Chapter 3
Affected Environment

3.1 Introduction

This Chapter describes the affected environment, including cultural, historical, social and economic conditions that would be affected by implementation of the alternatives described in Chapter 2. Aspects of the affected environments described in this chapter focus on the relevant major issues presented in Chapter 2. Certain critical environmental components require analysis under BLM policy. These items are presented below in Table 3.1-1.

Table 3.1-1 Critical Elements Requiring Mandatory Evaluation

Mandatory Item	Potentially Impacted	No Impact	Not Present On Site
Threatened and Endangered Species	X		
Floodplains		X	
Wilderness Values			X
ACECs			X
Water Resources	X		
Air Quality	X		
Cultural or Historical Values	X		
Prime or Unique Farmlands			X
Wild & Scenic Rivers			X
Wetland/Riparian		X	
Native American Religious Concerns	X		
Wastes, Hazardous or Solids			X
Invasive, Nonnative Species	X		
Environmental Justice		X	

3.2 Air Quality

3.2.1 Air Quality & Climate Summary

3.2.1.1 Climate

The climate of the project area is classified as mid-latitude semi-arid steppe (Trewartha & Horn, 1980). Steppe climate is characterized by large seasonal variations in temperature (cold winters and warm summers) and by precipitation levels that are low but still sufficient for grasses.

For more information on climate, please see the Air Quality Technical Report for the Badger Hills POD environmental assessment.

3.2.1.2 Air Quality

Air quality monitoring and dispersion modeling show air quality in the project area is generally good. All of the figures referenced in this section are found in Appendix 3.

Air Quality Component	Comment
Climate	
Temperature Yellowstone National Park	Mean annual maximum: 60 °F Mean annual minimum: 32 °F
Precipitation	Mean annual precipitation: 14.7 inches Mean annual snowfall: 37.7 inches Mean annual snow depth: 1 inch
Air Pollutant Concentrations	
MAAQS & NAAQS: Criteria pollutants from 1993 – 2003 Rosebud County, Montana	- NO_2: - 1 hour < 15% of MAAQS - annual < 10% of MAAQS - PM_{10} - 24 hour: - 1 exceedance 2003 - annual < 70% of MAAQS - SO_2 - 1 hour < 20% of MAAQS - 3 hour < 5% of NAAQS - 24 hour < 5 MAAQS annual < 10% of MAAQS
PSD Class I Increments (MDEQ, 2002)	- Yellowstone National Park - .02% of PSD Class I NO_2 annual - .6% of SO_2 annual - 11% of SO_2 24 hour - 7.2% of SO_2 3 hour - .1% of PM_{10} annual - 2% of PM_{10} 24 hour - North Absaroka Wilderness - .04% of PSD Class I NO_2 annual - 2% of SO_2 annual - 15.6% of SO_2 24 hour - 12.3% of SO_2 3 hour - .3% of PM_{10} annual - 3.9% of PM_{10} 24 hour - UL Bend Wilderness - .02% of PSD Class I NO_2 annual - .6% of SO_2 annual - 11% of SO_2 24 hour - 7.2% of SO_2 3 hour - .1% of PM_{10} annual - 2% of PM_{10} 24 hour - Northern Cheyenne Reservation - 50% of PSD Class I NO_2 annual - .25% of SO_2 annual - SO_2 24 hour exceedance - SO_2 3 hour exceedance - 3.5% of PM_{10} annual - 28% of PM_{10} 24 hour
Visibility	
Yellowstone National Park	- cleanest 20%: 140 – 168 miles - average:93 – 125 miles - haziest 20%: 59 – 78 miles

Atmospheric Deposition	
Little Big Horn Battlefield National Monument	- precipitation - pH: very slight acidification in 1998 & 1999 - SO4: <.8 mg/L - Wet deposition - SO4: < .4 kg/ha
Yellowstone National Park	- Total Sulfur: <50% of guidelines

3.2.2 Air Quality Methodology Summary

Indicators of air quality addressed in this study include concentrations of air pollutants, visibility and atmospheric deposition.

3.2.2.1 Pollutant Concentrations

Pollutant concentration refers to the mass of pollutant present in a volume of air, and can be reported in units of micrograms per cubic meter ($\mu g/m^3$), parts per million (ppm) or parts per billion (ppb). The State of Montana has used monitoring and modeling to determine that the project area is in compliance with Montana and federal concentration standards.

3.2.2.2 Visibility

The Inter-Agency Monitoring of Protected Visual Environments (IMPROVE) has measured visibility in national parks and wilderness areas in the United States since the 1980's. There is/are IMPROVE stations in Montana. Visibility can be expressed in terms of deceives (dV), a measure for describing perceived changes in visibility. One dV is defined as a change in visibility that is just perceptible to an average person.

Visibility data are calculated for each day, ranked from cleanest to haziest, and divided into three categories:

- 20% cleanest: mean visibility for the 20% of days with the best visibility
- average: the annual median visibility
- 20% haziest: mean visibility for the 20% of days with the poorest visibility

3.2.2.3 Atmospheric Deposition

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

- acids: such as sulfuric acid (H_2SO_4) and nitric acid (HNO_3); this acid deposition is sometimes referred to as "acid rain"
- air toxics: such as pesticides, herbicides and volatile organic compounds (VOC)
- nutrients: such as nitrate (NO_3^-) and ammonium (NH_4^+)

The estimation of atmospheric deposition is complicated by the contribution to deposition by several components: rain, snow, cloud water, particle settling and gaseous pollutants. Deposition varies with precipitation which, in turn, varies with elevation and time.

3.2.2.4 Wet Deposition

The National Atmospheric Deposition Program (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). There are 6 NADP stations in Montana and 8 NADP stations in Wyoming.

