

MINERALS APPENDIX

Introduction

The *Minerals Appendix* contains a discussion of the CBM emphasis area's geology and stratigraphy, the Reasonable Foreseeable Development Scenario (RFD), and a description of the cumulative effects projects evaluated for this study.

Coal Bed Methane

Coalbed methane (CBM) is a product of the transformation of plant material into coal; large volumes of methane are produced as coal matures due to heat of burial. This thermogenic methane-rich gas is adsorbed and stored on internal surfaces within the coal. The pressure of fluids (mostly formation water) in the coal reservoir keeps the methane adsorbed onto the coal and minimizes the formation of fractures in the coal. When meteoric waters encounter the methane-rich coals, bacteria act upon the coals and their entrained fluids to produce more methane (PTTC 2000). This biogenic methane-rich gas is also adsorbed onto the coal surfaces. Thermogenic methane can be differentiated from biogenic methane by the ratios of their stable carbon isotopes, that is, the ratio of C¹² to C¹³ compared to a standard such as the PeeDee belemnite, a fossil marine mollusk (Coplen 1994). Methane with relative enrichment of C¹² is indicative of low-temperature, biogenic gas; the heavier C¹³ isotope is enriched in the high-temperature gas. Both forms of methane have been reported in CBM reservoirs (USGS 2000).

Coalbed gas reservoirs, because of their fine-grained nature, are able to hold six or seven times as much gas as conventional sand or carbonate reservoirs (USGS 2000), a factor that has made CBM a desirable resource. Methane produced from coal beds is an unconventional hydrocarbon resource that has undergone rapid nationwide development in the past fifteen years (Nelson 2000). The Powder River Basin is estimated to contain approximately 39 trillion cubic feet [TCF] TCF (Hill et al. 2000)—approximately 10 percent of which is in Montana. The methane is contained in the Tertiary-age Fort Union Formation coal beds. Under reservoir conditions, the coal is under virgin hydrostatic pressure, which confines the coal and holds in the methane. Pumping water from the coal reduces hydrostatic pressure in the aquifer. The methane releases from the coal and moves through the natural cleat of the coal toward producing boreholes. As the water is pumped off the coal bed aquifer, pressure

in the coal is decreased, the coal fractures into a series of fine fractures known as cleat, and the methane is able to move through the fractures and any horizontal bedding planes toward producing boreholes.

CBM is currently produced only at the CX Ranch field in Big Horn County on the western edge of the Powder River Basin. During the first year of production, 1999, the field produced 204,433 million cubic feet (MCF) of natural gas. The subsequent year, 2000, the field produced 3.49 billion cubic feet (BCF) of natural gas (MBOGC 2001b). The operator expects to produce approximately twice as much gas during 2001 (Williams 2001).

CBM is prospective in the other RMP areas that are the subject of this EIS. In the Billings RMP area, the Bull Mountains Basin contains Fort Union Formation coals that may be similar to the Powder River Basin coals. The Big Horn Basin, Red Lodge area, and Crazy Mountains Basin also contain Fort Union Formation coals. Gallatin, Park, and Carbon counties contain unknown quantities of Cretaceous coals that may contain CBM. Blaine County contains Cretaceous coals associated with the Eagle Formation. These coals could also produce significant amounts of CBM.

CBM resources are subject to the same drainage issues as conventional oil and gas resource issues described above. It is assumed that a single CBM well will drain those resources in a single coal seam across 80 acres. Site-specific CBM drainage may, however, be different and needs to be monitored to protect federal and Indian lands.

Additional Counties

Park and Gallatin Counties do not produce oil or gas at the present time. Thick Tertiary sediments are present in the Crazy Mountains Basin, which is on strike with the Big Horn and Red Lodge Basins. These sediments may be prospective in the future as oil and gas activity progresses.

Blaine County is located in the center of the northern edge of the State; it includes the geologic features the Bears Paw Mountains and the adjacent Hogeland Basin. In 2000, 26 fields produced shallow, dry natural gas in Blaine County with little crude oil. Several small fields and the large Tiger Ridge field produce natural gas from the Eagle, Niobrara, and Second White Specks, all of which are shallow formations of the Late Cretaceous. Continued exploration and production drilling is expected to further increase production levels.

Production statistics, summarized in Figure GMA-4 (ALL 2001b), show a doubling of natural gas production in the past 15 years. Blaine County produced more than 21 percent of Montana’s total gas for 1999 and it shows increases since then. Oil production has varied within narrow limits at relatively low levels.

Conventional Oil and Gas Production Trends

Montana’s oil production for 1999 (the latest year for complete production statistics) was down by approximately 8 percent (from 16.61 million barrels of oil [mmbbo] to 15.27 mmbbo) from 1998. The oil production trend has been in place since 1984 when oil production began to decrease because of commodity prices. However, natural gas production increased by approximately 3 percent (59.7 billions cubic feet [BCF] to 61.6 BCF) over 1998. Natural gas production,

because of recent discoveries, has not shown the decline of oil production, but instead has shown gradual increases in yearly production (MBOGC 2000). Drilling within the State for conventional oil and gas increased by approximately 55 percent from 1998 to 1999. Geophysical activity continued in 1999 with four seismic contractors permitted 20 projects—a significant number of which involved 3-D shooting (MBOGC 2000). Horizontal well completions continue to be popular in the State; in 1999, MBOGC approval was given for seven new horizontal wells and two horizontal re-completions of existing vertical wells. In 1999, BLM approved four new horizontal wells and one horizontal recompletion. In 2000, BLM approved 13 new horizontal wells and 16 recompletions.

Figures MIN-1 through MIN-3 were constructed using the latest data available from the production files of the MBOGC. The only area of interest that shows production increases is Blaine County, which is one of the State’s most important natural gas regions.

Figure MIN-1

Powder River RMP Area Production Trends

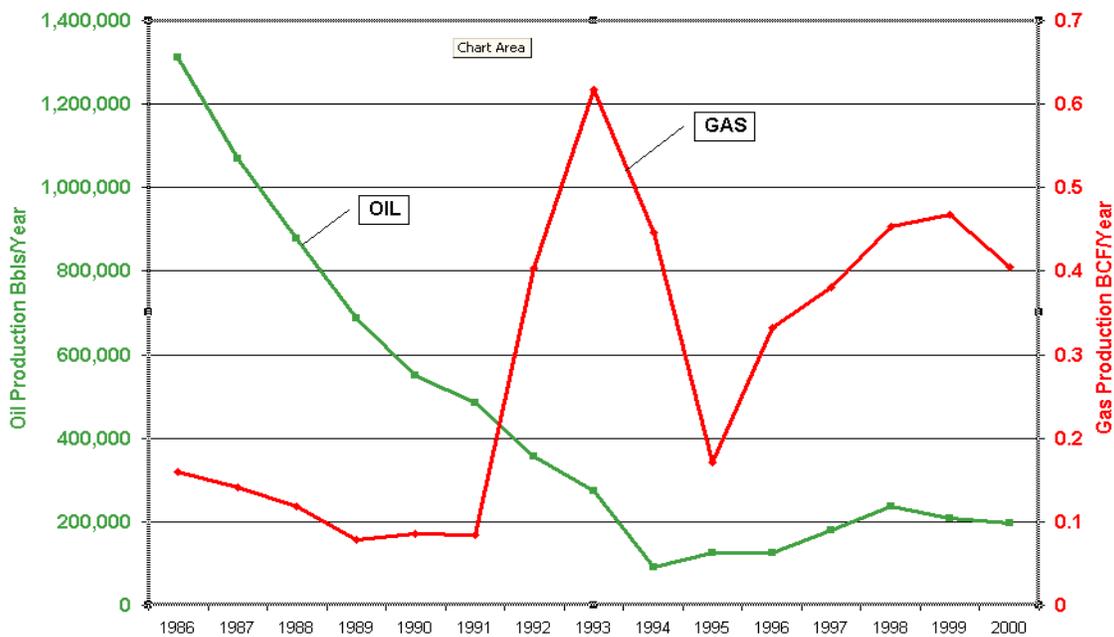


Figure MIN-2

Billings RMP Area Production Trends

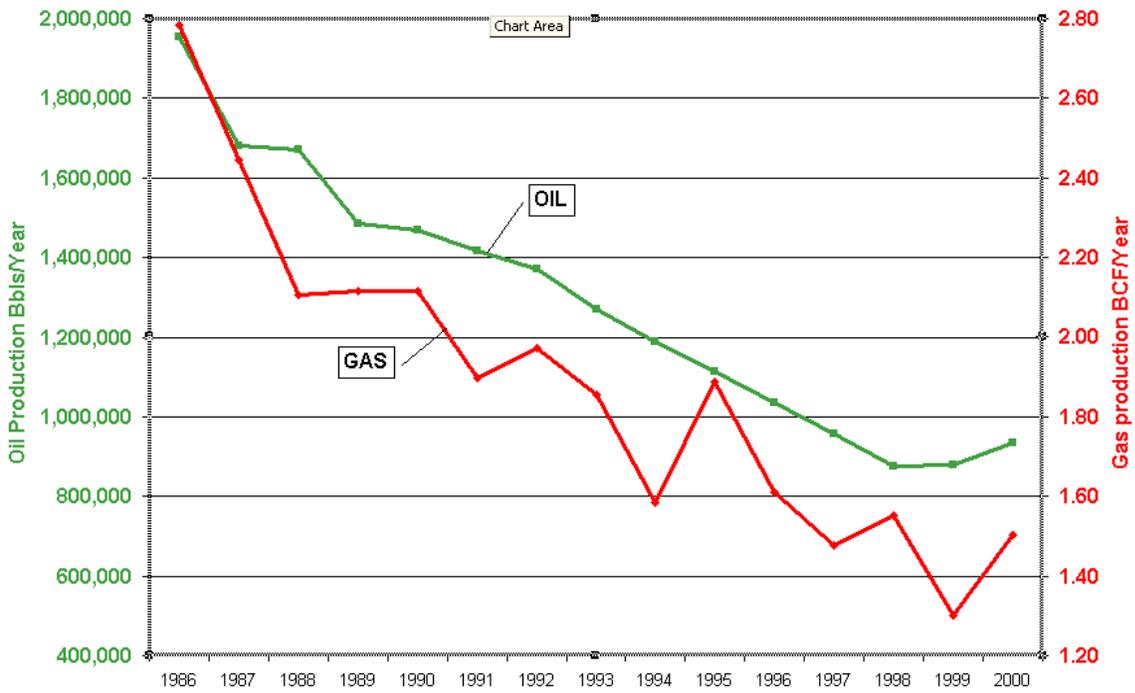
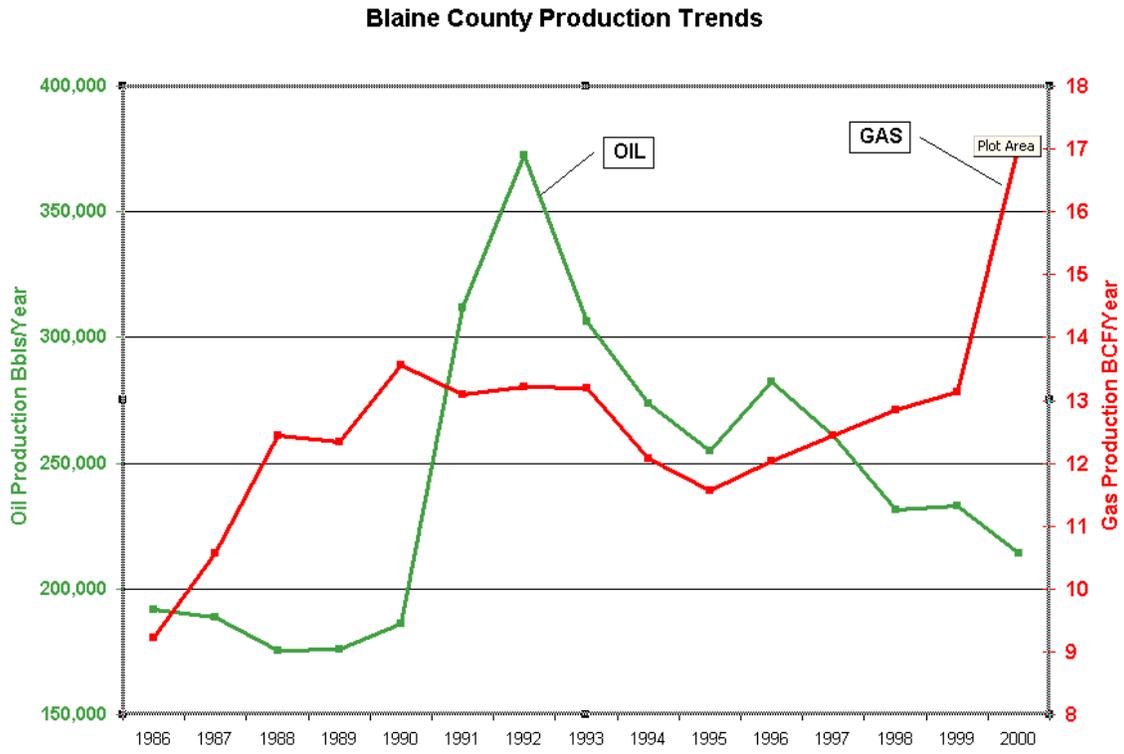


Figure MIN-3



REASONABLE FORESEEABLE DEVELOPMENT SCENARIO

Introduction

The Reasonably Foreseeable Development (RFD) scenario for the EIS predicts oil and gas development in five areas: the Powder River RMP area, the Billings RMP area, and in Blaine, Gallatin, and Park counties of Montana. The RFD projects drilling of both conventional and CBM wells, numbers of pipelines, and compressors needed for production of CBM wells. The RFD carries forward the production for conventional wells covered in the *Oil and Gas Amendment* for the two RMP areas.

