CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

MONTANA

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter presents the environmental impacts from management actions described in Chapter 2. The descriptions of predicted effects that would result from the exploration, construction, operation and maintenance and abandonment activities associated with coal bed natural gas (CBNG) for each alternative is compared to the pre-project environment.

Chapter 4 contains an *Introduction, Analysis Assumptions and Guidelines* section and individual Resource Topic discussions. Table 2-3, in Chapter 2, summarizes and compares the impacts of the alternatives. The *Introduction* outlines the chapter and provides an explanation of the organization and creation of assumptions. The *Analysis Assumptions and Guidelines* section presents the Reasonably Foreseeable Development scenario (RFD) used to predict the level of CBNG development and addresses the analysis assumptions common to all alternatives. The Resource Topic discussions are organized alphabetically. Under each resource topic, the following are addressed: assumptions, impacts from management common to all alternatives and impacts from management specific to each alternative.

The duration of the impacts are analyzed and described as either short-term (up to 5 years) or long-term (greater than 5 years). Impacts from management of conventional oil and gas are found in the *Impacts from Management Common to All Alternatives* sections. Impacts from management of CBNG are found in the *Impacts From Management Specific to Each Alternative* sections.

The narrative describing the impacts from management specific to each alternative includes subsections summarizing the impacts to the Crow and Northern Cheyenne tribes, mitigation measures and a conclusions summary. The conclusion summarizes the cumulative impacts from other regional ongoing and foreseen projects.

Cumulative impacts consider the alternative in combination with other substantial existing and future developments in and near the Final Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans (FSEIS) Planning Area, including oil and gas development projects, existing and future coal mines, new power plants, the Tongue River Railroad (TRR) and effects from Wyoming's CBNG development.

Project descriptions for activities considered in the cumulative impacts analysis are presented in the Minerals Appendix under Oil and Gas. Mitigation measures that are not already included as part of the alternatives are described and evaluated and the residual impacts are determined.

The resource discussions also address the differences between U.S. Bureau of Land Management (BLM) and State of Montana (state) impacts where divisions are meaningful. Physical impacts on landscapes from development disturbances can easily be quantified for Bureau of Land Management (BLM) and state regulated wells; however, effects on watersheds or wildlife from both BLM and state development cannot easily be distinguished and therefore are discussed in conjunction.

Analysis Assumptions and Guidelines

Analysis assumptions and guidelines provide common data to EIS team members to use when conducting the impact assessments for each resource. The assumptions and guidelines are based on previous events, experience of personnel and their knowledge of the resources in the Planning Area. The assumptions include the demand for various resources, the ability of the resources to meet the demand and how the actions will be carried out. An RFD was developed for this purpose and is discussed in the following sections.

Potential for Development—Reasonably Foreseeable Development Scenarios

The RFD addresses potential development on all lands, including the Crow and Northern Cheyenne reservations and the Ashland Ranger District of the U.S. Forest Service (USFS).

What has Changed in Chapter 4 Since the Draft SEIS (DSEIS)?

The impact analyses from the air quality and wildlife screens for Alternative H—Preferred Alternative were altered. The Air Quality and Climate section has additional changes, such as cumulative effects analysis from oil and gas development on climate change and also based on the completion of the supplemental air quality analysis (SAQA, BLM 2007).

The RFD is in no way stating that the BLM is making decisions for Indian lands or the USFS administered lands. For example, the decision to develop CBNG on Indian lands will be made by the Indian allottees and the tribes with concurrence of the Bureau of Indian Affairs (BIA), not by BLM.

The presumption of possible impacts to the environment is based on BLM guidance (BLM H-1624-1) provided for estimating the potential for oil and gas resources and for extrapolating the degree of development that is reasonably foreseeable over a given period of time. In the case of Montana's Powder River Basin and additional areas within the Billings and Powder River RMP areas, it is the level of CBNG development most likely to occur over the next 20-year period. The RFD is located in the Minerals Appendix, under "Reasonably Foreseeable Development Scenario". The following sections contain explanations of 1) the potential for CBNG resources within the Planning Area boundaries and 2) RFD for the different detailed development scenarios that are addressed by the various alternatives in this FSEIS.

Potential for CBNG Resources

An estimate of CBNG and conventional oil and gas resources was accomplished using many sources of information, including established files and databases, the BLM Resource Management Plans (RMPs) for the areas, coal information from the U.S. Geological Survey (USGS), professional and academic literature, available oil and gas maps, previous mineral assessments and expressions of interest and projections from the oil and gas industry. To project CBNG exploration and development, the areal extent of certain coals and the rank of coals in the CBNG emphasis area were considered.

Areas of subbituminous to bituminous coals were considered as the most likely to be explored and developed in Montana, although exploration and development has occurred mainly in subbituminous coal in the Wyoming portion of the Powder River Basin. The USGS produced an Open File Report (OF 96-92) showing the areas of coal, by rank, for the United States. This information indicates subbituminous and bituminous coals in many parts of the emphasis area. See Map MIN-1 in the Minerals Appendix for an illustration of this data and Map 4-1 for a geographical presentation of potential CBNG development within Montana.

Powder River, Rosebud, Custer and Big Horn counties contain the northern part of the Powder River Basin, which extends from Wyoming. Musselshell County has mostly subbituminous coal, while Carbon County has an extension of the Big Horn Basin coal, which is ranked as bituminous coal.

The amount of natural gas that could be produced from the coal beds in Montana has been projected to range from a low of 1 trillion cubic feet (TCF) (Crockett and Meyer 2001) to a high of 17.7 TCF (Nelson 2000). This and other information for Montana is used to predict where CBNG exploration is most likely to occur in the RMP areas. The RFD predicts the number of CBNG wells that would be drilled and completed during the next 20 years per alternative. By making these predictions, cumulative impacts can be assessed.

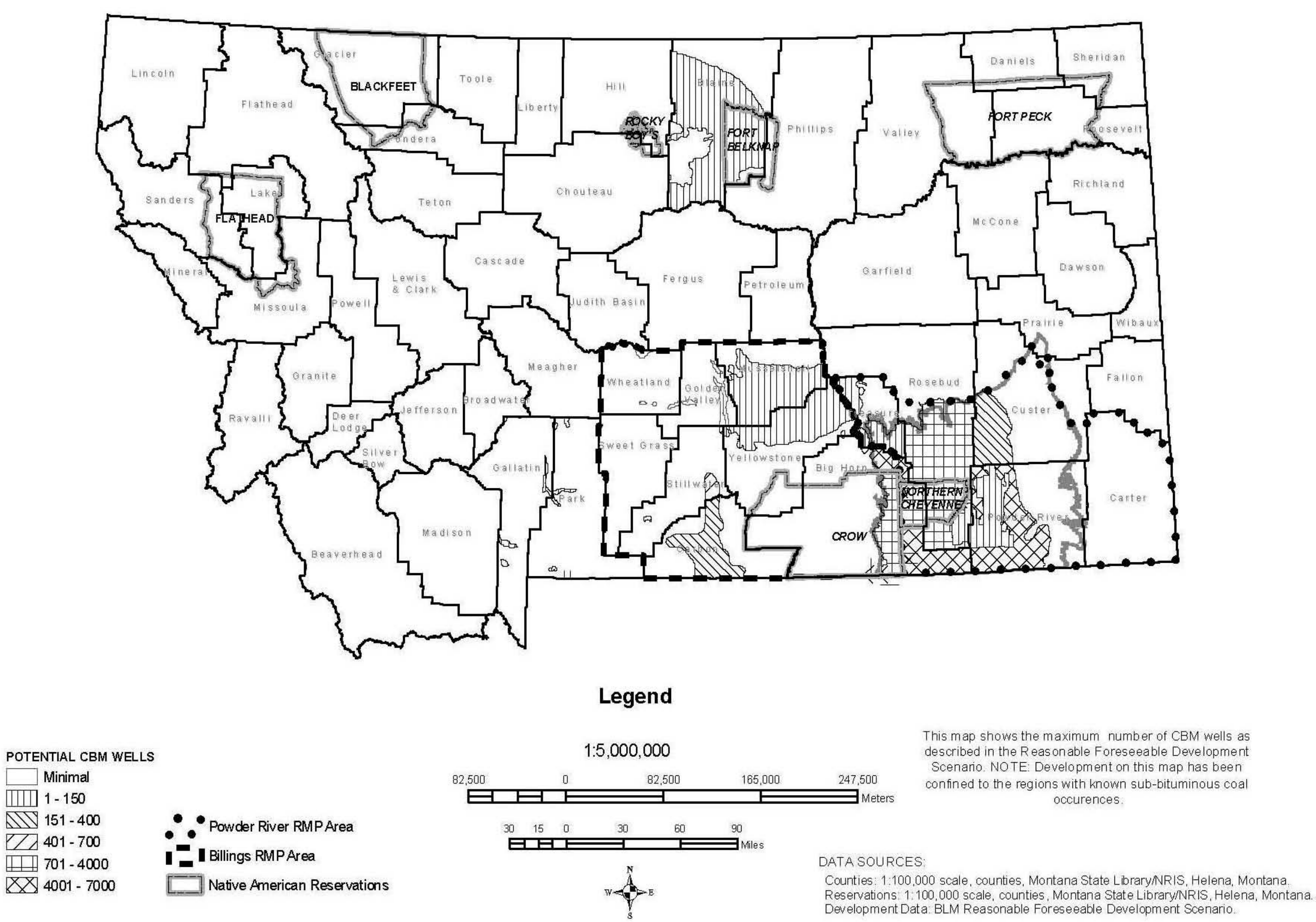
Reasonably Foreseeable Development Scenario

Projections of future CBNG development and production are difficult to make. Several variables complicate such forecasts, including new exploration, development or production techniques; increases or decreases in demand for natural gas; and price increases or decreases that may prompt larger or smaller development and production programs. For this FSEIS, a combination of historical trends, present activity, government and industry estimates and professional judgments were used in establishing the estimate of RFD. The RFD is discussed under three scenarios: restricted development, expanded development and phased development.

Restricted Development

Restricted development is applied to Alternative A. Under this scenario, the BLM would only approve exploration well permits and the state would only proceed with the development identified in the Stipulation and Settlement Agreement as presented in Chapter 2. With regards to the BLM exploration wells, an RFD of 200 wells per RMP area was assigned to provide a level of quantification for analysis; however, the BLM has no actual upper cap on issuing exploration well permits. The RFD numbers in no way represents a regulatory number for exploration wells that could be issued by the BLM.

Map 4-1: CBM Development Based on Reasonably Foreseeable Development Scenario



This map shows the maximum number of CBM wells as described in the Reasonable Foreseeable Development Scenario. NOTE: Development on this map has been confined to the regions with known sub-bituminous coal occurences.

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.
Development Data: BLM Reasonable Foreseeable Development Scenario.

Expanded Development

Expanded development is considered for Alternatives B, C, D and E. Expanded refers to the number of potential wells based on known coal volumes that would be drilled in the RMP areas during the next 20 years, regardless of mineral ownership. Given the current oil and gas stipulations, the restricted development areas and the unknown geographical distribution of coal bed natural gas, it is unlikely that the maximum well density of 1 well per producing coal seam per 80 acres would be achieved. Map 4-1 indicates the predicted number of wells per county overlying known coal occurrences. The estimate for expanded development ranges from 10,000 to 26,000 wells drilled, the upper limit includes the reasonably foreseeable future activity (RFFA) estimates of 4,000 wells each for the Crow and Northern Cheyenne reservations and 200 wells for the Custer National Forest. The Powder River RMP area could host as many as 7,500 to 14,000 producing CBNG wells during the next 20 years. The RFD also estimated that 200 to 800 new conventional oil and gas wells could be drilled in the Powder River RMP area during the same time period. In the Billings RMP area, an estimated 1,000 to 2,400 producing CBNG wells could be installed. Conventional oil and gas wells are estimated to increase by 250 to 975 during this same time.

The expanded development estimate also predicted the number of potential field and sales compressors needed to export the gas. This level of development would require from 400 to 1,000 field compressors and from 50 to 100 sales compressors. Estimates for the gathering and sales lines are also included in the RFD.

Phased Development

Phased development of CBNG resources on federal leases is analyzed in three alternatives. Alternatives F and G describe high and low ranges for phased development of federal CBNG, while Alternative H (discussed in the following section) is the preferred alternative for phased development. The three alternatives also address cumulative impacts from the phased development of federal CBNG. Phased development differs from the expanded (full-field) development scenario because BLM would limit the number of approved federal Applications for Permit to Drill (APDs) by year and by geographic area. Alternative F would incorporate a limit based on the high range of development predicted within the RFD and Alternative G would incorporate a limit based on the low range of development predicted within the RFD. These two phased-development alternatives would consider wells per watershed instead of wells per county (Tables 4-1 and 4-2). The same high range predicted total number of potential state, private and federal wells based on known coal volumes that would be drilled under expanded development over the next 20 years, regardless of mineral ownership, would still apply to Alternative F. The constraints (multiple screens) imposed under the phased-development alternatives would limit the number of BLM-issued annual APDs to 5 percent of the total issued (RFD scenario rate of development). The projected rate of development identified in the RFD will be applied to state-approved APDs during the next 20 years. The resulting development rate for state wells was used to identify the pace at which BLM APDs could be approved within the 5 percent constraint. The assumed phased development rate for Alternatives F and G is shown in Tables 4-3 and 4-4. Figures 4-1 and 4-1A show the assumed development rates for Alternatives F and G.

Coal reserves indicate that 15 watersheds may be developed for CBNG over the next 20 years. Of these 15 watersheds, five hold most of the CBNG potential in Montana. These five watersheds are all located in the Powder River Basin (PRB).

The watershed screen is a combination of the RFD rate of development as applied to the CBNG wells approved by the state and an assumed 5 percent limit applied to federal wells. The use of this screen has resulted in the predicted number of APDs to be issued per watershed per year. The assumed order of watershed development was determined by proximity to existing development (southern watersheds within the PRB portion of Montana), operator plans of development (PODs) being prepared or being reviewed by an agency (see Figure 3-4 and 3-5) and areas with multiple coal seams.

Applying the 5 percent annual screen and the watershed screen increases the predicted 20-year development period by three years. For years 12 through 23, BLM would not issue the total 5 percent of APDs anticipated because the watershed screen would influence development.

Estimates for the total number of compressors needed to export the gas are the same as predicted in the RFD for each RMP area under Alternative F. Under Alternative G, however, the number of compressors needed would be 65 percent fewer than the amount proposed in the RFD.

TABLE 4-1

**PREDICTED APDS/WATERSHED UNDER ALTERNATIVE F
HIGH-RANGE, PHASED CBNG DEVELOPMENT**

	Watershed Name	State	BLM	Total
1	Clarks Fork Yellowstone	233	217	450
2	Little Bighorn	675	0	675
3	Little Powder	104	96	200
4	Lower Bighorn	414	386	800
5	Lower Tongue	1,786	1,664	3,450
6	Lower Yellowstone-Sunday	880	820	1700
7	Middle Musselshell	52	48	100
8	Middle Powder	1,087	1,013	2,100
9	Mizpah	65	60	125
10	Rosebud	1,863	1,737	3,600
11	Stillwater	52	48	100
12	Upper Musselshell	39	36	75
13	Upper Tongue	1,993	1,857	3,850
14	Upper Yellowstone-Lake Basin	414	386	800
15	Upper Yellowstone-Pompeys Pillar	104	96	200
	Total Predicted APDs	9,759	8,466	18,225

TABLE 4-2

**PREDICTED APDS/WATERSHED UNDER ALTERNATIVE G
LOW-RANGE, PHASED CBNG DEVELOPMENT**

	Watershed Name	State	BLM	Total
1	Clarks Fork Yellowstone	88	82	170
2	Little Bighorn	240	0	240
3	Little Powder	36	34	70
4	Lower Bighorn	145	135	280
5	Lower Tongue	626	584	1,210
6	Lower Yellowstone-Sunday	311	289	600
7	Middle Musselshell	21	19	40
8	Middle Powder	383	357	740
9	Mizpah	21	19	40
10	Rosebud	657	613	1,270
11	Stillwater	21	19	40
12	Upper Musselshell	16	14	30
13	Upper Tongue	699	651	1,350
14	Upper Yellowstone-Lake Basin	155	145	300
15	Upper Yellowstone-Pompeys Pillar	47	43	90
	Total Predicted APDs	3,464	3,006	6,470

TABLE 4-3

ALTERNATIVE F ASSUMED DEVELOPMENT RATE (APDS)

Year	Percentage	State/Private	BLM	Total Annual
1	3%	488	119	607
2	5%	586	324	910
3	6%	1,074	0	1,074
4	6%	1,170	0	1,170
5	6%	1,074	0	1,074
6	5%	781	129	910
7	5%	683	227	910
8	5%	488	422	910
9	5%	488	422	910
10	5%	390	520	910
11	5%	293	617	910
12	5%	293	613	906
13	5%	293	531	824
14	5%	293	531	824
15	5%	293	531	824
16	4%	244	460	704
17	4%	244	459	703
18	4%	244	410	654
19	3%	195	348	543
20	2%	145	299	444
21	3%	0	509	509
22	3%	0	496	496
23	3%	0	499	499
	100%	9,759	8,466	18,225
Low-end Total*		8,974	6,918	15,892

*Low-end total reflects the reduction of wells if no drilling occurs within the crucial sage habitat areas on both private and federal mineral estates.

FIGURE 4-1

ALTERNATIVE F ASSUMED DEVELOPMENT RATE

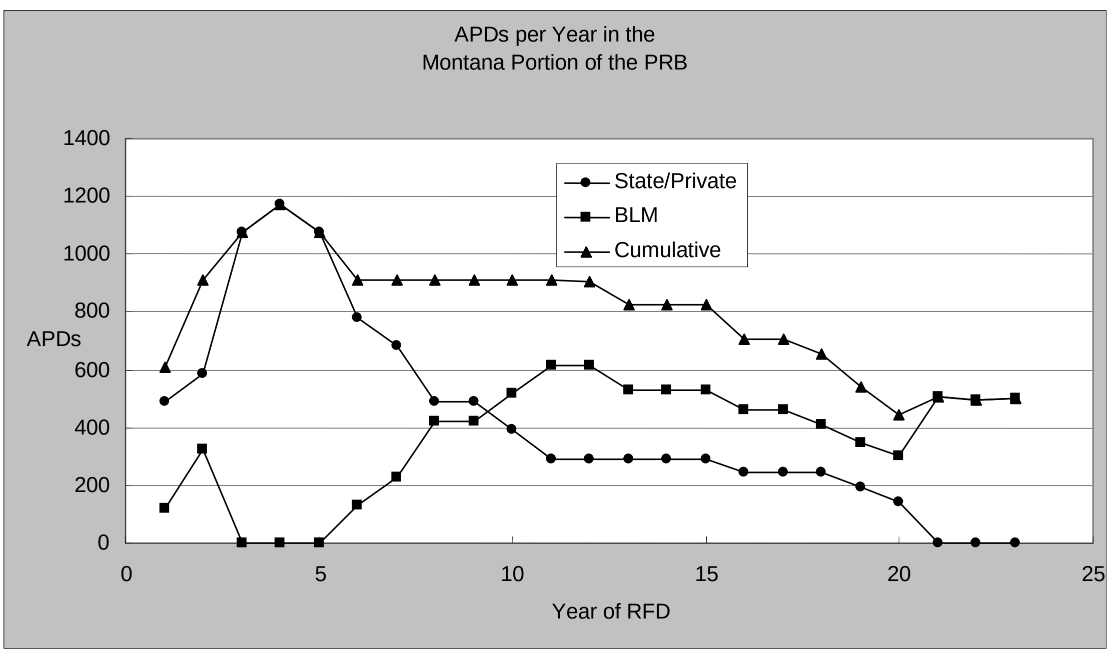


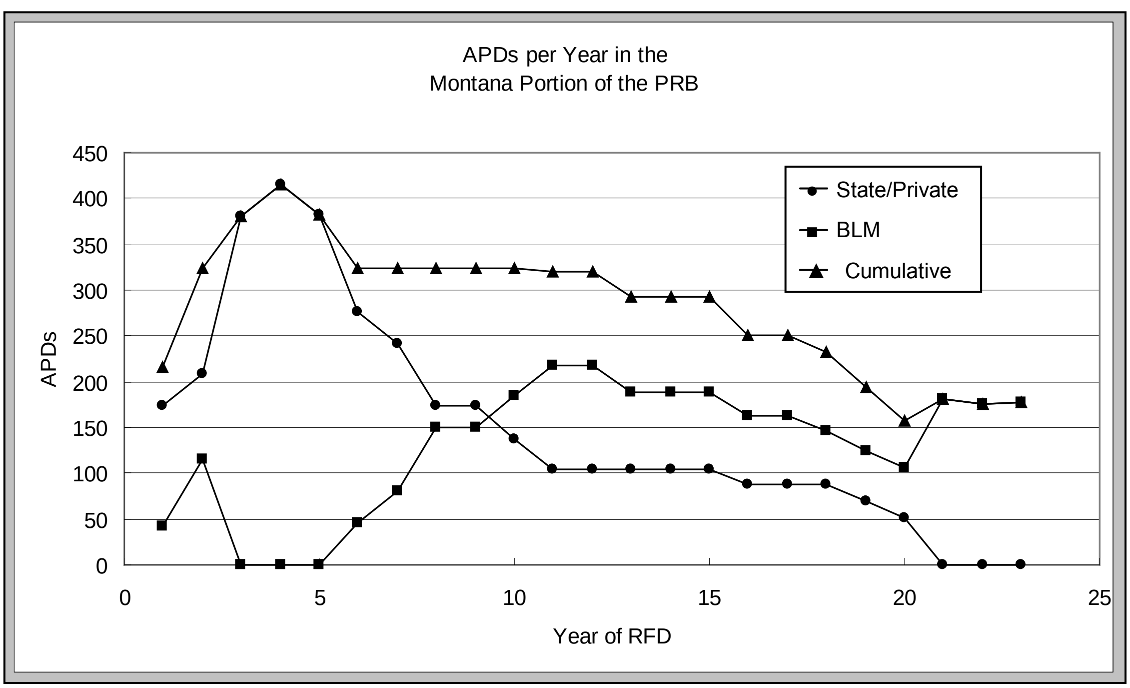
TABLE 4-4

ALTERNATIVE G ASSUMED DEVELOPMENT RATE (APDS)

Year	Percentage	State/Private	BLM	Total Annual
1	3%	173	42	215
2	5%	208	115	323
3	6%	381	0	381
4	6%	416	0	416
5	6%	382	0	382
6	5%	277	46	323
7	5%	242	81	323
8	5%	173	150	323
9	5%	173	150	323
10	5%	138	185	323
11	5%	104	217	321
12	5%	104	217	321
13	5%	104	189	293
14	5%	104	189	293
15	5%	104	188	292
16	4%	87	163	250
17	4%	87	163	250
18	4%	87	146	233
19	3%	69	124	193
20	2%	51	106	157
21	3%	0	181	181
22	3%	0	176	176
23	3%	0	177	177
	100%	3,464	3,006	6,470

FIGURE 4-1A

ALTERNATIVE G ASSUMED DEVELOPMENT RATE



Preferred Alternative Development

Development anticipated under Preferred Alternative H might differ slightly from the high-range, phased development scenario (Alternative F). The cumulative number of APDs per year would be similar; however, BLM could approve APDs each year and would not be restricted by the number of CBNG permits approved by the state. During the initial 5-year development period, BLM could issue APDs for federally administered minerals at a rate similar to permits issued by the state for private and state administered minerals. Furthermore, since BLM could issue APDs each year, the development scenario duration might be somewhat shorter than Alternative F at 23 years. The rate of development for approved state/private wells under the preferred alternative would be lower than predicted under the RFD. This is based on proposed federal wells associated with state-approved PODs Discussions with industry indicate future development would occur close to existing PODs characterized by high percentages of federal minerals (personal communication, Bruce Williams,, March 2006). Currently 367 federal APDs are pending approval within the boundaries of PODs previously approved by the state.

The preferred alternative would also consider wells per watershed instead of wells per county (Table 4-1), reflecting the phased development alternative; however the watershed screen would not be applied. The high-range, RFD-predicted total number of state, private and federal wells (18,225) would apply to the preferred alternative. The constraints (multiple screens) imposed under the preferred alternative would limit the impacts to key resources and would provide a process to determine if development proposals would have to be modified to alter the pace or place of development. The assumed rate of development for the preferred alternative over the next 21 years is identified in Table 4-5 and shown in Figure 4-2.

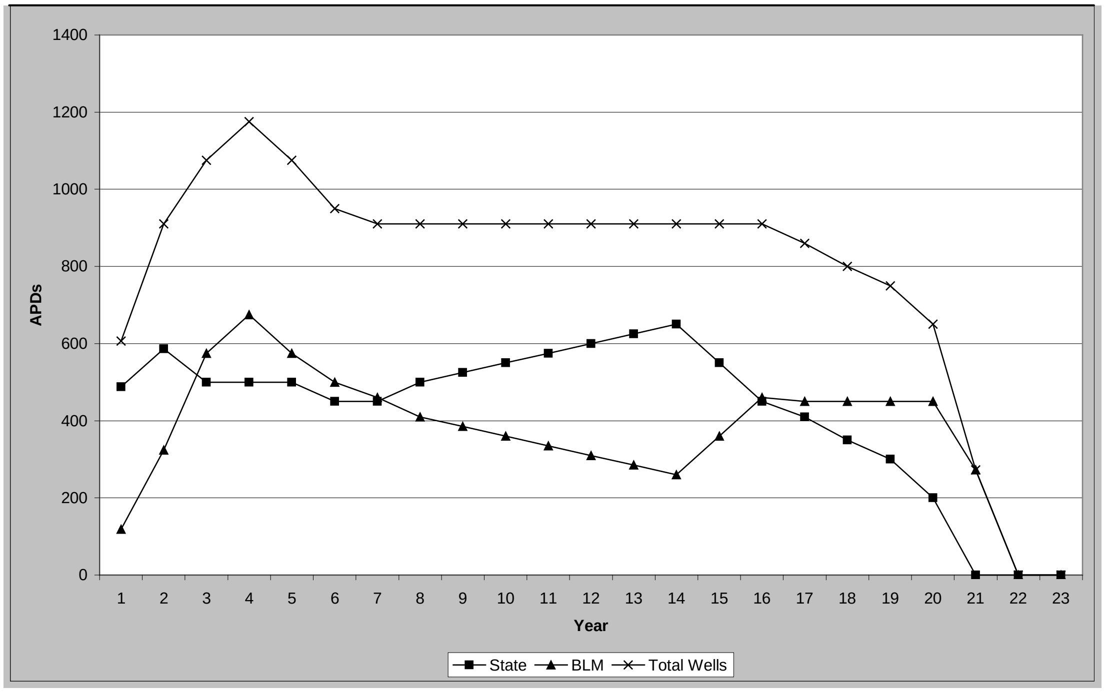
TABLE 4-5

PREFERRED ALTERNATIVE H ASSUMED DEVELOPMENT RATE (APDS)

Year	State/Private	BLM	Total Annual
1	488	119	607
2	586	324	910
3	500	575	1075
4	500	675	1,175
5	500	575	1,075
6	450	500	950
7	450	460	910
8	500	410	910
9	525	385	910
10	550	360	910
11	575	335	910
12	600	310	910
13	625	285	910
14	650	260	910
15	550	360	910
16	450	460	910
17	410	450	860
18	350	450	800
19	300	450	750
20	200	450	650
21	0	273	273
22	0	0	0
23	0	0	0
	9,759	8,466	18,225

FIGURE 4-2

PREFERRED ALTERNATIVE H ASSUMED DEVELOPMENT RATE



Estimates for the total number of compressors needed to export the gas are the same as predicted in the RFD.

The preferred alternative (Alternative H) differs from Alternative F as described below:

The preferred alternative would apply the condition on development in crucial sage-grouse habitat requiring no displacement of sage-grouse within crucial habitat areas. Specifically, the preferred alternative calls for maintaining the connectivity of the habitats, managing habitat to maintain healthy sage-grouse populations to serve as source populations and within the crucial sage grouse areas, maintain sage-grouse habitat so that population trends follow the general magnitude of decline or increase on control leks. BLM would work with operators, the Montana Board of Oil and Gas Conservation (MBOGC), the MFWP, the FWS and academia to identify best management practices/conditions of approval (BMPs/COAs) universally applied to all CBNG development in crucial habitat areas. This approach would identify BMPs, apply BMPs and monitor the effectiveness of BMPs. Should BMPs prove unable to meet the objectives of maintaining habitat connectivity and source populations for sage-grouse, additional or more stringent existing BMPs would be identified and applied.

In Alternatives F & H, the condition for allowable development within sage-grouse habitat areas (i.e., development cannot contribute to displacement of sage-grouse from crucial habitat areas) would probably lead to a lower number of wells drilled. The RFD predicted wells would be drilled on 80-acre spacing within the crucial sage-grouse habitat areas. Actual development in these areas might be significantly lower than predicted in the RFD. If operators chose to avoid all crucial habitat areas, approximately 2,333 fewer wells would be drilled. If the private minerals were fully developed within the crucial sage-grouse habitat areas, 1,549 fewer wells would be drilled.

To quantify impacts under Alternative F, the original RFD development numbers were used to assess impacts assuming operators could drill on current spacing and sage-grouse would not be displaced from habitat areas. Impacts were also quantified assuming no development would occur in these areas. This means 2,333 wells (with the associated roads, pipelines, compressors and produced water) would not be developed or installed. It also means gas would be left in place or drained from adjacent development. The most likely outcome would be somewhere between the full development and the no-development scenarios. Given the uncertainty associated with the effectiveness of alternative development scenarios regarding resource recovery, the low-end (no development) and high-end (full development) scenarios are used to bracket the impacts which would probably occur.