3.2.2.5 Dry Deposition

Dry deposition refers to the transfer of airborne gaseous and particulate material from the atmosphere to the Earth's surface. The Clean Air Status and Trends network (CASTNet) measures dry deposition of ozone (O_3), sulfur dioxide (SO_2), nitric acid (HNO_3), sulfate (SO_4^{--}), nitrate (NO_3^-), and ammonium (NH_4^{++}). There are no CASTNet stations in Montana. The CASTNet station nearest to the project area is in Yellowstone National Park.

3.2.2.6 Total Deposition

Total deposition refers to the sum of airborne material transferred to the Earth's surface by both wet and dry deposition. Total deposition guidelines have been estimated for several areas (USFS, 1989). Estimated total deposition guidelines include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" (defined as the acceptable level of total deposition). Total nitrogen deposition guidelines for Bridger Wilderness include the red line (set at 10 kg/ha/year) and the green line (set at 3-5 kg/ha/year). Total sulfur depositions guidelines for Bridger Wilderness include the redline (set at 5 kg/ha/year) and the green line (set at 20 kg/ka/year).

3.2.3 Existing Air Pollutant Concentrations

Figure 3.2.3-1 (see Appendix 3) presents background concentrations for the four criteria pollutants available in Montana. These concentrations are intended to represent air quality conditions throughout Montana. These air quality data were monitored by the Montana Power Company during 1980 and 1981 near Great Falls, Montana.

3.2.3.1 Carbon Monoxide

CO is an odorless, colorless gas formed during any combustion process, such as operation of engines, fireplaces, furnaces, etc. High concentrations of CO affect the oxygen-carrying capacity of the blood and can lead to unconsciousness and asphyxiation. Forest fires are natural sources of CO.

3.2.3.2 Nitrogen Dioxide

NO_2 is a red-brown gas formed during operation of internal combustion engines. Such engines emit a mixture of nitrogen gases, collectively called nitrogen oxides (NOx). NO_2 can contribute to "brown cloud" conditions, and can convert to ammonium and nitrate particles and nitric acid which can cause visibility impairment and acid rain. Bacterial action in soil can be a natural source of nitrogen compounds.

Other monitoring of NO_2 in the region includes concentrations on the Northern Cheyenne Reservation in Rosebud County, Montana (see Figures 3.2.3-2 and 3.2.3-3, Appendix 3). Both 1 hour and annual concentrations have been well below Montana and federal standards from 1993 through 2000.

Concern has been expressed regarding possible violations of the NO_2 Prevention of Significant Deterioration (PSD) increments in Yellowstone National Park, North Absaroka Wilderness Area, UL

Bend Wilderness Area and the Northern Cheyenne Reservation. In an environmental impact statement for the Roundup Power Project (MDEQ, 2002), a PSD increment consumption analysis showed a potential exceedance of the Class I significance level (the proposed, but not adopted PSD significance levels are 4% of the Class I increments). The analysis showed no violation of the NO_2 Class I increment (see Figure 3.2.3-4, Appendix 3).

Refer to the Air Quality Technical Report for the Badger Hills POD environmental assessment for further information.

3.2.3.3 Sulfur Dioxide

SO_2 forms during combustion from trace levels of sulfur in coal or diesel fuel, and can convert to ammonium sulfate (SO_4^{--}) and sulfuric acid (H_2SO_4) which can cause visibility impairment and acid rain. Volcanoes are natural sources of SO_2.

Other monitoring of SO2 in the region includes concentrations on the Northern Cheyenne Reservation in Rosebud County, Montana. One hour, three hour, 24 hour and mean annual concentrations are all in compliance with Montana and federal ambient air quality standards (MAAQS, NAAQS). One hour concentrations are less than 20% of the MAAQS, three hour concentrations are less than 5% of the NAAQS, 24 hour concentrations are less than 5% of the MAAQS, and mean annual concentrations are less than 10% of the MAAQS (see Figures 3.2.3-5 through 3.2.3-8, Appendix 3).

Concern has been expressed regarding possible violations of the SO_2 PSD increments in Yellowstone National Park, North Absaroka Wilderness Area, UL Bend Wilderness Area and the Northern Cheyenne Reservation. In an environmental impact statement for the Roundup Power Project (MDEQ, 2002), a PSD increment consumption analysis showed a potential exceedance of the Class I significance level and a potential violation of the 24 hour and 3 hour SO_2 Class I increments (see Figures 3.2.3-9 through 3.2.3-11).

Refer to the Air Quality Technical Report for the Badger Hills POD environmental assessment for further information.

3.2.3.4 Ozone

O_3 is a faint blue gas that is generally not emitted directly into the atmosphere, but is formed from NO_x and volatile organic compounds (VOC) emissions. As stated above, internal combustion engines are the main source of NO_x. Volatile organic compounds like turpenes are very reactive. Sources of VOC include paint, varnish and some types of vegetation. The faint acrid smell common after thunderstorms is due to ozone formation by lightning. O_3 is a strong oxidizing chemical that can burn lung and eyes, and damage plants. The State of Montana has recently begun monitoring ozone.

3.2.3.5 Particulate Matter

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

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

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

Other PM_{10} monitoring includes concentrations on the Northern Cheyenne Reservation in Rosebud County, Montana (see Figures 3.2.3-12 and 3.2.3-13, Appendix 3). While mean annual concentrations are less than 70% of the MAAQS, there was one exceedance of the 24 hour MAAQS in 2003.

Concern has been expressed regarding possible violations of the PM_{10} PSD increments in Yellowstone National Park, North Absaroka Wilderness Area, UL Bend Wilderness Area and the Northern Cheyenne Reservation. While PM10 concentrations were less than the PSD Class I increments for all four areas, the 24 hour concentration in the Northern Cheyenne Reservation was greater than the voluntary significance level.

Please refer to the Air Quality Technical Report for the Badger Hills POD environmental assessment for further information.