For the purpose of the analysis, the RFD will address potential CBM development of the Crow and Northern Cheyenne reservations and the Ashland Ranger District of the US Forest Service. This is in no way to say the BLM and the State of Montana are making decisions about the reservations or the Forest Service. The predictions are made so that all potential cumulative impacts are analyzed.

Predictions for exploration and development of coal bed methane (CBM) and conventional oil and gas in the RFD are based on: the BLM RMPs for the areas; coal information from the USGS; other referenced sources; expressions of interest; and projections from the oil and gas industry (Oct 18, 2000, CBM Coordination meeting).

Coal Bed Methane

To project CBM exploration and development, the areal extent of certain coals and the rank of coals in the study areas were considered. Areas of sub-bituminous to bituminous were considered as the most likely to be explored and developed in Montana, although exploration and development has occurred mainly in sub-bituminous coal in the Wyoming portion of the Powder River Basin (Basin). The USGS produced a map showing the areas of coal, by rank, for the United States (see Map MIN-1). This information indicates sub-bituminous and bituminous coals in many parts of the study area. Powder River, Rosebud, Custer, and Big Horn counties contain the northern part of the Basin, which extends north from Wyoming. Blaine and Musselshell counties have mostly sub-bituminous coal. Carbon County has an extension of the Big Horn Basin coal, which is ranked as bituminous coal. Gallatin and Park counties have scattered areas of bituminous to sub-bituminous coals. The projection of methane gas estimated to be produced from coal beds in Montana range from a low of 1 TCF (Crockett 2001-PRB est -

RMG, Casper) to a high of 17.7 TCF (estimated based on figures from Nelson 2000). This and other information for Montana is used to predict where CBM exploration is most likely to occur in study area. The RFD predicts the number of CBM wells that would be drilled and completed during the next 20 years.

Conventional Oil and Gas

Historical drilling activity and oil and gas price projections were used to project conventional oil and gas development for the RMPs. The RFD scenario describes a somewhat different level of activity than the scenario found in the BLM *Final Oil and Gas RMP/EIS Amendment* issued in 1992. This is primarily because of the use of a different span for historical drilling activity. The 1992 amendment used the span from 1973 to 1988 in forecasting future activity. This document uses a total period of 80 years in forecasting future development. This led to a slight difference in the level of drilling activity forecast.

Approximately 200 to 800 wells would be drilled in the Powder River RMP area. Approximately 250 to 975 wells would be drilled in the Billings RMP area. A total of 450 to 1,775 wells could be drilled in 20 years.

A total of 37,233 oil and gas wells have been drilled in Montana (Petroleum Information Corp 2001). In the study area (two RMP areas and three counties) 9,510 wells have been drilled. This is an average of approximately 450 wells drilled per year statewide. From 1995 through 1999 the conventional wells drilled in the state ranged from 209 to 482 (MBOGC Report 1999).

Coal Areas of Montana

The USGS produced a map showing the areas of coal in Montana. The RMPs also include maps that indicate areas of coal occurrence. The coal volume for each county was used to determine the number of potential CBM wells that could be drilled. The values for volumes of coal in each county came from the BLM RMPs for the area, study papers, or estimates based on coal thickness, and acres of identified coal fields in the county. The coal volumes are based upon all coal beds, not just ones that are likely to be developed because of their thickness, depth, and extent. In some cases the volumes are estimates rather than exact figures. The coal volume in tons was multiplied by a range of estimates of recoverable methane per ton (USGS Professional Report 1625, and Flores, et al. 2001) and

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then divided by an estimate of the gas production per well from CMS Energy's, October 18, 2000, presentation in Miles City (CMS 2000). The amount of gas to be produced per well (0.3 BCF per well) would be used as the lowest economic limit. This resulted in a range of wells that may be drilled over the next 20 years. The coal volume data came mostly from the Powder River and the Billings RMPs, supplemented by information from USGS and Gas Technology Institute (GTI) papers (Nelson 2000).

Coal resources in the Powder River Basin are in the Paleocene Fort Union Formation. About half of the estimated 30 trillion cubic feet of in-place CBM resource is recoverable. Less than half the coal resources occur in the Montana portion of the Basin. These sub-bituminous coals have low concentrations of gas per unit volume (Choate et al. 1984). However, because of the immense total coal thickness that reaches 170 feet in some areas in Montana (Campen 1990), vast quantities of CBM may be present.

Two formations in the Big Horn Basin contain coal. The Red Lodge-Bearcreek deposit is in the Paleocene Fort Union Formation. The coals are classed as sub-bituminous. Nine coal beds have an average total thickness of approximately 45 feet (Darrow, 1954). The Bridger Coal Field is in the upper Cretaceous Eagle Formation. The coal is bituminous in rank. Three coal beds totaling 6 feet are known in this deposit (Campen 1990). The extent of the coals is not known, although the coal may be a source of methane for certain Cretaceous sands (Judith River, Eagle) in the Dry Creek field, which is 5 to 10 miles southwest of Bridger, Montana.

Gas Well Spacing

The Montana Board of Oil and Gas Conservation (MBOGC) establishes the spacing of gas wells. Spacing for wildcat wells is 640 acres per well for each producing formation. MBOGC has the authority to change the well spacing to provide for maximum efficiency and recovery of gas reserves. Well spacing is usually changed after MBOGC has reviewed geologic, engineering and economic data provided by lease operators. The MBOGC then establishes the boundaries for a producing gas field. The planning area includes only one CBM field and numerous conventional gas fields. When a field is discovered, the exploration company would appear before MBOGC to request permanent spacing for the production. Based upon current CBM well spacing in Wyoming and Montana, spacing would probably range from one well per 80 acres to one well per 40 acres for CBM production. The spacing in the CX field is four wells per coal bed

per 160 acres. Because of the number of coals in the CX field, this could result in as many as 16 wells per 160 acres or potentially 64 wells per 640 acres. The well density has not reached this level at present and because of the faulting, splitting, and joining of the coals and absence of the coals in some sections this is not likely to happen. CBM is produced from three coal seams in the CX field. Each well produces methane from a single coal seam; however, in the future, wells may be designed to produce from multiple coal seams. This would decrease the number of wells required for production in the CX field.

Oil Well Spacing

The MBOGC also sets the spacing of oil wells. The spacing for an oil well in the state of Montana is based on the depth of the well. For well depth of 0 to 6,000 feet (ft.), the statewide spacing is one well per 40 acres; for well depth of 6,001 ft. to 11,000 ft., it would be one well per 160 acres; finally, for well depth of more than 11,001 ft., it would be one well per 320 acres. MBOGC has the authority to change the well spacing to provide for maximum efficiency and recovery of gas reserves. Well spacing is usually changed after MBOGC has reviewed geologic, engineering, and economic data provided by lease operators. The MBOGC then establishes the boundaries for the producing oil field. There are numerous fields within the planning area.

Areas of Disturbance

CBM

Surface disturbance for a typical CBM well includes 0.25 acres for the well pad and 0.75 acres for the access road for a total of 1 acre disturbed for drilling operations. Part of the well pad area is reclaimed for production operations, and the entire area of disturbance is reclaimed when the well is plugged and abandoned.

Conventional Oil & Gas Wells

Surface disturbance for a typical conventional shallow gas well (less than 2,000 feet deep) includes 0.5 acres for the well pad and a 2-mile bladed road for a total of 1 acre disturbed for drilling operations. Part of the well pad area is reclaimed for production operations, and the entire area of disturbance is reclaimed when the well is plugged and abandoned.

Surface disturbance for a typical shallow oil well (less than 5,000 feet deep) includes 2 acres for the well pad and 1.5 acres for a 1-mile bladed road for a total of

3.5 acres disturbed for drilling operations. Surface disturbance for a typical deep oil well (from 5,000 to 12,000 feet deep) includes 4 acres for the well pad and 1.5 acres for a 1-mile bladed road, for a total of 5.5 acres disturbed for drilling operations. Part of the well pad area is reclaimed for production operations, and the entire area of disturbance is reclaimed when the well is plugged and abandoned.

General Assumptions

- All numbers were rounded to the nearest significant number.
- The number of BLM-administered wells will be based on the BLM-administered oil and gas acreage in the county.
- 80 percent of Big Horn County is in the Billings RMP area.

Occurrence Potential

The text in this section discusses the oil and gas occurrence potential for each county.

Big Horn County

CBM

The southeastern and eastern portion of the county contains approximately 28,700 million tons of sub-bituminous coal (Powder River RMP). The area includes one CBM field (CX Ranch).

Conventional

The county has nine oil and gas fields, including four oil fields, one conventional gas field at Toluca, and an inactive gas field at Hardin. The oil and gas fields in Big Horn County produce from the Ft. Union, Shannon, Amsden, Madison, and Tensleep formations. Production has occurred from the Frontier formation (Hardin Gas field). A total of 844 wells have been drilled to date, of which 172 have been drilled on the Crow Reservation. One gas sales line runs through the north portion of Big Horn County, but none on the Crow Reservation.

Blaine County

CBM

There are areas of sub-bituminous coal throughout much of Blaine County. The estimated coal volume of

40 million tons for the county came from the USGS-MBMG report of 1963. The county does not have any CBM production.

Conventional

Blaine County has 26 oil and gas fields, with 2,123 (Petroleum Information 2001) wells drilled to date. There are 14 gas producing fields and five producing oil fields. Production occurs from the Judith River, Eagle, Bowdoin, Phillips, and Piper formations. Pipelines and compressor stations are in place in the existing fields.

Carbon County

CBM

Carbon County includes the Silvertip, Bear Creek, Bridger and the Joliet-Fromberg coal fields. The coal ranges from Ft Union to Eagle coal and is of sub-bituminous to bituminous nature. The volume of coal is estimated at approximately 760 million tons. The estimate of the gas content of the coals for sub-bituminous will be the same as the coals in the Powder River basin. The estimate for the bituminous coals for the RFD will be from 200 to 450 standard cubic feet (SCF)/ton.

Conventional

Carbon County includes 18 identified gas and oil fields. The wells produce from the Frontier, Phosporia-Tensleep, Judith River, Claggett, Eagle, and Greybull formations. Seven hundred thirty-five wells have been drilled in this county (Dwights well data).

Carter County

CBM

Bituminous or sub-bituminous coals have not been identified in Carter County. The only coal is of lignite rank, which is not considered to have a potential to produce methane in economic quantities.

Conventional

Carter County includes the Bell Creek, Southeast Bell Creek, and Repeat oil fields, as well as two gas fields near Hammond. They produce from the Muddy and Red River formations. There have been 434 wells drilled to date in this county.

Custer County

CBM

The Powder River RMP estimated 1.3 billion tons of sub-bituminous coal is located within Custer County. The coal occurs in the southern and southwestern portion of the county.

Conventional

The Liscom Creek and Pumpkin Creek fields are located in Custer County. Gas in these fields is produced from the Shannon formation. These fields have a small sales line in place.

Gallatin County

CBM

Very little coal is identified in Gallatin county; some has been identified in the eastern edge or southern part of the county. Coal mining has also historically occurred in Gallatin County (Roberts 1966, and Calvert 1912a and 1912b). The volume is estimated to be approximately 50 million tons of sub-bituminous to bituminous coal.

Conventional

There are no oil or gas fields in Gallatin County, and only 22 conventional wells have been drilled to date.

Golden Valley County

CBM

Although there is some coal shown for Golden Valley County, there are no volumes estimated. The coal that is shown is of the sub-bituminous rank.

Conventional

Two oil and two gas fields have been identified in this county, and 124 wells have been drilled to date. The wells have produced from the Cat Creek, Lakota, Niobrara, Frontier, Heath, and Tyler formations.

Musselshell County

CBM

The RMP estimated 646.6 million tons of sub-bituminous coal in the county. These Ft. Union coals are located in the Bull Mountain Basin.

Conventional

Thirty-five fields have been identified in Musselshell County, and 1,415 wells have been drilled to date. The wells have produced from the Amsden, Cat Creek, Morrison, Heath, and Tyler formations.

Park County

CBM

Park County has scattered areas of an estimated 100 million tons of sub-bituminous and bituminous coal. Coal mining has also historically occurred in Park County (Roberts 1966, and Calvert 1912a and 1912b). A gas transmission line runs through the center of the county.

Conventional

There are no identified oil and gas fields in Park County. There have been 32 wells drilled to date in the county.

Powder River County

CBM

Based on information from the RMP, there are 27 billion tons of sub-bituminous coal in the county. The coal is located mostly in the western half of the county.

Conventional

There are seven oil and gas fields in the county, including Bell Creek, which is the second-largest producing field in Montana (based on cumulative production). The Shannon and Muddy formations are productive in the county, and 1,249 wells have been drilled to date.

Rosebud County

CBM

Rosebud County contains 11.3 billion tons of sub-bituminous coal. The coal is located in the southern and eastern portion of the county.

Conventional

Rosebud County has 18 identified oil and gas fields producing from the Tyler formation, and 1,147 wells have been drilled to date.

Stillwater County

CBM

There is one identified bituminous coal field (Stillwater) in the county and it is estimated to have 475 million tons of Eagle formation coal. The coal is estimated to contain a much higher gas content per ton than the Powder River sub-bituminous coals. The county has three gas transmission lines running through the north half of the county.