Alternative development scenarios could include a less-dense well pattern drilled within the habitat areas. Another potential scenario might be wells drilled on a denser spacing, but with fewer wells per year drilled within the habitat areas and no compressors installed on these sites. This does not suggest that these options would be viable, but rather points out that some level of development within the crucial sage-grouse habitat areas would probably occur.

Assumptions Common to All Alternatives

Assumptions common to all alternatives address issues such as level of disturbance associated with various development scenarios, implementation of best management practices (BMPs), general assumptions for percentages of alternative themes and numbers for various field equipment utilized, well spacing for production of CBNG and water discharge and drawdown rates for expanded development.

These assumptions are used to ground the analysis so that similar comparisons can be conducted across the various resource topics and throughout the alternatives.

Levels of Disturbance

In evaluating environmental impacts, criteria for determining quantitative impacts are required. Further, to facilitate some uniformity with respect to impact analyses, the following synopsis was prepared to give a general understanding of the resources necessary for the installation and production of a single CBNG well.

These values were determined from a variety of sources, including previous CBNG Environmental Assessments, discussions with BLM and state personnel, discussions with CBNG operators and information derived from the review of numerous applicable documents. However, actual references are not provided as these numbers were ultimately derived through internal analysis based on understanding of current and proposed CBNG activities in Montana and other areas (including Wyoming, Colorado, New Mexico, Arkansas, Alabama and Oklahoma).

The values presented in Table 4-6 can be scaled to accommodate the various scenarios being proposed for exploration, construction and operation phases.

The following descriptions outline the assumptions used to develop Table 4-6.

Well Sites

Construction = 0.25 acre based on a 105-foot by 105-foot pad for exploration, construction and drilling operations

Operations = 0.058 acre based on a 50-foot by 50-foot pad for operations, well pad size may increase if multiple wells are drilled on the same pad, but total acres of disturbance would be less than separate well pads for single wells.

Access Roads

Two-track = 0.30 acre based on 12-foot-wide roads by 0.21 mile/well (this applies to both construction and operation)

Graveled Roads = 0.11 acre based on 12-foot-wide roads by 0.075 mile/well (this applies to both construction and operation)

Bladed Roads = 0.075 acre based on 12-foot-wide roads by 0.05 mile/well (this is for construction phase only)

Bladed Roads = 0.090 acre based on 12-foot-wide roads by 0.06 mile/well (this is for operation phase only)

Bladed Roads = 0.75 acre based on 12-foot-wide roads by 0.5 mile/well (this is for exploration only)

Utility Lines

Water = 0.35 acre based on 15-foot by 0.20 mile/well (construction only)

Elec. Utility Overhead = 0.20 acre based on 10-foot by 0.15 mile/well (construction and operation)

Elec. Utility Underground = 0.35 acre based on 15-foot by 0.20 mile/well (construction only)

Transportation Lines

Low Pressure Gas = 0.90 acre based on 15-foot by 0.5 mile/well (construction only)

Intermediate Pressure Gas = 0.25 acre based on 25-foot by 0.08 mile/well (construction only)

Battery Site

Construction and Operation = 0.5 acre per battery site. Assume one battery site per field compressor. Disturbance per well = (0.5/24) = 0.020

Access Roads = 0.15 acre based on 25-foot by 0.050 mile per well during construction and operations

Field Compressors = 1 compressor per 24 producing wells

TABLE 4-6

LEVEL OF DISTURBANCE

Facilities		**Exploratory Well Disturbance (acres/well)**	**Construction Disturbance (Short-term < 5-yr.) (acres/well)**	**Operation/Production Disturbance (Long-term >5-yr.) (acres/well)**
Well Sites		0.25	0.25	0.05
Access Roads/ Routes to Well Sites	Two-track	N/A	0.30	0.30
	Graveled	N/A	0.10	0.10
	Bladed	0.75	0.075	0.10
Utility Lines	Water	N/A	0.35	----[1]
	Overhead Elec.	N/A	0.20	0.20
	Underground Elec.	N/A	0.35	----
Transportation Lines	Low Pres. Gas	N/A	0.90	----
	Intermediate Pres. Gas	N/A	0.25	----
Processing Area	Battery Site	N/A	0.020	0.020
	Access Roads	N/A	0.15	0.15
	Field Compressor	N/A	----	(0.5/24) = 0.02
	1/24 producing wells			
	Sales Compressor	N/A	----	(1.0/240) = 0.005
	1/10 Field Compressors			
	Plastic Line[2]	N/A	----	0.5
	Gathering Line	N/A	----	0.25
	Sales Line	N/A	----	0.075
Produced Water Management	Discharge Point	N/A	0.01	0.002
	Storage Impoundment	N/A	0.3	0.25
Total Disturbance		1.0	3.25	2.0

Note: This table shows levels of disturbance associated with exploration and development of CBNG wells and field transfer equipment. All values represent acres per well unless otherwise noted.

[1]All utilities are completed underground and the land above is reclaimed so the acres of disturbance are removed from the operation column. **Note:** The intent of reclamation is to stabilize the area of disturbance and establish a vegetative cover similar to the native plant community that existed prior to disturbance. Reclamation success will vary as described in the *Vegetation* section.

[2]Lines within processing area are assumed to disturb an average width of 25 feet.

Sales Compressors = 1 compressor per 240 producing wells or 10 field compressors

Plastic line = 0.5 mile per well pad. Assume 3 wells per pad, 25-foot width

Gathering line = 2.0 miles/field compressor at 25-foot width or (5280*2*25/24/43,560) = 0.25 acre/well

Sales line = 6.0 miles/sales compressor at 25-foot wide. (6*5280*25/240/43,560) = 0.075 acre/well

Produced Water Management

Assume 1 discharge point for every 20 wells

Discharge points construction = 0.01 acre/point based on 20-foot by 20-foot area during construction

Discharge points operations = 0.002 acre/point based on 10-foot by 10-foot area during operations

Storage impoundments = 6 acres/impoundment during construction per well pod of 20 wells, assume one acre reclaimed from construction so 5 acres/impoundment during operation per POD of 20 wells

Total Area of Disturbance

Exploration = 1.0 acres/well

Construction = 3.25 acres/well

Operation = 2.0 acres/well

Field Rules and Leasing Stipulations

The discussion of impacts assumes the leasing stipulations described for each resource would be successfully implemented by each of the permitting agencies in each of the alternatives. Use of existing Lease Stipulations and mitigation measures (see Minerals Appendix, Table MIN-5) is considered to be standard operating procedures by BLM.

The MBOGC issues field rules that address the spacing of wells based on such factors as geology, technology and economics. The MBOGC will provide guidance to private landowners if requested on how and what to include in their leases to protect resources, but it is up to the individual lessor as to what they request from the operator in terms of reclamation, mitigation and other measures.

The Montana Trust Land Management Division (TLMD) of the Montana Department of Natural Resources and Conservation (DNRC) also has lease stipulations for their minerals as listed in the Minerals Appendix. The TLMD utilizes a set of standard stipulations on all oil and gas leases that is different from those used by BLM. Additional stipulations are placed on the leases on a case-by-case basis prior to their being leased. In addition, the TLMD undertakes a site-specific review process for exploration and operating plan proposals. This review process generates site-specific stipulations for issues such as steep topography, wildlife, streams, wooded areas and rivers and lakes. It was assumed that only requirements contained in existing federal and state law that apply to private land ownership will be enforced on private land.

Stipulations and field rules are intended to avoid potential effects on resource values and land uses from oil and gas activities and include actions such as site clearances and occupancy and timing restrictions.

Lease stipulations would be implemented before conducting exploration, production and abandonment activities. The following discussion of project impacts assumes applicable stipulations and field rules would be fully implemented and followed. The

The actual disturbance per well will be dependent on the actual site specific water management practices used.

success of these stipulations or field rules in avoiding covered impacts, in some instances, will require collection of site specific information regarding the resources to be protected relative to exploration, production and abandonment plans followed by strict adherence to the terms of the stipulations and field rules. Planned monitoring activities by the BLM for all resources have been outlined in a table attached in the Monitoring Appendix. Impacts described include those that would occur in spite of the successful implementation of stipulations or field rules, or where stipulations or field rules are not expected to avoid all impacts.

Proposed mitigation measures are intended to minimize the impacts that cannot be avoided. Mitigation measures also apply to all alternatives on BLM and state lands. Residual impacts are those expected to remain after the implementation of mitigation measures.

General Assumptions

Assumptions represent the best professional judgment of the specialist based on experience, similar occurrences and known circumstances and studies. Assumptions that are common to all of the alternatives provide the foundation for the analysis of impacts. The following assumptions apply to each alternative:

- The spacing for CBNG wells would be similar to CBNG well spacing in Wyoming with one well per 80 acres per coal seam. Up to five coal seams have been identified for possible methane extraction in the Powder River Basin. However, for analysis purposes, it is assumed that an average of three wells would be drilled per 80-acre spacing unit.

- The life of a typical CBNG production well is assumed to be 20 years, including construction and reclamation.

- CBNG wells will come on line and go off line as described in the RFD.

- Water production for a single CBNG well can be estimated by the following equation:

$$Q = 14.661e^{-0.0242t}$$

  Where Q = discharge in gpm and t = time in months. The average production over 20 years using this equation is 2.5 gpm; however discharge rates would begin at approximately 15 gpm and decrease over time as the coal seam becomes depressurized.

- The combination of the 2 preceding assumptions results in the maximum discharge for the total field occurring in year 6 of the development, for Alternatives B, C, D and E when 7,095 wells would be pumping at an average rate of 6.2 gpm to produce 43,989 gpm. This maximum produced water volume is used for the impact analysis.
- Under phased development for Alternative F, the maximum amount of water produced in the field would occur in year 12 when 10,081 wells would probably pump at an average rate of 3.5 gpm to produce 34,961 gpm. This maximum produced water volume is used for the impacts analysis for Alternative F.
- Under phased development for Alternative G, the maximum amount of water produced in the field would occur in year 12 when 3,577 wells would probably pump at an average rate of 3.5 gpm to produce 12,390 gpm. This maximum produced water volume is used for the impacts analysis for Alternative G.
- Under Alternative H, the maximum amount of water produced in the field would occur in year 16 when 13,403 wells would probably pump at an average rate of 2.9 gpm to produce 39,400 gpm. This maximum produced water volume is used for the impacts analysis for Alternative H.
- 20 percent of waters discharged will evaporate or infiltrate prior to reaching perennial waters.
- It is assumed that a single CBNG well will drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin suggests drainage may be across a broader radius (Crockett and Meyer 2001). Drainage issues will need to be assessed on a case-by-case basis to determine the drainage radius, which will depend upon local reservoir parameters.
- The level of disturbance associated with a production well is the same regardless of the method of completion, whether a single well bore per coal seam or multiple seam completions in a well bore.
- Typical drilling operations for each CBNG well, regardless of whether it was a CBNG exploration or production well, would require 3 to 5 days with an additional 2 to 3 days for completion work. A maximum of 7 to 8 people would be present on a well at any one time during this construction phase.
- Approximately 26,000 gallons of water would be needed to drill each well. The water will typically be obtained from other producing CBNG wells in the area, or trucked into remote sites as needed.
- Equipment present at each well site during construction would consist of the following: one or two truck-mounted drill rig(s), with three men per rig; one backhoe; one blade; three crew pick-up trucks; one well logging truck; one pipe truck; two to four water trucks; one cement truck; one electrical generator trailer; one frac tank for wastewater; and two large flat bed trailers. Not all vehicles would be at the well site at the same time or for the entire duration of drilling and completion operations.
- Portable toilets would be available at the drill sites. Garbage would be stored in closed containers. Sewage and solid waste would be hauled offsite to permitted disposal facilities.
- Each CBNG well would be equipped with a submersible pump ranging from 3 to 20 horsepower, depending on well depth, required pumping rate and other site conditions.
- Exploration wells would be visited once a day during testing and pumping operations. Pump tests could last as long as 6 months depending on the time required for measuring cumulative methane production estimates. Methane would be flared (burned off) continuously during the testing phase.
- Fuel for generators during exploration testing would be either gas (propane) or diesel and require at least one trip to the well site weekly. Small generators used during testing would be mobile, enclosed and between 15 to 20 kilowatts (kW).
- A larger generator used during production would serve several wells (three to four) and be in the range of 75 to 125 kW.
- The selected alternative (Alternative 2A) for water and that portion of Alternative 1 regarding the use of natural gas fired compressors for the Wyoming Powder River Basin oil and gas projects will be implemented under all

alternatives. This alternative assumes continued development of CBNG and conventional oil and gas resources would occur in the Wyoming Powder River Basin Planning Area. Up to 39,367 additional CBNG wells and 3,200 conventional oil and gas wells would be developed over the next 10 years.

- Under Alternatives B through H, the number of exploration/dry holes would be approximately 10 percent of the total estimated wells drilled.

- Under Alternatives B through E all exploration/dry holes would be drilled in the first 5 years of development. Under Alternatives F, G and H, exploration/dry holes would comprise approximately 10 percent of the wells drilled annually.

- Under Alternatives A and C, the number of wells connected to each compressor would be per operators plans; it is assumed that this is consistent with the RFD of 24 wells per compressor. This estimate is based on an average well production rate of 250,000 cubic feet per day methane being sent to a 6 million cubic feet per day, four-stage reciprocal compressor operating at 380 horsepower and using natural gas.

- Under Alternatives B, D, E, F, and G the number of wells connected to each compressor would be maximized; this is assumed to be approximately 35 wells at average production going to a 9 million cubic feet per day, four-stage reciprocal compressor. Under Alternative H, the number of wells connected to each field compressor reflects what is currently practiced by operators within the Montana portion of the PRB which is 40 wells per compressor. The maximization of well connections would reduce the number of field compressor sites and subsequently air emissions.

- No hydraulic fracturing or cavitation would be required to stimulate wells; however, low-pressure, low-volume water enhancement may be used. This would involve flushing the well with a few hundred gallons of water to clean the face of coal surface in the exposed seam. This process does not fracture the coal; it simply cleans out the existing fractures.

- Under Alternatives B and D in the theme of CBNG, multiple completions in a single borehole would be required. It is assumed that a small reduction in surface disturbance would be experienced, but that the levels of disturbance previously described are acceptable for these alternatives without alteration.

- Under Lands and Realty, when no transportation corridors are required, it is assumed the utility lines (power, water and gas) would be placed along separate routes, or in existing disturbances to and from the well site locations or compressor batteries, whichever is more suitable to the operator. When transportation corridors are required, it is assumed they would be placed adjacent to access roads and along existing disturbances, resulting in a 35 percent reduction of disturbed surface areas.

- Concerning Socioeconomics it is assumed the state would not enforce buffer zones on their minerals or on private minerals since they do not have a trust responsibility.

- The potential development on the reservations would be considered under the cumulative effects analysis based on the development outline in the RFD for the reservations.

- Under the Hydrology theme for Alternative B, untreated CBNG water from exploration wells would be placed in tanks and disposed of at a permitted injection well. It is assumed the use of pits, impoundments and other holding facilities as permitted under Alternative A would be allowed. In addition, it is assumed produced water would be injected into a deeper aquifer of lesser quality with no communication to aquifers used as sources of drinking water or into coal seam aquifers.

- Under the Hydrology theme for Alternatives C and D, produced water would be available for beneficial use. It is assumed industries and landowners would use approximately 20 percent of the produced water. The estimate of 20 percent is based on the observed beneficial uses at the CX Ranch and in Wyoming and on the perceived potential for similar uses throughout the Planning Area.

Assumption Rationale

CBNG Well Production Life

The rationale for using a 20-year lifespan for a typical CBNG well in Montana is based on several technical considerations as well as the best professional judgment of several specialists. The well life is based on the economic limit selected for the well, the wide variety of geologic basins in Montana, the data limitations, the variations in the rank of coals that may be encountered in Montana and a review of the well life of CBNG wells in other producing basins, including Wyoming and the San Juan Basin. These rationales are generally summarized below:

Montana Planning Area: The Planning Area for the FSEIS for BLM is the Billings and Powder River RMPs. Although an emphasis was placed on the Powder River Basin, assumptions used were derived for the entire Planning Area based on existing available information. CBNG production in Montana and Wyoming is relatively new as compared to conventional oil and gas production in either of these states. In Montana, approximately 550 producing CBNG wells exist in the CX Ranch Field near Decker, Montana. Throughout Montana, very little information is available relative to CBNG production or testing outside of the current producing area at CX Ranch. Further, there are a variety of underground coal seams that must be considered, including areas in the Powder River Basin, Bull Mountain Basin and areas elsewhere in the state (including the entirety of the two BLM RMPs).

1. **Economic Production Limits on CBNG Wells**: The BLM in Wyoming selected an average production life for CBNG wells in the Planning Area based on production decline analysis from existing production on federal leases. These analyses assume an economic limit of approximately 1,000 thousand cubic feet (MCF) per month (personal communication, Bob Chase, BLM). CBNG producers currently operating in the Wyoming Powder River Basin suggested the economic limit of 1,000 MCF per month to the BLM. Based on Wyoming's limited planning area and the extent of existing data available that is directly within the Planning Area, this approach appears justified. To date, no wells have been confirmed as reaching their economic limit in the Powder River Basin in either Wyoming or Montana. Several wells have reached monthly production of less than 1,000 MCF per month and several other wells have been shut-in. However, based on existing knowledge of CBNG operations, it is not clear whether shut-in wells will remain shut-in without further production.

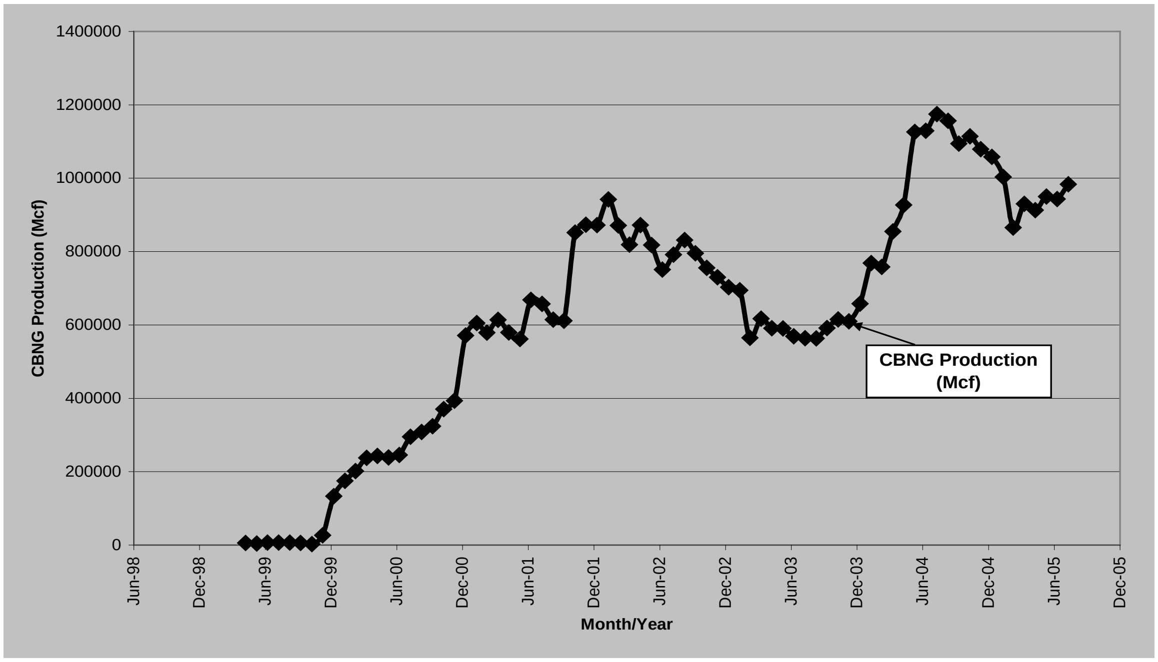
   The economic limits used by the Wyoming BLM of 1,000 MCF per month appear reasonable for planning in the Wyoming portion of the basin. However, there are many examples of wells producing at rates of less than 1,000 MCF per month for considerable periods. The Wyoming portion of the Powder River Basin has production rates less than 1,000 MCF while continuing to produce. However, it is currently unknown whether CBNG wells in the Montana Powder River Basin will be shut-in and plugged once a production rate of 1,000 MCF per month is achieved.

   Of further consideration is the rationale that the proposed economic production limit used in the Wyoming EIS is based on certain economics provided by operators currently producing in Wyoming. Many of these producers are relatively large businesses. In the case of conventional oil and gas production, it is common for larger producers to sell production to smaller companies that may be capable of operating projects at a lesser cost—especially later in the life of the project when production rates are substantially reduced. This progression of producing properties transitioning from large companies to smaller companies supports the argument that the viable economic production life of a CBNG well could be less than 1,000 MCF per month. This is especially significant considering the socioeconomic situation in Montana and especially relative to the Northern Cheyenne and Crow reservations.

2. **Geologic Differences**: Because the Montana Planning Area includes the entire state, there are significant differences in geology when comparing assumptions used for impact analyses between the two plans.

3. **Data Limitations**: CBNG production in Montana and Wyoming is relatively new as compared to conventional oil and gas production in either of these states. In Montana, approximately 550 producing CBNG wells exist in an area near Decker, Montana. Throughout Montana, little information is available relative to CBNG production or testing outside of one current producing area at CX Ranch. Further, there are a variety of underground coal seams that must be considered, including areas in the Powder River Basin, Bull Mountain Basin and areas elsewhere in the state (including the entirety of the two BLM RMP areas). Figure 4-3 presents production data for the CX Ranch field near Decker, Montana (MBOGC 2005). This figure shows that actual production of CBNG in Montana started in April 1999.

FIGURE 4-3
CBNG PRODUCTION CX RANCH FIELD



4. **Variations in Rank of Coal**: Coals in the Powder River Basin are all of Tertiary age throughout both Montana and Wyoming. However, the Montana Planning Area includes coals that are much older and of higher rank. For instance, the coal seams near Bozeman Pass and Great Falls are of Cretaceous age and have an overall higher rank than Powder River Basin coals. This suggests that these coals may contain methane that is more thermogenic in nature than biogenic. Although there is not any existing production data for areas other than the CX Ranch in Montana, it is reasonable to assume that CBNG wells in these areas may produce economic quantities of methane for longer durations than in the Powder River Basin without the benefit of historical production data. In certain situations, where multiple coal beds are present, a well's productive life can be extended by reworking the well to produce gas from deeper coal beds. For example, well completions in multiple coal beds could extend the life of a well site by 10 to 30 years.

Studies of CBNG wells in the San Juan Basin, which produce from greater depths than CBNG wells in the PRB, have projected CBNG gas production for 20 years. The deeper coal in other basins of Montana may produce in a similar fashion and have a well life of 20 years.

Differences in Produced Water Sodium Absorption Rate (SAR) and Electrical Conductivity (EC) Values

These differences are based on differences that exist across the basin. These differences are based on geologic and the available produced water data for each state. The geologic differences relate to how the coal seams change northward across the basin. In Wyoming, the coals seams are thicker (averaging up to 250 feet or more in aggregate thickness in many areas) and more continuous, northward in the basin into Montana, the coal seams thin (generally less than 100 aggregate feet) and become locally discontinuous.

In Montana there is a limited data set with little data outside the CX Ranch, which was used as the basis for the SAR and EC values in the DEIS. The produced water data available for the Montana Powder River Basin indicates there are significant differences in water quality in the northern part of the basin in comparison to the Wyoming portion of the Powder River Basin. The water quality data available for Montana varies enough from Wyoming that using the Wyoming data for impact analysis in Montana would underestimate the potential impacts in Montana.

Maximum Drawdown in Coal-Seam Aquifers

The Montana Bureau of Mines and Geology (Wheaton and Metesh 2002) released a report on the potential groundwater drawdown and recovery in the Montana portion of the Powder River Basin. The results of this report indicate that drawdown within the coal seams could be as high as 240 to 600 feet within the well field. The report also indicated drawdown as high as 300 feet in the interburden units and 6 feet in the overburden units. The results of the model showed drawdown up to 30 feet at a distance of approximately two miles from the well field and drawdown of five feet at a distance of approximately seven miles. The results of this model have been used for the impact analysis in this document.

Decrease Flow in Surface Water

In the Montana portion of the Powder River Basin, the bulk of the coals of the Fort Union Formation are confined to the Tongue River Member, while the Lebo and Tullock Members are predominantly shale and shaley sand (McLellan et al. 1990). Because of the confined nature of the coals and lack of the Wasatch Formation in Montana, the production of CBNG water is not expected to result in decreases to surface water base flows. There are also several potential increases to flow that may mask any potential decreases in surface water flow. The discharge of CBNG-produced water to the ground surface and surface waters would mask any reduction in flow in the surface waters.

Beneficial Use of CBNG Production Water

The Montana EIS preparation team assumes 20 percent of the produced water will be available for beneficial purposes in Alternatives C and D. Under Alternatives E, F, G and H it is assumed that emphasizing beneficial uses combined with increased flexibility for water management practices should result in an increase in beneficial water usage. The beneficial uses envisioned are based on current practices, such as livestock watering, creation of wildlife watering areas (Environmental News Network 2001), coal mine dust suppression (Fidelity 2001), irrigation, constructed wetlands (Davis 1995), domestic water supply, produced water as drilling fluid (Clark and Hemler 1992), de-icing of road aggregate storage piles (DeWalle and Geleone 1990) and enhancement of fisheries and riparian zones (Wyoming Game and Fish Department, n.d.).

Wyoming RFD Impacts

The Montana EIS accounts for the full scale of development proposed by the current Wyoming RFD (which has since been adopted). In the Minerals Appendix an expanded discussion regarding both the Wyodak RFD of 6,000 wells and the current Wyoming RFD with a proposed new 39,400 wells is addressed. Furthermore, within the *Hydrology and Air* sections of Chapter 4 under the *Conclusions for Alternative A* the effects of the expanded Wyoming RFD is acknowledged and accounted for in the impact analysis. These conclusions are also referenced under the other alternatives conclusion sections for cumulative impacts because they address the full range of possible impacts from Wyoming CBNG development.

Resource Topics

Air Quality and Climate

Air Quality

Existing air quality throughout most of the analysis area is in attainment with all ambient air quality standards. However, three areas have been designated as federal nonattainment areas where the applicable standards have been exceeded in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate).

Air emission impacts based on modeling show potential impacts only. Potential impacts would be mitigated through project level permitting by federal, state, or tribal regulatory agencies.

Alternatives A, B and D were modeled in the 2003 Final Statewide EIS based upon the modeling domain and receptor grids used in the Technical Support Document (Argonne 2002). Alternatives C and E were not modeled, as their emission sources were essentially the same as for Alternative B. Alternatives E, F and H were subsequently modeled for this FSEIS by using an updated grid system, which expanded the near-field receptor grid; an updated meteorological base year (2002); updated emission sources to the most currently available data (2004); and updating RFFAs to include the TRR. Alternative G was not modeled, but would represent emission levels of approximately 65 percent of Alternative F due to only 65 percent of CBNG wells being completed in this scenario. Additionally, CO was not modeled for Alternatives E, F and H in the FSEIS, as initial modeling conducted in the 2003 Oil and Gas EIS showed impacts were quite small in relation to existing applicable air quality standards.

In 2007, BLM prepared a Supplemental Air Quality Analysis to assess the level of CBNG development that would require mitigation to reduce the potential for impacts to air quality. The Supplemental Air Quality Analysis provides additional information and analyses regarding the level of CBNG development that would have the potential to impact air quality within the Powder River and Billings RMP areas. It includes an analysis and comparison of the potential for CBNG development to impact air quality under different air quality emission rates under the preferred alternative (Alternative H). The information contained within the Supplemental Air Quality Analysis is intended to expand on the air quality information presented in the DSEIS and the Air Quality Technical Support Document (revised October 2007).

Alternative A
No Action (Existing CBNG Management)

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations would be below applicable state and National Ambient Air Quality Standards and PSD increments for near-field and far-field modeling.
- Potential direct impact on visibility within one mandatory federal PSD Class I, one Class II Area and the Class II Crow Reservation.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} NAAQS and PSD Class II increments south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area.
  - Potential visibility impacts in 10 of 17 federal PSD Class I including the Crow and Fort Peck reservations. Additional visibility impacts to 7 of 13 PSD Class II sensitive areas including the Crow and Fort Belknap reservations.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.
- Potential direct visibility impacts within seven mandatory federal PSD Class I Areas and the Northern Cheyenne Reservation. Additional visibility impacts to seven federal PSD Class II areas including the Crow and Fort Belknap Reservations and three Wilderness Areas and one National Recreation Area and one National Monument.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine.
  - Potentially exceed the PSD Class II increments for 24-hour PM10 south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.
  - Potentially exceed PSD Class I increments for annual NO_2 on the Northern Cheyenne Reservation.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and Florence Lake in the Class II Cloud Peak Wilderness Area.
  - Potential visibility impacts in all federal PSD Class I and II sensitive areas including the Northern Cheyenne, Fort Peck, Fort Belknap and Crow reservations.