3.2.4 Existing Visibility

Figures 3.2.4-1 through 3.2.4-3, (Appendix 3), show and compare visibility values in Yellowstone National Park from 1992 through 2001. Visual range on the 20% cleanest days varies from 140 to 168 miles. Average visual range varies from 93 to 125 miles. Visual range for the 20% haziest days varies from 59 to 78 miles. Trend analysis of Yellowstone visibility data reveals no significant trend of worsening visibility from 1992 through 2001.

Visibility monitoring has begun in North Absaroka Wilderness, Fort Peck Reservation and the Northern Cheyenne Reservation. Those data are not yet available.

In an environmental impact assessment for the Roundup Power Project (MDEQ, 2002), visibility analysis predicted potential visibility impairment in Yellowstone National Park, North Absaroka Wilderness, UL Bend Wilderness and the Northern Cheyenne Reservation.

3.2.5 Existing Atmospheric Deposition

1.2.5.1 Wet Deposition

Figure 3.2.5-1, (Appendix 3), shows the precipitation pH in the Little Big Horn Battlefield National Monument near the Northern Cheyenne Reservation from 1987 through 2002. The natural acidity of rainwater is considered to be represented by a range of pH values from 5.0 to 5.6 (Seinfeld, 1986). Mean annual pH near the Northern Cheyenne Reservation is generally within this range, although mean annual pH fell to 4.9 in 1998 and 1999. Precipitation pH values lower than 5.0 may be considered acidification and may cause adverse effects to plants and animals.

Figure 3.2.5-2, (Appendix 3), shows mean annual sulfate concentrations in precipitation in the Little Big Horn Battlefield National Monument from 1984 through 2002. All values are below .8 mg/L.

Figure 3.2.5-3, (Appendix 3), shows wet sulfate deposition in the National Monument. All values are below .4 kg/ha.

1.2.5.2 Dry Deposition

No dry deposition data is available for eastern Montana.

3.2.5.3 Total Deposition

Figure 3.1.5-4, (Appendix 3), compares total sulfur deposition in Yellowstone National Park from 1992 through 1999 with the total sulfur deposition guidelines set for the Bridger Wilderness. Total sulfur deposition values are well below guidelines.

3.3 Cultural Resources

3.3.1 Survey Results

A review of BLM Cultural Resource Records shows that cultural resource work has been undertaken in the project area since the early 1970's. The Area of Potential Effect for cultural resources purposes is the extent of the POD regardless of surface ownership and where new wells were shown on cultural resource project maps. Site types previously recorded in the area consist of lithic scatters, stone circle sites, cairns, rock shelters, rock art, final resting places, bison kills and historic sites related to the 19th and 20th Century development of the area. Previous cultural resource and ethnographic projects have shown several of these to be sensitive to Native American groups with ties to the area (see Section 3.3.3 Traditional Cultural Values).

BLM cultural resource records show that the western portions of the project area were inventoried for cultural resource in the mid-late 1970's to early 1980's for proposed coal mines. The central portions of the POD along the Tongue River were inventoried as part of the Tongue River Dam Restoration project in 1991 and 1995, with excavations being completed in 1998 and reported in 1999 and 2000. Several other small inventories for cultural resources have been conducted in and near the POD boundaries since 1995. No sites have been located in these inventories. Collectively, the coal mine and Tongue River Dam inventories located 17 cultural resource sites including 2 bison kills, 1 rock shelter, 4 tipi ring sites, 4 lithic scatters, 5 historic homestead sites and 1 historic battlefield (see BLM Cultural Resources Report - *A Summary of Cultural Resources in the Fidelity Exploration and Production Company's Tongue River/Badger Hills POD, Big Horn County, Montana (Melton 2004)* for additional details). The referenced Summary report is an extensive and comprehensive compilation of cultural resources information in and near the project area.

National Register Eligibility has been formally determined for five of the seventeen sites. The two bison kills have been formally determined eligible for listing on the National Register of Historic Places. One of the lithic scatters and two of the historic sites have been formally determined not eligible for listing on the National Register of Historic Places. The three sites and one bison kill are associated with the Tongue River Dam Project. The other bison kill and historic site are associated with early 1980's coal mine inventory. Eligibility has not been formally determined for the remaining 12 sites. Ten of the sites (4 tipi ring sites, 1 rock shelter, 4 lithic scatters and 2 historic sites) have been recommended by their recorders or other agencies as not eligible for listing on the National Register of Historic Places.

One historic homestead site (24BH2187) requires additional information before a determination of eligibility could be made. The twelfth site is the Tongue River Heights Fight. Eligibility of this site has not been resolved in Montana. The site has been determined to be eligible for listing on the National Register of Historic Places in Wyoming.

Review of the project maps and site location maps show that all but three of the 17 sites would be avoided by development within the proposed POD and adjacent sections containing proposed wells. One of the sites is a historic ranch adjacent to a proposed well. The site has been determined not eligible for listing on the National Register of Historic Places and does not require additional cultural assessment work. One of the other sites is a bison kill that has been determined eligible for the National Register. The third site is the historic battlefield. Monitoring is recommended for the bison kill and battle sites, since there is some uncertainty about whether or not the sites currently physically exist. It would also partially fulfill the cultural resource monitoring requirements of the MT EIS. This information is also contained in the recently completed BLM report "*A Summary of Cultural Resources in the Fidelity Exploration and Production Company's Tongue River/Badger Hills POD, Big Horn County, Montana (Melton 2004).*

Class III cultural resource inventories for all of the Federal wells and associated infrastructure developments were completed by Foothills Archaeology Consultants of Story, Wyoming between December 2002 and August 2003. A total of 240 block inventory acres and 160 acres of linear inventory were completed. No sites and one isolated find location were observed in the cultural resource inventories (see Wardlow 2003a for details). An additional infrastructure corridor was inventoried due to a move made during an onsite visit by the BLM. A total of four acres were inventoried for this action. No cultural resources were located during the project (see Wardlow 2003c for details). BLM consulted with the Montana SHPO on this project in September, 2003. The SHPO concurred with BLM's determination on September 16, 2003, that there were no historic properties that would be affected by the proposed undertaking that was being permitted as part of the Federal action. The State of Montana also has prepared a cultural resource inventory dealing with the portions of the project (see Wardlow 2003b for details). A small portion of the main 2003 inventory intruded onto the state section. No cultural resources were located in the inventoried area (Wardlow 2003a).