Conventional

There are 11 identified oil and gas fields in the county. The producing formations are the Frontier, Eagle, Claggett, Cat Creek, Morrison, and Virgelle. There have been Three hundred sixty-seven 367 conventional wells have been drilled to date in the county.

Sweet Grass County

CBM

The coal estimates for the county are 100 million tons. In addition, there are gas transmission lines through the center and running southeast and northeast in the county.

Conventional

There is one identified field—a six-shooter dome—is in Sweet Grass County. This is the Sixshooter Dome. The productive formations in the county are the Eagle and Lakota, and . There have been 82 conventional wells have been drilled to date.

Treasure County

CBM

The RMP's coal estimates for the county from the RMP are 100 million tons. There is a gas transmission line running through the southeastern part of the county.

Conventional

There are no identified oil and gas fields in the county and no productive formations have been identified; however, 32 conventional wells have been drilled to date.

Wheatland County

CBM

No coal has been identified in Wheatland County. A gas transmission line runs through the eastern part of the county.

Conventional

One oil and gas field—Mud Creek—has been identified in the county. The Amsden formation is productive, and 60 conventional wells have been drilled to date in the county.

Yellowstone County

CBM

Five hundred ninety million tons of coal have been identified in the county. There are four gas transmission lines in the southern part of the county.

Conventional

There are six oil and gas fields identified in the county, and 425 conventional wells have been drilled to date. The productive formations that have been identified are the Mossersand, Amsden, and Dakota.

Crow Reservation

CBM

There has been 16.1 billion tons of coal identified on the Crow Reservation.

Conventional

The reservation includes the Soap Creek, Lodge Grass, Gray Blanket, and Ash Creek oil and gas fields. There have been 172 conventional wells drilled to date on the reservation. Production occurs from the Shannon, Tensleep, Amsden and Madison formations within the reservation.

Northern Cheyenne Reservation

CBM

Based upon limited data, it is estimated that 16.3 billion tons of sub-bituminous coal lie within the reservation. The coal is believed to underlie most or all of the reservation.

Conventional

The reservation does not have any known oil or gas fields. Twenty conventional wells have been drilled to date.

Ashland District, U.S. Forest Service

CBM

Tertiary Ft. Union coal is believed to underlie most or all of the Ashland Forest.

REASONABLE FORESEEABLE DEVELOPMENT— ALTERNATIVE A

CBM

A general assumption used for this alternative for CBM wells is that the number of townships of potential development in each county would be limited to areas where coal has been identified. Additionally, other assumptions were used for Alternative A for CBM wells. These include:

- CBM drilling would only be allowed where there was a need for additional data (townships where no CBM wells had been drilled by any company).
- CBM drilling would occur but there would be no production (from federal wells). That is, the permits would be for drilling and testing but no production.
- No pipelines, power-lines, or any production facilities would be installed at any of the federal CBM wells.
- There would be no discharge of produced water allowed from any of the federal CBM wells.
- For a high number, four wells per township were assumed; for the low number, one well per township was assumed.
- It was assumed that the number of townships in each county would be limited to areas where coal has been identified.

BLM-Administered

An estimated 400 acres based on 400 CBM well would be disturbed during exploratory drilling operations, (.25 acre/location and .75 acre/access road), which is the number of wells predicted to be drilled during the 20-year analysis period. The total number of acres could be reduced if more than one methane well is drilled on the well pad—as is the pattern in the CX Field.

State-Administered

Existing Management Assumptions

There will be 325 CBM wells permitted for the Redstone project area in Big Horn County. Of these, only 250 will be allowed to produce and 75 will be for

exploration only. Two hundred CBM exploration wells will be permitted for the rest of the state.

Forest Service—Administered

Currently the Custer National Forest, Ashland Ranger District, is not open for oil and gas leasing. Alternative A assumes that similar management would continue, no leases would be issued and no wells drilled.

Conventional Oil and Gas

The RFD scenario from the *Oil and Gas Amendment* contains projections for the number of wells and acres disturbed in each producing region. The disturbance for each well is based on the typical depth of wells for an area. Shallow wells generally disturb fewer acres. Tables 4.1 through 4.4 in the *Oil and Gas Amendment* (pp. 55 and 56) show totals for the planning area and each resource area. The assumptions for conventional oil and gas in this alternative are as follows:

- The unconstrained number of wells comes from the Oil and Gas Amendment RFD scenario.
- The constrained number of wells is derived from the resource analysis for wells foregone in No Surface Occupancy areas.
- The average acreage figure (total acres/total wells) for the resource area was used to estimate federal acres disturbed.
- The RFD projections have a 20-year life.
- A more detailed description of information for the assumptions is contained in the *Oil and Gas Amendment* in *Chapter 4, Social Economic Conditions* and in *Appendix C*, (BLM 1992).

BLM-Administered

The number of acres disturbed during drilling operations would be 1,342 acres based on 400 wells, which is the number of wells predicted to be drilled during the 20-year analysis period.

State of Montana

The number of acres disturbed during drilling operations would be 4,551 acres based on 891 new wells predicted for the 20-year analysis period in the

Powder River and Billings RMP areas. The conventional wells in Blaine, Park, and Gallatin counties will be based on historical drilling for those counties. The RFD for the State of Montana for conventional wells under this alternative is the same as Alternatives B, C, D, and E.

Forest Service—Administered

Currently the Custer National Forest, Ashland Ranger District, is not open for oil and gas leasing. Alternative A assumes that similar management would continue, no leases would be issued and no wells drilled.

Development Potential

The development potential for federal oil and gas in each county is described in the text that follows.

Big Horn County

CBM

Based on the review of unexplored coal areas in Big Horn County, there would be 20 to 64 exploration wells drilled on minerals under BLM jurisdiction. Approximately 16 to 44 of these wells would have production potential and 4 to 20 wells would be drilled and abandoned. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for five to 30 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Carbon County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of approximately 24 to 72 wells under this alternative. Sixteen to 48 of these wells would have the potential to be productive, and 8 to 24 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

Carbon County has potential for 10 to 45 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Carter County

CBM

There are no CBM wells projected to be drilled under this alternative in the county.

Conventional

The county has potential for 1 to 6 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Custer County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of from 20 to 64 wells under this alternative. Sixteen to 44 of these wells would have the potential to be productive, and four to 20 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Gallatin County

CBM

No CBM wells are projected to be drilled in this county on minerals under BLM jurisdiction with this alternative.

Golden Valley County

CBM

No CBM wells are projected to be drilled in this county on minerals under BLM jurisdiction with this alternative.

Conventional

The county has potential for one to six additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Musselshell County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of 10 to 40 wells under this alternative. From eight to 30 of these wells would have the potential to be productive, and two to 10 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for 20 to 90 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Park County

CBM

There are no CBM wells projected to be drilled in this county on minerals under BLM jurisdiction with this alternative.

Powder River County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of from 20 to 80 wells under this alternative. Sixteen to 60 of these wells would have the potential to be productive, and four to 20 wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Rosebud County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of 12 to 48 wells under this alternative. Eight to 32 of these wells would have the potential to be productive, and four to 16 wells will

be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for 10 to 40 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Stillwater County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of six to 24 wells under this alternative. Four to 18 of these wells would have the potential to be productive, and two to six wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for three to 12 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Sweet Grass County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of two to four wells under this alternative. Up to four of these wells would have the potential to be productive, and up to two wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to six additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Treasure County

CBM

Based on the unexplored coal areas in Treasure County, the BLM could permit the drilling of two to four wells under this alternative. Up to two of these wells would have the potential to be productive, and up to two wells

will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Wheatland County

CBM

There are no CBM wells projected to be drilled on minerals under BLM jurisdiction in the county.

Conventional

The county has potential for one to three additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

Yellowstone County

CBM

Based on the unexplored coal areas in the county, the BLM could permit the drilling of two to six wells under this alternative. Up to three of these wells would have the potential to be productive, and up to three wells will be drilled and abandoned. There would be no pipelines or production facilities for these wells. The only disturbance would be for the access road and well pad.

Conventional

The county has potential for five to 15 additional wells to be drilled on minerals under BLM jurisdiction in the next 20 years, based on historical drilling rates.

RFD Conclusion

CBM

During the life of the plan, it is estimated that the number of CBM exploration wells that may be drilled throughout the two RMP areas would range from a low of 120 wells to a high of 400 wells on BLM-administered minerals. CBM drilling would be allowed but there would be no production (from federal wells). This means the permits would be for drilling and testing but no production. There would be no pipelines or power-lines or any production facilities installed at any

of the federal CBM wells. There would be no discharge of produced water allowed from any of the federal CBM wells. This would result in approximately 400 acres of disturbance for the 400 wells (.25 acre/location and .75 acre/access road).

Powder River RMP Area

During the life of the plan, it is estimated that the number of CBM wells that may be drilled in the Powder River RMP area would range from a low of 60 wells to a high of 240 wells on BLM-administered minerals. CBM drilling would be allowed but there would be no production (from federal wells). This means the permits would be for drilling and testing but no production. There would be no pipelines or power-lines or any production facilities installed at any of the federal CBM wells. There would be no discharge of produced water allowed from any of the federal CBM wells. This would result in approximately 240 acres of disturbance for the 240 wells (.25 acre/location and .75 acre/access road).

Billings RMP Area

During the life of the plan, it is estimated that the number of CBM wells that may be drilled throughout the Billings RMP area would range from a low of 50 wells to a high of 160 wells on BLM-administered minerals. CBM drilling would be allowed but there would be no production from Federal wells. This means the permits would be for drilling and testing but no production. There would be no pipelines, power-lines, or any production facilities installed at any of the federal CBM wells. There would be no discharge of produced water allowed from any of the federal CBM wells. This would result in approximately 160 acres of disturbance for the 160 wells (.25 acre/location and .75 acre/access road).

Conventional Oil and Gas

Based on the Assumptions listed at the beginning of this section, the number of conventional oil and gas wells that could be drilled on BLM administered minerals would range from a low of 60 to a high of 260 wells. No estimates of disturbance were made for conventional wells.

Powder River RMP Area

The RFD estimates that 15 to 60 of these wells would be drilled on minerals under BLM jurisdiction. Most of

these wells would be drilled in or near the existing fields.

Billings RMP Area

The RFD estimates that 45 to 200 conventional wells are to be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in or near the existing fields.

REASONABLE FORESEEABLE DEVELOPMENT— Alternatives B, C, D, and E

Assumptions

CBM

The following assumptions were used to calculate the number of wells to be drilled, the number of in-field compressors, and the number of sales compressors required:

- The coal volume for each county and Indian reservation was taken from published sources such as the RMPs. For the RMPs, all tonnages are based on in-place coal with development potential defined as beds 5 feet thick or greater, with a 15:1 or less stripping ratio, and 500 feet of overburden or less. This gives a greater tonnage than actual limits currently used by the mining industry in the area, where stripping limits seldom exceed 200 feet of overburden or a ratio of 6:1. Tonnage calculations are based on 1,770 tons/acre-foot. For the Northern Cheyenne Reservation, the coal volumes from the USGS/U.S. Bureau of Mines reports is based on very limited data. The coal volumes for the Crow Reservation from the USGS/U.S. Bureau of Mines report were based on more extensive data. The coal tonnages in the RMPs include strippable coal, which may or may not contain producible methane in economic quantities
- The gas content per ton (26-50-74 SCF/ton) of sub-bituminous coal came from studies by the USGS (Professional Paper 1625A). The gas content for bituminous coal (200-350-450 SCF/ton) came from a paper by Campen and Gruber (1991), with the lower values estimated to give a range of wells.
- The spacing for the CBM wells would be one well per 80 acres per coal seam. The spacing was assumed after discussions with the MBOGC, as well as our understanding that Wyoming will be using this spacing (as a general rule) for CBM wells.
- Three coal seams would be developed per 80 acres. Another way of saying this is there would be three wells per pad in each 80 acres.
- One field compressor would service 24 CBM wells. The area of disturbance would be 0.5 acres.
- One sales compressor could handle 10 field compressors. The area of disturbance would be 0.5 acres.
- Each CBM well would produce .3 BCF of gas.
- Where the wells would be located in the counties or on Indian reservations was based on either the Montana Coal Occurrences from the USGS open file report OF 96-92, the RMPs, or information from the U.S. Bureau of Indian Affairs (BIA).
- No predictions were made based on distances to coal outcrops, thickness of individual coal seams, or thickness of overburden to coals. This information will be used by companies to place individual wells.
- The coal in each county did not include the coal on the Indian reservation in that specific county. The coal (from USGS and U.S. Bureau of Mines' report) on each Indian reservation resulted in a number of wells being drilled on each reservation.
- The RFD used the coal tonnages for the Indian reservations for the thickest coals (coals over 20 feet thick) because there were no coal seam thickness given for the Indian reservations.
- The RFD assumed that areas of lignite would not have economic production of methane so no wells were forecasted in those areas. We are not aware of any companies or individuals that are currently pursuing the testing of lignite for gas. With the present technology, it is unlikely that industry will be able to produce commercial amounts of gas from lignite within Montana, for the reasonably foreseeable future.
- The number of CBM producing wells in each county would be approximately 90 percent of the total CBM wells projected for that county.
- The number of CBM dry holes would be approximately 10 percent of the total CBM wells projected for that county.
- A 0.5-mile-long gathering line would be buried from the CBM well to the field compressor. The width of disturbance would be 15 feet. Multiple flowlines would be laid in the same trench from a well pad with more than one CBM well. Whenever possible, these lines would be placed in the access

road to the wells. This would result in 0.9 acres of disturbance per line.