Alternative C
Emphasize CBNG Development

- Impacts under Alternative C are expected to be comparable to those describe for Alternative B but somewhat increased in severity due to the lack of control over operators choice of compressor fuel, reduced limits on compressor hook ups and the lack of enforceable control measures.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.
- Potential direct visibility impacts within one mandatory federal PSD Class I Areas. Additional visibility impacts to three PSD Class II areas including the Crow Reservation, one Wilderness Area and one National Recreation Area.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$

NAAQS south of Spring Creek Mine.
  - Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area.
  - Potential visibility impacts in 14 of 17 federal PSD Class I and all Class II sensitive areas including the Northern Cheyenne, Fort Peck, Fort Belknap and Crow reservations.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts while Maintaining Existing Land Uses

- Impacts modeled for Alternative E would consist of the potential for localized short-term increases in NO_x, SO_2, PM_{10} and $PM_{2.5}$ concentrations.
- Maximum concentrations resulting from project-related activities are expected to be below applicable state and NAAQS and PSD increments.
- Alternative E would not result in a change in acid neutralizing capacity above significance thresholds for any Class I areas in the modeling domain.
- Visibility impacts above 1.0 dv would occur in 7 to 10 PSD Class I areas and 6 to 12 PSD Class II Areas.
- Given the non-project emission sources located throughout the analysis region, there would be a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative E. However, none of the predicted impacts exceeds state or NAAQS.
- The air-quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

Alternative F
Phased Development Multiple Screens (High Range)

- Impacts under Alternative F would be comparable to those described for Alternative E, but would be fewer and would level off over time due to the 5 percent annual limit for applications for permit to drill (APDs) approved on BLM-administered surface.
- Cumulative impacts under Alternative F would be the same as for Alternative E.
- The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

Alternative G
Low-range, Phased CBNG Development

- Impacts under Alternative G would be fewer than for Alternatives E or F due to a lower number of wells predicted to be drilled. This would result in a reduction of approximately 65 percent in the number of compressors that would be required. Fewer well pads and roads would also have to be constructed.
- Cumulative impacts under Alternative G would be fewer than for Alternatives E or F due to 65 percent less wells predicted to be drilled. This would result in construction of approximately 65 percent fewer compressors, well pads and roads.
- The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

Alternative H
Preferred Alternative - Multiple Screens

- Impacts under Alternatives H would be less than those described for Alternative E due to the implementation of the air quality screen for CBNG development.
- Cumulative impacts under Alternatives H would be less than those described for Alternative E due to the implementation of the air quality screen for CBNG development.
- The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

ASSUMPTIONS

Potential air quality impacts for Alternatives A, B and D were evaluated using the air quality model conducted for the 2003 Montana Statewide Final Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans (Statewide Document) (Argonne 2002). Alternatives C and E were not modeled for the Statewide Document, as their emission sources were essentially the same as for Alternative B. Those data and the impact analysis based on that modeling effort are retained in this FSEIS. Alternatives E, F and H were subsequently modeled for this FSEIS using an updated receptor grid system (which expanded the near-field receptor grid), an updated meteorological base year (2002), updated emission sources to the most currently available data (2004) and updating the reasonably foreseeable future actions (RFFAs) to include the TRR. Alternative G was not modeled, but would represent potential emission impacts at approximately 65 percent of Alternative F due to that percent fewer CBNG wells being completed under Alternative G compared to Alternative F.

Three groups of emission sources contribute to the modeled emission results. They are existing emissions, CBNG project-related emissions and RFFA emissions. Existing emissions consist of emissions from those sources that currently exist for the baseline year of 2004. Existing emission data were obtained from the appropriate state regulatory agencies as well as the Western Regional Air Project (WRAP) database. CBNG project-related emissions were developed on the basis of the RFD scenario outlined in the Minerals Appendix and modified for elements specific to each alternative. CBNG project-related emissions were further broken down into emissions that result from construction activities and emissions that result from operations and maintenance activities. RFFA emissions consist of those that would result from projects or facilities not currently operating, but reasonably expected to operate sometime during CBNG development. Examples of RFFA emission sources would be the TRR or the Roundup Power Plant.

The modeling methodology and detailed results for the model conducted for this FSEIS are contained within the Air Quality Appendix. A summary of the results is found in the impact analyses for Alternatives E, F and H, as well as a discussion of potential impacts for Alternative G.

Although the CBNG development (project sources) and non-project sources emit carbon dioxide and methane, climate impacts are anticipated to be small from implementation of any of the alternatives. Climate impacts may even be beneficial to the extent that:

- Development of the CBNG resource reduces the natural emissions of methane from coal mines
- Use of CBNG displaces combustion of coal or oil, both of which emit more carbon dioxide than methane per unit energy produced.

Carbon monoxide (CO) was not modeled for Alternatives E, F and H in the FSEIS, as initial modeling conducted in the Statewide Document (Argonne 2002) showed impacts were quite limited relative to existing applicable air quality standards.

The potential for ozone formation due to project-related sources was not included as part of the FSEIS modeling effort. The decision to not include ozone within the modeled constituents was based on results predicted in previous modeling efforts conducted for the Coal Study (ENSR 2005a, 2005b) and the 2003 Oil and Gas EIS (Argonne 2002). These modeling efforts indicated that primary pollutants (oxides of nitrogen [NO_x]), CO and non-methane volatile organic compounds (VOCs), which are known to be precursors required for the formation of ozone, would not be produced from project-related sources at levels that would contribute to ambient ground level ozone concentrations to any measurable extent.

With respect to analysis of prevention of significant deterioration (PSD) increments, a regulatory PSD increment analysis has to include all historic emission changes since the PSD trigger date, which extends back to 1978 for the area around Colstrip. Both increment expansion and consumption have taken place since that date. An analysis of this sort is beyond the scope of this project. The Montana Department of Environmental Quality (MDEQ), in cooperation with the Northern Cheyenne Tribe and the Environmental Protection Agency (EPA), is conducting this type of analysis. The results will be factored into the new source review process in permitting additional CBNG sources in the study area.

Potential impacts to air quality are summarized in this section. A more complete summary of the modeled potential air quality impacts for Alternatives A thru D are given in the Air Quality Appendix - Part 1 with a highly detailed description of the air quality modeling given in Argonne 2002. The Air Quality Appendix—Part 2 for this FSEIS—includes a detailed description of the methodology and results of the air quality modeling conducted for this FSEIS for Alternatives E, F and H.

Issues, Impact Types and Criteria

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (e.g. well operations, field and sales compressor engines), are potential causes of air quality impacts. These issues are more likely to generate public concern where natural gas development activities occur near residential areas. The Federal Land Managers (FLM), including the U.S. Department of Agriculture (USDA), USFS; the U.S. Department of Interior (USDI), National Park Service (NPS); and the USDI, U.S. Fish & Wildlife Service (FWS), have also expressed concerns regarding potential atmospheric deposition and visibility impacts within PSD Class I and PSD Class II areas under their administration, located throughout Montana, Wyoming, southwestern North Dakota, western South Dakota, northwestern Nebraska and southeastern Idaho.

Air pollution impacts are limited by local, state, tribal and federal air quality regulations, standards and implementation plans established under the Clean Air Act (CAA) and administered by the MDEQ—Air Resources Management Bureau and the EPA. Although not applicable to the proposed Alternatives, the Wyoming Department of Environmental Quality—Air Quality Division (WYDEQ) has similar jurisdiction over potential air pollutant emission sources in Wyoming, which can have a cumulative impact with MDEQ approved sources. Air quality regulations require certain proposed new, or modified existing, air pollutant emission sources (including CBNG compression facilities) to undergo a permitting review before their construction can begin.

Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation.

In addition, the U.S. Congress (through the CAA Section 116) authorized local, state and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements. Site-specific air quality analysis would be performed and additional emission control measures, including a best available control technology (BACT) analysis and determination, may be required by the applicable air quality regulatory agencies to ensure protection of air quality resources. Also, for resources discussed in this SEIS, the BLM will not authorize any activity that does not conform to all applicable local, state, tribal and federal air quality laws, regulations, standards and implementation plans.

The significance criteria for potential air quality impacts include local, state, tribal and federally enforced legal requirements to ensure air pollutant concentrations would remain within specific allowable levels. These requirements include the National and Montana Ambient Air Quality Standards, which set maximum limits for several air pollutants and PSD increments, which limit the incremental increase of NO_2, sulfur dioxide (SO_2) and particulate matter less than 10 microns in diameter (PM_{10}) concentrations above legally defined baseline levels. These legal limits were presented in Chapter 3. Where legal limits have not been established, the BLM uses the best available scientific information to identify thresholds of significant adverse impacts. Thresholds have been identified for hazardous air pollutant (HAP) exposure, potential atmospheric deposition impacts to sensitive lake water chemistry and a “just noticeable change” in potential visibility impacts.

An extensive air quality modeling technical support document was prepared by Argonne National Laboratory (Argonne 2002) and is summarized in the Air Quality Modeling Appendix of the Statewide Document (BLM 2003). This technical report is available for review (contact information is given in the Air Quality Appendix – Part 1). Argonne modeled potential changes in air quality from individual Alternatives A, B, C, D and E, non-project emission sources and all sources cumulatively by alternative. Since Alternatives B, C and E have similar emission inventories, a single air quality analysis represents all three alternatives.

An Air Quality Model Technical Support Document (AQTSD, revised October 2007) and a Supplemental Air Quality Analysis (SAQA) report were also prepared for the modeling effort conducted for this FSEIS. These documents are available for review on the FSEIS project website at http://www.blm.gov/eis/mt/milescity_seis/.

The air quality modeling was based on the best available engineering data and assumptions, meteorology data and dispersion modeling procedures, as well as professional and scientific judgment.

Due to the regional nature of this analysis, it should be considered a reasonable estimate of predicted impacts. Actual impacts at the time of project level development (subject to air pollutant emission source permitting) are likely to be less.

The EPA CALPUFF dispersion model was used with meteorological data generated by the MM5 (mesoscale model) and CALMET models. Meteorological information was assembled to characterize atmospheric transport and dispersion from several 1996 data sources, including the following:

1) 36 km gridded MM5 (mesoscale model) values with continuous four-dimensional data assimilation
2) Hourly surface observations (wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity and precipitation)
3) Twice-daily upper air vertical profiles (wind speed, wind direction, temperature and pressure)
4) PRISM-adjusted hourly precipitation measurements

Potential air pollutant emissions from the alternatives’ emission sources (denoted as project sources) were calculated separately to determine potential impacts. These emissions were then combined with existing sources, proposed non-Powder River Basin oil and gas developments, RFFA emissions (denoted as non-project sources) and RFFA emissions from potential CBNG development on the Northern Cheyenne and Crow reservations and the Ashland District of the Custer National Forest to determine the total potential cumulative air quality impacts. All of the tables in this analysis and the Air Quality Appendix display modeled emissions from the following:

1) The project sources only
2) The project sources combined with emissions from potential CBNG development on the Northern Cheyenne and Crow reservations and the Ashland District of the Custer National Forest (denoted as “Project + RFFA Sources)

3) The non-project sources
4) Cumulative totals

The non-project sources include development permitted by the following agencies and states: 1) MDEQ; 2) WYDEQ; and 3) within the states of North Dakota, South Dakota and Nebraska; and projections for the Wyoming Powder River Basin Oil and Gas Project DEIS Alternative sources (BLM 2002a); and other RFFA sources from states within the geographic area covered by the model. Table 4-7 shows total emissions from the non-project permitted and other RFFA sources, Wyoming Powder River Basin oil and gas project sources and Montana Powder River Basin oil and gas project sources, combined with RFFA sources. These emissions are for Alternatives B, C and E; Alternative A and D emissions would be lower and potential CBNG wells on the Northern Cheyenne and Crow reservations and the Ashland District of the Custer National Forest have been included with emissions for Alternatives B, C and E.

The meteorology data and air pollutant emission values were combined to predict maximum potential direct, indirect and cumulative near-field air quality impacts in the vicinity of assumed well and compressor engine emission sources for comparison with applicable air quality standards and PSD Class II increments. Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad and compressor station construction were used to predict the maximum annual and 24-hour average SO_2, particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) and PM_{10} impacts. Maximum air pollutant emissions from each CBNG well would be temporary (i.e., occurring during a 12-day construction period) and would occur in isolation, without significantly interacting with adjacent well locations. Particulate matter emissions from well pad, compressor station and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants was estimated at 50 percent during construction. During well completion testing, natural gas could be burned (flared) on a single day.

Air pollutant dispersion modeling was also performed to quantify potential particulate matter, CO, NO_2 and HAP impacts during operation. Operation emissions would primarily occur due to

TABLE 4-7

NON-PROJECT AND PROJECT TOTAL EMISSIONS SUMMARY

Source Category	Annual Emissions (tons/year) NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO	VOCs
Non-Project Sources (2006)						
DM&E Sources	14,391	3,655	722	263	799	294
CDWII Sources	1,269	563	257	---	---	---
Wyoming Sources	7,250	1,773	2,691	1,028	13,505	2,795
Montana Sources	3,169	950	2,279	1,003	2,576	880
Nebraska & North Dakota Sources	1,114	26	102	48	449	132
New Sources Subtotal	27,192	6,966	6,051	2,343	17,329	4,101
Montana RFFA Sources	2,844	4,796	127	71	6,171	20
Wyoming RFFA Sources	1,578	3,381	298	155	3,381	--
South Dakota RFFA Sources	289	35	53	53	175	71
Other RFFA Sources Subtotal	4,710	8,212	478	279	9,277	91
Wyoming Alternative 1 Project Sources (w/Project Year noted)	**17,834** (Yr 5)	**829** (Yr 3)	**2,918** (Yr 6)	**1,280** (Yr 5)	**14,799** (Yr 5)	**8,268** (Yr 5)
Total Non-Project Sources	**49,737**	**16,007**	**9,447**	**3,902**	**41,855**	**12.460**
Montana Alt. B, C and E Project + RFFA Sources (w/Project Year noted)	**9,959** (Yr 18)	**339** (Yr 5)	**1,230** (Yr 5)	**514** (Yr 15)	**9,378** (Yr 20)	**4,841** (Yr 20)

DM&E – Dakota, Minnesota and Eastern Railway Corporation

CDWII – Continental Divide/Wamsutter II and South Baggs Natural Gas Development Projects increased compression requirements, including field and sales compressor stations. Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, direct VOC emissions are not likely. HAP impacts were predicted based on an assumed, six-unit, 1,650-horsepower each, reciprocating compressor engine station operating at full load with emissions generated by a single stack.

The EPA CALPUFF dispersion model was also used to determine maximum far-field ambient air quality impacts at downwind mandatory federal PSD Class I areas and other sensitive receptors, to accomplish the following:

1) Determine if the PSD Class I increments might be exceeded
2) Calculate potential total sulfur and nitrogen deposition and their related potential impacts to sensitive lakes
3) Predict potential visibility impacts (regional haze) within distant sensitive receptors

The National Environmental Policy Act (NEPA) analysis compares potential air quality impacts from the proposed alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts and do not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. The MDEQ will perform the required regulatory PSD increment analysis during the new sources review process. This formal regulatory process will include analysis of impacts on Class I and II air quality areas by existing and proposed emission sources. The activities are not allowed to cause incremental effects greater than the stringent Class I thresholds to occur inside any PSD Class I Area. Stringent emission controls (BACT – Best Available Control Technology) and emission limits may be stipulated in air quality permits as a result of this review, or a permit could be denied.

Several lakes within five USFS-designated wilderness areas were identified as being sensitive to atmospheric deposition and for which the most recent and complete data have been collected. The USFS (Fox et al, 1989) has identified the following total deposition (wet plus dry) thresholds below which no adverse impacts to air-quality related values (AQRVs) are likely: 5 kilograms per hectare per year (kg/ha-yr) for sulfur and 3 kg/ha-yr for nitrogen. The USFS Rocky Mountain Region has also developed a screening method (U.S. Department of Agriculture Forest Service - USFS 2000) which identifies the following Limit of Acceptable Change regarding potential changes in lake chemistry: no more than a 10 percent change in acid neutralizing capacity (ANC) for those water bodies where the existing ANC is at or above 25 microequivalents per liter (μeq/l) and no more than a 1 μeq/l change for those extremely sensitive water bodies where the existing ANC is below 25 microequivalents per liter (*μ*eq/l). No sensitive lakes were identified by either the NPS or FWS.

Since the proposed Alternative and cumulative air pollutant emission sources constitute many small sources spread out over a very large area, discrete visible plumes are not likely to impact the distant sensitive areas, but the potential for cumulative visibility impacts (increased regional haze) is a concern. Regional haze degradation is caused by fine particles and gases scattering and absorbing light.

Potential changes to regional haze are calculated in terms of number of days with greater than a perceptible “just noticeable change” (1.0 deciview, or dv) in visibility when compared to background conditions. A 1.0 dv change is considered potentially significant in mandatory federal PSD Class I areas as described in the EPA Regional Haze Regulations (40 CFR 51.300 *et seq.*) and originally presented in Pitchford and Malm (1994). A 1.0 dv change is defined as about a 10 percent change in the extinction coefficient (corresponding to a 2 to 5 percent change in contrast, for a black target against a clear sky, at the most optically sensitive distance from an observer). This is a small but noticeable change in haziness under most circumstances when viewing scenes in mandatory federal Class I areas. However, the perceptibility threshold can be smaller or larger than this value depending on viewing conditions.

For example, a 1.0 dv change is not a “just noticeable change” in all cases for all scenes. Visibility changes less than 1.0 dv are likely to be perceptible in some cases, especially where the scene being viewed is highly sensitive to small amounts of pollution, such as a site with preferential forward light scattering. Under other view-specific conditions, such as where the sight path to a scenic feature is less than the maximum visual range, a change greater than 1.0 dv might be required to be a “just noticeable change.”

This NEPA analysis is not designed to be a regulatory analysis conducted to Federal Land Manager (FLM) specifications nor is the analysis designed to predict specific visibility impacts for specific views in specific mandatory federal PSD Class I areas based on specific project designs. Rather, it is to characterize reasonably foreseeable visibility conditions that are representative of a fairly broad geographic region, based on multiple assumptions regarding project and non-project source emissions. This approach is consistent with both the nature of regional haze and the requirements of NEPA. The modeling was conducted to identify areas that may require more detailed consideration when specific project-level permits are issued for CBNG development. At the time of a preconstruction air quality permit application, the applicable air quality regulatory agency may require a much more detailed visibility impact analysis. Factors such as the magnitude of dv change, frequency, time of the year and the meteorological conditions during times when predicted visibility impacts are above the 1.0 dv threshold should all be considered when identifying areas for scrutinizing at the project-permitting level.

The USFS, NPS and FWS have published their Final FLAG Phase I Report (Federal Register, Vol. 66 No. 2, dated January 3, 2001), providing a consistent and predictable process for assessing the impacts of new and existing sources on AQRVs including visibility. For example, the FLAG report states, "A cumulative effects analysis of new growth (defined as all PSD increment-consuming sources) on visibility impairment should be performed," and further, "If the visibility impairment from the proposed action, in combination with cumulative new source growth, is less than a change in extinction of 10 percent [1.0 dv] for all time periods, the FLMs will not likely object to the proposed action."

Air Quality Modeling Assumptions: Near-field impacts refer to receptor points less than 50 km (31.25 miles) from the emissions source; far-field impacts are greater than 50 km from the source. When reviewing the modeled near- and far-field results, it is important to understand the assumptions made regarding potential resource development. In developing this analysis, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used and specific locations) and so actual impacts may vary from the modeled values and would be affected by project permit conditions or stipulations. The modeling was based on the following assumptions:

- Total predicted short-term air pollutant concentrations were assumed to be the sum of the assumed background concentration, plus the predicted maximum cumulative modeled concentrations (for comparison to national and state AAQS; background concentrations are not added to modeled concentrations for comparison to PSD increments), which may occur under different meteorological conditions.
- Background air pollution concentrations were assumed to occur throughout the 20-year life of project at all locations in the region; even though this background was derived from monitoring primarily conducted in urban or industrial areas, rather than rural areas. The uniform background PM_{10} levels for each state are assumed to be representative of the background conditions for the entire modeled area of the PRB, based on monitoring data gathered throughout northeastern Wyoming and southeastern Montana.
- The maximum predicted air quality impacts occur only in the vicinity of the anticipated emission sources. Actual impacts would likely be less at distances beyond the predicted points of maximum impact.
- All emission sources were assumed to operate at their reasonably foreseeable maximum emission rates simultaneously throughout the life of project. Given the number of sources included in this analysis, the probability of such a scenario actually occurring over an entire year is very small.
- In developing the emissions inventory and model, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations, etc.) Most (90 percent) proposed CBNG wells and 30 percent of conventional wells were assumed to be fully operational and remain operating (no shut-ins) throughout the life of project.
- The total proposed booster (field) and pipeline (sales) compression engines were assumed to operate at their rated capacities continuously throughout the life of project (no phased increases or reductions). In actual developments, compression equipment is expected to be added or removed incrementally as required by the well field operation, compressor engines would operate below full horsepower ratings and all compressor stations would not be operating at maximum levels simultaneously.
- The HAP analyses assumed a 9,900 horsepower, six-unit, reciprocating compressor engine station would operate at full load and at maximum emission levels continuously throughout the life of project.
- The emissions inventory and model use peak years of construction and peak years of operations, which would not occur throughout the entire development region at the same time.

However, these conditions may occur in some areas.

- The emissions inventory and model assumed that an emission rate for compressor engines of 1.5 grams per brake horsepower-hour (b/bhp-hr) of NO_x. Since BACT is decided on a case-by-case basis, actual emission rates could be decided to be less or more than this level by the Departments of Environmental Quality in Wyoming or Montana and on Indian lands by EPA, for field and sales compressor engines. Actual NO_x emission rates may range from 0.7 to 2 b/bhp-hr.
- There are no applicable local, state, tribal or federal acid deposition standards. In the absence of applicable standards, the acid deposition analysis assumed that a “limit of acceptable change” is: a 10 percent change in ANC for lakes with a background ANC greater than 25 μeq/l; or a 1 μeq/l change in ANC for lakes with a background ANC less than 25 μeq/l and would be a reasonably foreseeable significant adverse impact. Further, the atmospheric deposition impact analysis assumed no other ecosystem components would affect lake chemistry for a full year (assuming no chemical buffering due to interaction with vegetation or soil materials).
- The visibility impact analysis assumed that a 1.0 dv “just noticeable change” would be a reasonably foreseeable significant adverse impact, although there are no applicable local, state, tribal or federal regulatory visibility standards. However, some FLMs are using 0.5 dv as a screening threshold for significance.
- Mitigation measures are included in the emissions inventory and model that may not be achievable in all circumstances. However, actual mitigation decided by the developers and local and state authorities may be greater or less than those assumed in the analysis. For example, maintaining a construction road speed limit of 15 mph may be reasonable in a construction zone but difficult to enforce elsewhere. Full (100 percent) mitigation of fugitive dust from disturbed lands may not be achievable. Further, 50 percent reduction in fugitive emissions is assumed based on construction road wetting on the unimproved access road to the pad and at the pad, but this level of effectiveness is characterized as the maximum possible. In the air quality modeling, no specific road wetting or other emissions were assumed to be used during the operations phase of the development (e.g., for maintenance vehicle traffic). However, during the review of proposed projects (applications for permit to drill [APDs]) the BLM would require specific mitigation measures in certain areas during the operational phase of development.
- Induced or secondary growth related to increases in vehicle miles traveled (believed to be on the order of 10 percent overall) is not included in the emissions inventory and model. Not all fugitive dust emissions (including county and other collector roads) have been included in the emissions inventory and model.
- Fugitive dust emissions from roads are treated as area sources rather than line sources in the model, which may thereby reduce or increase the predicted ambient concentrations at maximum concentration receptor points near the source, depending on the inputs to the model (e.g. meteorology, terrain). By not placing modeled receptors close to emission sources (e.g. wells and roads), the model may not capture higher ambient concentrations near these sources. A more refined, regulatory model may yield higher concentrations at locations near fugitive dust sources.
- For comparisons to the PSD Class I and II increments, the emissions inventory and model included only CBNG and reasonably forseeable future actions (RFFA) sources. Other existing increment consuming sources such as Campbell County coal mines were not included in this comparison, as the focus of the air quality analysis is on the proposed project and alternatives, and does not represent a regulatory PSD increment consumption analysis. A regulatory PSD increment consumption analysis needs to identify and consider all PSD increment consuming sources to determine the level of PSD Class II increment consumption. Additionally, a regulatory PSD increment analysis has to include all historic emission changes since the PSD trigger date, which extends back to 1978 for the area around Colstrip. Both increment expansion and consumption have occurred since that date. An analysis of this sort is beyond the scope of this project. MDEQ, in cooperation with the Northern Cheyenne Tribe and EPA, is conducting this type of analysis and the results will be factored into the new source review process in permitting additional CBNG sources in the study area.
- Monitoring data in Wyoming has indicated an upward trend in particulate matter concentrations in Campbell County since 1999, which coincides

with CBNG development but is also exacerbated by prolonged drought in the region.

Given these assumptions, the model represents an estimate of potential air quality impacts in the project area and region.

It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including the state, tribe, or EPA) would review specific air pollutant emissions preconstruction permit applications that examine potential project-wide air quality impacts for some categories of sources. As part of these permits (depending on source size), the air quality regulatory agencies could require additional air quality impacts analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality. Emission sources that would violate standards would not be permitted.

Impacts from Management Common to All Alternatives

Air quality impacts would occur during construction (due to surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing and drilling rig and vehicle engine exhaust) and production (including well production equipment and field and sales compression engine exhausts), as well as emissions associated with secondary growth. The amount of air pollutant emissions during construction and production would be controlled by watering; applying chemical stabilizers, surface material or reseeded vegetation to disturbed soils; and by air pollutant emission limitations imposed by applicable oil and gas lease management agencies and air quality regulatory agencies. Actual air quality impacts depend on the amount, duration, location and characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, etc.).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts to air quality would be minimal under this alternative. Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2 and PM_{10} concentrations could occur, but most maximum concentrations are expected to be below applicable state and National Ambient Air Quality Standards (NAAQS), as well as NAAQS PSD increments, as shown in Table 4-8. These results are for near-field modeling. Far-field modeling results were also found to be below NAAQS and PSD Increments (Additional data on near and far-field modeling results are contained in the Air Appendix – Part 1).

Alternative A project source emissions would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 0.65 percent which equates to a 0.04 μeq/l change. This is below threshold level of 1.0 μeq/l.

Direct visibility impacts from Alternative A project source emissions are predicted to be limited to the Class II, Crow Reservation. Up to 2 days annually were predicted to have a greater than “just noticeable change based on Alternative A project source emissions only. The Alternative A sources are predicted to have no direct impact on visibility in the other Class I and Class II areas (as shown in Table 4-11, under the “Project Sources Only” column.)

Cumulative Impacts

Given the extensive non-project emission sources located throughout the analysis region (including CBNG developments in the Wyoming section of the Powder River Basin), there is a potential for cumulative air quality impacts from Alternative A project sources and non-project sources to exceed applicable thresholds under Alternative A. Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 104 $\mu g/m^3$ for 24-hour PM_{10}. When combined with the assumed background level of 105 $\mu g/m^3$, the total impact of 210 $\mu g/m^3$ would exceed the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. Note that the Alternative A project sources contribute a maximum of 1.8 $\mu g/m^3$, as shown in Table 4-9. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

In addition, non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation, as well as the PSD Class II increment, near the maximum assumed development area (see Table 4-10). For the Northern

TABLE 4-8

ALTERNATIVE A—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact ($\mu g/m^3$)	PSD Increments [a] ($\mu g/m^3$) Class II	Montana Background ($\mu g/m^3$)	Total Impact[b] ($\mu g/m^3$)	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	1.94	25	11	12.9	100	100
	1-hour	20.6	n/a	117	138	566	n/a
SO_2	Annual	0.27	20	16	16	60	80
	24-hour	0.87	91	73	74	260	365
	3-hour	1.54	512	291	293	n/a	1,300
	1-hour	1.86	n/a	666	668	1,300	n/a
PM_{10}	Annual	0.52	17	30	31	50	Revoked
	24-hour	1.83	30	105	107	150	150
$PM_{2.5}$	Annual	0.27	n/a	8	8	15	15
	24-hour	0.97	n/a	20	21	35	35
CO	8-hour	29.78	n/a	6,600	6,630	10,000	10,000
	1-hour	49.4	n/a	15,000	15,049	26,000	40,000

[a] PSD Increment is to be compared to the Project Modeled Impact.
[b] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

TABLE 4-9

ALTERNATIVE A POTENTIAL NAAQS/MAAQS EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Back-ground	Cumulative Total	NAAQS/ MAAQS
Near-Field	PM_{10} 24-hr	1.8	n/a	104	105	210	150/150

TABLE 4-10

ALTERNATIVE A POTENTIAL PSD INCREMENT EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
Northern Cheyenne Reservation	PM_{10} 24-hr	0.5	n/a	8.4	8.7	8	n/a
Near-Field	PM_{10} 24-hr	1.8	n/a	104	105	n/a	30

n/a – not applicable

Cheyenne Reservation the far-field analysis indicated a maximum increment level of 8.7 $\mu g/m^3$ with the non-project sources contributing 8.4 $\mu g/m^3$ and the Alternative A project sources contributing up to 0.5 $\mu g/m^3$. All NEPA analysis comparisons to PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 μeq/l), the predicted cumulative impact of 1.6 μeq/l change would exceed the threshold level of 1.0 μeq/l. Approximately 2.5 percent of this change would be attributable to Alternative A project sources alone. It should be noted that the very low background ANC level is based on only four samples taken on 3 days between 1997 and 2000.

Potential visibility impacts were predicted to occur from non-project sources alone in every sensitive area analyzed (see Table 4-11). The Alternative A project sources in themselves were predicted to have a negligible direct impact on these areas (exception is the Class II Crow Reservation). However, the cumulative analysis predicted an average daily visibility impact increase of approximately 1 day per year for some Class I sensitive areas. Of the 15 mandatory federal PSD Class I areas analyzed, cumulative average annual impacts would occur at the Fitzpatrick Wilderness Area (up to 10 days per year); the Scapegoat Wilderness Area (up to 3 days per year); the Teton Wilderness Area (up to 10 days per year); the Washakie Wilderness Area (up to 15 days per year); and Wind Cave National Park (up to 28 days per year).

Up to 42 days annually were predicted to have a greater than “just noticeable change” within the re-designated PSD Class I Northern Cheyenne Reservation based on cumulative impact. The Alternative A project sources are predicted to have no direct impact on visibility whereas the non-project sources are predicted to have an impact of up to 38 days annually.