3.3.2 Paleontology

Paleontological Resources are defined as fragile and nonrenewable scientific record of the history of life on earth (BLM 1998). Past studies of paleontological resources at the Spring Creek and proposed CX Decker Mine have shown that the POD area has a low potential to yield significant vertebrate fossil remains. Fossils located in the Spring Creek Mine area include plant, amphibian, reptile and invertebrates (see Melton 2004 for further information). The POD Area occurs in similar geologic formations as the Spring Creek Mine and similar paleontological resources may occur. Protection on public lands extends to vertebrate fossils or specially designated areas. No areas designated for special management for paleontological resources are located near the project area in Montana. Although invertebrate fossils are not considered permitted paleontological resources, they do have cultural values to Native American groups and require consideration under laws and executive orders that deal with access and maintenance of religious sites and resources on public lands (Peterson and Deaver 2002). Fossils on split estate lands are considered part of the surface estate and belong to surface owner (BLM 1998). Unanticipated discoveries of paleontological resources would be dealt with through implementation of measures that require notification in the event of important discoveries and suspension of construction activity to prevent any loss of significant paleontological values.

3.3.3 Traditional Cultural Values

BLM has sponsored a number of projects to identify classes of sites and areas of traditional cultural values to the Northern Cheyenne and Crow Tribes. The Northern Cheyenne and Crow Tribal documents prepared for the Statewide Oil and Gas EIS and the Ethnographic Overview for Southeast Montana (NCT 2002, CTI 2002 and Deaver and Peterson 2002) lists classes of sites and natural resources that are cultural sensitive to the Tribes. Site types include kill sites, Northern Cheyenne Homesteads, large diameter stone circle sites, battlefields, rock art, campsites, ceremonial sites, final resting places, fasting beds, cairns,

environmental locations and medicine lodge sites. Natural resources include some types of invertebrate fossils, paint sources, springs and locations for special plants and animals.

A review of the homestead and spring data in the Ethnographic Overview and Northern Cheyenne Tribal report show no homestead or spring locations identified by the tribe. Four sites in the POD boundaries are included in the list of site types above. All are on private surface. These are one bison kill, one lithic scatter (camp site) and two stone circle sites. The lithic scatter has been impacted by rising water levels of the Tongue River Reservoir. The stone circle sites are approximately a quarter mile from any proposed development and would not be affected by it. The bison kill site has been excavated with input from the Crow Tribe (Brumley and Dickerson 2000). The site may have been destroyed by raising the Tongue River Reservoir, but monitoring is recommended to verify this. One additional site is adjacent to the POD. This is a historic 1876 skirmish between the Northern Cheyenne and Calvary under General George Crook. No physical evidence of the battle has been located in previous inventories in the Section, but monitoring is recommended to confirm this. No paint sources, plant collecting areas, or invertebrate fossil localities have been identified by past and present inventories in the POD area. Impacts to animal populations are addressed in the Wildlife Section of this document. Impacts to water are addressed in the hydrology section of the document.

3.4 Lands and Realty

The Project area is composed of a mixed ownership of both the surface estate and the mineral estate. Ownership of the surface estate and mineral estate is split among BLM, State of Montana, private individuals and private corporations (Map 3.4-1). Approximate acreage by ownership is shown in Table 3.4-1.

The Project area includes one existing BLM issued right-of-way in the NE¼SW¼, Section 26, T. 9 S., R. 40 E., in Big Horn County. The right-of-way is Big Horn County's RS 2477 Road Right-of-Way MTM-61090.

Table 3.4-1
Surface & Mineral Ownership

Status Type	Appx. Acres
BLM Surface	160
State Surface	800
Private Surface	6,720
BLM Minerals	3,720
State Minerals	800
Private Minerals	3,160