- There would then be steel lines going from each gathering field compressor to the sales compressor. There would be 2 miles of these steel lines per field compressor. The width of disturbance would be 25 feet. This would result in 6 acres of disturbance per line.
- The lines would go from the sales compressor to the sales lines. These would be high-pressure steel lines. There would be no more than 60 miles of these high-pressure steel lines per county. The width of disturbance would be 25 feet. This would result in 3 acres of disturbance per mile of sales line.
- Half of the projected wells would be drilled in the first 10 years and the remaining wells would be drilled in the second 10 years.
- The estimates for CBM wells did not take into account variations in topography, which could have a significant impact to actual placement and numbers of wells.
- The rate of development for the first 10 years will be as indicated in the industry projection of October 18, 2000, which is shown in Figure MIN-4. The rate of abandonment is presented in Figure MIN-5.
- For purposes of planning, the State of Montana would consider other counties, such as Blaine, Gallatin, or Park, which may have coal resources.

Conventional Wells

- Wells drilled to date in each county were taken from Dwights well data.
- The number of wells drilled to date was divided by 80 years, which is an approximation of how long exploration has been ongoing.
 - This number was divided in half, then multiplied by 10 years for the low estimate of drilling for the next 10 years.
 - The number was used as is, and was multiplied by 10 years for the moderate level of drilling for the next 10 years.
 - The number was multiplied by two (doubled), then multiplied by 10 years to calculate a high level of drilling for the next 10 years.

- The wells drilled on each reservation were counted in the total for each county.
- The percentage of dry holes for each county is based on the overall historical percentage of non-producing wells (71 percent), compared to the total wells drilled per county.
- The acres disturbed per well will be the same as shown in alternative A.

Development Potential

The development potential for CBM and conventional wells for all owners is described in the text that follows.

Big Horn County

CBM

Based on the volume of coal in these areas, Big Horn County could support from 2,500 to 7,000 CBM wells. Approximately, half of these wells (1,250 to 3,500) would be drilled on minerals under BLM jurisdiction. Producing CBM wells would range from 2,200 to 6,300 wells. Most of the wells in Big Horn County would be in the southeastern portion of the county. There would be from 100 to 250 field compressors. The number of sales compressors estimated for Big Horn County would be from 10 to 25. This level of production would require gathering and sales lines to be constructed. From 1,450 to 4,200 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Two hundred to 500 miles of low-pressure steel-lines would be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines. The sales lines would probably go north toward the main WBI pipeline or south to main lines in Wyoming.

Conventional

The county has potential for 50 to 200 additional wells to be drilled in the next 20 years, based on historical drilling rates. From 3 to 15 of these wells would be drilled on minerals under BLM jurisdiction.

Blaine County

CBM

An area of identified coal exists near Chinook where it is estimated that five to 15 CBM wells could be drilled,

and of these, five to 10 wells would be producing. This would result in one field compressor and up to one sales compressor. Three to 7 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells, and would follow the roads to the field compressors. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines.

Conventional

During the past 5 years, 134 conventional wells were drilled in the county. The county produces a significant portion of the non-associated gas produced in Montana, therefore the gas infrastructure is present. The RFD estimates from 150 to 500 conventional wells to be drilled in the next 20 years. Forty to 120 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in the existing fields.

Carbon County

CBM

The coal in Carbon County varies from Tertiary Ft. Union (sub-bituminous) to the Cretaceous Eagle (bituminous). The Eagle coal can contain more gas per ton than the Ft. Union coals. Based on the coal volumes and gas content, 150 to 400 wells could be drilled. Thirty to 60 of these wells would be drilled on minerals under BLM jurisdiction. From 135 to 360 producing CBM wells mostly would be located near the identified coal fields. The number of wells would require from five to 15 field compressors and one to two sales compressors. Ninety to 240 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. Ten to 30 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. There would be no more than 60 miles of sales lines laid to the main transmission lines.

Conventional

Based on historical drilling, it is estimated that 50 to 200 wells would be drilled in the next 20 years. From 10 to 40 of these wells would be drilled on minerals under BLM jurisdiction. Some of these would be wildcat wells, but the majority would probably be associated with the existing fields.

Carter County

CBM

CBM wells are not predicted to be drilled in Carter County because of the nonexistence of bituminous or sub-bituminous coals.

Conventional

Based on historical drilling rates, we anticipate 25 to 100 wells to be drilled in the next 20 years. Ten to 40 of these wells would be drilled on minerals under BLM jurisdiction.

Custer County

CBM

Based on the estimated quantity of coal, 100 to 300 wells will need to be drilled; of these, 90 to 270 would be producing wells. The CBM development would occur in the southwestern corner of the county. Twenty to 70 of these wells would be drilled on minerals under BLM jurisdiction. This many wells would require from five to 10 field compressors and one to two sales compressors. Additional pipelines would have to be built. Sixty to 180 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Ten to 20 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, we estimate from 15 to 60 wells will be drilled in the next 20 years. Five to 15 of these wells would need to be drilled on minerals under BLM jurisdiction.

Gallatin County

CBM

Based on the estimates of coal volume, five to 15 wells will need to be drilled; of these, five to 10 would be producing wells. This would require one in-field compressor and may require one sales compressor depending on where the wells are located in the county. There is one gas sales line going through the north part of the county. Three to 7 miles of plastic, low-pressure gathering lines would be needed. These lines would be

laid in the travel routes to the wells and would follow the roads to the field compressors. Additionally, 1 to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling activity, it is anticipated that one to five wells would need to be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Golden Valley County

CBM

No CBM wells are anticipated to be drilled in Golden Valley County.

Conventional

Based on historical drilling activity, it is anticipated that 10 to 30 wells would be drilled in the county over the next 20 years. Most of these will probably be near the existing fields. One or two of these wells would be drilled on minerals under BLM jurisdiction.

Musselshell County

CBM

Based on the estimates of coal in the county, it is projected that 60 to 150 wells would be drilled, and of these, there would be from 50 to 140 producing wells. Five to 20 of these wells would be drilled on minerals under BLM jurisdiction. These wells would require from two to five in-field compressors and one sales compressor. There are no gas sales lines running through the county. Thirty to 100 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Five to 10 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines.

Conventional

It is estimated that 100 to 350 wells will be drilled in the county in the next 20 years. Ten to 40 of these wells would be drilled on minerals under BLM jurisdiction.

Park County

CBM

It is estimated that 10 to 25 CBM wells would be drilled in Park County, and of these, there would be 10 to 20 producing wells. These would require one field compressor and no sales compressor. There also would be from 7 to 17 miles of plastic, low-pressure gathering lines needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressor. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. There is a compressor station currently located in the county, so it is assumed that the gas would be compressed to sales pressure.

Conventional

Based on historical activity, an estimated one to 10 wells will be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Powder River County

CBM

Based on the coals present in Powder River County, it is estimated that 2,300 to 6,700 CBM wells could be drilled. From 1,150 to 3,350 of these wells would be drilled on minerals under BLM jurisdiction. There would be 2,070 to 6,030 producing CBM wells, which would require 100 to 250 field compressors, and 10 to 25 sales compressors. There is a transmission line in the southeastern part of the county but more pipelines would have to be built to gather and transport the potential gas that could be produced from this many wells. From 1,380 to 4,000 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Two hundred to 500 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. There would be no more than 60 miles of sales lines laid to the main transmission lines.

Conventional

Based on historical drilling rates, it is anticipated that 80 to 300 conventional wells would need to be drilled in the county over the next 20 years. Thirty to 100 of these wells would be drilled on minerals under BLM jurisdiction.

Rosebud County

CBM

Based on the coal estimates for Rosebud County, the RFD projects 1,000 to 2,800 CBM wells will be drilled. From 500 to 1,400 of these wells would be drilled on minerals under BLM jurisdiction. There would be from 900 to 2,500 producing CBM wells, which would require approximately 40 to 100 field compressors and from five to 10 sales compressors. From 600 to 1650 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Eighty to 200 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors, and there would be no more than 60 miles of sales lines laid to the main transmission lines. There is one gas sales line that runs through the county south of Forsyth. The CBM development would occur in the southern and eastern half of the county.

Conventional

Based on historical drilling rates in the county, the RFD projects 50 to 300 wells to be drilled over the next 20 years. Five to 50 of these wells would be drilled on minerals under BLM jurisdiction.

Stillwater County

CBM

The RFD projects 300 to 700 CBM wells to be drilled in the county. Fifteen to 35 of these wells would be drilled on minerals under BLM jurisdiction. These would most likely be drilled in the vicinity of the existing coal field. From 270 to 630 would be producing CBM wells. This would require 10 to 25 field compressors and one to three sales compressors. One hundred and eighty to 420 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Twenty to 50 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 30 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, the RFD projects 25 to 100 conventional wells will be drilled in the next 20 years. Two to 5 of these wells would be drilled on minerals under BLM jurisdiction.

Sweet Grass County

CBM

Based on the estimated coal volume in Sweet Grass County, the RFD projects that 10 to 25 CBM wells could be drilled. One to 2 of these wells would be drilled on minerals under BLM jurisdiction. There would be eight to 25 producing CBM wells, which would require 1 or 2 in-field compressors and 1 sales compressor. Five to 15 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and follow the roads to the field compressors. Additionally, 1 to 3 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 10 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, the RFD projects that five to 20 conventional wells will be drilled in the next 20 years. Up to 1 of these wells would be drilled on minerals under BLM jurisdiction.

Treasure County

CBM

Based on the estimated coal volume in this county, the RFD projects that 10 to 25 CBM wells could be drilled. One to 2 of these wells would be drilled on minerals under BLM jurisdiction. There would be eight to 22 producing CBM wells, which would require 1 to 2 in-field compressors and 1 sales compressor. Five to 15 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 10 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling rates, the RFD projects one to 10 conventional wells will be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Wheatland County

CBM

No CBM wells are projected to be drilled in Wheatland County.

Conventional

Based on historical drilling rates, the RFD projects five to 15 conventional wells will be drilled in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Yellowstone County

CBM

Based on the identified coal, there could be from 50 to 150 CBM wells drilled in the next 20 years. One to 10 of these wells would be drilled on minerals under BLM jurisdiction. There would be 40 to 140 producing CBM wells in the county, which would require from two to five field compressors and one sales compressor. Twenty five to 90 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. Five to 10 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 10 miles of sales lines would be laid to the main transmission lines.

Conventional

Based on historical drilling in the county, there could be from 25 to 100 wells drilled in the county in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Crow Reservation

CBM

Based on the identified coal resources within the reservation, 1,400 to 4,000 CBM wells could be drilled; of these, 1,300 to 3,600 would be producing wells. The wells would probably be located in the eastern portion of the Crow Reservation. This would require from 50 to 150 field compressors and from five to 15 sales compressors. Eight hundred to 2,400 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. One hundred to 300 miles of low-pressure steel lines would

be laid from the field compressors to the sales compressors. No more than 60 miles of sales lines would be laid to the main transmission lines. This would result in 7,000 to 19,000 acres of disturbance.

Conventional

Based on historical drilling rates, 10 to 50 conventional wells could be drilled in the next 20 years.

Northern Cheyenne Reservation

CBM

Based on coal resources, 1,400 to 4,000 CBM wells could be drilled on the reservation; of these, there would be 1,300 to 3,600 producing wells. This would require 50 to 150 field compressors, and from five to 15 sales compressors. Eight hundred to 2,400 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From 100 to 300 miles of low-pressure steellines would be laid from the field compressors to the sales compressors. There would be no more than 60 miles of sales lines laid to the main transmission lines. This would result in 7,000 to 19,000 acres of disturbance.

Conventional

Based on historical drilling rates, one to five conventional wells could be drilled on the reservation in the next 20 years.

Ashland District, U.S. Forest Service

CBM

Coal resources are primarily concentrated in the southern portion of the district. Otter Creek and the Tongue River drainages have eroded or exposed many of the coal zones. Based on the coal resources, the RFD projects that approximately 200 wells may be drilled over 20 years. This would result in approximately 400 acres of disturbance.

RFD Conclusion

CBM

During the life of the plan, it is estimated that the number of CBM wells that may be drilled throughout

the five study areas would range from a low of 10,000 to a high of 26,000—of which 2,975 to 8,450 would be drilled on BLM-administered minerals. This is regardless of mineral ownership, and includes the Crow and Northern Cheyenne Indian Reservations. There would be from 8,500 to 24,000 producing CBM wells, of which 2,500 to 7,500 would be BLM administered. For a graphical presentation of these predictions, refer to Map 4-1 in Chapter 4 of this EIS. Table MIN-1 at the end of this section presents the RFD Expanded Development Scenario in numerical form.

These wells would require 350 to 1,000 field compressors, and 35 to 100 sales compressors. From 5,500 to 16,000 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. Seven hundred to 2,000 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors, and approximately 600 miles of sales lines would be laid to the main transmission lines. This would result in 36,500 to 116,500 acres of disturbance. The total acres of disturbance include the Crow Reservation, the Northern Cheyenne Reservation, and any disturbance in the Ashland District of the Custer Forest.

Powder River RMP Area

During the next 20 years, it is estimated that the number of CBM wells that may be drilled throughout the Powder River RMP area, regardless of mineral ownership, would range from a low of 6,800 to a high of 19,600. The number of wells drilled each year would range from 200 to 1,100. There also would be 6,100 to 17,000 producing CBM wells, which would require 250 to 700 field compressors and 25 to 70 sales compressors. From 4,000 to 11,300 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From 500 to 1,400 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. Approximately 350 miles of sales lines would be laid to the main transmission lines. This would result in 31,400 to 85,700 acres of disturbance.