The maximum potential cumulative visibility impacts (Table 4-12) predicted at the PSD Class II Crow Reservation were 69 days per year with Alternative A project sources directly contributing up to 2 days per year and non-project sources contributing up to 61 days per year. Fewer cumulative impacts were predicted at other PSD Class II sensitive receptors, including the Absaroka-Beartooth Wilderness Area (30 days per year), the Bighorn Canyon National Recreation Area (23 days per year), the Cloud Peak Wilderness Area (30 days per year), Devils Tower National Monument (39 days per year) and Jewel Cave National Monument (32 days per year). The Alternative A project sources contributed generally 1 to 2 days per year to these cumulative totals. Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

Crow Reservation

Given the proximity of proposed Alternative A emission sources near or on the Crow Reservation, it is understandable that several of the maximum air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 2 days per year from Alternative A project sources directly; up to 61 days per year from non-project sources; and up to 69 days per year from all sources cumulatively.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative A emission sources near or on the Northern Cheyenne Reservation, it is understandable that some of the maximum air pollutant impacts would occur on tribal lands. With the exception of a potential non-project and cumulative sources exceedance of the 24-hour PM_{10} Class I Increments, all direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: no increased haze days per year from Alternative A project sources directly; up to 38 days per year from non-project sources and up to 42 days per year from all sources cumulatively.

Potential Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities. Dust inhibitors (i.e., surfacing materials, non-saline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local and resource roads, which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits (i.e., 15 miles per hour [mph]) on all project-required roads in and adjacent to the project area.

TABLE 4-11

ALTERNATIVE A CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	Δdv[1]
Badlands Wilderness Area	0	n/a	17 to 25	18 to 25	10.0
Bridger Wilderness Area	0	n/a	8 to 10	8 to 10	10.9
Fitzpatrick Wilderness Area	0	n/a	7 to 9	8 to 10	13.5
Fort Peck Reservation	0	n/a	1 to 2	2 to 2	6.0
Gates of the Mountains Wilderness Area	0	n/a	3 to 4	3 to 4	12.7
Grand Teton National Park	0	n/a	4 to 6	4 to 6	5.8
Northern Absaroka Wilderness Area	0	n/a	10 to 12	11 to 12	11.3
Northern Cheyenne Reservation	0	n/a	30 to 38	33 to 42	39.9
Red Rock Lakes Wilderness Area	0	n/a	0 to 1	0 to 1	2.3
Scapegoat Wilderness Area	0	n/a	2 to 2	2 to 3	8.2
Teton Wilderness Area	0	n/a	7 to 9	7 to 10	11.9
Theodore Roosevelt National Park (North Unit)	0	n/a	1 to 2	1 to 2	3.3
Theodore Roosevelt National Park (South Unit)	0	n/a	2 to 4	2 to 4	3.9
U.L. Bend Wilderness Area	0	n/a	5 to 5	5 to 6	23.7
Washakie Wilderness Area	0	n/a	11 to 14	12 to 15	20.
Wind Cave National Park	0	n/a	21 to 27	22 to 28	7.7
Yellowstone National Park	0	n/a	9 to 11	9 to 11	9.0

[1]Δdv – change in deciview

TABLE 4-12

ALTERNATIVE A CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	Δdv
Absaroka Beartooth Wilderness Area	0	n/a	28 to 29	28 to 30	15.2
Agate Fossils Bed National Monument	0	n/a	10 to 15	10 to 15	10.4
Bighorn Canyon National Recreation Area	0	n/a	19 to 21	19 to 23	28.2
Black Elk Wilderness Area	0	n/a	20 to 26	20 to 26	8.4
Cloud Peak Wilderness Area	0	n/a	21 to 28	23 to 30	13.9
Crow Reservation	2	n/a	56 to 61	65 to 69	53.0
Devils Tower National Monument	0	n/a	24 to 38	26 to 39	9.7
Fort Belknap Reservation	0	n/a	60 to 61	61 to 61	23.6
Fort Laramie National Historic Site	0	n/a	13 to 17	13 to 17	14.4
Jewel Cave National Monument	0	n/a	24 to 31	24 to 32	11.0
Mount Rushmore National Memorial	0	n/a	17 to 22	17 to 22	7.5
Popo Agie Wilderness Area	0	n/a	8 to 10	8 to 10	11.9
Soldier Creek Wilderness Area	0	n/a	13 to 18	13 to 18	9.3

Potential emission reduction measures (BLM 1999d) are available to further limit NO_x and other pollutant emissions. The appropriate level of control would be determined and required by the applicable air quality regulatory agencies during the preconstruction permit process. Visibility impacts would be mitigated by reducing emissions of $PM_{2.5}$, NO_2 and SO_2.

Compressor emissions could be reduced by any of the following methods:

- **Reduce Compression Requirements.** Reduce the need for life of project compression by limiting the need for field compressors.
- **Electric Compression.** Using electric-powered compressor motors in place of the typical natural gas-fired compressor engines could eliminate direct NO_x emissions from compressor station locations.
- **Best Available Control Technology (BACT).** MDEQ would probably require BACT for compressor engines. Compressor engines would have an average potential NO_x emission rate of less than the 1.5 grams per horsepower per hour (b/bhp-hr) used in the modeling assessment.

Additional discussion of particulate and NO_x emission mitigation measures is provided in the Air Quality Appendix – Part 1. Mitigation measures for particulate matter have also been included in the Air Quality Appendix of this FSEIS. Some of these measures have been incorporated as management features of the alternatives (see Table 2-1 and Table 2-2 in Chapter 2).

Conclusion

Future development activities must comply with applicable local, state, tribal and federal air quality laws, statutes, regulations, standards, increments and implementation plans. Increases in air pollutant emissions would occur under Alternative A. Given the assumptions applied in this analysis, it is unlikely direct air quality impacts from Alternative A project sources would violate any local, state, tribal, or federal air quality standards. When combined with other non-project emission sources, the 24-hour PM_{10} PSD Class II increment and NAAQS was predicted to be exceeded near the Spring Creek Coal Mine. Additionally, the cumulative impact of Alternative A project and non-project sources were predicted to exceed the 24-hour PM_{10} PSD Class I increment at the Northern Cheyenne Reservation. Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area; and 2) visibility impact thresholds in all sensitive federal PSD Class I and Class II areas.

Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

There is the potential for direct air quality impacts to occur under this alternative. Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2 and PM_{10} concentrations could occur and some maximum concentrations are predicted to be above applicable state and NAAQS and PSD increments.

The modeled impacts from project sources are shown in Table 4-13. These results, which are all below the Montana Ambient Air Quality Standards (MAAQS), NAAQS and PSD increments, are for near-field modeling. Far-field modeling results for project sources are also below the MAAQS, NAAQS and PSD Increments. (Refer to “Project Sources Only” columns in the following tables.)

Alternative B project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 3.3 percent, which equates to a 0.19 μeq/l change. This is below threshold level of 1.0 μeq/l.

Even without other development in the region, Alternative B project sources alone may impact visibility within seven mandatory federal PSD Class I Areas. Impacts greater than a “just noticeable change” of 1.0 dv was predicted to average 3 days per year within the Washakie Wilderness Area (maximum 3.7 Δdv), 2 days per year within the Bridger, Fitzpatrick and North Absaroka Wilderness Areas (maximum 2.4, 2.3 and 3.6 Δdv, respectively and 1 day per year within the Teton Wilderness Area, U.L. Bend Wilderness Area and Yellowstone National Park (maximum 2.1, 4.3 and 3.0 Δdv, respectively). Given their proximity to anticipated Alternative B project sources, average annual visibility changes were also predicted to occur on up to 33 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 13.4 Δdv).

For PSD Class II areas, Alternative B project sources were predicted to impact visibility of greater than 1.0 dv on 9 days within the Bighorn Canyon National

TABLE 4-13

ALTERNATIVE B—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact (μg/m³)	PSD[1] Increments Class II (μg/m³)	Montana Background (μg/m³)	Total[2] Impact (μg/m³)	Montana AAQS (μg/m³)	NAAQS (μg/m³)
NO_2	Annual	9.1	25	11	20.1	100	100
	1-hour	99.7	n/a	117	217	566	n/a
SO_2	Annual	0.66	20	16	17	60	80
	24-hour	2.1	91	73	75	260	365
	3-hour	3.5	512	291	295	n/a	1,300
	1-hour	4.6	n/a	666	671	1,300	n/a
PM_{10}	Annual	3.6	17	30	34	50	50
	24-hour	12.1	30	105	117	150	150
$PM_{2.5}$	Annual	1.4	n/a	8	9	15	15
	24-hour	6.2	n/a	20	26	65	65
CO	8-hour	74.1	n/a	6,600	6,674	10,000	10,000
	1-hour	109	n/a	15,000	15,109	26,000	40,000

[1] PSD Increment is to be compared to the Project Modeled Impact.
[2] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

Recreation Area (maximum 5.4 Δdv) and on up to 61 days within the PSD Class II Crow Reservation (maximum 21.5 Δdv). Less extensive potential direct visibility impacts were also predicted for the PSD Class II Absaroka-Beartooth Wilderness Area (up to 2 days per year, max. 5.0 Δdv), Cloud Peak Wilderness Area (up to 6 days per year, max. 3.8 Δdv), Popo Agie Wilderness Area (up to 2 days per year, max. 2.6 Δdv), Devils Tower National Monument (up to 1 day per year, max. 2.8 Δdv) and Fort Belknap Reservation (up to 1 day per year, max. 4.1 Δdv).

Temporary Impacts

Based on modeling, the potential maximum 24-hour average PM_{10} concentration due to fugitive dust emissions from the largest construction site of the Montana Project (6-acre sales compressor station with a two-track road 480 m long and 12 m wide) was estimated to be about 57 $\mu g/m^3$, occurring about 400 m away from the center of construction site and about 200 m from the road. Although the temporary, short-term impacts of fugitive dust emissions from a construction site are not usually subjected to the requirements of ambient air quality standards, the total PM_{10} concentration, including the contributions from the largest construction site of the Montana Project, was estimated and compared with applicable MAAQS and NAAQS. Adding the estimated potential maximum 24-hour average PM_{10} concentration increase of 57 $\mu g/m^3$ to the background concentration of 105 $\mu g/m^3$ would amount to a total concentration of about 162 $\mu g/m^3$, which is about 108 percent of MAAQS. All other construction sites of the Montana Project would be smaller in size than the 6-acre sales compressor station construction site and therefore, potential PM_{10} concentration impacts at these smaller sites would be less.

In addition, it is anticipated temporary electrical generators would be used during construction of the compressor stations. The exact number of temporary natural gas and diesel generators for compressor stations cannot be predicted, but typical emission factors were used to estimate the near-field impacts from one temporary diesel generator. The potential ground-level concentrations resulting from operation of a temporary generator are as follows: CO 1-hour up to 403 $\mu g/m^3$, CO 8-hour up to 243 $\mu g/m^3$; NO_2 24-hour up to 7.5 $\mu g/m^3$; NO_2 annual up to 5.3 $\mu g/m^3$; $PM_{2.5}$ 3-hour up to 0.4 $\mu g/m^3$; $PM_{2.5}$ annual up to 0.4 $\mu g/m^3$; SO_2 3-hour up to 0.4 $\mu g/m^3$; SO_2 24-hour up to 0.3 $\mu g/m^3$; and SO_2 annual up to 0.013 $\mu g/m^3$. All concentrations are well below the ambient air quality standards.

The HAP impact analysis was based on a maximum assumed six-unit reciprocating compressor engine station as described in the Air Quality Appendix. Since neither the MDEQ nor EPA have established HAP standards, predicted 8-hour HAP concentrations were compared to a range of 8-hour state maximum Acceptable Ambient Concentration Levels (USEPA 1997a). Formaldehyde was the only HAP predicted to exceed even the lowest threshold level. The maximum predicted cumulative 8-hour formaldehyde impact was 11.9 $\mu g/m^3$, which is within the threshold range of 4.5 $\mu g/m^3$ (Pinnellas County Air Pollution Control Board, Florida) to 71 $\mu g/m^3$ (State of Nevada, Division of Environmental Protection, Air Quality Control). The maximum formaldehyde concentration was predicted to occur at 85 meters (less than 300 feet) adjacent to a compressor station; as the distance from the emission source increases, the predicted concentrations decrease rapidly.

Analysis was conducted to determine the possible incremental cancer-risk over a 70 year lifetime for a most likely exposure (MLE) to residents and to a maximally exposed individual (MEI), such as compressor station workers. These cancer risks were calculated based on the maximum predicted annual concentrations, EPA's unit risk factors for carcinogenic compounds (EPA 1997b) and an adjustment for time spent at home or on the job. This analysis assumed that residential exposure would be 20 years (well over the national nine year average duration a family lives at a residence) and worker exposure would be 20 years (the full life of project). In addition, it was assumed that family members would be exposed to the maximum formaldehyde concentrations 64 percent of the day and to one fourth of this concentration for the remaining 36 percent of the day.

The resulting incremental cancer risks were calculated to be 1.6 x 10^{-6} (MLE) and 2.2 x 10^{-6} (MEI). Both of these values fall near the lower end of the 1 to 100 x 10^{-6} threshold. The MLE and MEI cancer risks would fall below this threshold at 310 and 460 meters away from the emission source, respectively. This distance would be even less for smaller compressors.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative B. Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 107 $\mu g/m^3$ for 24-hr PM_{10}. When combined with the assumed background level of 105 $\mu g/m^3$, the total impact of 211 $\mu g/m^3$ would exceed the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. The Alternative B project sources contribute a maximum 12.1 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 13.1 $\mu g/m^3$ and the non-project sources contributed 104 $\mu g/m^3$. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

Furthermore, a maximum near-field cumulative impact for 24-hour $PM_{2.5}$ was determined to be 46 $\mu g/m^3$. When combined with the assumed background level of 20 $\mu g/m^3$, the total impact of 66 $\mu g/m^3$ would exceed the 24-hour $PM_{2.5}$ NAAQS of 65 $\mu g/m^3$. Note that the Alternative B project sources contribute a maximum 6.2 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 6.9 $\mu g/m^3$ (see Table 4-14).

In addition, Alternative B non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation and the Washakie Wilderness area. For the Northern Cheyenne Reservation the far-field analysis indicated a maximum increment level of 12.8 $\mu g/m^3$ with the non-project sources contributing 8.4 $\mu g/m^3$ and project sources contributing up to 4.2 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 5.9 $\mu g/m^3$.

For the Washakie Wilderness Area the far-field analysis indicated a maximum increment level of 9.2 $\mu g/m^3$ with the non-project sources contributing 7.2 $\mu g/m^3$ and project sources contributing up to 1.4 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 2.0 $\mu g/m^3$.

Alternative B non-project sources also have the potential to exceed the PSD Class I increment for annual NO_2 on the Northern Cheyenne Reservation (see Table 4-15). The far-field analysis indicated a maximum increment level of 4.2 $\mu g/m^3$ with the non-project sources contributing 0.5 $\mu g/m^3$ and project sources contributing up to 1.9 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 3.7 $\mu g/m^3$.

TABLE 4-14

ALTERNATIVE B POTENTIAL NAAQS/MAAQS EXCEEDANCES

Location	Pollutant	Contributions (μg/m³) Project Sources Only	Project + RFFA Sources	Non-Project Sources	Back-ground	Cumulative Total	NAAQS/MAAQS
Near-Field	$PM_{2.5}$ 24-hr	6.2	6.9	44.1	20	66	65/---
Near-Field	PM_{10} 24-hr	12.1	13.1	104	105	212	150/150

TABLE 4-15

ALTERNATIVE B POTENTIAL PSD INCREMENTS EXCEEDANCES

Location	Pollutant	Contributions (μg/m³) Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
Northern Cheyenne Reservation	PM_{10} 24-hr	4.2	5.9	8.4	12.8	8	n/a
Northern Cheyenne Reservation	NO_2 Annual	1.9	3.7	0.5	4.2	2.5	n/a
Washakie Wilderness Area	PM_{10} 24-hr	1.4	2.0	7.2	9.2	8	n/a
Near-Field	PM_{10} 24-hr	12.1	13.1	103.8	107	n/a	30

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 107 μg/m³ exceeds the Class II increment of 30 μg/m³ for 24-hour PM_{10}. The non-project source contribution was predicted to be up to 104μg/m³ and the project source contribution was predicted to be up to 12.1 μg/m³ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 13.1 μg/m³.

All NEPA analysis comparisons to PSD increments are intended to evaluate a threshold of concern. They do not represent a regulatory PSD increment consumption analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 μeq/l), the predicted cumulative impact of 1.8 μeq/l change would exceed the threshold level of 1.0 μeq/l. Approximately 11 percent of this change would be attributable to Alternative B project sources alone. Additionally, the potential cumulative impact of 10.4 μeq/l change would exceed the threshold level of 10 μeq/l for Florence Lake in the Class II Cloud Peak Wilderness Area.

Note that potential visibility impacts were predicted to occur from Alternative B non-project sources alone in every sensitive area analyzed. When Alternative B project sources are included in the cumulative analysis, average daily visibility impacts increase by 1 to 3 days per year at most areas, except the Northern Cheyenne Reservation and Class II Crow Reservation. Both are located near the potential Alternative B sources.

Cumulative impacts from non-project, Alternative B and RFFA sources are likely to degrade visibility within fourteen of the fifteen mandatory federal PSD Class I Areas. When Alternative B project sources are combined with the RFFA (Reservation and Forest Service) developments cumulative impacts resulted in an increase of 1 to 5 days per year, as shown in the table below. The cumulative impacts ranged from a total of 2 to 32 days per year for these Class I areas with a maximum Δdv of 29.1 for the U.L. Bend Wilderness Area.

Modeled project sources could impact seven of the PSD Class I Areas. A "just noticeable change" of 1.0 dv was predicted to average 3 day per year within the Washakie Wilderness Area, 2 days per year within the Bridger, Fitzpatrick and North Absaroka Wilderness Areas and 1 day per year within the Teton Wilderness Area, U.L. Bend Wilderness Area and Yellowstone National Park (see Table 4-16).

Given their proximity to anticipated Alternative B emission sources, cumulative average annual visibility changes were also predicted to occur on up to 92 days per year within the re-designated PSD Class I Northern Cheyenne Reservation. The maximum Δdv was modeled to be 54.8. Project sources alone contributed up to 33 days per year. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 60 days per year. Although no direct visibility impacts to the Fort Peck Reservation may be attributable to Alternative B project sources, the cumulative impact was predicted to increase 3 days per year with a maximum Δdv of 7.4.

For PSD Class II areas, cumulative impacts from project sources combined with the RFFA (Reservation and Forest Service) sources and non-project sources were predicted to be 11 days to 116 days per year, as shown in Table 4-17 below with a maximum Δdv of 66.9 (on Crow Reservation). The Alternative B project sources combined with RFFA sources contributed generally 1 to 55 days per year to these cumulative totals. Alternative B project source impacts were predicted to occur on 9 days within the Bighorn Canyon National Recreation Area and on up to 61 days within the PSD Class II Crow Reservation. Less extensive potential direct visibility impacts were also predicted for the PSD Class II Absaroka-Beartooth Wilderness Area (up to 9 days per year), Cloud Peak Wilderness Area (up to 6 days per year), Popo Agie Wilderness Area (up to 2 days per year), Devils Tower National Monument (up to 1 day per year) and Fort Belknap Reservation (up to 1 day per year). Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

TABLE 4-16

ALTERNATIVE B CLASS I AREA POTENTIAL VISIBILITY IMPACTS

	Contributions Visibility (No. of days >1.0 dv/yr)				
Location	**Project Sources Only**	**Project + RFFA Sources**	**Non-Project Sources**	**Cumulative Total**	**Maximum Δdv**
Badlands Wilderness Area	0	0	17 to 25	21 to 28	10.9
Bridger Wilderness Area	2	3	8 to 10	10 to 12	13.3
Fitzpatrick Wilderness Area	2	3	7 to 9	10 to 12	16.6
Fort Peck Reservation	0	1	1 to 2	4 to 5	7.4
Gates of the Mountains Wilderness Area	0	0	3 to 4	4 to 4	15.0
Grand Teton National Park	0	0	4 to 6	6 to 8	7.0
Northern Absaroka Wilderness Area	2	4	10 to 12	13 to 15	14.9
Northern Cheyenne Reservation	33	60	30 to 38	87 to 92	54.8
Red Rock Lakes Wilderness Area	0	0	0 to 1	2 to 3	2.9
Scapegoat Wilderness Area	0	0	2 to 2	3 to 3	9.9
Teton Wilderness Area	1	3	7 to 9	10 to 11	14.6
Theodore Roosevelt National Park (North Unit)	0	0	1 to 2	2 to 3	3.7
Theodore Roosevelt National Park (South Unit)	0	1	2 to 4	4 to 7	4.6
U.L. Bend Wilderness Area	1	1	5 to 5	6 to 8	29.1
Washakie Wilderness Area	3	5	11 to 14	16 to 18	24.8
Wind Cave National Park	0	0	21 to 27	25 to 32	9.1
Yellowstone National Park	1	3	9 to 11	12 to 13	12.8

TABLE 4-17

ALTERNATIVE B CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	2	4	28 to 29	32 to 33	21.5
Agate Fossils Bed National Monument	0	0	10 to 15	14 to 19	12.8
Bighorn Canyon National Recreation Area	9	17	19 to 21	32 to 34	34.0
Black Elk Wilderness Area	0	1	20 to 26	24 to 31	9.4
Cloud Peak Wilderness Area	6	10	21 to 28	35 to 39	16.3
Crow Reservation	61	75	56 to 61	113 to 116	66.9
Devils Tower National Monument	1	3	24 to 38	34 to 47	11.4
Fort Belknap Reservation	1	1	60 to 61	61 to 62	28.4
Fort Laramie National Historic Site	0	1	13 to 17	16 to 20	16.9
Jewel Cave National Monument	0	0	24 to 31	28 to 36	12.1
Mount Rushmore National Memorial	0	0	17 to 22	20 to 26	8.4
Popo Agie Wilderness Area	2	3	8 to 10	11 to 13	14.6
Soldier Creek Wilderness Area	0	0	13 to 18	16 to 21	11.4

Crow Reservation

Given the proximity of proposed Alternative B emission sources near or on the Crow Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 61 days per year from Alternative B project sources directly; up to 75 days per year from project and RFFA sources; up to 61 days per year from non-project sources; and up to 116 days per year from all sources cumulatively. The maximum Δdv was 66.9.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative B emission sources near or on the Northern Cheyenne Reservation, it is understandable that some of the maximum air pollutant impacts could occur on tribal lands. With the exception of a potential non-project and cumulative source exceedance of the 24-hour PM_{10} and annual NO_2 Class I Increments, all direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: up to 33 days per year from Alternative B project sources directly; up to 60 days per year from project and RFFA sources; up to 38 days per year from non-project sources and up to 92 days per year from all sources cumulatively. The maximum Δdv was 54.5.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative B sources would be the same as those presented for Alternative A sources above.

Conclusion

Future development activities must comply with applicable local, state, tribal and federal air quality laws, statutes, regulations, standards, increments and implementation plans. Increases in air pollutant emissions that could occur under Alternative B, resulting in direct air quality impacts would not be permitted. It is unlikely direct air quality impacts from Alternative B project sources alone would violate local, state, tribal or federal air quality standards.

When Alternative B project source impacts are combined with the RFFA (Reservation and Forest Service) sources and non-project sources, the 24-hour PM_{10} NAAQS and the 24-hour $PM_{2.5}$ NAAQS were predicted to be exceeded near the Spring Creek Coal Mine. In addition, cumulative impact of Alternative B project, RFFA and non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} and PSD Class I Increment for annual NO_2 on the Northern Cheyenne Reservation, as well as the PSD Class I increment for 24-hour PM_{10} on the Washakie Wilderness area.

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 107 $\mu g/m^3$ exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}.

Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and in Florence Lake in the Class II Cloud Peak Wilderness Area; and 2) visibility impact thresholds in all PSD Class I and Class II area (including 15 mandatory federal PSD Class I areas) included in this analysis.

Alternative C—Emphasize CBNG Development

Potential direct and cumulative air quality impacts are comparable to Alternative B.

Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

Potential direct air quality impacts could occur under this alternative. Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2 and PM_{10} concentrations could occur, but most maximum concentrations are expected to be below applicable state and NAAQS, as well as NAAQS PSD increments and some maximum concentrations are predicted to be above applicable state and NAAQS and PSD increments.

The modeled impacts from project sources only are shown in Table 4-18 below. These results, which are all below the MAAQS, NAAQS and PSD increments, are for near-field modeling. Far-field modeling results for project sources were also found to be below the MAAQS, NAAQS and PSD Increments. (Refer to "Project Sources Only" columns in the following tables.)

Alternative D project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 1.8 percent, which equates to a 0.1 μeq/l change. This is below threshold level of 1.0 μeq/l set as the level of significant impact.

Alternative D project sources by themselves are likely to directly degrade visibility within one mandatory federal PSD Class I Area. A greater than "just noticeable change" of 1.0 dv was predicted to average 1 day per year within the Washakie Wilderness Area (maximum 2 Δdv) and up to 17 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 8 Δdv).

For PSD Class II areas, Alternative D project sources were predicted to impact visibility greater than 1.0 dv on 3 days within the Bighorn Canyon National Recreation Area (maximum 3 Δdv), 1 day within the Cloud Peak Wilderness Area (maximum 2 Δdv) and up to 42 days within the PSD Class II Crow Reservation (maximum 11 Δdv).

Temporary Impacts

Temporary impacts for Alternative D are expected to be comparable to those described under Alternative B.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative D (see Table 4-19). Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 106 $\mu g/m^3$. When combined with the assumed background level of 105 $\mu g/m^3$, the total impact of 211 $\mu g/m^3$ would exceed the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. The Alternative D project source emissions would contribute a maximum of 10.8 $\mu g/m^3$ alone. The project and RFFA sources combined would contribute a maximum of 11.5 $\mu g/m^3$. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

TABLE 4-18

ALTERNATIVE D—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Montana Background ($\mu g/m^3$)	Total[2] Impact ($\mu g/m^3$)	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	6.4	25	17.4	20.1	100	100
	1-hour	49.5	n/a	167	217	566	n/a
SO_2	Annual	0.65	20	16.7	17	60	80
	24-hour	2.1	91	75.1	75	260	365
	3-hour	3.5	512	295	295	n/a	1,300
	1-hour	4.5	n/a	671	671	1,300	n/a
PM_{10}	Annual	3.3	17	33.3	34	50	50
	24-hour	10.8	30	116	117	150	150
$PM_{2.5}$	Annual	1.2	n/a	9.2	9	15	15
	24-hour	4.3	n/a	24.3	26	65	65
CO	8-hour	29.1	n/a	6,629	6,674	10,000	10,000
	1-hour	47.6	n/a	15,048	15,109	26,000	40,000

[1] PSD Increment is to be compared to the Project Modeled Impact.
[2] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

TABLE 4-19

ALTERNATIVE D POTENTIAL PSD INCREMENTS EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Background	Cumulative Total	NAAQS/ MAAQS
Near-Field	$PM_{2.5}$ 24-hr	4.3	4.7	44.1	20	65	65/---
Near-Field	PM_{10} 24-hr	10.8	11.5	103.8	105	211	150/150

TABLE 4-20

ALTERNATIVE D POTENTIAL PSD INCREMENTS EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
Northern Cheyenne Reservation	PM_{10} 24-hr	3.3	4.4	8.4	11.1	8	n/a
Washakie WSA	PM_{10} 24-hr	0.61	0.85	7.2	8.1	8	n/a
Near-Field	PM_{10} 24-hr	10.8	11.5	103.8	106.5	n/a	30

na=not applicable

Furthermore, a maximum near-field cumulative impact for 24-hour $PM_{2.5}$ was determined to be 45.3 $\mu g/m^3$. When combined with the assumed background level of 20 $\mu g/m^3$, the total impact of 65.3 $\mu g/m^3$ would exceed the 24-hour $PM_{2.5}$ NAAQS of 65 $\mu g/m^3$. Note that the Alternative D project sources contribute a maximum 4.3 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 4.7 $\mu g/m^3$.

In addition, Alternative D non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation (see Table 4-20). The far-field analysis indicated a maximum increment level of 9.8 $\mu g/m^3$ with the non-project sources contributing 8.4 $\mu g/m^3$ and the project sources contributing up to 3.3 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 4.4 $\mu g/m^3$. The far-field analysis also indicated a maximum cumulative increment level of 8.1 $\mu g/m^3$ for the Washakie Wilderness Area. Non-project sources were determined to contribute 7.2 $\mu g/m^3$ and the project sources contributing up to 0.61 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 0.85 $\mu g/m^3$.

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 106 $\mu g/m^3$ exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}. The non-project sources contribution was predicted to be up to 104 $\mu g/m^3$ and the project sources contributions were predicted to be up to 10.8 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 11.5 $\mu g/m^3$.

All NEPA analysis comparisons to PSD increments are intended to evaluate a threshold of concern. They do not represent a regulatory PSD Increment Consumption Analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 μeq/l), the predicted cumulative impact of 1.7 μeq/l change would exceed the threshold level of 1.0 μeq/l. Approximately 6 percent of this change would be attributable to Alternative D project sources alone.

Note that potential visibility impacts were predicted to occur from Alternative D non-project sources alone in every sensitive area analyzed. When Alternative D project and RFFA sources are included in the cumulative analysis, the average daily visibility impacts increase by 1 to 2 days per year for thirteen of the fifteen areas as noted (see Table 4-21). The maximum Δdv was predicted to be 26.0 at the U.L. Bend Wilderness Area. Alternative D project sources alone are likely to directly degrade visibility within only one of the fifteen mandatory federal PSD Class I Areas. A change of 1.6 dv was predicted to average 1 day per year within the Washakie Wilderness Area.

For PSD Class II areas, Alternative D project source impacts were predicted to occur on up to 1 day within the Cloud Peak Wilderness Area (maximum 1.9 Δdv) and up to 3 days within the Bighorn Canyon National Recreation Area (maximum 2.6 Δdv). Cumulative impacts from project with RFFA sources and non-project sources were predicted to be up to 35 days and 28 days per year, respectively.

