to minimize the potential for damage to facilities due to shrink/swell action in the supporting soil materials beneath the facilities.

Compaction can increase the potential for accelerated water erosion on more sloping soils and reduce soil productivity (vegetation success) in the compacted areas. Such accelerated erosion that could be enhanced by compaction of two-track road ways and pipeline and underground utilities construction would be minimal as most of these heavier soils occupy nearly level to gently sloping topography that is less susceptible to soil loss. Reduced productivity of these soils from the degradation of the plant growth medium in the compacted zone of the soil profile would likely last for the duration of vehicle use of the two-track roads, but would be ameliorated naturally over time by wetting/drying and freeze/thaw cycles over time or by loosening the compacted soil at the time of project decommissioning and abandonment. Compacted soils beneath graveled roads, well sites, and compressor stations would be mechanically loosened (tractor-pulled chisel or ripper) as part of reclamation activities at project decommissioning and abandonment. Any soil compaction that would result from pipeline or utilities construction would be mitigated again by mechanically loosening the affected heavier soils.

Soils with Limited Reclamation Potential. Implementation of the Proposed Action would disturb in the short-term approximately 57.8 (43.9 federal) acres of soils with characteristics that may pose difficulties to successful reclamation/revegetation (**Table 3-9**). This acreage of potentially difficult reclamation/revegetation represents 6.1 (6.8 federal) percent of the 938-acre total disturbance acreage (647 acres total federal disturbance) for the Project, respectively. Application of interim reclamation measures specified in the mitigation measures listed in Chapter 2 and those measures detailed in **Appendix C** would optimize soils stabilization and revegetation of the disturbed lands.

Following successful reclamation/revegetation of those disturbed lands to be reclaimed shortly after construction and well drilling and completion are complete, remaining long-term disturbance to soils posing difficulties to successful reclamation/revegetation would total approximately 7.2 (5.3 federal) acres (**Table 3-9**). These acreages represent 0.8 (0.8 federal) percent of the 938-acre total disturbance acreage (647 acres total federal disturbance) for the Project, respectively. Application of mitigation measures listed in Chapter 2 and those measures detailed in **Appendix C** would optimize re-establishment of protective vegetation in these soils at the time of Project decommissioning.

A summary of disturbance to sensitive soil types is indicated in **Table 3-9**.

Mitigation

Specifications regarding mitigation of soils required by the USFS for approval of CBM operations on the TBNG are detailed in **Appendix C**. The Company would reduce construction-associated disruption by minimizing the width of new roads and co-locating, to the extent feasible, pipelines and buried electrical lines into common utility corridors. Where excavations are necessary, sufficient topsoil to facilitate revegetation would be segregated from subsoils and returned to the surface upon the completion of operations. Where topsoils would be exposed for lengthy periods, the piles would be seeded or otherwise protected to prevent erosion and maintain soil microflora and microfauna.

The Company would prohibit off-road travel by its employees or contractors except in emergency situations. Project-related travel would be minimized to the extent feasible during wet periods when excessive road rutting (rut depths greater than 4 inches) could occur.

No road construction is expected to occur on slopes greater than 8 percent and no surface disturbance or occupancy would occur on slopes in excess of 25 percent. Construction would not occur during periods when the soil is frozen or when watershed damage is likely in the absence of a mitigation plan and approval from the USFS. Headcuts in channels of ephemeral streams used for discharge of produced water would be mitigated per specifications in the Company's Water Management Plan (Independent Production Company, 2002) to reduce erosion effects.

Stabilization and revegetation would occur as soon as practical following disturbance using seed mixes approved by the USFS and/or BLM.

3.5.4.2 The No Action Alternative

Under the No Action Alternative none of the proposed activities would occur on USFS-administered federal lands. Disturbance of soils by coal bed natural gas well drilling and field development would not occur. Disturbances to soils by continuing conventional oil and gas development would occur within the Project Area, and CBM development would continue on state and private lands near the Project Area. Ranching-associated impacts would likely continue at their present magnitude. Soil disturbance from surface coal mining is likely to continue adjacent to and expand within the Project Area for the foreseeable future.

3.6 VEGETATION AND WETLANDS

3.6.1 Affected Environment

3.6.1.1 Vegetation Cover Types

The Project Area occupies a mixed upland prairie grassland and sagebrush shrubland which is common in the Powder River Basin. Analyses of WGFD satellite imagery and Gap Analysis Project data from the University of Wyoming for the PRB O&G FEIS have delineated fourteen vegetation types within the EIS analysis area (BLM, 2003, pp. 3-92 to 3-103). Two of the three dominant cover types comprise nearly 100 percent of the Project Area:

- **Short-grass Prairie** (approximately 75 percent of the Project Area) represents WGFD sparse, very sparse, and thin dry herbaceous rangeland types occurring on drought-prone, mildly alkaline, medium- and fine-textured soils. Shrub growth is inconsistent, and annual precipitation is typically 10-16 inches. The two dominant species are blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*).
- **Sagebrush Shrubland** (approximately 25 percent of the Project Area) comprises sparse, moderately dense, and dense big sagebrush crown and a variety of understory forbs and grasses. Sagebrush shrublands are common throughout the Powder River Basin. Within the TBNG, sage height has been found to vary among low (less than 12 inches, 46

percent), moderate (12-23 inches, 49 percent), and high (over 23 inches, 5 percent) stands (USFS, 2001, p. 3-193). Dominant species may include Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*), silver sagebrush (*Artemisia cana*), and western wheatgrass (*Pascopyrum smithii*).

- **Mixed-grass Prairie** (less than 1 percent of the Project Area) comprises a mixture of low, medium, and high (based on chlorophyll content) herbaceous rangeland types. Common species include western wheatgrass, blue grama, prickly pear cactus (*Opuntia* spp.), and scarlet globemallow (*Sphaeralcea coccinea*).

Bare ground covers less than 1 percent of the Project Area. These data are inherently limited, in that the smallest mapped areas are approximately 30 acres in size.

The coarse scale of available vegetation mapping limits detection of riparian communities typically existing within narrow corridors. In addition to the major types listed above, it is likely that minor occurrences of the following are also located within the Project Area:

- **Herbaceous Riparian** consists of a variety of moist grasses, sedges, and rushes. Common species include woolly sedgy (*Carex lanuginosa*), common spike-rush (*Eleocharis palustris*), foxtail barley (*Hordeum jubatum*), wild licorice (*Glycyrrhiza lepidota*), and Canada goldenrod (*Solidago canadensis*).
- **Shrubby Riparian** consists of certain shrubs and herbaceous species existing in proximity to draws and gullies. Common species include hawthorn (*Crataegus* spp.), peachleaf willow (*Salix amygdaloides*), sandbar willow (*Salix exigua*), silver sagebrush, bluejoint reedgrass (*Calamagrostis canadensis*), and tufted hairgrass (*Deschampsia cespitosa*).

Some agriculture, open water, and disturbed surface types occur very sparsely within the Project Area.

Threatened, endangered, proposed, candidate and sensitive plant species are discussed in Section 3.8.

Existing impacts to vegetation within and adjacent to the Project Area have resulted from surface disturbances associated with ranching, conventional oil and gas development, road and railroad construction, and coal mining. As indicated in Section 3.10 and Table 3-17, the Project Area is covered by all or portions of ten USFS grazing allotments. Cattle and sheep ranching represent the dominant forms of agriculture in the Project vicinity. Ranching activity results in disturbance which has not been quantified (BLM, 2003, p. 3-108).

Conventional oil and gas development has resulted in drilling of 24 producing oil and gas wells within the Project Area. An additional 15 wells have been plugged and abandoned and well pads reclaimed. Assuming an average well pad size of approximately 0.25 acres, conventional oil and gas well locations equate to a long-term surface disturbance of approximately 6 acres. Additional short-term disturbance is associated with reclaimed ROWs of pipelines.

Numerous roads exist within the Project Area, some associated with servicing oil and gas wells or associated facilities. Excluding county-maintained roads, there are approximately 120 miles of existing roads within the project area, most being native-surfaced two track roads. Assuming an average ROW width of 12 feet, this equates to existing road surface disturbance of approximately 175 acres. Dust thrown up by passing vehicles can settle on nearby vegetation, damaging the plants (BLM, 2003, p. 3-108). The western portion of the project area is crossed by 4.6 miles of double track main line of the Burlington Northern/Santa Fe Railroad. Assuming a ROW width of approximately 75 feet, this equates to a surface disturbance of approximately 42 acres.

Surface coal mining activity has begun to impinge upon the Project Area. Active mining for the North Rochelle Mine has progressed onto portions of the Project Area in Sections 9 and 10, T42N, R70W (Daniel, 2003, personal communication). In addition, PRCC has constructed flood control reservoirs within the eastern portion of the Project Area. Approximately 60 acres of these reservoirs are contained within the Project Area boundary.

Finally, suppression of rangeland fires has caused changes in the types of vegetation prevalent in certain portions of the Grassland (BLM, 2003, p. 3-108).

3.6.1.2 Wetlands and Riparian Areas

Within the Project Area, wetlands and riparian areas represents small and isolated, but important ecosystems. Characterized by unique soils, vegetation, and hydrology, they occur as islands in the dominant expanse of high plains sagebrush and grassland communities. These areas represent habitat for plant and animal species which do not exist elsewhere in the Project Area.

Wetlands are areas transitional between strictly terrestrial and aquatic ecosystems. They are classified by the USFWS using the system developed by Cowardin et al.(1979) based upon vegetation, soil, and hydrologic conditions. Wetlands must exhibit all of the following characteristics (BLM, 2003, p.3-109):

1. At least periodically, the land supports hydrophytic vegetation.
2. Substrates are predominantly undrained hydric soils.
3. The substrate is non-soil and either saturated or covered by shallow water annually during the growth season.

Wetlands areas were identified within the Project Area using maps available from the National Wetlands Inventory (NWI) of the USFWS (USFWS, 2003, maps). Digital maps covering five USGS 7.5 minute topographic map sheets (Teckla; Teckla, SW; Piney Canyon, SW; Piney Canyon, NW; and Reno Reservoir) were obtained from the NWI website.

All wetlands within the Project Area are classified as palustrine, which includes all non-tidal wetlands dominated by trees, shrubs, emergents, mosses, or lichens (USFWS, 2003, online data). Wetlands located on the Northern Great Plains typically belong to the palustrine system. Wetlands are found scattered throughout the Project Area. Five wetland types were identified:

- **Emergent, temporarily flooded** (140 acres) wetlands are characterized by erect, rooted, herbaceous hydrophytes other than mosses and lichens. Vegetation is present for most of the growing season and is dominated by perennials. Surface water is present briefly during the growth season, but the water tables are usually significantly below the surface. This type is found throughout the Project Area. Naturally occurring playas, particularly common along the Porcupine Creek / Little Thunder Creek drainage divide, belong to this type. Other occurrences are the result of constructed impoundments.
- **Aquatic bed, semi-permanently flooded** (14 acres) wetlands include those dominated by plants growing in water typically less than two meters deep and which grow below the water surface during most of the growth season. Surface water typically persists during most of the year, and the water table is near surface at all times. In the Project Area, this type is found frequently along Porcupine Creek and associated with local stock ponds.
- **Emergent, seasonally flooded** (7 acres) wetlands are similar to emergent, temporarily flooded, but surface water is present for extended periods, particularly early in the growth season. Surface water is generally absent by the end of the growth season, and depth to the water table may be highly variable. This type is associated with local depressions in ephemeral channels and with stock ponds. It is also common within the channel of Porcupine Creek downstream of the Project Area.
- **Unconsolidated bottom, semi-permanently flooded** (3 acres) wetlands include those with at least 25 percent cover of particles of diameters less than 6 cm. and less than 30 percent vegetative cover. Surface water is present most of the year and the water table is near surface when surface water is absent. This type has been found associated with Porcupine Creek in NE Section 27, T42N, R71W.
- **Emergent, saturated** (less than one acre) wetlands are similar to emergent, seasonally flooded, but surface water is seldom present. However, the substrate is saturated to the surface for extended periods of the growth season. One occurrence is located in an unnamed tributary of Porcupine Creek in the SW NW of Section 1, T41N, R71W.

NWI digital maps include datasets of both polygonal and linear (i.e., lacking measured width) features identified from aerial or satellite imagery. Limited field checking of wetlands identification suggested that, in most cases, the linear features did not meet the complete requirements for wetlands classification. Accordingly, this EA analysis has been restricted to mapped polygonal features. In total, approximately 164 acres of wetlands are mapped within the Project Area, comprising slightly less than 1 percent of the area.

Riparian ecosystems occupy areas adjacent to water bodies and are characterized by high water tables and moist soils. Riparian areas are typified by high species diversity, density, and productivity. Riparian ecosystems include wetlands adjacent to waterbodies.

Within the study area of the Powder River Basin Oil and Gas FEIS, riparian areas represent approximately 3 percent of the total area (BLM, 2003, p. 3-94). Approximately two-thirds of riparian area is represented by the Wet Meadow type. Riparian ecosystems are much less common within and adjacent to the Project Area. Within the Antelope Creek and Upper Cheyenne watersheds, total riparian cover types represent only 0.1 percent and 0.3 percent, respectively, of total areas. Nearly all of the Antelope Creek contribution is from Forested

Riparian type occurring along Antelope Creek more than three miles downstream of the confluence with Porcupine Creek and well beyond the Project Area.

The principal existing impacts to wetlands and riparian areas in the Northern Great Plains result from widespread ranching and agricultural water withdrawals. Wetland and riparian ecosystems are highly responsive to changes in hydrologic conditions. Stream-sourced irrigation can have deleterious effects on associated wetlands and riparian communities. In the vicinity of the Project Area, however, irrigated croplands are uncommon. Within the study area of the Powder River Basin Oil and Gas FEIS, the Antelope Creek and Upper Cheyenne watersheds accounted for only 0.4 percent and 0.2 percent, respectively, of the total stream-sourced irrigation (BLM, 2003, p. 3-52). There are no currently-irrigated lands within the Project Area.

Conventional oil and gas development has caused impacts to wetlands and riparian areas within the Powder River Basin. Within the Project Area, no conventional wells, or plugged and abandoned conventional wells, are located within a delineated wetland. Existing roads within the Project Area may be used to access existing wells or production facilities. Within the Project Area boundary, approximately 0.7 miles of roads cross wetlands. Assuming a ROW width of 12 feet, this equates to existing disturbance of approximately 1.0 acres.

3.6.1.3 Non-Native Invasive Species

Increased occurrences of non-native invasive species, as well as those noxious weeds defined by Wyoming Statutes (WS 11-5-102.a.xi) as "the weeds, seeds or other plant parts that are considered detrimental, destructive, injurious or poisonous, either by virtue of their direct effect or as carriers of diseases or parasites that exist within this state, and are on the designated list" (State of Wyoming, 2003, online data) may accompany CBM development. Wyoming statute has designated 23 species of noxious weed. In addition, under authority of the Wyoming Weed and Pest Control Act of 1973 (WS 11-5-119), counties may designate additional weeds of concern. Campbell County has designated and tracks common cocklebur (Xanthium strumarium) and wild licorice. A listing of noxious weeds for Campbell County is presented in **Table 3-10.**

Table 3-10 Campbell County Noxious Weeds

Common Name	Designee	Scientific Name	Occurrence
Skeletonleaf bursage	State	*Ambrosia tomentosa*	Present
Common burdock	State	*Arctium minus*	11-100 acres
Hoary cress	State	*Cardaria draba*	No data
Hairy whitetop	State	*Cardaria pubescens*	101-1,000 acres
Musk thistle	State	*Carduus nutans*	Present
Diffuse knapweed	State	*Centaurea diffusa*	Present
Spotted knapweed	State	*Centaurea maculosa*	Present
Russian knapweed	State	*Centaurea repens*	Present
Canada thistle	State	*Cirsium arvense*	Present
Field bindweed	State	*Convolvulus arvensis*	Present
Houndstongue	State	*Cynoglossum officinale*	11-100 acres
Quackgrass	State	*Elytrigia repens*	Present

Common Name	Designee	Scientific Name	Occurrence
Leafy Spurge	State	*Euphorbia esula*	Present
Wild licorice	County	*Glycyrrhiza lepidota*	Present
Dyer's woad	State	*Isatis tinctoria*	Present
Perennial pepperweed	State	*Lepidium latifolium*	Less than 10 acres
Dalmation toadflax	State	*Linaria dalmatica*	Present
Scotch thistle	State	*Onopordum acanthium*	11-100 acres
Perennial sowthistle	State	*Sonchus arvensis*	Present
Saltcedar	State	*Tamarix chinensis*	Present
Common cocklebur	County	*Xanthium strumarium*	Present

Source: 1995 CAPS Survey (University of Wyoming, 2003)

A consultation with Merv Griswold, Campbell County Noxious Weeds Control Supervisor, indicates that the main species of concern in the Project Area are black henbane (*Hyoscyamus niger*), skeleton leaf bursage, Canada thistle, scotch thistle, and yellow toadflax (*Linaria vulgaris*). Field bindweed may also be a concern. A number of additional weed species is currently being monitored by the University of Wyoming's Cooperative Agricultural Pest Survey (University of Wyoming, 2003, online data). A number of these additional species may also occur in Campbell County.

The TBNG does not have a current inventory of noxious weed species and infestation levels (USFS, 2001, p. 3-160). According to Douglas Ranger District Staff (Bradshaw, 2003, personal communication), noxious weeds most likely to be encountered within the Project Area would likely be Canada thistle and possibly Russian thistle (*Salsola iberica*). Whitetop has been found along Phillips Road in Gibson Draw about six miles southeast of the Project Area. Salt cedar is known to occur south of the Project Area along Antelope Creek.

3.6.1.4 Regulatory Environment

Laws and regulations dealing with management and protection of vegetation and wetlands include:

- Clean Water Act (33 USC Chap. 26, 33 USC 1344, 33 CFR 323).
- Federal Noxious Weed Act of 1974 (7 USC 2801-2814).
- Forest and Rangeland Renewable Resources Planning Act of 1974 (16 USC 1601-1610).
- Federal Land Policy and Management Act of 1976 (FLPMA), (43 USC 1701 et seq., 43 CFR 3809).
- National Forest Management Act of 1976, as amended (16 USC 1600 et seq., 36 CFR 219.6).
- Executive Order 11990, Protection of Wetlands, 1977.
- Executive Order 13112, National Invasive Species Management Plan, 1999.
- USFS Manual 2670: Wildlife, Fish, And Sensitive Plant Habitat Management.

3.6.2 Regulatory Status

Management of vegetation and wetlands resources within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement (USFS, 2001) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a).

Recommended mitigation measures relating to vegetation and wetlands are also discussed in the Powder River Basin Oil and Gas FEIS (BLM, 2003, pp. 4-395 to 4-396).

3.6.3 Environmental Consequences

3.6.3.1 The Proposed Action

Vegetation and land cover issues raised during scoping included:

- Potential for disturbance of riparian vegetation resulting from changed water levels, degraded water quality, and altered sedimentation resulting from discharge of large volumes of produced water;
- Insufficiency of plant inventories for use in long-term monitoring of CBM effects; and
- Potential for increased influx of noxious weeds associated with degradation and sodification of local soils from CBM produced water.