Billings RMP Area

During the next 20 years, it is estimated that the number of CBM wells that may be drilled throughout the Billings RMP area, regardless of mineral ownership, would range from 1,000 to 6,600. There would be 900 to 5,950 producing CBM wells, which would require 40 to 250 field compressors and 5 to 25 sales

compressors. Six hundred to 4,000 miles of plastic, low-pressure gathering lines needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From 80 to 500 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. Approximately 230 miles of sales lines would be laid to the main transmission lines. This would result in 5,200 to 30,500 acres of disturbance.

Blaine County

The RFD estimates three to 10 CBM wells could be drilled. This would result in one field compressor and up to 1 sales compressors. There would be from 2 to 7 miles of plastic, low-pressure gathering lines needed, which would be laid in the travel routes to the wells and follow the roads to the field compressors. From 1 to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines. This would result in 75 to 100 acres of disturbance.

Park County

Ten to 25 CBM wells would be drilled in Park County. These wells would require 1 field compressor and no sales compressor. Seven to 17 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressor. One to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. Presently, there is a compressor station located in the county so it is assumed that the gas would be compressed to sales pressure at the compressor station. This would result in 40 to 100 acres of disturbance.

Gallatin County

Based on the estimates of coal volume, it is anticipated that five to 15 wells would need to be drilled. This would require 1 field compressor, and may require 1 sales compressor depending on where the wells are located in the county. There is one gas sales line going through the north part of the county. Three to 10 miles of plastic, low-pressure gathering lines would be needed. These lines would be laid in the travel routes to the wells and would follow the roads to the field compressors. From 1 to 2 miles of low-pressure steel lines would be laid from the field compressors to the sales compressors. No more than 20 miles of sales lines would be laid to the main transmission lines. This would result in 80 to 120 acres of disturbance.

Conventional Oil and Gas

Based on the Assumptions listed at the beginning of this section, the number of conventional oil and gas wells that could be drilled would range from 750 to 2,900. The number of wells drilled each year would range from five to 15 in each of the 17 counties if the wells were distributed equally among the counties. No estimates of disturbance were made for conventional wells.

Powder River RMP Area

The RFD estimates that 300 to 1,300 conventional wells would be drilled in the next 20 years in the

Powder River RMP area. Seventy to 300 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in or near the existing fields.

Billings RMP Area

The RFD estimates that 250 to 975 conventional wells would be drilled in the next 20 years in the Billings RMP area. Twenty-five to 100 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in or near the existing fields.

Blaine County

The RFD estimates that 150 to 500 conventional wells would be drilled in Blaine County in the next 20 years. From 32 to 127 of these wells would be drilled on minerals under BLM jurisdiction. Most of these wells would be drilled in the existing fields.

Park County

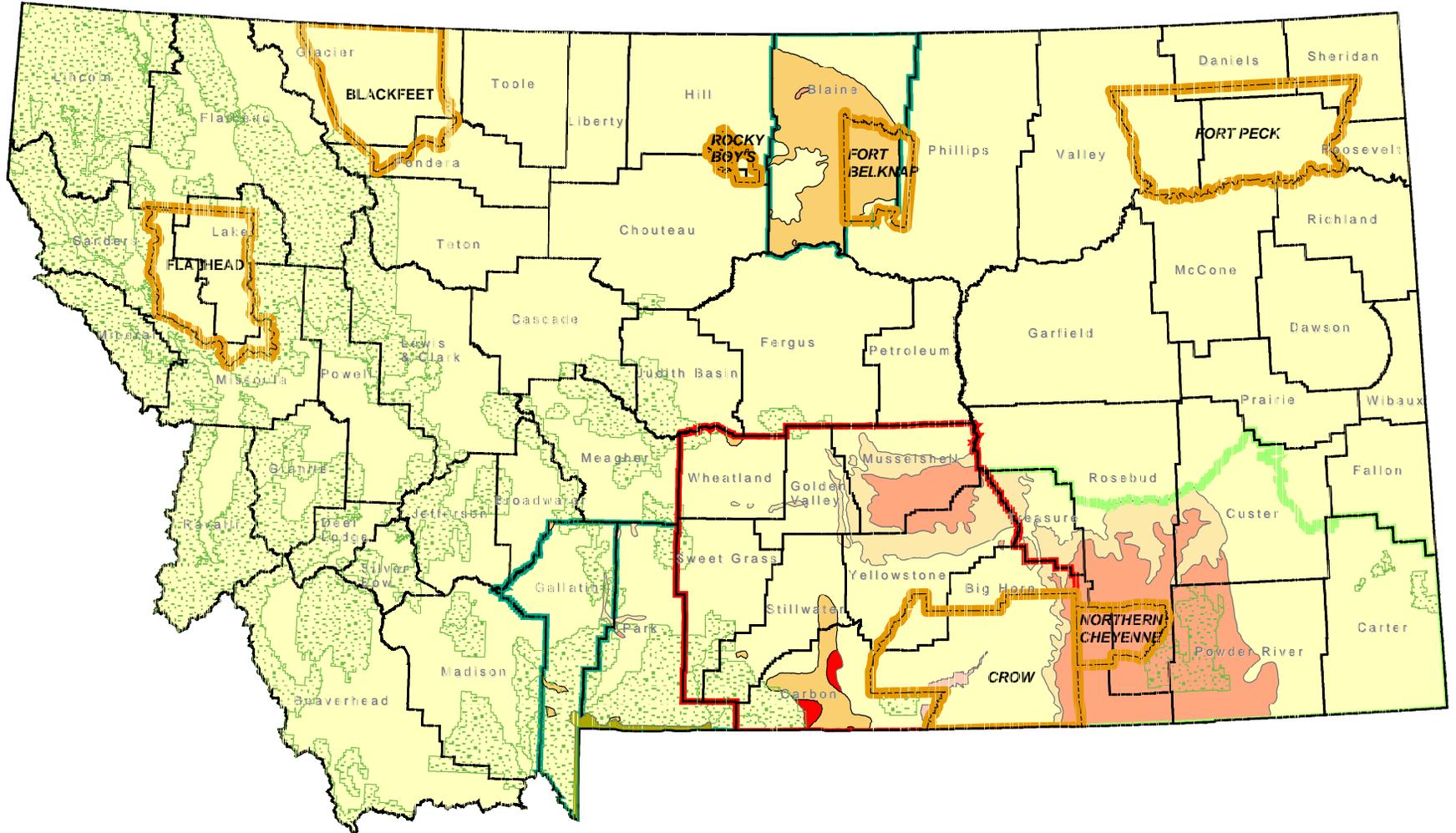
Based on historical activity, it is estimated that two to eight wells will be drilled in Park County in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

Gallatin County

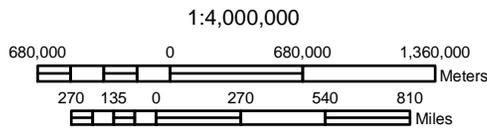
Based on historical drilling activity, it is anticipated that from one to six wells would be drilled in Gallatin County in the next 20 years. None of these wells would be drilled on minerals under BLM jurisdiction.

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MIN-1: Coal Rank RFD Map



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|--|--------------------------------|--|---|
| | Native American Reservations | | Coal Rank |
| | Special Consideration Counties | | Sub-Bituminous |
| | Powder River RMP Area | | Sub-Bituminous / of doubtful value |
| | Billings RMP Area | | Med. and High Volatile Bituminous |
| | National Recreation Area | | Med. and High Volatile Bituminous / of doubtful value |
| | Yellowstone National Park | | |
| | National Forest | | |



NOTE: Coal Data is from the Coal Fields of the Conterminous United States, USGS 96-92

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
 Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
 National Forests: 1:100,000 scale, national forests, Montana State Library/NRIS, Helena, Montana
 Parks: 1:100,000 scale, parks, Montana State Library/NRIS, Helena, Montana
 Development Data: BLM Reasonable Foreseeable Development Scenario

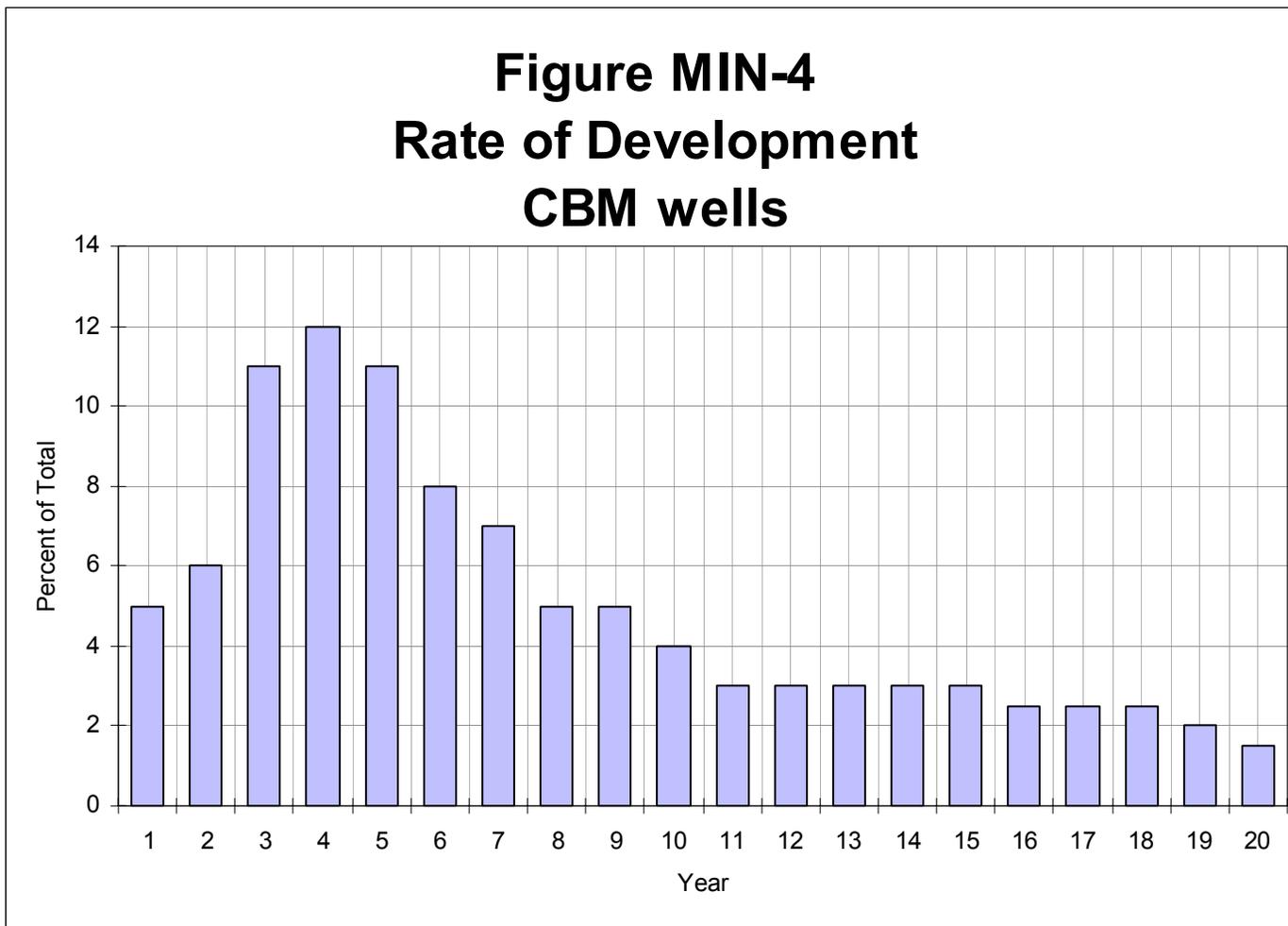
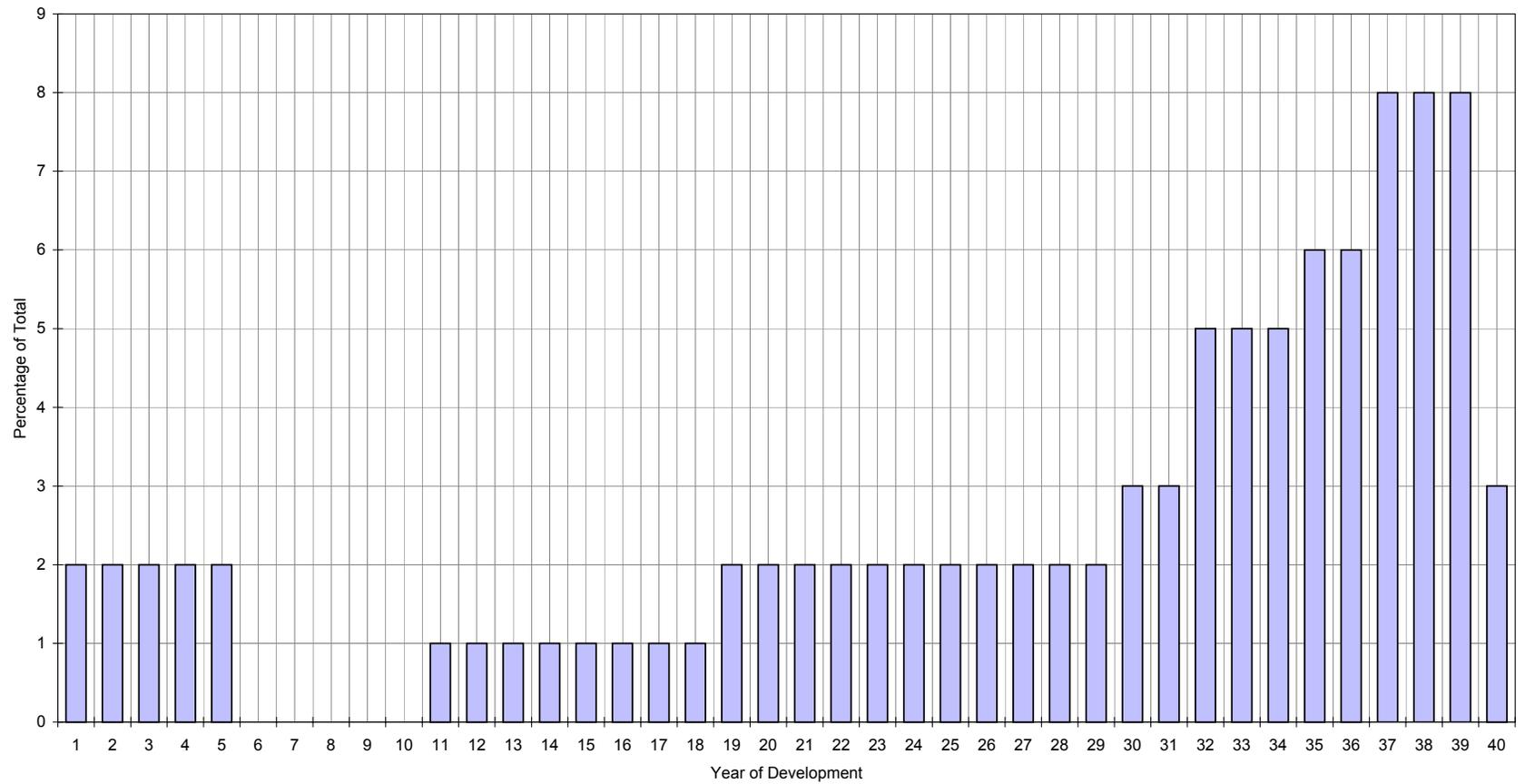


