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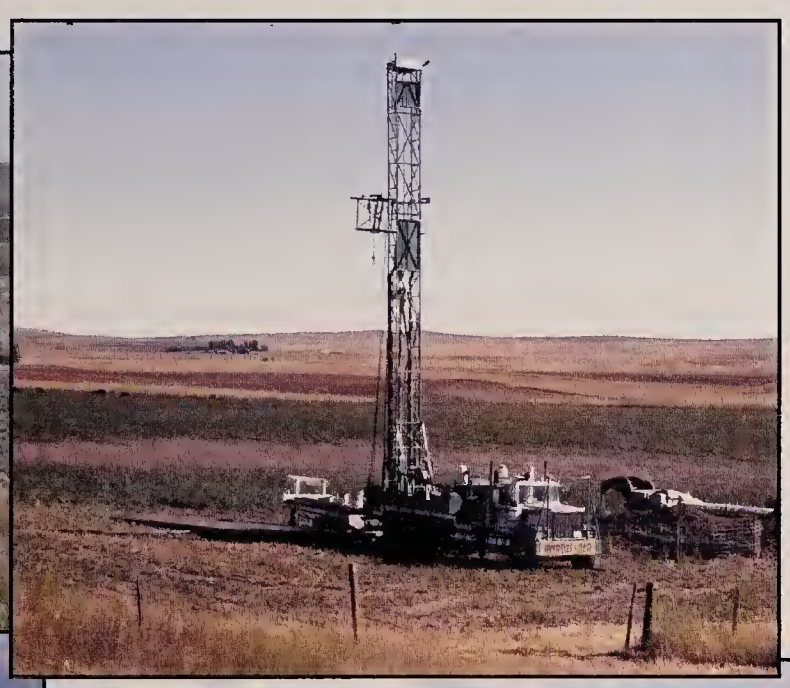

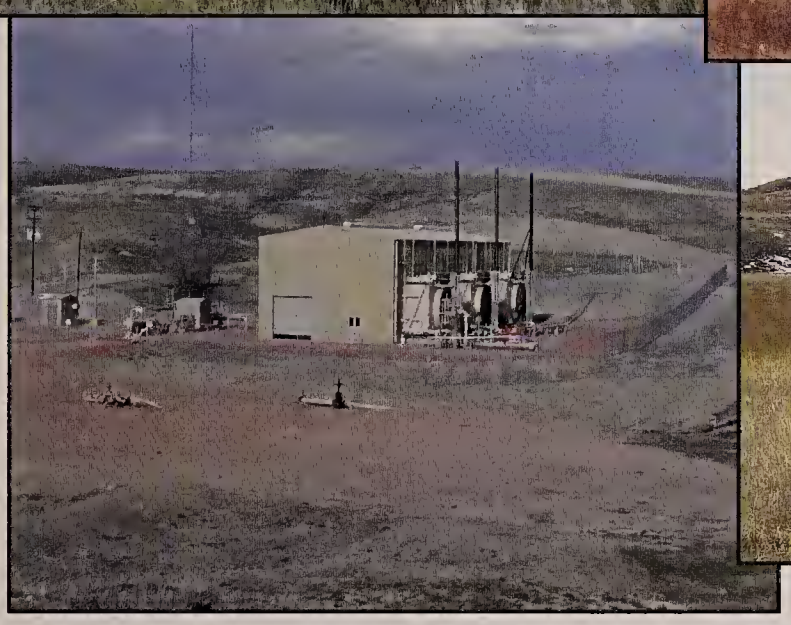

MISSION STATEMENT

It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

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Appendix A
Reasonably Foreseeable Development Scenario

REASONABLY FORESEEABLE DEVELOPMENT SCENARIO FOR

OIL AND GAS DEVELOPMENT IN THE

BUFFALO FIELD OFFICE AREA,

CAMPBELL, JOHNSON, AND SHERIDAN COUNTIES, WYOMING

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Wyoming State Office - Reservoir Management Group

Released: February 2001

REASONABLY FORESEEABLE DEVELOPMENT SCENARIO FOR OIL AND GAS DEVELOPMENT IN THE BUFFALO FIELD OFFICE AREA, WYOMING

SUMMARY

Estimating how much oil and gas activity will occur on federal acreage in the Buffalo Field Office Area (BFOA) during the next ten years is at best difficult. It is expected that, with a few exceptions, all public domain and acquired minerals will be available for leasing as indicated by the current land use plan. Review of oil and gas price, occurrence potential, play analysis, and leasing, seismic, drilling, and production activities was needed to understand the oil and gas resource potential. This information was used to project activity through 2010. Where appropriate, the coalbed methane (CBM) resource is discussed separately from conventional oil and gas.

The BFOA is in northeast Wyoming (Figure 1) and most of it lies in the Powder River Basin. Fifteen oil and gas plays have been identified and are summarized by the U.S. Geological Survey (Dolton 1990). An oil and/or gas play is an area, geologic formation, or geologic trend which has good potential for oil and/or gas development or is generating a large amount of interest in leasing and drilling.

The CBM play covers the central part of the BFOA and is currently one of the most active gas plays in the country. Ninety eight percent of the CBM resources are in Campbell, Johnson, and Sheridan counties, Wyoming. Converse and Natrona counties contain the remaining two percent. Montana contains about two percent of the total estimated CBM resources in the Powder River Basin, excluding native lands.

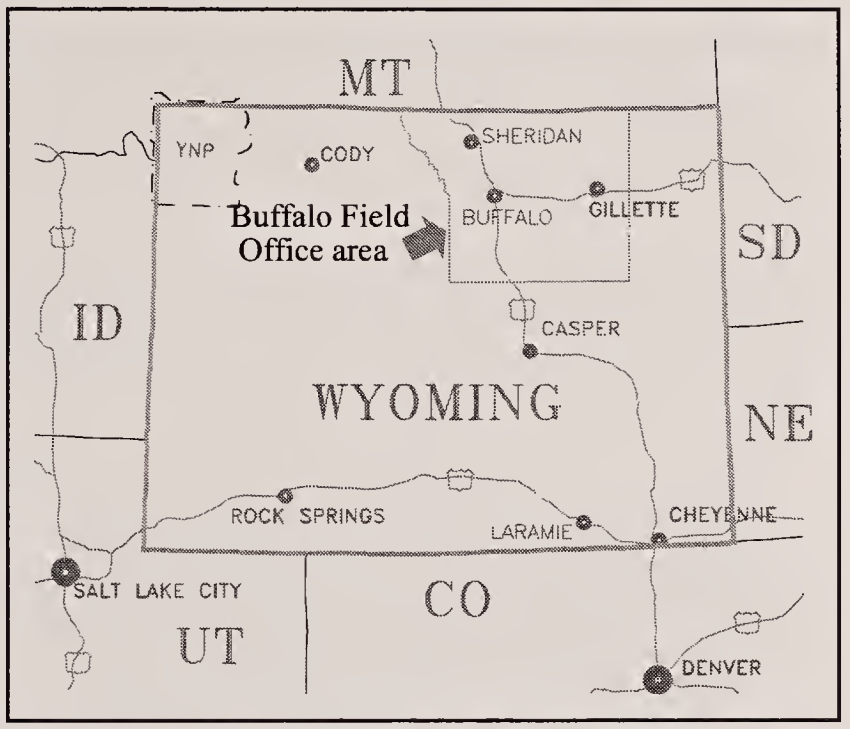

Figure 1 Index map showing location of the Buffalo Field Office area.

Federal oil and gas leasing through 2010 will average between 100,000 and 500,000 acres per year. Average bids are expected to be between $10 to $50 per acre. From February 1990 to August 1999, the BLM received $83 million in oil and gas lease bonuses for the BFOA. About $51 million of that total is estimated to be directly attributed to CBM interest.

Seismic activity on BLM administered surface will average 15 surveys per year through 2010. Most will be three dimensional surveys rather than the two dimensional surveys common in the past. Most seismic activity will continue to occur in Campbell County.

Through 2010, non CBM federal wells are expected to be drilled at an average of 30 to 150 per year, but, could be as high as 200 per year. New non CBM field discoveries will average five to ten per year, with average field size being two to five wells.

Future CBM drilling was estimated, using 28 trillion cubic feet of gas as the recoverable reserve. This is the high estimate, but was used so that the largest potential impact could be assessed. Three reasonably foreseeable development scenarios for CBM, were calculated based on different average well recoveries. The moderate scenario projects 81,000 total CBM wells in Wyoming, with 50,000 wells drilled by 2010. The high scenario projects 139,000 total wells, with 80,000 being drilled by 2010.

BFOA oil production in 1998 was 17 million barrels. Although oil production may show minor year-to-year increases, overall it is anticipated to decline about five percent per year over the period reviewed. This projection could change if a major oil play develops or prices increase substantially and stabilize. Oil production from federal leases will continue to be about 50% of total oil production.

Non CBM gas production declined from 3.4 billion cubic feet of gas (BCFG)/month in January 1986 to 1.3 BCFG/month in January 1999. Although there may be year-to-year increases, the decline in non CBM gas production is expected to continue through 2010.

CBM production increased from 0.28 BCFG/month in January 1995 to 4.57 BCFG/month in June 1999, an average annual increase of 62 percent. Annual gas production rates are expected to continue to increase through 2005. Production rates will then level off for a few years before starting to decline. During June 1999 14 million barrels of water (1,800 acre feet) were produced.

Currently there are about 1,282 productive federal non-CBM oil and gas wells in the BFOA. Although the number of producing oil wells may increase slightly year-to-year it will almost certainly decline over the next ten years. During the next ten years the number of federal non CBM wells abandoned will exceed the number of federal non CBM wells drilled.

INTRODUCTION

The following scenario presents an estimate of future activity within the BFOA, under the current land use plan, unless otherwise noted.

It was assumed that all public domain and acquired minerals would be available for leasing and development without excessive restrictions, except for:

- wilderness and wilderness study areas (only the Fortification Creek Wilderness Study Area, 12,419 acres mostly in T. 52 N., R. 72 W., has high oil and gas occurrence potential);
- selected areas within federally approved coal mine plans; and
- Wyoming Game and Fish big game winter ranges adjacent to the Bighorn National Forest.

Impacts caused by oil and gas development, and impacts to oil and gas development cannot be assessed without estimating future oil and gas activity. Estimates of future activity need to take into account:

- crude oil and natural gas prices and anticipated price changes;
- oil and gas occurrence potential;

- oil and gas play analysis (including looking at the potential development of new plays such as horizontal drilling in the Niobrara Formation or CBM development) or renewed interest in old plays;
- leasing;
- seismic surveys, including advances in three-dimensional analysis;
- drilling; and
- production, including advances in, and application of technology, such as secondary and enhanced oil recovery.

The above factors cannot be predicted with certainty, but some generalizations are possible. The estimates presented here are based on past activity and trends and anticipated future price increases. Those estimates may be lower than what actually happens if price and play developments are more positive than anticipated. Likewise, if exploration in existing plays is disappointing, new plays are not developed, and/or commodity prices are less than anticipated, these estimates may be optimistic.

OIL AND GAS PRICES

The annual change in oil price for the lower 48 states was estimated to range between -1.3 and +1.5 percent for the 1999-2020 period (Energy Information Administration 1998), with a best guess increase of 0.4 percent per year (Figure 2). The actual increase in oil price the past few years has been much higher than predicted. Wyoming sweet crude prices, as reported by Conoco, Inc., were $8.13 in December of 1998 and increased to $24.89 in December of 2000. Average U.S. petroleum consumption is estimated to increase 18 to 46 percent during 1999-2020 (Energy Information Agency 1998).

The average annual change in gas price was projected to be between -0.7 and +1.2 percent during 1999-2020, with a best guess increase of 0.5 percent (Energy Information Administration 1998). Figure 3 shows this projection. The actual increase in gas price the past few years has been much higher than predicted. Opal sweet gas spot prices, as reported by the Oil and Gas Journal, were $2.00 in December of 1998 and increased to $6.00 in December of 2000.

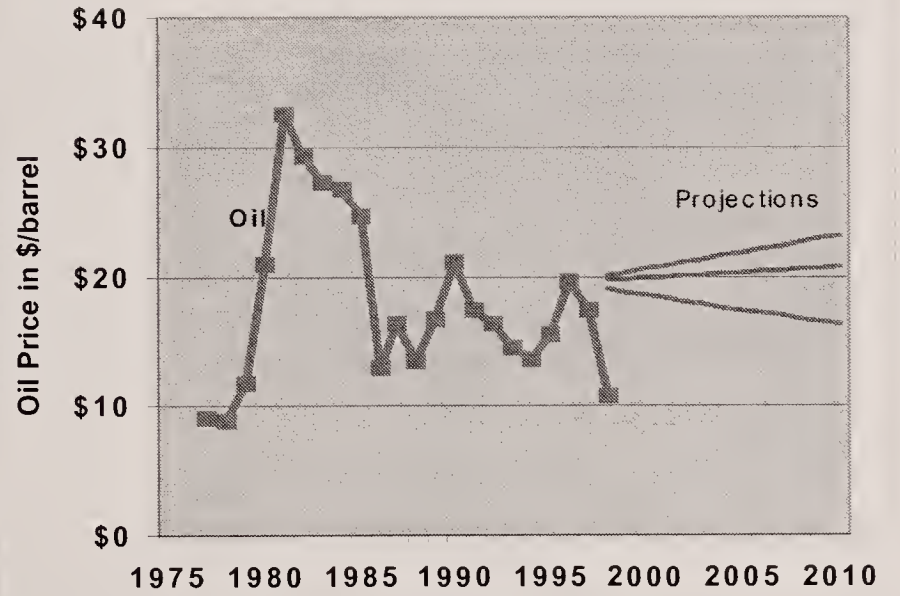

Figure 2 Historic oil prices (Wyoming State Geological Survey 1996) and projections (Energy Information Administration 1998).

OIL AND GAS OCCURRENCE POTENTIAL

Projection of future oil and gas activity must first consider where those resources might occur. To do this an occurrence potential map was constructed (Map 1). The oil and gas occurrence potential was classified as High, Moderate, Low, or None. Explanation of these classifications is given on the map. Note that most of the BFOA has high occurrence potential. The classification is based on geology, data from oil and gas test wells, and the play areas described by Dolton, et al (1990). The Geologic Map of Wyoming (Love and Christiansen 1985) and the Structure Contour Map of the Powder River Basin and Casper Arch, Wyoming and Montana (Petroleum Information 1987) were also used. Map 1 does not indicate whether these resources can be developed economically.

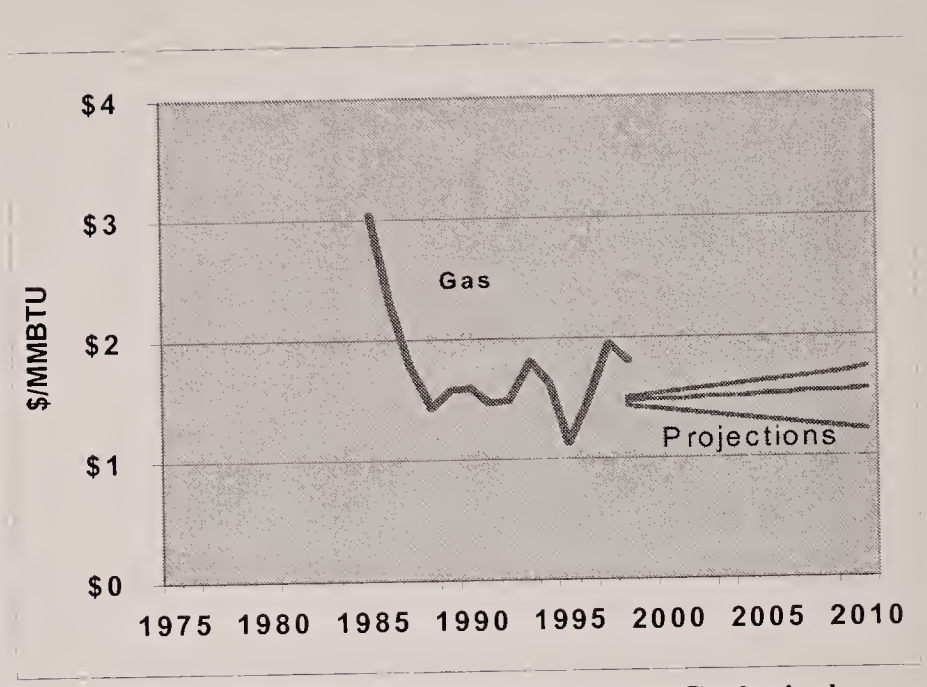

Figure 3 Historic gas prices (Wyoming State Geological Survey 1996) and projections (Energy Information Administration 1998).

OIL AND GAS PLAYS

Non CBM Plays

Fifteen oil and gas plays in the BFOA were identified and described by the U.S. Geological Survey (Dolton, et al 1990). An oil and gas play is an area where a geologic formation can contain oil and/or gas deposits. These plays are summarized in Table 1. Nearly all the hydrocarbons produced from fields within the BFOA are from these plays. The amount of undiscovered oil and gas remaining in the BFOA cannot be estimated from the information in Table 1. This is because geologic heterogeneity, uneven distribution of resources, and reservoir size variations keep hydrocarbons from being evenly distributed across a play area. Two plays not reported by Dolton, et al (1990) are the CBM gas play and the Niobrara Formation fractured shale play.

(CBM) Play

During deposition and compaction of the organic material which ultimately becomes coal, large quantities of methane gas are generated. Methane gas produced from coal has a lower energy (BTU) content than other natural gas produced in the BFOA. Methane molecules are trapped by adsorption in the coal micro pores, and porosity.

The BFOA contains some of the largest coal deposits in the country. The most extensive coal beds are in the Paleocene age Tongue River member of the Fort Union Formation.

The approximate area of potential CBM development can be defined based on depth to coal and coal thickness (Map 2). The play was one of the most active gas plays in the country for 1998-2000. Initially, wells were less than 500 feet deep and were concentrated just west of coal mines on the plays east side. Over

time, well depths have increased and growth of the play has extended to the west. Many new wells are more than 1,000 feet deep. To develop the deepest coals in the Tongue River member, wells may need to be drilled as deep as 3,000 feet.

In October 1999 there were over 1,230 producing and 900 shut-in wells in the play. Figure 4 shows CBM production from the BFOA. Production for October 1999 was 5.8 BCFG. The BFOA experienced a production increase that averaged 62% per year for the period October 1994-October 1999. Lack of pipeline capacity limited production until late 1999 when two new lines were completed into the Powder River Basin. Based on Wyoming Oil and Gas Conservation Commission data, cumulative CBM production through October 1999 was 110 BCFG.

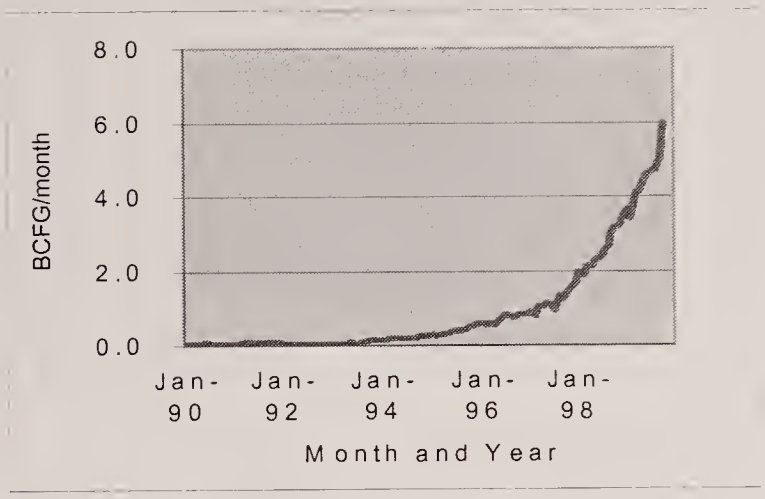

Figure 4 CBM production for BFOA.

CBM resource estimates (Potential Gas Committee 1998) for the Powder River Basin range from 4,664 to 15,859 BCFG with a best guess of 9,329 BCFG. The U.S. Geological Survey also estimated the CBM resources in the Powder River Basin, but their estimate is several years old and was made before the play began rapid and extensive expansion. Their estimates appear to be too low and were not used in this analysis.

Figure 5 displays the drilling history in the BFOA for 1990-1998. There was a general decline in the number of wells drilled through 1994, with most wells drilling in the Minnelusa play. After 1994, total wells increase due to CBM drilling. Most wells listed as "others" on Figure 5 were drilled in the Shannon or Sussex sandstones.

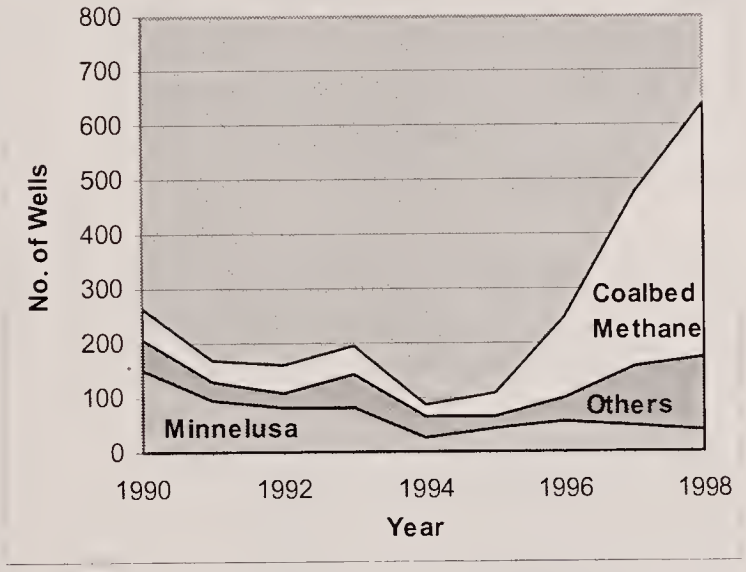

Figure 5 Wells drilled in the BFOA during 1990-1998. Data are from PI/Dwights.

Niobrara Formation Fractured Shale Play Economic development of the Niobrara Formation fractured shale play will almost certainly depend upon successful application of horizontal well technology. This play is currently in it's infancy and is somewhat problematic. Undiscovered reserves cannot be predicted with reasonable certainty, except that the potential recovery may be as large as several million barrels of oil and associated natural gas. Although horizontal wells were used to develop oil and gas reserves in fractured shale reservoirs in southeast Wyoming, overall results have been disappointing in the Powder River Basin. Unless there are a few economic wells drilled, it is unlikely that this play will have significant development in the foreseeable future.

LEASING

After initial field work, research, and subsurface mapping (which sometimes includes use of seismic data), leasing is often the next step in oil and gas development. Leasing may be based on speculation, with the most risky leases usually purchased for the lowest prices.

Leases on lands where the U.S. owns the oil and gas rights are offered via oral auction at least quarterly. Their maximum size is 2,560 acres and the minimum bid is $2.00 per acre. An administrative fee of $75.00 per parcel is charged and each successful bidder must meet citizenship and legal requirements. Leases are issued for a ten year term and a 12.5% royalty rate on production is required to be paid. Leases which become productive, are held by production and do not terminate until all wells on the lease have ceased production. Many private oil and gas leases contain a "Pugh clause", which allows only the developed portion of the lease to be held by production. However, federal leases have no such clause, allowing one well to hold an entire lease.

Wyoming lease sales are held on even numbered months, usually in Cheyenne. Since August 1996, only lands requested for lease have been offered. Before that, virtually all federal lands available for lease were offered at each sale. Each lease contains restrictive stipulations which protect potentially affected resource values.

The number of federal acres in the BFOA offered for lease and leased, on a sale-by-sale basis, is shown in Figure 6. No sale was held in April of 1996. Note the abrupt increase in acreage leased during the June-December 1998 period. For 1998, over 660,000 acres were leased. The additional acreage offered and leased, was mostly in Johnson and Sheridan counties. That increase was due to increased interest in CBM.

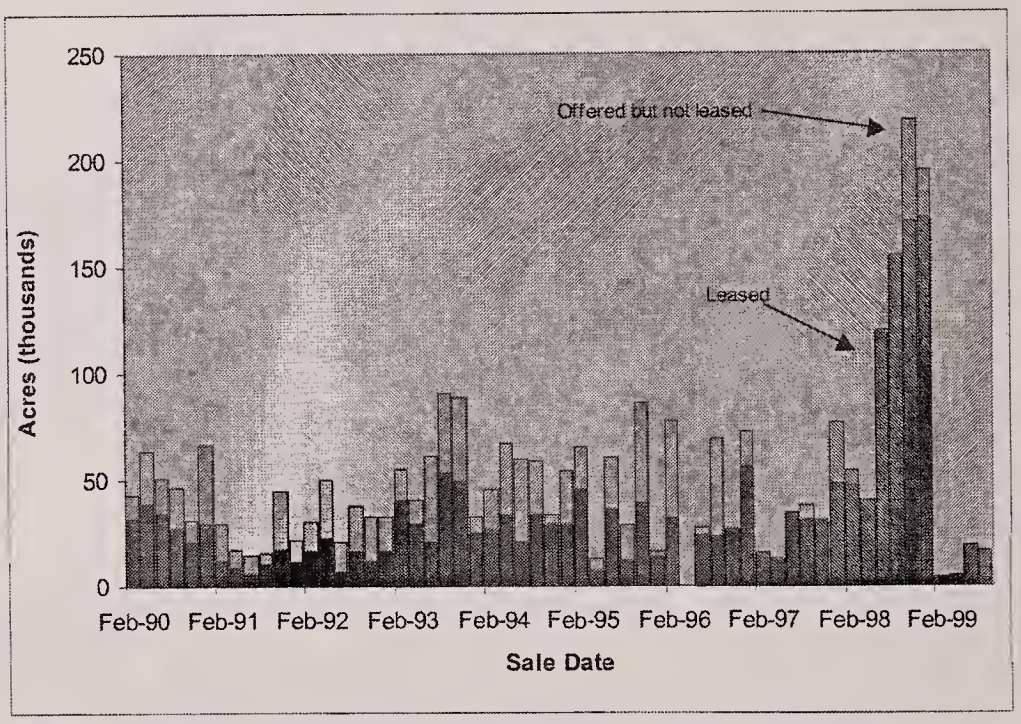

Figure 6 Federal oil and gas lease acres offered and leased for BFOA. Data are from BLM files.

The total bonus bid amount for each sale and the average per acre bid for federal oil and gas leases in the BFOA are shown in Figure 7. Bids are shown on a sale-by-sale basis. Again, no sale was held in April of 1996. Note the steady decline in average bid before December 1995. Beginning in December 1995, the average bid began to increase. Bids began to increase at an even higher rate starting in August of 1997. Those increases were due almost entirely to increased interest in CBM. Since December 1998 the amount of acreage leased and bonus money received has dropped substantially. This is probably because nearly all available federal acreage in the CBM play area is now under lease.