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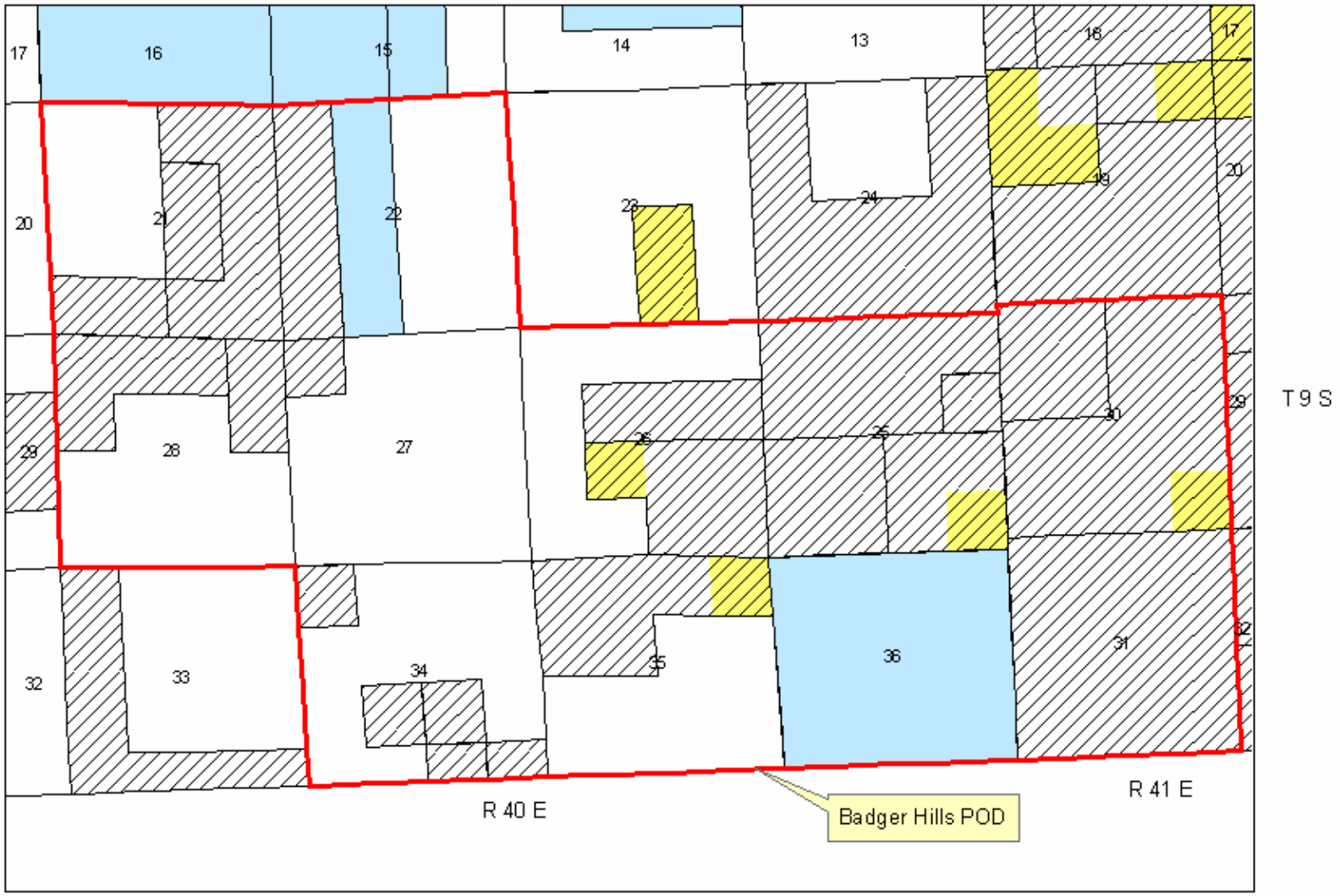
Map 3.4-1

Badger Hills POD - Federal Minerals



3.5 Social and Economic Conditions

The project area is located in the southeastern corner of Big Horn County, just south of the Decker coal mine, ten miles east of the Crow Reservation, twenty-four miles south of the Northern Cheyenne Reservation and twenty-five miles by paved road from Sheridan, Wyoming, the nearest community. A description of the social, economic and fiscal conditions on the Reservations and Big Horn County can be found in the Affected Environment of Chapter 3 and the Socioeconomic Appendix of the MT EIS. The proposed action is an expansion to CBNG production in the CX Field. The MBOGC reported natural gas production in Big Horn county in 2002 was 9,679,910 MCF (DNRC Annual Review FY2002, page 19), approximately 11 percent of total statewide production. However, oil and gas production taxes contributed less than one-tenth of one percent of County revenues in FY 1999 (MT EIS, Socioeconomics Appendix, Table SEA-1).

Discussions between BLM and landowners located in and near the project area indicate a concern about knowing when the permits would be issued. The landowners indicated this information would enable them to plan their operations around the construction, drilling and completion operations.

3.5.1 Environmental Justice

Native Americans are one of several groups identified by the federal government as minority populations to be considered when the federal government evaluates potential impacts from a proposed project. The impact analysis will identify and address any disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations.

Big Horn and Rosebud Counties include the Northern Cheyenne and Crow Indian reservations with substantial Native American populations. In Big Horn County, where the proposed project is located, the population is 60 percent Native American. This county includes most of the Crow Reservation and part of the Northern Cheyenne Reservation. Slightly over thirty percent of Rosebud County is Native American. This county is located north of the project area and includes the part of the Northern Cheyenne Reservation not located in Big Horn County. Census data for the year 2000 shows that over 500 Native Americans lived on the Crow Reservation and over 4000 Native Americans lived on the Northern Cheyenne Reservation.

In 2000, 24% of the population living in Big Horn County and 17% of the population in Rosebud County had incomes below the poverty level. These figures compare to a state figure of 13% and reflect the relatively large numbers of persons on the reservations living in poverty.

3.6 Soils

The soils in the project area have developed in alluvium and residuum derived from the Tongue River Member of the Tertiary Fort Union Formation and the Eocene Wasatch Formation. Lithology consists of light to dark yellow and tan siltstone and sandstones with coal seams in a matrix of shale. In many areas the near-surface coals have burned, baking the surrounding rock, producing red, hard fragments. Higher ridges and hills are often protected by an erosion-resistant cap of clinker or sandstone. Differences in lithology and geomorphology have produced the soil variations in the area.

Soils in the project area are primarily the Haverson, Thedalund and Midway series. Soils have surface and subsurface textures of silt loam and silty clay loam. Permeability is commonly moderate and hazard of erosion from water and wind is commonly slight to moderate. Soil depths vary from deep on lesser slopes to shallow and very shallow on steeper slopes. Soils are generally productive; though vary with

texture, slope and other characteristics. Slopes may be as much as 75 percent though are generally 12 to 15 percent. The Plan of Development includes soil maps and detailed soil series, complexes, profile descriptions, physical and chemical.

3.6.1 Land Application Area Soils

Two areas have been selected as managed irrigation sites with native vegetation for the application of water produced with CBNG. The areas are adjacent to sites selected for the construction of impoundments or total containment reservoirs. Soils in the area adjacent to reservoir 22-3590 are predominately in the Arvada series. Soils in the area adjacent to reservoir 34-3490 are predominately in the Harvey series and Haverson series. At this time, this area has been eliminated for irrigation through the site selection screening process. Soils in the area adjacent to reservoir 44-3490 are predominately in the Midway series. Soils in the managed irrigation areas are considered suitable for irrigation under normal agronomic conditions as outlined in USDA-NRCS National Engineering Handbook Part 652 - Irrigation Guide Chapter 2. These sites were selected using the procedures in Protocol for Evaluating, Designing, Operating, and Monitoring Managed Irrigation Systems for Coal Bed Natural Gas Produced Water: Tongue River – Badger Hills Project, Bighorn County, Montana (Harvey, 2003) and summarized in Appendix 2. Soils and effects from irrigation will be monitored and management processes adjusted to address effects on and adjacent to the managed irrigation sites. Information about soil series and characteristics is included in Fidelity's POD.