Direct Impacts

Surface disturbance to vegetative cover would result from construction of roads, compressor stations, pipelines, water discharge lines, and drilling of wells. As indicated in **Table 2-7**, total maximum short-term surface disturbance resulting from construction of the Proposed Action would approximate 938 acres (647 acres on USFS surface, 81 acres on State of Wyoming surface, and 209 acres on private surface). Following near-term reclamation, long-term surface disturbance would amount to approximately 114 acres (72 acres on USFS surface, 14 acres on State of Wyoming surface, and 28 acres on private surface). Roads comprise most of the long-term disturbance. Project-constructed roads not required for USFS management purposes would be reclaimed on federal surface at the end of the Project as required by the USFS. Some permanent loss of vegetation cover would occur where roads are not reclaimed.

Direct impacts to wetlands and riparian areas would occur from construction of roads and pipelines. A summary of wetlands disturbance is indicated in **Table 3-11**.

Table 3-11 Summary of Maximum Wetlands Disturbance, Proposed Action

Disturbance	Linear Surface Disturbance (Feet)			Maximum ROW (Feet)	Maximum Surface Disturbance (Acres)		
	Federal	State	Private		Federal	State	Private
Long-term							
Roads	797	260	298	12	0.22	0.07	0.08
Short-term							
Utility Corridors	4,117	0	1,164	50	4.73	0.00	1.34
HP Gas Pipeline	30	0	688	80	0.06	0.00	1.26
Totals	4,944	260	2,150		5.01	0.07	2.68

Wetland and riparian ecosystems are sensitive to the quality and quantity of produced water. As indicated in Section 3.3, discharge of produced CBM water into ephemeral drainages has the potential for raising water tables, possibly converting some ephemeral drainages to perennial, and altering soil saturation. All of these effects could alter certain wetlands and potentially associated riparian areas within the Project Area. The great majority of wetlands, which occur within naturally occurring playas or along drainages which would not receive CBM discharge, would likely be unaffected by the Proposed Action.

Within the Project Area, principal effects from discharge of produced water could include (BLM, 2003, pgs. 4-174 to 4-175):

- Increased erosion with resultant increase in sediment load in some channels. Most drainages receiving produced water are heavily covered with range grasses. Established channels, such as Porcupine Creek and the unnamed tributary which joins Porcupine Creek in Section 27, 42N 71W, have established channels which could be susceptible to bank erosion. Identified erosional features in these channels would be stabilized prior to discharge.
- Changes to the composition and physical structure of the vegetation community in wetlands and riparian areas. Plants with low tolerance for year-round wetting as opposed to periodic flow could be negatively affected. Cottonwood trees are particularly susceptible, however, no cottonwood trees would be affected by the Proposed Action.

No on-channel impoundments, with the exception of upgrades to two existing stock reservoirs, are planned. Discharge to off-channel impoundments is restricted to one existing stock and wildlife reservoir on USFS surface (Section 34, T42N, R71W). Discharge has been requested by the USFS. No land application of produced water is planned.

Impacts to wetlands would most likely be restricted to the immediate vicinity of Porcupine Creek, to Boss Draw and Corder creeks, and to several unnamed tributaries of Porcupine Creek, with the most extensive impacts probably restricted to Porcupine Creek. A total of 17.1 acres could be affected, representing approximately 10 percent of the wetlands within the Project Area, as indicated in **Table 3-12**.

Table 3-12 Potentially Affected Wetlands, Proposed Action

Drainage	Dominant Wetland Type	Potential Disturbance (Acres)
Porcupine Creek	Emergent, temporarily flooded	7.1
Boss Draw	Emergent, temporarily flooded	3.6
Corder Creek	Emergent, temporarily flooded	3.3
Unnamed Tributary, 23 and 26, 42N, 71W	Emergent, temporarily flooded	3.1
Totals		**17.1**

With the exception of the vicinity of Porcupine Creek, effects to wetlands would be minor and temporary, since the volumes of CBM discharge would decline rapidly, and infiltration and evapotransporation would rapidly remove water from channels below the discharge points. For the same reason, effects related to increased erosion or sedimentation would be minimal. Within three years of production onset, produced water flows would be expected to be approximately 1/8 of their initial, maximum discharge rate (Independent Production Company, 2002, p. 6). Impacts to Porcupine Creek would likely be greater, as the creek is likely to be temporarily transformed (for a probable period of from three to five years) from an ephemeral to a perennial stream, as discussed in the section in Chapter 4 dealing with cumulative impacts.

Inventories of native plant species within the TBNG have been conducted by the USFS over many years. These data should be sufficient to detect any major alterations in plant communities during the temporary period of CBM water discharge.

Indirect Impacts

Possible indirect effects to vegetative cover could include (BLM, 2003, p. 4-153):

- Increased potential for spread of noxious weeds associated with construction surface disturbance.
- Potential for changes in vegetation type and diversity associated with increased flow in ephemeral drainages and conversion of some ephemeral streams to perennial streams.
- Alteration in wildlife food supply resulting from vegetation changes.

Potential for the spread of noxious weeds was an issue raised during public scoping. The Company is committed to mitigative measures which would reduce the possibility of introduction and spread of non-native invasive species. Weed invasion resulting from vegetative cover change associated with sodification of local soils is unlikely, based upon the sodium content and salinity of produced water expected within the Project Area (Independent Production Company, 2002, Appendix A).

Significant deleterious effects to wildlife food supply and to vegetation type and diversity are unlikely because the amount of vegetative cover that would experience long-term disturbance resulting from the Proposed Action is limited to approximately 1 percent of the Project Area.

Mitigation

Surface disturbances will be minimized to the extent feasible by co-locating constructed roads and utility corridors within common or adjoining rights-of-way. Where roads or pipelines must cross wetland or riparian areas, crossings will be made as close as practical to a perpendicular direction to minimize disturbance. The Company will monitor constructed facilities within the Project Area for the spread of noxious weeds and will take control measures as approved by the USFS or BLM. All constructed roads not required for long-term management activities by the USFS would be reclaimed at the end of the Project. Reclamation efforts would use seed mixtures approved by the USFS or BLM and certified as being weed free.

3.6.3.2 The No Action Alternative

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action Alternative, no negative impacts to vegetation or wetland and riparian areas additional to existing impacts would occur. Conventional oil and gas development would continue within the Project Area, and CBM development would continue on state and private lands near the Project Area. Ranching-associated impacts would likely continue at their present magnitude. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future.

3.7 WILDLIFE AND FISHERIES

The boundary of the Project Area encompasses more than 17,000 acres of grassland and sagebrush habitat suitable for a wide variety of terrestrial species. Wetlands and riparian vegetation corridors associated with certain ephemeral drainages and with Porcupine Creek, while areally less extensive, provide habitat for additional terrestrial and aquatic animals.

3.7.1 Affected Environment

As discussed in Section 3.6, vegetative cover of the Project Area is divided almost entirely between short-grass prairie (approximately 75 percent of the area) and sagebrush shrubland (approximately 25 percent of the area). Mixed-grass prairie comprises less than 1 percent of ground cover. Approximately 164 acres of wetlands occur within the major vegetation type areas. Wetlands comprise slightly less than 1 percent of the Project Area. Although the coarse scale of regional vegetation mapping does not define riparian corridors within the Project Area, herbaceous and shrubby riparian ecosystems are known to occur within some of the principal draws.

Common year round or seasonal residents of short-grass and mixed-grass prairie environments known from within or near the Project Area include golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), lark bunting (*Calamospiza melanocorys*), horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), lark sparrow (*Chondestes grammacus*), vesper sparrow (*Pooecetes gramineus*), chestnut-collared longspur (*Calcarius ornatus*), McCown's longspur (*Calcarius mccownii*),

American badger (*Taxidea taxus*), coyote (*Canis latrans*), swift fox (*Vulpes velox*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), black-tailed jackrabbit (*Lepus californicus*), plains pocket gopher (*Geomys bursarius*), black-tailed prairie dog (*Cynomys ludovicianus*), Ord's kangaroo rat (*Dipodomys ordii*), deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), prairie rattlesnake (*Crotalus viridis*), and pronghorn (*Antilocapra americana*).

Common year round or seasonal residents of sagebrush shrublands known from within or near the Project Area include Swainson's hawk, northern harrier (*Circus cyaneus*), Say's phoebe (*Sayornis saya*), western kingbird (*Tyrannus verticalis*), horned lark, sage thrasher (*Oreoscoptes montanus*), Brewer's sparrow (*Spizella breweri*), vesper sparrow, sage sparrow (*Amphispiza belli*), western meadowlark, greater sage grouse (*Centrocercus urophasianus*), desert cottontail (*Sylvilagus audoboni*), black-tailed jackrabbit, thirteen-lined ground squirrel, northern pocket gopher (*Thomomys talpoides*), Ord's kangaroo rat, deer mouse, prairie vole (*Microtus orchrogaster*), eastern short-horned lizard (*Phrynosoma douglasii*), prairie rattlesnake, pronghorn, and mule deer (*Odocoileus hemionus*).

Common year round or seasonal residents of riparian areas from within or near the Project Area include northern harrier, Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), common snipe (*Gallinago gallinago*), short-eared owl (*Asio flammeus*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothylpis trichas*), savannah sparrow (*Passerculus sandwichensis*), song sparrow (*Melospiza melodia*), red-winged blackbird (*Agelaius phoeniceus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), meadow vole (*Microtus pennsylvanicus*), deer mouse, red fox (*Vulpes vulpes*), bull snake (*Pituophis catenifer*), tiger salamander (*Ambystoma tigrinum*), northern leopard frog (*Rana pipiens*), pronghorn, and mule deer and white-tailed deer (*Odocoileus virginianus*) (BLM, 2003, pp. 3-113 to 3-114; Sauer, et al., 2002, online data; Wyoming Gap Analysis, 2001, online data).

The Project Area is located within the Hilight Bill Geographic Area of the TBNG and lies approximately five miles west of the Broken Hills Geographic Area. Characteristics of both areas are populations of pronghorn, mule deer, and elk. Raptor nesting is common within the Hilight Bill area (USFS, 2001a, pp. 2-3 and 2-22).

3.7.1.1 Big Game Animals

In the general area of the Proposed Action, big game species consist of pronghorn, elk (*Cervus elaphus*), mule deer, and white-tailed deer. WGF indicates various range types for big game animals (WGF, 2002, GIS metadata). Types noted within or near the Project Area include:

- **Yearlong** - These are areas in which a population or portion of a population makes general use of a habitat on a year round basis, except occasionally under severe winter or drought conditions.
- **Winter/Yearlong** - These are areas in which a population or portion of a population makes general use of a habitat on a year round basis but in which during the winter (approximately December 1 through April 30) there is a significant influx of additional animals from other seasonal ranges.

- **Crucial** - These are seasonal habitat areas which have been documented as the determining factor in a population's ability to maintain itself at a certain level (typically a population objective) over the long term.

Only pronghorn and mule deer are found within the Project Area. Elk yearlong and winter/yearlong range occurs within a few miles of the Project Area to the east. Elk crucial winter range areas occur within about five miles northeast and southeast of the Project Area and birthing areas have been located about 10 miles to the east in the Broken Hills Geographic Area. White-tailed deer are known only from a small area in the vicinity of Porcupine Reservoir several miles south of the Project Area and beyond the NARC surface coal mine. Consequently, neither elk nor white-tailed deer are discussed further in this EA (WGF, 2002, GIS maps).

Pronghorn

Wyoming supports the largest pronghorn population in North America (Clark and Stromberg, 1987) and the species is known to inhabit the Project Area year-round. The species is most abundant in short- and mixed-grass habitats such as those dominating the Project Area (BLM, 2003, p. 3-117). Approximately the northern one third of the area (32 percent) is considered winter/yearlong range while the southern two thirds (68 percent) is designated yearlong range. Pronghorn migration routes have been located 10-20 miles to the east in the general vicinity of the Cheyenne River. All of the Project Area is contained within WGF pronghorn herd unit 740, the Cheyenne River herd (WGF, 2002, GIS maps). During 1996-2000, the average population for the Cheyenne River herd has been estimated at 34,155 individuals. Estimated post-hunting season population in 2001 was 31,023. The population is considered stable, with adequate sexual and generational diversity, but has been consistently below the WGF target population of 38,000. The population shortfall has been considered to result from harsh winter conditions Within the Cheyenne River herd, the population numbers are much higher than average within Hunt Area 27, which encompasses the Project Area (BLM, 2003, p. 3-121; WGF, 1999, p. 154; WGF, 2001, pp. 1 to 17).

Mule Deer

Mule deer frequent habitats which include short- and mixed-grass prairies, sagebrush shrublands, and shrubby riparian areas. Mule deer population within the Powder River Basin as a whole has exceeded WGF management goals. Populations in all but WGF herd unit 753 are stable or increasing. All of the Project Area is contained within WGF mule deer herd unit 752, the Thunder Basin herd, which exhibits a stable population trend. Estimated average population for this herd during 1996-2000 was 17,656 individuals. The population is currently 15 percent below the upwardly-revised WGF target population of 20,000. Previously, the herd was above population objectives, but expanded hunting and a harsh winter have resulted in current numbers. Herd sexual and generational diversity are considered to be adequate (WGF, 2001, pp. 129 to 149). Within and near the Project Area, mule deer habitat is generally restricted to the vicinity of major drainages, such as Porcupine Creek, Antelope Creek, and Little Thunder Creek. Yearlong habitat occurs over about 14 percent (2,500 acres) of the Project Area, mainly along Porcupine Creek and in the southernmost portion of the area (WGF, 2002, GIS maps; WGF, 1999, p. 153).

3.7.1.2 Other Mammals

In addition to species listed above, less common residents of short- and mixed-grass communities within or near the Project Area may include Merriam's shrew (*Sorex merriami*), northern grasshopper mouse (*Onychomys leucogaster*), olive-backed pocket mouse (*Perognathus fasciatus*), and long-tailed weasel (*Mustela frenata*). Additional sagebrush shrubland residents could include mountain (Nutall's) cottontail (*Sylvilagus nuttallii*), white-tailed jackrabbit (*Lepus townsendii*), olive-backed pocket mouse, sagebrush vole (*Lemmiscus curtatus*), gray fox (*Urocyon cinereoargenteus*), striped skunk (*Mephitis mephitis*), and bobcat (*Lynx rufus*). Additional residents which may occur in riparian shrublands could include mountain (Nuttall's) cottontail and common porcupine (*Erethizon dorsatum*) (WGF, 1999, pp. 125 to 154; Wyoming GAP Analysis, 2001, online data).

Bat species which are widely distributed in Wyoming and which may occur in the vicinity of the Project Area include the western small-footed myotis (*Myotis ciliolabrum*), little brown myotis (*Myotis lucifugus*), hoary bat (*Lasiurus cinereus*), big brown bat (*Eptesicus fuscus*), fringed myotis *(Myotis thysanodes pahasapensis)*, and Townsend's big-eared bat (*Plecotus townsendii*) (WGF, 1999, pp. 128 to 131).

Townsend's big-eared bat is a special status species discussed in Section 3-8.

3.7.1.3 Raptors

The TBNG Hilight Bill Geographic Area which encompasses the Project Area is noted for a high incidence of raptor nesting (USFS, 2001, p. 2-22). Various ongoing raptor surveys have located approximately 100 nest sites within one mile of and including the Project Area (USFS, 2003, GIS maps; PRCC, 2002, GIS maps; Triton Coal Company, 2002, GIS maps). Approximately two thirds of the observations have identified the species. Of 64 identified nests, raptors represented include ferruginous hawk (46 nests), Swainson's hawk (7 nests), golden eagle (7 nests), western burrowing owl (*Athene cunicularia*) (3 nests), and red-tailed hawk (*Buteo jamaicensis*) (1 nest). An additional 32 nests were located without identification to species. The number of nests is considered to be an approximation in that multiple proximal locations may actually represent a single nest (Gayer, 2003, personal communication). For bald eagle, golden eagle, merlin, ferruginous hawk, and Swainson's hawk, nests are considered active by the USFS unless it can be demonstrated they have not been occupied for seven consecutive years. For the burrowing owl and other raptor species, a nest is no longer considered active if it has been unoccupied during the current or most recent nesting season (USFS, 2001, p. 1-20).

In addition to those represented in the nest surveys, other raptors known or suspected to occur in the vicinity of the Project Area include bald eagle (*Haliaeetus leucocephalus*), northern harrier, merlin (*Falco columbarius*), prairie falcon (*Falco mexicanus*), peregrine falcon (*Falco peregrinus*), northern goshawk *(Accipiter gentilis*), and great horned owl (*Bubo virginianus*).

All of the raptors discussed below are extremely widespread throughout most of Wyoming. All inhabit a variety of habitats, but typically about half of their ranges consist of Wyoming big sagebrush and mixed-prairie grasslands (Wyoming GAP Analysis, 2001, online data).

Golden Eagle

Golden eagles are common, widely distributed, year-round residents of Wyoming and the West generally. Prey consists mainly of rabbits and larger rodents and they are known to sometimes scavenge dead lambs (Udvardy, 1993, p. 543). They typically nest in trees or on cliff faces. Raptor surveys previously cited have located golden eagle nests throughout the Hilight Bill and northern portion of the Broken Hills geographic areas of the TBNG. No nests have been identified within the Project Area, but seven are located within one mile of the Project Area boundary.

Red-tailed Hawk

Red-tailed hawks are common, widely distributed, year-round residents of Wyoming. They prefer trees, particularly cottonwoods, and cliff faces for nest sites (Wyoming GAP Analysis, 2001, online data) and commonly perch atop fence posts and telephone poles. Dominant prey consists of rodents or other small mammals and occasionally lizards (Udvardy, 1993, p. 538). Ongoing raptor surveys have identified one nest site within the western portion of the Project Area.

Swainson's Hawk

Swainson's hawks are common, widely distributed, summer residents of Wyoming. Nesting preferences are for isolated trees outside of riparian areas (Wyoming GAP Analysis, 2001, online data). Main prey consists of rodents, although these hawks will occasionally feed on grasshoppers and locusts. The bird winters mainly in South America and migrates in large flocks (Udvardy, 1993, p. 538). Raptor surveys have identified seven nest sites, mostly in the eastern portion of the Project Area. Within the Hilight Bill Geographic Area, including the Project Area, Swainson's hawk nests are much less common than are those identified as belonging to ferruginous hawks or golden eagles.

Prairie Falcon

Prairie falcons are common, widely distributed, year-round residents of Wyoming. Nesting preferences are for cliff habitats and nests are uncommon (BLM, 2003, p. 3-147). Nests are commonly reused in subsequent years. Principal prey consists of rodents and other small mammals and ground birds (Udvardy, 1993, p. 776). Raptor surveys have identified prairie falcon nests approximately two to eight miles south of the Project Area and about four to five miles to the northeast.