For the period surveyed in Figure 7, about $83 million in total bid bonuses was received for land in the BFOA. About $51 million appears to have been bid to obtain leases for their CBM potential. Maps 3 and 4 highlight average dollar-per-acre bids compiled on a township-by-township basis. They compare federal oil and gas leasing in 1995 and 1998. These maps show the dramatic increase in lease biding in the CBM play area. Highest bids were centered in the BFOA.

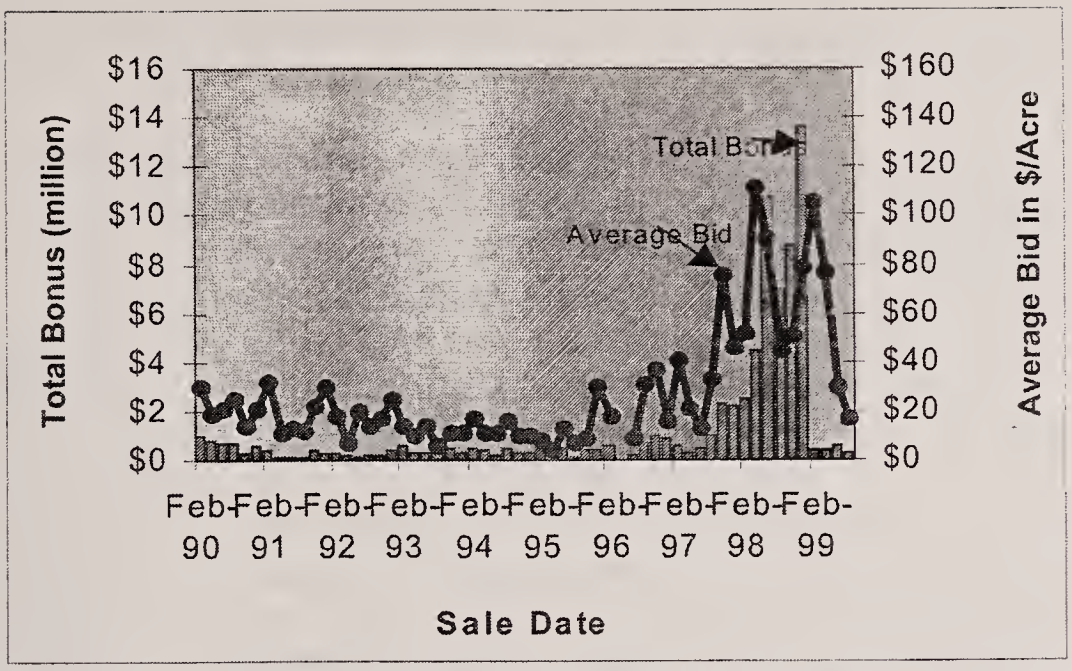

Figure 7 Federal oil and gas lease sale bid results for BFOA. Data are from BLM files.

Many of the federal leases in the CBM play area are large (more than 1,000 acres) and the entire lease will be held by production until the last well ceases production. For most leases this will be many years beyond their primary term. Since these leases will be held by production, it will be more difficult for others to acquire enough acreage to justify tests of deeper horizons. This will suppress development potential of the deeper horizons in the CBM play area.

The amount of federal oil and gas acreage under lease to 2010 is projected to be between 1.5 and 3.0 million acres. Acreage leased annually is projected to average between 100,00 and 500,000 acres. Average bids are estimated to be between $10 and $50 per acre.

SEISMIC SURVEYS

Seismic surveys on Bureau managed surface are authorized by approval of Notices of Intent to Conduct Geophysical Operations (Notices). From 1984 through 1998 the number of approved Notices has decreased substantially (Figure 8). Until a sustained oil price in excess of $30.00 per barrel occurs, the number of Notices will probably remain low. It is questionable whether a price increase would spur new Notices, since the BFOA already has extensive seismic coverage. Much of this existing data could probably be reprocessed with computers, rather than making new on-the-ground seismic surveys.

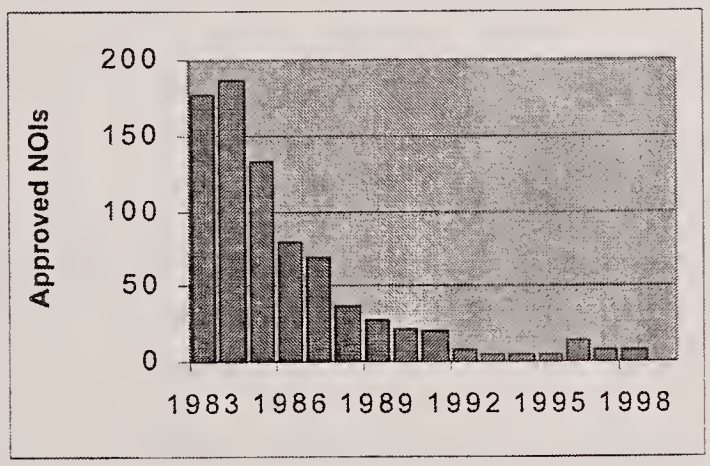

Figure 8 Approved Notices on BLM managed surface in the BFOA. Data are from BLM files.

There has been recent interest in three-dimensional surveys. Although more expensive than conventional seismic surveys, they give a three-dimensional picture of the subsurface. Most of these surveys have been over or near oil fields in eastern Campbell County where there is little Bureau managed surface. If successful, three-dimensional surveys could increase Notices to about 15 per year. Seismic data is not generally used in the CBM play, therefore, activity in this play is not expected to increase the number of Notices.

DRILLING OPERATIONS

Non CBM Drilling

Before an oil or gas well is drilled, an Application for Permit to Drill (Permit) must be filed with the WOGCC. If the well will be on federal lands, the Permit must also be filed with the Bureau. Figure 9 plots the total and federal non CBM Permits approved for 1985-1999. The WOGCC approved 2,851 total Permits during that period. About 50% (1,397 Permits) were Federal. Around 80% were actually drilled.

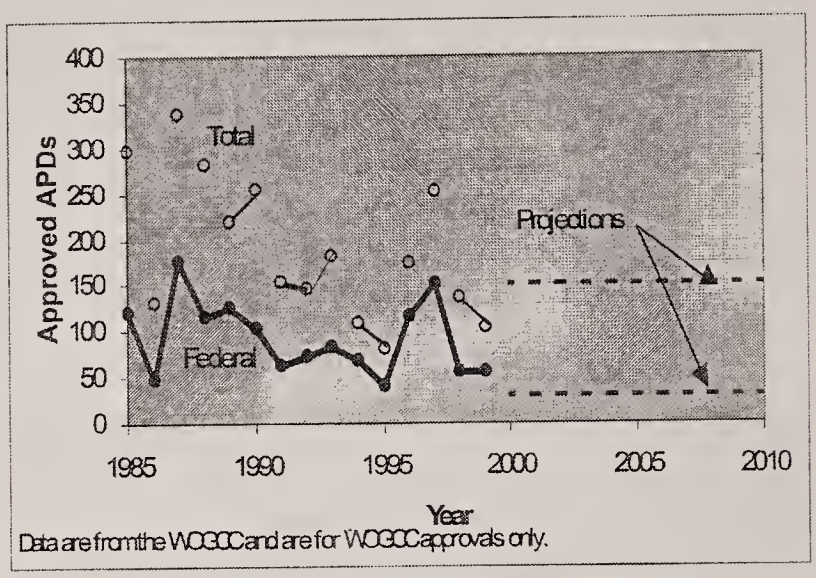

Figure 9 Approved non CBM Permits (APDs) and projections through 2010

Historical data indicate there is a general correlation between the number of approved non CBM Permits and oil price. Although not shown here, this correlation indicates a sharp increase in Permits would not be expected until oil prices are above $25 to $30 per barrel for a sustained period.

Historical data indicates total non CBM Permits will range from 100 to 300 per year, through 2010. They could possibly go as high as 400 per year, although this is not likely unless oil prices are above $25-$30 per barrel for a sustained period. The number of approved Federal Permits is expected to range from 30 to 150 annually with a possible high of 200.

General areas of anticipated development activity in the BFOA are shown on Map 5. This map shows the general areas of anticipated drilling activity, exclusive of CBM, through 2010. It was drawn after reviewing information on:

- areas of past drilling activity;
- the oil and gas plays outlined by Dolton, et al (1990);
- information obtained from Glaser (1992);
- federal oil and gas lease sale results; and
- a general knowledge of Powder River Basin geology.

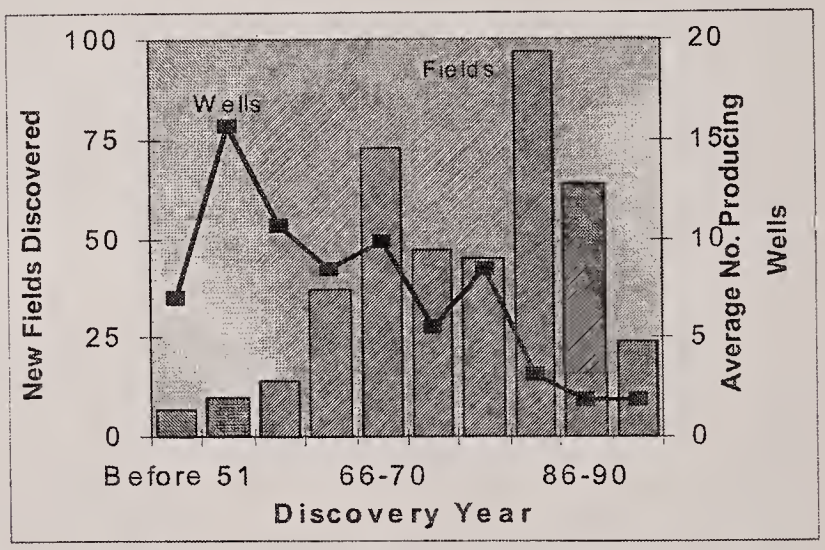

Figure 10 Number of oil and gas field discoveries and the average number of field wells producing in 1997. Data are from WOGCC.

New oil and gas fields will continue to be discovered. Their number and size are difficult to predict with confidence. As Figure 10 shows, the discovery rate of fields has been somewhat erratic, but the trend was upward until the 1981-1985 interval. Field discoveries peaked in the mid-eighties and the rate is now trending downward. During 1981-1990, an average of 16 non CBM fields were discovered annually in the BFOA. It is unlikely this field discovery rate will occur again. Past patterns indicate the number of new non CBM

field discoveries should average between five and ten annually through 2010. Most of the total new fields discovered during the next several years will be CBM fields.

The size of field discoveries, as measured by the number of wells producing in 1997, shows a distinct downward trend over time (Figure 10). Many of the fields discovered since the mid-eighties are productive from the Minnelusa Formation. Although these fields typically produce from fewer than ten wells, they usually have relatively high oil recoveries on a per-well basis. About 20% of the non CBM fields discovered since 1980, produce less than 30,000 barrels of oil from only one well and are probably uneconomic.

Past trends suggests that newly discovered non CBM fields will produce from less than ten wells. Average field size of new discoveries will probably be from two to five productive wells per field.

Carbon Dioxide Drilling The injection of carbon dioxide gas into oil reservoirs to enhance recovery has received some attention by industry since the early 1980's. This type of enhanced oil recovery has been of great interest were existing waterflood operations in old fields are approaching the end of their productive lives. The Powder River Basin contains a large number of these types of oil fields that are candidates for carbon dioxide injection. A few pilot carbon dioxide floods have tested the feasibility of this process in the Powder River Basin. The oil and gas industry has been interested in proceeding with additional tests of this type of flooding, if a supply of carbon dioxide gas could be easily accessed. To get the volumes of gas required to operate a flood, a pipeline would be required to bring it to the local fields.

The Bureau is presently analyzing the affects of laying a pipeline(Petro Source Carbon Dioxide Pipeline Project Environmental Assessment) into the Powder River Basin from Baroil in south central Wyoming. The present target date for completion of this pipeline is late 2001 or prior to February of 2002. During this initial construction phase, the pipeline would only extend to the area of the Salt Creek and Sussex fields north of Casper. Howell Corporation appears to be the only company pursuing an early test of a carbon dioxide flood. They are actively planning a pilot flood in the north part of the Salt Creek Field for soon after the pipeline is installed. Westport Oil & Gas operates the Sussex field and does not appear to have immediate plans to start a flood. A second phase of pipeline construction is planned to the Hartzog Draw area, to the northeast of the Salt Creek Field. That extension would not be completed until 2003.

Information received indicates that very few new carbon dioxide flood related wells are likely to result in the short term (to 2010), because of this new access to a cheaper source of carbon dioxide gas. Targets for these types of floods are the larger developed oil fields. These candidate fields will have been fully delineated by past drilling and already undergone some type of water flood. At present there is no conclusive engineering database to allow a determination of what the best flood candidates are. In addition to the Salt Creek and Sussex fields, a number of other fields have already had some type of pilot carbon dioxide flood or have been mentioned as having potential for a flood. Those potential candidate fields are; Hartzog Draw, House Creek, Rozet, Kitty, Slattery, Meadow Creek, Culp Draw, Triangle U, House Creek, Hilight, Mush Creek, Lance Creek, Mule Creek, Dillinger Ranch, Cole Creek, and Glenrock.

Existing wellbores are expected to be adequate for use in any carbon dioxide flood and few new wells will be needed. Some new wells may be required to optimize the pattern of injection or production from a reservoir. Most new wells would be placed on an existing pad, where that new wellbore would be needed to replace an existing wellbore that has to be abandoned due to technical problems. The number of potential new wells are included in the projection made above for total non CBM drilling.

Horizontal Wells Horizontal drilling results in the BFOA have been disappointing. If future attempts to exploit oil and gas reserves in the Niobrara or other formations are successful, horizontal drilling activity could rise abruptly. Because of this uncertainty, estimates of horizontal wells drilled per-year range from two to ten or higher.

CBM Drilling

Wyoming CBM development activities are currently "booming" in the BFOA. This "boom" will almost certainly continue for a few more years, with the eastern side of the CBM development area (Map 2) being developed first. Because the western part of the CBM area contains a larger amount of federal mineral acreage than the eastern part of the CBM play area, delays in approving federal Permits may slow development in the western part of the area.

An estimate of recoverable resources was first required, to be able to determine reasonably foreseeable development scenarios for CBM drilling. See the "Oil and Gas Production" section (below) for procedures used to determine recoverable CBM resources for the five counties in Wyoming and for the Montana portion of the Powder River Basin. Using the estimate of recoverable resources, three scenarios for reasonably foreseeable development of CBM are predicted. The high resource estimate (28 trillion cubic feet of gas (TCFG)) was used in order to determine the maximum number of wells that can reasonably be expected to develop this play. The graphs shown below (Figures 11 and 12) are based on calculated reserves of 28 TCFG.

The three scenarios described are based on average recoveries of 0.20, 0.35, and 0.50 BCFG per well. These three average well recoveries allow low, moderate, and high projections of the cumulative number of wells that could be drilled (Figure 11). The moderate scenario projects 81,000 total CBM wells in Wyoming, with 50,000 wells drilled by 2010. The high scenario projects 139,000 total wells, with 80,000 being drilled by 2010.

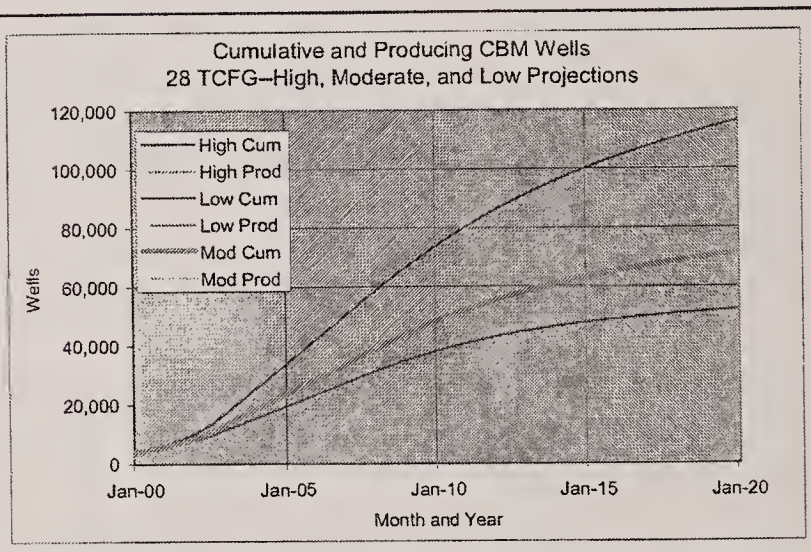

Figure 11 Projections of cumulative wells drilled and total producing wells for low, moderate, and high CBM scenarios. Data used are from WOGCC and BLM.

Curves showing the number of wells producing at one time are also shown on Figure 11. They are derived from the cumulative drilling projection curves. The low projection indicates the maximum number of wells producing at one time is 38,000. The high projection is 81,000 producing wells. Notice that for all three scenarios the number of producing wells increases until 2013-2014 then declines 10-16 percent per year.

The number of wells drilled monthly is also projected for three scenarios (see Figure 12). These projections were derived from the graph shown in Figure 11. They are based on historical trends, drilling time, well depth, and estimated Permit approval rates. The minimum drilling rate is estimated to be 330 wells per month (3,960 wells per year) for the height of drilling activity (January, 2003 through December, 2007). A maximum rate was projected to be 690 wells per month (3,960 wells per year). About one-half of these wells would be federal.

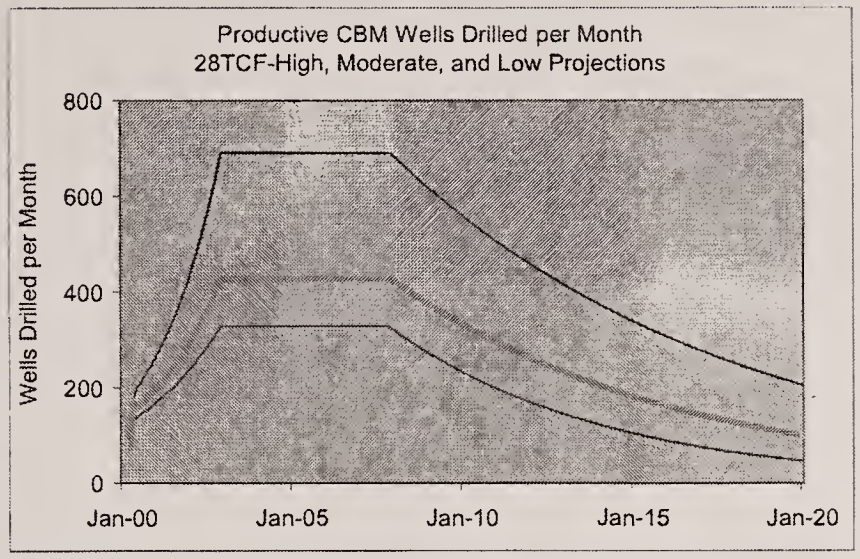

Figure 12 Estimate of productive wells drilled per month for low, high, and moderate scenarios.

Montana Recent proposals by operators indicate 9,551 wells will be drilled in the Montana portion of the Powder River Basin by 2010. This well projection appears to be too high, as discussed below in the "Recoverable CBM Resources in Montana" section.

OIL AND GAS PRODUCTION

Non CBM Production

Oil production from wells on federal, fee, and state minerals is shown in Figure 13. Production during 1984-1991 was relatively stable, but has declined sharply since. The decline averaged eight percent per year from 1991-1998. During 1990-1995 oil production from wells on federal minerals averaged 51% of the total oil production.

Oil production will continue to decline about five to eight percent per year, unless large new discoveries are made, or there is a long term increase in price. A price increase would stimulate the search for new deposits, allow old fields to be produced longer, and allow increased use of enhanced oil recovery methods. It is unlikely that annual oil production will again reach 30 million barrels.

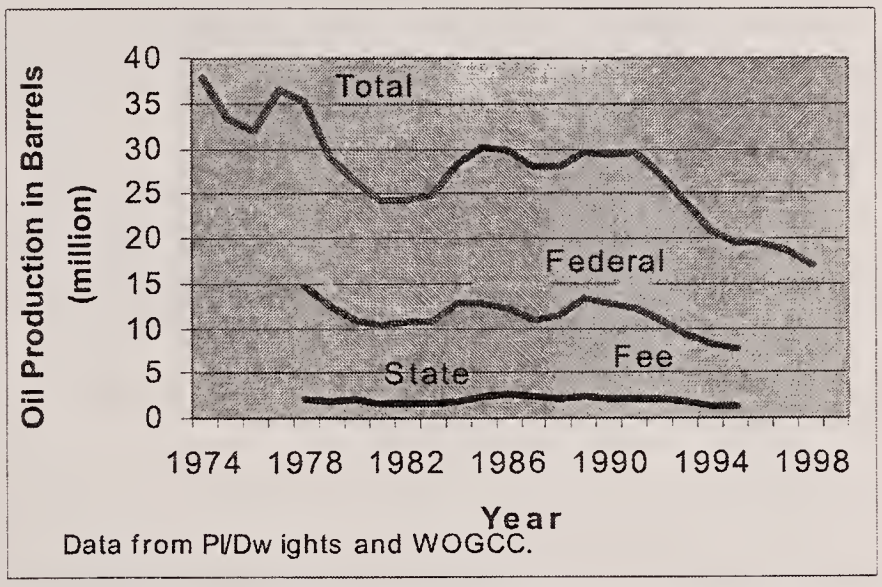

Figure 13 Oil production from federal, fee, and state wells in the BFOA.

Gas production from wells on federal, fee, and state minerals has been much more erratic (Figure 14). Total gas production declined 53 percent from 1987-1994. In 1994, CBM was only 12 percent of total gas production in the BFOA. The gas production decline was reversed in 1995 due to increasing CBM production. Total gas production increased 21 percent per year since 1994. This trend is expected to continue.

The total number of non CBM producing wells in the BFOA increased from 1978-1984, but has decreased since 1990. The number of wells will probably continue to decrease through 2010, although there may be a few year-to-year increases. During 1990-1994, 58 more non-CBM federal wells were abandoned per year than were drilled per year. This trend is expected to continue, but the number of wells plugged in excess of the number of new wells drilled will probably decrease.

During 1990-1995, about 50 percent of the total producing wells in the BFOA were federal wells. The number of productive federal wells is expected to remain at about 50% of total productive wells.

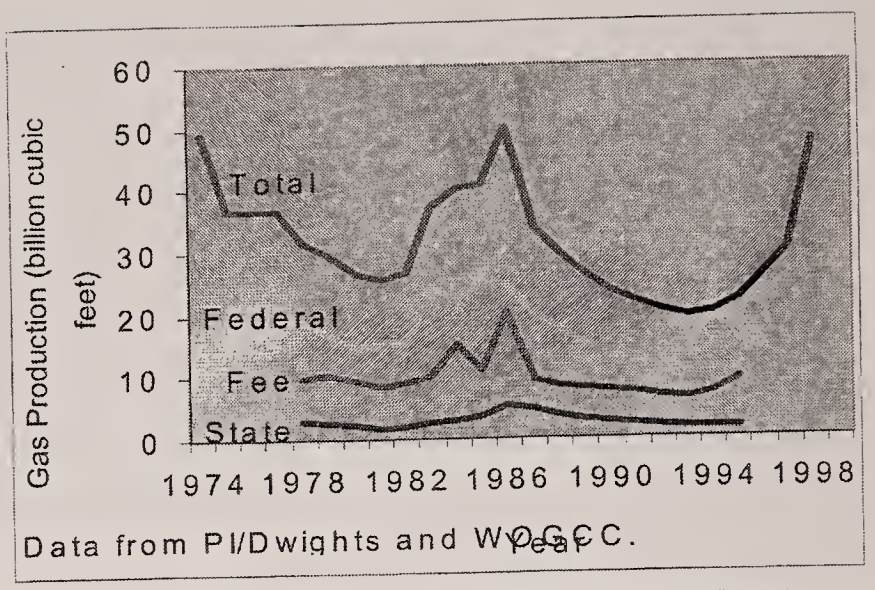

Figure 14 Gas production from federal, fee, and state wells in the BFOA.

CBM Production

Summary Recoverable resource estimates for CBM in the Powder River Basin vary widely. Five sets of recent estimates (including our estimates) are listed in Table 2. Because of the variation, the Wyoming Reservoir Management Group took the latest available information and made additional calculations for gas-in-place and recoverable CBM resources. Recently available coal tonnage, gas content, and water pressure data were used in these calculations. The data, some of which is still proprietary, allowed detailed calculations of total gas-in-place in the Powder River Basin. A range of recovery factors was used, therefore there is a range of estimated recoverable CBM resources.

Recoverable Res. TCFG	Source	Date
4.198-8.396-14.273	Potential Gas Comm.	March, 1998
9.329	Gas Research Inst.	1999
25.2	Goolsby and Assoc.	August, 1999
14.6	Lance Oil and Gas	August, 1999
16-23-28	BLM-WRMG	November, 2000

Table 2 Recent estimates of recoverable coal gas for the Powder River Basin. The Lance Oil and Gas estimate is unpublished.

Ninety eight percent of the CBM resources are in Campbell, Johnson, and Sheridan counties, Wyoming. Converse and Natrona counties contain the remaining two percent. Montana contains about two percent of the total estimated CBM methane resources in the Powder River Basin, excluding native lands.

Future CBM drilling was estimated (see "CBM Drilling", above) using 28 TCFG as the recoverable gas reserve. This is the high estimate and was used to assess possible impacts at the highest potential drilling rate. Three reasonably foreseeable development scenarios were calculated based on different average well recoveries. The moderate scenario projects 81,000 total CBM wells in Wyoming, with 50,000 wells drilled by 2010. The high scenario projects 139,000 total wells, with 80,000 being drilled by 2010.

Methodology Gas-in-place and recoverable gas resources were calculated using a volumetric approach. Information used to make these calculations was:

1. Coal tonnage data from the U.S. Geological Survey was used. Data was obtained from coal outcrops and 18,207 drill holes. About ¾ of the drill holes were for coal assessment; the remainder were oil and gas wells. Coal tonnage was calculated using the Wood et al (1983) method for each resource classification {measured, indicated, inferred, and hypothetical (Flores 1999)}. Only coal beds 20 feet thicker or more were included. Tonnages were calculated over the intervals shown in Table 3. Conversion factors of 1,750 tons/acre foot for lignite and 1,770 tons/acre foot for subbituminous coal were used (Flores 1999).

Depth (Feet)	scf/ton
0-200	3
200-500	13
500-1,000	27
1,000-1,200	38
1,200-1,500	43
1,500-2,000	56
2,000-2,500	68
over 2,500	78

Table 3 Depth intervals and gas content (scf/ton = standard cubic feet per ton) for Powder River Basin.

2. Gas content in the coal was determined based on an average synthesized methane adsorption isotherm (Figure 15). This isotherm was constructed from 28 to 37 synthesized isotherms obtained from coal core samples from the Powder River Basin. The pressure shown in Figure 15 is the pressure at which CBM begins to desorb, or escape from coal. Much of the original data is still confidential.