The Alternative D project sources with RFFA sources contributed generally 1 to 7 days per year to the cumulative totals for the Class II areas listed in Table 4-22. The maximum Δdv was predicted to be 30.6 at the Bighorn Canyon National Recreation Area and 59.3 at the Crow Reservation. Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

Crow Reservation

Given the proximity of proposed Alternative D emission sources near or on the Crow Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 42 days per year from Alternative D project sources directly; up to 56 days per year from project and RFFA sources combined; up to 61 days per year from non-project sources; and up to 105 days per year from all sources cumulatively. The maximum Δdv was predicted to be 59.3.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative D emission sources near or on the Northern Cheyenne Reservation, it is understandable that air pollutant impacts would occur on tribal lands. With the exception of a potential non-project and cumulative source exceedance of the 24-hour PM_{10}

TABLE 4-21

ALTERNATIVE D CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	0	17 to 25	20 to 26	10.4
Bridger Wilderness Area	0	1	8 to 10	9 to 11	11.7
Fitzpatrick Wilderness Area	0	0	7 to 9	8 to 10	14.6
Fort Peck Reservation	0	0	1 to 2	2 to 3	6.5
Gates of the Mountains Wilderness Area	0	0	3 to 4	3 to 4	13.7
Grand Teton National Park	0	0	4 to 6	5 to 7	6.3
Northern Absaroka Wilderness Area	0	1	10 to 12	12 to 14	12.4
Northern Cheyenne Reservation	17	38	30 to 38	70 to 76	47.9
Red Rock Lakes Wilderness Area	0	0	0 to 1	1 to 2	2.6
Scapegoat Wilderness Area	0	0	2 to 2	2 to 3	8.9
Teton Wilderness Area	0	0	7 to 9	9 to 10	12.9
Theodore Roosevelt National Park (North Unit)	0	0	1 to 2	1 to 2	3.5
Theodore Roosevelt National Park (South Unit)	0	0	2 to 4	3 to 5	4.2
U.L. Bend Wilderness Area	0	0	5 to 5	5 to 6	26
Washakie Wilderness Area	1	1	11 to 14	14 to 16	21.9
Wind Cave National Park	0	0	21 to 27	23 to 29	8.2
Yellowstone National Park	0	0	9 to 11	11 to 12	10.5

TABLE 4-22

ALTERNATIVE D CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	0	1	28 to 29	30 to 31	17.8
Agate Fossils Bed National Monument	0	0	10 to 15	12 to 17	11.4
Bighorn Canyon National Recreation Area	3	7	19 to 21	25 to 28	30.6
Black Elk Wilderness Area	0	0	20 to 26	22 to 28	8.8
Cloud Peak Wilderness Area	1	2	21 to 28	28 to 35	14.9
Crow Reservation	42	56	56 to 61	102 to 105	59.3
Devils Tower National Monument	0	0	24 to 38	29 to 42	10.3
Fort Belknap Reservation	0	0	60 to 61	61 to 61	25.5
Fort Laramie National Historic Sites	0	0	13 to 17	15 to 18	15.5
Jewel Cave National Monument	0	0	24 to 31	26 to 34	11.5
Mount Rushmore National Monument	0	0	17 to 22	18 to 23	7.9
Popo Agie Wilderness Area	0	1	8 to 10	9 to 11	12.9
Soldier Creek Wilderness Area	0	0	13 to 18	14 to 20	10.1

Class I increments, all direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: up to 17 days per year from Alternative D project sources directly; up to 38 days per year from project and RFFA sources combined; up to 38 days per year from non-project sources; and, up to 76 days per year from all sources cumulatively. The maximum Δdv was predicted to be 47.9.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative D sources would be the same as those presented for Alternative A sources above.

Conclusion

Future development activities must comply with applicable local, state, tribal and federal air quality laws, statutes, regulations, standards, increments and implementation plans. Increases in air pollutant emissions would occur under Alternative D. Given the assumptions applied in this analysis, it is unlikely direct air quality impacts from Alternative D project sources alone would violate any local, state, tribal, or federal air quality standards.

When combined with Alternative D non-project sources and RFFA sources, the 24-hour PM_{10} NAAQS and 24-hour $PM_{2.5}$ NAAQS was predicted to be exceeded near the Spring Creek Coal Mine. In addition, the cumulative impact from Alternative D project sources with RFFA sources and non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation. For Class II areas near the Spring Creek Coal Mine, the cumulative impact is predicted to exceed the Class II increment for 24-hour PM_{10}.

Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area; and 2) visibility impact thresholds in all PSD Class I and Class II areas (including 15 mandatory federal PSD Class I areas) included in this analysis.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts while Maintaining Existing Land Uses

Alternative E has been modeled in the FSEIS to allow direct comparison of the 2003 Final EIS preferred Alternative E to the new preferred Alternative H. The new air model was also used to predict impacts from Alternatives F and H. The new model incorporated an extended near-field receptor grid to include an expanded portion of the CBNG development area for both Montana and Wyoming, updated the emission inventories to the most currently available year (2004), added in the TRR as an RFFA and added emission sources identified by Environmental Defense Fund that were within the modeling domain. The new model also used three years of meteorological data initially to determine the meteorological year showing the highest impacts for the modeled base year (2004). The base year modeling indicated that meteorological year 2002 predicted the highest impacts and was chosen as the meteorological year for modeling future alternatives development. Assumptions used in the Statewide EIS for air emissions relating to CBNG development, as well as conventional oil and gas development, apply for the new modeling effort as well.

Under the new model, predicted impacts for the base year indicated the potential for localized short-term increases in NO_x, SO_2, PM_{10} and $PM_{2.5}$ concentrations. However, maximum concentrations were predicted to be below applicable state and NAAQS, as well as PSD increments. The new model incorporated the emissions used for base year modeling and adjusted the emission factors for non-project-related sources to account for changes to future emissions. This was done to allow a direct comparison of modeled impacts to applicable state and NAAQS, as well as PSD increments. Again, this was only done for comparative purposes; it does not constitute an effort to predict PSD increment consumption. In general, the base-year modeled impacts predicted ambient air concentrations that were higher than the monitored levels obtained for the year 2004.

Most source groups were modeled separately and, in some cases, were added together in the post-processing phase of modeling. This was done to provide a conservative estimate of impacts from various source groupings; in actuality, however, impacts were often at different receptors and occurred at different meteorological hours. A detailed description of the new model and predicted results are included in the Air Quality Appendix – Part 2.

Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts, localized short-term increases in NO_x, SO_2, PM_{10} and $PM_{2.5}$ concentrations could occur, but most maximum concentrations are expected to be below applicable state and NAAQS, as well as PSD increments. Additionally, the air quality permitting process would be used to analyze emission sources at the project level for CBNG development and to develop any needed mitigation. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

The modeled impacts from Montana CBNG sources only are shown in Table 4-23 below. These results for near-field modeling are all below the MAAQS, WAAQS and NAAQS; Far-field modeling results for project sources were also found to be below the MAAQS, NAAQS and most PSD increments. (Refer to “Project Sources Only” columns in the following tables.) The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore, the sum of the individual contributions will not always equal the cumulative totals.

TABLE 4-23

ALTERNATIVE E PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Montana Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact (μg/m³)	MT CBNG (Operation) Modeled Impact (μg/m³)	Montana Base Year (All Sources) (μg/m³)	PSD Increments[1] (μg/m³) Class II	Montana AAQS (μg/m³)	NAAQS (μg/m³)
NO_2	Annual	0.46	3.60	3.91	25	100	100
	1-hour	118.6	435	428	n/a	566	n/a
SO_2	Annual	0.04	0.10	1.71	20	60	80
	24-hour	0.56	0.98	15.1	91	260	365
	3-hour	3.54	4.82	43.9	512	n/a	1,300
	1-hour	10.57	11.51	140	n/a	1,300	n/a
PM_{10}	Annual	0.25	1.43	3.52	17	n/a	n/a
	24-hour	3.33	12.9	30.6	30	150	150
$PM_{2.5}$	Annual	0.01	0.20	0.88	n/a	15	15
	24-hour	0.10	2.16	6.83	n/a	35	35

Wyoming Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact (μg/m³)	MT CBNG (Operation) Modeled Impact (μg/m³)	Wyoming Base Year (All Sources) (μg/m³)	PSD Increments[1] (μg/m³) Class II	Wyoming AAQS (μg/m³)	NAAQS (μg/m³)
NO_2	Annual	0.01	0.23	27.2	25	100	100
SO_2	Annual	0.001	0.01	17	20	60	80
	24-hour	0.01	0.06	124	91	260	365
	3-hour	0.03	0.22	552	512	1,300	1,300
PM_{10}	Annual	0.01	0.16	13.5	17	n/a	n/a
	24-hour	0.09	2.02	89.2	30	150	150
$PM_{2.5}$	Annual	0.004	0.07	2.11	n/a	15	15
	24-hour	0.04	1.10	9.4	n/a	35	35

[1] PSD increment is to be compared to the Montana CBNG modeled impact.

n/a – not applicable

Alternative E project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact would be an ANC change of 133 percent, which equates to a 2.6 μeq/l change. This is above the threshold level of 1.0 μeq/l set as the level of significant impact. However, this represents a 0.2 μeq/l change from the base year modeled impact of 2.4 μeq/l.

Using Visibility Method 2 indicates that Alternative E CBNG sources by themselves are likely to have an impact on visibility within ten mandatory federal PSD Class I Areas. A greater than “just noticeable change” of 1.0 dv was predicted to average up to 4 days per year within the Bridger Wilderness Area (maximum 2.3 Δdv), 3 days per year within the Fitzpatrick Wilderness Area (maximum 2.3 Δdv), 1 day per year within the Fort Peck Reservation (maximum 1.4 Δdv), 6 days per year within the North Absaroka Wilderness Area (maximum 2.5 Δdv), 2 days per year within the Teton Wilderness Area (maximum 1.2 Δdv), 3 days per year within Theodore Roosevelt National Park (maximum 1.3 Δdv), 6 days per year within the Washakie Wilderness Area (maximum 2.2 Δdv), 1 day per year within Wind Cave National Park (maximum 1.2 Δdv), 2 days per year within Yellowstone National Park (maximum 2.4 Δdv) and 235 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 15.1 Δdv). Using Visibility Method 6 to predict visibility impacts indicates that Alternative E project sources by themselves were predicted to have an impact on visibility within five mandatory federal PSD Class I areas. A greater than “just noticeable change” of 1.0 dv was predicted to average up to 1 day per year within the Fort Peck Reservation (maximum 1 Δdv), 3 days per year within the North Absaroka Wilderness Area (maximum 1.5 Δdv), 2 days per year within Theodore Roosevelt National Park (maximum 1.5 Δdv), 1 day per year within the UL Bend Wilderness Area (maximum 1 Δdv), 3 days per year within the Washakie Wilderness Area (maximum 1.2 Δdv) and 1 day per year within Yellowstone National Park (maximum 1.3 Δdv). Additionally, Alternative E project sources alone were predicted to impact visibility above 1.0 dv for 215 days within the designated PSD Class I Northern Cheyenne Reservation (maximum 13 Δdv).

Alternative E project sources were predicted with Visibility Method 6 to impact visibility greater than 1.0 dv on six PSD Class II areas. The model indicated up to 4 days per year within the Absaroka Beartooth Wilderness Area (maximum 3.3 Δdv), 24 days within the Bighorn Canyon National Recreation Area (maximum 3.5 Δdv), 9 days per year within the Cloud Peak Wilderness Area (maximum 7.1 Δdv), 248 days per year within the Crow Reservation (maximum 13.4 Δdv), 2 days per year within the Devils Tower National Monument (maximum 1.1 Δdv) and 4 days per year within the Wind River Reservation (maximum 1.3 Δdv).

Hazardous Air Pollutant Impacts

Estimates of HAPs impacts were developed for both 1-hour and annual near-field impacts for Montana CBNG sources. Results of the 1-hour modeled impacts for these modeling efforts were compared to the reference exposure levels (RELs) (EPA 1990). Short-term impacts for the six analyzed compounds (benzene, ethyl benzene, formaldehyde, n-hexane, toluene and xylene) were compared to the RELs. Results showed that all impacts were well below the RELs, except for formaldehyde in the Wyoming near-field receptor grid. Impacts are approximately 50 percent of the established acute REL for formaldehyde for Alternative E. In Montana, the 1-hour formaldehyde impact is approximately 18 percent or less of the established acute REL.

Temporary Impacts

Temporary impacts for Alternative E are expected to be comparable to those described under Alternative B.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative E. However, none of the predicted impacts would exceed state or NAAQS.

The maximum predicted 1-hour NO_2 concentration for all sources combined for Montana near-field receptors is 531 μg/m^3 compared with a NAAQS of 566 μg/m^3. The base year maximum predicted impact for 1-hour NO_2 concentrations from all sources combined is 428 μg/m^3. Thus, predicted future-year impacts represent an increase of 24 percent. For existing Montana CBNG sources, the base year, 1-hour NO_2 concentration impacts would be 122 μg/m^3 for construction and 200 μg/m^3 for operation. The maximum predicted impacts would be 118.6 μg/m^3 and 435 μg/m^3 for construction and operation, respectively. This indicates a slight decrease in ambient levels as construction declines and an increase of 117 percent from increased well operation. The predicted 1-hour NO_2 concentration from the TRR is 263 μg/m^3, which is higher than the change due to combined Montana CBNG construction and operation.

The maximum predicted base year impact to Wyoming near-field receptors for annual NO_2 concentration from all sources combined is 27.2 μg/m^3. The future predicted impact is 40.7 μg/m^3, representing an increase of 50 percent. The Wyoming Ambient Air Quality Standards (WAAQS)/NAAQS is 100 μg/m^3. All modeled source groups' annual NO_2 impacts are below the WAAQS/NAAQS. However, the base year modeled impact exceeds the PSD Class II increment of 25 μg/m^3. Actual monitoring data for the base year are significantly lower than base year model results, indicating the conservative nature of the model.

The maximum model predicted base year 24-hour PM_{10} impact to Montana near-field receptors from all sources combined is 30.1 μg/m^3. The future year impact from all combined sources is 45.5 μg/m^3, or an increase of 51 percent. Again, the base year model results indicate an exceedance of the PSD Class II increment level (30 μg/m^3), while actual monitored data are well below the PSD increment. The change from base year to future modeled year of 15.4 μg/m^3 is below the PSD Class II increment level. For existing Montana CBNG sources, the base year predicted impact is 2.91 μg/m^3 for construction and 2.93 μg/m^3 for operation. Future modeled impacts of 3.33 μg/m^3 and 12.9 μg/m^3 indicate increases of 14 percent due to construction and 340 percent for operation. The predicted 24-hour PM_{10} impacts from RFFA sources (TRR and Roundup Power Plant) are 1.38 μg/m^3 and 0.49 μg/m^3, respectively.

All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

The maximum predicted base year impact to Wyoming near-field receptors for 24-hour PM_{10} concentrations from all sources combined is 89.2 μg/m^3. The future predicted impact is 105.8 μg/m^3, representing an increase of 18.6 percent. The WAAQS/NAAQS is 150 μg/m^3. All modeled source groups' 24-hour PM_{10} impacts are below the WAAQS/NAAQS. However, the base year modeled impact exceeds the PSD Class II increment of 30 μg/m^3. The change from base year to future modeled year of 16.6 μg/m^3 is below the PSD Class II increment.

The maximum predicted 24-hour SO_2 concentration for all sources combined for Montana near-field receptors is 15.1 μg/m^3, compared to an NAAQS of 365 μg/m^3. The base year maximum predicted impact for 24-hour SO_2 concentration from all sources combined is 15.1 μg/m^3. Thus, predicted future year impacts represent no change from the base year. For existing Montana CBNG sources, the base year 24-hour SO_2 concentration impacts are 0.45 μg/m^3 for construction and 0.21 μg/m^3 for operation. The maximum predicted impacts are 0.56 μg/m^3 and 0.98 μg/m^3 for construction and operation, respectively. This indicates a slight change above the base year impacts. The predicted 24-hour SO_2 concentration from the TRR is 3.08 μg/m^3, which is higher than the change due to combined Montana CBNG construction and operation. The predicted 24-hour SO_2 concentration from the Roundup Power Plant is the same as for Montana CBNG construction.

The maximum predicted base year impacts to Wyoming near-field receptors for 24-hour SO_2 and 3-hour SO_2 concentrations from all sources combined are 124 μg/m^3 and 552 μg/m^3. The future predicted impacts are unchanged from the base year. The base year modeled 24-hour SO_2 and 3-hour SO_2 concentration impacts exceed the PSD Class II increments of 91 μg/m^3 and 512 μg/m^3.

In addition, Alternative E all sources combined has the potential to exceed the PSD Class I increments for annual NO_2 and 24-hour PM_{10} on the Northern Cheyenne Reservation (see Table 4-24). The far-field analysis indicated a maximum increment level of 3.78 μg/m^3 for annual NO_2 and 10.9 μg/m^3 for 24-hour PM_{10}. The annual NO_2 level represents a change from the base year of 3.49 μg/m^3, which is above the Class I PSD increment. However, the 24-hour PM_{10} change over the base year is 3.57 μg/m^3, which is lower than the PSD increment. Additionally, the Alternative E all-Montana sources and Montana CBNG operation sources have the potential to exceed the PSD Class I increment for annual NO_2 and 24-hour PM_{10} on the Northern Cheyenne Reservation. The impacts predicted from all Montana sources combined are 3.73 μg/m^3 for annual NO_2 and 9.73 μg/m^3 for 24-hour PM_{10}. Montana CBNG operation sources contribute 3.57 μg/m^3 to annual NO_2 and 9.17 μg/m^3 to 24-hour PM_{10}. This is because in future year modeling the CBNG resource development for Indian owned land and Forestry Service managed land (RFFAs) was included in the Montana CBNG source group. These high impacts are most likely due to RFFA development within the Northern Cheyenne Reservation and Custer National Forest. The

Fort Peck Reservation indicates a potential to exceed the Class I PSD increment for 24-hour SO_2 of 5 $\mu g/m^3$, with all sources combined having a modeled impact of 7.02 $\mu g/m^3$. The combined "other" source group category, containing mines, refineries and various non-coal or oil and gas related sources, contributes 6.82 $\mu g/m^3$ to this and is unchanged from the base year model. Similarly, Theodore Roosevelt National Park has the potential to exceed the Class I PSD increment for 3-hour and 24-hour SO_2. Again, the other source group contributes over 99 percent to these totals, which are unchanged from the modeled base year.

For Class II areas, the maximum cumulative impact from all combined sources of 45.8 $\mu g/m^3$ on the Crow Reservation exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}. The Montana coal sources' contribution was predicted to be up to 44.8 $\mu g/m^3$, indicating CBNG sources contributions of 1.0 $\mu g/m^3$ alone.

All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 µeq/l), the predicted cumulative impact of 2.6 µeq/l change would exceed the threshold level of 1.0 µeq/l. The base year modeled background for Upper Frozen Lake was 2.4 µeq/l, with CBNG related project activities contributing only 0.2 µeq/l to the cumulative impact of 2.6 µeq/l.

Potential visibility impacts were predicted to occur from Alternative E non-project sources alone in every sensitive area analyzed. When Alternative E project and RFFA sources are included in the cumulative analysis, the predicted visibility impacts show an increase of 23 days in the Northern Cheyenne Reservation (see Table 4-25). The maximum Δdv was predicted to be 45.6 at the Bridger Wilderness Area.

For PSD Class II areas, Alternative E Montana project plus RFFA source visibility impacts were predicted to occur in six sensitive areas. Cumulative impacts from Montana CBNG, combined with RFFA sources, added 8 days to the total days of predicted impacts to the Crow Reservation and 2 days to the Cloud Peak Wilderness Area. Non-project sources showed modeled visibility impacts at all Class II sensitive areas, with the maximum of 365 days at the Crow Reservation. The Alternative E Montana CBNG sources, CBNG with RFFA sources and non-project sources visibility impacts for the Class II areas are listed in Table 4-26. The maximum Δdv was predicted to be 57.8 at the Crow Reservation.

TABLE 4-24

ALTERNATIVE E POTENTIAL PSD INCREMENTS EXCEEDANCES

		Contributions ($\mu g/m^3$)				
Location	**Pollutant**	**MT CBNG Only**	**All Sources**	**Base Year All Sources**	**PSD Class I Increment**	**PSD Class II Increment**
Northern Cheyenne Reservation	Annual NO_2	3.57	3.78	0.123	2.5	n/a
	24-hr PM_{10}	9.17	10.9	0.229	8	n/a
Fort Peck Reservation	24-hr SO_2	0.0004	7.02	6.97	5	n/a
Theodore Roosevelt NP	3-hr SO_2	0.0007	36.6	36.5	30	n/a
	24-hr SO_2	0.0002	10.9	10.9	5	n/a
Crow Reservation	24-hr PM_{10}	18.8	45.8	46.7	n/a	30
MT Near Field	24-hr PM_{10}	12.9	45.5	30.6	n/a	30
WY Near Field	Annual NO_2	0.23	40.7	27.2	n/a	25
	24-hr PM_{10}	2.02	106	89.2	n/a	30
	Annual PM_{10}	0.16	19.1	13.5	n/a	17
	3-hr SO_2	0.22	552	552	n/a	512
	24-hr SO_2	0.06	124	124	n/a	91

na=not applicable

TABLE 4-25

ALTERNATIVE E CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	0	1 to 90	219	23
Bob Marshall Wilderness Area	0	0	1 to 22	28	6
Bridger Wilderness Area	0	0	1 to 70	146	45.6
Fitzpatrick Wilderness Area	0	0	1 to 43	109	31.8
Fort Peck Reservation	1	1	1 to 16	92	16.9
Gates of the Mountains Wilderness Area	0	0	12 to 40	69	11.8
Grand Teton National Park	0	0	2 to 32	92	18.2
Northern Absaroka Wilderness Area	3	3	1 to 34	90	25.6
Northern Cheyenne Reservation	215	238	2 to 59	325	33.8
Red Rock Lakes Wilderness Area	0	0	1 to 19	50	9.4
Scapegoat Wilderness Area	0	0	5 to 31	48	11.3
Teton Wilderness Area	0	0	1 to 32	92	26.8
Theodore Roosevelt National Park	2	2	1 to 32	172	35.6
U.L. Bend Wilderness Area	1	1	5 to 47	99	15.4
Washakie Wilderness Area	3	3	1 to 38	115	36.8
Wind Cave National Park	0	0	1 to 122	262	27.5
Yellowstone National Park	1	1	2 to 38	105	22.6

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

Crow Reservation

Given the proximity of proposed Alternative E emission sources, either near or on the Crow Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to be in compliance with applicable air quality standards and increments, except the 24-hour PM_{10} Class II increment. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 248 days per year from Alternative E CBNG sources directly; up to 256 days per year from project and RFFA sources combined; up to 359 days per year from non-project sources; and up to 365 days per year from all sources cumulatively. The maximum Δdv was predicted to be 57.8.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative E emission sources, either near or on the Northern Cheyenne Reservation, it is understandable that air pollutant impacts would occur on tribal lands. With the exception of potential Montana CBNG and cumulative source exceedance of the annual NO_2 and 24-hour PM_{10} Class I Increments, all direct, indirect and cumulative impacts were predicted to in compliance with applicable air quality standards and increments. Using Method 6, the following potential visibility impacts were predicted using Method 6 to occur on the Northern Cheyenne Reservation: up to 215 days per year from Alternative E Montana CBNG sources directly; up to 238 days per year from Montana CBNG and RFFA sources combined; up to 59 days per year from non-project sources; and, up to 219 days per year from all

TABLE 4-26

ALTERNATIVE E CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions to Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	4	4	1 to 74	137	30.3
Agate Fossils Bed National Monument	0	1	9 to 9	237	39.9
Bighorn Canyon National Recreation Area	24	24	18 to 74	298	41.1
Black Elk Wilderness Area	0	0	18 to 18	233	27.0
Cloud Peak Wilderness Area	9	11	1 to 29	147	23.9
Crow Reservation	248	256	37 to 359	365	57.8
Devils Tower National Monument	2	2	1 to 20	279	27.8
Fort Belknap Reservation	0	0	5 to 50	92	14.3
Fort Laramie National Historic Site	0	0	7 to 7	249	53.7
Jedediah Smith Wilderness Area	0	0	19 to 19	96	17.4
Jewel Cave National Monument	0	0	19 to 19	252	29.3
Lee Metcalf Wilderness Area	0	0	10 to 79	114	15.3
Mount Naomi Wilderness Area	0	0	1 to 1	52	19.8
Mount Rushmore National Monument	0	0	14 to 14	221	26.2
Popo Agie Wilderness Area	0	0	4 to 14	137	50.2
Soldier Creek Wilderness Area	0	0	11 to 11	245	39.6
Westville Mountain Wilderness Area	0	0	0 to 0	40	16.1
Wind River Reservation	4	4	13 to 35	243	56.6

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

sources cumulatively. The maximum Δdv was predicted to be 23.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative E sources would be the same as those presented for Alternative A sources above. Mitigation measures used to reduce potential visibility impacts are discussed under Alternative H in this Chapter.

Alternative F—Phased Development Multiple Screens (High Range)

The potential direct air quality impacts that could occur under this alternative are nearly identical to those predicted under Alternative E. Extensive review of modeling results presented for Alternative E indicates that many predicted impacts come from existing emission sources within the model domain, or are due to RFFA or non-project emissions. Potential near-field (direct, indirect and cumulative) air quality impacts show that, while localized short-term increases in NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations could occur, most maximum concentrations are expected to be below applicable state and NAAQS, as well as PSD increments. When compared to base year modeled impacts a few maximum concentrations are predicted to be above applicable state and NAAQS and PSD increments, however, the change from base year to future modeled year is insignificant and considerably below NAAQS and PSD increments. Additionally, the air quality permitting process would be used to analyze emission sources at the project level for CBNG development and institute any needed mitigation. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

CALPOST Visibility Method 6 was used to predict visibility impacts under Alternative F, which indicated project sources alone would likely have an impact on visibility within four mandatory federal PSD Class I areas. A greater than “just noticeable change” of 1.0 dv was predicted to average up to 3 days per year within the North Absaroka Wilderness Area (maximum 1.4 Δdv), 2 days per year within Theodore Roosevelt National Park (maximum 1.4 Δdv), 3 days per year within the Washakie Wilderness Area (maximum 1.1 Δdv) and 1 day per year within Yellowstone National Park (maximum 1.2 Δdv). Additionally, Alternative F project sources alone were predicted to impact visibility above 1.0 dv for 214 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 12.5 Δdv).

Visibility Method 6 was used to predict Alternative F project sources that would impact visibility greater than 1.0 dv on six PSD Class II areas. The model indicated up to 3 days per year within the Absaroka Beartooth Wilderness Area (maximum 3.1 Δdv), 18 days per year within the Bighorn Canyon National Recreation Area (maximum 3.1 Δdv), 8 days per year within the Cloud Peak Wilderness Area (maximum 6.8 Δdv), 115 days per year within the Crow Reservation (maximum 12.9 Δdv), 1 day per year within the Devils Tower National Monument (maximum 1 Δdv) and 3 days per year within the Wind River Reservation (maximum 1.2 Δdv).

Because of the conditions for development within the crucial sage-grouse habitat areas, a lower level of development would likely occur over approximately 93,529 acres (93,529 acres represents 12.8 percent of the potential CBNG development area within the Powder River Basin), which constitutes the area of the four identified crucial sage-grouse habitat areas. This lower level of development could result in an overall reduction of approximately 12.8 percent in CBNG related air emissions and associated impacts. Decreases in CBNG related air emissions and associated impacts would likely be higher within and locally around the four identified crucial sage-grouse habitat areas. The actual decrease in CBNG related air emissions and associated impacts would depend on the level of development that might take place within the four crucial sage-grouse habitat areas.

The modeled impacts from CBNG sources only are shown in Table 4-27.

Temporary Impacts

Temporary impacts for Alternative F are expected to be comparable to those described under Alternative E.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative F. However, none of the model predicted impacts would exceed state or NAAQS. As discussed for Alternative E and as presented in Table 4-24, impacts for Alternative F could exceed PSD Class I and Class II increments. The impacts that could exceed PSD increments are generally due to existing RFFA or non-project sources, as described under Alternative E. All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

Potential visibility impacts were predicted to occur from Alternative F non-project sources alone in every sensitive area analyzed. Alternative F project and RFFA sources are combined in the cumulative analysis, with the predicted visibility impacts showing a change of an increase of 23 days in the Northern Cheyenne Reservation (see Table 4-28). The maximum Δdv was predicted to be 45.6 at the Bridger Wilderness Area.

For PSD Class II areas, Alternative F Montana project and RFFA source visibility impacts were predicted to occur in six sensitive areas. Cumulative impacts from Montana CBNG combined with RFFA sources added 8 days to the total days of predicted impacts to the Crow Reservation and 2 days to the Cloud Peak Wilderness Area. Non-project sources showed modeled visibility impacts at all Class II sensitive areas, with the maximum of 365 days at the Crow Reservation. The Alternative F Montana CBNG sources, CBNG with RFFA sources and non-project sources visibility impacts for the Class II areas are listed in Table 4-29. The maximum Δdv was predicted to be 57.7 at the Crow Reservation.