3.6.2 Impoundment Sites Soils

Three sites have been selected to construct impoundments or total containment reservoirs to store water produced with CBNG. Backhoe pits were excavated near the center of each of the three sites. Soils were examined and physical and chemical characteristics were analyzed to determine suitability for reservoirs. Impoundment 22-3590 is located on a bench to the north of Badger Creek. Soils in the area are predominately in the Thedalund-Wibaux complex with moderate permeability. Impoundment 34-3490 is located on a bench to the south of Badger Creek. Soils in the area are predominately in the Shale outcrop-Midway complex with moderate permeability. Impoundment 44-3490 is located on a bench above the Tongue River. Soils in the area are predominately in the Thedalund-Midway complex with slow permeability. Detailed information about soil series and characteristics is included in Fidelity's POD.

Table 3.6-1 Soils Characteristics for Off-Channel Reservoirs within the Tongue River-Badger Hills Project

Reservoir Name	Map Symbol	Soil Name	USDA Texture				
				Lower	Upper	Lower	Upper
23-0299	Re	Renohill	silty clay	0.06	0.20	7.9	8.4
	Wy	Winnett	clay	0.00	0.06	8.0	8.5
33-3390	MVf	Midway	silty clay loam	0.06	0.20	7.4	8.4
34-3490	Hcb	Harvey	loam	0.60	2.00	7.4	7.8
	MVe	Midway	silty clay loam	0.06	0.20	7.4	8.4
	Soc	Shale outcrop					
44-3490	MVe	Midway	silty clay loam	0.06	0.20	7.4	8.4
	MVf	Midway	silty clay loam	0.06	0.20	7.4	8.4
22-3590	Ayd	Arvada	Silty clay/clay	0.00	0.60	7.8	9.5
	THn	Thedalund	Loam	0.60	2.00	7.4	7.8

3.7 Water Resources

3.7.1 Surface Water

All of the proposed well sites drain to the Tongue River watershed upstream from the Tongue River Reservoir. The entire length of the Tongue River from the Wyoming state line to its junction with the Yellowstone River is listed on the Montana Department of Environmental Quality's (MDEQ's) 1996 303(d) list for impaired streams under the Clean Water Act. Only the reach of the Tongue River from the diversion dam just above Pumpkin Creek to the mouth is listed on the MDEQ's 2002, or Draft 2004, 303(d) lists. This section of the stream is impaired due to flow alteration. Dam construction and flow regulation/modification are believed to be responsible for this impairment. The Tongue River Reservoir is also listed as impaired on the 1996, 2002 and Draft 2004 303(d) lists. This impairment results from high levels of Algal Growth/Chlorophyll. Domestic Wastewater Lagoons and Agriculture are believed to be responsible for these increased levels.

There is a United States Geological Survey (USGS) Gaging Station (06306300) located just upstream of this POD, near the Montana-Wyoming State Line. Data from this station should be representative of this reach of the Tongue River. Additional USGS Stations considered in this analysis are located immediately below the Tongue River Dam (06307500) and at the southern boundary of the Northern Cheyenne Reservation (Birney Day School Station) (06307616). Major discharges into the Tongue River downstream from this site in Montana include the East and West Decker Coal Mines. No new CBNG discharges are being permitted in the Wyoming portion of the Tongue River watershed. The existing Wyoming discharges are represented in the monitoring data collected at the USGS stations and is considered as part of the existing environment.

Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR) are the parameters most likely to be affected by CBNG development (BLM, 2003). Therefore, this discussion would focus on these parameters. EC is the ease with which water would transmit a current and is proportional to salinity or total dissolved solids (TDS) concentration. SAR is a complex ratio of sodium vs. calcium plus magnesium and is an important parameter for determining the usability of water for irrigation (BLM, 2003, ARS, 1954).

Prior to issuing a Montana Pollutant Discharge Elimination System (MPDES) permit, the MDEQ must conduct an analysis for all parameters for which narrative or numeric standards have been developed. The BLM would not allow for the discharge of water from federal wells until a MPDES permit has been approved by the MDEQ for that discharge. The discharge proposed for this project is covered by the existing MPDES permit number MT 0030457.

The existing water quality, as measured by EC and SAR, of the Tongue River at the three stations listed above has been calculated for 7Q10 flows (the lowest flow that would be expected to be seen for seven consecutive days over any 10 year period); high mean monthly flows and low mean monthly flows. This water quality information for these flows was determined based upon historical USGS data with extrapolation of EC, Na, Ca and Mg values to the flow rates of interest. The results of this analysis at each station for each flow are shown in Table 3.7.1-1 below.

For additional information on surface water, refer to the Badger Hills Hydrology Technical Report. For more general information regarding surface water, refer to Chapter 3, Affected Environment, pages 3-22 through 3-31 (MT EIS, BLM, 2003), the Water Resources Technical Report (ALL, 2001) and the Surface Water Quality Analysis Technical Report (SWQATR) (Greystone and ALL, 2003).

Table 3.7-1 Existing Surface Water Quality

	Tongue River at State Line Existing Conditions (1985-2002)*		
	Flow (cfs)	EC (µS/cm)	SAR
7Q10	35	1,193	1.42
LMM	176	636	0.70
HMM	1,638	267	0.26

	Tongue River Below Dam Existing Conditions (1975-2002)*		
	Flow (cfs)	EC (µS/cm)	SAR
7Q10	23	1,043	1.24
LMM	173	657	0.70
HMM	1,429	281	0.28

	Tongue River at Birney Day School Existing Conditions (1979-2002)*		
	Flow (cfs)	EC (µS/cm)	SAR
7Q10	49	1,125	1.56
LMM	179	717	1.02
HMM	1,119	379	0.56

* These values include the effects of CBNG in Wyoming. No new discharges into the Tongue River are being permitted in Wyoming.