Great Horned Owl

Great horned owls are common, widely distributed, year-round residents of Wyoming. Nesting preferences are for trees, cliffs, and talus associations. When nesting in trees, there is a preference for solitary trees or the edge of a grove. Cottonwoods are popular (WGF, 1999, p. 65). Prey consists of rabbits, rodents, birds, and sometimes larger animals such as skunks. The

species is tolerant of humans (BLM, 2003, p. 3-147). Raptor surveys have identified only a few nests within the TBNG and none in the vicinity of the Project Area. Between 310 and 670 breeding pairs may occupy the study area of the Powder River Basin Oil and Gas FEIS (BLM, 2003, p. 3-148).

Bald eagles, ferruginous hawks, western burrowing owls, and northern harriers, are special status species discussed in Section 3.8.

3.7.1.4 Upland Game Birds

Common year-round or seasonally resident upland game birds known from within or near the Project Area include greater sage grouse and sharp-tailed grouse (*Tympanuchus phasianellus*). Occurrences of any of these birds is possible in the vicinity of the Project Area, although sharp-tailed grouse is more commonly found farther north in mid-grass prairie environments. No sharp-tailed grouse leks are currently known from either the Antelope Creek or Upper Cheyenne watersheds (BLM, 2003, p. 3-148; WGF, 1999, p. 44).

Sage grouse is a special status species discussed under Section 3.8. Scoping did not identify issues of concern relating to upland game birds other than sage grouse, and the group is not discussed further in this EA.

3.7.1.5 Other Birds

Migratory Birds

The USFWS has established a listing of birds of conservation concern, including primarily those birds protected under terms of the Migratory Bird Treaty Act. The Project Area is contained within Bird Conservation Region 17 (Badlands and Prairies). Non-raptors from the list which may occur in the vicinity of the Project Area include mountain plover (*Charadrius montanus*), upland sandpiper (*Bartramia longicauda*), long-billed curlew (*Numenius americanus*), Wilson's phalarope (*Phalaropus tricolor*), Brewer's sparrow (*Spizella breweri*), grasshopper sparrow (*Ammodramus savannarum*), McCown's longspur (*Calcarius mccownii*), and chestnut-collared longspur (*Calcarius ornatus*) (USFWS, 2002, Table 17). Wilson's phalarope is a summer resident of certain riparian areas. Brewer's sparrow is a summer resident primarily of sage communities. Grasshopper sparrow, McCown's longspur, and chestnut-collared longspur are summer residents of short- and mixed-grass prairies. (Wyoming GAP Analysis, 2002, online data).

Mountain plover, Brewer's sparrow, grasshopper sparrow, Mc Cown's longspur, and chestnut-collared curlew are special status species discussed in Section 3.8.

Waterfowl

A number of common migratory or resident waterfowl occur in the vicinity of the Project Area. In addition to the Canada goose (*Branta canadensis*), ducks and teals whose ranges include the Hilight Bill Geographic Area include the wood duck (*Aix spansa*), mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), American widgeon (*Anas*

americana), northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata*), blue-winged teal (*Anas discors*), and cinnamon teal (*Anas cyanoptera*). Summer resident wading and shore birds whose ranges encompass the Project Area include the great blue heron (*Ardia herodias*), killdeer (*Charadrius vociferus*), American avocet (*Recurvirostra americana*), black-necked stilt (*Himantopus mexicanus*), spotted sandpiper (*Actitis macularia*), and Wilson's phalarope. These birds could make use of appropriate habitat associated with mine reservoir margins, along Porcupine Creek, or in other wetlands and riparian corridors (BLM, 2003, p. 3-150; WGF, 1999, pp. 26 to 33; Wyoming GAP Analysis, 2001, online data). As indicated in Section 3.6, these habitats encompass approximately 1 percent of the Project Area.

3.7.1.6 Amphibians

Amphibians which may be found in wetland or riparian communities in the vicinity of the Project Area include tiger salamander (*Ambystoma tigrinum*), plains spadefoot (*Scaphiopus bombifroms*), Great Plains toad (*Bufo cognatus*), Woodhouse's toad (*Bufo woodhousei*), boreal chorus frog (*Pseudacris triseriata*), and northern leopard frog (*Rana pipiens*) (WGF, 1999, pp. 156 to 158). The northern leopard frog is a special status species discussed in more detail in Section 3.8.

Field work conducted in support of this EA identified frog vocalizations, although no animals were observed, at a stock pond in NW Section 2, T41N, R72W, at the North Corder Creek mine reservoir in Section 29, T42N, R70W, and along Porcupine Creek where it is crossed by Antelope Road.

3.7.1.7 Fisheries

Porcupine Creek is an ephemeral stream which is a tributary of Antelope Creek, also an ephemeral stream. Under Chapter 1 of the Wyoming Water Quality Regulations, both of these streams are classified as 3B waters by WDEQ. Class 3B streams are intermittent or ephemeral tributary waters and adjacent wetlands which, because of natural habitat conditions, do not support, nor have the ability to support, fish populations or spawning. These streams have sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna which inhabit waters of the state at some stage in their life cycles. Class 3B waters are typified by frequent linear wetland occurrences within or adjacent to the stream channel.

Notwithstanding the WDEQ classification, minnows were observed in Porcupine Creek where it is crossed by Antelope Road (SW SW Section 25, T42N, R71W). The minnows appeared to be a type of dace, but did not appear to be a long-nosed dace. None of the USFS sensitive species was observed. No fish species were observed at any other location.

3.7.2 Regulatory Environment

A large number of laws regulate management and protection of wildlife, including:

- Migratory Bird Treaty Act of 1918, as amended (16 USC 703-712, 50 CFR 10.13).
- Clean Water Act of 1948 (33 USC Chap. 26, 33 USC 1344, 33 CFR 323).
- Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884, 50 CFR Pts. 17, 23).
- Forest and Rangeland Renewable Resources Planning Act of 1974 (16 USC 1601-1610).
- Federal Land Policy and Management Act of 1976 (FLPMA), (43 USC 1701 et seq., 43 CFR 3809).
- National Forest Management Act of 1976, as amended (16 USC 1600 et seq., 36 CFR 219.6).
- The Public Rangeland Improvement Act of 1978 (43 U.S.C. 1901 et. seq).
- Fish and Wildlife Conservation Act of 1980 ("Nongame Act"); as amended (16 U.S.C. 2901-2911; 94 Stat. 1322).
- USFS Manual 2670: Wildlife, Fish, And Sensitive Plant Habitat Management
- Wyoming Statutes Title 23, Chap. 3.

3.7.3 Regulatory Status

Management of wildlife resources within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement (USFS, 2001) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a).

Recommended mitigation measures relating to wildlife are also discussed in the Powder River Basin Oil and Gas FEIS (BLM, 2003, pp. 4-397 to 4-399).

3.7.4 Environmental Consequences

Significant wildlife and fisheries issues raised during scoping include the following:

- Potential disturbance of breeding areas and migration routes and fragmentation of habitat, in particular sage grouse habitat, associated with roads and production facilities resulting from CBM development.
- Possible deleterious effects on wildlife populations resulting from increased human presence, vehicular traffic, and other activities on the Grassland.
- Potential for increased power line-related mortality among raptors and waterfowl and of increased sage grouse mortality resulting from new utility pole raptor perches near leks.
- Potential for negative impacts to fisheries resulting from reduced water quality, altered water temperatures, and increased sedimentation associated with high volumes of discharged produced water.
- Insufficiency of current wildlife and habitat inventories and baseline studies for use in long-term monitoring of any deleterious effects of CBM development.

3.7.4.1 The Proposed Action

Direct Impacts

Construction of the Proposed Action would result in disturbance of pronghorn and mule deer range as indicated in Table 3-13. Crucial range for either species does not occur within the Project Area. Most of the long-term disturbance is associated with roads. The construction of new roads would be partially ameliorated by closure of some existing roads by the USFS following a Roads Analysis Process.

Table 3-13 Maximum Disturbance of Big Game Range by Surface Ownership, Proposed Action

Species	Short-Term Disturbance (Acres)				Long-Term Disturbance (Acres)			
	Federal	State	Private	Totals	Federal	State	Private	Totals
Pronghorn								
Winter/Yearlong	165.8	43.1	67.8	267.7	21.2	6.6	7.8	35.5
Yearlong	454.5	27.7	141.2	623.4	47.2	7.8	11.3	66.3
Total Pronghorn	620.3	70.8	209.0	900.1	68.4	14.4	19.0	101.8
Mule Deer								
Yearlong	101.0	1.3	34.8	137.7	10.5	0.5	2.4	13.4

Source: Wyoming GAP Analysis, 2001, GIS Data. Rounding issues may affect totals.

Direct, long-term disturbance to big game habitat would affect approximately 0.5 percent of the total Project Area. Short-term disturbance, affecting approximately 5.0 percent of big game habitat, would be reclaimed as soon as practical following construction. Reclaimed areas would produce less forage for a few years until revegetation is successful. Grasses and forbs may be more abundant and productive initially than predecessor vegetation in reclaimed areas; however, shrub communities would likely take 8 to 20 years to completely recover (BLM, 2003, p. 4-180). Discharge of produced water to certain ephemeral drainages could increase the amount of riparian and wetlands habitat available and result in increased occurrences of animals dependent on those ecosystems.

The loss of some surface habitat and increased human activity would likely result in some increased mortality among small and relatively immobile species, particularly during and in the vicinity of construction activities. Impacts to small mammals would likely be masked by naturally-caused population variations. Many species possess a high reproductive capacity allowing a rapid recovery from increased mortality.

Increased wildlife mortality resulting from animal/vehicle collisions is a potential direct impact resulting from increased road mileage and traffic. The highest potential for road kills would exist during the construction phase, expected to last approximately 18 months. Remote monitoring of wells and facilities would minimize the need for onsite observations during the production phase. The great majority of construction and maintenance operations would occur during daylight hours, unlike the situation with conventional oil and gas operations.

Increased mortality of raptors resulting from development of above ground high voltage electrical distribution lines into the Project Area is a potential direct impact. PRECorp, the company constructing the power lines, would ensure that supporting structures are designed to minimize the potential for raptor electrocution (Avian Power Line Interaction Committee, 1996). The use of electrical support structures as perches for raptors could lead to an increase in sage grouse mortality. No constructed power pole would be located within 3,000 feet of any identified lek, and the probability of increased sage grouse mortality from raptor hunting would be minimal.

Most raptors tend to be intolerant of human activity and would avoid nesting in proximity to drilling or construction activity. Timing limitations would restrict construction activities during nesting season. Elevated noise levels have been shown to be a factor in raptor displacement (BLM, 2003, p. 4-219). Noise measurements are typically measured using the dBA scale, which adjusts high and low frequencies to more closely approximate human hearing. To convert measurements made in the dBA scale to the dB scale, a correction factor would be added to the dBA measurements at the determined high and low frequencies. Although it is possible to convert specified frequencies from the dBA scale to dB scale, it may not be possible to represent noise measurements measured in dBs as representative of the sound pressure levels experienced by a particular animal species. Just as the dB scale was adjusted for human hearing, the dB scale may not accurately represent perceived sound levels by any particular species. For this reason, the discussion of noise impacts to wildlife is described in terms of dBAs, for which noise measurements are commonly available. Further discussion of noise associated with the Proposed Action is contained in Section 3.12.

Long-term elevated noise levels resulting from construction of the Proposed Action would be restricted to the vicinity of compressor stations. Only three nest sites have been located within one mile of a compressor station. These sites, and the estimated noise levels from the closest compressor station, are indicated in **Table 3-14**.

Table 3-14 Raptor Nests and Compressor Station[1] Noise Levels, Proposed Action

Affected Raptor	Distance to Source (Feet)	Source	Noise Level at Nest (dBA)
Ferruginous Hawk Nest	2,150	1st. Stage Compressor Station 17-42-70	46.3
Ferruginous Hawk Nest	2,300	1st. Stage compressor Station 29-42-70	48.1
Golden Eagle Nest	1,700	1st. Stage Compressor Station 12-41-71	50.2

[1]Assumes six 350 HP compressors at each station.

There are no raptor nests located within one mile of the single second and third stage compressor station and no grouse leks located within one mile of any compressor station. At a distance of one mile from a main compressor station, compressor noise is estimated to be approximately 45.1 dBA, which is about the same noise level as that characteristic of a rural area during the day (see Table 3-18). Rural background day noise levels are estimated to be approximately 45 dBA. Rural background night noise levels are estimated to be approximately 35 dBA (BLM, 2003, p.

4-334). Therefore, there are no adverse impacts expected to sage grouse or raptors resulting from noise associated with compressor operations.

Both Porcupine Creek and Antelope Creek are WDEQ Class 3B waters which do not naturally support nor have the ability to support fish populations or spawning. As discussed in Section 3.3, the quality of produced water in the Project Area is good. Water discharged to ephemeral drainages tributary to Porcupine Creek may expand wetland and riparian habitats within those drainages and expand opportunities for wildlife populations subsisting in those environments. Mitigation of existing erosion features in drainages receiving produced water would minimize increases in erosion and sedimentation. Ultimately, the water flowing down Porcupine Creek would be processed through one or more reservoirs and settling ponds within the NARC surface coal mine and would undergo further temporary storage within the 330 acre-feet Porcupine Reservoir downstream of the NARC mine. Major negative impacts to wildlife from produced water discharge are not anticipated.

The USFS, other federal agencies, the University of Wyoming, oil and gas companies, adjacent coal mines, and the Company have conducted extensive biological surveys and support ongoing surveys in and near the Project Area. Data obtained from these surveys are sufficient to establish current baseline conditions and determine the level of impacts resulting from construction of the Proposed Action.

Indirect Impacts

Construction activities would likely result in reduction of habitat use by big game species. Big game are known to avoid areas of human activity, at least temporarily, and it is possible that some long-term avoidance of habitat near construction areas could occur. Avoidance could result in under-use of suitable habitat and overuse of more stressed habitat (BLM, 2003, p. 4-180). Wildlife distribution patterns could change. However, observations of pronghorn in existing CBM fields suggest that they become somewhat tolerant of human activities except during hunting season (BLM, 1999, p. 4-89). Mule deer may be even more tolerant than are pronghorn. Mule deer have been observed using areas adjacent to oilfield access roads (Easterly et al., 1991).

Fragmentation of habitat (particularly sagebrush communities) could result from construction. Disturbance could also include reduction of forage and hiding cover, nesting and breeding cover, and thermal cover. Negative impacts to small mammal populations could potentially reduce raptor hunting success. However, it is unlikely that habitat fragmentation would pose a serious threat to raptor populations (BLM, 2003, p. 4-219).

Construction of new roads could increase the possibility of legal hunting and poaching big game by increasing access opportunities.

Mitigation

Surface disturbance would be minimized consistent with developing the Company's mineral resources. Measures to be taken would include:

- Minimizing new road construction and road upgrading and widening through the use of existing roads and limiting most new road construction to two-track status to limit fragmentation of habitat. Project-related travel would be restricted to roads with the exception of emergency situations.
- The Company would employ training of its staff and contractors regarding safe operation and operating speeds of vehicles to minimize the risk of collisions with wildlife. The Company would also acquaint staff and contractors with applicable wildlife laws and would discipline employees found to have violated such laws.
- The Company would limit construction of above ground power lines near streams and other water bodies to reduce the possibility of collisions with waterfowl.
- Firearms and dogs would not be allowed within the Project Area and Company drug, alcohol, and firearms policies would be rigorously enforced.
- Impacts to wetlands and riparian areas would be minimized through minimization of construction within 100 feet of ephemeral stream channels and erosion control measures installed within produced water discharge drainages. Construction in ephemeral drainages would be limited to periods when flows are not expected and linear crossings would be constructed perpendicular to the drainage wherever practical.
- Reserve pits would employ fencing and other wildlife protective measures consistent with those conditions required by the USFS and indicated in **Appendix C**, or by the BLM. The Company would instruct employees and contractors to avoid littering.
- ROW fencing is not planned and trenches associated with pipeline construction would be closed as soon as practical.

The Company would comply with wildlife NSO, CSU, and timing standards and guidelines contained within the RMP and summarized in **Table 1-3**.

3.7.4.2 The No Action Alternative

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action Alternative, no negative impacts to wildlife resources additional to existing impacts would occur. Conventional oil and gas development would continue within the Project Area, and CBM development would continue on state and private lands near the Project Area. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future.

3.8 SPECIAL STATUS SPECIES

3.8.1 Affected Environment

For the purposes of this EA, special status species are those listed by the USFWS as threatened, endangered, proposed, or candidate species (USFWS, 2003, online data); or species included by USFS Region 2 on the regional forest sensitive species list (USFS, 2002); or included on BLM's Wyoming state sensitive species list (BLM, 2002, online data); or on the WGF native status species list (Fertig et al., 1999, online data). The USFS TBNG-designated management indicator species are also included. Only those species which are known or suspected to occur within the

vicinity of the Project Area, i.e. within the Hilight Bill Geographic Area, and only those officially listed by one of the four government agencies, are discussed. Occurrence probabilities were determined during informal consultations with USFS biologists while preparing the Biological Assessment, Biological Evaluation, and Management Indicator Species assessments in conjunction with this EA (Bill Barrett Corporation, 2003). Different species may be included on the lists of the various agencies.

The USFWS, under terms of the Endangered Species Act, uses the following special status designations:

- **Endangered species** are those in danger of extinction throughout all or a significant portion of their range.
- **Threatened species** are those likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
- **Proposed species** are those for which the USFWS has published a proposed rule for listing.
- **Candidate species** are those for which the USFWS has sufficient information on biological vulnerability and threats to warrant issuance of a proposed rule for listing, but for which publication of a proposed rule is precluded by other higher priority listing actions.

In addition to official agency listings, the Wyoming Natural Diversity Database (WYNDD), a participant in the Natural Heritage Program Network, maintains lists of species of concern (Fertig et al., 1999, online data). Each of the official lists was examined, following consultation with the USFS, to select species of concern which might occur in the vicinity of the Project Area. Where WYNDD information was available, the Natural Heritage Program rankings were included. Also consulted was the USFWS listing of birds of conservation concern for Bird Conservation Region 17 (USFWS, 2002, p. 40). The species selected are indicated in **Table 3-15**.