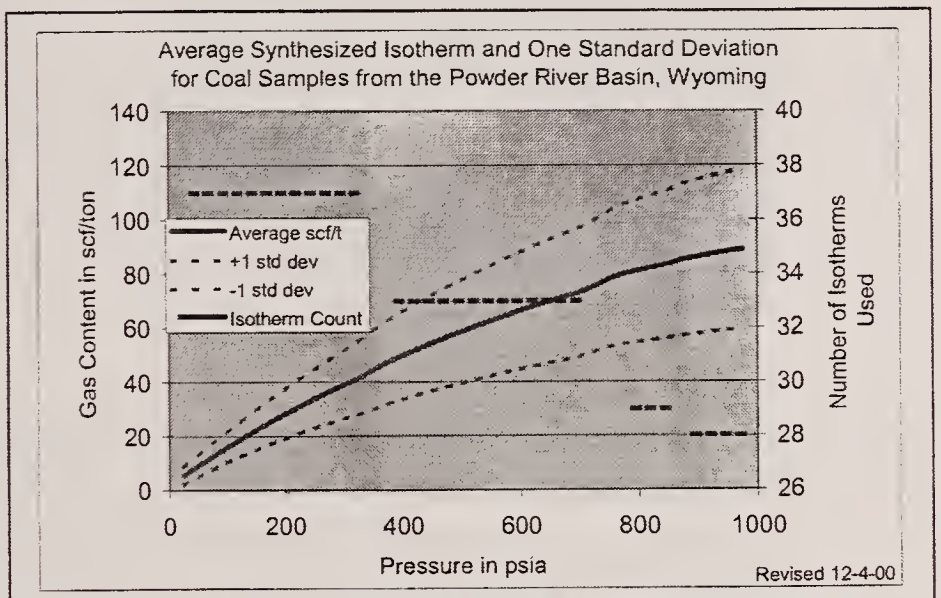

Figure 15 Average methane adsorption isotherm based on averaged synthesized data from coal cores. Data are from USGS, industry sources, and WOGCC.

3. A method to calculate pressure at the top of coal, at different coal depths, is needed in order to calculate gas-in-place at those depths. The pressure at the top of the coal must first be determined. To get an estimate of that pressure, data from 18 water monitor wells was used to correlate depth of the coal and depth to the top of water (piezometric surface). Figure 16 shows this correlation. Several of these wells are clustered in one area, therefore those wells were averaged and one averaged well was plotted on the graph. If the depth to top of coal is known, then Figure 16 is used to determine depth to top of water. The depth to top of water is then multiplied by 0.433 psi/foot (fresh water gradient) to obtain pressure at the top of the coal of interest.

4. The water monitor well data indicates that the pressure exerted by the water in the coal does not allow its gas to escape. Therefore, some water must first be removed to lower pressure, and allow

the coalbed methane to desorb. At some point pressure will be lowered enough for the gas in the coal to be desorbed. The initial desorption pressure can be estimated by using water monitor well data. Several water monitor wells have measured the lowering of the water level and initial gas desorption pressure. Figure 17 shows a correlation between initial pressure at the top of the coal and initial desorption pressure. After initial desorption pressure is determined the graph in Figure 15 can be used to estimate gas content in the coal. Coal gas contents in standard cubic feet per ton (scf/ton)used for specific depth intervals are shown in Table 3.

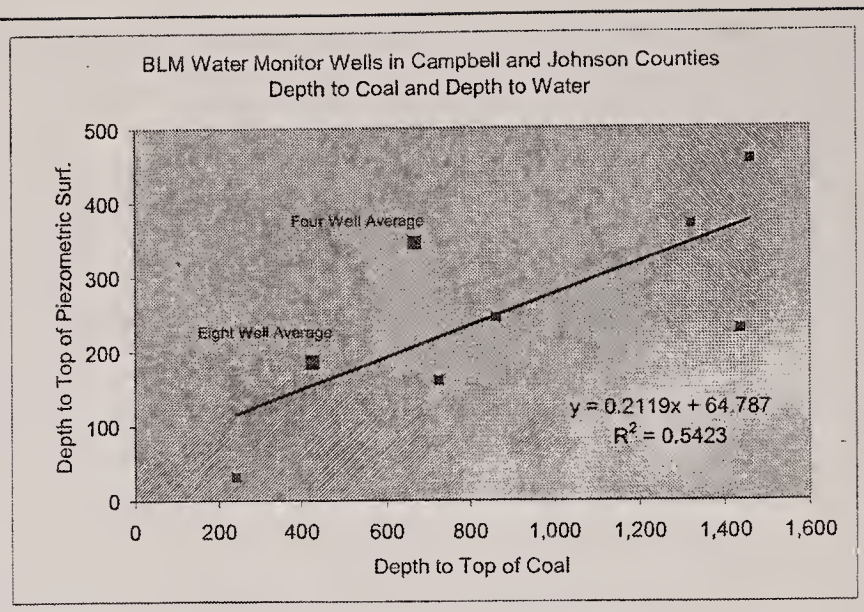

Figure 16 Correlation of coal depth and depth to top of water, in monitor wells. Data are from BLM files.

5. Gas-in-place calculations can be made by multiplying coal tonnage for specified depth intervals (calculated in item 1, above) by the coal gas contents listed in Table 3. Results of calculations for gas-in-place, by county, are shown in Table 4. Calculations were made only for coals in the Fort Union and Wasatch formations. Coals in Cretaceous and older formations were not included. They probably do not contain any significant CBM resources when compared with coals in the shallower Fort Union and Watch formations.

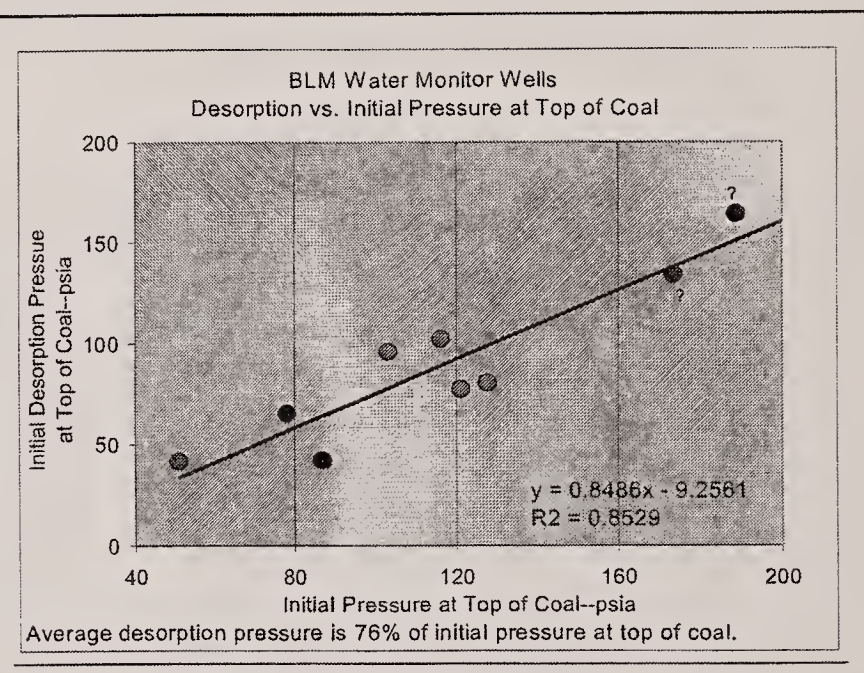

Figure 17 Correlation between pressure at the top of the coal and initial coal gas desorption pressure in water monitor wells.

6. After gas-in-place has been calculated, recovery factors can be applied to determine recoverable gas resources. Recovery factors used in this estimate of recoverable resources are summarized in Table 5. Determination of a recovery factor is difficult and subject to considerable speculation, therefore a range of recovery factors (low, moderate, and high) was used.

County	Gas-In-Place BCFG	Recoverable Resources (BCFG)		
		Low	Moderate	High
Campbell	15,411	7,644	9,945	12,258
Converse	666	327	426	526
Johnson	13,523	6,722	8,741	10,773
Natrona	24	12	15	19
Sheridan	5,933	2,928	3,810	4,703
WY Total	35,557	17,633	22,937	28,279

Table 4 Gas-in-place and estimates of recoverable CBM resources for the Powder River Basin.

Recoverable CBM Resources in Wyoming Using the procedure described above, recoverable resources for five counties in Wyoming were calculated. Table 4 shows the low, moderate, and high estimates for recoverable resources for each county. The high estimate totals 28 TCFG for the Wyoming part of the Powder River Basin.

Depth	Recovery Factors		
	Low	Moderate	High
0-200 ft.	2%	10%	25%
Over 200 ft.	50%	65%	80%

Table 5 Recovery factors used to calculate CBM resources in the Powder River Basin.

Recoverable CBM Resources in Montana The resource in the Montana part of the Powder River Basin is minor relative to Wyoming's resource. Using the approach described above in "Methodology", gas-in-place resources are 479 BCFG and recoverable resources are 205 to 343 BCFG. Only about one and a half percent the total Powder River Basin gas-in-place is in Montana, exclusive of the Indian reservations.

Recent operator proposals indicate 9,551 wells will be drilled in Montana by 2010. The average well is projected to recover 0.3 BCFG. Multiplying total wells by recovery per well, indicates at least 2,900 BCFG would be recovered. This is much larger than the 205 to 343 BCFG thought to be recoverable from the coals. The number of actual CBM wells that could be drilled to produce the recoverable resource of 205 to 343 would be much less than the 9,551 wells proposed.

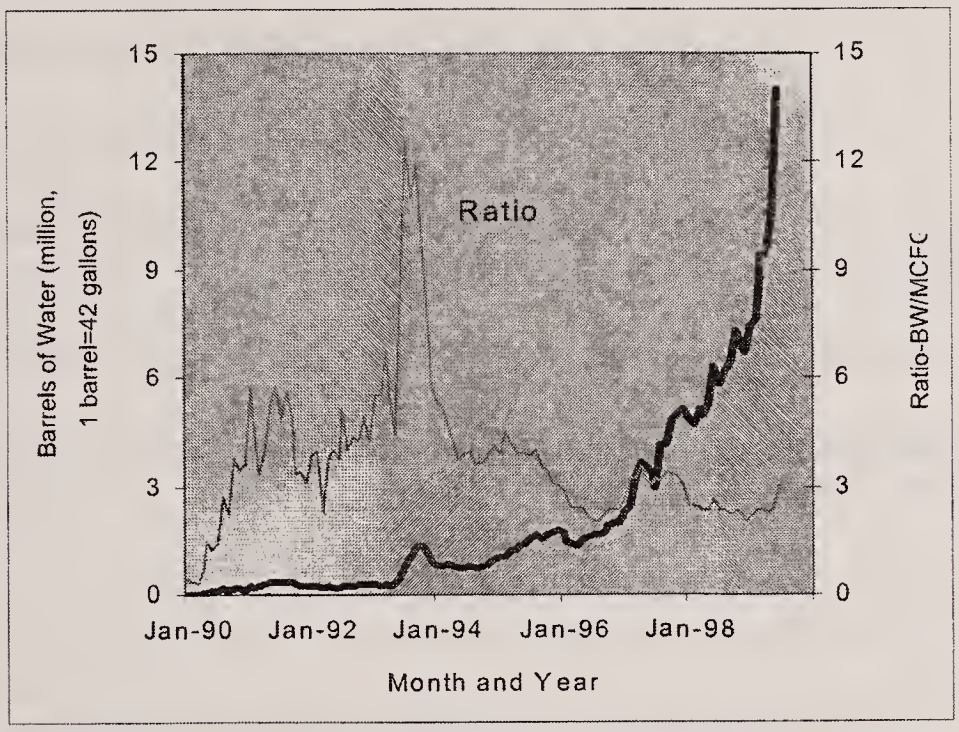

Figure 18 Water production associated with CBM production in the BFOA. One million barrels of water is equivalent to 129 acre feet. Data from WOGCC.

Water Production Large quantities of water are produced with CBM. During June 1999, 3.4 barrels of water were produced for every thousand cubic feet of CBM. This ratio should decrease over time because water production generally declines during the life of a CBM well. Figure 18 shows water production associated with CBM production in the BFOA. During June 1999, 14 million barrels of water (1,800 acre feet) were produced in the BFOA.

CONCLUSIONS

A "boom" in CBM development is currently underway in the BFOA. Gas production has increased sharply and will probably continue to increase for the next few years. Oil and gas development, exclusive of CBM, will continue to slowly decline. Oil production will continue to decline. Seismic activity as measured by the number of approved Notices, has increased from the low activity levels of the early 1990s but will probably not go much higher. The amount of federal acreage under lease has increased substantially since 1997. Because federal leases do not contain a "Pugh clause", much of the federal acreage under lease in the CBM area will be held by production for many years after the primary lease term.

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GLOSSARY

Abandon To cease producing oil and/or gas from a well. This may involve several steps: one or more cement plugs are placed in the borehole to prevent migration of fluids between the different formations, equipment is removed, and the wellsite is reclaimed.

Acquired Minerals Mineral rights that were patented into non federal ownership and were later reacquired by the United States.

BCFG Billion cubic feet of gas.

BOPD Barrels of oil per day, this is usually the unit of measure for oil production at the wellhead. One barrel is 42 U.S. gallons.

BFOA Buffalo Field Office area, comprised of Campbell, Johnson, and Sheridan counties, Wyoming.

CBM Coalbed methane, natural gas originating from and residing in coal beds.

Development Potential Oil and gas development potentials are based on estimated average drilling density and are defined as follows: HIGH--over one well/township/year, MODERATE--0.2 to 1.0 wells/township/year, LOW--less than 0.2 wells/township/year, VERY LOW-- less than 0.02 wells/town ship/year, ZERO--no drilling.

Enhanced Oil Recovery A process where chemicals such as surfactants or carbon dioxide are injected into the reservoir to mix with the oil so that additional oil can be recovered.

MMBO Million barrels of oil.

Occurrence Potential HIGH--There is a demonstrated existence of petroleum source, reservoir quality strata, and traps. Areas of high potential have discovered oil occurrences or free oil recovery from well tests. MODERATE--There is direct or indirect geological evidence that petroleum source, reservoir quality strata, and trapping mechanisms are present. Discovered occurrences are not present but there may be shows of oil in core or drill stem tests. LOW--There is geological evidence that a petroleum source, reservoir quality strata, or trapping mechanisms are not present. NONE--There is a demonstrated absence of a petroleum source, reservoir quality strata, or trapping mechanisms. Demonstrated absence means physical evidence documented in geological literature.

Oil and Gas Field A natural accumulation of oil and gas in the subsurface. Oil and gas may be present in two or more reservoirs at different depths.

Oil and Gas Lease A federal oil and gas lease is a legal document that gives the lease holder the right to explore for and develop any oil and gas that may be present under the area designated in the lease while complying with any surface use conditions which may have been stipulated when the lease was issued.

Oil and Gas Reservoir A geologic layer containing hydrocarbons and enough porosity and permeability so that the hydrocarbons can be produced.

Play The geographic extent of an oil and/or gas bearing formation or interval.

Public Domain Minerals Mineral rights that have always been the property of the United States.

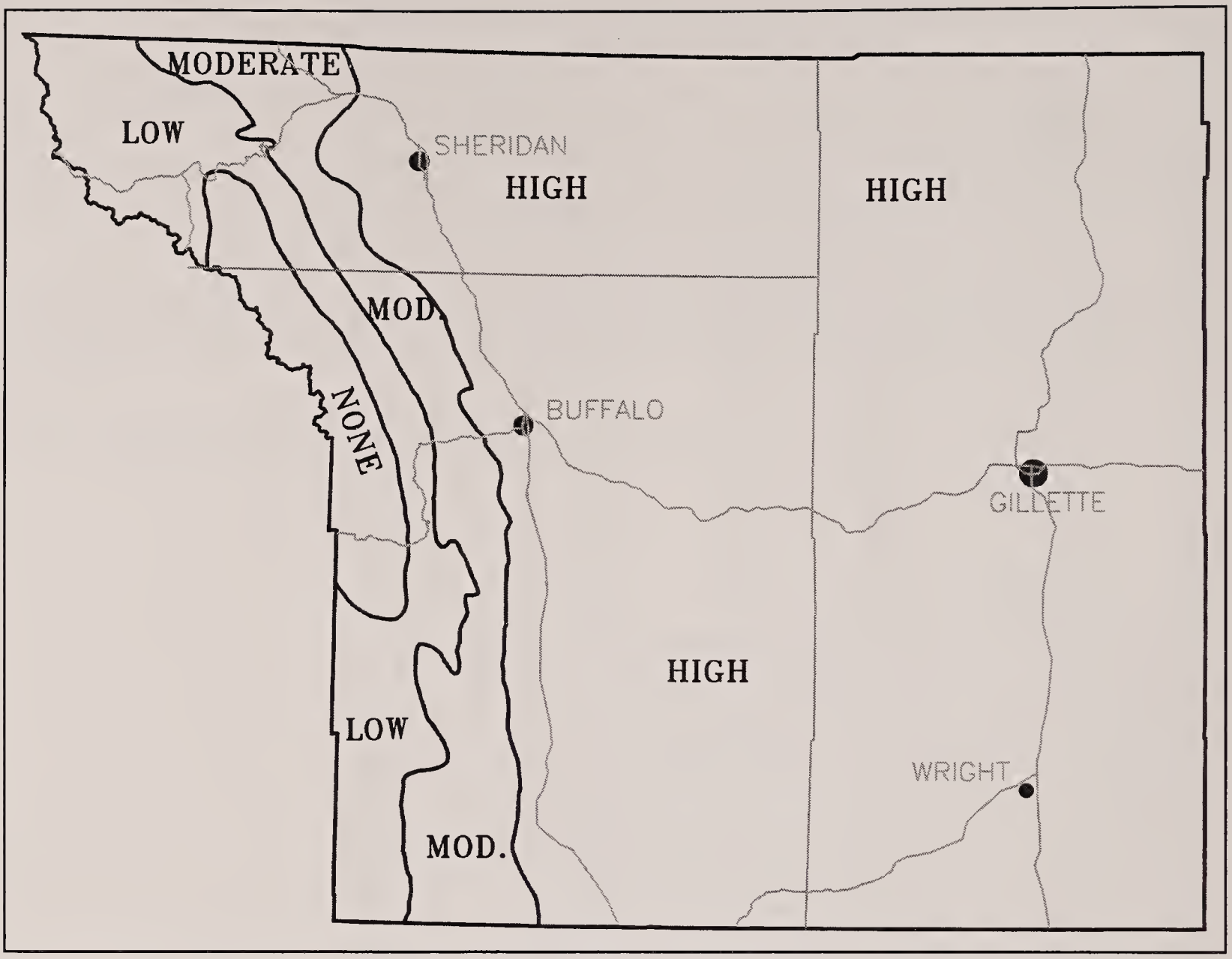
Pugh Clause A term in an oil and gas lease that prevents a productive well from holding acreage not allocated to that well. In other words if well spacing is 40 acres/well, one well cannot keep more than 40 acres of the oil and gas lease from expiring after the primary term of the lease.

Secondary Recovery A process whereby pressure in an oil and gas reservoir is artificially maintained or increased so that more oil can be recovered. This is usually done by injecting water or natural gas into the reservoir.

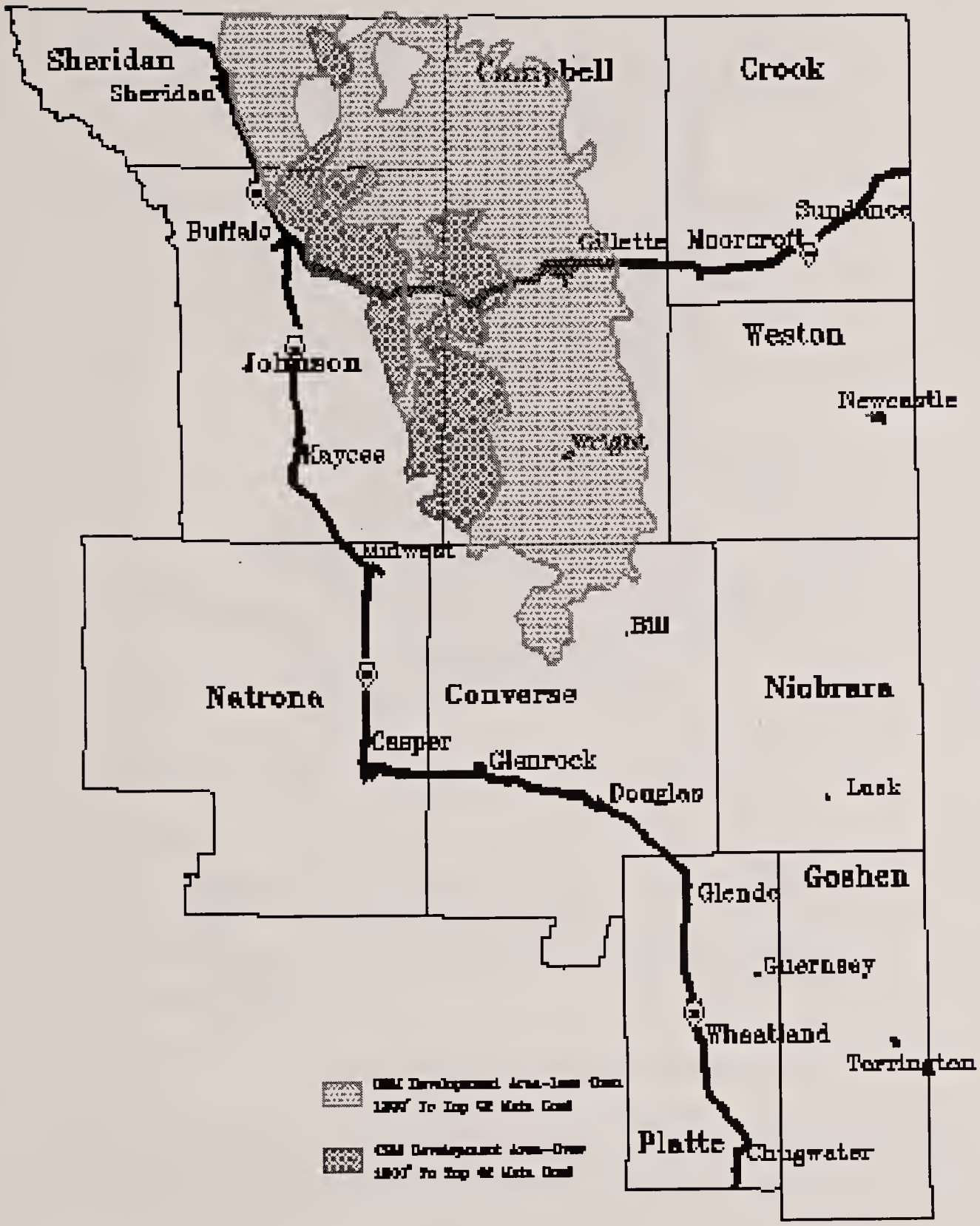
WOGCC Wyoming Oil and Gas Conservation Commission

Table 1 Summary of all the oil and gas plays evaluated by Dolton, et al (1990). The reader is cautioned against estimating undiscovered reserves in the BFOA based on this table.