The 7Q10 Values for the State Line and Birney Day School Station have changed from the original Badger Hills EA due to updated USGS data.

3.7.2 Groundwater

The CBNG wells to be drilled under this proposal would be between approximately 240 and 1,218 feet deep, being finished in the Dietz 1, Dietz 2, Dietz 3, Monarch and Carney coal zones. All of these coal seams are contained within the Tongue River Member of the Fort Union Formation. Based upon water analysis from 27 existing CBNG wells near the POD area, the weighted mean CBNG water is expected to have a SAR of approximately 54 and an EC of approximately 1,987 µS/cm. The water produced from the CX Field should also be similar to this quality.

The water from these new wells would be handled with the water currently being produced in the CX Field. There are 246 existing CBNG wells in the CX field with an average discharge rate of 4 gallons per minute (gpm) for a current total of 984 gpm discharging to the Tongue River. The maximum discharge from the new wells is anticipated to be 14 gpm. It is anticipated that the discharge from the new wells would decrease at a rate of 20% per year, while the discharge from the existing wells would decrease at a rate of 30% per year. Using these assumptions, the total project water production would increase to an initial maximum of 3,476 gpm and total discharge would be 1,021 gpm after 5 years.

Due to the common clay rich layers in the Tongue River member of the Fort Union formation, the vertical hydraulic conductivity of this unit is very low. The geometric mean horizontal hydraulic conductivity values of the coal seam aquifers in the Fort Union Formation is 1.1 feet per day (Wheaton and Metesh, 2002). Mean storativity values of these coals are approximately $9x10^{-4}$ (storativity is unitless) (Wheaton and Metesh, 2002). The average thicknesses of the produced coal seams from the well prognoses

contained in the POD Book are as follows: Dietz 1 = 25 feet; Dietz 2 = 19 feet; Dietz 3 = 17 feet; Monarch = 22 feet; Carney = 23 feet.

The CX field CBNG development and Wyoming CBNG development are located adjacent to the project area. These developments are currently leading to the drawdown of local coal seams. In the Environmental Impacts section of this EA, it is estimated that drawdown may extend up to 3.6 miles from CBNG developments in this areas. If a 3.6 mile buffer is placed around the CX field and the Wyoming development, a total of 72 domestic or stock wells and 12 springs are located within the buffer.

For additional information on groundwater, refer to the Badger Hills Hydrology Technical Report. For additional general information on groundwater, refer to Chapter 3, Affected Environment pages 3-22 through 3-39 (groundwater), MT EIS, (BLM, 2003) the 2D Groundwater Report (Wheaton and Metesh, 2001) and the 3D Groundwater Report (Wheaton and Metesh, 2002).

3.8 Vegetation

The Project area is characterized by three major cover types, each with specific vegetation characteristics. Mixed sagebrush/grasslands are located along the eastern boundary and central portions of the project area. Dominant species include big sagebrush, western wheatgrass and needle and thread grass. Considerable amounts of the sagebrush community along the eastern border has been converted to grassland as a result of herbicide treatments. The floodplain/riparian type is located along the Tongue River and Badger Creek corridors bisecting the project area. The Badger Creek corridor is primarily flood irrigated hay meadows with western wheatgrass being the dominant vegetation. The Badger Creek riparian zone is primarily herbaceous in nature with few trees and shrubs present. The Tongue River corridor is mostly developed hayfields and a narrow riparian zone dominated by plains cottonwood and shrubs. The most dominant cover type in the project area is “breaks” associated the Tongue River and side drainages. Dominant vegetation in this type includes Ponderosa Pine, juniper, big sagebrush, bluebunch and western wheatgrass and green needlegrass. Dominant species within each cover type area would vary with soil type, aspect and topography. The project area does not contain any known threatened or endangered plant species.

3.8.1 Invasive Species

The Project area does not contain any known infestations of state-listed noxious weeds or invasive/exotic plant based upon a search of inventory maps/databases and field investigations. However, leafy spurge, an extremely aggressive noxious weed, occurs throughout the nearby Hanging Woman Creek drainage and will undoubtedly spread to this area in the future.

3.9 Wildlife

Wildlife habitat within the project area is currently fragmented by agricultural fields, power line and railroad corridors and a primary county road. Most of the project area is a working ranch with a low level of human disturbance to wildlife, except in areas with gas production.

Fidelity has contracted with Hayden-Wing Associates (H-W) of Laramie, Wy. to develop a Wildlife Monitoring and Protection Plan (WMPP) for the project area. In accordance with requirements set forth in the CBNG Programmatic Wildlife Monitoring and Protection Plan for the Statewide MT EIS, H-W conducted extensive baseline wildlife surveys for Threatened/Endangered species (T/E) including bald eagles and black-footed ferrets, raptors, prairie grouse, black-tailed prairie dogs and mountain plovers on the project area. Additionally, the project area and surrounding landscape has been extensively surveyed by federal, state, private and corporate biologists for wildlife habitat attributes as coal and natural gas

production as developed. The following is a summary of wildlife habitat values, including current baseline information gathered by H-W, BLM biologists and associates for the project area.

3.9.1 Threatened, Endangered and Special Status Species

Bald eagles are the only known Federally-Designated Threatened or Endangered species inhabiting this area. There is an active bald eagle nest located within 1/8 mile of the project boundary. This nest is located on private surface/mineral estate. The nearest proposed federal mineral activity is about one mile from the nest location. There is an active Fidelity private well within ½ mile of the nest. Bald eagles commonly migrate through the Tongue River valley and would winter in the river corridor as long as open water and food sources remain available. Five surveys conducted in January and December of 2003 and January of 2004 documented between 16 and 57 bald eagles using that portion of the Tongue River corridor encompassing the project area (BLM files). No definitive winter roost has been identified at this time.