Table 3-15 Special Status Species, Proposed Action

Common Name	Scientific Name	Agency Status	Heritage Program Status *
USFWS Listed Species			
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	G4/S2B,S3N
Black-footed ferret	*Mustela nigripes*	Endangered	G1/S1
Ute ladies' tresses	*Spiranthes diluvialis*	Threatened	G3/S1
Agency Sensitive Species			
Birds			
Ferruginous hawk	*Buteo regalis*	FSR2, BLM	Not Listed
Northern harrier	*Circus cyaneus*	FSR2	Not Listed
Western burrowing owl	*Athene cunicularia*	FSR2, BLM	G4/S3B,SZN
Mountain plover	*Charadrius montanus*	FSR2	G2/S2B,SZN
Loggerhead shrike	*Lanius ludovicianus*	FSR2, BLM	Not Listed
Baird's sparrow	*Ammodramus bairdii*	FSR2, BLM	Not Listed

Common Name	Scientific Name	Agency Status	Heritage Program Status *
Brewer's sparrow	*Spizella breweri*	FSR2	G5/S3B,SZN
Grasshopper sparrow	*Ammodramus savannarum*	WYGF	G5/S3B,SZN
Sage sparrow	*Amphispiza belli*	FSR2, BLM	G5/S3B,SZN
McCown's Longspur	*Calcarius mccownii*	FSR2	G5/S3B,SZN
Chestnut-collared longspur	*Calcarius ornatus*	FSR2	G5/S2B,SZN
Purple martin	*Progne subis*	FSR2	Not listed
Mammals			
Black-tailed prairie dog	*Cynomys ludovicianus*	FSR2, USFWS Candidate	G4/S2S3
Swift fox	*Vulpes velox*	FSR2, BLM, WGF	G3/S2S3
Townsend's big-eared bat	*Plecotus tonwsendii*	FSR2, BLM, WGF	G4/S1B,S2N
Amphibians			
Northern leopard frog	*Rana pipiens*	FSR2, BLM	G5/S3
Fish			
Finescale dace	*Phoxinus neogaeus*	FSR2	G5/S1?
Plants			
Barr's milkvetch	*Astragalus barrii*	FSR2, BLM	G3/S3
USFS TBNG Highlight Bill Geographic Area Management Indicator Species			
Greater sage grouse	*Centrocercus urophasianus*	FSR2, BLM	Not Listed

* Heritage Program Rankings
WYNDD uses a standardized ranking system developed by The Nature Conservancy's Natural Heritage Network to assess the global and statewide conservation status of each plant and animal species, subspecies, and variety. Each taxon is ranked on a
scale of 1-5, from highest conservation concern to lowest. Codes are as follows:
G Global rank: Rank refers to the rangewide status of a species.
T Trinomial rank: Rank refers to the rangewide status of a subspecies or variety.
S State rank: Rank refers to the status of the taxon (species or subspecies) in Wyoming. State ranks differ from state to state.
1 Critically imperiled because of extreme rarity (often known from 5 or fewer extant occurrences or very few remaining individuals) or because some factor of a species' life history makes it vulnerable to extinction.
2 Imperiled because of rarity (often known from 6-20 occurrences) or because of factors demonstrably making a species vulnerable to extinction.
3 Rare or local throughout its range or found locally in a restricted range (usually known from 21-100 occurrences).
4 Apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
5 Demonstrably secure, although the species may be rare in parts of its range, especially at the periphery.
H Known only from historical records. 1950 is the cutoff for plants; 1970 is the cutoff date for animals.
X Believed to be extinct.
A Accidental or vagrant: A taxon that is not known to regularly breed in the state or which appears very infrequently (typically refers to birds and bats).
B Breeding rank: A state rank modifier indicating the status of a migratory species during the breeding season (used mostly for migratory birds and bats)
N Nonbreeding rank: A state rank modifier indicating the status of a migratory species during the non-breeding season (used mostly for migratory birds and bats)
ZN or ZB Taxa that are not of significant concern in Wyoming during breeding (ZB) or non-breeding (ZN) seasons. Such taxa often are not encountered in the same locations from year to year.
U Possibly in peril, but status uncertain; more information is needed.
Q Questions exist regarding the taxonomic validity of a species, subspecies, or variety.
? Questions exist regarding the assigned G, T, or S rank of a taxon.

No plant species of concern have been designated for discussion in this EA.

3.8.1.1 USFWS Listed Species

The USFWS was informally consulted regarding threatened, endangered, proposed, and candidate species considered for listing under the terms of the Endangered Species Act (Long, 2002, personal communication). Listed and proposed species include:

Black-footed ferret

The black-footed ferret is a secretive, nocturnal carnivore species that is found almost exclusively in prairie dog colonies. Its primary prey is the prairie dog, and abandoned prairie dog burrows are commonly used by the ferret for shelter. Once found throughout the Great Plains, the species is now considered by biologists to be one of the most endangered mammals in the U.S.

Black-footed ferret surveys have been conducted on all USFS lands where prairie dog poisoning has occurred in the past (Byer, et al., 2000). No recent observations of black-footed ferret have been recorded on the TBNG, although the USFS has completed surveys in areas of suitable habitat. After ten consecutive years of surveys in accordance with USFWS protocol for conducting black-footed ferret searches, beginning in 1981, no evidence was found to suggest black-footed ferrets occur on the TBNG (Cartwright, 1991). Effective February 2, 2004, the USFWS is no longer requiring surveys for black-footed ferrets in the State of Wyoming (Bill Barrett Corporation, 2003, Acceptance Certification, pg. 1).

Bald eagle

Habitat for the bald eagle is generally along lakes, large rivers, and coasts. The species feeds mostly on fish but also on carrion and mammals such as rabbits, and constructs a platform nest of sticks and vegetation on cliff ledges or in tree forks. Species-wide populations are recovering from earlier declines. The species was down-listed from endangered to threatened in 1995 and, as of July 6, 1999, has been proposed for delisting (BLM, 2003, p. 3-175).

There is known occurrence of bald eagle nests within several miles of the Project Area (USFS, 2003, GIS maps). Date of last observation indicates that the species still occurs in the area. The bald eagle is the only federally threatened species known to occur on the TBNG. Its presence on the TBNG is common in winter, although it rarely breeds there in summer.

Other

The black-tailed prairie dog is a candidate species for listing. It is discussed below under Sensitive Species. More detailed information regarding USFWS listed species is included in the Biological Assessment.

The Ute ladies'-tresses orchid (*Spiranthes diluvialis*) is a federally threatened species. The plant is a perennial, terrestrial orchid that is endemic to moist soils near wetland meadows, springs, lakes, and perennial streams. It occurs generally in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows at elevations from 4,200 to 7,000 feet. The orchid colonizes early success ional riparian habitats such as point bars, sand bars, and low lying gravelly, sandy, or cobbly edges, persisting in those areas where the hydrology provides continual dampness in the root zone through the growing season. Only four occurrences are known in Wyoming, including one in a tributary to Antelope Creek in Converse County, approximately 28 miles to the west southwest of Porcupine Creek. The known population is separated from any potentially suitable habitat in the Project Area by at least four major drainages. The confluence of Porcupine and Antelope creeks is located downstream of the known occurrence. (BLM, 2003, p. 3-177; and Bill Barrett Corporation, 2003, Acceptance Certification pg. 2). While discharge of produced water is likely to temporarily create or expand limited occurrences of wetlands within the Project Area, potentially including habitat suitable for Ute ladies' tresses, such habitat has either been uncommon or non-existent previously. Therefore, occurrences of this plant are not expected within the Project Area. Surveys conducted in the general vicinity of the Project Area in 1997 and 1998, as well as surveys conducted by the Company in 2003, did not find additional populations. Informal consultation with the USFWS (Long, 2002, personal communication) and with the USFS did not identify this plant as a species of concern within the Project Area.

3.8.1.2 USFS, BLM, or WGF Sensitive Species

Birds

Raptors Special status raptors include ferruginous hawk, northern harrier, and western burrowing owl.

Ferruginous hawks are common, widely distributed summer Wyoming residents. Primary habitat includes grasslands and shrublands with abundant ground squirrels or other small mammals. Less important prey include birds, reptiles, and insects. The bird may occupy diverse nest locations (Wyoming GAP Analysis, 2001, online data and Udvardy, 1993, p. 540). Ferruginous hawk nests are the most common located by USFS and coal mine raptor surveys (USFS, 2003, GIS maps; Triton Coal Company, 2002, GIS maps and Powder River Coal Company, 2002, GIS maps), with more than 40 being identified within one mile of the Project Area. Nests occur throughout the Project Area, but appear to be slightly more common in the northern and eastern areas. Exact counts of this and other raptor nests are somewhat uncertain as locational variances from different surveys may overestimate total nest sites (Gayer, 2003, personal communication). Closely-spaced multiple nest locations probably represent a single nesting territory, whether or not individual nest sites may have been duplicated by aerial survey methodology. The species exhibits a positive population trend in Wyoming (Sauer et al., 2002, online data).

The northern harrier (also known as the marsh hawk) is a common, widely distributed, summer resident of Wyoming. It nests on the ground, on cliffs, or talus associations (WGF, 1999, p. 38). Principal prey consists of small mammals, rodents, and sometimes young of other birds

(Udvardy, 1993, p. 454). Raptor surveys have not identified northern harriers in the vicinity of the Project Area. As many as 250 breeding pairs may exist within the study area of the Powder River Basin Oil and Gas FEIS (BLM, 2003, p. 3-145).

Western burrowing owls are uncommon but widely-distributed Wyoming summer residents. The species nests in prairie dog and ground squirrel burrows and is found in prairie grasslands and shrublands. Prey preference includes insects, small birds, lizards, and rodents. It is known to breed in Wyoming (Wyoming GAP Analysis, 2001, online data; Udvardy, 1993, p. 687; and BLM, 2003, p. 3-186). In the vicinity of the Project Area, burrowing owl habitat is commonly associated with prairie dog colonies. USFS, WGF, and coal mine (WGF, 2002, GIS maps; and Triton Coal Company, 2002, GIS maps) data have located two burrowing owl nests in the eastern portion of the Project Area and several miles south and northwest of the Project Area. Other nests and habitat have been located to the east in the Cellar Rosecrans Geographic Area of the TBNG.

Other sensitive species raptors known from the TBNG include peregrine falcons and northern goshawks. Informal consultation with the USFS suggested that suitable habitat for these species is not found within the Project Area and they have not been considered further in this EA.

Birds of Riparian Communities Birds found in riparian communities which are known or suspected to occur within the general vicinity of the Project Area include yellow-billed cuckoo, fox sparrow, Lewis' woodpecker, black tern, and common loon. Informal consultation with the USFS suggested that suitable habitat for these species is not found within the Project Area and they have not been considered further in this EA.

Birds of Prairie and Shrubland Communities Birds found in prairie and shrubland communities which are known or suspected to occur within the vicinity of the Project Area include mountain plover, loggerhead shrike, Baird's sparrow, Brewer's sparrow, grasshopper sparrow, sage sparrow, McCown's longspur, chestnut-collared longspur, and purple martin.

Mountain plover prefer dry, short-grass prairies. The birds frequently select areas modified by prairie dogs, grazing, and fire. Plovers feed primarily on insects, especially grasshoppers; and nest in a depression on bare ground. The species-wide population trend is down dramatically, over 50 percent from 1966 to 1996, due primarily to habitat loss and some grazing and farming practices. In February, 1999, the mountain plover was proposed for listing as a threatened species under the Endangered Species Act. The USFWS determined in August, 2003, that the plover would not be listed.

Information provided by the USFS indicates that there is no known occurrence of mountain plover within the Project Area. Suitable habitat for mountain plover is present within the Project Area, and the species may potentially occur. The species is a summer TBNG resident with several known nesting locations to the south and east of the project area (USFS 2003, GIS maps and Keinath et al., 2001). USFS personnel have conducted mountain plover surveys conforming to USFWS protocols on the TBNG since 1992 and plover surveys were conducted by the Company in support of this EA.

Loggerhead shrikes are common summer Wyoming residents often found in short- and mixed-grass prairie and shrubland environments. The species typically subsists on insects, particularly grasshoppers and crickets, as well as mice and small birds. It is known to breed throughout the state (Wyoming GAP Analysis, 2001, online data; Udvardy, 1993, p. 549; and BLM, 2003, p. 3-187).

Baird's sparrows are uncommon summer resident's of short-grass prairie environments, subsisting mostly on seeds and insects. The bird is a reluctant flyer when flushed, preferring to slip away through the grass (Udvardy, 1993, p. 555).

Brewer's sparrows are common summer residents principally found in sage shrubland environments. The species subsists principally on seeds and insects (Udvardy, 1993, p. 609).

Grasshopper sparrows are common summer residents of mixed- and short-grass communities and sage-associated grasslands. Diet consists mainly of seeds and insects (Wyoming GAP Analysis, 2001, online data and Udvardy, 1993, p. 552).

Sage sparrow habitat includes sagebrush shrublands, chaparral, and dry foothills. The bird is a common summer resident, observed more frequently north of the Project Area (Wyoming GAP Analysis, 2001, online data and Udvardy, 1993, p. 610).

McCown's longspur is a common summer resident of short-grass prairie communities, overgrazed pasturelands or newly-seeded fields, and mountain meadows. The bird is widespread in southern Campbell County, including the TBNG (Wyoming GAP Analysis, 2001, online data and Udvardy, 1993, p. 559).

Chestnut-collared longspurs are uncommon summer residents known from short-grass and mixed-grass prairies. The bird prefers a thicker and taller growth than that characteristic of McCown's longspur habitat. The species is common in large flocks in southeastern Wyoming and is the most common of the plains longspurs (Wyoming GAP Analysis, 2001, online data and Udvardy, 1993, p. 560).

Purple martins are the largest swallows in North America. The species is found in open and semi-open areas, including open woodlands, and also displays some affinity for lakes and marshes. Western populations have declined, possibly as a result of competition with starlings (Udvardy, 1993, p. 701). Preferred habitat is not present within the Project Area.

Mammals

As of February 4, 2002, the black-tailed prairie dog is a candidate species for listing under the Endangered Species Act. Listing has been precluded to date by higher priority actions. The species is a common resident of eastern Wyoming, most abundant in short-grass prairies. It is diurnally active and does not hibernate. The black-tailed prairie dog is a highly social animal living in colonies of up to 100 acres or larger. The species is an important prey for other mammals and raptors (Wyoming GAP Analysis, 2001, online data; Whitaker, 1992, p. 408; and BLM, 2003, p. 3-179).

The swift fox occurs over much of Wyoming where it is considered a common resident. It is a mostly nocturnal, solitary fox, excavating its own den or enlarging badger or marmot dens. The species exhibits a preference for flat to gently rolling terrain in short- and mixed-grassland environments. Principal prey includes rabbits, various rodents, and birds. In January, 2002, the USFWS did not support listing this species as threatened (Wyoming GAP Analysis, 2001, online data; Whitaker, 1992, p. 547; and BLM, 2003, p. 3-189). USFS and WGF surveys (USFS, 2003, GIS maps) have located swift fox dens mostly north and west of the Project Area. No dens have been identified within the Project Area.

Bats of concern to one or more agencies include the fringe-tailed myotis, long-eared myotis, and Townsend's big-eared bat. Habitat for all three bat species encompasses the vegetation communities within the Project Area, although preferred habitats are forests. All are extremely susceptible to disturbance during hibernation. Townsend's big-eared bat is a widely distributed but rare species which forms nursing colonies. The species subsists almost exclusively on moths (Wyoming GAP Analysis, 2001, online data; and Whitaker, 1992, p. 327).

Amphibians

Northern leopard frogs are widespread, common inhabitants of various riparian communities. Cattail marshes and beaver ponds are particularly important habitats. Diet consists of insects, invertebrates, and small vertebrates (Wyoming GAP Analysis, 2001, online data; BLM, 2003, p. 3-181; and WGF, 1999, p. 156).

Fish

Finescale dace are widely distributed in glaciated regions of southern Canada and the northern United States, although no occurrences are known from Campbell County. Habitat includes bog ponds, streams, and lakes. The fish feeds mainly on insects, crustaceans, and plankton. A survey for aquatic species conducted for this EA did not reveal representatives of this species. The survey is discussed in more detail in the Biological Evaluation (Bill Barrett Corporation, 2003).

Plants

Barr's milkvetch is a stemless, mat-forming perennial forb which forms low cushions less than 15 cm in height and up to 30 cm across. The species is found primarily on dry, sparsely vegetated rocky prairie breaks, hillsides, and ridges underlain by calcareous shales and silty sandstones. It is often found in mid-slope positions on north- and east-facing topography. The plant is widespread throughout the Great Plains (Fertig et al., 1999, online data).

More detailed information regarding Barr's milkvetch and other USFS sensitive species is included in the Biological Evaluation.

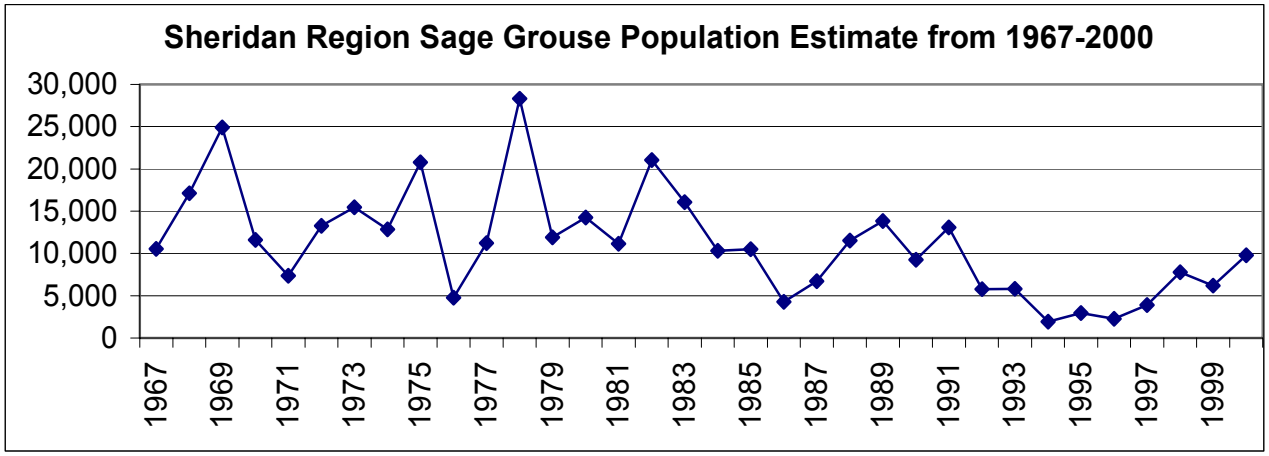
3.8.1.3 USFS Management Indicator Species

Management Indicator Species (MIS) are those species that indicate habitat suitability for other species with similar habitat needs. The sage grouse is the only MIS identified by the USFS for the Hilight Bill Geographic Area portion of the TBNG (USFS, 2001, pg. 2-24).

Greater Sage Grouse

Sage grouse are widespread, common residents of sagebrush shrubland communities and in sage-associated grasslands. Diet consists principally of the buds and leaves of sagebrush, and the species does not occur in the absence of substantial stands of sagebrush. Ideal sage cover is between 10 percent and 50 percent, with average shrub height of 4 to 16 inches. Sagebrush habitats within the Project Area may provide only minimal values for winter habitat and nesting and brooding habitats due to the short height and sparseness of understory vegetation (Bill Barret Corporation, 2003, Acceptance Certificate, pg. 5). Within the Powder River Basin, the range of the species has not contracted, in contrast to the situation in other western states. Population estimates are based upon locations of male display grounds (leks) (Wyoming GAP Analysis, 2001, online data; Udvardy, 1993, p. 606; and BLM, 2003, p. 3-194). Statewide, the species has displayed a fluctuating, but generally decreasing population since monitoring by WGF began in 1967, as indicated in **Figure 3-4**. This decline has been particularly pronounced in the eastern portion of Wyoming. Population declines have been attributed, in part, to increased human disturbance during critical periods of the bird's life cycle (Bill Barret Corporation, 2003, Acceptance Certificate, pg. 5).