Crow Reservation

Alternative F emission sources near or on the Crow Reservation would lead to potential air pollutant

TABLE 4-27

ALTERNATIVE F—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Montana Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Montana Base Year ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.26	3.59	3.91	25	100	100
	1-hour	67	435	428	n/a	566	n/a
SO_2	Annual	0.02	0.10	1.71	20	60	80
	24-hour	0.35	0.97	15.1	91	260	365
	3-hour	2.08	4.82	43.9	512	n/a	1,300
	1-hour	6.05	11.51	140	n/a	1,300	n/a
PM_{10}	Annual	0.15	1.43	3.52	17	n/a	n/a
	24-hour	2.03	12.87	30.6	30	150	150
$PM_{2.5}$	Annual	0.01	0.20	0.88	n/a	15	15
	24-hour	0.20	2.16	6.83	n/a	35	35

Wyoming Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Wyoming Base Year ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Wyoming AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.014	0.23	27.2	25	100	100
SO_2	Annual	0.128	1.93	17	20	60	80
	24-hour	0.013	0.15	124	91	260	365
	3-hour	0.054	1.04	552	512	1,300	1,300
PM_{10}	Annual	0.003	0.06	13.5	17	n/a	n/a
	24-hour	0.072	0.22	89.2	30	150	150
$PM_{2.5}$	Annual	0.014	0.06	2.11	n/a	15	15
	24-hour	0.002	0.01	9.4	n/a	35	35

[1] PSD Increment is to be compared to the Montana CBNG Modeled Impact.

n/a – not applicable

TABLE 4-28

ALTERNATIVE F CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	0	1 to 90	219	23
Bob Marshall Wilderness Area	0	0	1 to 22	28	6
Bridger Wilderness Area	0	0	1 to 70	146	45.6
Fitzpatrick Wilderness Area	0	0	1 to 43	109	31.8
Fort Peck Reservation	0	0	1 to 16	91	16.9
Gates of the Mountain Wilderness Area	0	0	12 to 40	69	11.8
Grand Teton National Park	0	0	2 to 32	92	18.2
Northern Absaroka Wilderness Area	3	3	1 to 34	90	25.5
Northern Cheyenne Reservation	214	237	2 to 59	328	33.8
Red Rock Lakes Wilderness Area	0	0	1 to 19	50	9.4
Scapegoat Wilderness Area	0	0	5 to 31	48	11.3
Teton Wilderness Area	0	0	1 to 32	92	26.7
Theodore Roosevelt National Park	2	2	1 to 32	172	35.6
U.L. Bend Wilderness Area	0	0	5 to 47	97	15.3
Washakie Wilderness Area	3	3	1 to 38	115	36.8
Wind Cave National Park	0	0	1 to 122	262	27.5
Yellowstone National Park	1	1	2 to 38	105	22.5

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

TABLE 4-29

ALTERNATIVE F CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	3	3	1 to 74	137	30.2
Agate Fossils Bed National Monument	0	0	4 to 134	237	39.9
Bighorn Canyon National Recreation Area	18	18	4 to 129	298	40.9
Black Elk Wilderness Area	0	0	1 to 94	233	27
Cloud Peak Wilderness Area	8	10	1 to 52	146	23.9
Crow Reservation	115	123	13 to 359	365	57.7
Devils Tower National Monument	1	1	1 to 97	279	27.8
Fort Belknap Reservation	0	0	5 to 50	92	14.3
Fort Laramie National Historic Site	0	0	1 to 145	249	53.7
Jedediah Smith Wilderness Area	0	0	3 to 31	95	17.4
Jewel Cave National Monument	0	0	1 to 109	252	29.3
Lee Metcalf Wilderness Area	0	0	1 to 79	114	15.2
Mount Naomi Wilderness Area	0	0	1 to 25	52	19.8
Mount Rushmore National Monument	0	0	1 to 91	221	26.2
Popo Agie Wilderness Area	0	0	1 to 66	137	50.2
Soldier Creek Wilderness Area	0	0	4 to 142	245	39.6
Westville Mountain Wilderness Area	0	0	2 to 12	40	16.1
Wind River Reservation	3	3	4 to 96	243	56.5

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values impacts on tribal lands. All direct, indirect and cumulative impacts were predicted to be in compliance with applicable air quality standards and increments, with the exception of the 24-hour PM_{10} PSD Class II increment, which was shown under Alternative E to be due to a coal source and not project-related. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 257 days per year from Alternative F Montana CBNG sources directly, up to 265 days per year from project and RFFA sources combined, up to 359 days per year from non-project sources and up to 365 days per year from all sources cumulatively. The maximum Δdv was predicted to be 57.8 (Table 4-29).

Northern Cheyenne Reservation

Given the proximity of proposed Alternative F emission sources near or on the Northern Cheyenne Reservation, it is understandable that air pollutant impacts would occur on tribal lands. With the exception of potential project and cumulative source exceedance of the annual NO_2 and 24-hour PM_{10} Class I increments, all direct, indirect and cumulative impacts were predicted to be in compliance with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: up to 214 days per year from Alternative F Montana CBNG sources directly, up to 237 days per year from project and RFFA sources combined, up to 59 days per year from non-project sources and up to 328 days per year from all sources cumulatively. The maximum Δdv was predicted to be 33.8 (Table 4-28).

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative F sources would be the same as those presented for Alternative A sources above. Mitigation measures that could be used to reduce these potential impacts are discussed under Alternative H in this chapter.Alternative G—Low Range Phased CBNG Development

Potential direct air quality impacts are comparable to Alternative F, but would be reduced by approximately 65 percent (this reduction would not be directly linear due to variables such as photochemistry, well locations, etc.) The air quality permitting process would be used to analyze emission sources at the project level for CBNG development and develop any mitigation needed. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

Cumulative Impacts

Given the non-project emission sources located throughout the model domain, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative G. While project-related impacts would be reduced by approximately 65 percent, impacts for Alternative G would still have the potential to exceed PSD Class I and Class II increments. The impacts that have the potential to exceed PSD increments are generally due to existing, RFFA, or non-project sources, as described under Alternative E. As was previously described under Alternative E, base year modeled impacts show the potential to exceed PSD Class I and Class II increments even without considering project emission sources. The existing and non-project emission sources contributing to the base year impacts would be unchanged under Alternative G; thus the potential for exceeding PSD increments would be similar to that described for Alternative E. Additionally, certain RFFAs (TRR and Roundup Power Plant) would be the same under each alternative. Receptors near these emission sources would be affected similarly under each alternative, with project emission sources contributing only a small portion of the total.

Alternative H—Preferred Alternative - Multiple Screens

The potential direct air quality impacts that could occur under Alternative H were modeled using five different scenarios within the SAQA. The results presented here are from scenario 1 which represents the predicted model emissions that would result from the implementation of Alternative H and using current practices for the development of CBNG resources within the PRB of Montana. A review of modeling results indicates that many of the predicted emissions come from existing emission sources within the model domain, or are due to RFFA or non-project emissions. Potential near-field (direct, indirect and cumulative) air quality impacts show that localized short-term increases in NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations could occur, but maximum concentrations are predicted to be below applicable state and NAAQS, as well as PSD increments.

Using Visibility Method 6 to predict visibility impacts indicates that Alternative H project sources would not result in a “just noticeable change” to visibility of greater than 1.0 dv at any of the mandatory federal PSD Class I Areas evaluated within the modeling domain. Alternative H project

TABLE 4-30

ALTERNATIVE H (SCENARIO 1)—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact (μg/m³)	MT CBNG (Operation) Modeled Impact (μg/m³)	Montana Base Year (μg/m³)	PSD Increments[1] (μg/m³) Class II	Montana AAQS (μg/m³)	NAAQS (μg/m³)
Montana Impacts							
NO_2	Annual	0.24	1.69	3.91	25	100	100
	1-hour	33.1	251	428	n/a	566	n/a
SO_2	Annual	0.024	0.007	1.71	20	60	80
	24-hour	0.16	0.049	15.1	91	260	365
	3-hour	0.94	0.28	43.9	512	n/a	1,300
	1-hour	3.18	0.94	140	n/a	1,300	n/a
PM_{10}	Annual	0.18	0.43	3.52	17	50	50
	24-hour	1.13	2.9	30.6	30	150	150
$PM_{2.5}$	Annual	0.052	0.21	0.88	n/a	15	15
	24-hour	0.37	1.49	6.83	n/a	65	65

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact (μg/m³)	MT CBNG (Operation) Modeled Impact (μg/m³)	Wyoming Base Year (μg/m³)	PSD Increments[1] (μg/m³) Class II	Wyoming AAQS (μg/m³)	NAAQS (μg/m³)
Wyoming Impacts							
NO_2	Annual	0.048	0.35	27.2	25	100	100
SO_2	Annual	0.005	0.002	17	20	60	80
	24-hour	0.03	0.009	124	91	260	365
	3-hour	0.15	0.04	552	512	1,300	1,300
PM_{10}	Annual	0.047	0.13	13.5	17	50	50
	24-hour	0.28	0.93	89.2	30	150	150
$PM_{2.5}$	Annual	0.017	0.082	2.11	n/a	15	15
	24-hour	0.13	0.69	9.4	n/a	65	65

[1] PSD Increment is to be compared to the Montana CBNG Modeled Impact.

n/a – not applicable

sources were predicted to impact visibility above 1.0 dv for 19 days within the designated PSD Class I Northern Cheyenne Reservation.

Using Visibility Method 6 to predict visibility impacts indicates that Alternative H project sources would result in a “just noticeable change” to visibility of greater than 1.0 dv at four PSD Class II areas. The model results predict one day per year within the Absaroka Beartooth Wilderness Area, four days per year within the Bighorn Canyon National Recreation Area, four days per year within the Cloud Peak Wilderness Area, and 61 days per year within the Crow Reservation.

The modeled impacts from project sources are shown in Table 4-30.

Temporary Impacts

Temporary impacts for Alternative H would be less than those described under Alternative E due to implementation of the provisions within the Air Quality Screen.

Cumulative Impacts

Cumulative impacts under Alternative H (scenario 1) for the Montana near-field receptor grid indicate that there are no exceedances of air quality standards predicted. The 1-hour NO_2 ambient concentration for the All Montana source group is 539 µg/m^3 and for the All Sources source group is 540 µg/m^3. While the standard of 565 µg/m^3 is not exceeded, the model predicted concentrations are close enough to the standard to indicate that there is a potential for this standard to be exceeded.

Crow Reservation

At the Crow Reservation, all direct, indirect and cumulative impacts are predicted to be below any applicable air quality standards.

Alternative H project sources were predicted to impact visibility above 1.0 dv for 61 days within the PSD Class II Crow Reservation. Up to 165 days of impacted visibility are predicted to occur from CBNG RFFA sources and up to 365 days of impacted visibility are predicted to occur from all sources cumulatively (Table 4-32).

Northern Cheyenne Reservation

At the Northern Cheyenne Reservation, all direct, indirect and cumulative impacts are predicted to be below any applicable air quality standards.

Alternative H project sources were predicted to impact visibility above 1.0 dv for 19 days within the designated PSD Class I Northern Cheyenne Reservation. Up to 136 days of impacted visibility are predicted to occur from CBNG RFFA sources and up to 337 days of impacted visibility are predicted to occur from all sources cumulatively (Table 4-31).

TABLE 4-31

ALTERNATIVE H (SCENARIO 1) - CLASS I AREA POTENTIAL VISIBILITY IMPACTS

	Contributions Visibility (No. of days >1.0 dv/yr)				
Location	**Montana CBNG Sources Only**	**Montana CBNG +RFFA Sources**	**Non-Project Sources**	**All Sources Cumulative Total**	**Maximum Δdv**
Badlands Wilderness Area	0	0	1 to 90	218	12.5
Bob Marshall Wilderness Area	0	0	1 to 22	28	4.2
Bridger Wilderness Area	0	0	1 to 70	146	15.2
Fitzpatrick Wilderness Area	0	0	1 to 43	109	12.8
Fort Peck Reservation	0	0	1 to 16	90	8
Gates of the Mountains Wilderness Area	0	0	12 to 40	69	9.1
Grand Teton National Park	0	0	2 to 32	92	7.6
Northern Absaroka Wilderness Area	0	0	1 to 34	90	12.5
Northern Cheyenne Reservation	19	136	2 to 59	337	15.5
Red Rock Lakes Wilderness Area	0	0	1 to 19	50	5.3
Scapegoat Wilderness Area	0	0	5 to 31	48	6.7
Teton Wilderness Area	0	0	1 to 32	92	11.9
Theodore Roosevelt National Park	0	0	1 to 32	170	13.6
U.L. Bend Wilderness Area	0	0	5 to 47	98	5.9
Washakie Wilderness Area	0	0	1 to 38	115	15.2
Wind Cave National Park	0	0	1 to 122	260	14.7
Yellowstone National Park	0	0	2 to 38	105	9.6

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

TABLE 4-32

ALTERNATIVE H (SCENARIO 1) - CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	All Sources Cumulative Total	
Absaroka Beartooth Wilderness Area	1	1	1 to 74	136	12.5
Agate Fossils Bed National Monument	0	0	4 to 134	237	13.2
Bighorn Canyon National Recreation Area	4	7	4 to 129	313	63.9
Black Elk Wilderness Area	0	0	1 to 94	232	15
Cloud Peak Wilderness Area	4	4	1 to 52	145	17
Crow Reservation	61	165	13 to 359	365	66.5
Devils Tower National Monument	0	0	1 to 97	278	13.4
Fort Belknap Reservation	0	0	5 to 50	92	5.4
Fort Laramie National Historic Site	0	0	1 to 145	249	14.9
Jedediah Smith Wilderness Area	0	0	3 to 31	95	6.6
Jewel Cave National Monument	0	0	1 to 109	251	14.1
Lee Metcalf Wilderness Area	0	0	1 to 79	112	6.1
Mount Naomi Wilderness Area	0	0	1 to 25	52	7
Mount Rushmore National Monument	0	0	1 to 91	220	14.7
Popo Agie Wilderness Area	0	0	1 to 66	137	16.3
Soldier Creek Wilderness Area	0	0	4 to 142	245	12.5
Westville Mountain Wilderness Area	0	0	2 to 12	40	5.6
Wind River Reservation	0	0	4 to 96	243	2.1

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

Mitigation

Potential mitigation measures to further reduce possible ambient air quality impacts from Alternative H sources would be the same as those presented for Alternative A sources.

Modeled visibility impacts resulting from project CBNG sources do not show the potential to increase the number of days with visibility impairment to mandatory Class I areas. Modeled visibility impacts resulting from project CBNG sources do show the potential to increase the number of days with visibility impairment at the designated Class I Northern Cheyenne Reservation and at the Class II Crow Reservation. Mitigation measures would be used to minimize these model predicted increases. In addition to the mitigation measures presented below, BLM would work with and assist cooperating agencies to perform visibility modeling studies in conjunction with monitoring conducted under Alternative H. The results of the monitoring and visibility modeling studies would be reviewed by the Air Quality Task Group. The Air Quality Task Group would also work with BLM to identify and select the appropriate party to perform the modeling studies. This might entail operator-funded, third-party contractors; BLM-funded agency or private contractors; or some other combination of funding sources.

Mitigation measures that could be used to reduce potential visibility impacts include the following:

- Reduce source emissions from drilling operations by minimizing the number of well pads through use of improved drilling technologies such as horizontal drilling, or other similar approaches that may become available during the expected CBNG development and operation duration. This would result in decreased emissions of particulate matter from well pad and road construction during the construction and would reduce particulate matter emissions from travel along roads to well pads during the operation phase.

- Increasing spacing between well pads would cause a decrease in localized ambient impacts as well as reducing far-field effects to an extent.
- Requiring the use of best available control technology (BACT) for certain emission sources, such as compressor engines, would reduce emissions. If BACT alone did not provide sufficient reduction in emissions to avoid visibility impacts, a requirement for the lowest achievable emissions rate (LAER) might become necessary for CBNG development in areas with visibility impact concerns. As an example, LAER for compressors could involve use of electric powered compressor engines.
- Use of alternate fuels such as low sulfur and low nitrogen content fuels would minimize NO_x and SO_2 formation.
- Alternative H has a feedback loop where the effectiveness of each mitigation measure, or set of measures, is quantified through monitoring and modeling. As monitoring and modeling results become available, BLM might adopt more stringent measures to avoid predicted air quality impacts. BLM would provide CBNG operators with a target of no exceedances of ambient air quality standards and a list of possible mitigation measures to minimize impacts to visibility. Operators would then design projects with selected mitigation measures. Alternative H's adaptive management approach would allow BLM to accept the proposals and retroactively apply successful mitigation measures to existing projects, as needed. While DEQ would play a lead role in ongoing air quality monitoring and modeling, BLM would support it in performing any additional work that might be required to meet Alternative H objectives of no exceedances.

The following mitigation measures were discussed in Chapter 2 as part of the description of the Air Quality Screen of Alternative H.

- The number of wells connected to each compressor would be maximized and natural-gas-fired or electrical compressors or generators would be required.
- To reduce dust, operators of federal leases would have to post and enforce speed limits for their employees and contractors. Operators could work with local government to use dust suppression techniques on roads. See additional mitigation measures in the Air Quality and Climate Appendix.
- If subsequent visibility modeling conducted as part of the air screen indicates unacceptable impacts would occur at a future point in the PRB development, modeling would then include mitigation scenarios that would investigate mitigation measures. Mitigation efforts would focus on compressor motors and the extent of operating compressors because it appears that gas-fired compressor motors account for approximately 90% of the overall project emissions and visibility impacts.

Supplemental Air Quality Analysis

The air analysis conducted for the DSEIS showed the potential for CBNG project-related activities to have an impact on air quality (particularly to visibility) at certain Class I areas within the planning area, including the Northern Cheyenne Reservation. The Supplemental Air Quality Analysis (SAQA) was conducted to determine at what level CBNG project-related development would have an impact on visibility at the Northern Cheyenne Reservation, as well as on other Class I areas within the planning area and to modify the preferred alternative to include monitoring, mitigation and avoidance of those potential impacts.

The SAQA contains data on five scenarios that were modeled for the planning area. The revised Alternative H scenario was modeled to better determine the direct impacts to air quality from project-related CBNG development. The first and second scenarios are modifications that reflect the differences in how current CBNG development is conducted within the Montana portion of the Powder River Basin versus what was predicted in the DSEIS. Two additional mitigation scenarios were modeled with data presented on impacts resulting from reduced compression requirements for project CBNG development under the first and second scenarios.

The SAQA also contains a modification to the preferred alternative to allow for monitoring, mitigation and avoidance of the potential impacts to air quality within the planning area. These changes are included in the preferred alternative.

The data contained within the SAQA are intended to augment information in the DSEIS, not replace it.

Project-related emissions include those from CBNG construction and operations activities in Montana. The scenarios presented within the SAQA were analyzed to achieve the following:

- Assess project-related versus non-project-related CBNG emissions under Revised Alternative H.
- Assess emissions associated with compressor operations using different NO_X emissions factors and adjusting well to field to sales compressor ratios to more accurately represent current practice within the Montana portion of the PRB under scenarios 1 and 2.
- Assess the level at which project-related CBNG emissions would have to be reduced to achieve zero days of impacts to visibility at the PSD Class I areas under scenarios 1A and 2A.

The DSEIS evaluated potential emissions from Coal Bed Natural Gas (CBNG) related activities by combining project related CBNG development, as outlined in the Reasonably Foreseeable Development (RFD) scenario, with non-project related CBNG development on the Crow and Northern Cheyenne reservations, as outlined in the Reasonably Foreseeable Future Actions (RFFA) scenario, into one emissions source group. The SAQA evaluates these two emissions groups separately to allow for the determination of potential air quality impacts that result directly from project related CBNG activities. Also included are potential air quality impacts from emission sources in Montana (All Montana Source Group), which includes project related CNBG emissions, and cumulative emissions (All Source Group) which includes all emissions sources both project related and non-project related. Information on the potential air quality impacts from specific source groups is contained within Appendix C of the SAQA document. Additionally, emission points representing potential emissions from CBNG construction, operations, and maintenance activities were decentralized within each watershed to better represent actual development conditions. The adjustments to emission point locations and the separation of RFD and RFFA CBNG wells were applied to each of the supplemental scenarios analyzed which are described below. Emission factors used were derived from the air quality modeling analyses conducted for the Statewide Document (BLM, 2003) conducted by Argonne National Laboratories (Argonne 2002). The air modeling analysis was conducted to separate project RFD emissions from non-project RFFA emissions; decentralize the project RFD and non-project RFFA emission source points; and utilize a well to field compressor to sales compressor ratio of 240 wells connected to 10 field compressors connected to 1 sales compressor (240:10:1) with a NO_X emissions factor for compressors of 1.5 grams per brake horsepower-hour (1.5 g/bhp-hr). This scenario is referred to in the SAQA document as Alternative H Revised.

Current CBNG development within the Montana portion of the Powder River Basin (PRB) is conducted using a ratio of 200 wells connected to 5 field compressors connected to 1 sales compressor. The SAQA includes an air modeling analysis scenario which uses this ratio of 200:5:1 and a NO_X emissions factor for compressors of 1.5 g/bhp-hr for project RFD wells; the well to field compressor to sales compressor ratio for non-project RFFA wells was not adjusted. This scenario is referred to as scenario 1.

The SAQA also evaluates an air modeling analysis scenario (scenario 2) using the 200:5:1 well to field compressor to sales compressor ratio and the NO_X emissions factor of 1.0 g/bhp-hr for project RFD wells; the NO_X emissions factor for non-project RFFA wells was not adjusted. The 1.0 g/bhp-hr NOx emission factor was selected for scenario 2 to reflect an emission level permitted by the Montana Department of Environmental Quality (MDEQ) for certain CBNG compressors within the PRB. scenarios 1 and 2 utilize the same number of operating CBNG wells but would have varying compressor and horsepower requirements and subsequent emissions output related to compressor operations. The lowering of the NO_X emissions factor to reflect some MDEQ permitting levels for scenario 2 would further reduce the emissions associated with scenario 1.

The SAQA evaluates a mitigation scenario (scenario 1A) which assumes a 50% reduction applied to scenario 1 compressor horsepower requirements. This scenario reduces compressor operations emissions and associated maintenance emissions by 50% but leaves all other emissions the same as previously modeled for scenario 1. The effect of this assumption reduces calculated compressor emissions by 50% for NO_X, SO_2, PM_{10}, and $PM_{2.5}$.

The SAQA evaluates a second air quality mitigation scenario (scenario 2A) which assumes a 50% reduction applied to the scenario 2 compressor horsepower requirements. This scenario reduces compressor operations emissions and associated maintenance emissions by 50% but leaves all other emissions the same as previously modeled for scenario 2. The effect of this assumption reduces calculated compressor emissions by 50% for NO_X, SO_2, PM_{10}, and $PM_{2.5}$.

The SAQA also includes revised emissions data for the Tongue River Railroad (TRR) which was reconfigured to better simulate a linear emission source. The total emissions for the TRR were kept constant and are the same as presented in the AQTSD; however, the number of emission points representing the TRR alignment was increased from 20 to 96.

Project related emissions include emissions from CBNG construction and operations activities in Montana. The five scenarios presented were analyzed to assess project related versus non-project related CBNG emissions under Revised Alternative H, assess emissions associated with compressor operations utilizing different NO_X emissions factors and adjusting well to field to sales compressor ratios to more accurately represents current practice within the Montana portion of the PRB under scenarios 1 and 2, and assess at what level project related CBNG emissions would need to be reduced to achieve zero days of impacts to visibility at the Prevention of Significant Deterioration (PSD) Class I areas under scenarios 1A and 2A.

The SAQA analyses used the CALMET and CALPUFF models to assess the potential for impacts from project-related and non-project-related cumulative air emissions of PM_{10}, $PM_{2.5}$, NO_X, and SO_2 on air quality and air quality related values at near-field receptor locations within the PRB and far-field receptor locations within the modeling domain.

Far-field receptor locations consist of PSD Class I and Class II areas. Results of these analyses show that project-related CBNG activities would not have the potential to exceed NAAQS or MAAQS for NO_2, PM_{10}, $PM_{2.5}$, or SO_2 under any of the scenarios evaluated at either near-field or far-field receptors or NO_2, PM_{10}, or SO_2 PSD increments.

Visibility impacts to Class I and Class II areas were evaluated using the Federal Land Managers Air Quality Related Values Workgroup (FLAG) Method 2 and the Regional Haze Rule Method 6. Method 6 Results are presented as consistent with the Best Available Retrofit Technique (BART) guideline. Using Method 6, visibility impacts were evaluated for select Class I and Class II areas within the modeling domain. Visibility impacts were evaluated for the designated Class I Northern Cheyenne Reservation because of its proximity to proposed development. Using Method 6, visibility impacts to the Northern Cheyenne Reservation consisted of 19 days for scenario 1, zero days for scenario 1A, 7 days for scenario 2 and zero days of visibility impacts under scenario 2A. As a result, BLM modified the Air Quality Screen for Alternative H to more proactively track development and assess potential impacts relative to CBNG project-related development to mitigate potential visibility impacts before any days of visibility impacts would occur from project-related development to nearby Class I areas; in particular the Northern Cheyenne Reservation.

Climate Change

Introduction

The assessment of greenhouse gas (GHG) emissions and climate is an ongoing scientific endeavor. Oil and gas development is likely to contribute to future emissions of GHGs to the atmosphere. However, while it’s generally accepted that human activities are changing the composition of Earth's atmosphere; important scientific questions remain about how much warming will occur, how fast it will occur, and how warming will affect the rest of the climate system including temperatures, precipitation patterns and storms. Additionally, while oil and gas development may contribute emissions of GHGs, the amount of any contribution cannot be compared to any regulatory standards because there are no applicable Federal or State standards at this time. It has been noted that “[t]o date, many of the models needed to make effective decisions at the local and regional levels have not been developed” (DOI, 2007). According to the USGS (2008) “It is currently beyond the scope of existing science to identify a specific source of CO_2 emissions and designate it as the cause of specific climate impacts…”. The EPA has noted that “Answering these questions will require advances in scientific knowledge in a number of areas:

- Improving understanding of natural climatic variations, changes in the sun's energy, land-use changes, the warming or cooling effects of pollutant aerosols, and the impacts of changing humidity and cloud cover.
- Determining the relative contribution to climate change of human activities and natural causes.
- Projecting future greenhouse emissions and how the climate system will respond within a narrow range.

- Improving understanding of the potential for rapid or abrupt climate change.

Addressing these and other areas of scientific uncertainty is a major priority of the U.S. Climate Change Science Program (CCSP).” (EPA, 2007; http://www.epa.gov/climatechange/science/stateofknowledge.html#ref).

Given these analysis limitations, accounting and disclosure of potential GHG emissions is the preferred option at this time. A comparison between project emissions and total State, U.S. and global emissions is provided on Table 4-CC-3.

This analysis focuses on GHG emissions from CBNG development. The development of CBNG in Montana is not anticipated to noticeably affect sinks of GHGs, and the feasibility of CBNG development is not anticipated to be affected by global climatic change.

Five scenarios were evaluated for GHG emissions from CBNG development in Montana. These are No Action (Alternative A), high RFD with no screens (Alternatives B, C, D and E), high RFD with restrictive screens (Alternative F), low RFD with restrictive screens (Alternative G), and high RFD with less restrictive screens (Alternative H).

Sources of CO_2 from the project include emissions from construction activities, operations, and maintenance. The emissions for each type of source were discretely determined for Alternatives B, C, D and E which were based on the high RFD with no screens (see table 4-CC-1). For other alternatives the emissions were proportioned based upon the ratio of gas anticipated to be produced in each alternative relative to the high RFD with no screens (see Table 4-CC-2).

The EPA has noted that “[t]he U.S. natural gas system encompasses hundreds of thousands of wells, hundreds of processing facilities, and over a million miles of transmission and distribution pipeline. All industry sectors, including gas production, processing, transmission, and distribution emit methane to the atmosphere to varying degrees. Methane emissions are generally process-related, with normal operations, routine maintenance, and system upsets being the primary contributors” (EPA, 2007b). The amount of methane (CH_4) that is emitted relative to the amount of gas produced was calculated by using Energy Information Administration (EIA) estimates of US total methane emissions from natural gas systems (EIA, 2007) from 1995 to 2006, plotted against EIA data for the gross withdrawal of natural gas (EIA, 2008). EIA methane emission data (EIA, 2007) also allows for the estimation of the likely sources of methane emissions, with emissions from production and processing accounting for 37.9% of methane emissions from natural gas systems. This allows for the calculation of an emission factor of 2.36 million metric tones (MMT) carbon dioxide equivalent (CO_2e) of methane per trillion cubic feet (TCF) of gas produced.

The adoption of the EPA’s Gas STAR BMPs is not a part of any of the alternatives, and it is a voluntary program; however if these practices were employed it would reduce the volume of methane emitted per TCF of gas and emissions would be less than reported from this analysis. By following these practices the EPA has reported reductions of 85.9 BCF of emissions for 2006 (the latest year figures were available for). EPA estimates that this is the equivalent of removing approximately 7.5 million cars from the road for the year.

Calculated CH_4 emission values are combined with the CO_2 emissions values to give a total GHG emission value for each alternative in terms of CO_2e. These resulting values are divided by 40 to give an average annual emission rate. This annual emission rate is then compared to existing (2004 & 2005) and projected statewide, nationwide and global emissions values (see Table 4-CC-3).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

There would be no additional contribution to atmospheric CO_2e levels from the development of CBNG in Montana under this alternative. See Tables 4-CC-2 and 4-CC-3 for CO_2e emissions that are projected result with no additional CBNG development in Montana.

Alternatives B, C, D, & E

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 45.9 MMT (see Table 4-CC-1). Emissions of methane are anticipated to equal approximately 11.8 MMT in CO_2 equivalents (CO_2e) over the life of the project. These emissions combine to contribute 57.7 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 1.44 MMT of CO_2e per year. According to the EPA’s online calculator (EPA, 2008c; http://www.epa.gov/cleanenergy/energy-resources/calculator.html) this average annual rate would be approximately equivalent to the annual greenhouse gas emissions from 264,000 passenger vehicles, or the annual CO_2 emissions of 0.3 coal fired power plants.