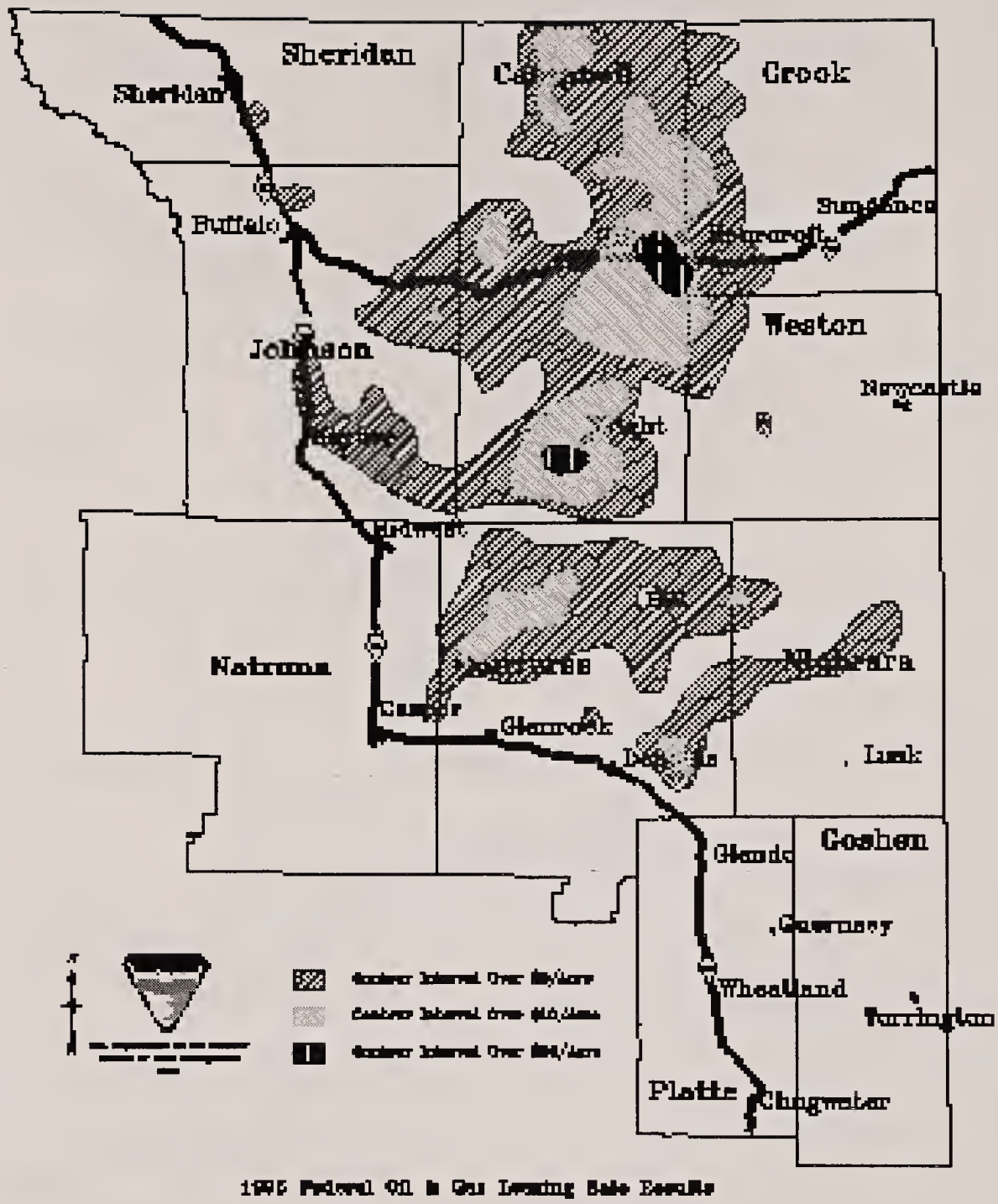
Oil and Gas Play	Total Play area	Play Area in BFOA	% of Play Area in BFOA	% of BFOA in Play Area	No. of fields	Estimated Reserves		Remarks
						MMBO	BCFG	
Basin Margin Anticline	8.12	1.37	16.9%	18.6%	5	24	21	Exploration nearing conclusion, future discoveries probably in small subtle traps.
Basin Margin Subthrust	2.12	0.54	25.5%	7.3%	NA	NA	NA	Geologic data limited, accurate prediction of future reserves or field sizes not possible.
Dakota	18.63	0.77	4.1%	10.5%	21	158	158	
Deep Frontier	5.47	0.85	15.6%	11.6%	6	37	100	
Lakota	21.21	4.06	19.2%	55.2%	NA	NA	NA	Undiscovered fields are probably small.
Leo	8.05	0.30	3.7%	4.0%	60	110	30	
Mesaverde & Lewis (stratigraphic)	7.99	3.41	42.7%	46.3%	10	66	91	
Minnelusa (total)	17.01	3.22	18.9%	43.7%	165	822	203	In explored area most discoveries will be fields with 3MMBO or less. In unexplored area field size will be similar to explored area.
Minnelusa (explored area)	NA	NA	NA	NA	26	48	10	
Minnelusa (unexplored area)	NA	NA	NA	NA	139	775	194	
Minnelusa (less prospective)	4.93	0.00	0.0%	0.0%	NA	NA	NA	
Mowry Shale	11.63	3.96	34.1%	53.9%	NA	NA	NA	Lightly explored, possible large nonconventional resource.
Muddy (total)	21.25	4.04	19.0%	55.0%	39	441	1298	
Muddy (explored area, shallow)	NA	NA	NA	NA	10	60	82	
Muddy (unexplored area, deep)	NA	NA	NA	NA	30	381	1216	
Shannon marine shelf	8.40	4.07	48.4%	55.3%	20	128	103	Sx & Sh combined
Sussex marine shelf	10.77	3.46	32.1%	47.0%	(combined w/shannon)			



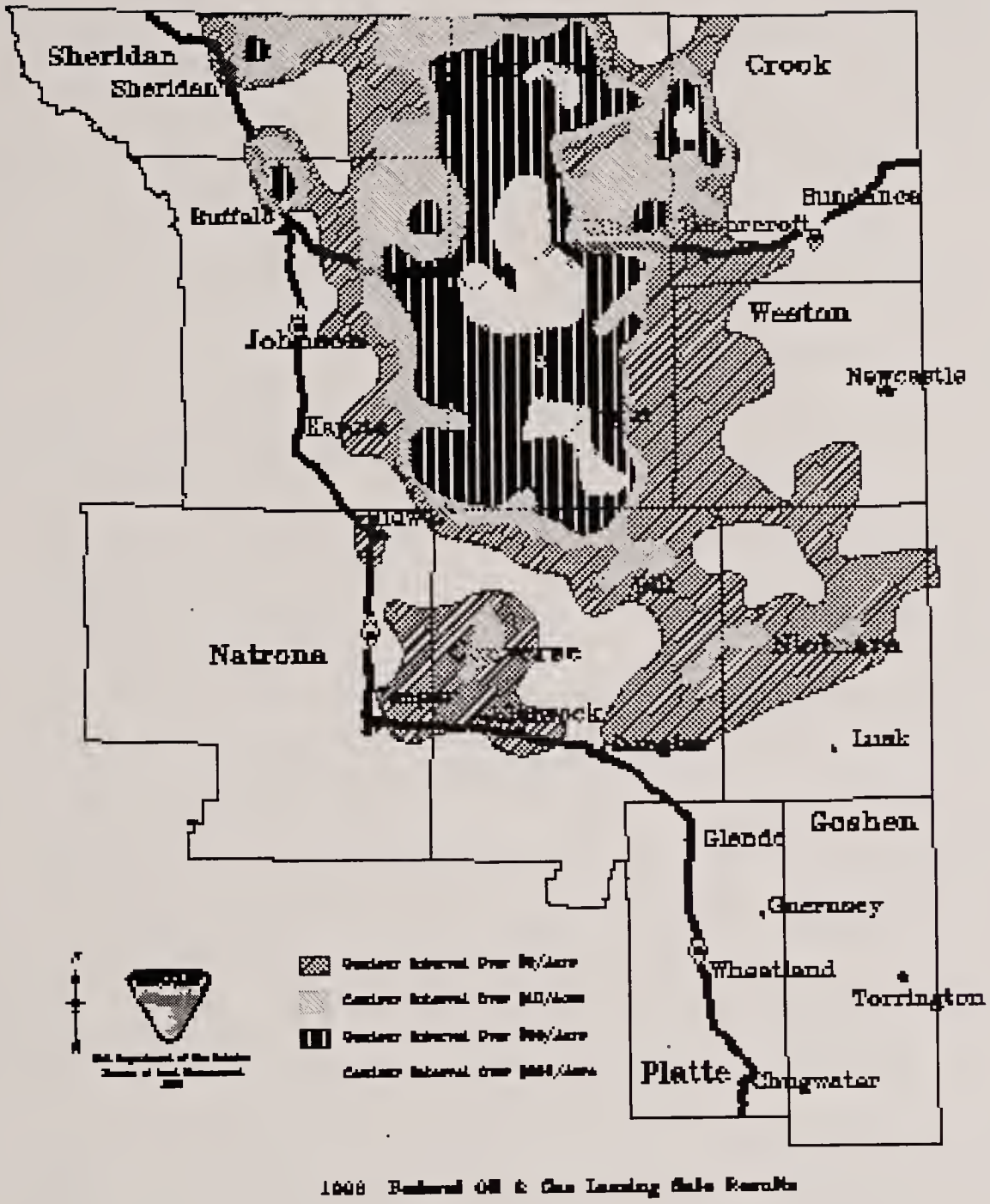
Map 1 Oil and gas occurrence potential map of BFOA. Definitions are: HIGH–Inclusion in a U.S. Geological Survey play. Documented or physical evidence of the existence of source rock, thermal maturation, and reservoir quality strata and traps. MODERATE–Geophysical or geologic indications of the presence of source rock, thermal maturation, and reservoir quality strata and traps. Indications of occurrence are based on indirect evidence. LOW-Indications that one or two of the following may not be present: (1) source rock, (2) thermal maturation, or (3) reservoir quality strata and traps. NONE-There is a demonstrated absence of source rock, thermal maturation, and reservoir rock that precludes the occurrence of hydrocarbons. Demonstrated absence means physical evidence documented in geological literature.



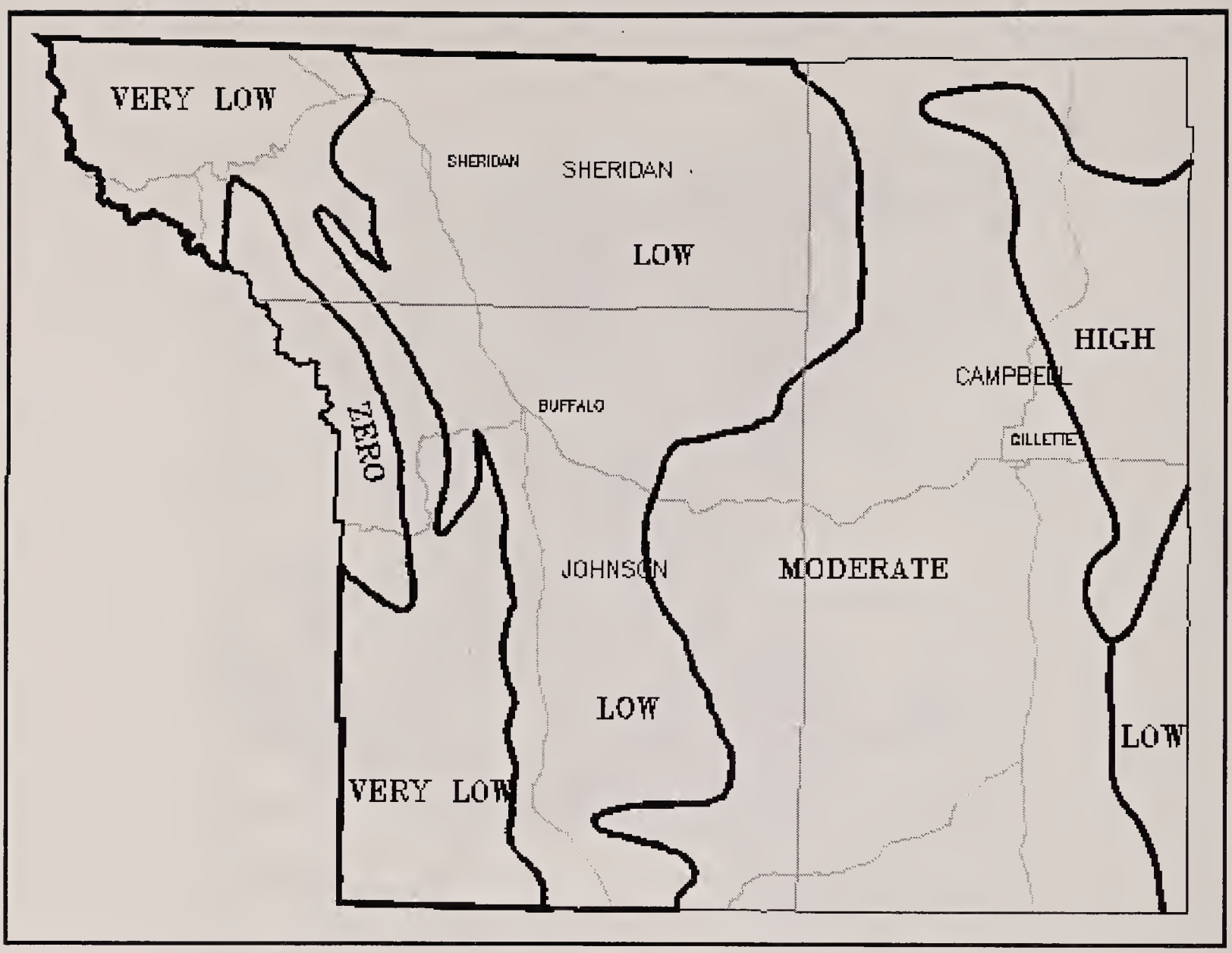
Map 2 CBM development area. The boundary is based on depth to top of coal, thickness of thickest coal, drilling activity, and federal oil and gas lease sale results.



Map 3 Average dollar-per-acre bids from 1995 federal oil and gas lease sales. Intervals were mapped at bid prices of $2.00, $10.00, and $50.00 per acre. Data were compiled on a township-by-township basis.



Map 4 Average dollar-per-acre bids from 1998 federal oil and gas lease sales. Intervals were mapped at bid prices of $2.00, $10.00, $50.00, and $200.00 per acre. Data were compiled on a township-by-township basis.



Map 5 Oil and gas development potential map for non CBM wells in the BFOA. Development potential is based on estimated drilling density and is defined as follows: HIGH– greater than 1 well/township/year; MODERATE– 0.1 to 1.0 well/township/year; LOW– 0.02 to 0.09 well/township/year; VERY LOW– less than 0.02 well/township/year; ZERO– no drilling expected.

Appendix B
Montana and Wyoming
Powder River Interim Water Quality
Memorandum of Cooperation

MONTANA AND WYOMING POWDER RIVER INTERIM WATER QUALITY CRITERIA MEMORANDUM OF COOPERATION

WHEREAS, the State of Montana and the State of Wyoming recognize a responsibility and an opportunity to cooperate work collaboratively to protect water quality in the Powder River Basin and to facilitate the development of Coal Bed Methane (CBM) activities in the respective states, and

WHEREAS, the State of Montana and the State of Wyoming will pursue a process that would establish respective responsibilities for managing and controlling salinity, SAR and other pollutants of concern; and

WHEREAS, the States of Montana and Wyoming have met in several meetings to work out the technical details of this cooperative approach; and

WHEREAS, the State of Montana and State of Wyoming realize that an interim effort is necessary until more stream flow and water quality data can be collected and analyzed to determine the assimilative capacity of waters in the Powder River drainage, and until the effects of CBM development are better known, and Montana completes the development and adoption of water quality standards, an EIS and a Total Maximum Daily Load (TMDL) plan for the basin; and

WHEREAS, the State of Wyoming recognizes Montana's downstream interests and has committed to apply certain limits on the development of CBM activities, during the term of this cooperative effort; and

WHEREAS, the State of Montana has recognized Wyoming's desire to continue to cautiously grant NPDES permits during this interim period; and

WHEREAS, the State of Wyoming has will work with and support Montana's efforts to develop long-term water quality standards and an equitable allocation of the assimilative capacity if one exists.

NOW THEREFORE, the parties enter into this Memorandum of Cooperation (MOC).

I. Parties.

The parties to this MOC are the signatories as set forth on Page 4. The director of the Wyoming Department of Environmental Quality is entering into this MOC to further the purposes of the Wyoming Environmental Quality Act W.S. 35-11-109(a)(ii). The director of the Montana Department of Environmental Quality is entering into the MOC to further the purposes of the Montana Water Quality Act , Title 75, Chapter 5, Montana Code Annotated.

II. Purpose of MOC

The purpose of this MOC is to document the parties' commitments and their intent to protect and maintain water quality conditions within Montana during an interim period while new CBM discharges in Wyoming are cautiously allowed. At the conclusion of this interim period, the parties shall negotiate a final MOC that will include recognition of protective water quality standards and allocation of any assimilative capacity.

III. Interim Threshold Criteria for Salinity and Sodium

1. Powder River

The two states will use the highest sampled monthly values of electrical conductivity (EC) from 1990 through 1999 for the Powder River at the Moorhead gauging station as interim upper threshold criteria. Montana shall monitor the Moorhead data and report to Wyoming the average monthly EC and its comparability to the appropriate monthly value. If in any given month the average EC exceeds the threshold criteria, as listed herein, Wyoming will use its ongoing monitoring of sodium levels to determine the potential source and cause of the exceedance. The results of this investigation will be reported to Montana in a timely manner. If the exceedance is found to be attributable to CBM discharges, Wyoming will initiate appropriate steps through its regulatory mechanisms to return salinity levels into conformity with this MOC.

The Upper Threshold Salinity Monthly Values (EC in µmhos/cm) for the Powder River at the Moorhead, Montana gauging station, based on the data from the 1990's are:

January	2200
February	2300
March	2300
April	1700
May	2100
June	2200
July	2800
August	2400
September	2600
October	1900
November	2000
December	1800

The two states recognize that sodium levels and the Sodium Adsorption Ratio (SAR) may have an effect on water uses. However, at this time no clear threshold can be developed due to a lack of data. The State of Wyoming will, through its monitoring program, track sodium concentrations in the Powder River above the state line, evaluate the source of changes through various modeling techniques and report the results of these evaluations to Montana.

2. Little Powder River

The states will use statistical step tests and 90th percentile, 90% confidence limits (90/90) for EC, SAR, and Total Dissolved Solids (TDS) derived from monthly flow weighted historic data as threshold criteria to indicate whether a change has occurred. Montana shall monitor the data from the Little Powder above Dry Creek, near Weston, and report the flow-weighted results to Wyoming. The step tests and 90/90 criteria will be based on a continuous and cumulative evaluation of available data from 1985 forward. Pre-1985 data will not be used because baseline conditions delineated by the older data sets differ from post-1984 conditions. If a step test shows a significant difference or the 90/90 confidence limit is exceeded, Wyoming will conduct an evaluation as to the possible source of the trend or exceedance and report the results to Montana in a timely manner. If the difference or exceedance is found to be attributable to CBM discharges, Wyoming will initiate appropriate steps through its regulatory mechanisms to return salinity levels into conformity with this MOC.

IV. Other Pollutants of Concern

Montana accepts Wyoming's antidegradation policy as protective of Montana's water quality standards. However, should Wyoming consider an application to degrade, Montana will be included as a participant in the waiver review process so that the states may equitably allocate any assimilative capacity.

V. Monitoring Program

Wyoming and Montana are committed to the development of a monitoring program to implement this MOC and to the development of a final MOC.

VI. Standard Frequency of Data Review and Evaluation

The parties will meet periodically and review the results of their respective monitoring programs, to promptly report evaluations and results, and review the overall success of the program.

VII. Term of MOC

It is the intent of the parties that this interim MOC is for a period of 18 months from its' effective date. During the fall of 2002 the parties anticipate re-negotiating a final MOC that will address meeting downstream standards for the Powder and Little Powder Rivers and TMDLs.

VIII. Public Participation

Opportunity for public participation was provided during the technical sessions that led up to this MOC. The parties are committed to keeping the public informed about the implementation and success of this MOC. All technical information and evaluations resulting from this MOC will be available to the public.

IX. Dispute Resolution

The parties agree that disputes that arise as a result of this MOC shall be resolved through communication and cooperative problem solving involving the parties

X. Amendment

This MOC may be amended or modified at any time upon the consent of all parties.

XI. Vacating MOC

Any party may withdraw from this MOC by providing written notice to the other parties.

XII. Effective Date

This MOC is effective upon the last date of signature by a party, as listed below.

1. **MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY**

(September 5, 2001)

Jan Sensibaugh, Director Date

2. **WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY**

(September 7, 2001)

Dennis Hemmer, Director Date

Appendix C
Standard Conditions of Approval

STANDARD "CONDITIONS OF APPROVAL" FOR APDS

BLM-BUFFALO FIELD OFFICE

Mitigating measures (i.e., stipulations), in the form of "Conditions of Approval", are applied to both APD and Sundry Notice Drilling Plans & Surface Use Plans when: 1)they are not specifically addressed in those plans, and; 2)they are needed to mitigate impacts to resource values identified at the onsite inspection or during review of the plans. The first section identifies standard mitigating measures applicable to development involving only coal bed methane. The second section identifies standard mitigating measures that are pertinent to all federal oil & gas lease development. Not all of the mitigating measures in this second section are applicable to coal bed methane development.

It is important to note that site-specific stipulations also are developed by the BLM authorized officer, as needed, on a case-by-case basis at the onsite inspection to address special, unanticipated issues not addressed by a standard mitigating measure (e.g., erosive soils, steep slopes, proximity to existing improvements, etc.) These special mitigating measures obviously cannot be listed here. The following are the standard mitigating measures that are always applied (if not already specifically addressed in the plans).

Section 1 - APPLICABLE TO COAL BED METHANE WELL DEVELOPMENT ONLY

1. The operator is committed to all of the mitigation measures and monitoring contained in the Wyodak Coal Bed Methane Project Environmental Impact Statement (EIS) approved November 17, 1999 and the Wyodak Drainage Environmental Assessment (EA) approved March 26, 2001. The operator is also committed to the **Standard "Conditions of Approval" for APD's, BLM-Buffalo Field Office.**

2. A pre-construction field meeting shall be conducted prior to beginning any dirt work approved under this POD. The operator shall contact the BLM Authorized Officer (responsible NRS @ 307-684-1100) at least 4-days prior to beginning operations so that the meeting can be scheduled. The operator is responsible for having all contractors present (dirt contractors, drilling contractor, pipeline contractor, project oversight personnel, etc.) including the overall field operations superintendent, and for providing all contractors copies of the approved POD, project map and BLM *Conditions of Approval* pertinent to the work that each will be doing.

3. Pit will be **adequately** fenced during and after drilling operations until pit is reclaimed so as to effectively keep out wildlife and livestock. **Adequate fencing**, in lieu of more stringent requirements by the surface owner, is defined as follows:

-Construction materials will consist of steel or wood posts. Three or four strand wire (smooth or barbed) fence or hog panel (16-foot length by 50-inch height) or plastic snow fence must be used with connectors such as fence staples, quick-connect clips, hog rings, hose clamps, twisted wire, etc. Electric fences will not be allowed.

-Construction standards: Posts shall be firmly set in ground. If wire used must be taut and evenly spaced, from ground level to top wire, to effectively keep out animals. Hog panels must be tied securely into posts and one another using fence staples, clamps, etc. Plastic snow fencing must be taut and sturdy. Fence must be at least 2-feet from edge of pit. 3 sides fenced before beginning drilling, the fourth side fenced immediately upon completion of drilling and prior to rig release. Fence must be left up and maintained in adequate condition until pit is closed

4. Pits will be closed as soon as possible, but no later than 90 days from time of drilling/well completion, unless an extension is given by the BLM Authorized Officer. Squeezing of pit fluids and cuttings is not authorized. Pits must be dry of fluids or they must be removed via vac truck or other environmentally acceptable method prior to backfiling, recontouring and replacement of topsoil. Mud and cuttings left in pit must be buried at least 3-feet below recontoured grade. The operator will be responsible for recontouring any subsidence areas that develop from closing a pit before it is sufficiently dry.

5. The operator shall complete wells as soon as possible, but no later than 30 days after drilling operations, unless an extension is given by the BLM Authorized Officer.

6. Operators must submit a *Surface Use Data Summary Form* (Attachment A) as part of every Master Surface Use Plan.

7. If in the process of air drilling the wells there is a need to utilize mud, all circulating fluids will be contained either in an approved pit or in an aboveground containment tank. The pit or containment tank will be large enough to safely contain the capacity of all expected fluids without danger of overflow. Fluid and cuttings will not be squeezed out of the pit, and the pit will be reclaimed in an expedient manner per the above requirements.

8. Coal Bed Methane Monitoring Well Stipulation (applies on a case-by-case determination).

   The objective of the monitor well program is to collect data and monitor the effects of coal bed methane development on the groundwater system including the target aquifer(s), overlying and underlying sand zones, and other zones of local importance. Data will be used to characterize and monitor aquifer properties, drawdown, interaquifer communication, leakage, recharge, water quality, and water production / methane production interaction.

As required by the Wyodak EIS/ROD (11/17/99) and in consultation with BLM, the operator will be responsible for drilling, completing, and equipping a set of monitoring wells, as described below. The specific location will be determined in consultation with the BLM, and may only be drilled in a location where the oil and gas mineral estate is owned by the Federal Government. A well set will include wells completed in the production zone(s) and sand aquifer(s), above and/or below the production zone(s). A typical well set would consist of two or more monitor wells depending on the number of production and sand zones. The two or more monitor wells are to be on the same location, situated 20 to 60 feet apart (depending on topography and site specific constraints). In addition to drilling and completing the wells, the CBM operator is responsible for geophysical logging of the wells, obtaining surface access for the drilling and operation of the monitor wells, and all permitting (Wyoming State Engineer's Office, etc.). The operator is also responsible for a portion of the cost of the monitoring equipment and set-up (the BLM will do the actual equipment setup). This cost share has been established for this year (2002) at $10,000 for a two well set and $15,000 for each set consisting of more than 2 wells. **The operator must provide cost share dollars before BLM can equip the wells. These monitor wells must be drilled, completed, equipped and operating at least 30 days prior to any water or gas production from the well(s) authorized under this approval.**

WELL COMPLETIONS

COAL WELL (S)

The coal well(s) of the well sets will be completed in a manner similar to a CBM production well. The well(s) will be drilled to the top of the production zone(s) and 5 1/2" (minimum OD) steel casing will be set and cemented from the top of coal to the surface. The coal will then be drilled out, leaving an open whole completion. The well will then be circulated with fresh water to remove any remaining drilling fluids. If the coal doesn't appear to be making water during the clean up of the well bore, under-reaming and/or enhancement may be required. The well must be completed on top with a standard well head, i.e. KVF 'Gillette Special' well head (2x2 or 2x4 with a 2", centered tubing port and threaded auxiliary access port in the mandrel).

SAND WELL

The depth of the sand well(s) will be determined in the field utilizing the geophysical logs from the coal well. On wells less than 500 feet, the hole must be drilled with a minimum of a 8 3/4" bit to accommodate SDR17, 5 inch ID (minimum) PVC casing and allowing for proper placement of gravel pack and bentonite grout. If larger casing is used, a larger hole will have to be drilled. Upon completion of drilling, geophysical logs will be run to determine the exact placement of the well screen. The well casing will include 10 to 20 feet of blank pipe on the bottom (capped), .020 slot well screen open to the selected sand zone, and blank pipe to the surface. The well will then be gravel packed with 10-20

silica sand to cover the well screen (and associated sand zone) and backfilled with bentonite gravel (or pellets) to the surface. The top of the well casing must have threads (slip to thread adapter) and a vented cap.
On wells greater than 500 feet, 5 1/2" (minimum) steel casing will be set through the sand zone, cemented to surface, and perforated, 4 shots per foot, through the sand zone. The well will then be cleaned up by air lifting until all drilling fluids and solids are removed, clear water is produced, and a yield is estimated. Steel cased wells will be completed at the surface utilizing a standard wellhead as described in the coal well completion section above.

The operator shall submit APDs to BLM for the monitor wells. The APDs should include the completed APD cover sheet (Form 3160-3), survey plats, a drilling plan and a surface use plan (including a map). The monitor wells are subject to the same spud notification requirements and completion report requirements as regular federal wells (see General Conditions of Approval). If you have any questions concerning this stipulation and for information on locating and equipping of the wells, please contact Mike Brogan, BLM Hydrologist, at (307) 261-7600.

Requirements for exploratory and permanent water management plans are listed separately below:

Exploratory Water Management Plan

Items to be addressed in the Exploratory Water Management plan include the following:

- Must include a USGS topographic map (1:24000) (or legible copy) showing the actual discharge points, well locations, access routes, pipeline routes, erosion control and stabilization measures, impoundments (reservoirs), etc.

- Discharge points must be not be located on hill tops or upland areas. They must be located in existing low gradient channels (below any active or potentially active head cuts). Discharge can be to to existing impoundments of adequate size to store all the test water or designed to pass the discharge water (through outlet pipes or reinforced spillways).

- Water energy dissipation measures must be designed and constructed at discharge points and at any unstable downstream sections (minor head cuts, eroding channel sections, etc.).

- Before any water is discharged (including exploratory discharge), all applicable permits and authorizations from such agencies as the Wyoming Dept. of Environmental Quality (WDEQ), Wyoming State Engineers Office (WSEO) and Army Corp of Engineers (COE) must be obtained.

- Exploratory discharge will be allowed only until the wells have been properly tested to prove production. Only surface piping will be authorized for exploratory discharge, no trenching will be allowed.

- Before any water is discharged a standard quality analysis as required by DEQ-DPDES (barium, iron, manganese, radium-226, chlorides, sulfates, pH, TDS, and TPH) from each well or from representative wells (from each zone of production) must be submitted to BLM.

- Upon completion of the exploration/research project, an updated standard water quality analysis for each coal zone will be submitted to BLM.

- The lessee/operator shall provide a comprehensive ***water management plan*** as part of the APD that addresses how produced water will be handled during the testing and production of well(s). Adequate information should be available to develop this plan before wells are drilled.

- For exploratory wells in areas of unknown, untested production potential, the operator will need a temporary (drilling and testing) water management plan. If the well(s) prove to be productive, the operator will then need to submit a permanent water management plan via a Sundry Notice for BLM approval prior to producing the well(s).

Permanent Water Management Plan

Items to be addressed include the following:

- A USGS topographic map (1:24000) (or legible copy) showing location of the actual discharge points, wells, access routes, pipeline routes, erosion control and stabilization measures, and impoundments (reservoirs).