Figure 3-4: Sage Grouse Population Trends



Source: Wyoming Game and Fish Department

USFS surveys have not located leks within the Project Area, but numerous leks have been identified outside of the Project boundary, mostly to the east and north, although only one lek is located within two miles of the Project Area boundary. The Company conducted a survey for sage grouse leks in support of this EA; no new leks were discovered. Survey results are discussed in more detail in the Management Indicator Species Assessment accompanying this EA.

More detailed information regarding USFS management indicator species is included in the Management Indicator Species assessment (Bill Barrett Corporation, 2003, p. 49).

3.8.2 Regulatory Environment

Laws and regulations relating to management and protection of special status species include:

- Migratory Bird Treaty Act of 1918, as amended (16 USC 703-712, 50 CFR 10.13).
- Bald and Golden Eagle Protection Act of 1940, as amended ((16 U.S.C. 668-668d).
- Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884, 50 CFR Pts. 17, 23).
- Federal Land Policy and Management Act of 1976 (FLPMA), (43 USC 1701 et seq., 43 CFR 3809).
- National Forest Management Act of 1976, as amended (16 USC 1600 et seq., 36 CFR 219.6).
- Fish and Wildlife Conservation Act of 1980 ("Nongame Act"); as amended (16 U.S.C. 2901-2911; 94 Stat. 1322).
- USFS Manual 2670: Wildlife, Fish, And Sensitive Plant Habitat Management.
- BLM Manual 6840: Special Status Species Management.

3.8.3 Regulatory Status

Management of special status species within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement (USFS, 2001) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a).

Recommended mitigation measures relating to wildlife are also discussed in the Powder River Basin Oil and Gas FEIS (BLM, 2003, pp. 4-397 to 4-402).

3.8.4 Environmental Consequences

Significant issues raised during scoping relating to special status species include the following:

- Potential disturbance of breeding areas and migration routes and fragmentation of habitat, in particular sage grouse habitat, associated with roads and production facilities resulting from CBM development.
- Possible deleterious effects on wildlife populations resulting from increased human presence, vehicular traffic, and other activities on the Grassland.
- Potential for increased power line-related mortality among raptors and waterfowl and of increased sage grouse mortality resulting from new utility pole raptor perches near leks.

3.8.4.1 The Proposed Action

Direct Impacts

USFW Listed Species. No impacts to black-footed ferret are anticipated to occur as the species does not appear to exist in the vicinity of the Project Area. Surveys for this species are not currently required by the USFS.

Bald eagles are not known to nest within the Project Area, but nests have been observed in the general vicinity of the Proposed Action. Proximal human activity or noise during breeding season could result in increased reproductive failure. Construction of power poles could increase prospects for eagle electrocution, but could also provide additional hunting perches resulting in increased feeding efficiency. Increased vehicle traffic has the prospect of increasing collisions with carrion-feeding eagles. The scattered nature of disturbance and rarity of bald eagles in the vicinity of the Project Area suggests that construction of the Proposed Action would be unlikely to cause long-term negative impacts to the bald eagle population.

Agency-Designated Sensitive Species. The probability of negative impacts to bald eagles would also apply to other raptors and to ferruginous hawks in particular. Above ground facilities would be located at least .25 miles (LOS) from known nests in conformance with the 2001 revision of the TBNG LRMP (USFS, 2001, pg. 1-21) and three wells were dropped from the Proposed Action as the result of an inability to relocate them sufficiently distant from ferruginous hawk nests. Impacts to osprey are considered to be unlikely, as it is highly doubtful that the species occurs within the Project Area, given an absence of suitable water bodies and prey. Clearance surveys for burrowing owls have been required by the USFS within the vicinity of the Proposed Action. Only two nest sites are known within the Project Area, and only a very small portion of owl habitat would be disturbed on a long-term basis. Merlin nests have not been identified in the vicinity of the Proposed Action.

Bird species dependent upon prairie grassland or sage shrubland environments include mountain plover, loggerhead shrike, Baird's sparrow, Brewer's sparrow, grasshopper sparrow, sage sparrow, McCown's longspur, chestnut-collared longspur, and purple martin. All of these birds could undergo displacement during construction, but abundant replacement habitat exists within the Project Area. Long-term disturbance of approximately 1 percent of habitat required by these species suggests that long-term disruption of these populations is unlikely.

Mountain plover are known to exist in the vicinity of the Project Area, although ongoing surveys to locate nest sites have been unsuccessful within the Project Area. Approximately 1 percent of the Project Area would undergo long-term disruption due to construction of the Proposed Action. During the production phase, intermittent activity to well sites could disturb breeding populations. Construction activity, such as power pole construction near plover habitat, has the potential to increase raptor predation. Construction of the Proposed Action would also likely create additional habitat favorable to mountain plovers. The scattered nature and magnitude of disturbance would be unlikely to cause long-term displacement of plover populations.

Swift fox are not known to den within the Project Area, but may be infrequent visitors. The small amounts of short- and long-term disruption of vegetative cover within the vicinity would be unlikely to significantly adversely affect fox prey species. Similarly, neither the nesting habitats nor principal prey of bat species would be likely to suffer adverse effects due to construction of the Proposed Action. Long-term disruption of mammal species of concern is considered unlikely.

Disturbance to black-tailed prairie dogs would principally involve surface disturbance in the vicinity of existing colonies. A total of approximately 314 acres of prairie dog colonies comprising four separate towns has been identified within the Project Area (USFS, 2003, GIS maps). Total short term disturbance of prairie dog colonies from roads, utility corridors, and well sites would be approximately 7.0 acres (2.2 percent). Total long-term disturbance from roads and well sites would be approximately 0.7 acres (0.2 percent). All of this disturbance would occur on USFS surface in Section 3, T41N, R71W. Sylvatic plague is a major contributor to prairie dog mortality. Increased transmission of plague via human vectors during construction and production is considered unlikely (BLM, 2003, p. 4-256). Significant negative impacts to black-tailed prairie dogs are considered unlikely.

Northern leopard frogs could be directly affected by an increase in water flowing through the riparian communities in which the species, if present within the Project Area, would occur. Since the likely result of increased discharge would be expansion of wetland and riparian environments, it seems unlikely that long-term disruption of this species would occur.

The occurrence of finescale dace within the Project Area is considered unlikely. The species has not been documented to occur in Campbell County. Both Antelope Creek and Porcupine Creek are WDEQ Class 3B streams, considered incapable of supporting fish populations and spawning.

USFS biologists have identified three localized areas within the Project Area which may represent potential habitat for Barr's milkvetch. No representatives of the species were discovered during recent USFS surveys, although there are documented occurrences near the southern portion of the Project Area. Since all construction associated with the Proposed Action would avoid potential habitat, no impacts to the species are expected.

USFS Management Indicator Species. Potential exists for disruption of greater sage grouse habitat resulting principally from construction of roads and linear utility corridors. The USFS and the Company are sensitive to the potential for destruction of sage grouse habitat, and avoidance of critical sage habitat has been included in design of the Proposed Action, as indicated in **Appendix H**. A very small portion of available sagebrush shrubland (a maximum of approximately 5 percent short-term and 1 percent over the Project life) would be disturbed during construction of the Proposed Action and facilities were relocated during onsite inspections to minimize habitat fragmentation. Above ground utility poles have been located away from known leks to minimize the potential for increased raptor predation.

Breeding sage grouse may be sensitive to noise. There are no sage grouse leks located within one mile of any compressor station. Rural background day noise levels are estimated to be approximately 45 dBA. At a distance of one mile from a second and third stage compressor

station, compressor noise is estimated to be approximately 45.1 dBA. Or about the same noise level as that characteristic of a rural area during the day (see Table 3-18). Rural background night noise levels are estimated to be approximately 35 dBA (BLM, 2003, p. 4-334). Therefore, there are no adverse impacts expected to sage grouse resulting from noise associated with compressor operations. The Company would observe various mitigation measures discussed subsequently to minimize impacts to the sage grouse population.

Indirect Impacts

Discharge of produced water, particularly within Porcupine Creek, could both positively and negatively affect different species as associated wetland and riparian environments are displaced, altered, or expanded. Since riparian environments will, in general, expand, it is likely that no long-term negative impacts to these populations would occur.

Construction of power poles would potentially offer more perches for hunting raptors and could increase hunting efficiency. Where the prey is another species of concern, such as mountain plover, increased raptor predation could have negative impacts on that population. Mitigation would be applied in those instances.

Mitigation

Surface disturbance would be minimized consistent with development of the Company's mineral resources. Measures to be taken would include:

- The Company would ensure that power line supporting structures are designed to minimize the potential for raptor electrocution (Avian Power Line Interaction Committee, 1996).
- For construction proposed in sagebrush communities during the sage grouse nesting season, the Company would conduct clearance surveys within 0.5 miles of the proposed activity.
- Compressor stations would be located to avoid noise levels exceeding 49 dBA at sage grouse display grounds.
- Above ground power lines would not be located within 0.5 miles of sage grouse breeding or nesting grounds.
- Should construction occur during mountain plover nesting season, clearance surveys would be conducted by the Company. Site-specific project areas would be evaluated for suitable mountain plover habitat. No ground-disturbing activities would occur in suitable mountain plover nesting habitat prior to the completion of clearance surveys for nesting mountain plovers conducted in compliance with the USFWS' Mountain Plover Survey Guidelines by a USFS- or BLM-approved biologist.

- Project-related features that encourage or enhance the hunting efficiency of predators of mountain plover would not be constructed within 0.25 miles of known mountain plover nest sites.

The Company would comply with wildlife NSO, CSU, and timing limitations contained within the RMP and summarized in **Table 1-3**, and with mitigation measures indicated in the Powder River Basin Oil and Gas FEIS (BLM, 2003, pp. 4-399 to 4-402).

3.8.4.2 The No Action Alternative

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action Alternative, no negative impacts to special status species additional to existing impacts would occur. Conventional oil and gas development would continue within the Project Area, and CBM development would continue on state and private lands near the Project Area. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future.

3.9 CULTURAL RESOURCES

3.9.1 Affected Environment

In compliance with various regulatory requirements subsequently discussed, a Class I Inventory file search and Class III Inventory cultural resource survey were conducted for the Proposed Action during the spring and summer of 2002 (Meyer, 2002). Those inventories covered the Project Area as then defined, including some acreage on the west side which was, as discussed previously, subsequently submitted separately to the BLM and which is not included in this EA. The Project Area has been previously heavily surveyed for cultural resources due to the proximal surface coal mines. Of the approximately 17,480 acre area considered for the Project Class III Inventory survey, only 2,960 acres had not been recently (post 1982) inventoried. During the course of the Class I Inventory records search, 11 previous surveys were consulted and their data incorporated into the current Project inventory. Details of the locations of these prior surveys are discussed in Meyer (2002, p. 3-1). The most recent survey completes block survey coverage of the entire Project Area. These studies indicate that the Project Area contains evidence of prehistoric and historic cultural activity.

3.9.1.1 Prehistoric Resources

Archeologists use a chronological system developed by Frison (1991) to date prehistoric cultural resources of the Northern Great Plains, including the area of the Powder River Basin and TBNG. This chronology is based on artifact type, principally spear points, associated with sites dated using radiocarbon techniques. The chronology varies by several hundred years among different authorities due to the limitations of precision of radiocarbon dates, but a commonly accepted version (BLM, 2003, p. 3-207) is indicated in **Table 3-16.**

Human activity has been recorded in Wyoming for more than 11,000 years. The earliest known cultural evidence is a find of Clovis spear points in association with at least seven mammoths from the Colby site in the Big Horn Basin. This site was dated at ca. 9250 BC (Meyer, 2002, p. 4-1). Paleoindian sites represent the initial occupation of what was then a high steppe environment by a hunter-gatherer economy. Sites from this period are uncommon because of the passage of time and various climatic changes (Meyer, 2002, p. 4-1).

The Archaic period opened with a climate generally drier than the present and ended with climatic conditions similar to those presently occurring in the area. Few sites from the Early Plains Archaic have been recognized. Climate stabilization around 5,500 years BP appears to have coincided with an increase in the human population as indicated by an increase in the number of cultural sites found. Stone rings have been dated to the Middle Plains Archaic.

Late Plains Archaic sites are very numerous and seem to indicate another increase in the human population. The culture appears to have relied heavily on bison, which were obtained in sophisticated communal kills. The pace of technological change increased as indicated by a succession of three cultural complexes. The youngest of these complexes, Besant, is sometimes associated with finds of Woodland ceramics (Meyer, 2002, p. 4-2).

Table 3-16 Cultural Resource Chronology for the Northern Great Plains

Age (Years B.P.)	Cultural History Chronology Northern Great Plains
1,000 _	Late Prehistoric and Protohistoric (to ca. 200 Years BP)
2,000 _	Late Plains Archaic
3,000 _	Middle Plains Archaic
4,000 _	
5,000 _	
6,000 _	Early Plains Archaic
7,000 _	
8,000 _	
9,000 _	Paleoindian
10,000 _	
11,000 _	

The Besant culture represents a transition from the Late Prehistoric to the Protohistoric period. The technology is typified by use of the bow and arrow and increasing use of ceramics. The number of sites exceeds those of the Late Plains Archaic period and these sites are characterized by a wider variety of cultural types than those from earlier populations. During the latter portions of this time, evidence of numerous incursions of other cultural groups into the region has been discovered. The Protohistoric period is considered to have intended ca. 1800 AD, or with evidence of contact between native peoples and Euro-Americans.

Prehistoric sites are highly variable, but are typified by lithic scatter, camp sites, bison kill sites, lithic procurement areas, and surface stone features. Lithic procurement sites may be either primary (quarries or outcrops) or secondary (redeposited materials).

3.9.1.2 Historic Resources

A number of Native American tribes occupied the grasslands of the Northern Great Plains during historic times. Tribes known to have frequented these areas include the Affiliated Tribes (Mandan, Hidatsa, and Arikara), Cheyenne, Assiniboin, Blackfoot, Crow, Lakota, Pawnee, Chippewa, and Kiowa. Although tribal reservations are maintained in close proximity to some management units of the Northern Great Plains national grasslands, no tribe is closely associated with the TBNG.

The earliest influx of Euro-Americans into the Powder River Basin consisted of small numbers of fur traders, government explorers, military expeditions, and hunting parties. The most heavily traveled routes skirted the western and southern flanks of the basin. The fur trade declined in the late 1830s, but several major emigrant trails passed along the southern edge of the basin. In 1868, the federal government negotiated the Ft. Laramie treaty with native peoples, prohibiting Euro-American settlement or travel through the Powder River Basin or within the Black Hills.

Gold discoveries in the Black Hills in 1874 resulted in an influx of Euro-Americans, breaking the Ft. Laramie treaty and initiating the military subjugation of the native tribes. The Homestead Act of 1862 encouraged settlement. Settlers began cattle grazing on open range in the area of the TBNG during the late 1800s. The harsh winter of 1886-1887 devastated open range cattle herds, changed cattle ranching techniques, and resulted in the initiation of sheep ranching in the area.

Expansion of railroads into northeastern Wyoming brought major changes. Railway expansion resulted in the development of towns along the tracks, such as Lusk, Newcastle, Douglas, and Gillette. Population boomed with the arrival of the railroads and resulted in subdivision of the initial Wyoming counties into smaller, more local units. Campbell County was created from the western portions of Weston and Crook counties in 1911.

Unlike much of Wyoming, dry land farming, principally wheat and hay, was common in Campbell County in the early part of the last century. Drought followed by a severe winter in 1919-1920, brought depression to Wyoming a decade prior to the Great Depression. Many small farmers and ranchers went out of business and the period was marked by a consolidation of land into larger ranches more capable of economic operations. The financial collapse of 1929, followed by five years of drought, continued this consolidation. A number of programs under the Roosevelt administration resulted in repurchase of land from bankrupted settlers and assisted the transition away from farming to a dominantly ranch economy. Population dropped while prosperity improved and many of the older homesteads were abandoned.

Mineral resource development accelerated in the second half of the twentieth century. Coal mining had begun at Cambria near Newcastle in 1889 and continued until 1928. Some marginally economic underground coal mining occurred in the 1920s, to be succeeded by the current era of large surface mines which began in the 1970s. Oil and gas development began in

the late 1940s and development of conventional oil and gas resources peaked in the early 1970s (Meyer, 2002, pp. 5-1 to 5-10; BLM, 2003, pp. 3-211 to 3-213).

3.9.1.3 Survey Results

The bulk of the Project Area is contained within the greater Antelope Creek watershed while the northeastern corner lies within the greater Upper Cheyenne watershed. Cultural survey coverage is greater in the general area than the average for the Powder River Basin because of extensive Class III Inventory block surveys conducted by surface coal mines in the vicinity. Much of the area has a low to medium site density. Overall cultural resource site densities are approximately 4.7 sites per square mile within the Antelope Creek watershed and 5.2 sites per square mile within the Upper Cheyenne watershed. Average site density for the Powder River Basin is 6.1 sites per square mile. Prehistoric sites considered eligible for listing in the National Register of Historic Places (NRHP) comprised 23.0 percent and 9.4 percent, respectively, of total sites known from the two watersheds. Average prehistoric site eligibility probability for the Powder River Basin is 13.0 percent (BLM, 2003, pp. 3-222 to 3-223, p. 4-282). Approximately 1,200 sites have been discovered on the entire TBNG, of which about 160 (13.3 percent) have been determined eligible for listing in the NRHP (USFS, 2001, p. 3-438).

Within the Project Area, 107 cultural resource sites have been identified. Of these, 82 were previously known and evaluated for listing. Five of these sites are eligible for listing in the NRHP. The current Class III Inventory survey discovered 25 new sites. Of these sites, none has been recommended as eligible for listing (McClelland, 2003). Of the total of 107 sites contained within the Project boundary, 61 are exclusively prehistoric in age, 15 contain both prehistoric and historic artifacts, and one site is of unknown age.

Project Area prehistoric sites consist of lithic scatter, camps, a stone ring, faunal remains, and a deflated hearth. In addition, 14 prehistoric Isolated Finds (IFs) were located during the Project fieldwork. In all, 12 temporally diagnostic prehistoric artifacts were collected during the current survey, ten from sites and two as isolated finds. Age of the artifacts ranges from Paleoindian to Late Prehistoric. The Paleoindian specimen is an apparent Goshen/Mill Iron projectile point and may be the oldest cultural material found in the vicinity of the Project (Meyer, 2002, pp. 7-1 to 7-13).

Area historic sites considered eligible for listing in the NRHP comprise 7.9 percent of total sites within the Antelope Creek watershed and 4.8 percent, of total sites within the Upper Cheyenne watershed. Average historic site eligibility probability for the Powder River Basin is 9.6 percent (BLM, 2003, pp. 3-226, 4-282). Of 107 cultural sites located within the Project Area during the current or previous surveys, 30 are solely historic and an additional 15 contain both historic and prehistoric artifacts. One site is of unknown age. Of the historic sites, one is eligible for listing in the NRHP. Historic sites are dominantly homestead or ranch remains (Meyer, 2002, pp. 7-1 to 7-13).