Figure MIN-5
Rate of Abandonment of CBM Wells



**TABLE MIN-1
RFD NUMERICAL PREDICTIONS FOR EXPANDED DEVELOPMENT SCENARIO**

County	Total Drilled			Production			Dry Holes/Exploration			Acreage Overlying Coal Occurrences
	Expanded	State	BLM	Expanded	State	BLM	Expanded	State	BLM	Acres
Big Horn	7,000	3,500	3,500	6,300	3,150	3,150	700	350	350	524,738
Blaine	10	10	0	9	9	0	1	1	0	1,024,000
Carbon	400	320	80	360	288	72	40	32	8	448,000
Carter	0	0	0	0	0	0	0	0	0	0
Custer	300	230	70	270	207	63	30	23	7	418,000
Gallatin	15	15	0	14	14	0	2	2	0	47,500
Golden Valley	0	0	0	0	0	0	0	0	0	103,000
Musselshell	150	130	20	135	117	18	15	13	2	764,000
Park	25	25	0	23	23	0	3	3	0	32,000
Powder River	6,700	3,350	3,350	6,030	3,015	3,015	670	335	335	713,500
Rosebud	2,800	1,400	1,400	2,520	1,260	1,260	280	140	140	1,005,500
Stillwater	700	665	35	630	599	32	70	67	4	65,500
Sweetgrass	25	23	2	23	21	2	3	2	0	0
Treasure	25	24	1	23	22	1	3	2	0	153,500
Wheatland	0	0	0	0	0	0	0	0	0	30,406
Yellowstone	150	140	10	135	126	9	15	14	1	678,000
Sub-total	18,300	9,832	8,468	16,470	8,849	7,621	1,830	983	847	6,007,644

**TABLE MIN-1
RFD NUMERICAL PREDICTIONS FOR EXPANDED DEVELOPMENT SCENARIO**

County	Total Drilled			Production			Dry Holes/Exploration			Acreage Overlying Coal Occurrences
	Expanded	State	BLM	Expanded	State	BLM	Expanded	State	BLM	Acres
Northern Cheyenne	4,000	0	0	3,600	0	0	400	0	0	445,000
Crow	4,000	0	0	3,600	0	0	400	0	0	332,000
Forest Service	50	0	0	45	0	0	5	0	0	501,500
Sub-total	8,200	0	0	7,245	0	0	805	0	0	1,278,500
Total	26,500	9,832	8,468	23,715	8,849	7,621	2,635	983	847	7,286,144
Powder River RMP	15,635	7,899	7,716	14,072	7,109	6,944	1,564	790	772	2,726,033
Billings RMP	2,615	1,884	753	2,354	1,695	677	262	188	75	2,178,111
Counties	50	50	0	45	45	0	5	5	0	1,103,500
Totals	18,300	9,832	8,468	16,470	8,849	7,621	1,830	983	847	6,007,644
	Big Horn County		Drilled	Production	Dry Holes					
Powder River RMP	83.00%		5810	5229	581					
Billings RMP	17.00%		1190	1071	119					

Note: Percentages indicate portion of Big Horn county overlying known coal occurrence within each RMP excluding the Crow Reservation lands.

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Compliance with NEPA requires analysis of cumulative effects for each alternative. Cumulative effects on the environment are those that result from the incremental impacts of an alternative when added to the other past, present and reasonably anticipated future actions, regardless of who undertakes those actions. In analyzing cumulative effects from this project, it will be important to understand the incremental impacts from other past, present, and future actions planned for the RMP areas. However, not every project can be included in the analysis or the result could become cumbersome; thus, providing decision makers with extraneous information. Therefore, the importance of scoping cannot be overstressed because it provides the initial opportunity to identify boundaries for a meaningful analysis. The cumulative effects study approach is defined by discussing the Study Area Delineation (spatial boundary); past, present, and future projects that meet a minimum criteria of magnitude as to add to the cumulative effect and time frame for the analysis and is discussed in the conclusions section of each alternative.

Study Area Delineation

The planning area for BLM is the Billings RMP area (10,791,964 acres) and the Powder River RMP area (8,567,125 acres). Acre estimates are for all land within the RMP's regardless of ownership, federal, state or private. The state planning area is statewide with emphasis on the BLM planning area and Blaine (2,711,407 acres), Park (1,788,816 acres), and Gallatin (1,683,586 acres) counties. The combination of the two RMP areas and three counties amounts to approximately 25 million acres.

The study area proposed for the EIS/RMP is exceptionally large and limits the type of analyses that can be included in the subject analysis. It is important to note that the objective of the cumulative analysis is not to perform the perfect analysis, but to select projects that would be appropriate to the subject analysis and aid in the selection of a preferred alternative. With this in mind, the objective is not to make an attempt to choose all projects throughout the entire state of Montana that might add to the cumulative effect of either BLM's or the state's action. This extreme is simply not practical; however, if the thought is more focused, cumulative impact analysis could be chosen on a practical level. Cumulative impacts that might affect other resources are not considered as regionally extensive, the projects/activities to consider may be different. For example, groundwater impacts would be limited to the

general area of CBM production. This would also be the case with soils, agriculture and grazing, cultural and paleontological resources, geology and minerals, Indian trust assets, socioeconomics, and others. Other than air quality related impacts (including visual) and surface and ground water influences from Wyoming CBM development, BLM believes the proposed study area is appropriate for this plan and is consistent with other BLM plans. Using this approach, combined with the general knowledge of the area, consideration of a study area that is essentially the Powder River Basin is appropriate. We are, however, limited to some extent in what can be considered and must strive to choose those areas and projects and activities that are truly applicable to the process.

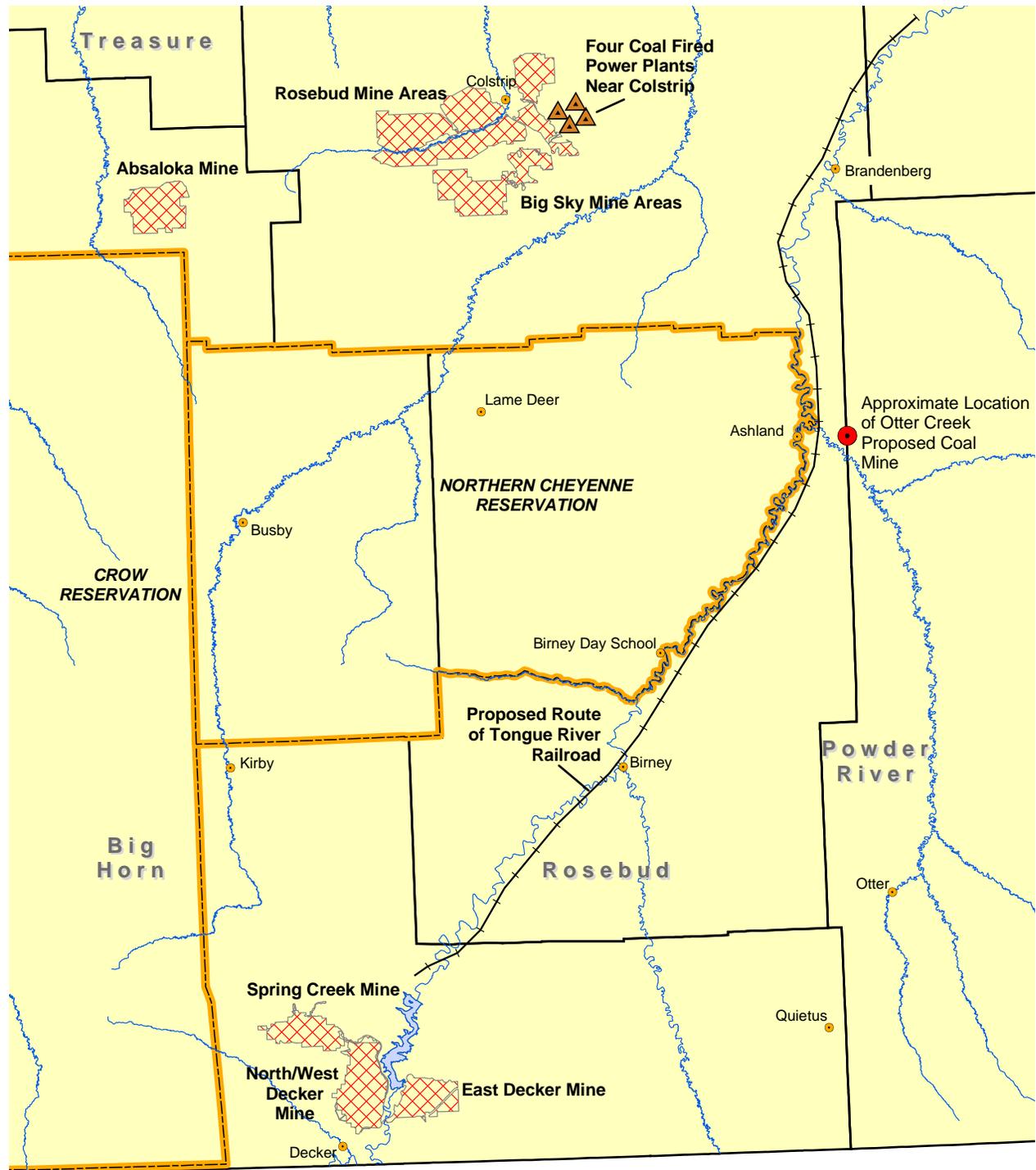
As such, the cumulative analysis for this EIS will emphasize impacts from oil and gas industry-related projects within the project study area and appropriate adjacent areas, depending on the resource being analyzed. The cumulative analysis also considered impacts from the largest foreseeable non-oil and gas industry developments. Activities and projects of sufficient magnitude that may result in cumulative impacts to the environment include natural gas and oil production; surface coal mining; railroads; highways; water storage reservoirs; power plants; potential wildfires; and effects from CBM development in Wyoming, the Ashland Ranger District and on the Crow and Northern Cheyenne reservations. Map MIN-2 indicates the locations of projects included in the cumulative effects analysis.

A discussion of each project or type included in the cumulative effects analysis follows.

Natural Gas and Oil Production

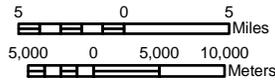
Impacts from conventional natural gas and oil production are addressed in the *Impacts from Management Common to All Alternatives* discussion under the individual resource topic section of the *Impacts From Management Specific to Each Resource and Alternative*. The impacts from conventional oil and gas development are consistent with the BLM's 1994 *Final Oil and Gas EIS RMP Plan Amendment* to the Billings, Powder River, and South Dakota RMPs, and the state's 1989 *Oil and Gas Drilling and Production in Montana Final EIS*.

MIN-2: Location Map of Cumulative Effects Projects With CBM Emphasis Area



Legend

- Cities
- Rivers
- Coal Mines
- Native American Reservations



DATA SOURCES

County Boundaries: 1:100,000 scale, Counties, Montana State Library/NRIS, Helena, Montana.
 Cities: 1:100,000 scale, Cities, Montana State Library/NRIS, Helena, Montana.
 Mines: Montana Bureau of Mines & Geology.
 Otter Creek Site: EMRIA Report #1, 1975.

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Surface Coal Mining

There are currently 12 active surface mines in the state, ranging from 10 acres to nearly 25,000 acres. A total of approximately 61,000 acres are currently permitted in the state. Approximately 32,000 acres of the 61,000 acres permitted have been disturbed and 15,000 of these disturbed acres have been backfilled, graded, topsoiled, and permanently seeded to reclamation standards (OSM 1998).