The CCS conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development under these alternatives would add approximately 3.9% to the State's emissions (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.020% and a 0.0039% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

The cumulative impact of the GHG emissions from the SEIS decisions (CBNG development) together with other activities with GHG emissions that have occurred, are occurring or are reasonably foreseeable are set forth herein. Assuming there are other GHG emitting activities that have, are, or will occur, the impacts of those activities, together with this Amendment's activities could result in certain climatic changes.

Montana emissions projections for 2010 and 2020 are also available from the CCS GHG Inventory (2007). These projections "are based on a compilation of various existing projections of electricity generation, fuel use, and other GHG emitting activities" (CCS, 2007) and as such it incorporates all past present and reasonably foreseeable GHG emitting activities in the State. The reference case scenario "[a]ssumes very limited CBM activity". Therefore, this scenario is comparable to that assumed for Alternative A (Existing Management), and is used as the baseline for this analysis. Based upon these values CBNG development under these alternatives would add approximately 3.7% to the State's emissions in 2010 and 3.5% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. These projections incorporate all past present and reasonably foreseeable GHG emitting activities. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.019% and a 0.017% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0034% and a 0.0029% increase respectively.

The EPA has evaluated the likely cumulative impacts from increased atmospheric CO_2 levels for the mountain west (EPA Region 8; EPA 2008a; http://www.epa.gov/region8/climatechange/ClimateChange101FINAL.pdf). This evaluation is included by reference here. This analysis indicates that "In the coming decades, scientists project that climate change will lead to significant changes in the Mountain West and Great Plains". The mid-range of the IPCC is for a change of 5.4^{o}F. This is enough to make Missoula as warm as Denver is now.

At a broader level the EPA has evaluated a variety of potential national and global impacts from climate change (EPA 2007b; www.epa.gov/climatechange/effects/index.html). This evaluation is included by reference here. These impacts include an increase in average temperature, shrinking of glaciers, thawing of permafrost, later freezing and earlier break-up of ice on rivers and lakes, lengthening of growing seasons, shifts in plant and animal ranges and earlier flowering of trees. Human health, agriculture, natural ecosystems, coastal areas, and heating and cooling requirements are examples of systems that are sensitive to climate change.

Additional discussions of the various types of impacts that can be expected from climate change are available at the EPA's Climate Change website (www.epa.gov/climatechange) (EPA, 2008c).

According to the Intergovernmental Panel on Climate Change (IPCC, 2007) global climate change may ultimately contribute to a rise in sea level, destruction of estuaries and coastal wetlands, and changes in regional temperature and rainfall patterns, with major implications to agricultural and coastal communities. The IPCC has suggested that the average global surface temperature could rise 1 to 4.5 degrees Fahrenheit (°F) in the next 50 years, with significant regional variation. The National Academy of Sciences (2008) has confirmed these estimates, but also indicated that there are uncertainties regarding how climate change may affect different regions. Computer models indicate that such increases in temperature will not be equally distributed globally, but are likely to be accentuated at higher latitudes, such as in the Arctic, where the temperature increase may be more than double the global average (BLM 2007). Also, warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures is more

TABLE 4-CC-1:

PROJECTED CO_2 EMISSIONS FROM CBNG DEVELOPMENT BASED ON THE RFD FOR ALTERNATIVES B, C, D, AND E

Emission Source	CO_2 (MMT)	% of total
Construction Emissions		
Heavy Equipment	0.64	1.4%
Commuting Vehicles	0.01	0.02%
Total Construction	**0.65**	**1.42%**
Operations Emissions		
Compressor Stations		
Field Compressors	9.87	21.5%
Sales Compressors	34.80	75.9%
Dehydrators	0.49	1.1%
Commuting Vehicles	0.0001	0.0003%
Wells		
Workovers - On-site	0.04	0.08%
Workovers - On-road	0.001	0.003%
Well and Pipeline Inspections	0.001	0.003%
Total Operations	**45.20**	**98.55%**
Maintenance Emissions		
Road Maintenance		
Heavy Equipment	0.01	0.03%
Commuting Vehicles	0.0001	0.0002%
Compressor Station Maintenance		
Commuting Vehicles	0.0002	0.000%
Total Maintenance	**0.014**	**0.03%**
TOTAL CO_2 EMISSIONS	***45.9***	

(Well:Field:Sales = 200:5:1)

likely than increases in daily maximum temperatures. Vulnerabilities to climate change depend considerably on specific geographic and social contexts.

Alternative F—Phased Development Multiple Screens (High Range)

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 25.7 MMT. Emissions of methane are anticipated to equal approximately 6.6 MMT in CO_2e over the life of the project. These emissions combine to contribute 32.3 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 0.81 MMT of CO_2e per year. According to the EPA's online calculator (EPA, 2008b; http://www.epa.gov/cleanenergy/energy-resources/calculator.html) this average annual rate

TABLE 4-CC-2:

PROJECTED CBNG CO_2 AND CH_4 EMISSIONS BY ALTERNATIVE OVER THE LIFE OF THE PROJECT

Alternative	Estimated CO_2 Emissions (MMT CO_2e)	Estimated CH_4 Emissions (MMT CO_2e)	Total Estimated Emissions (MMT CO_2e)
Alt A	0.0	0.0	0.0
Alts B,C,D & E	45.9	11.8	57.7
Alt F	25.7	6.6	32.3
Alt G	9.2	2.4	11.5
Alt H	31.2	8.0	39.2

MMT = Millions of Metric Tons
CO_2e = Carbon Dioxide Equivalent

would be approximately equivalent to the annual greenhouse gas emissions from 148,000 passenger vehicles, or the annual CO_2 emissions of 0.2 coal fired power plants.

The Center for Climate Strategies conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development would add approximately 2.2% to the State's emissions under this alternative (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.011% and a 0.0022% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

Based upon the CCS GHG Inventory (2007) CBNG development under this alternative would add approximately 2.1% to the State's emissions in 2010 and 1.9% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.011% and a 0.010% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0019% and a 0.0016% increase respectively (see Table 4-CC-3).

TABLE 4-CC-3:
COMPARISON OF MONTANA, U.S. AND GLOBAL CO_2E EMISSIONS & PROJECTIONS TO CO_2E EMISSIONS PROJECTED FOR CBNG DEVELOPMENT IN MONTANA

			MMT of Emissions per Year		
			Existing* (2004/2005)	Projected 2010	Projected 2020
Alternative A	Montana[1]	MMT CO_2e	36.8	38.5	41.7
	U.S.[2]	MMT CO_2e	7,181	7,405	8,275
	Global[2]	MMT CO_2e	36,510	41,851	49,750
Alternatives B,C,D & E	Montana	MMT CO_2e	38.2	39.9	43.1
		% diff+	3.9%	3.7%	3.5%
	U.S.	MMT CO_2e	7,182	7,406	8,276
		% diff+	0.020%	0.019%	0.017%
	Global	MMT CO_2e	36,511	41,852	49,751
		% diff+	0.0039%	0.0034%	0.0029%
Alternative F	Montana	MMT CO_2e	37.6	39.3	42.5
		% diff+	2.2%	2.1%	1.9%
	U.S.	MMT CO_2e	7,182	7,406	8,275
		% diff+	0.011%	0.011%	0.010%
	Global	MMT CO_2e	36,511	41,852	49,751
		% diff+	0.0022%	0.0019%	0.0016%
Alternative G	Montana	MMT CO_2e	37.1	38.8	42.0
		% diff+	0.8%	0.7%	0.7%
	U.S.	MMT CO_2e	7,181	7,405	8,275
		% diff+	0.004%	0.004%	0.003%
	Global	MMT CO_2e	36,510	41,851	49,750
		% diff+	0.0008%	0.0007%	0.0006%
Alternative H	Montana	MMT CO_2e	37.8	39.5	42.7
		% diff+	2.7%	2.5%	2.4%
	U.S.	MMT CO_2e	7,182	7,406	8,276
		% diff+	0.014%	0.013%	0.012%
	Global	MMT CO_2e	36,511	41,852	49,751
		% diff+	0.0027%	0.0023%	0.0020%

* Values for Montana and the U.S. are for 2005, global values are for 2004.
1 = CSC, 2007 2 = EIA, 2007 and EPA, 2006
MMT = Millions of Metric Tons
CO_2e = Carbon Dioxide Equivalent
\+ % difference from the No Action

The likely cumulative climatic impacts from increased atmospheric CO_2e levels would not be measurably different from those described for alternatives B, C, D and E.

Alternative G—Phased Development Multiple Screens (Low Range)

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 9.2 MMT. Emissions of methane are anticipated to equal approximately 2.4 MMT in CO_2e over the life of the project. These emissions combine to contribute 11.5 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 0.29 MMT of CO_2e per year. According to the EPA's online calculator (EPA, 2008b; http://www.epa.gov/cleanenergy/energy-resources/calculator.html) this average annual rate would be approximately equivalent to the annual greenhouse gas emissions from 53,000 passenger vehicles, or the annual CO_2 emissions of 0.1 coal fired power plants.

The Center for Climate Strategies has conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development would add approximately 0.8% to the State's emissions under this alternative (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.004% and a 0.0008% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

Based upon the CCS GHG Inventory (2007) CBNG development under this alternative would add approximately 0.7% to the State's emissions in 2010 and 0.7% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.004% and a 0.003% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0007% and a 0.0006% increase respectively.

The likely cumulative climatic impacts from increased atmospheric CO_2e levels would not be measurably different from those described for alternatives B, C, D and E.

Alternative H—Preferred Alternative - Multiple Screens

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 31.2 MMT. Emissions of methane are anticipated to equal approximately 8.0 MMT in CO_2e over the life of the project. These emissions combine to contribute 39.2 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 0.98 MMT of CO_2e per year. According to the EPA's online calculator (EPA, 2008b; http://www.epa.gov/cleanenergy/energy-resources/calculator.html) this average annual rate would be approximately equivalent to the annual greenhouse gas emissions from 179,000 passenger vehicles, or the annual CO_2 emissions of 0.2 coal fired power plants.

The Center for Climate Strategies conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development would add approximately 2.7% to the State's emissions under this alternative (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.014% and a 0.0027% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

Based upon the CCS GHG Inventory (2007) CBNG development under this alternative would add approximately 2.5% to the State's emissions in 2010 and 2.4% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.013% and a 0.012% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0023% and a 0.0020% increase respectively.

The likely cumulative climatic impacts from increased atmospheric CO_2e levels would not be measurably different from those described for alternatives B, C, D and E.

Cultural Resources

Cultural Resources *Approximately 73,600 cultural resource sites exist above known coal resources within the CBNG emphasis area*
Alternative A **No Action (Existing CBNG Management)**
• An estimated 17 cultural resource sites could be identified during foreseen CBNG activities. Of these only one or two would likely be eligible or need additional work to evaluate eligibility for the NRHP. • Cumulative Impacts: – An estimated 4,285 cultural sites could be identified resulting in 430 to 612 sites that could be eligible for the NRHP.
Alternatives B, C and D
• The number of cultural resource sites identified would be practically the same for Alternatives B, C and D based on the level of development, associated area of disturbance and minor differences between the alternative realty management actions. An estimated 630 cultural resource sites could be identified. • Cumulative Impacts: – An estimated 5,135 cultural sites could be identified. Of these between 514 and 734 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. – Potential for impacts to TCPs would increase with the development of CBNG.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• An estimated 893 to 1,080 cultural resource sites could be identified. • Cumulative Impacts: – An estimated 5,398 to 5,585 cultural sites could be identified. Of these between 540 and 798 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. – Potential for impacts to TCPs would increase with the development of CBNG.
Alternative F **Phased Development Multiple Screens (High Range)**
• The number of cultural resource sites identified would be similar to Alternative E. • An estimated 893 to 1,080 cultural resource sites could be identified. • Should no drilling occur within crucial sage-grouse habitat, the number of cultural resources sites that could be identified would be reduced by 12.8 percent. • Cumulative Impacts: – An estimated 5,398 to 5,585 cultural sites could be identified. Of these between 540 and 798 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. – The potential for impacts to TCPs would increase with the development of CBNG. – Should no drilling occur within crucial sage-grouse habitat, the cumulative number of cultural resources sites that could be identified would be reduced from 5,447 to 5,284.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to those for Alternative F, except that expected impacts to cultural resource sites would be reduced by approximately 65 percent due to fewer federal applications for permit to drill (APDs) being issued. • An estimated 312 to 378 cultural resource sites could be identified based on the reduced number of federal APDs being issued. • Cumulative Impacts: • An estimated 4,817 to 4,883 cultural sites could be identified based on the reduced number of federal APDs being issued. Of these between 482 and 698 sites would likely be eligible or need additional work to evaluate eligibility for the National register of Historic Places (NRHP). • Potential for impacts to TCPs would be similar to Alternative F, but would be reduced by approximately 65 percent based on the reduced number of federal APDs being issued.
Alternative H **Preferred Alternative - Multiple Screens**
• The number of cultural resource sites identified would be similar to those for Alternatives E and F. • Should no drilling occur within crucial sage-grouse habitat, the number of cultural resources sites that could be identified would be reduced by 12.8 percent • An estimated 893 to 1080 cultural resource sites could be identified. • Cumulative Impacts: • An estimated 5,398 to 5,585 cultural sites could be identified. Of these between 540 and 798 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. • Potential for impacts to TCPs would increase with the development of CBNG.

Assumptions

Cultural resources would be treated similarly and equally in terms of type, composition and significance; their distributions and densities are detailed in Chapter 3. Cultural resources are treated in this manner only for purposes of evaluation in this report, since the particular cultural resources to be affected are not necessarily known at this time. It must be understood that not all cultural resources are equal in terms of importance, National Register eligibility, density and location. Federally recognized tribes will need to be consulted, consistent with the requirements of the National Historic Preservation Act (NHPA) and regulations found at 36 Code of Federal Regulations (CFR) Part 800. Most of the mitigation for Native American cultural resources will entail avoidance, particularly any site associated with burials of human remains. Cultural resource attributes will have to be taken into consideration when impacts are considered for each individual CBNG development. Operators will need to develop an approach for mitigating cultural resources based on the plan for CBNG development that they submit. The Cultural Resource section of that plan will need to include the following guidelines in BLM's 8100 Manual Series, the Secretary of the Interior’s Standards and Guidelines For Archaeology and Historic Preservation (FR 48 (190)44716-44742, 1983) and the Advisory Council on Historic Preservation’s document the “Treatment of Archaeological Properties” (ACHP 1980)

Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. There would be one site for every 100 acres surveyed for cultural resources. This assumption was made by averaging the number of sites vs. acres surveyed in the Planning Area from existing surveys. This estimate is based on surveys that covered 19 percent of the estimated CBNG development area. The actual number of cultural resources in a particular CBNG development field could vary dramatically depending on the exact location of the field.

Impacts from Management Common To All Alternatives

Cultural resources would be impacted by surface and subsurface disturbing activities. Activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) that result in changes to the natural landscape could cause the most disturbance and could have the greatest effect on cultural resources. Other activities, such as increased travel and vandalism resulting from access improvements and increased erosion resulting from surface disturbances, would also impact cultural resources. These activities can also produce indirect impacts to cultural resources from fires; and to rock art sites from gas emissions, abrasive dust and vibrations from drilling equipment. Noise, activity, traffic and smells can affect the quality and continued use of Traditional Cultural Properties (TCPs). Traditional Cultural Properties important to the Northern Cheyenne and Crow and their perceptions of mitigation are presented in The Northern Cheyenne Tribe and its Reservation: 2002 (The Northern Cheyenne Tribe 2002), Crow Reservation (Crow Tribe of Indians 2002) and An Ethnographic Overview of Southeast Montana (Peterson and Deaver 2002).

Impacts would occur at an estimated 318 cultural resource sites. Of these sites, 32 to 46 are projected to be eligible for the National Register of Historic Places. The estimated number of sites includes 176 cultural resource sites from disturbance by conventional oil and gas development and 142 sites as a result of impacts caused by cumulative projects foreseen including surface coal mining activities. Additional cultural resources could be found as a result of cultural resource inventories conducted before beginning surface disturbing activities. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

The TRR tabulated all cultural resources within a 100-foot ROW of the proposed corridor and extending 1,500 feet on either side of the alignment. The Surface Transportation Board’s environmental analysis section for its SEIS indicated that with mitigation neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Identified traditional cultural properties within the 3,000-foot-wide corridor consist of two known sites. One site (24BH1617) was identified as a medicine wheel and the other site is an important paint/mineral source currently used by the Northern Cheyenne Tribe to obtain red ochre (Deaver and Tallbull 1991) Both of these sites could be affected by visual or audible impacts caused during construction; however, mitigation measures, as agreed to with the tribes, would be implemented.

Based on the information presented in the environmental analysis section of the FSEIS, it appears that battlefields and TCPs would most likely be indirectly affected by TRR operation and maintenance.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Alternative A has the least impact to cultural resources of all alternatives since this alternative has the least amount of surface and subsurface disturbance. Approximately 17 cultural resource sites would be identified by all projected CBNG activities in state and BLM planning areas. An estimated four sites would be impacted from exploration activities in state planning areas; six sites would be impacted from production activities at CX Ranch; and seven would be impacted from exploration activities in BLM planning areas. One or two of these identified sites could be found eligible for the National Register of Historic Places. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from production.

Crow Reservation

Impacts to cultural resources on the Crow Reservation are not expected because no exploration wells are planned for installation on the Reservation at this time. However if exploration wells were to be drilled on the Reservation the likelihood of site impacts would occur at a similar frequency as described for Cultural Resources in general though there could be an increase in cultural resource sites identified because of the increased number of possible TCPs.

Northern Cheyenne Reservation

Impacts to cultural resources on the Northern Cheyenne Reservation also are not expected at this time because the Northern Cheyenne have not indicated that exploration wells would be drilled. As with the Crow Reservation, it is anticipated that, should the Northern Cheyenne Tribe explore its reservation for CBNG resources, cultural resources would be encountered with the same regularity as described for cultural resources in general. It is conceivable that the density of cultural sites would be increased on the reservation because of the increased possibility of TCPs. It is assumed that the tribe would be involved in all surveys and site inspections on the reservation. Therefore, the incidents of cultural resource impacts could be minimized and possibly avoided altogether.

Conclusion

Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other cumulative effect analysis project activities could identify 4,285 cultural resource sites. Impacts from surface disturbance would be minimized by using existing disturbances where possible and by allowing aboveground utility lines. The impacts from erosion as a result of surface discharge of produced water at CX Ranch would be negligible because of the conveyance systems used to transport the relatively small amount of discharged water. The mitigation measures would be the same as those discussed in Chapter 2. However, given the number of acres likely to be disturbed by all anticipated CBNG development, it is unlikely that it would be necessary to mitigate sites or cultural properties through data recovery. In almost all situations, direct impacts to cultural properties would be avoided by relocating well sites or pipelines. Monitoring may indicate sites adjacent to the development fields are being indirectly affected by vandalism and other types of indirect impacts in which case data recovery would be the preferred mitigation. Consultation with tribes may indicate the presence of TCPs that would have to be avoided or which would require alteration of the well field plan in order to mitigate impacts to TCPs.

These are the best estimates of cultural resources that can be derived at this level of study. It is understood that sites occur in clusters based on a host of various criteria (location to water, slope, view, predominate wind, etc) and that some sites are more important than others.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Under this alternative, an estimated 629 cultural resource sites would be identified by all projected CBNG activities in state and BLM planning areas. An estimated 16 sites would be impacted by exploration activities in state planning areas, 335 sites from production activities in state planning areas, 10 sites from exploration activities in BLM planning areas and 269 sites from production activities on BLM planning areas.

Crow Reservation

Impacts to cultural resources on the Crow Reservation would be minimal because no development is anticipated on the reservation at this time. Disturbance totals include TCPs that would be identified off reservation and impacted from the above mentioned activities.

Northern Cheyenne Reservation

There would be no impacts to cultural resources on the Northern Cheyenne Reservation based on commercial CBNG development within the region. Disturbance totals include TCPs that would be identified off reservation and impacted from the above mentioned activities.

Conclusion

Over the next 20 years, disturbances from CBNG development in state, BLM, Native American and

USFS planning areas; conventional oil and gas development; and surface coal mining activities would identify approximately 5,135 cultural resource sites. These totals include traditional cultural properties that would be identified and impacted from the abovementioned activities. The requirement of transportation corridors, one-way in-and-out roads and the prevention of surface discharge of produced water would help to minimize the number of cultural resource sites impacted. The mitigation measures would be the same as those discussed in Chapter 2.

Alternative C—Emphasize CBNG Development

Under this alternative, impacts to cultural resources would be similar to Alternative B with the following exceptions: transportation corridors are not required, thereby increasing the number of disturbed acres and the likelihood of identifying and, hence, disturbing, more sites; discharge of produced water directly to the ground surface would increase erosion and site disturbance; power lines may be aboveground or buried, which would decrease the number of disturbed acres. The estimated number of cultural sites identified under Alternative C would total 629.

Crow Reservation

There would be no impacts to cultural resources on the Crow Reservation from commercial CBNG development in the region.

Northern Cheyenne Reservation

Impacts to cultural resources on the Northern Cheyenne Reservation would be minimal based on the off-reservation development and avoidance practices employed.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance from roads and utilities would be greater because one-way in-and-out roads and transportation corridors would not be required. Cultural resource inventories would need to be conducted along the surface watercourses. Surface discharge of produced water would result in increased erosion. The discharge of produced water to the surface would increase erosion and cause increased surface disturbance. The increased surface disturbance would be in the area near the production area and in the downstream segments of perennial streams and valleys leading to the major surface waters. Further discussion of erosion and the disturbances to soils can be found in the Soils section of this chapter. Mitigation measures would be similar to Alternative B with some exceptions. Mitigation measures would include the use of piping instead of discharging waters into drainage ditches in order to minimize erosion.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Under this alternative, impacts to cultural resources would be similar to Alternative B.

Crow Reservation

There would be no impacts to cultural resources on the Crow Reservation from commercial CBNG development within the region.

Northern Cheyenne Reservation

There would be no impacts to Northern Cheyenne cultural resources on the reservation from off-reservation CBNG development. Off-reservation TCPs may be impacted in some locals but avoidance and early identification should eliminate any important sites from being disturbed.

Conclusion

Cumulative impacts would be similar to Alternative B. Mitigation measures would be the same as for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts while Maintaining Existing Land Uses

Under this alternative, the impact to cultural resources would be similar to Alternative B with the following exceptions: the removal of an inactive buffer zone around active coal mines and reservations would increase the potential acreage for CBNG development and hence potentially increase the number of cultural resources encountered; there might be a decrease in the number of well pads built since operators would be able to use vertical wells for deep coal seams; transportation and utility corridors are not required, thereby increasing the number of disturbed acres and hence encountered cultural resources; power lines may be aboveground or buried, which should decrease the number of disturbed acres in most areas.

The operator's project plan would help develop a survey identification strategy and increase the likelihood of cultural resource identification and implementation of mitigation measures. The estimated number of cultural resources identified under Alternative E would be 893 to 1,080. Additional cultural resources could be found as a result of cultural resource inventories conducted before beginning surface disturbing activities. Locating cultural resources would result in a better understanding of the nature and distribution of those resources.

Crow Reservation

No cultural resources would be impacted on the Crow Reservation from commercial CBNG development off-reservation lands. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with the tribes and their representatives.

Northern Cheyenne Reservation

No cultural resources would be impacted on the Northern Cheyenne Reservation from commercial CBNG development off-reservation lands. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with the tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

With these specific measures in place to mitigate impacts to Northern Cheyenne culturally important sites and with the BLM committed to providing technical assistance to the tribe in inventorying, recording and evaluating cultural sites, it is plausible that impacts will be reduced.

Conclusion

Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other RFFA could identify 5,398 to 5,585 cultural resource sites. With the implementation of specific Northern Cheyenne and general Native American mitigation measures impacts to off-reservation TCP sites will be reduced and data collection efforts enhanced.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative an estimated 893 to 1,080 cultural resource sites could be identified during field surveys conducted before surface disturbing activities occur for proposed CBNG exploration and production sites in the Planning Area. Locating cultural resource sites would result in the accumulation of additional artifacts and information. Impacts to cultural resources and sites identified before surface disturbing activities occur would be similar to those described in Alternatives B, C, D and E. Known cultural resources and sites would be protected by implementing mitigation measures such as locating CBNG activities to avoid cultural resources and sites and BMPs.

Given that some level of development is likely to occur in the crucial sage-grouse habitat areas, the total acreage of surveyed land will remain the same. However, less intense development over 93,529 acres would reduce the potential for direct impacts to cultural resources within these areas.

Crow Reservation

CBNG activities that would be located off of the Crow Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Crow Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious *and* cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives.

Northern Cheyenne Reservation

CBNG activities that would be located off of the Northern Cheyenne Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Northern Cheyenne Tribe would be protected due to mitigation measures that would relocate development activities to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

Conclusion

Under this Alternative, an estimated 893 to 1,080 cultural resource sites could be discovered during field surveys conducted before federal permits are approved and before surface disturbing activities occur for proposed TRR and CBNG exploration and production sites in the two RMP areas. Known cultural resources and sites would be protected by implementing mitigation measures and BMPs. Mitigation measures would be the same as those discussed in Chapter 2. Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other RFFA project activities could identify 5,398 to 5,585 cultural resource sites. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

The Surface Transportation Board’s section of environmental analysis for its SEIS concluded that with mitigation neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts to cultural resources would be similar to Alternative F except that they would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under this alternative an estimated 312 to 378 cultural resource sites could be identified during field surveys conducted before surface disturbing activities occur for proposed CBNG exploration and production sites in the Planning Area.

Crow Reservation

CBNG activities that would be located off of the Crow Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Crow Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious *and* cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives.

Northern Cheyenne Reservation

CBNG activities that would be located off of the Northern Cheyenne Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Northern Cheyenne Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

Conclusion

Under this Alternative, an estimated 312 to 378 cultural resource sites could be discovered during field surveys conducted before federal permits are approved and before surface disturbing activities occur for proposed TRR and CBNG exploration and production sites in the two RMP areas. Known cultural resources and sites would be protected because activities would be relocated to avoid cultural resources and sites. Mitigation measures would be the same as those discussed in Chapter 2. Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other cumulative effect analysis project activities could identify 4,817 to 4,883 cultural resource sites. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

Transportation Boards' section of environmental analysis for their SEIS concluded that with mitigation neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative an estimated 893 to 1,080 cultural resource sites could be discovered during field surveys conducted before surface disturbing activities occur for proposed CBNG exploration and production sites in the Planning Area. Of these sites, the majority are predicted to be located in the Powder River RMP area. Locating cultural resource sites would result in the accumulation of additional artifacts and information. Impacts to cultural resources and sites identified before surface disturbing activities occur would be similar to those described in Alternatives B, C, D and E. Known cultural resources and sites would be protected by implementing mitigation and BMPs, such as locating CBNG activities to avoid cultural resources and sites.

Crow Reservation

CBNG activities that would be located off of the Crow Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Crow Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources is held confidential by the tribe and BLM which minimizes opportunities for theft and vandalism of cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives.

Northern Cheyenne Reservation

CBNG activities that would be located off of the Northern Cheyenne Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Northern Cheyenne Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources is held confidential by the tribe and BLM which minimizes opportunities for theft and vandalism of cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

Conclusion

Under this Alternative, an estimated 893 to 1,080 cultural resource sites could be discovered during field surveys conducted before federal permits are approved and before surface disturbing activities occur for proposed TRR and CBNG exploration and production sites in the two RMP areas. Known cultural resources and sites would be protected because activities would be relocated to avoid cultural resources and sites. Mitigation measures would be the same as those discussed in Chapter 2. Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other cumulative effect analysis project activities could identify 5,398 to 5,585 cultural resource sites. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

The Transportation Boards' section on environmental analysis for their SEIS concluded that, with mitigation, neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Geology and Minerals

Geology and Minerals
Montana's mineral resources are intimately tied to the complex geologic framework of the state. Locatable minerals and conventional Oil and Gas resources are found throughout the Planning Area in various recoverable and non-recoverable amounts

Alternative A
No Action (Existing CBNG Management)

- Federal:
  - Only minor loss of CBNG during testing operations.
- State:
  - Irretrievable commitment of CBNG resources from production on state planning areas.
  - Delayed development or expansion of conventional oil and gas, coal mining and surface mineral mining in minor instances with no interruption to existing activities.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - Irretrievable commitment of CBNG resources from production, magnitude and complexity to reflect increase scale of development.
  - Potential mineral drainage between federal mineral estates and state, private and tribal developments depending on site-specific conditions.
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Mineral drainage issues same as for federal.
  - The presence of shallow CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs

Alternative C
Emphasize CBNG Development

- Federal:
  - Same as Alternative B with minor increase in water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.
- State:
  - Same as Alternative B.
  - Potential mineral drainage between federal mineral estates and state, private, or tribal developments depending on site-specific conditions.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Federal:
  - Same as Alternative B.
- State:
  - Same as Alternative B.
  - Potential mineral drainage between Federal mineral estates and state, private, or tribal developments depending on site-specific conditions.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Federal:
  - Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.
  - Protection of tribal CBNG from drainage because of resource protection protocols.
- State:
  - Potential mineral drainage between federal mineral estates and state, private or tribal developments depending on site-specific conditions.

Alternative F
Phased Development Multiple Screens (High Range)

- Federal:
  - Rate of development managed by limit set on the number of Federal APDs that would be approved per year
  - Geographic development of CBNG resources managed through limits set on the number of federal APDs allowed for each 4th Order Watershed
  - Limit on amount of untreated produced water from federal wells discharged within each 4th Order Watershed.
  - Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells.
  - Protection of tribal resources from federal wells within 5 miles of reservation boundaries.
  - Potential drainage of federal CBNG from production on state, private and tribal leases depending on site-specific conditions, increased potential for drainage of federal CBNG due to the cumulative limit on the number of Federal APDs allowed per year.
  - Potential drainage of federal CBNG underlying crucial sage-grouse habitat, or a reduction in the production of federal CBNG in crucial sage-grouse habitat if alternative development scenarios are implemented.
- Potential operational interference within coal mine permit boundaries and adjacent to coal mines.
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Potential drainage of the federal CBNG from production on state and private leases depending on site-specific conditions.
  - Potential for drainage or lower levels of production from some private and state leases if operators cannot economically develop small tracts of these leases within the crucial sage-grouse habitat areas.
- The presence of CBNG production could delay certain types of seismic activities.