3.9.2 Regulatory Environment

A large number of federal laws and implementing regulations pertain to the evaluation and protection of significant cultural resource properties and preservation of cultural values. Several of these require consultations with local Native American tribes when dealing with applicable antiquities. Among the most significant of these laws and regulations are:

- Antiquities Act of 1906, as amended (16 USC 431-433).
- Preservation of American Antiquities (43 CFR 3).
- National Historic Preservation Act of 1966, Section 106, as amended, (16 USC 470, Executive Order 13007).
- National Register of Historic Places (36 CFR 60).
- National Environmental Policy Act of 1969 (42 USC 4321-4361, 40 CFR 1500-1508).
- Protection and Enhancement of the Cultural Environment, 1971 (Executive Order 11593).
- Federal Land Policy and Management Act of 1976 (43 USC 1701 *et seq.*).
- American Indian Religious Freedom Act Amendments of 1978, as amended (42 USC 1996, 43 CFR 7).
- Archeological Resources Protection Act of 1979, as amended (16 USC 470aa-470ll).
- Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001, 43 CFR 10).

3.9.3 Regulatory Status

Management of cultural resources within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement (USFS, 2001; Cables, 2002) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a). The USFS may make land use decisions that would limit access. A factor in these decisions would be potential effects on Native American cultural values as protected by many of the laws and regulations listed previously. Many natural features of the Great Plains continue to be regarded as places of spiritual and cultural significance to Native Americans.

The 2001 revision of the TBNG RMP (USFS, 2001a, p. 1-28) contains grassland-wide directives for management of cultural resources. One of these directives is a requirement for consultation with designated representatives of federally recognized Native American tribes during project design. As part of the scoping process for the Proposed Action, scoping notices describing the Project and its potential effects were sent to 26 leaders of various interested, recognized tribes as indicated in **Appendix E**.

Recommended mitigation measures relating to cultural resources are also discussed in the PRB FEIS (BLM, 2003, p. 4-394).

3.9.4 Environmental Consequences

No comments or concerns relating to the area of cultural resources were returned from the scoping process, as indicated in **Appendix F**. Impacts to cultural resources were analyzed with respect to the following criteria:

- The loss of NRHP values from sites that would otherwise be eligible for listing.
- Downstream erosion of known or undiscovered sites by increased flow from CBM produced water in perennial streams.
- Increase in unauthorized collection or destruction of artifacts through vandalism.
- Degradation of visual integrity in the area of historic trails from surface-disturbing activities.
- Disturbance of sites of cultural and spiritual significance to Native Americans.

Avoidance of cultural sites is the preferred mitigation (BLM, 2003, p. 4-278).

3.9.4.1 The Proposed Action

Direct Impacts

Potential destructive impacts to eligible cultural resources would occur primarily from road and facilities construction disturbances to undiscovered sites. The entire Project Area has been block surveyed for cultural resources. It is therefore unlikely that construction in previously surveyed areas would disturb resources of significance.

As this EA was in preparation, the USFS expressed concerns regarding potential impacts to cultural sites downstream of discharged produced CBM water. Specifically, concerns were directed to possible sites downstream of the Project Area and the NARC coal mine. The USFS believes that CBM water added to the flows in perennial streams, possibly augmented by storm floods, could damage archeological sites.

Perennial watercourses were areas likely to have been frequented by native peoples. It is possible that high volumes of CBM produced water discharged into existing ephemeral drainages could result in higher water levels and associated increased erosion in receiving perennial streams downstream from the Project Area. Increased erosion could damage or destroy known or undiscovered cultural sites along these streams. However, the volumes of water which would be produced under the Proposed Action are small in comparison to typical storm events, as indicated in the Company's Water Management Plan (Independent Production Company, 2002, p. 16, Appendix G).

Water from the Proposed Action would be stored in reservoirs and beneficially used by the NARC surface coal mine. Maximum net flow anticipated to reach mine reservoirs is approximately 1.51 cfs. This compares to estimated Porcupine Creek storm flows of 12.43 cfs, 27.86 cfs, and 47.44 cfs for 2, 5, and 10 year storm events, respectively. These storm discharge

flows represent only precipitation within the Project Area. Actual flows, which would likely include contributions from drainages upstream of the Project Area, would probably be greater.

High velocity flows associated with storm events are more likely to affect cultural sites than are low flows.

In addition, CBM produced water flow volumes decline rapidly, typically approximately 50 percent annually in the Powder River Basin (Eastern Research Group, 2002, p. 4). Thus, even the erosion associated with these lower flow rates would be very temporary. Finally, water received by the NARC mine would be used mainly for dust suppression and washdown. Most of the produced water would be largely consumed by evaporation or infiltration within or adjacent to the mine, as discussed in more detail in Section 3.3. Any remaining water released by the mine following passage through its Railroad Loop settlement reservoir would be further contained 1.5 miles downstream in the existing 50 acre Porcupine Reservoir.

No historic trails have been identified within the Project Area.

No impacts to Native American cultural values are expected. No concerns regarding the Project have been received from contacted Native American tribes. No sites of cultural or spiritual significance to Native Americans are known to occur within the Project Area.

The discovery and evaluation of 25 previously unknown cultural sites within the Project Area has been a beneficial impact of the Proposed Action.

Indirect Impacts

The development of additional road mileage would increase access to areas previously more isolated, possibly resulting in an increased potential for illegal collecting of artifacts or increased vandalism. These impacts would be reduced through enforcement of the Archeological Resource Protection Act of 1979 by the USFS.

Mitigation

All sites eligible for listing in the National Register of Historic Places will be avoided by the Proposed Action. To ensure that cultural resource sites were identified, the Company has conducted Class I and Class III inventories of the Project Area to determine the location of cultural sites of potential significance. In the event that Project plans were to change, and sites eligible for listing in the NRHP were to be affected, the USFS would be notified. Prior to commencement of any work which could affect the eligible sites, the USFS would develop mitigation plans in consultation with the Wyoming SHPO, the Company, and other appropriate parties consistent with the Company's right to develop its mineral resources.

Surface disturbance would be minimized through the development of common utility corridors often co-located with road ROWs. In the unlikely event that surface disturbing activities uncover previously unknown cultural artifacts, the Company would cease operations at the site of the discovery and notify the USFS or BLM, as appropriate. An evaluation by the appropriate

agency or by an agency-approved archeologist to determine the recommended course of action would be conducted.

The Company would instruct all of its employees and contractors of the importance of protection of cultural resources, would discourage the illegal collection or destruction of antiquities, and would inform such employees and contractors that violations of the Company's policies in this matter could result in dismissal. The Company would instruct its employees and contractors in procedures to be followed in the event of discovery of human remains as required by applicable regulations.

Visual integrity effects would be minimized through the use of small well houses painted appropriately to blend into the landscape. Electrical power to wells would be via buried cables co-located with pipelines.

3.9.4.2 The No Action Alternative

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action Alternative, no additional negative impacts to cultural resources would occur. There would be no possibility that cultural resources would be adversely affected by the unintentional destruction of undiscovered materials that could occur during Project implementation. Conversely, there would be no further documentation of cultural resource materials that might be found as the Project was implemented and mitigation measures were taken. Oil and gas development would continue on state and private lands near the Project Area. Cultural resource materials on those lands would be protected by state regulations.

Failure to implement the Proposed Action would not stop various types of development in the Project Area. It is highly likely that advance of the mine face of existing surface coal mines adjacent to the Project Area will continue for the foreseeable future. Such activity over the next approximately 20 years would result in complete destruction of any uncurated artifacts in or near the Project Area.

3.10 LAND USE, TRANSPORTATION, AND RECREATION

The principal uses of land around the Project Area are rangeland for livestock grazing, mining, oil and gas exploration and production, and recreation. The predominant land uses within the Project Area include surface coal mining activities, rangeland and grasslands. Land ownership consists of federal, state, and private lands. A regional network of state highways, county, and USFS roads provides the basic transportation infrastructure for access to the Project Area.

3.10.1 Affected Environment

3.10.1.1 Land Status

The Project Area lies entirely within southeastern Campbell County in northeastern Wyoming and approximately 1 ¼ miles north of the Campbell County/Converse County line. Many areas of Campbell and Converse counties are undeveloped. The Project Area of approximately 17,940

acres includes approximately 13,069 acres located within the TBNG administered by the USFS. Over 2,000 acres of the Project Area are not leased by the Company. The TBNG occupies over 572,000 acres in a mosaic of state, federal, and private land and located in Campbell, Converse, Crook, Niobrara, and Weston Counties in northeastern Wyoming. The remainder of the Project Area includes 1,393 acres belonging to the State of Wyoming and 1,918 acres owned by private interests.

The center of the Project Area is located approximately 14 miles southeast of Wright, Wyoming, and seven miles east of Wyoming Highway 59 near Teckla, Wyoming. Campbell County has a population of 34,853. Two incorporated communities are located in Campbell County, Gillette and Wright. Gillette has a population of 20,319 while Wright has a population of 1,393. Converse County has a population of 12,052 with about 44 percent of its population located in Douglas, the County seat with a population of 5,288. Glenrock, the second largest city, has a population of 2,231 (US Census, 2001).

3.10.1.2 Land Management and Use

Ranching and minerals development characterize land use activities in Campbell and Converse counties. Coal mining and urban development are focused in specific locations near the Project Area. County governments have jurisdiction over the development of non-public lands.

Federal lands are managed in accordance with applicable laws and land use plans. The plans control the use of public lands for a variety of activities. Plans are updated periodically to respond to changing conditions and resource values. The Project Area is located on lands analyzed by the Wyodak Drainage EA in 2001 and completely within the area evaluated by the Powder River Basin Oil and Gas Project EIS in 2003. A revised land use management plan was prepared for the TBNG in 2001, the *Thunder Basin National Grassland Land and Resource Management Plan 2001 Revision* and the *FEIS for the Northern Great Plains Management Plans Revision,* for which a ROD (Cables 2002) was subsequently issued.

The 2001 RMP describes, in general terms, the desired condition of the TBNG and allocates land into Management Areas. Management Areas are defined by the resources that could be optimally administered from a portion of the surface or subsurface in a given location. Each Management Area is described in terms of resource goals, objectives, standards, and guidelines that guide implementation of projects within the area. The mix of Management Area prescriptions in the 2001 RMP provides for continued coal, oil and gas development, livestock grazing, and other uses. The management direction for minerals on the TBNG lands within the Project Area is detailed in the 2001 RMP.

Due to arid conditions and limited soil and water resources, livestock grazing represents the primary form of agriculture in the general Project Area. Grazing occurs on a year-round basis. The average size ranch in Campbell County is 4,500 acres. No irrigated lands are located in the Project Area (USFS, 2003). Six operators graze livestock on both private and public land within the Project Area. **Table 3-17** summarizes the allotments.

Table 3-17 Project Area Grazing Allotments

Allotment Number	Allotment Name	USFS Acres	State Acres	Private Acres	Total Acres	USFS Animal Unit Months	USFS Acres per AUM
9215	Blow Out	642	0	330	972	150	4.2
9223	Mackey	3,276	0	1,390	4,666	755	4.34
9240	School Creek	15,302	2,111	5,913	23,326	3,467	4.41
9242	South Wright	990	0	0	990	153	6.47
9264	Wilkinson	2,543	920	1,024	4,487	514	4.95
9280	Booster	975	0	617	1,592	258	3.78
9281	South Turner	2,050	101	45	2,196	373	5.5
9282	North Turner	849	0	0	849	168	5.05
9284	Tanner Draw	1,435	0	157	1,592	203	7.07
9286	Briggs Draw	643	1,126	0	1,769	64	10.05

Source: (USFS, personal communication, 2003)

Coal mining and production of oil and gas are the leading industries in Campbell County. Campbell County produces over 25 percent of all coal nationally and is the largest oil producing county in Wyoming. Campbell County is often referred to as the "Energy Capital of the United States (Campbell County, 2003). Conventional oil and gas resources have been developed in and around the Project Area. Some CBM development has occurred near and to the west of the Project Area. One pilot CBM well has been drilled in the Project Area, but has been shut in. There are three surface coal mines in the Project Area that extract coal beneath the existing surface. These mines include the Peabody Energy (Powder River Coal Company) North Antelope/Rochelle Complex (NARC) to the immediate southeast of the Project Area, the Triton Coal Company North Rochelle Mine located northeast of the planned production area and the Kennecott (Antelope Coal Company) Antelope Mine located to the southwest.

3.10.1.3 Roads and Access

Surface transportation in Campbell County and Converse County is provided by a network of state, county, local, and primitive roads. The town of Douglas is located on Interstate 25. North from Douglas to Gillette, State Highway 59 travels past Wright and the Project Area, which is located several miles to the east. Both counties are served by a network of county-maintained gravel roads. Figure 1-1 shows the Project Area in relation to primary access roads.

Traffic in and around the Project Area is primarily associated with current coal mining activities and some conventional oil and gas activities. The Project Area is reached via Wyoming Highway 59, which connects Gillette to the northwest of the Project Area to Douglas to the south. Campbell County-maintained roads provide the main access corridors to the Project Area itself. County-maintained all-weather roads are both paved and surfaced with aggregate. The Project Area lies mostly south of the Edwards and Reno county roads, which provide entry to the northern part of the Project Area. Antelope county road accesses the Project from the south and crosses the western portion of the Project Area. Mackey county road provides access to the eastern portion of the Project Area, which is located north of the NARC surface coal mine. Matheson county road serves the western portion of the Project Area, west of the railroad line, and links Antelope and Edwards roads. Limited access to the far northeastern portion of the

Project Area is provided by USFS Road 934 (Payne Road). Maintenance for State roads are provided by Wyoming Department of Transportation, maintenance for County Roads are provided by Campbell County and maintenance for USFS roads are provided by the USFS.

County-maintained roads provide numerous connections to a network of USFS local roads. Approximately 131.24 miles of existing roads exist within the Project Area. This network would provide the principal existing access to the vicinity of drilling locations or to the locations themselves. New roads proposed for this Project would branch mainly from the USFS road network.

The large surface coal mines in the Project Area have resulted in development of extensive railroad facilities for transportation of coal. A main line of the Burlington Northern/Santa Fe railroad crosses the western portion of the Project Area in a north-south direction. This line separates roads in the westernmost portion of the Project Area from those roads further east. The western portion of the Project Area contains the locations for over proposed 30 wells and the location for one of the first stage compressor stations. Matheson and Edwards county roads provide access across the railroad track allowing linkage of the western and eastern portions of the Project Area.

3.10.1.4 Recreation

Public land on and adjacent to the Project Area is an important recreational resource for local residents and nonresidents. These areas offer a wide variety of recreational opportunities in diverse settings, including hunting and bird watching. While only limited recreational use data are available for the Project Area, these activities are the predominant recreational activity. No developed recreation sites occur in the Project Area (USFS, 1991).

The principal recreational activity in the vicinity of the Project Area is probably hunting. Impacts on hunting success are difficult to estimate. Increased road mileage would improve access to the Project Area, potentially increasing game harvest. Conversely, construction activities associated with Project development could cause pronghorn and mule deer to avoid certain areas. Development activities beyond the Project Area could also result in displacement of big game onto undeveloped or post-development portions of the Project Area. Increased Project-associated vehicular traffic may result in some increased mortality of game animals. Long-term effects on hunting success, however, are expected to be minimal or non-existent.

3.10.2 Environmental Consequences

3.10.2.1 The Proposed Action

Impacts to land use as a result of implementing the Proposed Action would be small. A relatively small amount of surface would be impacted by the project. Existing land uses would be able to continue without much effect. The Company has committed to the implementation of mitigation measures that would further minimize impacts.

The proposed short-term and long-term improvements of the Proposed Action would have minor on-site and off-site land use impacts, but each new well and/or associated facility would be subject to review under applicable programs, policies and procedures implemented by the USFS and BLM intended to avoid and/or minimize impacts at the site. Implementation of the Proposed Project is consistent with land use policies developed in the 2001 RMP (USFS, 2001a).

Implementation of the Proposed Action would result in short-term and long-term disturbances to the surface. Short-term disturbance would affect approximately 938 acres or five percent of the Project Area. Most of it would be associated with the construction of pipelines and roads. Interim reclamation would occur after a well is drilled, completed, and pipelines and compressor stations are installed. Interim reclamation would restore areas not needed for production to their original state, or as close as possible. After interim reclamation takes place, the Proposed Action's disturbance would be reduced to approximately 114 acres for the long term, about 0.6 percent of the Project Area. Long-term disturbance would include approximately 72 acres on USFS surface, 14 acres on State of Wyoming surface, and 28 acres on private surface. Roads comprise most of the long-term disturbance.

Long-term disturbance of federal surface would approximate 72 acres; however, grazing use on these lands should not be greatly affected. Grazing will continue to take place on existing leases. The Company would coordinate project activities with ranching operations to minimize conflicts and would maintain all fences, cattle guards, etc., required for the Company's transportation network. The 72 acres of long-term disturbance on federal land would result in a loss of approximately 13.1 AUMs, or 0.2 percent of the total of 6,105 AUMs available in the Big Porcupine project area. Reclamation during and after each well is plugged and abandoned would return disturbed lands to pre-disturbance production for livestock grazing.

Although no direct impacts to irrigated agricultural lands are anticipated within the Project Area due to the absence of such lands in the Project Area, some lands along Antelope Creek downstream from its confluence with Porcupine Creek have been irrigated in the past. The reported range of SAR values of 5.2 to 6.4 for representative water samples from three wells into the Wyodak coal seam located adjacent to the Project Area indicate irrigation water taken directly from these wells would not result in adverse impacts to soil structure and vegetation. The produced water's discharge into the Porcupine Creek watershed above Antelope Creek should also result in the dilution of these SAR values to levels lower than the range presented above.

The BLM (2003, page 4-293) also reported a range of tolerance by field crops to salinity measured as EC in irrigation water of 0.7 to 5.3 mmhos/cm. Salinity levels for the three wells noted above range from 0.6 to 1.3 mmhos/cm; this range of EC falls well within the range of tolerance by field crops. Both SAR and salinity levels in drainages conveying produced waters from CBM wells in the Project Area would not be expected to have any adverse impacts to lands and crops should lands be irrigated downstream along Antelope Creek.

Hunting opportunities for pronghorn, mule deer and game bird and bird watching activities on the Big Porcupine project area may be increased because of increased access to the area resulting from newly built Project roads. Legal access to federal land would not be restricted or

eliminated. On the other hand, hunting may diminish near active drilling locations for safety and aesthetic considerations (i.e., hunters may choose to hunt in other areas with less industrial development).

There would be intermittent and temporary increased use of county roads to gain access to the Project Area, increasing traffic in the daylight hours. There could be an associated increase in accidents on state highways and county roads. The increase in traffic would reflect the level of drilling activity over the life of the project. After the wells are drilled, the increase in traffic would subside as telemetry equipment would limit trips to the well sties for routine operations. Existing ROWs would be respected, and ROW holders would be notified before any actions occur within such ROWs.