Appendix 1 contains tables listing all T/E and BLM-listed sensitive status species thought to occur in Montana. These tables describe potential habitat and, therefore, potential presence of a species in the project area. In many cases, inventories have not been conducted for the occurrence of a particular species, although habitat information is from wildlife and plant inventories conducted in the area.

3.9.2 Big Game Species

Mule deer are found year round in the project area. Portions of the area, including the Tongue River Breaks and associated drainages, are considered important winter range. Recent studies have not been completed to fully understand and document deer movement patterns; however, it is reasonable to assume mule deer move seasonally from higher elevation landscapes (i.e., Little Wolf Mountains, Custer National Forest, Badger Hills) to important lower elevation winter range in the Tongue River corridor. White-tailed deer are very common, especially along the Tongue River and adjacent side drainages. Antelope are common but less adundant than deer. There is a small herd of elk (est. < 100 individuals) steadily expanding into the project area vicinity but their movements and numbers are not well understood (J. Ensign, MDFWP, personal communication). Recent BLM surveys indicate the elk remain in the project area year-round and often frequent the area from the Tongue River along the state line east to the Badger Hills and north into the river breaks northeast of Tongue River Reservoir and into the Custer National Forest. Other big game, including black bear and mountain lion, are known to occur in the area but specific data on these species are not available.

3.9.3 Upland Game Birds

The project area contains habitat for sharp tailed and sage-grouse. There are five known (active/historic) sharp-tailed grouse leks and two (one active/one historic) sage-grouse leks within two miles of proposed well locations. There are no known leks located within the actual project boundary. Most of the sagebrush-dominant habitat within the project area has been treated with herbicides thereby greatly reducing habitat quality for winter use or nesting by sage grouse. One radio-collared sage grouse hen was observed nesting about two miles east of the project area in 2003 (B. Walker, U of M graduate student, (personal communication) therefore, the project area may provide some brood-rearing habitat. Wild turkeys are year-round residents in this area and nest throughout the ponderosa pine uplands and riparian areas.

3.9.4 Raptors

Many species of raptors nest within the project area (project area plus one mile buffer). Active nests/territories have been identified for red-tailed hawk(7 nests), prairie falcon(2), burrowing owl(1), great-horned owl(3) and golden eagle(2). Additionally, river valleys such as the Tongue River are migration routes for raptors.

3.9.5 Prairie Dogs and Associated Species

There are three black-tailed prairie dog towns encompassing about 40-50 acres located within the project boundary (H-W, 2003, unpublished report). None of these are located on federal surface/mineral estate. Although habitat is available, surveys conducted in 2003 by H-W following accepted FWS protocols failed to identify mountain plover or black-footed ferret activity within the project boundary. Additionally, no burrowing owl activity was observed during multiple surveys in 2003 on active prairie dog towns in the project area.

3.9.6 Migratory Bird Species

Baseline surveys conducted by the Montana Natural Heritage Program identified 104 species of birds inhabiting this portion of Southeast Montana and another 55 species as probable/possible inhabitants (Carlsen and Cooper, 2003). BLM commissioned 2 separate breeding bird surveys (unpublished reports by USGS and University of Montana) in the project area and surrounding landscape in 2001 and 2003. Ten transects recorded 62 species of breeding birds of which western meadowlarks, lark/vesper/clay-collared/Brewer's sparrows and Brewer's blackbirds and brown-headed cowbirds were the most common species represented. H-W identified active great blue heron and double-breasted cormorant rookeries within one mile of the project area during 2003 wildlife baseline surveys. These rookeries are located on private surface/mineral estate. Appendix 1 includes a tabular summary of all Montana BLM bird species of special concern. Included in this summary is an analysis of potential habitat and possible occurrences of these species in the project area. These species are in very low numbers and/or simply have not been documented on recent surveys. These may include, but not limited to, ferruginous and Swainson's hawks, hairy woodpecker, loggerhead shrike and others as shown in Appendix 1.

3.9.7 Aquatic Resources

The Tongue River and Badger Creek are perennial waters that bisect the project area. This reach of the Tongue River supports at least 27 species of fish (FWP, 1980) with smallmouth bass, sauger and catfish being the dominant sport fishes represented. A recent baseline aquatic survey commissioned by BLM of 5 tributary streams near the project area documented 11 fish species in stream reaches sampled. Brassy minnows represented 58% of the total sample (Confluence Consulting, 2003). The northern leopard frog, tiger salamander and spiny soft-shell turtle are common in and along the Tongue River, tributaries and surrounding riparian landscapes.

1.9.8 West Nile Virus

West Nile Virus (WNV) is a mosquito-borne disease that can cause encephalitis and other brainstem diseases to humans. Mosquitoes spread this virus after they feed on infected birds and then people, other birds and animals. WNV is not spread by person-to-person contact and there is no evidence people can get the virus by handling infected animals. Although most of the attention has been focused on human health issues, WNV has had a significant impact on vertebrate wildlife populations. WNV was identified as a mortality factor in a sage grouse population near Gillette, Wy. in 2003. This population is part of a

research project evaluating CBNG development impacts to sage grouse populations in Southeast Montana/Northeast Wyoming.

Mosquitoes can potentially breed in any standing water that lasts more than 4 days. In the Powder River Basin, which includes the project area, there is generally increased surface water availability associated with CBNG development. WNV has been identified in mosquitoes trapped in and around CBNG produced - water reservoirs in the vicinity of the sage grouse mortalities (B. Walker, personal communication). Research on this issue is currently being conducted by several entities (ie, Wyoming Veterinary Lab, University of Montana, Montana State University, USDA and University of Alberta).