- Discharge points must be not be located on hill tops or upland areas. They must be located in low gradient existing channels (below any active or potentially active head cuts). Cumulative discharge must not exceed the naturally occurring, mean annual peak flow of the receiving channel. Discharges can be to existing impoundments that are designed (outlet pipes or reinforced spillways) to pass the proposed discharge water, the naturally occurring mean annual flow, and any existing discharge water.

- Before any water is discharged a standard quality analysis as required by DEQ-DPDES (barium, iron, manganese, radium-226, chlorides, sulfates, pH, TDS, and TPH) from each well or from representative wells (from each zone of production)

must be submitted to BLM.

- Upon completion of the drilling operations, an updated standard water quality analysis for each coal zone will be submitted to BLM.

- Plans for, and/or designs of, erosion control and stabilization measures must be provided. Any in-channel measures must be designed to accommodate existing and proposed discharges in addition to naturally occurring flow. Head cuts ≥ 6 feet will require an engineered design. This design will be reviewed by a BLM civil engineer prior to approval.

- Any new impoundments or modifications of existing structures must be properly permitted with the Wyoming State Engineers Office (WSEO) and/or the Army Corps of Engineers (COE) and designed with outlet works to pass all "existing, planned, and potential discharge"** water in addition to naturally occurring mean annual flow. Operators are cautioned that the outlet works must be designed in such a manner as not to affect any existing downstream Water Rights. In addition, the combination of flood storage (the volume of storage above the outlet works and below the spillway) and spillway capacity must be adequate to accommodate a specific design flood as required by the Wyoming State Engineers Office (WSEO). The required design depends on the size of the impoundment (25-year, 6-hour storm event, or 100 year, 24-hour storm event). Flood storage alone must be adequate to contain lesser events. If passage of water through the spillway is to be frequent, the spillway must be reinforced and designed for continual flow (no regular flows on earthen spillways).

  ** The "existing, planned and potential discharge" can be roughly calculated by determining the watershed area, dividing by the minimum well spacing (currently 80 acres), and multiplying this by the average discharge rate. As is obvious, it is undesirable to put impoundments on the main stem of a large drainage area.

For reservoirs on BLM surface lands that are proposed as part of the water management plan (WMP), the operator must provide the following information:

- For each reservoir smaller than 20 acre-feet capacity and with a dam height of less than 20' (20/20), the operator must include in the WMP the information that would normally be required by the Wyoming State Engineer's Office (WSEO) for a stock water reservoir permit. This information would need to clearly show that each reservoir is being constructed using BLM specifications for earthwork placement and principle spillway configuration. After a case-by-case consideration of the factors below (A. and B.), BLM would either approve or disapprove each reservoir. Upon approval by the BLM, the operator would then need to have each reservoir permitted by the WSEO.

- For reservoirs greater than 20/20, the permit application must be submitted to the BLM as part of the WMP with the information that would be normally required for permitting by the WSEO. If approved by the BLM State Engineer at the Wyoming State BLM office, the operator would then be required to submit an application to the WSEO for approval under the Safety of Dams program.

  Reservoirs on BLM surface will be approved or disapproved on a case-by-case basis after considering the following factors:

  A. Proper siting and design.
  B. Existing resource uses/needs and multiple-use management principles.

  Please be advised that BLM will apply special *Conditions-of-Approval* to authorized reservoirs depending upon case-by-case consideration of the above-factors. Construction monitoring by BLM Authorized Officers would also be required on a case-by-case basis.

- Water production rates (for each discharge point) must be disclosed including discharge schedule (initial, intermediate, and final rates and duration) and maximum, mean, and minimum anticipated rates.

- Before any water is discharged a standard quality analysis as required by DEQ-DPDES (barium, iron, manganese, radium-226, chlorides, sulfates, pH, TDS, and TPH) from each well or from representative wells (from each zone of production) must be submitted to BLM.

- Upon completion of the drilling operations, an updated standard water quality analysis for each coal zone will be submitted to BLM.

- A hydrologic watershed analysis, based on field reconnaissance, must be done and must include the following:

  A. Watershed area
  B. Average watershed slope
  C. Existing channel (average slope, width, depth, condition, etc.) calculation of mean annual runoff
  D. Peak flow analysis (2-, 10-, and 25-year return interval at a minimum)
  E. Destination (i.e., tributary to the Belle Fourche River)
  F. Description of the existing watershed including:

  i) existing wells (location, depth, water level, use, condition)
  ii) existing impoundments (location, size, volume, use, condition, description of outlet works and spillway)

iii) road crossings (crossing type - culvert size (BLM minimum is 18-inch diameter), low water crossing, bridge, etc. and condition)
iv) water related uses (flood irrigated/subirrigated crops, livestock, etc.)
v) potential down stream concerns (on channel impoundments, hay meadows, coal mine reclamation and sediment structures, unimproved channel crossings, etc.) and plans to mitigate impacts.

NOTE: Operators must submit a *Hydrologic Watershed Field Analysis Summary Form* (Attachment B) as part of all water management plans. If the water management plan includes more than one drainage area, additional summary sheets will be required.

- Monitoring Plans, which must include as a minimum:

A. Discharge point(s) will be monitored on a monthly basis for the first year of operation. Inspectors will note the condition of each discharge point, check for evidence of erosion, and schedule any remedial work if required.

B. Dam outlets (spillways and pipes) and culvert outlets will be checked quarterly, or after major storm events for the first year of operation. Inspectors will note the condition of the discharge point, check for evidence of erosion, and schedule any remedial work if required.

C. Erosion stabilization measures (head cuts, etc.) will be inspected for signs of erosion or structure failure. Inspectors will note condition and schedule any remedial work if required.

D. Downstream channel (below the well(s)/project) will be inspected for signs of accelerated erosion due and/or vegetaion changes to the continuous flow of produced water.

After the first year of operation, inspections will occur annually unless specific sites have required remedial action.

NOTE:
General Guidance for Land Application of CBM Produced Water

Land application of produced water has the potential to produce negative, long term impacts to soil physical and chemical properties if not properly managed. Proposals to land apply CBM produced water on federal projects must include the following information as part of the exploratory and/or permanent water management plans:

1. Site characterization. The site characterization must include field investigations of soils and vegetation. The site should be described in detail, and soil samples should be collected and

analyzed to determine important soil chemical and physical properties. Site descriptions should include maps, vegetation descriptions, soils descriptions, laboratory analysis and location of proposed application sites. Photo documentation of the site should be included. Laboratory analysis of produced water should also be included with the site characterization study.

2. Project description. The project description must include the proposed method(s) of water application, application rates and schedules and physical layout of application areas. Complete maps of the application infrastructure should be included. Detail any soil or water amendments which will be utilized, or physical soil manipulations which are planned. Project descriptions should demonstrate that land application is feasible given the results of the site characterization.

3. Monitoring Plan. Periodic monitoring of soils and vegetation will be required to assure that negative impacts are not occurring, or are being remediated. Monitoring must include soil sampling and laboratory analysis.

4. Winter operations. Detail practices which will be used to prevent the buildup of ice on the soil surface during sub freezing temperatures.

5. Mitigation Plan. A plan must be developed which outlines mitigation measures which will be implemented in the event negative soils or vegetation impacts are detected during routine monitoring. Potential mitigation measures might include soil or water amendments, physical manipulation or vegetative treatments.

These criteria are general in nature, and must be adjusted to site-specific conditions. Detailed soil sampling criteria have not yet been developed, so project proposals will be evaluated on a case-by-case basis during the interim. More specific guidance/requirements may be forthcoming as the result on ongoing research and coordination.

All water management plans (exploratory and permanent) submitted subsequent to receipt of a POD or APD(s) must include a Lessee's or Operator's Representative and Certification as follows:

> *I hereby certify that I, or persons under my direct supervision, have inspected the watershed area(s) affected by our coal bed methane drilling and production plans; that I am familiar with the conditions which currently exist; that the statements made in this plan are, to the best of my knowledge, true and correct; and that the work associated with operations proposed herein will by performed by _____ and its contractors and subcontractors in conformity with this plan and the terms and conditions under which it is approved. This statement is subject to the provisions of 18 U.S.C. 1001 for the filing of a false statement.*
>
> *Date* _____
> *Name and Title*_____

If the water management plan is included as part of the POD Master Surface Use Plan or APD Surface Use Plan, then the Certification Statement already required under APD Item 13. of the Surface Use Plan will suffice.

Section 2 - PERTINENT TO ALL OIL & GAS WELL DEVELOPMENT

A. CONSTRUCTION

1. Remove all available topsoil (depths vary from 4" on ridges to 12+ in bottoms) from the location including areas of cut, fill, and/or spoil storage areas and stockpile at the site. Topsoil will also be salvaged for use in reclamation on all other areas of surface disturbance (roads, pipelines, etc.). Clearly segregate topsoil from excess spoil material. Any topsoil stockpiled for one year or longer will be signed and stabilized with vegetation. Seed with annual ryegrass or other suitable cover crop.

2. The operator will not push soil material and overburden over side slopes or into drainages. All soil material disturbed will be placed in an area where it can be retrieved without creating additional undue surface disturbance and where it doesn't impede watershed and drainage flows.

3. Construct the backslope no steeper than ½:1. and construct the foreslope no steeper than 2:1, unless otherwise directed by the BLM authorized officer.

4. Maintain a minimum 20' undisturbed vegetative border between toe-of-fill of pad and/or pit areas and the edge of adjacent drainages, unless otherwise directed by the BLM Authorized Officer.

5. With the overall objective of minimizing surface disturbance and retaining land stability & productivity, the operator shall utilize equipment that is appropriate to the scope and scale of work being done for roads and well pads (utilize equipment no larger than needed for the job.)

6. All overhead power lines will be built to protect raptors from accidental electrocution.

7. The operator shall utilize wheel trenchers or ditch witches to construct all pipeline trenches, except where extreme topography or other environmental factors preclude their use.

8. A flare pit will be constructed on the well pad for use during drilling operations. It will be located at least 125-feet from the well head and will be located down-wind from the prevailing winds.

9. Pit will be **adequately** fenced during and after drilling operations until pit is reclaimed so as to effectively keep out wildlife and livestock. This requires that it be fenced on the

three nonworking sides prior to drilling and on the remaining side **immediately** following rig release. Fencing will be constructed in accordance with BLM specifications.

10. The reserve pit will be oriented to prevent collection of surface runoff. After the drilling rig is removed, the operator may need to construct a trench on the uphill side of the reserve pit to divert surface drainage around it. If constructed, the trench will be left intact until the pit is closed.

11. The reserve pit will be lined with an impermeable liner if permeable subsurface material is encountered. An impermeable liner is any liner having a permeability less than 10^{-7} cm/sec. The liner will be installed so that it will not leak and will be chemically compatible with all substances which may be put in the pit. Liners made of any man-made synthetic material will be of sufficient strength and thickness to withstand normal installation and pit use.

12. The reserve pit will be constructed so that half of its total volume is in solid cut material (below natural ground level).

13. If any cultural values (sites, artifacts, remains) are observed during operation of this lease/permit/right-of-way, they will be left intact and the Buffalo Area Manager notified. The authorized officer will conduct an evaluation of the cultural values to establish appropriate mitigation, salvage or treatment.

14. If paleontological resources, either large and conspicuous, and/or a significant scientific value are discovered during construction, the find will be reported to the Authorized Officer immediately. Construction will be suspended within 250 feet of said find. An evaluation of the paleontological discovery will be made by a BLM approved professional paleontologist within five (5) working days, weather permitting, to determine the appropriate action(s) to prevent the potential loss of any significant paleontological values. Operations within 250 feet of such a discovery will not be resumed until written authorization to proceed is issued by the Authorized Officer. The applicant will bear the cost of any required paleontological appraisals, surface collection of fossils, or salvage of any large conspicuous fossils of significant scientific interest discovered during the operation.

15. Culverts will be placed on channel bottoms on firm, uniform beds which have been shaped to accept them and aligned parallel to the channel to minimize erosion. Backfill will be thoroughly compacted.

16. The minimum diameter for culverts will be 18 inches.

17. Low water crossings will be constructed at original stream bed elevation in a manner that will prevent any blockage or restriction of the existing channel. Material removed will be stockpiled for use in reclamation of the crossings.

18. Construction-related traffic will be restricted to approved routes. Cross-country vehicle travel will not be allowed.

19. Construction activity will not be conducted using frozen or saturated soil material or during periods when watershed damage is likely to occur.

20. Any pipelines/flowlines off of the disturbed well pad that are not specifically addressed in the APD, must be authorized by the BLM via a Sundry Notice prior to construction.

21. Pipeline construction shall not block nor change the natural course of any drainage. Suspended pipelines shall provide adequate clearance for maximum runoff.

22. Pipeline trenches shall be compacted during backfilling. Pipeline trenches shall be maintained in order to correct settlement and erosion.

B. <u>OPERATIONS/MAINTENANCE</u>

1. Confine all equipment and vehicles to the access road, pad, and area specified in the APD or POD.

2. All waste, other than human waste and drilling fluids, will be contained in a portable trash cage. This waste will be transported to a State approved waste disposal site immediately upon completion of drilling operations. No trash or empty barrels will be placed in the reserve pit or buried on location. All state and local laws and regulations pertaining to disposal of human and solid waste will be complied with.

3. Rat and mouse holes shall be filled and compacted from the bottom to the top immediately upon release of the drilling rig from the location.

4. The operator will be responsible for control of noxious weeds on all areas of surface disturbance associated with this project (well locations, roads, water management facilities, etc.) Use of pesticides shall comply with the applicable Federal and State laws. Pesticides shall be used only in accordance with their registered uses and within limitations imposed by the Secretary of Interior. Prior to the use of pesticides on public land, the holder shall obtain from the BLM authorized officer written approval of a plan showing the type and quantity of material to be used, pest(s) to be controlled, method of application, location of storage and disposal of containers, and any other information deemed necessary by the authorized officer to such use.

5. All permanent above-ground structures (specify type of structures, e.g. , production equipment, tanks, transformers, insulators, etc.) not subject to safety requirements will be painted to blend with the natural color of the landscape. The paint used will be a color which simulates "Standard Environmental Colors." The color selected for this (site,

project), is (name and Munsell Soil Color Number).

6. Sewage shall be placed in a self-contained, chemically treated porta-potty on location.

7. The operator and their contractors shall ensure that all use, production, storage, transport and disposal of hazardous and extremely hazardous materials associated with the drilling, completion and production of this well will be in accordance with all applicable existing or hereafter promulgated federal, state and local government rules, regulations and guidelines. All project-related activities involving hazardous materials will be conducted in a manner to minimize potential environmental impacts. A file will be maintained onsite containing current Material Safety Data Sheets (MSDS) for all chemicals, compounds and/or substances which are used in the course of construction, drilling, completion and production operations.

8. Produced fluids shall be put in test tanks on location during completion work. Produced water will be put in the reserve pit during completion work per Onshore Order #7.

9. The only fluids/waste materials which are authorized to go into the reserve pit are RCRA exempt exploration and production wastes. These include:

-drilling muds & cuttings
-rigwash
-excess cement and certain completion & stimulation fluids defined by EPA as exempt

It does not include drilling rig waste, such as:

-spent hydraulic fluids
-used engine oil
-used oil filter
-empty cement, drilling mud, or other product sacks
-empty paint, pipe dope, chemical or other product containers
-excess chemicals or chemical rinsate

Any evidence of non-exempt wastes being put into the reserve pit may result in the BLM Authorized Officer requiring specific testing and closure requirements.

11. Operators are advised that prior to installation of any oil and gas well production equipment which has the potential to emit air contaminants, the owner or operator of the equipment must notify the Wyoming Department of Environmental Quality, Air Quality Division (phone 307-777-7391) to determine permit requirements. Examples of pertinent well production equipment include fuel-fired equipment (e.g., diesel generators), separators, storage tanks, engines and dehydrators.

C. DRY HOLE/RECLAMATION

1. All disturbed lands associated with this project, including the pipelines, access roads,

water management facilities, etc will be expediently reclaimed and reseeded in accordance with the surface use plan.

2 Disturbed lands will be recontoured back to conform with existing undisturbed topography. No depressions will be left that trap water or form ponds.

3 The fluids and mud must be dry in the reserve pit before recontouring pit area. The operator will be responsible for recontouring of any subsidence areas that develop from closing a pit before it is completely dry. The plastic pit liner will be cut off below grade and properly disposed of at a state authorized landfill before beginning to recontour the site.

4 Before the location has been reshaped and prior to redistributing the topsoil, the operator will rip or scarify the drilling platform and access road on the contour, to a depth of at least 12 inches. The rippers are to be no farther than 24 inches apart .

5 Distribute the topsoil evenly over the entire location and other disturbed areas. Prepare the seedbed by disking to a depth of 4-to-6 inches following the contour .

6 Waterbars are to be constructed at least one (1) foot deep, on the contour with approximately two (2) feet of drop per 100 feet of waterbar to ensure drainage, and extended into established vegetation. All waterbars are to be constructed with the berm on the downhill side to prevent the soft material from silting in the trench. The initial waterbar should be constructed at the top of the backslope. Subsequent waterbars should follow the following general spacing guidelines:

% SLOPE	**SPACING INTERVAL (feet)**
2 or <	200
2 – 4	100
4 – 5	75
5 or >	50

7. The operator will drill seed on the contour to a depth of .5 inch, followed by cultipaction to compact the seedbed, preventing soil and seed losses. To maintain quality and purity, the current years tested, certified seed with a minimum germination rate of 80% and a minimum purity of 90% will be used. On BLM surface or in lieu of a different specific mix desired by the surface owner, use the following:

SPECIES-CULTIVAR	**LBS PLS/ACRE**

determined at the site-specific onsite inspection)

8. Slopes too steep for machinery may be hand broadcast and raked with twice the specified amount of seed.

9. Complete fall seeding after September 15 and prior to ground frost. To be effective,

complete spring seeding after the frost has left the ground and prior to May 15.

10. The operator will reshape abandoned access roads by pushing the fill material back into the cuts. On roads to be permanently closed, waterbars are to be constructed near the contour across the shaped road, utilizing the spacing guidelines contained in No. 5 above.

11. Disk and seed the access road per number 6 above.

12. All rehabilitation work, including seeding, will be completed as soon as feasible following plugging.

13. Following reseeding, the location will be temporarily fenced off (**if not already fenced**) for at least two complete growing seasons to ensure long-term reclamation success, unless otherwise requested by the surface owner.

14. BLM will not release the performance bond until the area has been successfully revegetated (evaluation will be made after the second complete growing season) and has met all other reclamation goals of the surface owner and surface management agency.

15. A Notice of Intent to Abandon and a Subsequent Report of Abandonment must be submitted for abandonment approval.

16. For performance bond release approval, a Final Abandonment Notice with a surface owner release must be submitted prior to a final abandonment evaluation by BLM.

D. PRODUCING WELL

1. The entire location will be fenced off with a 4-strand barbed wire fence (or sheep fence based on site-specific conditions), with H-braces on the corners and a cattleguard, far enough outside of disturbed areas and soil stockpiles to allow for perimeter rehab within the fenced location.

2. Landscape those areas not required for production to the surrounding topography as soon as possible. The fluids and mud must be dry in the reserve pit before recontouring pit area. The operator will be responsible for recontouring and reseeding of any subsidence areas that develop from closing a pit before it is completely dry.

3. Reduce the backslope to 2:1 and the foreslope to 3:1, unless otherwise directed by the BLM Authorized Officer. Reduce slopes by pulling fill material up from foreslope into the toe of cut slopes.

4. Production facilities (including dikes) must be placed on the cut portion of the location and a minimum of 15 feet from the toe of the back cut.

5. A dike will be constructed completely around the production facilities (i.e. production tanks, water tanks, and heater-treater). The dikes for the production facilities must be constructed of **impermeable** soil, hold 110% of the capacity of the largest tank plus 1-foot of freeboard, and be independent of the back cut.

6. Any chemicals used in treating the wells (e.g., corrosion inhibitor, emulsion breaker, etc.) will be in a secure, fenced-in area that has an appropriate secondary containment structure (dikes, catchment pan, etc.)

7. The load out line coming from the oil/condensate tank(s) will have a suitable containment structure to capture and recycle any oil spillage that might occur.

8. Individual production facilities (tanks, treaters, etc.) will be adequately fenced off **(if entire facility not already fenced off).**

9. Distribute stockpiled topsoil evenly over those areas not required for production and reseed as recommended. **Due to fragile soils, the entire well location may need to be fenced off to ensure revegetation and stability of the reclaimed location perimeter throughout the producing life of the well, subject to the discretion of the BLM Authorized Officer.

10. Upgrade and maintain access roads and drainage control (e.g., culverts, drainage dips, ditching, crowning, surfacing, etc.) as necessary and as directed by the BLM Authorized Officer to prevent soil erosion and accommodate safe, year-round traffic.

12. Prior to construction of production facilities not specifically addressed in the APD, the operator shall submit a Sundry Notice to the BLM Authorized Officer for approval.

13. If not already required prior to constructing and drilling the well location, the operator shall immediately upgrade the entire access road to BLM standards (including topsoiling, crowning, ditching, drainage culverts, surfacing, etc.) to ensure safe, environmentally-sound, year-round access.

14. Waterbars shall be installed on all reclaimed pipeline corridors per the guidelines in C.5.

F. GENERAL INFORMATION

1. Please contact (pertinent NRS), Natural Resource Specialist, @ (307) 684-11xx, Bureau of Land Management, Buffalo, if there are any questions concerning the above surface use stipulations.

ATTACHMENT A

CBM PROJECT SURFACE USE DATA SUMMARY FORM

Company Name:	Date:
Project Name:	County:
Number of Wells: Leases Involved:	
Township (s) Involved: T N R W Sections:	
T N R W Sections:	
Number of Proposed Central Gathering/Metering Facilities:	
Miles of Proposed Improved Roads (including spot upgrade areas):	
Miles of Existing and Proposed 2-Track Roads:	
Miles of Corridor (define utilities):	
Miles of Gas Pipeline Not w/in a Corridor:	
Water Pipeline Not w/in a Corridor:	
Miles of Buried Power Cable Not w/in a Corridor:	
Watershed(s) Involved:	
Number of Proposed Discharge Points:	
Additional Comments:	
Prepared By:	Telephone:

Attachment B

Hydrologic Watershed Field Analysis Summary Sheet

POD Name: Company: Watershed(s) involved: Watershed Area :
Average Watershed Slope:.
Existing Channel information
Average Bank Full Width ft.
Average Channel Slope . feet/Foot
Average Channel Width ft. and Depth ft..
General Channel Condition: Stable/Unstable (potential erosion areas of concern)

Channel Vegetative Cover/ Dominant Species:

Calculation of Mean Annual Flow(Loham): [ ] ac.ft. and/or [ ] cfs.
(Show calculations used in BLM and Industry accepted procedures.)

Peak Flow Analysis

Recurrence Interval (Years)	Exceedence Probability(%)	Peak Flow (CFS / $Mi.^2$)	Peak Flow for Complete Basin (CFS)
2	.50		
5	.20		
10	.10		
25	.04		
50	.02		
100	.01		

Appendix D
Mitigation,
Monitoring, and Reporting Plan

Introduction

This Appendix outlines the planning process for Mitigation Monitoring and Reporting (MMRP) of the Powder River Basin Oil and Gas Project Area. This document describes the basic components of the plan and steps involved in its implementation.

The PRBO&G Draft EIS contains a detailed description of the nature of exploration and development of coal bed methane in the Powder River Basin. It is speculative to predict how future development will proceed. There is uncertainty about the specifics of future development. Because of this uncertainty, a number of assumptions were necessary to predict the impacts associated with future development. Those assumptions may or may not be correct. Therefore, mitigation measures may need to be modified as development evolves.

Purpose and Need

There is uncertainty regarding how the environment will react to future development in the Powder River Basin. For instance, will adopted mitigation and best management practices be adequate to prevent water quality degradation in the Tongue, Powder and Little Powder Rivers? Will operating within decibel level thresholds be sufficient to protect grouse breeding integrity? These questions are particularly relevant given our current ability to predict cumulative perturbations on the ecosystem. Predictions regarding the severity of the impacts are complicated further by the fact that some of the development may occur on private and state lands where protective measures (such as seasonal restrictions to protect big game and raptor nests, no surface occupancy stipulations) are not typically applied. Will perturbations on private lands increase density on Federal lands resulting in deteriorating quality of habitat?

The uncertainties as to where and at what level development will proceed as well as uncertainties associated with the environmental sciences that were used to predict impacts suggest that the one-time determination of impacts that is included in the EIS may not be appropriate for this project. A MMRP may be suitable for dealing with these uncertainties. Such a plan/process would provide a mechanism for continuously modifying management practices in order to allow development while continuing to protect the environment. CEQ regulations require appropriate application of continual monitoring and assessment. Section 102(2)(B) of NEPA calls for *"methods ... which will insure that presently unquantified environmental amenities and values may be given appropriate* consideration," CEQ regulations (40 CFR 1505.2(c); 1505.3(c) and (d)) state *"a monitoring and enforcement program shall be adopted and summarized, where applicable for any mitigation"* and that agencies *"may provide for monitoring to assure that their decisions are carried out and should do so in important cases."* The lead agency must *"upon request, inform cooperating* or *commenting agencies on progress in carrying out mitigation measures which they have proposed and which were adopted in the decision. " And, "upon request, make available to the public the results of relevant monitoring.*

Goals and Objectives

The goals and objectives of the MMRP are to develop resource-monitoring plans for specified resources to:

- Determine the effects of development on these resources;
- Determine the effectiveness of the mitigation measures contained in the Record of Decision (ROD);
- Modify the mitigation measures as deemed appropriate to achieve the stated goal/objective;
- Assure that non-oil-and-gas related BLM decisions (such as grazing, recreation, etc.) regarding, are coordinated with oil and gas-related development;
- Provide a rapid response to unnecessary/undue environmental change;
- Validate predictive models used in the EIS and revise the models/projections as necessary based on field observations and monitoring;
- Accurately monitor and predict cumulative impacts through BLM maintenance of a Geographic Information System (GIS) on Federal and non-Federal lands and how they are affecting resources;
- Provide guidance for monitoring (surveys) upon which the need to initiate Section 7 consultation with the USFWS will be determined.

Resource Monitoring Plans and Objectives

Monitoring Plans will be prepared for the following resources and activities. Determination of the on-the-ground monitoring will be made by the BLM and cooperating agencies that carry out the monitoring programs.

- **Wildlife Resource**

Upland Game - Sage grouse/sharp-tailed grouse

1. Monitor and document grouse populations, breeding and nesting activity for changes, if any, in numbers, distribution, and reaction to oil/gas development.

2. Document changes, if any, in breeding and nesting population numbers, distribution, habitat quality, and changes in animal numbers, distribution, and reaction to oil/gas development.

Raptors –

1. Monitor and document raptor populations and their nesting activity and locations within the PRB.

2. Document changes, if any, in nesting locations, active nest sites, and their reaction to oil/gas development.

T/E & Sensitive Species - Bald eagle, black-footed ferret, mountain plover

1. Complete clearance surveys and document results for these species within the PRB.

2. For sightings or sign, initiate consultation with the USFWS and initiate intensive monitoring for the species occurrence and distribution.