Several mines are present in and around the CBM emphasis area. They include operating mines, mines undergoing expansion, reclamation of older mines, and future planned mines. Mines that are generally located within the Powder River Basin and have a potential to add to the cumulative impact include the Spring Creek, Decker, Big Sky, Rosebud, Absaloka, and two new mines planned for Otter Creek. These mines are located in three general areas: the Spring Creek and Decker mines are in southeast portion of Big Horn County just east of the Crow Reservation; the Absaloka mine is located just outside the northeastern corner of the Crow Reservation in Big Horn County; and the Rosebud and Big Sky mines are located near Colstrip, Montana, just north of the Northern Cheyenne Reservation. If the

Otter Creek mines were to be established, they would be sited in the southwestern portion of Powder River County. Table MIN-2 shows the average annual production of each mine in the emphasis area along with environmental data for permitted acres, disturbed acres, and backfilled and re-topsoiled acres.

In addition to the quantities identified in the Table MIN-2, the Spring Creek and Rosebud mines have each applied for permits to expand their permitted surface acreage by approximately 2,500 acres and 1,500 acres, respectively. The MDEQ expects both permits to be approved before the end of 2001 (Bohman 2001). Approximately 32,900 acres remain to be disturbed by mining operations during the next 20 years. This estimate is based on current activities and foreseen future developments.

Surface water quality within the vicinity of the coal mines is impacted by increased sediment load resulting from increased erosion during mining. This is mitigated by the use of sediment settling ponds and the vegetating of overburden and topsoil storage areas. The discharge of groundwater pumped from mine pits may also affect surface water depending on the quality of groundwater within the mine vicinity and the quantity of groundwater discharged. Much of the groundwater

**TABLE MIN-2
 SURFACE MINES WITHIN THE CBM EMPHASIS AREA**

Mine	Annual Average Production (Short Tons)	Permitted Surface Acres	Disturbed Acres	Backfilled and Re-topsoiled Acres
Spring Creek	11,000,000	4,500	2,300	300
Decker (North/West and East)	10,000,000	11,400	6,300	1,700
Big Sky (Area A&B)	2,850,000	8,100	3,600	2,600
Rosebud (Areas A, B, C, D, and E)	10,350,000	24,900	13,050	6,400
Absaloka	5,500,000	5,400	3,150	2,200
Otter Creek (Mines 1 and 2)	10,000,000 ¹	3,000 ²	0	0
Total	49,700,000	57,300	28,400	13,200

Note: This table shows the cumulative disturbances and reclamation efforts associated with each of the surface mining operations within the CBM Emphasis Area.

¹Estimated value based on production rates from similar mining operations within the region.

²The estimated acreage for the Otter Creek mines is from the Resource and Potential Reclamation Evaluation, Otter Creek Study Site EMRIA Report #1, 1975, and to date has not been permitted but represents the potential surface acres needed to develop this resource.

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pumped from the mine pits is stored and used to control dust on roads, truck and train car loading areas, and the mine face. In some instances, mining activities require the diversion of streams or drainage areas that are within the area to be mined. Approximate original topography, including stream channels and drainage areas, are restored during mine reclamation activities. All mines are required to monitor their discharges and obtain MPDES permits. The majority of discharges are related to storm responses with the exception of the Decker mines, which has a permit for a regular discharge of 4.5 cubic feet per second into the Tongue River.

Impacts to groundwater resources resulting from surface coal mine activities are usually related to drawdown and quality issues from backfilled spoils. Coal beds are among the most dependable and utilized aquifers in eastern Montana, because of their fracture-related transmissivity and lateral continuity. Adjacent portions of these aquifers discharge water into the mining pit, which requires that it be pumped-off resulting in the lowering of the water levels within aquifers adjacent to the mine. The area affected and the distance from the mine affected depends on the particular aquifer characteristics of the area, presence of faults, rates of surface water and precipitation recharge, and other factors, and will vary depending on the location of the mine. Groundwater wells, springs, and surface streams within the area can be impacted by the lowered water levels. Those located nearest the mine experience the greatest impact. In the mining areas near Colstrip and Decker, coal aquifers have shown drawdown as much as 75 feet and a radius of impact up to 4 miles (Wheaton and Metesh 2001). The resulting total area of groundwater impact from coal mines is calculated to be 366,000 acres. The rate at which water levels recover varies between mining regions, but normally requires more than 20 years (Wheaton and Van Voast 1998).

Overburden replaced in the mine pits during reclamation is approximately inverted from its original orientation. The mineral content of these near-surface unsaturated and weathered rock layers used in typical overburden affect the groundwater quality within the area of the reclaimed mines. The resulting poor water quality is present for many years after mining is completed. Elevated levels of sodium, magnesium, calcium, bicarbonate, chlorides, and sulfates are possible, as well as increased total dissolved solids (TDS). Dissolution of these salts causes increases in TDS concentrations in the spoils aquifers that have been observed at levels 50 percent to 200 percent

greater than the adjacent bedrock aquifers (Wheaton and Van Voast 1998). With time, some sites return to pre-mining quality; however, the impacts to water quality may be everlasting at other sites where soluble salts are continuously generated by weathering and oxidation.

Coal Mine Impacts on Air Quality

Coal mines have an effect on air quality within the region surrounding the surface operations. Air pollutant emissions data are available for five surface coal mines within the emphasis area; three are in Big Horn County (Absaloka, Spring Creek, and Decker mines), and two are in Rosebud County (Big Sky and Rosebud mines). Table MIN-3 shows the average air pollutant emissions from the mines within the emphasis area. Volatile organic compounds (VOCs) shown in the table would also include any fugitive methane vented from the mines.

Future impacts also would be realized from opening new mines, expanding existing mines, and installing power generation plants at existing coal mines.

Railroads

The Tongue River Railroad is a proposal to build a new coal-hauling railroad along the Tongue River from Miles City to Decker, Montana. The Tongue River Railroad Company (TRRC) was authorized to begin construction of the 117-mile railroad in 1996 by the Surface Transportation Board. Operations were scheduled to begin in 2001 but construction has not commenced and no projected start date is available. The rail system, if built, would consist of several spur lines connected to individual coal mines throughout the CBM emphasis area. The total system would measure approximately 150 miles. Assuming an average 200-foot wide right-of-way, an estimated 3,600 acres would be disturbed by construction and operation activities within the planning areas.

The construction of this rail system would create numerous other impacts, including socioeconomic issues for local towns along the route, alteration to ranch and grazing lands, reductions in air quality, impediments to Native American cultural sites, increased erosion along the Tongue River riparian areas, increased sedimentation loading in the Tongue River, introduction of noxious weeds, and increased obstructions to wildlife habitat.

**TABLE MIN-3
 AVERAGE AIR POLLUTANT EMISSIONS FROM SURFACE MINES WITHIN THE EMPHASIS
 AREA (TONS/YEAR)**

Source	PM ₁₀ ¹	CO ²	NO ₂ ³	SO ₂ ⁴	VOCs ⁵
Existing Coal Mines (5)—Avg/Mine	412.1	323.4	290.2	56.5	18.8

Notes: This table summarizes the impacts to air quality from surface mining sources within the emphasis area (MDEQ—1999 Air Quality Monitoring Data). Values were obtained from 1999 Toxic Release Inventory for the State of Montana.

¹PM₁₀—Particulate matter that is less than or equal to 10 microns in size.

²CO—Carbon monoxide

³NO₂—Nitrous oxides

⁴SO₂—Sulfur dioxide

⁵VOCs—Volatile organic compounds

Highways

There are no current proposals for new highways within the CBM emphasis area. It is assumed that several secondary highways, state routes, and county roads will undergo some form of repair, resurfacing, widening, or extension during the course of CBM development. Currently, a list of proposed road improvements within the CBM emphasis area is not available for analysis and quantification. These activities, however, would subject the adjacent lands to impacts associated with linear construction and surface disturbances. For the purposes of this analysis, we are assuming that 250 miles of existing road would be improved over the next 20 years.

Water Storage Reservoirs

The Tongue River flows about 100 miles from its headwaters in Wyoming's Bighorn Mountains to the Tongue River Reservoir. The reservoir is approximately 8 miles long and 1 mile wide, with an average depth of 20 feet, and was completed in 1940. Water leaving the north end of the reservoir flows about 190 miles, northeasterly, until it reaches its confluence with the Yellowstone River at Miles City.

The reservoir was enlarged in 1999, at the request of the Department of Natural Resources and Conservation (DNRC), Northern Cheyenne Tribe, and the U.S. Bureau of Reclamation. The enlargement included the reconstruction of the dam and disturbance of 157 acres. The disturbance included aggregate mining, roads, staging areas, and railroad layout areas, some of which have been reclaimed. As a result of the enlargement, the reservoir capacity was increased by 13,000 acre-feet,

the surface water level raised by 4 feet, and the surface area expanded by some 400 acres to nearly 3,615 acres.

Power Generation Plants

Five existing power generation plants are located within the CBM emphasis area, and all are coal-fired. Four are located in Rosebud County near the coal mine area and one is located in Billings. The resource area most affected by the burning of coal to produce electrical power is air quality. Air quality data from all five power generation plants are available. Table MIN-4 summarizes the impacts to air quality from these plants within the emphasis area, according to the MDEQ 1999 Air Quality Monitoring Data.

There are plans to construct a coal gasification power plant in Hardin, Montana. The plant would be retrofitted into an existing manufacturing facility, resulting in reduced surface disturbances. It is understood the plant plans to use approximately 500,000 tons of coal per year supplied by the Absaloka mine, 20 miles east of Hardin. Additional information regarding the coal gasification process, estimated emission levels, and the power generation process is not available at this time.

Other power plants maybe envisioned due to the electrical industry's deregulation and the increased demand nation wide. Some of these plants may find it advantageous to locate in Montana near a source of coal or natural gas; however, no new plants were presented to the DEQ for permitting at the time of new data cut-off, June 2001.

**TABLE MIN-4
 AVERAGE AIR POLLUTANT EMISSIONS FROM FIVE MAJOR SOURCES WITHIN THE EMPHASIS
 AREA
 (TONS/YEAR)**

Source	PM ₁₀ ¹	CO ²	NO ₂ ³	SO ₂ ⁴	VOCs ⁵
Existing Power Plants (5)—Avg/Plant	55.0	453.1	5036.2	3065.5	54.1

Note: Values were obtained from 1999 Toxic Release Inventory for the State of Montana.

¹PM₁₀—Particulate matter that is less than or equal to 10 microns in size.

²CO—Carbon monoxide

³NO₂—Nitrous oxides

⁴SO₂—Sulfur dioxide

⁵VOCs—Volatile organic compounds

Wildfires

The BLM Fire Management Program suppresses wildfires and uses prescribed fires to achieve land management objectives. Nationally, 63 percent of wildfires are caused by lightning and the remaining 37 percent by human activities. The average wildfire consumes approximately 370 acres, but the acreage can more than double in severe years that have drought, high winds, or above normal lightning.

Prescribed fires are carefully planned to remove old, woody vegetation, prepare areas for reseeding, or reduce the natural accumulation of dead vegetation. They make room for growth of more nourishing forage for livestock and wildlife, and are often designed to burn a mosaic pattern, leaving patches to serve as cover for some wildlife species. The average prescribed fire covers 150 acres of land.

Based on previous RMPs, it is estimated that 25 wildfires would occur per year in the planning area. The fires would range in size from 1/4 acre to 1,000 acres. Surface disturbances caused from fire lines would average 3 acres per fire or a total of 75 acres per year.

Wyoming CBM Production

CBM production in Wyoming is concentrated in the Powder River Basin. CBM resources of the Powder River Basin are more extensively developed in Wyoming than in Montana. Most of the surface area of the basin is located in Wyoming, with 92 percent of the coal volume located in the Powder River basin lying within Wyoming (Ellis et al., 1999). The CBM development in Wyoming has the potential to impact

water resources in Montana through the drawdown of groundwater within coal seam aquifers that extend from Wyoming north into Montana and by the discharge of CBM-produced waters in Wyoming to surface waters that flow north into Montana. The potential magnitude of the impact to Montana water resources from Wyoming CBM production is tied to the RFD of CBM in Wyoming. Projections for the RFD of CBM in the Wyoming portion of the Powder River basin adjacent to Montana have been the subject of recent BLM reports.

CBM development in Wyoming has the potential to cause substantial impacts in Montana to surface water quality and groundwater resources. The Wyoming DEQ and the Montana DEQ have adopted an interim memorandum of cooperation on limiting discharge to watersheds that extend into Montana, the probability of future agreements is tentative.

The *Coalbed Methane Project Final EIS (Wyodak EIS)* (BLM 1999b) projected 6,000 CBM wells in the Buffalo Field Office Area. The water model, done as part of the EIS, estimated an average production rate of 12 gpm per CBM well. This level of development was estimated to result in an increase of approximately 1.1 percent (452 cfs to 457 cfs) in the average flow volume of the Powder River at Moorhead, Montana (BLM 1999b), and an increase of approximately 50 percent (22 cfs to 33 cfs) in the average flow volume in the Little Powder River at the Weston station, which is located approximately 20 miles south of the Wyoming/Montana border. These increases are based on yearly averages. However, during low-flow periods, the Powder River flow volume could be increased by more than 800 percent as a result of the discharge of CBM-produced waters. Flow volumes in the Little

Powder River would consist entirely of discharged CBM-produced waters (BLM 2001b).