Mitigation

Surface disturbances will be minimized to the extent feasible by co-locating constructed roads and utility corridors within common or adjoining rights-of-way. Where roads or pipelines must cross wetland or riparian areas, crossings will be made as close as practical to a perpendicular direction to minimize disturbance. The Company will monitor constructed facilities within the Project Area for the spread of noxious weeds and will take control measures as approved by the USFS or BLM. Cattle guards will be installed on Project roads where appropriate. All constructed roads not required for long-term management activities by the USFS would be reclaimed at the end of the Project. Reclamation efforts would use seed mixtures approved by the USFS or BLM and certified as being weed free.

3.10.2.2 The No Action Alternative

Under the No Action Alternative, no land use changes would occur on federal land as a result of CBM development associated with the Project. Hunters would not be able to use new roads for increased access, but there would be no hindrance to hunting from well site activities. No AUMs would be lost on USFS lands. CBM development would probably continue on adjacent private and state lands. Effects of that development on those lands would be similar to the effects resulting from the implementation of the Proposed Action.

3.11 VISUAL RESOURCES

3.11.1 Affected Environment

The landscape of the Project Area is dominated by fairly level plains with slopes predominantly of less than 15 percent (USFS, 2001, p. 2-21). The level to rolling surface is covered mostly by grasslands and sagebrush-dominated grasslands. Most of the Project Area's landscape is comprised of scenery that is common for the region (BLM, 2003, p. 3-252).

The USFS-administered lands within the Project Area are classified by the USFS using the Scenery Management System (USFS, 1996) as "low" in terms of scenic integrity level (USFS,

2001, Scenic Integrity Objective (SIO) Map, Chapter 2). The classification of low indicates the mostly grassland plains landscapes of the USFS lands within the Project Area appear moderately altered by oil, gas, and mineral (coal) development, and to a lesser extent, some grazing improvements such as fences and stock water impoundments (BLM, 2003, p. 3-258). Additional modifications to the landscape from new activities in areas of low scenic integrity should be compatible or complementary to the landscape character.

Human activity currently affecting the landscape and visual quality in the Project Area includes highways, roads, railroads, residential structures, electrical transmission and distribution lines, electrical substation, pipeline ROWs, existing oil and gas facilities, and surface coal mine related features.

3.11.2 Regulatory Environment

Laws and regulations dealing with management and protection of visual resources include:

- The Multiple Use Sustained Yield Act of 1960.
- Forest and Rangeland Renewable Resources Planning Act of 1974 (16 USC 1601-1610).
- Federal Land Policy and Management Act of 1976 (FLPMA), (43 USC 1701 et seq., 43 CFR 3809).
- National Forest Management Act of 1976, as amended (16 USC 1600 et seq., 36 CFR 219.6).
- USFS Manual, Chapter 2380, Landscape Management.

3.11.3 Regulatory Status

Management of visual resources within the TBNG is determined by policy directives contained in the Northern Great Plains Management Plans Revision Final Environmental Impact Statement (USFS, 2001) and the Land and Resource Management Plan for the Thunder Basin National Grassland (USFS, 2001a).

Recommended mitigation measures relating to visual resources are also discussed in the Powder River Basin Oil and Gas FEIS (BLM, 2003, p. 4-403).

3.11.4 Environmental Consequences

3.11.4.1 The Proposed Action

Direct/Indirect Impacts

Implementation of the Proposed Action in the Project Area would add additional facilities and linear features such as pipeline ROWs and power lines to the existing landscape that already supports facilities/features of oil and gas development, power lines, transportation (roads and railroads), livestock grazing, and coal mining. Scenery management guidelines for the TBNG are to manage activities to be consistent with the SIOs for a management area. USFS-

administered lands within the Project Area are designated as Management Area 8.4 (Mineral Production and Development).

The desired condition for landscapes in this management area is that facilities and landscape modifications can be visible, but are reasonably mitigated to blend and harmonize with natural features. Onsite inspections for the Proposed Action have been completed that finalized locations for all facilities/features. Scenic integrity was a factor that was taken into consideration as part of the final siting of facilities/features by the USFS and Company. Therefore, the addition of additional facilities/features that are similar to those already present within the Project Area would result in minimal impacts to the scenic integrity of the Project Area.

Mitigation

Consistent with the USFS standard COAs indicated in **Appendix C**, the Company would paint facilities with standard environmental colors approved by the USFS or the BLM. Electrical power lines required for operation of individual wells (480 volt) would be buried with pipelines in common utility corridors rather than being erected on above ground poles.

3.11.4.2 The No Action Alternative

If none of the proposed activities were to occur on federal lands as a result of implementing the No Action Alternative, adverse impacts to visual resources in the Project Area in addition to the existing impacts would not occur. Conventional oil and gas development would continue within the Project Area, and CBM development would continue on state and private lands near the Project Area. Ranching-associated impacts would likely continue at their present magnitude. Surface coal mining is likely to continue adjacent to and within the Project Area for the foreseeable future. All of the above continuing actions would add facilities to state and private lands that are consistent with those types of facilities present on federal, state, and private lands within the Project Area.

3.12 NOISE

3.12.1 Affected Environment

Noise is generally described as unwanted sound. Discussions of environmental noise do not focus on pure tones because commonly heard sounds have complex frequency and pressure characteristics. Accordingly, sound measurement equipment has been designed to account for the sensitivity of human hearing to different frequencies. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. For measuring noise in ordinary environments, A-weighted correction factors are employed. The filter de-emphasizes the very low and very high frequencies of sound in a manner similar to the response of the human ear. Therefore, the A-weighted decibel (dBA) is a good correlation to a human's subjective reaction to noise (BLM, 2003 page 3-274).

The dBA measurement is on a logarithmic scale. The apparent increase in "loudness" doubles for every 10 dBA increase in noise (Bell, 1982). Taking a baseline noise level of 50 dBA in a daytime residential area, noise of 60 dBA would be twice as loud, 70 dBA would be four times as loud, and 80 dBA would be eight times as loud. Sound levels associated with field operations and other environments are shown in **Table 3-18**.

Table 3-18 Sound Levels Associated With Noise Environments and Field Operations

Noise Source	Scale of A-weighted Sound Level (dBA)	Human Judgment of Noise Loudness (relative to a reference loudness of 50 dB*)
Typical CBM construction site at 50 feet	85	*approximately 16 times as loud
Well drilling operations/ pumpjack operation at 50 feet	82 – 86	
Gas compressor operations at 50 feet	76-77	
Diesel truck, 40 mph at 50 feet	75	*approximately 8 times as loud
Produced water injection facility at 50 feet	71	
Large, busy department store	60	
Light traffic at 50 feet	56	*approximately 2 times as loud
Rural area daytime	45+	Reference loudness
Rural area at night	35+	Quiet *1/2 as loud
Human voice whisper at 5 feet	20	Very quiet

*These values are logarithmic measurements (i.e., every 10-dBA increase is perceived by the human ear as approximately twice the previous noise level; therefore, drilling operations are about twice as loud as an injection facility). Source: Compiled from BLM 2003 page 3-274; BLM 2000b; SAIC, 2002; USGS 1981
+Corrected for high winds.

The Inverse Square Law of Noise Propagation that states that sound level intensity decreases by approximately 6 dBA with every doubling of the distance from the source. Further reduction occurs when sound energy travels far enough to be appreciably reduced by absorption (Harris, 1991).

3.12.1.1 Existing Noise Levels

The major sources of ambient noise are industrial facilities that currently exist in the area, including operating wells, traffic noise from county roads, and frequent high winds. Background noise surveys were not conducted in the project area.

The anticipated noise level in rural areas is approximately 40 dBA during the day and 30 dBA during the night. These noise levels assume that these rural areas are distant from transportation corridors (highways and railroads) and populated areas and that the wind speed is very low. However, the wind speed within the project area is generally high. A review of the climatology from the Casper Airport shows that the wind speed exceeds 8 miles per hour (mph) 80 percent of the time between the hours of 7:00 a.m. to 10:00 p.m., and 67 percent of the time from 10:00 p.m. to 7:00 a.m. Noise is not usually measured when the wind exceeds 8 mph because the noise produced by the wind is generally the dominant source. Therefore, the estimated existing noise levels are conservative and are most likely 5-10 dBA higher during normal windy conditions in

Wyoming. For the purpose of this discussion, rural background noise was conservatively estimated to be 45 dBA during the day and 35 dBA at night (BLM, 2003 Chapter 3).

Levels of noise close to currently existing industrial facilities and transportation corridors are likely to be in the range of 50 to 70 dBA, depending on the proximity to these sources. The most significant noise source from CBM operations results from the operation of compressor stations. Noise from these compressor stations has been estimated to be 55 dBA at 600 feet (corresponding to 76 dBA at 50 feet) from the compressor station (BLM, 2000b).

Noise Receptors

The land uses in the Big Porcupine CBM Project Area range from sparsely populated rural regions to industrial areas, including coal mining and CBM operations. Noise receptors in the Project Area include the town of Teckla located in Section 2 T41N and R71W and the Wilkenson Ranch located in Section 26 T42N and R71W. Other temporary or transient receptors that may be exposed to noise in the Project Area could include hunters and other recreational users, coal mine personnel, and CBM operation field workers.

3.12.2 Regulatory Environment

EPA has established a level of 55 dBA as a guideline for acceptable environmental noise for outdoor locations "in which quiet is a basis for use" (EPA, 1974). To substantiate this noise level as acceptable near a compressor station, the Federal Energy Regulatory Commission (FERC) established 55 dBA as the criterion for the maximum noise level that can be allowed from a new compressor station at sensitive receptors such as residences, schools, medical facilities, and recreational areas. This noise level was assigned to be protective of public health and welfare.

Laws or regulations on acceptable noise limits have not been established by the State of Wyoming.

3.12.3 Environmental Consequences

Scoping identified the possible increase in noise levels associated with operation of gas compressors and its potential to negatively affect human and animal life as an area of concern.

3.12.3.1 The Proposed Action

The purpose of the noise analysis in this EA is to estimate and characterize construction and operational impacts resulting from the Proposed Action and the No Action Alternative. Detailed predictive noise modeling to precisely define future noise levels was not considered necessary.

The primary source of potential noise impacts resulting from the Proposed Action would be from the construction and operation of the five first stage and one second and third stage compressor stations. The compressor stations are identified in the following **Table 3-19** and are shown on

Figure 2-2. The compressor stations may include from one to six engines at each location, although not more than eight total first stage compressors are anticipated to be operational for the Proposed Action, but for the noise impacts discussed in this section, it is assumed that each compressor station would have six engines running simultaneously.

Table 3-19 Proposed Compressor Station Locations

Compressor Station	Location	Description
1st. Stage		
17-42-70	NW/NW/SE Sec 17 T42,R70	1-6 350-Horsepower Engines
29-42-70	SE/SW/NW Sec 29 T42,R70	1-6 350-Horsepower Engines
13-42-71	SW/SW/SW Sec 13 T42,R71	1-6 350-Horsepower Engines
1-41-71	SW/NW/NW Sec 1 T41,R71	1-6 350-Horsepower Engines
12-41-71	SW/NW/SW Sec 12 T41,R71	1-6 350-Horsepower Engines
2nd and 3rd.Stage		
23-42-71	SW/SW/NE Sec 23 T42,R71	1-6 1650-Horsepower Engines

Additional noise would also result from road and well pad construction and increased traffic associated with CBM maintenance operations. Late in the producing life of some wells, the individual wells may have low-power blower compressors installed. These are run by electric motors of 5 horsepower or less and are completely enclosed within the well housing. Therefore, no noise impacts are expected from installation of blower compressors.

Construction Noise Impacts

The primary source of construction noise impacts resulting from the Proposed Action would be from drilling operations and construction compressor stations. Additional noise would also result from road and well pad construction and increased traffic associated with these activities.

Noise impacts during the construction phase would be temporary at any location and would result from vehicles and the operation of construction equipment. Individual construction sites would be sufficiently widespread so that elevated noise levels from each site would not overlap in time or space with other sites. Based on an average noise level of 85 dBA measured at 50 feet from a typical CBM construction site, the expected noise levels was estimated between the nearest receptor to a construction site, the compressor Booster Station 1-41-71 and the community of Teckla. The distance between the two is approximately 2,100 feet. Using the Inverse Square Law of Noise Propagation, the expected noise level at Teckla is approximately 53 dBA. See **Table 3-20.** The noise level is lower than the EPA noise guidelines. Therefore, no human receptors are expected to be impacted by construction activities.

Table 3-20 Reduction of Sound Level Intensity of a Construction-Related Source as a Function of Receptor Distance

Distance feet	dBA
50	85
100	79
200	73
400	67
800	61
1600	55
3200	49

Nighttime noise levels would remain at existing levels because construction would not occur at night.

Noise during the drilling phase would also be elevated above pre-existing levels. Typically, the noise from a drilling rig is 74 dBA at 200 feet from the rig (USGS, 1981). Noise emanating from drilling rigs would decrease to 60 dBA at 1,000 feet, to 57 dBA at 1,500 feet, and to 54 dBA at 2,000 feet. Any residences within 1,500 feet of a drilling rig would experience noise levels above 55 dBA for the 1 to 4 days anticipated to drill the natural gas wells. The town of Teckla is located approximately 700 feet from several potential well sites. While these wells are being constructed, Teckla may experience noise levels up to 63 dBA for 1 to 4 days for each well that is drilled.

The impacts to temporary or transient receptors such as hunters would be dependent on their distance from the construction and drilling operations. In most cases hunters and other recreational users probably avoid areas with activity and would not be within a half a mile from construction and drilling operations and would not be exposed to levels above 55 dBA.

Operational Noise Impacts

The primary source of operational noise impacts resulting from the Proposed Action would be from the operation of compressor stations. Additional noise would also result from increased traffic associated with CBM maintenance operations.

The highest operational noise would occur around the six booster and one main compressor stations. Small booster compressor engines rated at 350 horsepower would be operated to gather natural gas from wells to the larger compressor stations. A maximum of six booster compressor engines could be operated at any location. At the main compressor station, large reciprocating engines rated at 1,650 horsepower would be installed to facilitate transmission of natural gas to high-pressure transmission pipelines. Three or six of the larger engines would be installed at the main location.

Noise has been measured at typical compressor units. A noise level of 77 dBA from one large compressor engine can be expected at 50 feet from a compressor building since all compressors would be installed in enclosed buildings because of the harsh Wyoming winter weather. Noise

from the smaller booster compressor engines would be slightly lower or approximately 73 dBA at 50 feet (USGS, 1981).

The effect of multiple noise sources in not arithmetically additive, but rather is a logarithmic addition. The total effect of multiple collocated noise sources can be estimated mathematically (Harris, 1991). Using the established mathematical relationship, the overall noise level of six large (second and third stage) compressor engines operating simultaneously with a source noise of 77 dBA from each engine was calculated. The resultant overall source noise level would be 84.8 dBA at 50 feet from the enclosure building (**Table 3-21**). The overall noise from a compressor station with three engines would be 81.8 dBA at 50 feet. For the smaller first stage engines, the overall noise would be 80.8 dBA at 50 feet for six engines, and 77.8 dBA at 50 feet for three engines.

Table 3-21. Reduction of Sound Level Intensity at a Main Compressor Station as a Function of Receptor Distance

Distance (feet)	Noise from 6 Reciprocating Engines at Distance (dBA)	Noise above Night Rural Background (35 dBA)
50	85	50
100	79	44
200	73	38
400	67	32
800	61	26
1600	55	20
3200	49	14
9000	40	5

The closest human receptor to the second and third stage compressor station would be located at the Wilkenson Ranch, 4,200 feet away. The absolute noise level from the main reciprocating compressor station would be below 55 dBA at the ranch (Table 3-21). There is no reason to suspect that the public health and welfare of the general population would be at risk from any of the identified effects of noise at the level beyond 1,600 feet from the largest proposed PRB compressor station. Noise from the second and third stage compressor station would be noticed or audible at distances within 2,800 feet of the compressor station during the daytime and at 9,000 feet from the compressor station during the nighttime hours. No significant noise impacts are expected to occur from operating the second and third stage compressor station.

Noise impacts from the first stage compressor stations (six booster compressor engines) are similar to those from the main station but are less (**Tables 3-21 and 3-22**). Generally, noise from booster compressor engines would be about 4 dBA lower than for the larger compressor engines.

Table 3-22 Reduction of Sound Level Intensity of a First Stage Compressor Station as a Function of Receptor Distance

Distance (feet)	Noise from 6 Booster Engines at distance (dBA)	Noise above Night Rural Background (35 dBA)
50	81	46
100	75	40
200	69	34
400	63	28
800	57	22
1600	51	16
3200	45	10
9000	36	1

The closest human receptor to a first stage compressor station would be located at the Wilkenson Ranch or the town of Teckla. The ranch is 7,700 feet from first stage compressor station 13-42-71 and the town of Teckla is located approximately 2,100 feet from first stage compressor station 1-41-71. The absolute noise levels from these compressor stations would be well below 55 dBA at these receptor locations. There is no reason to suspect that the public health and welfare of the general population would be at risk from any at this level of the identified effects of noise beyond 1,000 feet from a booster compressor station. As long as the first stage compressor stations are constructed at least 1,000 feet from existing residences, no significant noise impacts would occur. However, noise from these compressor engines would be noticed or audible at distances within 1,800 feet from the compressor station during the daytime and 6,500 feet from the compressor station during the nighttime hours. No significant noise impacts are expected to occur from operating a first stage compressor station.

Under the Proposed Action, truck traffic may increase slightly in association with CBM maintenance activities. Truck traffic will be infrequent, short in duration, and the associated noise levels are considerably less than that of the compressor stations previously discussed. Impacts from traffic noise are expected to be minimal.

Temporary or transient receptors such as hunters could be exposed to noise levels above 55 dBA. Actual noise exposure levels would be dependent on their distance from the compressor stations. Hunters and other recreational users are not expected to spend extended periods of time in the vicinity of any of the compressor stations, and, therefore, the impact from exposure to noise levels from compressor stations and other CBM operations are expected to be minimal.

Mitigation

Based on the location of the noise receptors no noise mitigation measures are recommended. The compressor stations will be housed in buildings that would decrease the perceived noise levels. Routine maintenance of the engines would ensure they run properly. If, upon construction, noise from one of the compressor stations requires mitigation to protect human health and welfare of the general public, mufflers, constructed sound barriers, or some other mitigation technology may be implemented.

3.12.3.2 The No Action Alternative

The No Action Alternative is included for comparative purposes only. Should the federal action be denied, noise associated with construction and operational activities associated with the Project would not occur.

The noise impacts associated with existing industrial activities and transportation corridors, however, would still be present. Noise impacts associated with coal mining operations and roads, highways, and trains in the project area may increase as mining activities move into and expand over the project area.

3.13 SOCIOECONOMICS

3.13.1 Affected Environment

The region of economic influence from the Proposed Action includes Campbell and Converse counties. The Proposed Action is located in southern Campbell County. The southern boundary of the Project Area is located immediately north of Converse County. The cities of Gillette, Wright, and Douglas would be directly affected by increased CBM activity because of their proximity to the Project Area. Suppliers and workers would likely be located in or near these cities. Gillette and Wright are incorporated municipalities in Campbell County. Gillette, the county seat, is located in the northern portion of the county, approximately 50 miles north of the center of the Project Area, and is the county's largest city. Wright is located in southern Campbell County about 20 miles northwest of the central Project Area. The majority of economic impacts from the Proposed Action would likely occur to Campbell County.