Aquatics -

Ponds developed for fisheries shall be fenced to exclude livestock; water quality in these ponds shall be sampled on an annual basis for selenium, TDS, and sodium bicarbonate, at a minimum.

Stream channel monitoring for erosion, degradation, and riparian health shall be conducted on an annual basis. Surveys shall include no less than one stream reach above all CBM discharges and several stream reaches below CBM discharges. Monitoring stations will be placed above all CBM outfalls and below all CBM outfalls, at least on mainstems.

Sub-watersheds that will receive CBM produced waters and shall be monitored for macroinvertebrates and fish populations include: Upper Tongue River, Upper Powder River, Salt Creek, Crazy Woman Creek, Clear Creek, Middle Powder River, Little Powder River, Antelope Creek, Upper Cheyenne River, and Upper Belle Fourche River. Sampling sites shall be established at existing flow and water quality monitoring stations where possible. Sampling shall occur on an annual basis during low flow periods, and all data collected shall be entered into a central database. At least two sampling locations per stream or river shall be established in these watersheds:

- **Water**

Groundwater

The effects of infiltrated waters on the water quality of existing shallow groundwater are not documented at this time. Potential impacts will be highly variable depending on local geologic and hydrologic conditions. It may be necessary to conduct investigations at representative sites around the basin to quantify these impacts, and provide site-specific guidance on the placement and design of CBM related impoundments.

The existing groundwater-monitoring program consisting of a battery of wells throughout the project area will continue and expand as development proceeds.

Surface water

The Bureau of Land Management, in cooperation with the WDEQ, WSEO, USGS and others fund an extensive network of surface water monitoring sites in the project area. Approximately 47 stations are currently operated to continuously record stream

flow on major rivers and streams in the area. Over half of these sites include periodic water quality analysis as well. The PAW also contracts water quality sampling at 26 sites on tributary streams in the region.

All parties involved are currently developing a comprehensive, basin wide surface water-monitoring plan that will integrate the efforts of all cooperators into a single monitoring effort. All data from this monitoring network will be compiled at a single depository and will be available to all interested parties.

Natural Springs

Initial flow rates would be measured, and a water quality sample would be obtained. Periodically the springs would be re-evaluated to monitor any changes in the quantity or quality as a result of CBM development.

- **Reclamation/Best Management Practices**

Surface disturbance revegetation -

1. Annually monitor and report on disturbed site reclamation/revegetation and invasive species concerns.

- **Soils**

1. Compile data related to LAD operation and mitigation to determine best management practices under various soil/water parameters.

- **Air Quality**

Nitrogen oxide emissions

1. Complete an annual monitoring report of actual on-the-ground calculated potential NO, emissions (i.e., the level of NO., emission from permitted, actually constructed/installed facilities based upon the permitted level of emissions per well location, compressor facility, etc.) for a sample size of the project area.

2. Continue to cooperate in the implementation of existing visibility and atmospheric deposition impact monitoring programs. Evaluate need for additional monitoring.

- **Transportation**

Access roads and sales pipelines

1. Monitor construction to ensure design and use standards are met and maintained.

2. GIS will be updated at least semi-annually based on companies' submittals of as built georeferenced POD maps.

Mitigation, Monitoring and Reporting Planning Process Implementation

The BLM Buffalo Field Manager will implement the MMRP by establishing the *Powder River Basin Working Group* (PRBWG). The PRBWG will function as a resource working group consisting of BLM, cooperating agencies and other agencies who have expertise in the area. The structure of the PRBWG will be as follows:

The PRBWG may include representatives from the following federal, and state agencies:

- Bureau of Land Management [Buffalo and Platte Field Offices and personnel with special expertise from other BLM offices]
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- USDA Forest Service
- State of Wyoming agencies [Wyoming Game and Fish Department, Wyoming Department of Transportation, Wyoming Department of Environmental Quality - Air and Water Quality Divisions, State Historic Preservation Office, State Engineers Office, Wyoming Oil and Gas Conservation Commission, etc.]
- U.S. Environmental Protection Agency
- Johnson, Sheridan, Campbell and Converse County government [particularly planning and zoning, road and bridge]

An MMRP will be initiated after the approval of the PRBO&G ROD. The primary function of the PRBWG will be to:

- Review the development and implementation of monitoring plans for the PRB oil and gas development;
- Meet at a minimum once a year or more often as needed;
- Keep written record of meetings and disseminate to members and interested public;
- Conduct field inspections as needed to review the implementation of construction and rehabilitation operations; Review status quo and any new information since last meeting (e.g., monitoring results of impact mitigation effectiveness);
- Synthesize monitoring plan activities/expectations for the coming year, based upon operator input and new information;
- Review recommendations from the Task Groups and submit a recommendation to BLM (e.g., management practices and monitoring needs for upcoming field season);
- Oversee implementation of monitoring.

The PRBWG may establish Task Groups. The individual Task Groups would be initiated during the first meeting.

The BLM will implement and coordinate the MMRP Process. The leadership for the coordination will be located in the BLM Buffalo Field Office. Meetings of the PRBWG

and TG's will be held at a minimum, annually. Minutes of the meetings will be made available to the public. A qualified facilitator, if deemed necessary, will facilitate the PRBWG meetings. The meeting agenda will include the following:

Function of PRBWG at First Meeting:

Explain Purpose and Need for MMRP process;

- Explain organizational structure and functional responsibilities of PRBWG and TGs;
- Establish and select PRBWG representatives;
- Review draft Memorandum of Understanding;
- Establish and select TG members;
- Set date, time, and place for next PRBWG meeting.

Function of PRBWG at Subsequent Meetings:

- Review minutes from previous meeting;
- Reports presented from the TG's on monitoring results;
- Review recommendations from TG's;
- Develop any changes to mitigation measure recommendations if necessary;
- Submit recommendations and monitoring results to BLM;
- BLM specify any new directives, set date, time, and place for next PRBWG meeting.

Task Group Functions. Separate resource or activity Task Groups (TG's) will be established to complete the following:

- Recommend implementation of specified resource/activity monitoring plans;
- Keep written record of meetings and disseminate to PRBWG members and interested public;
- Implementation protocol including proposed fund sources;
- Annual monitoring report needs and meeting frequency;
- Resource concerns (e.g., based upon current conditions, drilling plans, etc.)
- Preparation of the monitoring plan and for evaluation of monitoring results, review, evaluate and summarize past/present data pertaining to the resource;
- Annual survey/inventory, monitoring, etc. that needs to be completed;
- Evaluation of mitigation measure(s) effectiveness;
- Results of monitoring and evaluation of the effect of project development on the resource;
- Implement monitoring plan as approved by BLM.
- Review and evaluate monitoring data collected;
- Present and submit monitoring results annually to PRBWG;
- Review and evaluate current monitoring plan;
- Modify monitoring plan and implement as approved by BLM;
- Recommend modifications to the development and monitoring plan to the PRBWG and BLM;

- If necessary, recommend modification to mitigation as needed.

The TG leadership for the coordination among the group and for the development, implementation, and reporting results of the monitoring plans will be as determined by group members. Meetings of the TG's will be held as often as deemed necessary but at least annually. The TG meetings will be facilitated as deemed by the group. TG meetings will be held during work hours. The agenda will be developed by the TG leader to address the necessary items as defined under the TG Functions above.

MMRP Funding

The PRBWG will work with the O&G industry to implement the monitoring programs specified. Agencies and cooperators will work with industry in corporate funding of monitoring to the extent that budget allocations permit.

Appendix E
Surface Water Quality Data

Surface Water Quality Data at Selected USGS Water Quality Monitoring Stations[1] Within the Powder River Basin

Sub-Watershed	Station Location	Station ID	Period of Record	Timeline	Temp (^{O}C)	Conductivity (uS/cm)	SAR	TDS (mg/L)	TSS (mg/L)	Hardness (mg/L)	Ph
Little Bighorn River	Little Bighorn R Bl Pass Cr Nr Wyola MT	06290500	1969-1998	Pre-1995	7.7	540	0.6	345	1,291	256	8.1
				Count	222	278	139	139	19	139	112
				Post-1995	8.3	534	NA	NA	NA	NA	NA
				Count	19	19	0	0	0	0	0
Upper Tongue River	Tongue R at Birney Day School Br Nr Birney MT	06307616	1979-1999	Pre-1995	11.7	645	1.7	495	53	324	8.3
				Count	136	134	33	33	69	33	67
				Post-1995	16.7	529	NA	NA	NA	NA	NA
				Count	18	19	0	0	0	0	0
	Tongue R at State Line nr Decker MT	6306300	1985-1999	Pre-1995	11.7	556	0.5	NA	NA	NA	3
				Count	86	84	18	0	0	0	18
				Post-1995	10.5	513	0.5	NA	NA	NA	8.3
				Count	30	31	7	0	0	0	6
Middle Fork Powder River	Powder River Near Kaycee, WY	06312500	1949-1991	Value	10.3	1,191	2	834	NA	452	8.0
				Count	299	237	217	170	NA	241	227
North Fork Powder	Nowood River Near Ten Sleep, WY	06270000	1950-1986	Pre-1995	9.3	802	0.5	566	952	409	8
				Count	204	87	168	167	147	168	105
Upper Powder River	Powder River At Arvada, WY	06317000	1946-2001	Pre-1995	11.6	2,603	6.3	1,888	19,095	682	7.9
				Count	306	362	242	242	109	277	261
				Post-1995	9.6	2,057	4.8	NA	14,400	574	8
				Count	24	24	8	0	1	8	24
South Fork Powder River	South Fork Power River Near Kaycee, WY	06313000	1949-1997	Pre-1995	11.1	3,352	5.7	2,660	21,502	1,073	7.8
				Count	223	198	195	201	97	202	189
				Post-1995	17	4,430	NA	NA	NA	NA	8.2
				Count	1	1	0	0	0	0	1
Salt Creek	Salt Creek Near Sussex, WY	06313400	1967-2001	Pre-1995	10.4	6,454	31.7	NA	NA	435	8.1
				Count	334	191	170	0	0	170	168
				Post-1995	8.4	5,797	15.5	NA	NA	650	8.1
				Count	18	17	2	0	0	2	18
Crazy Woman Creek	Crazy Woman Creek at Upper Sta, Near Arvada, WY	06316400	1949-2001	Pre-1995	11.3	1,770	2	NA	NA	740	8.0
				Count	234	169	172	0	0	177	161
				Post-1995	15.1	1,185	2.0	NA	NA	660	8.0
				Count	15	15	2	0	0	2	15
Clear Creek	Clear Creek Near Arvada, WY	06324000	1949-2001	1949-1992	9.1	1,167	1.4	830	141	496	8
				Count	405	235	177	163	214	216	233
				2001	4.3	1,141	1.1	NA	NA	480	8
				Count	8	8	8	0	0	8	8
Middle Powder River	Powder River at Broadus MT	06324710	1975-1995	Value	13.9	1,974	4.7	1,550	5,232	640	8.3
				Count	130	62	2	2	122	2	14

Surface Water Quality Data at Selected USGS Water Quality Monitoring Stations[1] Within the Powder River Basin

Sub-Watershed	Station Location	Station ID	Period of Record	Timeline	Temp (^{O}C)	Conductivity (uS/cm)	SAR	TDS (mg/L)	TSS (mg/L)	Hardness (mg/L)	Ph
Little Powder River	L Powder River Ab Dry C Nr Weston, WY	06324970	1975-2001	Pre-1995	11.3	2,804	5.9	NA	NA	795	8.1
				Count	235	153	129	0	0	130	139
				Post-1995	10.0	2,737	6.1	NA	NA	739	8
				Count	35	35	10	0	0	10	35
Little Missouri River	Little Missouri River near Alzada MT	06334000	1969-1970	Pre-1995	17.3	2,426	5	1,990	NA	780	7.8
				Count	6	7	7	7	0	7	7
Antelope Creek	Antelope C Nr Teckla WY	06364700	1977-2001	1977-1981	12.5	2,157	2.7	1,684	112	910	7.9
				Count	52	47	45	45	50	45	46
				2001	5.4	2,920	3	NA	NA	1,267	7.7
				Count	3	3	3	0	0	3	3
Dry Fork Cheyenne River	Dry Fork Cheyenne River Near Bill, WY	06365300	1977-1987	Value	8.7	1,723	1	1,375	1,193	943	7.8
				Count	65	40	30	30	49	31	36
Upper Cheyenne River	Cheyenne River Nr Dull Center WY	06365900	1975-1987	Value	13.8	2,620	3.6	2,109	1,242	1,041	8.0
				Count	107	81	64	64	60	64	79
	Little Thunder Creek Near Hampshire, WY	06375600	1977-1997	Pre-1995	10.4	1,806	5.2	1,403	.1,042	468	8.0
				Count	76	59	50	28	27	59	28
				Post-1995	11.6	1,398	NA	NA	140	NA	7.9
				Count	4	4	0	0	4	0	4
	Lodgepole C Nr Hampshire WY	06378300	1978-1981	Value	10.8	2,788	23.4	1,847	208	124	8.6
				Count	30	27	24	25	31	25	25
	Black Thunder Creek near Hampshire, WY	06376300	2001	Value	4.2	1,980	5.7	NA	NA	480	8.4
				Count	3	3	3	0	0	3	3
	Upper Cheyenne R. nr Riverview, WY	06386500	1969-1980	Value	15.5	3,321	7.3	2,500	2,296	799	8.1
				Count	78	49	49	49	28	49	46
Lightning Creek	Lance Creek Near Riverview, WY	06386000	1971-1983	Value	13.2	3,153	7.2	2,420	2,238	799	7.9
				Count	115	82	75	75	71	75	78
Upper Belle Fouche River	Belle Fourche River Below Moorcroft, WY	06426500	1972-2001	Pre-1995	10.8	2,342	6.1	1,718	695	600	8.1
				Count	220	158	79	76	101	80	151
				Post-1995	8.7	2,588	5.1	NA	NA	865	8.1
				Count	23	23	8	0	0	8	23
Middle North Platte River	North Platte River Below Casper, WY	06645000	1949-1999	Pre-1995	9.3	761	1.6	527	271	273	8.1
				Count	377	444	257	216	10	282	421
				Post-1995	9.6	614	NA	NA	NA	NA	8.2
				Count	16	16	0	0	0	0	16

[1] (USGS 2001)

Surface Water Quality Data at Selected USGS Water Quality Monitoring Stations[1] Within the Powder River Basin

Sub-Watershed	Station Location	Station ID	Period of Record	Parameters									
				Timeline	Ba (ug/L)	Fe (ug/L)	Mn (ug/L)	As (ug/L)	Se (ug/L)	Cl (mg/L)	SO_4 (mg/L)	Na (mg/L)	Ca (mg/L)
Little Bighorn River	Little Bighorn R Bl Pass Cr Nr Wyola MT	06290500	1969-1998	Pre-1995	NA	24	14	NA	NA	2	109	22	62
				Count	0	115	109	0	0	140	139	139	139
				Post-1995	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Count	0	0	0	0	0	0	0	0	0
Upper Tongue River	Tongue R at Birney Day School Br Nr Birney MT	06307616	1979-1999	Pre-1995	NA	18	10	2	1	4	171	36	55
				Count	0	84	18	10	8	93	93	93	93
				Post-1995	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Count	0	0	0	0	0	0	0	0	0
	Tongue R at State Line nr Decker MT	6306300	1985-1999	Pre-1995	NA	30	8	NA	NA	2	82	16	42
				Count	0	18	8	0	0	18	18	18	18
				Post-1995	NA	NA	NA	NA	NA	2	85	17	45
				Count	0	0	0	0	0	7	7	7	7
Middle Fork Powder River	Powder River Near Kaycee, WY	06312500	1949-1991	Value	NA	72	NA	NA	NA	52	382	94	110
				Count	0	22	NA	NA	NA	357	353	333	357
North Fork Powder	Nowood River Near Ten Sleep, WY	06270000	1950-1986	Pre-1995	NA	145	NA	NA	NA	3	278	24	111
				Count	0	27	0	0	0	180	182	182	182
Upper Powder River	Powder River At Arvada, WY	06317000	1946-2001	Pre-1995	NA	123	8	12	12	238	854	378	154
				Count	0	29	3	1	1	362	362	334	362
				Post-1995	122	221	14	NA	NA	111	756	239	136
				Count	8	8	8	0	0	23	23	23	23
South Fork Powder River	South Fork Power River Near Kaycee, WY	06313000	1949-1997	Pre-1995	NA	87	40	NA	17	153	1,612	447	292
				Count	0	28	5	0	9	245	245	238	245
				Post-1995	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Count	0	0	0	0	0	0	0	0	0
Salt Creek	Salt Creek Near Sussex, WY	06313400	1967-2001	Pre-1995	NA	95	165	6	1	1,097	1,128	1,311	96
				Count	0	49	30	24	22	260	259	261	261
				Post-1995	0	0	0	NA	NA	756	2,079	1,100	177
				Count	2	2	2	0	0	17	17	17	17
Crazy Woman Creek	Crazy Woman Creek at Upper Sta, Near Arvada, WY	06316400	1949-2001	Pre-1995	120	87	77	1	1	11	803	132	165
				Count	5	60	21	12	12	190	190	185	190
				Post-1995	40	10	104	NA	NA	8	700	121	136
				Count	2	2	2	0	0	2	2	2	2
Clear Creek	Clear Creek Near Arvada, WY	06324000	1949-2001	1949-1992	8	104	26	2	2	5	464	78	111
				Count	16	42	16	16	18	242	250	213	235
				2001	36	16	18	NA	NA	4	397	61	112
				Count	8	8	8	0	0	8	8	8	8
Middle Powder River	Powder River at Broadus MT	06324710	1975-1995	Value	NA	20	NA	NA	NA	160	832	334	120
				Count	0	2	NA	NA	NA	14	14	14	14

Surface Water Quality Data at Selected USGS Water Quality Monitoring Stations[1] Within the Powder River Basin

Sub-Watershed	Station Location	Station ID	Period of Record	Parameters									
				Timeline	Ba (ug/L)	Fe (ug/L)	Mn (ug/L)	As (ug/L)	Se (ug/L)	Cl (mg/L)	SO_4 (mg/L)	Na (mg/L)	Ca (mg/L)
Little Powder River	L Powder River Ab Dry C Nr Weston, WY	06324970	1975-2001	Pre-1995	214	72	136	8	1	22	1,256	394	150
				Count	7	115	48	39	39	173	173	172	172
				Post-1995	47	40	94	NA	NA	37	1,254	369	146
				Count	9	12	21	0	0	34	34	34	34
Little Missouri River	Little Missouri River near Alzada MT	06334000	1969-1970	Pre-1995	NA	NA	NA	NA	NA	9	1,218	335	176
				Count	0	0	0	0	0	7	7	7	7
Antelope Creek	Antelope C Nr Teckla WY	06364700	1977-2001	1977-1981	167	58	375	1	0	16	942	188	225
				Count	6	37	17	10	8	45	45	45	45
				2001	30	200	2,107	NA	NA	23	1,404	251	307
				Count	3	3	3	0	0	3	3	3	3
Dry Fork Cheyenne River	Dry Fork Cheyenne River Near Bill, WY	06365300	1977-1987	Value	NA	121	124	1	0	17	709	71	204
				Count	0	32	7	15	8	41	41	40	41
Upper Cheyenne River	Cheyenne River Nr Dull Center WY	06365900	1975-1987	Value	167	66	316	1	0	23	1,241	262	234
				Count	6	58	21	20	12	74	74	74	74
	Little Thunder Creek Near Hampshire, WY	06375600	1977-1997	Pre-1995	180	78	73	2	1	31	660	238	83
				Count	49	5	42	29	7	6	45	46	46
				Post-1995	NA	14	45	NA	NA	50	517	145	93
				Count	0	4	4	0	0	4	4	4	4
	Lodgepole C Nr Hampshire WY	06378300	1978-1981	Value	133	162	50	5	1	17	767	625	22
				Count	6	24	10	8	6	25	25	24	24
	Black Thunder Creek near Hampshire, WY	06376300	2001	Value	65	23	21	NA	NA	25	612	281	86
				Count	3	3	3	0	0	3	3	3	3
	Upper Cheyenne R. nr Riverview, WY	06386500	1969-1980	Value	NA	84	361	5	1	74	1,482	497	193
				Count	0	41	14	14	14	49	49	49	49
Lightning Creek	Lance Creek Near Riverview, WY	06386000	1971-1983	Value	NA	150	345	4	1	106	1,346	470	194
				Count	0	79	10	25	22	81	81	81	81
Upper Belle Fouche River	Belle Fourche River Below Moorcroft, WY	06426500	1972-2001	Pre-1995	125	92	185	2	2	79	844	339	115
				Count	4	87	55	22	19	107	107	105	106
				Post-1995	56	26	108	NA	NA	113	1,125	352	151
				Count	8	8	22	0	0	8	8	8	8
Middle North Platte River	North Platte River Below Casper, WY	06645000	1949-1999	Pre-1995	NA	73	16	2	5	18	231	60	68
				Count	0	25	13	4	23	323	325	297	323
				Post-1995	NA	NA	12	NA	NA	NA	NA	NA	NA
				Count	0	0	4	0	0	0	0	0	0

[1] (USGS 2001)

Surface Water Quality Data at Selected USGS Water Quality Monitoring Stations[1] Within the Powder River Basin

Sub-Watershed	Station Location	Station ID	Period of Record	Timeline	Mg (mg/L)	K (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)
Little Bighorn River	Little Bighorn R Bl Pass Cr Nr Wyola MT	06290500	1969-1998	Pre-1995	25	1.9	236	1
				Count	139	139	139	111
				Post-1995	NA	NA	NA	NA
				Count	0	0	0	0
Upper Tongue River	Tongue R at Birney Day School Br Nr Birney MT	06307616	1979-1999	Pre-1995	37	3.8	NA	NA
				Count	93	93	0	0
				Post-1995	NA	NA	NA	NA
				Count	0	0	0	0
	Tongue R at State Line nr Decker MT	6306300	1985-1999	Pre-1995	23	2.1	NA	NA
				Count	18	18	0	0
				Post-1995	24	2.5	NA	NA
				Count	7	7	0	0
Middle Fork Powder River	Powder River Near Kaycee, WY	06312500	1949-1991	Value	41	3.2	218	0
				Count	357	313	235	161
North Fork Powder	Nowood River Near Ten Sleep, WY	06270000	1950-1986	Pre-1995	32	2.2	204	0
				Count	182	182	162	162
Upper Powder River	Powder River At Arvada, WY	06317000	1946-2001	Pre-1995	64	7.3	269	0
				Count	362	327	270	238
				Post-1995	59	8.7	NA	NA
				Count	23	23	0	0
South Fork Powder River	South Fork Power River Near Kaycee, WY	06313000	1949-1997	Pre-1995	80	10.1	194	0
				Count	245	237	201	135
				Post-1995	NA	NA	NA	NA
				Count	0	0	0	0
Salt Creek	Salt Creek Near Sussex, WY	06313400	1967-2001	Pre-1995	56	18.0	773	3
				Count	261	259	161	161
				Post-1995	121	22.0	NA	NA
				Count	17	17	0	0
Crazy Woman Creek	Crazy Woman Creek at Upper Sta, Near Arvada, WY	06316400	1949-2001	Pre-1995	84	4.8	238	1
				Count	190	185	165	160
				Post-1995	77	4.5	NA	NA
				Count	2	2	0	0
Clear Creek	Clear Creek Near Arvada, WY	06324000	1949-2001	1949-1992	56	4.8	235	1
				Count	235	204	218	180
				2001	49	4.6	NA	NA
				Count	8	8	0	0
Middle Powder River	Powder River at Broadus MT	06324710	1975-1995	Value	66	7.1	280	0
				Count	14	14	2	2

Surface Water Quality Data at Selected USGS Water Quality Monitoring Stations[1] Within the Powder River Basin

Sub-Watershed	Station Location	Station ID	Period of Record	Timeline	Mg (mg/L)	K (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)
Little Powder River	L Powder River Ab Dry C Nr Weston, WY	06324970	1975-2001	Pre-1995	95	18.3	387	0
				Count	173	173	115	106
				Post-1995	101	17.6	NA	NA
				Count	34	34	0	0
Little Missouri River	Little Missouri River near Alzada MT	06334000	1969-1970	Pre-1995	83	13	303	0
				Count	7	7	7	7
Antelope Creek	Antelope C Nr Teckla WY	06364700	1977-2001	1977-1981	85	14.4	394	0
				Count	45	45	43	43
				2001	120	17.0	NA	NA
				Count	3	3	0	0
Dry Fork Cheyenne River	Dry Fork Cheyenne River Near Bill, WY	06365300	1977-1987	Value	100	13.3	389	0
				Count	40	41	15	15
Upper Cheyenne River	Cheyenne River Nr Dull Center WY	06365900	1975-1987	Value	100	14.8	326	0
				Count	74	74	59	59
	Little Thunder Creek Near Hampshire, WY	06375600	1977-1997	Pre-1995	52	12.3	274	0
				Count	46	45	45	27
				Post-1995	50	13.6	NA	NA
				Count	4	4	0	0
	Lodgepole C Nr Hampshire WY	06378300	1978-1981	Value	18	7.3	760	28
				Count	24	24	21	21
	Black Thunder Creek near Hampshire, WY	06376300	2001	Value	64	14.4	NA	NA
				Count	3	3	0	0
	Upper Cheyenne R. nr Riverview, WY	06386500	1969-1980	Value	77	11.6	302	0
				Count	49	49	37	37
Lightning Creek	Lance Creek Near Riverview, WY	06386000	1971-1983	Value	72	12.9	355	0
				Count	81	81	36	36
Upper Belle Fouche River	Belle Fourche River Below Moorcroft, WY	06426500	1972-2001	Pre-1995	74	12.4	425	1
				Count	106	107	57	57
				Post-1995	1,171	13.8	NA	NA
				Count	8	8	0	0
Middle North Platte River	North Platte River Below Casper, WY	06645000	1949-1999	Pre-1995	24	3.6	170	1
				Count	323	293	264	195
				Post-1995	NA	NA	NA	NA
				Count	0	0	0	0

[1] (USGS 2001)