The quality of CBM produced water from individual wells in the Wyoming portion of the PRB shows considerable variability (Rice et al, 2000); water quality parameters such as SAR vary from approximately 5 to over 30 and TDS varies from approximately 250 mg/L to more than 2000 mg/L. Watershed averages in Wyoming also show variation (BLM, 1999); water quality parameters such as SAR vary from an average of 17 in the Powder River Watershed to 9 in the Little Powder River watershed. As CBM development continues in Wyoming, these average water quality parameter values may change. Surface water quality would be affected by CBM water discharge, with yearly average SAR values increasing from 4.0 to 4.1 in the Powder River and from 6.0 to 7.5 in the Little Powder River. Impact to the quality of water within the Powder River during low-flow periods is expected to increase water quality concentrations for compounds common to CBM produced water, including increases in the SAR from values that could be as low as 1 up to approximately 17. During low-flow periods in the Little Powder River, SAR is expected to increase from approximately 6.5 to an estimated value of approximately 9. The Wyoming EIS (BLM, 1999) did not address potential impacts to the Tongue River from discharge of CBM-produced waters within Wyoming. However, it is expected that impacts of similar magnitude to those predicted for the Powder and Little Powder could occur.

Following the release of the Wyodak EIS (BLM 1999), the BLM has reassessed the RFD for the Wyoming portion of the Powder River Basin and has issued a new RFD (BLM 2001a). This more recent reasonable foreseeable development study by the BLM indicates that the total number of CBM wells in the Wyoming portion of the Powder River Basin may approach 50,000 wells (BLM 2001a). An EIS using this level of development is in progress, but some extrapolations can be made from the existing EIS. This level of development represents an increase of more than 8 times the number of CBM wells included in the 1999 Wyodak EIS, and if realized, could have a corresponding increase in impact on the quantity and quality of surface water in Montana's Powder River Basin watersheds in terms of annual average measures and especially during periods of low-flow or base-flow. However, actual impacts will be dependant upon the manner in which discharges are managed with respect to CBM development in Wyoming.

Rivers within the Wyoming portion of the PRB show considerable seasonal variation in terms of flow volume

and water quality. The flow volume in the Powder River ranges from a maximum of 1,400 cfs to a minimum of 0.5 cfs. Water quality also varies because flow volume contains varying amounts of meteoric water added to the base-flow contributed by groundwater. If CBM water discharge rates are essentially constant throughout the year, resultant flows in the river would vary depending upon the ratio of CBM discharge to natural river flow. Impacts to the Powder River would include a 9 percent increase in the annual average flow volume (450 cfs to 500 cfs), as well as an increase in the annual average SAR value to 5.2. Impacts during natural low-flow periods, however, would cause the river to flow at rates 70 times normal with SAR values in excess of 17.

Annual average flow within the Little Powder River with the impact of CBM discharge water is extrapolated to increase from 22 cfs to 92 cfs and a resultant SAR of 9. Depending on how CBM-discharges are managed in Wyoming, these flow rates and water qualities could be maintained during traditionally low-flow periods when the river is normally often dry.

Impacts to the Tongue River drainage are not included in the Wyodak EIS, however, impacts to surface water quantity and quality resulting from the increase in the number of CBM wells and the resultant increase in the volume of CBM water discharged in Wyoming are possible. The Upper Tongue River watershed is currently the site of CBM production and it is expected that more development would occur. Impacts to the Tongue River in Montana are expected to be commensurate with impacts to the Powder and Little Powder Rivers by Wyoming CBM production. These impacts would result in increases in surface water quantity and decreases in quality. This could result in 3 to 5 times more water entering Montana and an increase in SAR from 0.7 to 5. This is important because Tongue River water quality is the highest in the PRB and the river feeds the Tongue River Reservoir.

Groundwater resources in Montana could also be impacted from CBM production in Wyoming. CBM-producing wells in northern Wyoming would cause a drawdown of coal aquifers on adjacent land, with groundwater drawdown possibly extending northward into Montana. Groundwater computer modeling for the Wyodak EIS indicates that the 5-foot drawdown level could extend up to 18 miles from the edge of production, given a 12-gpm per well rate of water withdrawal (BLM 1999). The modeling values are based on assumptions made regarding the known geology of the Wyoming portion of the basin, which field data has shown to differ from the Montana portion of the basin. The Wyoming coal seams that have been

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developed are deeper and thicker than the seams in Montana. In addition, the 12-gpm water production value for the state was a “snap-shot” derived from current production data at a single point (1997) early in the life of the PRB CBM play. The 20-year average rate of 2.5 gpm for Montana was derived from carefully organized data from a single CBM field considering production trends with time. Nonetheless, both the 12 gpm and the 2.5 gpm rates are projections that may need to be monitored and refined over time as CBM development proceeds. Given these groundwater modeling results and related assumptions, if CBM fields were located in Wyoming adjacent to the border with Montana, this could affect groundwater levels for a distance of up to 18 miles into Montana, assuming the parameters used in the Wyoming computer model are applicable to this area of Montana. Drawdown impacts of this magnitude would result in impacts to private lands, the Crow Indian Reservation, state-owned lands, and federal lands controlled by BLM.

CBM Development on Indian Reservations and the Ashland Ranger District

The development of CBM resources on the Crow and Northern Cheyenne reservations and on the Ashland Ranger District is assumed to take place during the next 20 years and is therefore included in the cumulative effects analysis. The RFD estimated that 1,400 to 4,000 wells could be developed on each reservation and 50 to 200 wells on the Ashland Ranger District. The impacts associated with this development would be similar to the impacts described within each of the resource topics per alternative and adjusted for magnitude. Of course, the land disturbances, wildlife, cultural and paleontological, visual, social economic, recreational, air quality, soils, and special status species impacts described for those resources would be experienced on the reservations and on the Ranger District. The surface and groundwater quality impacts would be felt on the reservations and on the District but they would also contribute to changes in the watersheds into which the flow.

Agency-Approved Natural Resource Mitigation Measures

Mitigation measures are restrictions on lease operations, which are intended to minimize or avoid impacts to resources or land uses from oil and gas activities. The mitigation measures listed in Table MIN-5 would be applied to permits by the approving agency. The list is not all inclusive, but

presents the mitigation measures most often used in the planning area. The wording of the mitigation measure may be modified or additional measures may be developed to address specific conditions. Mitigation measures would be included as needed with approved permits during all phases of CBM development.

**TABLE MIN-5
MITIGATION MEASURES THAT WOULD BE APPLIED
AS APPROPRIATE TO MINIMIZE IMPACTS**

Mitigation Measure	BLM	State
Disturbed areas resulting from any construction will be seeded following the BLM seeding policy, state guidance or surface owner's requirements. Depending on surface ownership seeding is usually required during the fall or late spring.	X	
To the extent practicable, vegetation will be preserved and protected from construction operations and equipment except where clearing operations are required to conduct oil and gas operations, such as for roads, well pads, pipelines, power lines, utility lines, and structures. Clearing of vegetation will be restricted to the minimum area needed for construction and equipment.	X	X
Temporary and permanent access roads will be avoided on south-facing slopes within big game winter range, where practicable.	X	
To the maximum extent practicable, all maintenance yards, field offices, and staging areas will be arranged to minimize disturbance to trees, shrubs, and other native vegetation.	X	
Topsoil removed by construction activities will be stockpiled for reclamation. Sensitive habitat areas will not be used for topsoil storage.	X	
The TLMD must provide approval prior to constructing well pads, roads, power lines, and related facilities that require surface disturbance. The lessee must comply with required mitigation measures.		X
The lessee must submit an Operating Plan or Amendment to an existing Operating Plan before any activities are conducted on the lease premises. No activities shall occur until the plan has been approved by the TLMD in writing. If the surface activity is detrimental to trust resources, surface activity may be denied.		X
The lessee must contact the surface owner in writing at least 30 days prior to any surface activity, and provide a copy of the correspondence to the TLMD.		X
No surface occupancy shall be allowed unless approved by the DNRC director. In addition, no surface occupancy is allowed on any right-of-way identified on official highway plans on file at the Department of Transportation in Helena, Montana.		X
Prior to cutting or removing timber for exploration or development activities, the lessee must acquire the approval of the appropriate TLMD area office.		X

MINERALS APPENDIX
 AGENCY-APPROVED NATURAL RESOURCE MITIGATION MEASURES

**TABLE MIN-5
 MITIGATION MEASURES THAT WOULD BE APPLIED
 AS APPROPRIATE TO MINIMIZE IMPACTS**

Mitigation Measure	BLM	State
No surface occupancy is allowed within the bed of a navigable river, abandoned channels, or on islands and accretions. In addition, upon completion of a successful well, where river title is disputed, the lessee will file an interpleader action under Rule 22, M.R.Civ.P. in Montana District Court, and name all potential royalty claimants as defendants.		X
Any activity within 1/8 mile of a river, lake, or reservoir on or adjacent to the lease must be approved in writing by the TLMD. No surface occupancy is allowed within the bed of the river, abandoned channels, the bed of the lake or reservoir, or on islands and accretions associated with the water body.		X
No activity shall be allowed within 100 feet of any perennial or seasonal stream, pond, lake, prairie pothole, wetland, spring, reservoir, well, aqueduct, irrigation ditch, canal, or related facilities without prior approval of the TLMD.		X
Site use may be restricted if there are existing surface uses, such as center pivots, wheel lines, etc.		X
No surface occupancy of cemetery sites is permitted without written approval of the TLMD.		X
The planting of grasses, forbs, trees, or shrubs beneficial to wildlife will follow the BLM seeding policy. When needed, BLM will require installation of erosion and sedimentation control measures, such as riprap, erosion mats, mulch, bales, dikes or water bars. Riprap material and placement must be approved by the appropriate agency.	X	
Erosion control and site restoration measures will be initiated as soon as a particular area is no longer needed for exploration, production, staging, or access. Disturbed areas will be recontoured to provide proper drainage.	X	
Topsoil piles may be required to be seeded following the BLM seeding policy.	X	
Surface use may be restricted or denied if unstable soil conditions or steep topography exist.		X
All above-ground electrical poles and lines will be raptor-proofed to avoid electrocution following the criteria and outlined in the Avian Power Line Interaction Committee (APLIC) (1994) and APLIC (1996). (APLIC 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute, Washington D.C. 78 pp.; APLIC 1996. Suggested Practices for Raptor Protection on Power Lines. Edison Electric Institute. Washington, D.C. 128 pp.).	X	X
Conduct three nesting habitat surveys for mountain plover in suitable habitat between May 1 and June 15. Surface use may be deleted in accordance with 43 CFR 3101.1-2.	X	
To protect wildlife during periods important to their survival, surface disturbance would be restricted from December 1 to June 15. This would protect wildlife in crucial winter range, elk calving areas, and nesting grouse.		X

**TABLE MIN-5
MITIGATION MEASURES THAT WOULD BE APPLIED
AS APPROPRIATE TO MINIMIZE IMPACTS**

Mitigation Measure	BLM	State
The TLMD will contact MFWP and FWS for advice on alleviating possible conflicts caused by proposed activities—additional mitigation may be required.		X
A survey for wildlife and plant species of concern may be required prior to disturbance. Identified species will be avoided, unless otherwise authorized by the TLMD.		X
The TLMD will complete an initial review for cultural resources and, where applicable, paleontological resources of the area intended for disturbance and may require a cultural resources inventory. Based on the results of the inventory, TLMD may restrict surface activity for the purpose of protecting significant resources located on the lease premises.		X
If the lease area contains biological weed control sites, these sites must be avoided unless authorized by the TLMD.		X
Wooded areas will be avoided unless otherwise authorized by the TLMD.		X
All seed used for re-vegetation will be pure live seed certified free of noxious weeds.		X
If drainage is occurring on the land in the lease, and if a well is not drilled within 2 years after the lease is issued, the TLMD will consider cancellation of the lease for failure to drill and offset well.		X
Cuts and fills for new roads will be sloped to prevent erosion and to facilitate revegetation.	X	
Additional mitigation measures may be required to prevent the further spread of noxious weeds. Such measures may include power washing vehicles, car pooling, timing restriction for seismic activities, and other measures.		X
It is the responsibility of the operator to control noxious weeds on lands disturbed in association with oil and gas lease operations. Lease-associated weed control strategies, when required by BLM, are to be coordinated with any involved surface owners and local weed control boards. A pesticide-use proposal must be prepared, and reviewed and approved by BLM prior to any herbicide application on lands disturbed by federal oil and gas lease operations. A pesticide application record must be within 24 hours after completion of application of herbicides. Additional measures may be required to prevent the spread of noxious weeds.	X	
Activities such as stream crossings that could directly impact sensitive or protected fish species will be undertaken during non-spawning periods for these species. In the unlikely event that multiple, sensitive, or protected fish species with back-to-back spawning periods are present in the same stream reach, one of the following options will be exercised. These options include selecting a nearby, alternative stream crossing site that does not provide suitable spawning habitat for the fish species of concern; using a nearby, existing stream crossing over the channel to avoid instream disturbances; or using shore-based equipment to position and extend the pipeline or other item (e.g., temporary bridge) across the stream, thereby avoiding in-channel activities.	X	

MINERALS APPENDIX
 AGENCY-APPROVED NATURAL RESOURCE MITIGATION MEASURES

**TABLE MIN-5
 MITIGATION MEASURES THAT WOULD BE APPLIED
 AS APPROPRIATE TO MINIMIZE IMPACTS**

Mitigation Measure	BLM	State
Operators must develop a Spill Prevention Control and Countermeasures plan to deal with accidental spills, the plan would include the strategic placement of berms and dikes.	X	
The road ditches would be flat bottomed “V” ditches would not be allowed. Place water turn outs where appropriate to lessen the water impacts upon the ditches.	X	