Douglas, the county seat and largest city in Converse County, would also likely be affected by development of the Proposed Action. Douglas is located approximately 60 miles south of the central Project Area. Economic impacts to Converse County would likely be less than those to Campbell County.

Wyoming Highway 59 provides the principal north-south transportation in the vicinity of the Project Area. Interstate Highway 90 provides east-west travel from Gillette, while Interstate Highway 25 provides access from Cheyenne to Casper through Douglas. Several railroads in the vicinity transport large volumes of coal from surface mines near the Project Area.

3.13.1.1 Demographics

Table 3-23 provides population data for Campbell and Converse counties and their primary cities (WDAI, 2000, online data), as well as their growth rates since the 1990 census. Campbell County displays a slightly higher rate of population growth (14.7 percent) than does Converse County (8.3 percent). The State of Wyoming displayed a growth rate of 8.9 percent over the same 10-year period. Slightly more than half of Wyoming's population growth occurred in rural

areas (outside incorporated cities) (Taylor, 2002, p. 4). Wyoming's population is projected to increase at 0.5 percent per year (WDAI, 1999, online data) in the near future.

Table 3-23 Campbell County and Converse County Population Statistics, 1990-2000

County and City	1990	2000	Growth Rate 1990 - 2000 (percent)	Annual Change 1990-2000 (percent)
Campbell County	29,370	33,698	14.7	1.47
Gillette	17,635	19,646	11.4	1.14
Wright	1,236	1,347	9.0	0.90
Converse County	11,128	12,052	8.3	0.80
Douglas	5,076	5,288	4.2	0.40

Source: WDAI, 2003.

In 2000, the city of Gillette contained 58 percent and Wright contained approximately 4 percent of the population of Campbell County. The city of Douglas contained approximately 44 percent of the population of Converse County. Converse County can be described, therefore, as predominantly rural.

Population growth is caused by either the natural increase resulting from more births than deaths or by a net immigration of individuals from outside the area. In Campbell County, approximately 80 percent of its 1990 – 2000 population growth was attributed to a natural increase while approximately 20 percent was attributed to migrations into the county. Converse County's increase was attributed approximately 60 percent to natural increase and 40 percent to immigration (Taylor, 2002, p. 3).

The populations of both Campbell and Converse counties are primarily European American, 96 percent and 95 percent respectively. Each county contains small populations of African Americans, Asian Americans, Native Americans, and others (WDAI, 2000).

3.13.1.2 Economic Activity

Wyoming's economy reached the bottom of an energy bust in 1987 and started to recover thereafter. The recovery began to slow in 1996. The state economic forecast is for slow growth through 2008 (WDAI, 1999, online data). The primary economic activities in Campbell and Converse Counties are based upon minerals extraction, including coal mining and oil and gas production. Ranching and farming are also important.

Campbell County is supported by coal mining, oil and gas production, mining service activities and agriculture. The manufacturing sector is growing (WDOE, 1998a, online data; NEWEDC, 2003, online data). Most new business entries are energy related (CCEDC, 2001, online data). Wyoming is the top coal producing state in the United States, and more than 90 percent of Wyoming coal comes from Campbell County (CCCC, 1998, online data). Coal production from the county in 2000 was 299,650,294 tons, an increase of 1.82 percent from the previous year

(CCEDC, 2001, online data). **Table 3-24** indicates the trends of earnings and employment for the mining sector (including coal, oil, and natural gas production) from 1995 through 1999.

Table 3-24 Mining Sector Economic Activity

Industry Earnings (Thousands Of Dollars)					
	1995	**1996**	**1997**	**1998**	**1999**
Wyoming	$1,093,728	$1,010,725	$1,129,845	$1,152,376	$1,148,023
Campbell Co.	$259,397	$263,694	$268,415	$282,910	$295,139
Converse Co	$34,755	$38,177	$39,502	$41,533	$36,032
Total Employment (Numbers Of Jobs)					
	1995	**1996**	**1997**	**1998**	**1999**
Wyoming	19,096	17,749	18,914	18,589	17,811
Campbell Co.	4,430	4,407	4,485	4,598	4,832
Converse Co.	768	818	849	855	727

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Campbell County accounts for approximately 25 percent of annual Wyoming oil production and for approximately 95 percent of state CBM production (BLM, 2002, fig. 62, 68). Conventional oil and gas production in the county declined by about 8 percent from 2001 to 2002, as companies reduced expenditures designed to increase production (CCEDC, 2001, online data). The main industry focus in the county has been on the recent dramatic efforts at developing CBM resources. By August 2000, Campbell County contained 3,390 producing CBM wells with another 1,953 wells about to commence production (WGS, 2001, p. 8). In August 2000 the Wyoming Geological Survey estimated recoverable CBM reserves in the Powder River Basin to be approximately 25 trillion cubic feet and forecast 2 billion cubic feet per day (bcfd) production rates from an estimated 35,000 future wells. The Survey further estimated Basin CBM production life at 35 to 37 years (CCEDC, 2001, online data).

Much of this development is expected to occur within Campbell County. CBM production, however, is not expected to yield an increase in employment comparable to previous energy booms. This is because CBM is extracted from shallow wells using truck-mounted drilling rigs, resulting in quick and relatively simple drilling operations (Foulke et al., 2001, online data).

The State of Wyoming benefits from revenue obtained from CBM development through several taxes. Revenues are based on the value of the gas produced, which is dependent upon its selling price and upon ownership of the mineral estate. Revenues are received from:

- Severance taxes of 6 percent of the value on all gas produced, which goes to the State's General Fund.
- Royalties from gas produced from State of Wyoming leases (typically 16.67 percent royalty rate).
- Lease bonuses, which go to the state's Permanent Mineral Trust Fund.
- Half of federal lease bonuses.
- Half of the royalty from gas produced from federal lands (half of the standard federal 12.5 percent royalty rate).

- Sales and use taxes from the purchase of equipment associated with development activities (WSGS, 2001, pp. 17-18).

The total taxable production of oil and gas for Wyoming in 2000 was 58,020,990 barrels and 1,294,152,091 million cubic feet respectively. The assessed value of this production was $1,438,975,976 for oil and $3,365,840,728 for gas. In recent years, state tax revenues from Campbell County from coal and crude and stripper oil production have been the highest in Wyoming (BLM, 2003, pg. 3-285). The total mineral income to Wyoming for fiscal years 1997 through 2001 is shown in **Table 3-25** (WDAI, 2002, p. 37).

Table 3-25 Wyoming Mineral Income - Fiscal Years 1997 – 2001

Source	1997	1998	1999	2000	2001
Ad Valorem Taxes	$267,438,424	$263,271,161	$224,308,663	$265,433,379	$413,354,190
Severance Taxes	$232,779,079	$227,535,416	$196,459,204	$275,122,976	$447,973,278
Federal Mineral Royalties	$238,346,960	$223,251,695	$231,029,084	$309,092,848	$448,120,028
State Mineral Royalties	$29,800,814	$28,962,025	$27,720,888	$34,099,206	$56,020,765
Sales and Use Taxes	$35,515,973	$34,824,144	$28,800,218	$29,491,611	$44,024,305
State Rentals and Fees	$4,441,102	$5,720,602	$6,747,746	$8,434,827	$12,702,754
Total	$808,322,352	$783,565,043	$715,065,803	$921,674,847	$1,422,195,320

Sources: Wyoming Department of Administration & Information: Economic Analysis Division; Wyoming Department of Revenue, Mineral Tax Division; Wyoming State Lands and Investments Office; and Wyoming State Treasurer's Office; Consensus Revenue Estimating Group.

Campbell County also has a rich history of ranching and farming. In 1998, the county livestock population was estimated at 86,000 cattle and 37,000 sheep. Acreage in crops was estimated at 91,800 acres total, including hay, oats, wheat and barley.

Other economic activities in Converse County include ranching, coal, oil and natural gas production, railroads and other transportation, and tourism. Growth industries in Converse County include business services, construction, retail and wholesale trade, and mining (WDOE, 1998a; online data, NEWEDC, 2003, online data).

3.13.1.3 Employment and Income

Wyoming has experienced an average labor force growth of 15.0 percent since 1990. The State of Wyoming's average unemployment rate for 2001 was 3.9 percent, with an average labor force of 271,262 (WDOE, 2001b, online data).

Table 3-26 displays the relative contributions to overall salaries made by the primary employers in Campbell County. The coal mining sector and oil and gas operations provide the greatest amounts of compensation and the highest average wages of all the industries in the county. CBM Development has contributed to economic growth in Campbell and Converse counties.

Table 3-26 1999 Campbell County Payroll Costs By Industry

Major Industry	Annual Payroll	Employees	Avg. Annual Salary
Mining (including oil & gas)	$267,098,594	6,123	$43,622
Wholesale Trade	$114,755,820	2,958	$38,795
Services	$81,054,562	3,810	$21,274
Transportation & Communication	$40,465,780	1,247	$32,451
Retail Trade	$39,946,086	3,389	$11,787
Manufacturing	$29,436,181	933	$31,550
Construction	$23,594,537	846	$27,890
Finance, Insurance, & Real Estate	$14,315,273	435	$32,909
Public Administration	$11,395,735	377	$30,227
Agriculture, Forestry, & Fishing	$3,169,638	176	$18,009
Total	$625,232,206	20,294	$30,809

Source: American Community Network Applied Geographic Solutions, Inc.; (NEWEDC, 2002).

Campbell County's employment rate is the third highest in Wyoming and employment rates have remained strong in recent years (CCEDC, 2001, online data). Since 1990, the Campbell County labor force has increased by 5,958 to 22,360, an increase of 36.3 percent, above the average growth rate for the state. Recent employment figures indicate an increase in number of job opportunities in the county (Foulke, 2001, online data).

The largest employment sectors in Campbell County are minerals extraction, wholesale and retail trade, services, and local government (WDOE, 1998a, online data). Government employees work primarily for the Campbell County school district. Of the county's top ten employers, five are associated with coal mining operations, and one with energy (gas) services. **Table 3-27** displays average monthly employment figures for the county. The 2001 unemployment rate averaged 2.9 percent, less than the state rate, with a total average labor force of 22,360.

Table 3-27 Campbell County Employment -Average Monthly Employment First Quarter 2002

Employment Sector	Number of Jobs	Percent of Total
Mining (including Oil and Gas Production)	6,174	30.2
Total Government (including Public Schools)	3,338	16.3
Wholesale and Retail Trade	2,804	13.7
Construction	1,923	9.4
Accommodation, Food Service	1,548	7.6
Other Services	888	4.3
Health Care and Social Services	735	3.6
Administrative, Waste Services	681	3.3
Professional, Technical Services	576	2.8
Transportation, Warehousing	563	2.8
Manufacturing	460	2.2
Finance, Insurance and Real Estate	459	2.2
Utilities	159	0.8
Arts, Entertainment, Recreation	78	0.4

Employment Sector	Number of Jobs	Percent of Total
Agriculture	32	0.2
Educational Services	28	0.1
Management of Companies	27	0.1
Total	20,473	100

Source: Labor Market Information, First Quarter 2002; (NEWEDC, 2002).

The three major employers in Converse County are local government, retail trade, and accommodation and food services. Converse County's labor force has increased by 846 (14.8 percent) since 1990, a rate slightly below that of the state's growth. Recent employment figures indicate that Converse County has shown a minor decrease in the number of job opportunities (Foulke, 2001, online data). Government employees work primarily for the Converse County school district. Of the county's top ten employers, three are associated with coal mining operations, and one with uranium extraction. The unemployment rate in Converse County averaged 4.2 percent in 2001, slightly above the state average, with a total average labor force of 6,575. **Table 3-28** displays average monthly employment figures for Converse County.

Table 3-28 Converse County Employment - First Quarter 2002 Employment Distribution

Employment Sector	Number of Jobs	Percent of Total
Government	1,286	33.5
Retail Trade	449	11.7
Accommodation and Food Services	417	10.9
Mining (Including Oil and Gas Production)	352	9.2
Construction	315	8.2
Health Care and Social Assistance	208	5.4
Transportation and Warehousing	135	3.5
Manufacturing	112	2.9
Other Services	86	2.2
Finance and Insurance	79	2.1
Information	65	1.7
Technical Services	64	1.7
Wholesale Trade	58	1.5
Administrative and Waste Services	53	1.4
Real Estate	47	1.2
Arts, Entertainment and Recreation	40	1.0
Sporting, Hobby, Book and Music Stores	14	0.4
Total Average Monthly Employment	3,837	100

Source: Department of Employment Resources Division, Research and Planning December 2002; (NEWEDC, 2003)

3.13.1.4 Environmental Justice

Executive Order 12898, February 11, 1994, Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations, addresses the potential for impacts from federal actions which may disproportionately affect minority or low-income populations. A specific consideration of equity and fairness in resource decision making is encompassed in the

issue of environmental justice. All federal actions will consider potentially disproportionate effects on minority or low income communities. Consideration of environmental justice issues should be highlighted for decision makers. Where possible, measures should be taken to avoid impact to these communities or to mitigate any adverse effects.

The Project Area lies in extreme southern Campbell County, within 1.5 miles of the Converse County line in one area. Populations within the counties are 96 percent and 95 percent European American in origin. Within the Project Area, there are no communities with significant low-income or minority populations, so specific actions to address environ mental justice concerns were not implemented for the Project.

No Indian reservation is located in the vicinity of the Project Area. The appropriate Native American tribes were contacted during scoping for the proposal. No known Native American cultural sites, sacred sites, or burials are within the proposed areas of potential direct effect.

The unincorporated settlement of Teckla is located in the southern portion of the Project Area. The settlement consists of approximately a half dozen mobile homes and may represent a low-income community. No information regarding population or income levels was available for this site. Teckla is located proximal to areas that would experience increased activity during the construction and operation of the Proposed Action. It is also located within one half mile of the current boundary of the NARC coal mine, in an area likely to undergo mining within the next 10-15 years.

3.13.2 Environmental Consequences

3.13.2.1 The Proposed Action

Direct Impacts

Many of the workers on this Project would likely come from the local workforce. Much of the income made by Project employees would circulate within the Project Area, adding economic benefits.

Additional revenues would be generated for the municipalities, counties, state, and federal governments by the various taxes on the purchase of equipment and supplies, valuation on development activities, and taxes and royalties on production of coalbed methane. Projecting from basin-wide estimates in the Powder River Basin Oil and Gas FEIS, Campbell County could receive approximately $9.2 million in ad valorem taxes from the Proposed Action. The United States could receive approximately $13.5 million from federal oil and gas royalties (BLM, 2003, pp. 4-348, 4-351).

Indirect Impacts

Influx of outside workers could increase demands on local housing, schools, and social services. However, as previously indicated, most of the workforce is expected to be drawn from local communities. Construction of the Proposed Action would require minimal numbers of

employees, as indicated in **Table 2-6**, and demand for temporary housing is therefore anticipated to be low.

Mitigation

The Company would implement hiring policies that encourage the use of local or regional workers. No significant negative socioeconomic consequences are anticipated.

3.13.2.2 The No Action Alternative

Because socioeconomic impacts from the Proposed Action are considered to be insignificant, the Project would result in net economic benefits. If the Proposed Action were not constructed, the United States, the State of Wyoming, and other governmental entities would be negatively affected by loss of various tax revenues. Local communities would not receive beneficial economic returns from Project development. Assuming continued development of surface coal mines across most or all of the Project Area, and continued drainage from existing and future federal and non-federal wells in the vicinity of the Project Area, the No Action Alternative would result in a permanent loss of CBM royalties to the United States.

3.14 RESIDUAL IMPACTS

Implementation of the Proposed Action, including applicant committed mitigations measures, would result in the total initial (short-term) disturbance of approximately 9,38 acres (647 federal) and the residual long-term total disturbance of 114 acres (72 federal) following reclamation of areas disturbed during construction but no longer needed to support ongoing project operations and maintenance.

This disturbance would effect some minor changes in topography in limited areas of cuts and fills needed for construction of roads and well sites. Methane gas (natural gas) would be extracted from the coal seam reservoirs. Vegetative cover and soil productivity would be lost or reduced temporarily for short-term disturbances. Reclamation and revegetation would occur immediately after cessation of construction activity for pipelines, electrical utilities, and portions of well sites no longer needed for operations and maintenance. Cover and productivity would likely be restored to pre-disturbance levels within 1 to 3 years. In the long-term, life of the project, vegetative cover would be replaced by surface facilities and structures, road surfacing materials such as gravel, and native soil in the case of two-track roads. These long-term armored conditions would limit accelerated soil erosion, loss, and stream sedimentation. In the short-term, some increase in wind and water soil erosion, stream sedimentation, and weed infestation could occur while desired vegetation is effectively re-established within 3 years.

Some increased surface water runoff may be expected in addition to increased discharge of CBM produced water into affected streams and watersheds. Increased flows may alter stream channel configurations over time; however, much of the natural and produced water flows are expected to be controlled and beneficially used by the downstream coal mines or lost to infiltration and

evapotranporation over the life of the Project. Some ephemeral streams, notably Porcupine Creek, may be temporarily transformed into perennial streams for a portion of the Project life. Return to original conditions would occur as water production declines. Water quality of ephemeral stream flows in the Project Area and downstream are expected to be maintained or possibly improved from the discharge of the CBM produced water. Wetlands and riparian areas are expected to benefit for the life of the Project from increased channelized and subsurface alluvial flows within stream channels receiving discharged water.

Groundwater would be lost from the subsurface coal seams; however, surface discharge would allow for some relatively rapid (within 20 years) recharge of the near surface aquifers of the Wasatch Formation. Complete recovery of the water levels in the coal aquifers would be a long-term process, 25 to more than 100 years, because most of the recharge would come from overlying and underlying sand and undeveloped coal units that, in turn, would be recharged from surface infiltration.

Some additional particulate emissions would occur in the short-term, primarily during the construction of roads, pipelines, and well sites. Dust controls would be implemented when warranted to limit impacts. Criteria pollutant emissions would be limited and controlled to meet state air quality requirements. The project is expected to contribute less than 0.5 percent of the projected emissions and associated impacts to air quality related values modeled in the PRB O&G FEIS.

Surface disturbance would reduce wildlife habitat (938 acres in the short-term and 114 acres in the long-term) and livestock grazing (loss of 13 AUMs) in the long-term due to loss or reduction in forage. Additional short-term impacts to wildlife, including potentially increased stress levels and displacement from affected habitats, would occur due to human/vehicular activity and noise, especially during construction, drilling, and completion activities.

Some loss of unidentified archaeological, historic, and paleontological artifacts/fossils would likely occur during construction operations.

The mostly limited, dispersed recreational opportunities would not be affected by the proposed Project. Visual resource standards set for TBNG areas in the Project Area would be maintained as set in the new TBNG management plan. Some small spills of, or exposure to, hazardous materials may occur.

Local and regional benefits to economic conditions are expected to result from Project implementation.

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