Appendix F
Project Area Soils Characteristics

Project Area Soil Series Characteristics

Map Unit	Major Soil Series	Surface Texture	Slope Range	Severe Wind Erosion Hazard	Severe Water Erosion Hazard	Severe Shrink-Swell Potential	Salinity	Prime Agricultural Soils	Poor Revegetation Potential
WY002	Midway	Silty Clay Loam	2-35 percent						
	Samday	Clay Loam	2-45 percent		X	X			X
	Rock Outcrop								X
WY004	Haverson	Loam	0-6 percent					X	
	Glenberg	Fine Sandy Loam	0-3 percent					X	
	Bone	Clay Loam	0-6 percent			X	X		
WY042	Cabbart	Loam	2-75 percent						X
	Yawdim	Silty Clay	2-70 percent		X	X			X
	Hesper	Silty Clay Loam	0-15 percent						
WY043	Ridge	Sandy Loam	4-65 percent				NR		
	Broadus	Loam	8-65 percent				NR		
	Reeder	Loam	2-25 percent						
WY044	Havre	Loam	0-6 percent						
	Hanly	Fine Sandy Loam	0-6 percent						
	Glendive	Loam	0-8 percent						
WY045	Cabbart	Loam	2-75 percent						X
	Yawdim	Silty Clay	2-70 percent		X	X			X
	Thurlow	Silty Clay Loam	0-15 percent						
WY046	Cabba	Silty Loam	15-50 percent		X*				X
	Ringling	Channery Loam	8-95 percent						X
	Yawdim	Silty Clay	2-70 percent		X	X			X
WY047	Draknab	Fine Sandy Loam	0-4 percent	X					
	Arvada	Clay Loam	0-6 percent			X			
	Bidman	Loam	0-15 percent			X			
WY048	Riverwash								
	Haverdad	Fine Sandy Loam	0-6 percent					X	
	Clarkelen	Loam	0-3 percent						
WY049	Shingle	Clay Loam	0-80 percent		X*				X
	Renohill	Clay Loam	3-25 percent		X*	X			
	Forkwood	Clay Loam	0-15 percent					X	
WY050	Shingle	Loam	10-40 percent		X*				X
	Taluce	Sandy Loam	15-40 percent						X
	Kishona	Loam	3-6 percent						
WY051	Wyarno	Clay Loam	0-9 percent			X			
	Hargreave	Fine	3-15 percent						

Map Unit	Major Soil Series	Surface Texture	Slope Range	Severe Wind Erosion Hazard	Severe Water Erosion Hazard	Severe Shrink-Swell Potential	Salinity	Prime Agricultural Soils	Poor Revegetation Potential
		Sandy Loam							
	Moskee	Fine Sandy Loam	0-45 percent		X*			X	
WY053	Shingle	Loam	2-60 percent		X*				X
	Cushman	Clay Loam	0-15 percent						
	Taluce	Fine Sandy Loam	3-30 percent						X
WY055	Haverdad	Fine Sandy Loam	0-6 percent					X	
	Havre	Loam	0-6 percent						
	Zigweid	Loam	0-15 percent					X	
WY056	Samday	Clay Loam	2-60 percent		X*	X			X
	Shingle	Loam	2-60 percent		X*				X
	Rock Outcrop								X
WY057	Doney	Silt Loam	6-90 percent		X*				X
	Shaak	Loam	0-6 percent			X			
	Wayden	Silty Clay	0-35 percent		X*	X			
WY058	Abac	Silt Loam	9-35 percent						X
	Peritsa	Silt Loam	9-35 percent						
	Rock Outcrop								X
WY059	Rock Outcrop								X
	Starley	Loam	10-60 percent						X
	Woosley	Loam	2-15 percent		X*				
WY060	Tolman	Channery Loam	5-70 percent						X
	Abac	Silt Loam	9-35 percent						X
	Rock Outcrop								X
WY061	Agneston	Coarse Sandy Loam	10-50 percent						X
	Rock Outcrop								X
	Granile	Coarse Sandy Loam	10-50 percent						
WY062	Owen Creek	Clay Loam	9-30 percent			X			
	Tongue River	Silty Loam	2-60 percent	X	X*		NR		
	Gateway	Loam	6-50 percent	X		X	NR		X
WY063	Wolf	Loam	0-3 percent						
	Platner	Clay Loam	0-25 percent			X			
	Platsher	Loam	0-3 percent			X			
WY064	Platsher	Loam	0-3 percent			X			
	Recluse	Loam	3-6 percent					X	
	Parmleed	Sandy Loam	3-9 percent			X			
WY065	Baux	Loam	3-60 percent		X*				X
	Bauxson	Channery Loam	3-60 percent		X*				X
	Harlan	Loam	0-15 percent		X*			X	
WY066	Moskee	Fine Sandy Loam	0-45 percent		X*			X	
	Hargreave	Fine	3-15 percent						

Map Unit	Major Soil Series	Surface Texture	Slope Range	Severe Wind Erosion Hazard	Severe Water Erosion Hazard	Severe Shrink-Swell Potential	Salinity	Prime Agricultural Soils	Poor Revegetation Potential
		Sandy Loam							
	Shingle	Loam	2-60 percent		X*				X
WY078	Frisco	Sandy Loam	2-70 percent				NR		
	Troutville	Coarse Sandy Loam	2-60 percent				NR		X
	Teewinot	Gravelly Loam	5-70 percent	X			NR		X
WY081	Barnum	Fine Sandy Loam	0-3 percent					X	
	Haverdad	Loam	0-3 percent					X	
	Rock Outcrop								X
WY082	Renohill	Clay Loam	3-12 percent			X			
	Shingle	Loam	3-45 percent						X
	Parmleed	Sandy Loam	3-9 percent			X			
WY084	Keyner	Sandy Loam	0-6 percent				X		
	Samday	Clay Loam	3-12 percent			X			X
	Rock Outcrop								X
WY085	Samday	Clay Loam	3-12 percent			X			X
	Badland								X
	Rock Outcrop								X
WY086	Cambria	Fine Sandy Loam	2-15 percent						
	Shingle	Loam	3-45 percent						X
	Kishona	Loam	10-30 percent						
WY087	Shingle	Loam	3-45 percent						X
	Cambria	Fine Sandy Loam	2-15 percent						
	Renohill	Clay Loam	3-12 percent			X			
WY088	Sunup	Gravelly Loam	10-30 percent						X
	Rock Outcrop								X
	Spearfish	Fine Sandy Loam	10-30 percent						X
WY114	Tassel	Fine Sandy Loam	2-30 percent						X
	Turnercrest	Sandy Loam	6-30 percent						
	Terro	Sandy Loam	2-10 percent						
WY115	Shingle	Loam	6-30 percent						X
	Samday	Clay Loam	2-45 percent		X*	X			X
	Absted	Fine Sandy Loam	0-6 percent			X	X		
WY124	Platsher	Loam	0-9 percent			X			
	Kishona	Loam	0-15 percent						
	Hiland	Sandy	3-15 percent	X				X	

Map Unit	Major Soil Series	Surface Texture	Slope Range	Severe Wind Erosion Hazard	Severe Water Erosion Hazard	Severe Shrink-Swell Potential	Salinity	Prime Agricultural Soils	Poor Revegetation Potential
		Loam							
WY125	Shingle	Clay Loam	0-75 percent						X
	Theedle	Loam	3-40 percent						
	Wibaux	Gravelly Loam	0-75 percent						X
WY126	Hiland	Sandy Loam	0-15 percent	X				X	
	Vonalee	Sandy Loam	0-15 percent	X					
	Maysdorf	Sandy Loam	0-15 percent						
WY127	Kishona	Loam	0-15 percent						
	Shingle	Clay Loam	0-75 percent						X
	Theedle	Loam	3-40 percent						
WY128	Renohill	Clay Loam	3-15 percent			X			
	Cushman	Loam	0-15 percent						
	Cambria	Loam	0-9 percent						
WY129	Bidman	Loam	0-9 percent			X			
	Parmleed	Loam	3-15 percent			X			
	Renohill	Clay Loam	3-15 percent			X			
WY130	Renohill	Clay Loam	3-15 percent			X			
	Bidman	Loam	0-6 percent			X			
	Ulm	Clay Loam	0-6 percent			X		X	
WY204	Hiland	Sandy Clay Loam	0-15 percent					X	
	Ustic Torriorthents	Loamy Sand	3-30 percent						
	Bowbac	Sandy Loam	0-15 percent						
WY203	Clarkelen	Sandy Loam	0-3 percent						
	Draknab	Loamy Sand	0-3 percent	X					
	Haverdad	Fine Sandy Loam	0-3 percent					X	
WY205	Dwyer	Loamy Sand	0-15 percent	X					X
	Orpha	Loamy Sand	0-15 percent	X					
	Hiland	Sandy Clay Loam	0-15 percent					X	
WY206	Wibaux	Channery Loam	0-45 percent						X
	Rock Outcrop								X
	Shingle	Clay Loam	3-45 percent		X*				X
WY207	Hiland	Sandy Clay Loam	0-15 percent					X	
	Bowbac	Sandy Loam	0-15 percent	X					
	Tassel	Fine Sandy	10-30 percent	X					X

Map Unit	Major Soil Series	Surface Texture	Slope Range	Severe Wind Erosion Hazard	Severe Water Erosion Hazard	Severe Shrink-Swell Potential	Salinity	Prime Agricultural Soils	Poor Revegetation Potential
		Loam							
WY208	Shingle	Clay Loam	3-45 percent		X*				X
	Samday	Clay Loam	3-30 percent			X			X
	Hiland	Sandy Clay Loam	0-15 percent					X	
WY209	Hiland	Sandy Clay Loam	0-15 percent					X	
	Shingle	Clay Loam	3-45 percent		X*				X
	Tassel	Fine Sandy Loam	10-30 percent	X					X
WY210	Ulm	Loam	0-15 percent			X		X	
	Renohill	Fine Sandy Loam	0-15 percent			X			
	Shingle	Clay Loam	3-45 percent		X*				X
WY211	Shingle	Clay Loam	3-45 percent		X*				X
	Tassel	Fine Sandy Loam	10-30 percent	X					X
	Rock Outcrop								X
WY315	Rock Outcrop								X
	Hazton	Gravelly Sandy Loam	10-40 percent						X
	Redsun	Channery Loam	3-30 percent						X
WY316	Hiland	Sandy Loam	0-15 percent	X				X	
	Bowbac	Loamy Fine Sand	3-15 percent						
	Keyner	Sandy Clay Loam	0-12 percent				X		
WY317	Shingle	Loam	3-45 percent		X*				X
	Taluce	Sandy Loam	6-40 percent						X
	Amodac	Fine Sandy Loam	2-12 percent				X		
WY321	Hiland	Sandy Loam	0-15 percent	X				X	
	Orpha	Loamy Sand	3-45 percent	X					
	Bowbac	Loamy Fine Sand	3-15 percent						
WY322	Roughlock	Loam	0-15 percent						
	Rock Outcrop								X
	Rekop	Loam	5-40 percent						X
WY323	Lolite	Clay	5-50 percent		X	X			X
	Hiland	Sandy Loam	0-15 percent	X				X	
	Vonalee	Loamy	3-15 percent	X					

Map Unit	Major Soil Series	Surface Texture	Slope Range	Severe Wind Erosion Hazard	Severe Water Erosion Hazard	Severe Shrink-Swell Potential	Salinity	Prime Agricultural Soils	Poor Revegetation Potential
		Sand							
WY324	Hiland	Sandy Loam	0-15 percent	X				X	
	Forkwood	Loam	0-12 percent					X	
	Zigweid	Loam	2-15 percent					X	
WY325	Lolite	Clay	5-50 percent		X	X			X
	Rock Outcrop								X
	Keyner	Sandy Clay Loam	0-12 percent				X		

Appendix G
Water Well Agreement

This agreement is made and entered into this _____day of _____, _____by and between _____, hereinafter referred to as "Landowner" and _____, with offices at _____, hereinafter referred to as "Producer."

WHEREAS, Landowner(s) have existing water wells within their property boundaries, providing Landowner(s) water for domestic and agricultural/livestock water,

AND WHEREAS, Producer has acquired leases for the development of Coal Bed Methane Gas (CBM) and intends to drill and complete wells for the production of CBM,

AND WHEREAS, the development and production of CBM usually requires the production of water in conjunction with CBM and may require the localized reduction of water levels within certain individual strata of the Fort Union Coals,

AND WHEREAS, Producer has advised Landowner that the production of water in association with gas could adversely affect the productive capacity of Landowner's existing water wells which draw water from the Fort Union aquifer.

NOW THEREFORE, as consideration for the mutual covenants herein, in order to facilitate the multiple usage of the natural resources consistent with sound environmental practices, to mitigate potential adverse effects on the Landowner's water wells, to assure prompt and effective remediation, and to reduce the need for regulatory intervention by State and Federal agencies, the Landowner and Producer agree as follows:

DEFINITIONS:

Fort Union Coals: The Fort Union Coals, as used herein, shall mean those individual coal beds or several coal beds contained within the Tongue River member of the Fort Union Formation, bounded above by the Wasatch Formation of Eocene, and below by the Lebo Shale Member.

Circle of Influence (COI): The area that falls within the circle, the center of which is the location of a producing CBM well, which has a radius of one-half mile (2;640 feet) and contains approximately 502.66 acres.

Impaired Water Well: Any water well properly permitted with the Wyoming State Engineer's Office existing on the Landowner's property within the COI, existing at the time of the CBM development, that experiences a significant reduction of capacity to deliver water in quantity and/or quality sufficient to support the ordinary and customary use of the well.

Strat Test: Any test well that is drilled with the purpose of obtaining geologic information that is not completed for production and is subsequently plugged and abandoned. Strat Tests may produce water and/or gas for a period not to exceed thirty (30) days without creating a COI.

CSM Well: Any well drilled and completed for the production of coal bed methane that withdraws water and/or gas and water from the aquifer for a period exceeding sixty (60) days,

AGREED:

1. Upon establishment of a COI, the Producer, at its sole cost and risk will measure, or cause to be measured, the static water level and productive capacity (the baseline measurement) of properly permitted water wells within the COI and will attempt to determine the depth and configuration of these wells through consultation with the Landowner and from the records of the State Engineer of the State of Wyoming. The Producer shall also test for the presence of methane in the water wells. Tests shall be performed in accordance with test procedures attached hereto.

2. Landowner shall, upon reasonable notice, allow the testing of water wells within the COI, including a static water level test which may require the cessation of withdrawals of water from the well for a period not to exceed twenty four (24) hours.

3. Producer shall establish a continuing water well monitoring program, the intent of which is to enable the Producer to identify changes in the capacity of the Landowner's water wells within the COI. The Landowner shall allow continued periodic testing of the water wells within the COI for this purpose. Producer shall, upon request of the Landowner, provide all test data, both "baseline data" and monitoring data to the Landowner.

4. If a water well within the COI becomes an "Impaired Water Well" as defined herein, Landowner shall first take reasonable steps to verify that the impairment is not due to mechanical, electrical, down hole integrity, or pump problems and, if none of these problems appear to be the cause of the impairment, Landowner shall notify Producer of the impairment. Notice shall be made by phone and by writing, delivered by hand or by registered mail to the Producer at the noted address.

5. Within sixty (60) days of receipt of Notice of Impairment, Producer shall restore the Landowner's access to water of sufficient quantity and quality to offset such impairment by reconfiguring, redrilling the well, the drilling of a new well, or by other means. It is recognized that additional power costs may be associated with any reconfiguration of an impaired water well. The specific site of the well or water access may be changed by mutual agreement of Producer and Landowner.

6. Producer agrees that upon notice of impairment and during the curative period, to provide and make available water for domestic and livestock usage in quantity, quality, and location required for the maintenance of normal and customary domestic, grazing, and livestock operations. Producer shall develop emergency procedures for immediate delivery of water to any such effected Landowner within twenty-four (24) hours of notice. Producer shall notify all Landowners within any COI of the Producer's representative appointed to handle such matters, providing a local contact and a twenty-four (24) hour emergency contact. Landowner shall make a good faith effort to inform Producer by phone, fax, or

other expedient method of communicating of any impending loss or damage to livestock, allowing Producer a reasonable opportunity to mitigate such damage.

7. In the event it is determined that there is an Impaired Water Well, as defined above, in any COI, that COI shall be expanded based on the location of the impaired well or wells. The COI shall be divided into equal quadrants (NE, NW, SW, SE) and based upon which quadrant the impaired water well is located in, that quadrant shall be expanded by the area include within an arc one eighth of a mile wide (660 feet) outside the existing COI. Likewise, should it be determined that there is an impaired water well within the expanded quadrant of the COI, the quadrant shall be again expanded by another 660 feet increment. This expansion approach shall be used to expand any COI in any direction where impairment is determined during the life of the CBM well. Notwithstanding the above, if no water well exist within any COI or quadrant thereof, the arcs and associated quadrants not containing a water well shall be expanded to include the nearest water well.

8. At any time that the Lessee undertakes activities to enhance Landowner's water well capacity or to restore Landowner's impaired water well capacity, and should such activities require permits from regulatory agencies or permissions from third parties for surface-entry, Landowner shall aid and assist Producer in the obtaining of permits and permissions necessary to conduct the operations. All costs of the operations, including fees for obtaining permits and permissions, shall be borne by the Producer.

9. An Arbitration Board shall be formed for the purpose of arbitrating disputes between . Producer and Landowner under this Agreement. The Board shall consist of five (5) members, each member shall be appointed for a two (2)-year term with two (2) members being selected by vote of those Landowners within the various COIs and two (2) members being selected by vote of the Producers that are party of this Agreement and one (1) member being representative of the Wyoming State Engineer's Office.

10. In instances where a water well has become an Impaired Water Well as defined herein, and Landowner and Producer have not been able to agree on the cause of the damage, the Arbitration Board shall determine the cause of the impairment and decide which of the parties shall ultimately be responsible for bearing the cost of remediation. The Arbitration Board shall have the right to apportion and divide the cost among the parties in the event that both mechanical elements, the responsibility of the Landowner, and aquifer drawdown, the responsibility of the Producer, are both factors in causing the water well to become impaired.

11. In the event that the interpretation or enforcement of this Agreement results in legal action, the cost of such action, including reasonable attorney's fees, shall be borne by the individual parties, except in the event that the Landowner is the Prevailing party, in which case the Producer shall bear the costs.

12. The terms and provisions contained herein shall run with the land and shall be binding on the heirs, successors, and assigns of Landowner and Producer. This agreement shall terminate upon the expiration of the last Oil and Gas Lease or the plugging and

abandonment of the last CBM well to which this Agreement applies, whichever is the later date.

This Agreement may be executed in any number of counterparts, each of which shall be considered an original.

AGREED AND ACCEPTED THIS

_____ Day of _____, _____

PRODUCER:

BY: _____

_____

(Name)

_____

(Title, if applicable)

_____

(Company Name)

_____

(Mailing Address)

_____

(Telephone Number)

AGREED AND ACCEPTED THIS

_____ Day of _____, _____

LANDOWNER:

BY: _____

BY: _____

(Name)

_____

(Title, if applicable)

_____

(Land/Company Name)

_____

(Mailing Address)

_____

(Telephone Number)

Appendix H
Biological Assessment

Biological Assessment

POWDER RIVER BASIN OIL AND GAS PROJECT

Prepared for:

U.S. Department of Interior

Fish and Wildlife Service

December 2001

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Biological Assessment for the Powder River Basin Oil and Gas Project

Introduction

The purpose of the Biological Assessment (BA) is to review the BLM's Preferred Alternative (Alternative 1) for the Draft Environmental Impact Statement (DEIS) for the Powder River Basin (PRB) Oil and Gas Project and Draft Planning Amendment in sufficient detail to determine if the action "may affect" any federally listed threatened, endangered, or proposed species. This BA was prepared in accordance with the legal requirements set forth under Section 7 (c) of the Endangered Species Act (16 U.S.C.) 1536, stating that a biological assessment be prepared for any Federal action that is a major construction activity to determine the effects of the proposed action on listed and proposed species.

Consultation to Date

In a letter dated June 5, 2001 (Attachment A), regarding the preparation of the Draft Environmental Impact Statement (DEIS) for the PRB Oil and Gas Project, the U.S. Department of Interior, Fish and Wildlife Service (USFWS) referenced its earlier letter (June 5, 2000 [Attachment B]) that identified several threatened, endangered, or proposed species that may be present and potentially affected in the Project Area. These species are the bald eagle (*Haliaeetus leucocephalus*), black-footed ferret (*Mustela nigripes*), mountain plover (*Charadrius montanus*), and Ute ladies'-tresses orchid (*Spiranthes diluvialis*).

Description of the Project

A group of oil and gas companies, collectively identified as the PRB Companies (Companies), has notified the U.S. Department of Interior, Bureau of Land Management (BLM) and U.S. Department of Agriculture, Forest Service (FS) of their intent to develop additional coal bed methane (CBM) resources in Wyoming's PRB. Implementation of this project would continue and expand development of CBM that has been occurring in the PRB over the last few years. In general, the Companies propose to 1) drill, complete, operate, and reclaim almost 39,400 new natural gas wells; and 2) construct, operate, and reclaim various ancillary facilities needed to support the new wells, including roads, pipelines for gathering gas and produced water, electrical utilities, and compressors.

The Companies hold valid federal, state, and private leases for oil and natural gas in the Project Area. The leases exist in a hodge-podge pattern of BLM, state, private,

and split estate ownership, which results in an interspersed pattern rather than large tracts of single ownership. The leases have created contractual and property rights for the Companies from the United States, the State of Wyoming, and private mineral owners to develop oil and natural gas resources. The purpose of the Companies' proposal is to extract and transport oil and natural gas at a profit from the portions of the Project Area leased by them.

The Preferred Alternative would occur in an almost 8 million-acre Project Area. The Project Area encompasses all or parts of Campbell, Converse, Johnson, and Sheridan counties and all or parts of eighteen 4th order watersheds (sub-watersheds). The Preferred Alternative would involve both public and privately owned lands. The public lands include lands administered by the BLM, National Forest System lands, and state lands. Surface ownership is mostly owned by private entities, but the federal government owns the oil and gas rights. Additional information on land ownership and jurisdiction is presented in Chapter 3 of the DEIS.

The Preferred Alternative is to continue development of CBM and conventional oil/gas resources within the Project Area. It is projected that an additional 39,367 CBM wells and 3,200 conventional (i.e., non-CBM) oil/gas wells would be developed over the next ten years. The Preferred Alternative is a combination of the Companies' proposal and the BLM's Reasonably Foreseeable Development (RFD) Scenario. The BLM used the RFD Scenario's moderate level of development and the Companies' proposal to establish the overall level of development of CBM resources likely for the Preferred Alternative. The BLM used the RFD Scenario to establish the overall level of additional development of non-CBM resources within the PRB.

If the Preferred Alternative is implemented, the Companies would drill, complete, and operate 51,444 CBM wells in a ten-year period, including the 12,077 CBM wells already drilled or permitted for drilling in the Project Area. The Companies also would construct the ancillary facilities needed to support these wells. The ancillary facilities include access roads, pipelines for gathering gas and produced water, electrical utilities, facilities for measuring and compressing gas, facilities for treating, discharging, disposing of, containing, or injecting produced water, and pipelines for delivering gas to high-pressure transmission pipelines headed to market.

The overall life of the Preferred Alternative, including drilling, production, and reclamation, is expected to be about 20 years. Construction of the 39,367 new wells would begin during 2002. The productive life of each well is expected to be about seven years. Accordingly, production from at least some of the 39,367 new wells is expected to last until 2018. Final reclamation of these wells would occur during the two to three years following the end of production for each well. Thus, the Preferred Alternative would be completed around 2021.

Based on the practice of collocation and knowledge of where multiple gas-productive coal beds exist, the BLM and Companies project the 39,367 new wells would be drilled from about 26,000 well pads. The total number of wells and well pads are based on an 80-acre well spacing pattern overall (i.e., eight pads per square mile). Including the pads constructed for wells drilled before 2002, the 51,444 CBM wells would be distributed across almost 35,600 well pads. The number of wells on a pad would range from one to three.

Under the Preferred Alternative, the Companies would drill, operate, and maintain wells and construct ancillary facilities in ten of the 18 sub-watersheds that comprise the Project Area. However, most (63 percent) of the new wells and facilities would be constructed in two sub-watersheds: the Upper Powder River and Upper Belle Fourche River sub-watersheds. Other sub-watersheds with relatively high numbers of wells and facilities include Clear Creek, Crazy Woman Creek, Upper Tongue River, and Little Powder River.

Overall, implementation of the CBM portion of the Preferred Alternative could disturb as many as 211,992 surface acres, most of which would be associated with the construction of pipelines, roads, and water handling facilities. Compressor stations would account for the smallest amount of the overall surface disturbance. Short-term (i.e., during the construction period) direct disturbance of land surface would encompass about three percent of the Project Area (about 240,000 acres). Following the reclamation of pipelines and the partial reclamation of other facilities, such as well pads, the Preferred Alternative's long-term disturbance (i.e., lasting beyond the construction period) from CBM development would encompass about 108,800 acres. The long-term disturbance is 45 percent less than the total short-term disturbance. The roads and water handling facilities would comprise most of the long-term disturbance.

The DEIS describes the Preferred Alternative (Alternative 1), as well as the other alternatives considered, in detail. The following sections describe the existing environment, potential effects from the Preferred Alternative, the determination, the cumulative effects, and the anticipated mitigation actions for the listed or proposed species considered by the USFWS to possibly be affected within the Project Area.

Bald Eagle

Existing Environment

On February 14, 1978, the bald eagle was listed as endangered in all of the conterminous United States except Minnesota, Wisconsin, Michigan, Oregon, and Washington, where it was classified as endangered (43 F.R. 6233). The USFWS reclassified the bald eagle from endangered to threatened throughout its range in the lower 48 states on July, 12, 1995 (60 F.R. 36000). The bald eagle was proposed for delisting on July 6, 1999 (64 F.R. 36454). Currently, the proposal has not been finalized or withdrawn.

Bald eagles usually nest in trees near water, but are known to nest on cliffs and the ground. Nest sites are usually in large trees near (i.e., within one mile of) shorelines in relatively remote areas that are free of disturbance (USFWS 1999). The bald eagle typically lays a clutch ranging from one to three eggs that are incubated by both the male and female birds for approximately 35 days resulting in usually one or two eaglets produced by the pair (Stalmaster 1987). Typically, the recommended spatial buffer around nests for threatened and endangered raptors in arid landscapes, including the bald eagle, is 1.0 mile (Roman and Muck 1999).

Feeding areas, diurnal perches, and night roosts are fundamental elements of bald eagle winter range. Wintering bald eagles primarily occur where all three of these elements are in close proximity, although they will fly up to 15 miles where these elements are sparsely distributed across the landscape (Swisher 1964), as in this part of Wyoming. Food availability is probably the single most important factor affecting winter bald eagle distribution and abundance (Steenhof 1976). Fish and waterfowl are the primary sources of food where eagles occur along rivers and lakes. Big game and livestock carrion, as well as larger rodents (e.g., prairie dogs) also can be important dietary components where these resources are available.

Bald eagles nest throughout Wyoming, including the Project Area. The Non-game Division of the Wyoming Game and Fish Department (WGFD) knows nest locations in the Project Area, for the most part. Within the Project Area, active nests and winter roosts tend to be associated with forested riparian areas and large lakes and reservoirs that have mature cottonwood trees.

Effects of the Preferred Alternative

Several direct effects to bald eagles including human disturbance, equipment noise, power line collision and electrocution, and vehicular collision may affect bald eagles. Human disturbances during the life of the Preferred Alternative may vary by type and intensity, ranging from one-time pedestrian surveys of development areas, well pad construction and well development, to regular maintenance trips to wells, as well as various equipment operation by humans. Raptors have been known to become accustomed to some human activities, particularly activities that occur regularly and predictably. However, in some cases, particularly nesting and wintering roosts, raptors may exhibit particular sensitivities to nearby human activities, regardless of the activity and its intensity. Disturbance to nesting raptors can cause nest failure, nest abandonment, and unsuccessful fledgling of young. New and additional levels of human disturbance in an area relatively void of human disturbance may have a negative effect to wintering bald eagles roosting and perching in the Project Area. Due to the relative lack of human activity, bald eagles may exhibit sensitivities to activities of short duration and extent that would not otherwise affect bald eagles of other landscapes that are more accustomed to disturbance.

Noise and activities around facilities may disturb bald eagles in nesting attempts, and perhaps foraging, within a certain distance of compressor stations and other facilities. The extent to which these disturbances would affect the bald eagle is unknown and depends on the frequency of maintenance activities, the amount of noise produced by the different types of facilities, and the ability of bald eagles to become accustomed to both consistent noise, and sporadically occurring maintenance activities.

The presence of new aboveground power lines would increase the potential for power line collisions and electrocutions. Power lines from individual well pods to the facilities within each pod, would be constructed underground. These lines are expected to account for the majority of the new lines constructed during the life of the project.

Increased vehicular traffic may result in increased collisions with bald eagles. Collisions with vehicles are often associated with carrion feeding along high-speed road-

ways. Because project-related activities are expected to increase commercial and private traffic levels on public highways within the Project Area, the potential for vehicular collision along these existing highways is expected to increase. Due to the unimproved nature of the existing and proposed access roads, vehicle speeds are not expected to be similar to highway speeds. Within CBM development fields, county roads used to travel to and from the facilities are posted for a 45-mph speed limit. Therefore, vehicle collisions with bald eagles are expected to be uncommon.

Indirect effects to the bald eagle would result from destruction of prey habitat due to well pad and road construction and discharging water, as well as fragmentation of prey habitat and human disturbance to prey populations. Collectively, habitat destruction and disturbance due to project-related activities may result in the loss of suitable nesting and wintering habitats and the loss of preferred prey species habitats and possible reductions in prey base numbers. Quantification of potential losses is directly associated with expected losses by vegetation type. Prey species, particularly small- and medium-sized mammals, may experience losses due to direct mortality and/or loss of habitat. In some instances, particularly with water handling methods, local habitat conditions may improve from the increased water availability and, in turn, benefit local prey species and their dependent predators, including the bald eagle. These benefits may be considered non-permanent, because any improved water availability conditions are expected to return to pre-project levels following the life of the Project. Local prey species may experience a temporary shift in population levels, while population numbers respond to new environmental conditions.

Water handling methods would most likely affect prey habitats and, subsequently, prey population numbers, but water handling methods would not likely directly affect bald eagles or their habitats. Potential adverse effects of water handling facilities may include localized destruction of prey habitats and possible changes in population numbers of locally occurring prey species (i.e., small- and medium-sized mammals).

Mitigation

- In the event that a bald eagle (dead or injured) is located during construction or operation, the USFWS' Wyoming Field Office (307-772-2374) and the USFWS' Law Enforcement Office (307-261-6365) will be notified within 24 hours.
- The BLM shall monitor all take of bald eagle habitat associated with the Preferred Alternative. The actual measurement of disturbed habitat can be the responsibility of the BLM' agent (consultant, contractor, etc.) with a written summary provided to the USFWS' Wyoming Field Office upon project completion, or immediately if the anticipated impact area is exceeded.
- Removing carrion from or near roads as soon as possible would minimize the possibility of vehicular collision with bald eagles foraging on or near roads.
- All power lines would be built to protect raptors, including wintering bald eagles, from accidental electrocution using methods detailed by the Avian Power Line Interaction Committee (1996).

- The appropriate standard seasonal or year-long stipulations for raptors, including wintering bald eagles, as identified by the BLM's Resource Management Plan (BLM 1985), would be applied.
- Special habitats for raptors, including wintering bald eagles, would be identified and considered during the review of the APD/POD or Sundry Notices. A minimum disturbance-free buffer zone of 0.5 mile (i.e., no surface occupancy) would be established for all active raptor nests that were located by surveys during the nesting season (i.e., February 1 through July 31), and this buffer zone would be observed year-round for all bald eagle nest sites. A seasonal minimum disturbance-free buffer zone of one mile would be established for all bald eagle nest sites (February 15 – August 15) and for all bald eagle winter roost sites (November 1 – April 1). These buffer zones and timing may be adjusted based on site-specific information through coordination with, and written approval from, the USFWS.
- Speed limits on all roads associated with project activities shall not exceed 35 miles per hour to minimize the chance of a collision with a bald eagle or other wildlife or livestock. The speed limit shall be enforced.

Determination

Implementation of the Preferred Alternative **is likely to adversely affect, but not likely to jeopardize the continued existence of** the bald eagle and its habitat. The determination is based on the evaluation of the potential adverse effects of the Preferred Alternative on the bald eagle and includes implementation of the mitigation measures presented in this BA.

Black-footed Ferret

Existing Environment

The black-footed ferret (*Mustela nigripes*) is a federally-listed endangered species. The black-footed ferret, a nocturnally active mammal, is closely associated with prairie dogs, depending almost entirely upon the prairie dog for its survival. The decline in ferret populations has been attributed to the reduction in the extensive prairie dog colonies that historically existed in the western United States. Ferrets may occur within colonies of white-tailed or black-tailed prairie dogs. The Project Area is within the range of both the black-tailed and white-tailed prairie dog. The USFWS has determined that, at a minimum, potential habitat for the black-footed ferret must include a single white-tailed prairie dog colony of greater than 200 acres, or a complex of smaller colonies within a 4.3 mile (7 km) radius circle totaling 200 acres (USFWS 1989). The minimum colony size of black-tailed prairie dogs required to be considered black-footed ferret habitat is 80 acres (USFWS 1989). At least 382 black-tailed prairie dog colonies greater than 80 acres in size have been identified to date within the Project Area. Additional colonies are expected to be found, due to the vast areal extent of short-grass and mixed-grass prairie within the Project Area.

The Project Area is within the historical range of the black-footed ferret, although no black-footed ferrets are presently known to occur in northeastern Wyoming. The last known wild population was discovered in 1981 near the town of Meeteetse. Individuals from this population were captured in 1985 through 1987 and raised in protective captive breeding facilities in an effort to prevent the species' extinction (Clark and Stromberg 1987). Recent survey efforts in a former re-introduction site within the Shirley Basin have identified that a population has been successfully established. This is the only known population in Wyoming (Marinari 2001). Other populations of reintroduced captive-bred individuals exist in nearby Badlands National Park in South Dakota, eastern Montana, and Arizona. Extensive efforts have failed to identify any populations of this species within the Project Area; hence this species is not expected to occur within the Project Area.

Effects of the Preferred Alternative

No effects to the black-footed ferret are expected because there are no known occurrences within the Project Area. Surveys by the USFWS for the black-footed ferret have been extensive in Wyoming without any individuals found anywhere within the Project Area.

Mitigation

- Prairie dog colonies would be surveyed for the presence of black-footed ferrets if the colonies meet USFWS guidelines (USFWS 1989). When surveys are required, the entire colony or colony complex affected by the Preferred Alternative would be surveyed. These surveys are required even if part of the colony has a burrow density below eight per acre. If any black-footed ferrets are located, the USFWS would be consulted. Absolutely no disturbance would be allowed within the prairie dog colonies that are found to be inhabited by black-footed ferrets. Disturbance in prairie dog colonies not inhabited by black-footed ferrets would be avoided, wherever possible, to protect the prairie dogs, as well as sensitive species living within the colonies such as the burrowing owl.

Determination

Implementation of the Preferred Alternative **is not likely to adversely affect** the black-footed ferret. This determination is based on the mitigation measures presented in this BA and because of the lack of known black-footed ferret colonies in the Project Area.

Mountain Plover

Existing Environment

The mountain plover (*Charadrius montanus*) is proposed for federal listing as a threatened species (USFWS 2001). This species utilizes high, dry, shortgrass prairie with vegetation typically shorter than four inches tall. Within this habitat, areas of blue grama (*Bouteloua gracilis*) and buffalograss (*Buchloe dactyloides*) are most often utilized, as well as areas of mixed-grass associations dominated by needle-and-thread (*Hesperostipa comata*) and blue grama (Dinsmore 1983).

Nests consist of a small scrape on flat ground in open areas. Most nests are placed on slopes of less than five degrees in areas where vegetation is less than three inches tall in April. More than half of identified nests occurred within 12 inches of old cow manure piles and almost 20 percent were found against old manure piles in similar habitats in Colorado. Nests in similar habitats in Montana (Dinsmore 1983) and other areas (Ehrlich et al. 1988) were nearly always associated with the heavily grazed short-grass vegetation of prairie dog colonies.

Mountain plovers arrive on their breeding grounds in late March with egg-laying beginning in late April. Clutches are hatched by late June and chicks fledge by late July. The fall migration begins in late August and most birds are gone from the breeding grounds by late September.

In Wyoming, this species is a common breeding resident (Luce et al. 1999) and does occur within suitable habitats in the Project Area. Data compiled by the BLM office in Buffalo indicate mountain plover nesting has been documented sporadically throughout the Project Area, including northeastern Converse County, near Gillette and Sheridan. The Wyoming Natural Diversity Database recently published the results of their 2001 survey efforts (modified from the USFWS protocol) in the Powder River Basin of Wyoming (Keinath et al. 2001). Surveys were made only from public roads leaving a great deal of potentially suitable habitats unsurveyed. During these surveys, nine sightings of mountain plovers were recorded, of which two where within the Project Area. Suitable habitat was identified in the Project Area, but characterized as limited and fragmented.

Effects of the Preferred Alternative

The Preferred Alternative has the potential to have substantial adverse direct and indirect effects to the mountain plover. Direct loss of individuals and nests may occur as a result of vehicle collision and equipment operation in nesting areas. Chicks and eggs in nests may also be lost if disturbance or harassment occurs frequently, preventing adults from tending to chicks or nests and allowing excessive heating, chilling, or predation to occur. Frequent disturbance may lead to nest abandonment. Re-nesting may occur at another, less disturbed location, but a net loss in reproductive potential may occur with loss of the initial nest. Mountain plovers also show a high rate of nest site fidelity, often using the same general area year after year. Modifications that

make these sites less suitable for nesting would likely result in decreased reproductive success. New nests may be placed in less suitable habitat, resulting in potentially lower reproductive success.

Noise and activities around facilities would likely prevent mountain plovers from nesting, and perhaps foraging, within a certain distance of compressor stations and other facilities. The extent to which these disturbances would affect the mountain plover is unknown and depends on the frequency of maintenance activities, the amount of noise produced by the different types of facilities, and the ability of mountain plovers to become accustomed to consistent noise and sporadically occurring maintenance activities.

Preferred nesting habitats, such as bare soil, may be created by construction and production activities. While providing habitat, these areas are also likely to result in nests being abandoned or destroyed when activities continue during the nesting season. The potential for this type of impact to occur would be greatest during the production phase, when limited, intermittent activity occurs at well pads and along some access roads. Mountain plovers may arrive and begin nesting on bare ground in these areas, only to be disturbed or have nests destroyed the next time the road is used or the well pad is visited. This impact is most likely when activities occur at an interval of one week or more. During the construction phase, continuous activity is likely to prevent nest establishment in proximity to activities.

Disturbance of prairie dog colonies that provide important habitat components for the mountain plover may have negative effects on this species by reducing the amount of heavily grazed short-grass prairie vegetation.

Predator populations that often increase in areas impacted by humans, such as corvids (i.e., crows, ravens), raptors, coyotes, badgers, weasels, and foxes, may experience an increase in some affected portions of the Project Area and would likely adversely affect mountain plovers. New fences, transmission lines, and buildings would provide new perch and nest sites for avian predators, while buildings and other facilities may provide new denning sites for mammalian predators. Increases in vehicular collisions with wildlife along new and existing roads would provide a food source that may allow increases in predator populations that could also prey on mountain plovers.

Mitigation

- In the event that a mountain plover is located during construction or operation, the USFWS' Wyoming Field Office (307-772-2374) and the USFWS' Law Enforcement Office (307-261-6365) will be notified within 24 hours.
- The BLM shall monitor all take of mountain plover habitat associated with the Preferred Alternative. The actual measurement of disturbed habitat can be the responsibility of the BLM' agent (consultant, contractor, etc.) with a written summary provided to the USFWS' Wyoming Field Office upon project completion, or immediately if the anticipated impact area is exceeded.

- No ground-disturbing activities shall occur in suitable nesting habitat prior to surveys conducted in compliance with the USFWS' Mountain Plover Survey Guidelines (Deibert et al. 1999), regardless of the timing of the disturbance. Once occupied mountain plover nesting habitat is located, the BLM shall re-initiate section 7 consultation with the USFWS on any project-related activities proposed for such habitat. The amount and nature of ground-disturbing activities shall be limited within identified nesting areas in a manner to avoid the abandonment of these areas.
- Operators and the BLM shall be provided by the USFWS with educational material illustrating and describing the mountain plover, its habitat needs, life history, threats, and gas development activities that may lead to incidental take of eggs, chicks, or adults with requirements that these materials be posted in common areas and circulated in a memorandum among all employees and service providers.
- Surveys for nesting mountain plovers would be conducted by appropriately trained personnel if ground-disturbing activities related to the Preferred Alternative are anticipated to occur between May 1 and June 30. A disturbance-free buffer zone of 0.25 mile would be established around all mountain plover nesting locations between March 15 and July 31.
- Project-related features that encourage or enhance the hunting efficiency of predators of mountain plover would not be constructed within 0.25 mile of known mountain plover nest sites.
- Construction of ancillary facilities (e.g., compressor stations, processing plants) shall not be located within 0.5 mile of known nesting areas. The 200-meter buffer described in the USFWS' Mountain Plover Survey Guidelines (Deibert et al. 1999) must be considered for effects of any action regardless of surface ownership.
- The threats of vehicle collision to adult plovers and their broods shall be minimized, especially within breeding aggregation areas. Where possible, locate roads outside of plover nesting areas. Within 0.5 mile of identified nesting areas, speed limits shall be posted at 25 mph on resource roads and 35 mph on local roads for traffic during the breeding season. Road-killed animals (excluding migratory birds) shall be promptly removed from areas within 0.5 mile of identified nesting areas to avoid attracting avian and mammalian predators. If possible, work schedules and shift changes should be set to avoid the periods from 30 minutes before to 30 minutes after sunrise and sunset during June and July, when mountain plovers and other wildlife are most active.
- Creation of hunting perches or nest sites for avian predators within 0.5 mile of identified nesting areas shall be avoided by burying powerlines, using the lowest possible structures for fences and other structures and by incorporating perch-inhibiting devices into their design. This 0.5-mile buffer and the 200-meter buffer described in the USFWS' Mountain Plover Survey Guidelines (Deibert et al. 1999) must be considered for effects of any action, regardless of surface ownership.
- Capped and abandoned wells shall be identified with markers no taller than four feet with perch inhibiting devices on the top to avoid creation of raptor hunting perches within 0.5 mile of nesting areas.

- Reclamation of areas of previously suitable mountain plover habitat would include the seeding of vegetation to produce suitable habitat for mountain plover.
- To minimize destruction of nests and disturbance to breeding plovers from reclamation activities, no grading, seeding, or other ground-disturbing activities shall occur from April 10 to July 10 unless surveys consistent with the USFWS' Mountain Plover Survey Guidelines (Deibert et al. 1999) find that no plovers are nesting in the area.

Determination

Implementation of the Preferred Alternative is **likely to adversely affect, but not likely to jeopardize the continued existence of** the mountain plover or its habitat. The determination is based on the evaluation of the potential adverse effects of the Preferred Alternative on the mountain plover and includes implementation of the mitigation measures presented in this BA.

Ute Ladies'-tresses Orchid

Existing Environment

Ute ladies'-tresses orchid (*Spiranthes diluvialis*), listed as a federally threatened species, is a perennial herb with erect, glandular-pubescent stems 12 to 50 cm tall arising from tuberous-thickened roots (USFWS 1992). This species flowers from late July to September. Plants probably do not flower every year and may remain dormant below ground during drought years. In Wyoming, Ute ladies'-tresses orchid is known from the western Great Plains in Converse, Goshen, Laramie, and Niobrara counties. Rangewide, Ute ladies'-tresses orchid occurs primarily on moist, sub-irrigated or seasonally flooded soils in valley bottoms, gravel bars, old oxbows, or floodplains bordering springs, lakes, rivers, or perennial streams between 1780 and 6800 feet elevation (Fertig and Beauvais 1999). Suitable soils vary from sandy or coarse cobbley alluvium to calcareous, histic, or fine-textured clays and loams. Populations have been documented from alkaline sedge meadows, riverine floodplains, flooded alkaline meadows adjacent to ponderosa pine-Douglas-fir woodlands, sagebrush steppe, and streamside floodplains. Some occurrences are also found on agricultural lands managed for winter or early season grazing or hay production. Known sites often have low vegetative cover and may be subjected to periodic disturbances (e.g., flooding or grazing). Populations are often dynamic and shift within a watershed as disturbances create new habitat or succession eliminates old habitat (Fertig and Beauvais 1999). The orchid is well adapted to disturbances from stream movement and is tolerant of other disturbances, such as grazing, that are common to grassland riparian habitats (USFWS 1995). It is known to be established in heavily disturbed sites, such as revegetated gravel pits, heavily grazed riparian edges and along well-traveled foot trails on old berms (USFWS 1995). Ute ladies'-tresses orchid is commonly associated with horsetail, milkweed, verbena, blue-eyed grass, reedgrass, goldenrod, and arrowgrass.

This species is known from four populations in Wyoming, all discovered between 1993 and 1997 (Fertig and Beauvais 1999). One of these populations is recorded from northwestern Converse County and is within the Project Area. There is the potential for this species to occur in suitable habitats within the Project Area.

Effects of the Preferred Alternative

The potential for direct effects to the Ute ladies'-tresses orchid is expected to be minimal. There are no existing oil and gas wells in the upper portion of the Antelope Creek sub-watershed near the known population of this species. None of the wells that are part of the Preferred Alternative would be constructed near that location. There is the potential that other populations of this species may occur in the Project Area. Because of the ability of this species to persist below ground or above ground without flowering, single season surveys that meet the current USFWS survey guidelines may not detect populations. As a result, part or all of undetected populations could be lost to surface disturbing activities.

Adverse effects to currently undocumented populations of this species could occur as a result of hydrological alterations associated with the Preferred Alternative. The discharge of produced water is expected to substantially alter the distribution and extent of riparian and wetland areas, with the net effect being an increase in the extent of these areas. This action may provide additional suitable habitat for the Ute ladies'-tresses orchid in areas that are not currently suitable, while at the same time rendering unsuitable some habitat that is currently suitable. Effects along any particular drainage would depend on the amount, quality, timing, and location of water discharge, stream geomorphology, precipitation, and other factors. Salt tolerance can be expected, to some degree, due to the alkaline soils associated with some habitat types of the species. Habitats and populations of this species may be affected by increased erosion or sediment deposition. Some streams would be greatly affected by discharge, while others would be affected only minimally or not at all. The exact nature of water discharge-related impacts would need to be addressed during Application for Permit to Drill (APD) review, when water discharge points have been chosen, and Ute ladies'-tresses surveys completed. It is possible that occurrences of this species downstream of discharge points would not be identified by surveys, particularly if no facilities are planned in the vicinity. These occurrences could be affected by changes in local hydrology resulting from upstream discharge of produced water. The extent of these impacts cannot be quantified at present, due to the lack of surveys for this species, the lack of precise discharge point locations and the lack of knowledge of the interactions between upstream discharges, existing flows, and local conditions in potential habitats for the Ute ladies'-tresses orchid.

Both direct and indirect disturbances to populations and habitats of the Ute ladies'-tresses orchid have the potential to increase the distribution and extent of noxious weeds, such as Canada thistle, that occur in similar habitats. Dense populations of noxious weeds reduce the amount of habitat available to the orchid and could result in the exclusion of the orchid.

Mitigation

- At the discretion of the surface owner, native species would be planted to re-establish special habitats.
- Potentially suitable habitats for Ute ladies'-tresses (i.e., wetlands and associated wet meadow areas) would be surveyed according to USFWS standards (USFWS 1992) if ground-disturbing activities are anticipated within these habitat types. Roads and facility locations would be adjusted to remove any potential for impacts.
- All equipment and vehicles must be washed before moving to another location to minimize the spread of noxious weed seeds.

Determination

Implementation of the Preferred Alternative **is likely to adversely affect, but not likely to jeopardize the continued existence of** the Ute ladies'-tresses orchid or its habitat. The determination is based on the evaluation of the potential adverse effects of the Preferred Alternative on the Ute ladies'-tresses orchid and includes implementation of the mitigation measures presented in this BA.

Cumulative Effects

Implementation of the Preferred Alternative would contribute to cumulative adverse effects to the threatened, endangered, and proposed species in the Project Area. Cumulative short- and long-term disturbances to these species are many and stem from several sources. Included in the evaluated cumulative effects are the direct effects of oil and gas (CBM and non-CBM) extraction related to the Preferred Alternative, as well as development of new oil and gas wells on adjacent lands. Oil and gas development would occur on a mix of federal, state, private, and on split estate lands. Additional oil and gas extraction (CBM and non-CBM) may occur at a later date within the Project Area beyond the level of development currently considered. Activities other than oil and gas extraction contributing to cumulative effects in the Project Area include: coal mining; uranium mining; sand, gravel, and scoria mining; ranching; agriculture; road and railroad construction; and rural and urban housing development.

On-going coal mining activities within the PRB disturb surface lands at a rate of approximately 2,000 acres per year, with 1,850 acres successfully reclaimed on an annual basis. At present, coal mining has disturbed approximately 54,000 acres, while 20,200 acres have been successfully reclaimed. An unknown portion of disturbed coal mining area is currently undergoing reclamation, but has not yet met success standards. A similar level of both new disturbance and reclamation success is expected in the near future.

Uranium mining within the PRB has resulted in the disturbance of approximately 4,400 acres, while sand, gravel, and scoria mining has resulted in the disturbance of approximately 1,200 acres. Agriculture has resulted in impacts to approximately

113,643 acres of lands formally occupied by native vegetation that that served as suitable habitat for wildlife.

Urban development within the PRB has resulted in the loss of approximately 4,362 acres of native vegetation as suitable wildlife habitat. A minor amount of new rural and urban development is expected in the foreseeable future, but no estimate of the amount or types of vegetation disturbance has yet been made. Cumulative impacts to vegetation from roads, railroads, and rural development are anticipated but have not been estimated.

The total acreage directly affected by CBM development related to the Preferred Alternative would not be disturbed simultaneously, because Project development would be distributed over the life of the Project. Some of the disturbed acreage would be reclaimed or would be in the process of being reclaimed when new disturbances are initiated. CBM development is expected to occur at a rate faster than abandonment and reclamation of wells. In the near future, the amount of disturbed habitats would increase, although the anticipated life of CBM wells (12-20 years) indicates that reclamation would eventually overtake new well development, resulting in a net decrease in disturbed vegetation for the long-term.

Cumulative effects would also occur to vegetation resources as a result of indirect impacts. One indirect impact to native vegetation is the potential import and spread of noxious weeds around Project facilities and along roadways. Noxious weeds have the ability to displace native vegetation and hinder reclamation efforts, thus reducing the habitat quality and lengthening the duration of the adverse effect. If weed mitigation and preventative procedures were applied to all construction and reclamation practices, the impact of noxious weeds would be minimized. In areas reclaimed after CBM development elsewhere, the reclaimed areas often differ substantially from undisturbed areas in terms of vegetation cover. Reclaimed areas may not serve ecosystem functions presently served by undisturbed vegetation communities and habitats, particularly in the short-term, when species composition, shrub cover, and other environmental factors are likely to be different. Establishment of noxious weeds and alternation of vegetation along drainages and reclaimed areas has the potential to alter wildlife habitat composition and distribution. As a result, shifts in habitat composition or distribution may affect the four species discussed in this BA.

Unavoidable adverse effects to the four threatened, endangered, and proposed species from the Preferred Alternative would be some direct loss of habitat, indirect loss of habitat due to human and equipment disturbance, habitat fragmentation, displacement of bald eagle prey species and the resultant change in bald eagle foraging, and mortality caused by equipment activities, motor vehicle collisions, power line collisions, and power line electrocution. As a result, individuals may be reduced in number but not enough to significantly impact the populations.

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Appendix I
Outline of Treatment Plan for Cultural Resources

Powder River Basin Oil and Gas EIS
Outline of Treatment Plan for Cultural Resources

This outlines basic standards and procedures to expedite planning and permitting. Justifications, standards and procedures are discussed in greater detail in the Plan for Cultural Resources.

- Inventory and Evaluation Standards
- Findings of Effect
- Management of Historic Properties
- Monitoring
- Employee and Contractor Involvement
- Unanticipated Discoveries and Human Remains
- Curation
- Dispute Resolution
- Amendments

Plan for Cultural Resources

- Goal and Objectives

Brief discussion of statutes and regulations requiring management of historic properties, management goals and objectives, and implementation of objectives

  - Authority
  - Goals
  - Objectives
  - Implementation

- Inventory and Planning

A discussion of how identification of cultural resources fits into the planning process and basic standards for the Project Area.

  - Defining the APE
  - Authority
  - Levels of Inventory
  - Reporting
  - Integration with Planning

- Property Types

Known and anticipated prehistoric and historic resource types in the Project Area

  - Prehistoric
  - Historic

- Evaluation

Clarification of the need for evaluation and general criteria for the identified property types.

  - Planning Requirements
  - Criteria for Evaluation

- Native American Consultation

The status of consultation in the Project Area at the time of the EIS and a discussion of procedures and protocols for the consideration of Native American concerns that may affect planning

- Management of Historic Properties

Discussion of anticipated and typical management strategies for various property types

  - Common Situations
  - Types of Effects
  - Access Regulation
  - Avoidance and Protection
  - Visual, Auditory, and Atmospheric Effects
  - Stability and Erosion
  - Landscape Management
  - Minimizing Adverse Effects
  - Mitigation

- Monitoring

Rationale and guidelines for monitoring compliance with stipulations and mitigation measures, and for assessing the effectiveness of those stipulations and mitigation measures

  - Purpose and Need
  - Monitoring Compliance
  - Monitoring Effectiveness
  - Monitoring Operations

- Discoveries and Inadvertent Effects

Standard stipulations and procedures for unanticipated discoveries, including human remains, and inadvertent impacts to known historic properties.

- Historic Contexts

Brief discussions of the historic contexts within which historic properties are evaluated

  - Prehistoric Periods
    - Paleoindian
    - Early Archaic
    - Middle Archaic
    - Late Prehistoric
    - Protohistoric
  - Historic Themes
    - Exploration and Fur Trade
    - Emigration
    - Military
    - Ranching, Farming, and Homesteading
    - Mining
    - Railroads