Alternative G
Phased Development Multiple Screens (Low Range)

- Federal:
  - Rate of development managed by limit set on the number of Federal APDs that would be approved per year.
  - Geographic development of CBNG resources managed through limits set on the number of federal APDs allowed for each 4th Order Watershed.
  - Limit on amount of untreated produced water from federal wells discharged within each 4th Order Watershed.
  - Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells
  - Protection of tribal resources from federal wells within 5 miles of reservation boundary.
  - Potential drainage of the federal CBNG from production on state, private and tribal leases depending on site-specific conditions, increased potential for drainage of federal CBNG due to the cumulative limit on the number of Federal APDs allowed per year.
  - Potential drainage of federal CBNG underlying crucial sage-grouse habitat, or a reduction in the production of federal CBNG in crucial sage-grouse habitat if alternative development scenarios are implemented.
  - The presence of CBNG production could delay certain types of seismic activities
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Potential drainage of the federal CBNG from production on state and private leases depending on site-specific conditions.
  - Potential for drainage or lower levels of production from some private and state leases if operators cannot economically develop small tracts of these leases within the crucial sage-grouse habitat areas
- The presence of CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs

Alternative H
Preferred Alternative - Multiple Screens

- Federal:
  - Rate of development managed by the number of Federal APDs that would be approved per year to protect other resources.
  - Geographic development of CBNG resources managed by the location of federal APDs approved to protect other resources.
  - Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells
  - Protection of tribal resources from federal wells within 5 miles of reservation boundaries.
  - Potential drainage of the federal CBNG from production on state, private and tribal leases depending on site-specific conditions, increased potential for drainage of federal CBNG due to the cumulative limit on the number of Federal APDs allowed per year.
  - Potential drainage of federal CBNG underlying crucial sage-grouse habitat, or a reduction in the production of federal CBNG in crucial sage-grouse habitat if alternative development scenarios are implemented.
- The presence of CBNG production could delay certain types of seismic activities.
- Irretrievable commitment of CBNG resources from production, magnitude and complexity to reflect increase scale of development.
- Potential drainage of federal CBNG from production on state, private and tribal leases depending on site-specific conditions.
- Potential operational interference within coal mine permit boundaries and adjacent to coal mines.
- Protection of tribal CBNG from drainage by federal CBNG wells because of 5-mile buffer zone.
- The presence of CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs.
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Potential mineral drainage of the federal mineral estates from production on state and private leases depending on site-specific conditions.

Assumptions

Federal oil and gas leases would continue to be issued with standard lease terms and stipulations as identified by BLM. No Surface Occupancy (NSO), Controlled Surface Use (CSU) and Timing Restriction (Timing) stipulations provide protection to other resources from oil and gas lease activities. A detailed listing and description of stipulations are found in the Final Oil and Gas EIS/Amendment (BLM 1992).

- Federal APDs and Sundry Notices would continue to be issued with Conditions of Approval (COAs) as identified by BLM. COAs provide mitigation to minimize or eliminate impacts to other resources or land uses from oil and gas activities. COAs must conform to lease rights and land use decisions.
- BLM would continue to consult with private surface owners before approving oil and gas activities on private surface. Surface owner requirements can be incorporated as COAs.
- BLM would continue to require a certification that a signed agreement between the private surface owner and the CBNG operator exists before approving drilling operations on private surface.
- The Miles City Field Office and the Reservoir Management Group located in the Casper BLM Office would share drainage case information for

cases within one mile of the Montana Wyoming state line.

- Other related Assumptions regarding typical CBNG operations are found at the beginning of this chapter.

Impacts From Management Common to All Alternatives

The production or drainage of oil and gas results in the irreversible and irretrievable loss of these resources. Oil and gas resources within a lease area can be directly removed by wells located on the lease area or drained by wells located adjacent to the lease when geologic conditions allow. Gas resources are irreversibly and irretrievably lost during venting or flaring operations. The cumulative impact to oil and gas resources would be a reduction in the known amount of these resources.

Existing BLM and State regulations allow for the production of oil and gas in a manner that conserves those resources so they are not wasted. Oil and gas production is guided by well spacing rules, field rules, lease development requirements and protective agreements such as communitization and unitization agreements. Flaring and venting operations must be conducted in accordance with agency approval, which also seeks to limit the wasting of gas resources as well as minimizing air quality and safety impacts.

CBNG development in Wyoming would result in drainage to Montana lands by wells just across the state boundary. The 80-mile-wide belt of the Powder River Basin that is prospective for CBNG would represent approximately 320 1/4-by-1/2-mile (80-acre) spacing units draining resources (gas) from the adjacent state. Hydrocarbon (including CBNG) drainage is mitigated by regulations contained in 43 CFR Parts 3100, 3106, 3108, 3130 and 3160. These regulations are meant to avoid waste and protect correlative mineral rights. Regulatory mechanisms include communitization agreements, protection well demands and compensatory royalties.

Oil and gas development would impact strippable coal resources in areas adjacent to existing coal mines or in new areas of coal mine interest. Oil and gas well bores and the production infrastructure would hinder the mining of coal in areas of oil and gas production.

BLM-issued oil and gas leases are issued with an NSO stipulation in an area with an active federal coal lease and an approved mine plan. The NSO stipulation prohibits surface occupancy and use for oil and gas lease operations. In areas outside of approved mine plans, BLM may issue both coal and oil and gas leases on the same parcel of land. BLM regulations support approval of applications from the first lessee, but also require lessees to resolve conflicts. Resolution of conflicts is further guided by BLM Instruction Memorandum WO-IM-2003-253 (BLM 2003a).

Conventional oil and gas lease operations would not impact CBNG resources because of the geology and well bore requirements. Migration of conventional oil and gas from source rocks to coal seams usually does not occur because of impermeable layers that exist between the hydrocarbon bearing formations and the coal seams. The BLM and State require well bores to be completed with steel casing and cement in key locations of the well annulus to prevent the migration of fluids and drastically reduce the migration of hydrocarbons from one formation to another formation.

Conventional oil and gas wells and the associated infrastructure could be located on a lease area with CBNG wells and associated infrastructure.

Sand, gravel, or scoria needed for lease operations can be removed from BLM-administered surface by the operator from areas disturbed by lease operations under authority of the lease. Removal of sand, gravel, or scoria from BLM-administered surface by the operator outside of the area of disturbance for lease operations or removal by a third party would require a separate permit approved by BLM.

Methane migration due to CBNG extraction is a possibility but highly unlikely based on the nature of the Powder River Basin methane, the low-grade coals present in the basin and the geologic formations between the coal seams and the ground surface. These low-grade, low-strength coals do not support extensive fracturing that might give rise to methane seeps (GRI 2000). Furthermore, preliminary results of the on-going BLM Casper, Wyoming study, (see Chapter 3 geology and minerals discussion) do not indicate that seepage is occurring (Personal Communication, Dan Leeman, Mike McKinley and Ed Heffern, November 2005).

The methane contained in Fort Union coals of the PRB is present in a free state, adsorbed on interior pore surfaces and micropores of the coal matrix and dissolved in water contained within the coal seam. CBNG wells depressurize coals by producing water, as water production continues coals begin producing methane as the pressure drops below the local desorption pressure threshold. With continued water production, pressure around the CBNG wells drops and the depressurization front migrates out from the producing wells—as the front migrates outwards, net water movement is always toward the producing wells. Methane molecules and bubbles of gas will not migrate against the water flow within the coals. If a water well or monitoring well produces methane, this suggests the methane is indigenous to coals around the well and was mobilized by the migration of the depressurization front. Figure 4-4 below illustrates the phenomenon of de-pressurization and methane drainage.

Migration of methane is largely driven by water migration in the coal, operators report that migration within a well-managed CBNG field leads ultimately to drainage of between 40 and 80 acres per well, this is radial migration of 660 to 1320 feet over seven to ten or more years.

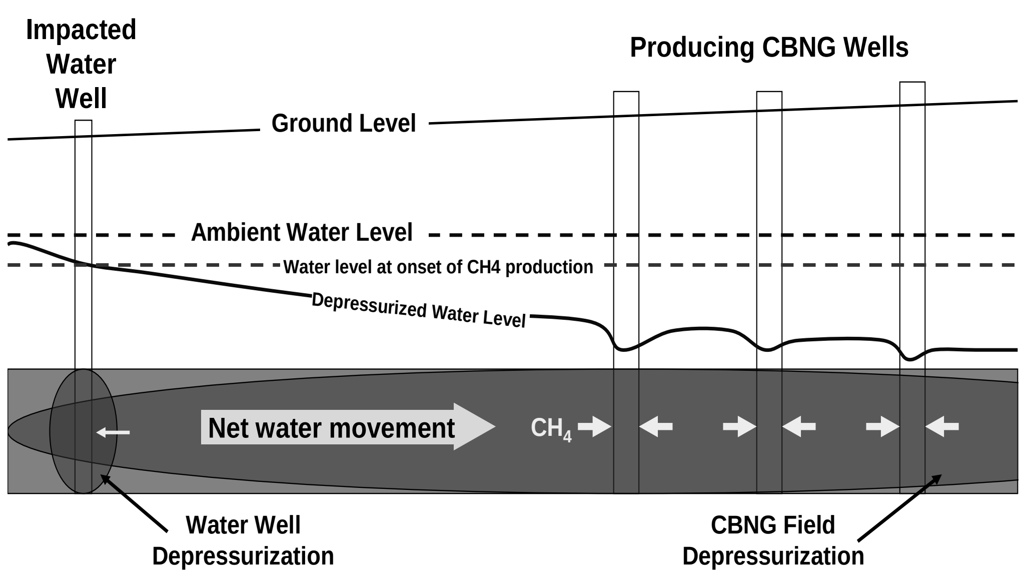
Monitoring wells in the area of Decker, Montana have been impacted by methane production since before any CBNG wells were drilled in Montana; these wells were likely impacted by dewatering performed by the coal mines in the vicinity (Wheaton et al. 2006). Some monitoring wells produced gas as soon as they were completed, even though they were located considerably outside the influences of either coal mines or CBNG production. Outside of either coal mining or CBNG activities MBMG has recorded methane release for four monitoring wells. Since the arrival of CBNG production to the Montana portion of the PRB, more water wells and monitoring wells have been recorded with methane release. The MBMG maintains a database of water wells and monitoring wells which release methane; the database currently shows four wells have been influenced by coal mine de-watering and 16 wells by CBNG dewatering. Four of the 16 wells released gas previous to CBNG development but have been noted to release more gas now (Wheaton et al. 2006).

Potential seepage areas may contain existing well bores and areas where faults, fractures, or sandstone layers occur in an orientation that provides a vertical conduit for movement of methane from depressurized coals. Methane hazard areas have not been mapped or compiled within the Project Area. No estimate of seepage is available for the PRB.

Water well mitigation agreements currently in use in the PRB were reviewed to determine the effectiveness of these agreements to alleviate the impacts of methane migration and seepage. Typical agreements included a definition of well or water source impacts that included the increased presence of methane or changes in water quality. The agreements required the operator to reconfigure, redrill, or replace; the well or water source in such a case. Access to another water source could also be

FIGURE 4-4

DEPRESSURIZATION OF CBNG STRATA AND METHANE PRODUCTION



provided as a method to mitigate such impairment. The implementation of a Water Well Mitigation Agreement can be a method to rectify the effects to domestic water wells or springs from methane migration caused by CBNG production.

BLM has the responsibility and authority to protect resources and land uses including public health and safety, from its authorized activities. BLM can impose requirements or restrictions on companies through conditions of approval included with approved permits. Implementation of conditions of approval should mitigate impacts to resources and land uses, including public health and safety.

Mitigation measures could include cisterns or gas extractors that allow the water to de-gas. Water level manipulation by way of injection wells will likely be of little use in controlling methane. The water well may ultimately need to be plugged and water supplied to the land owner by another means such as a new well completed in a different coal.

CBNG production may impact adjacent coal mines by increasing coal bed aquifer drawdown and by interfering with expansion of existing coal mines. However a symbiotic relationship could be established whereby the coal mine benefits from methane extraction prior to coal removal. The added dewatering from CBNG operations would beneficially affect the coal mines during production operations but could hinder and complicate aquifer restoration efforts once mining activities cease. In addition, the removal of coal seam water may create a situation where some coal mines would need to purchase water for dust control. Spring Creek Mine is a dry mine that does not produce water.

The drawdown of groundwater from coal seams would not damage the coal resource through compaction, nor would the likelihood of coal seam fires be greater than before. The circumstances for self-ignition of coal would not be present in the immediate vicinity of CBNG wells. During the production stage of CBNG activity, conditions essential to cultivate spontaneous combustion of coal such as oxidation, heat of wetting, airflow rate, coal particle size, pyrite content and temperature are not present. In fact, the design and construction of CBNG wells efficiently vents heat out of the coal so that temperatures needed for coal ignition are neither present nor anticipated.

All oil and gas wells, including CBNG wells, must be plugged and abandoned when the wells are no longer capable of production or needed. The plugging procedure must be approved by either BLM or the state. Unlike abandoned underground coal mines, CBNG wells leave no underground voids vulnerable to further subsidence or associated spontaneous coal ignition. The probability of completely dewatering a coal bed and exposing large areas of fine coal particles to oxygen are unlikely due to the nature of producing CBNG in the PRB (Lyman and Volkmer 2001).

The presence of CBNG wells and the associated infrastructure could prevent certain types of seismic operations from being conducted in the area of CBNG production. The use of explosives could damage well bores or surface equipment and could damage the upper coal seam used for CBNG production.

The drawdown of groundwater from CBNG activities has been identified as the cause of surface subsidence in Wyoming (Case et al. 2000). The subsidence was recorded as 1/2 inch and represents a minimal impact to surface lands. In Montana where coal seams are thinner, subsidence would be less than what has been observed in Wyoming where coal seams are thicker.

Impacts From Management Specific To Each Alternative

Alternative A—No Action (Existing CBNG Management)

Under this alternative, CBNG production would be limited by the number of wells that can be permitted for CBNG production by BLM and the State. The total number of producing CBNG wells is limited to 250 by the terms of the Settlement Agreement affecting the State. The constraint is in place until the State has completed an EIS addressing the impacts from CBNG field development throughout the state. BLM is not approving the production of CBNG from federal wells until completion of the EIS, which addresses the impacts from CBNG field development in the Powder River and Billings RMP areas.

The production and venting of CBNG during the testing phase represent an irretrievable loss of that resource. Under the existing situation, CBNG may be drained from federal lands by producing CBNG wells on private and state leases. This drainage of federal CBNG represents an irretrievable loss of that resource. The venting of CBNG during coal mining represents the irretrievable loss of the resource.

Expansion of the Decker coal mine to the west and south and expansion of the Spring Creek coal mine to the south would be constrained by CBNG wells and the associated infrastructure of the CX Field. Mine expansion could occur after abandonment of the CX Field and removal of facilities and equipment.

Removal of groundwater by CBNG wells in coal seams that are being mined by Decker and Spring Creek could reduce the amount of groundwater flowing into the mine areas. Reduction in the amount of groundwater or degradation of groundwater quality by CBNG production would reduce the amount of groundwater available for domestic water wells from a particular coal seam. CBNG could migrate to domestic wells or escape at the surface from the removal of groundwater for CBNG production.

Crow Reservation

Producing CBNG wells located within one mile of the Crow Reservation boundary could drain CBNG resources from the Reservation. This drainage of Indian owned or privately owned CBNG would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBNG wells and associated infrastructure on private and state lands could influence the location of future CBNG wells and associated infrastructure on lands within the Crow Reservation. This scenario is not anticipated under Alternative A because of the State Settlement Agreement.

A detailed description of potential drainage impacts to Crow resources is found in the *Environmental Justice* section and a detailed description of potential impacts to groundwater from drawdown by CBNG wells is found in the Hydrology section.

Northern Cheyenne Reservation

It is not anticipated any producing CBNG wells would be located within one mile of the Northern Cheyenne Reservation boundary and therefore drainage of tribal CBNG resources from the Reservation is not anticipated.

Conclusion

The production of CBNG by state and private wells and the venting of CBNG represent the irreversible and irretrievable loss of the resource. The restrictions on the total number of CBNG wells approved for production reduces and delays associated revenues to lessees and government. The venting of CBNG during coal mining represents the irreversible and irretrievable loss of the resource.

Production of CBNG should not impact the geology of the production area or any conventional oil and gas in the area of CBNG production. CBNG wells and the associated infrastructure would hinder the expansion of the Decker and Spring Creek coal mines toward the CX Field. The production of CBNG would not prohibit the production of conventional oil and gas resources from the area of CBNG production. The production of conventional oil and gas in or around the CX Field would increase and intensify the impacts to other resources and on land uses.

The mitigation measures for this alternative would be similar to those described in Chapter 2.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Under this alternative, the types of impacts experienced would be similar to those described under Alternative A, but increased because of expanded CBNG production on state, private and BLM oil and gas lease areas. The increased development as part of this alternative would result in more CBNG production and the irretrievable commitment of more resources. Increased CBNG production would amplify the opportunity for methane drainage from adjacent leases. Under this alternative, multiple coal seams would be developed from a single well bore. All coal seams would be developed at the same time and directional drilling for deeper coal seams would be required.

This alternative also includes a 1-mile buffer zone around active coal mines that would minimize the operational interference and water drawdown impacts from nearby CBNG production. Production of CBNG would not be authorized on federal leases within a 2-mile buffer zone in Montana along the Reservation boundary. The state may allow production of CBNG from state leases within the buffer zone. The prohibition on the production of CBNG within the buffer zone would not apply to private leases within the buffer zone.

The drawdown of groundwater from coal seams would not damage the coal resource present through compaction, nor would the likelihood of coal seam fires be greater than before. The circumstances for self-ignition of coal would not be present in the direct vicinity of CBNG wells in the emphasis area. During the production stage of CBNG activity, conditions essential to cultivate spontaneous combustion of coal such as oxidation, heat of wetting, airflow rate, coal particle size, pyrite content and temperature are not present. In fact, the design and construction of CBNG wells efficiently vents heat out of the coal so that temperatures needed for coal ignition are neither present nor anticipated.

After the coal seam is exhausted of economically recoverable methane resources, wells must be plugged and sealed. Unlike abandoned mines, CBNG wells leave no underground voids vulnerable to further subsidence and associated spontaneous coal ignition. The probability of completely dewatering a coal bed and revealing large areas of fine coal particles to oxygen seem exceedingly remote (Lyman and Volkmer 2001). Further discussion regarding groundwater issues is contained in the *Hydrology* section of this chapter.

The drawdown of groundwater from CBNG activities has been identified as the cause of surface subsidence in Wyoming (Case et al. 2000). The subsidence was recorded as 1/2 inch and therefore represents a minute impact to surface lands. In Montana where coal seams are thinner, subsidence would be less than what has been observed in Wyoming where coal seams are thicker.

Crow Reservation

Impacts to mineral resources on the Crow Reservation would be the same as described above in this alternative. Producing CBNG wells located within one mile of the Crow Reservation boundary could drain CBNG resources from the Reservation. This drainage of Indian owned or privately owned CBNG would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBNG wells and associated infrastructure on private and state lands could influence the location of future CBNG wells and associated infrastructure on lands within the Crow Reservation. Expanded CBNG development activities would increase the impacts and extraction of tribal CBNG resources.

Northern Cheyenne Reservation

Impacts to mineral resources on the Northern Cheyenne reservation would be the same as described above in this alternative. Producing CBNG wells located within one mile of the Northern Cheyenne Reservation boundary could drain CBNG resources from the Reservation. This drainage of Indian owned or privately owned CBNG would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBNG wells and associated infrastructure on private and state lands could influence the location of future CBNG wells and associated infrastructure on lands within the Crow Reservation. Expanded CBNG development activities would increase the impacts and extraction of tribal CBNG resources.

Conclusion

One of the cumulative impacts from this alternative would be increased production of CBNG from an increased number of producing wells including tribal wells and from multiple coal seam development simultaneously. Multiple coal seam development simultaneously would result in the production of a higher rate of CBNG than single seam completions. Along with venting of CBNG during well testing, this would represent an irreversible and irretrievable loss of the resource.

The increased number of producing CBNG wells and the associated infrastructure could inhibit the expansion of existing coal mines, even with the 1-mile buffer zone. This would delay or possibly preclude the mining of coal in certain areas. Areas of new coal mine interest would be excluded from opening new coal mines by the existence of producing CBNG wells and infrastructure.

The mitigation measures for this alternative would be similar to those described in Chapter 2. Additional mitigation measures include buffer zones around existing coal mines and simultaneous production of multiple coal seams through single well bores, subsurface injection of untreated water produced with CBNG and maximizing the number of producing CBNG wells connected to field compressors.

Alternative C—Emphasize CBNG Development

Under this alternative, CBNG production could occur on state, private and BLM lease areas. Operators would not be required to produce CBNG simultaneously from multiple coal seams through a single well bore. CBNG production from multiple coal seams could occur simultaneously through single well bores or simultaneously through separate well bores or different coal seams could be developed separately (staggered over time) or a combination of production methods.

Allowing CBNG production from state, private and BLM leases would increase the amount of CBNG produced. Producing CBNG from multiple coal seams simultaneously would have impacts similar to those described in Alternative B. The potential for drainage of CBNG resources by producing CBNG wells would increase with the increase in the number of producing wells. Directional drilling would not be required. Without directionally drilled wells, the impacts from vertical wells would be the same as Alternative A but increased for the scale of development.

CBNG production will impact adjacent coal mines by increasing coal bed aquifer drawdown and by interfering with expansion of existing coal mines. The added dewatering from CBNG operations would affect the coal mines by hindering and complicating aquifer restoration efforts the mine must perform once mining activities cease. In addition, the removal of coal seam water may create a situation where some coal mines would need to purchase water for dust control.

The drawdown of groundwater does not represent an immediate impact to surface lands resulting from subsidence. The thinness of the coal seam aquifers and their shallow depth should prevent them from being substantially impacted by groundwater withdrawal and subsequent aquifer compaction.

Crow Reservation

Impacts on the Crow Reservation would be the same as described for the study area in general for Alternative C. However, without the 2-mile Reservation buffer zone, tribal CBNG resources would have an increased vulnerability to drainage from adjacent state, federal and private wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the study area under this Alternative. Furthermore, without the 2-mile Reservation buffer zone, tribal CBNG resources would have an increased vulnerability to drainage from adjacent state, federal and private wells.

Conclusion

The cumulative impacts for this alternative would be similar to Alternative B with some exceptions. The removal of the requirement for a buffer zone around coal mines would result in increased drawdown and greater operational interference within the mines from CBNG production. After mining has ceased, the added dewatering will need to be remediated by the mine operators. Remediation bonds executed by the mine operators prior to operations will need to be honored. Unless the impact of the CBNG production can be separated from impacts by the coal mine, the remediation bond will force the mine operator to spend more money to remediate the aquifer. Coal mine operators may develop aquifer mitigation agreements with CBNG operators prior to CBNG production. The mitigation measures for this alternative would be similar to Alternative A.

Tribal development of CBNG resources on reservations would increase the irreversible and irretrievable loss of the resource.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts from management objectives outlined in Alternative D would be similar to the impacts described under Alternative B.

Crow Reservation

Impacts to the Crow Reservation would be similar to impacts described in Alternative B.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to impacts described in Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts to coal and existing coal mines would be the same as Alternative C because a buffer zone would not be required around existing coal mines.

Impacts to CBNG resources would be the same as Alternative B if all coal seams are produced simultaneously or to Alternative C if coal seams are produced separately. Impacts to CBNG production and wells would be the same as Alternative A because multiple seam production through a single well bore would not be required.

Impacts on conventional oil and gas resources would be the same as discussed in the *Management Common* section.

The production of CBNG and the venting of CBNG represent the irreversible and irretrievable loss of the resource. Drainage by off-lease CBNG wells represents the irreversible and irretrievable loss of the resource and royalties to the lessee of the lease being drained.

For Alternative E, the Crow and Northern Cheyenne Reservation would be protected from drawdown of coal seam aquifers and drainage of tribal CBNG resources as described in Chapter 2 of this document. To gauge incipient impacts related to groundwater and CBNG resource drainage on the Crow and Northern Cheyenne reservations, monitoring wells would be required to be installed during the exploration phase on all BLM-administered oil and gas leases that show hydrologic connectivity with the reservation aquifers.

Crow Reservation

Impacts to the Crow Reservation from federal lease operators under Alternative E would be minimized. A buffer zone would not be established around the borders of the Reservation. However, other mitigation options would be available for consideration by the tribes. These include reducing production rates, shutting in the well or wells, payment of compensatory royalties, establishment of communitization agreements, or spacing to protect reservation CBNG resources from drainage. Under this alternative, there would be no drainage of tribal CBNG resources by federal lease operators. The potential for drainage by private lands within the reservation boundary and along the exterior boundary would still exist.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation from federal lease operators under Alternative E would be minimized. A buffer zone would not be established around the borders of the Reservation. The BLM has the responsibility to use reasonable means to prevent drainage of tribal CBNG caused by development on federal lands. Operators would be required to provide site-specific analyses prior to field development in areas of potential drainage to tribal CBNG resources. In these analyses, operators must demonstrate whether and to what extent federal CBNG production is likely to drain Reservation CBNG. The analysis would be used by BLM to determine the timing of CBNG production, monitoring requirements and additional data needs.

If monitoring or reservoir modeling indicates drainage of CBNG resources is occurring, the BLM would enter negotiations with the operator and the tribe to protect the correlative rights of the tribe. BLM requirements could include reducing production rates, shutting in the well or wells, establishment of communitization agreements, or payment of compensatory royalty.

To protect the correlative rights of the tribe from state and private CBNG development, the BLM would represent the tribe at MBOGC hearings that set spacing units for the production of CBNG resources including state and private lands. The BLM would work with the MBOGC under its existing Memorandum of Understanding to protect tribal resources that may be affected by state or private permits, or establishment of CBNG spacing units adjacent to tribal resources. Under this alternative, there would be no drainage of tribal CBNG resources by federal lease operators. The potential for drainage by private lands within the reservation boundary and along the exterior boundary would be minimized to the extent possible.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative B with the exception that injection of produced water would not be required. Injection of produced water into a subsurface formation approved by the state would be one water management option available to operators under this alternative and such disposal would not impact other mineral resources. Other produced water management options would be making produced water available for beneficial uses and treating, as needed, produced water before being discharged onto the surface or into bodies of water or used in managed irrigation. Impacts from produced water management options are described in other resource sections, such as hydrology and soils.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, impacts to CBNG resources would be similar to Alternative E except that they would be dispersed or spread out over time and place by numerical limits for cumulative and watershed specific APDs that BLM would approve per year. Impacts to coal and existing coal mines would be the same as Alternative C except they might be delayed or dispersed over time and place. The annual, calendar-based cumulative limit placed on federal APDs approved by BLM would be set at five percent (910 APDs) of the high-range number of state, private and federal CBNG APDs (18,225) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide Document). A limit would also be established on the number of federal APDs that would be approved each year within each 4th Order Watershed. This limit would be set at the total number of wells predicted for each watershed times the predicted rate of development in the Statewide Document. These combined limits would serve to level the impacts over a 20-year development period.

Imposition of phased development limits may impair the ability of some operators to develop their leases in a timely fashion due to the inability to obtain a sufficient number of federal APDs within a given year or timeframe to allow for development within a particular lease or area. This could result in a less orderly development of the gas resource and could result in lost or delayed revenue for the operators and other royalty interests. This less orderly development could also result in unintended environmental impacts due to possible increases in surface disturbance necessary to produce the wells. Producing infrastructure for the wells may have to bypass certain areas and then additional infrastructure installed later as wells are drilled.

The production of CBNG and the venting of CBNG represent the irreversible and irretrievable loss of the resource. Drainage of federal CBNG by off-lease CBNG wells represents the irreversible and irretrievable loss of the federal resource and royalties to the lessee as well as the federal government and state of Montana. Under Alternative F, watershed specific and cumulative numerical limits would be placed on the number of federal APDs approved each year. This could result in the situation where state and private leases that adjoin federal leases could experience CBNG resource development for a number of years prior to federal APDs being approved for the federal leases. For example, state and private APDs could use the majority of annually approved APDs (ratio 80 percent: 20 percent) for the first several years resulting in a disproportionate development pattern in the field. This would result in a delay of CBNG resources developed on federal leases. The development occurring on adjoining state or private leases would increase the potential for drainage of federal minerals and may cause wells on federal minerals to be uneconomic and not drilled. The lack of equitable and concurrent federal development would result in a loss of royalty income to the federal government as well as the state portion and a loss of income to the lessee of the federal lease.

There are currently 120 wells drilled on federal minerals within the CX Field. As a result of an Order issued by the U.S. District Court for Montana, restrictions were imposed upon BLM regarding the annual number of CBNG APDs that can be approved by BLM during preparation of the FSEIS. Subsequent to the District Court Order, the Ninth Circuit Court of Appeals issued an injunction which prohibited BLM from approving any permits for the production of CBNG in the Montana portion of the PRB. These restrictions resulted in extended delays to approximately five percent of the federal APDs submitted. Drilling and development of adjoining state and private minerals has continued and it is likely that the five percent federal mineral locations are being drained and may no longer be economical to drill. For Alternative F, if five percent of the proposed wells were not drilled because of restrictions on the number of annual APDs approved, a total of 425 wells would not be drilled representing a loss of approximately 127.5 billion cubic feet (BCF) of natural gas to the Federal Government. This would be a loss of income to the lessees of the federal leases and a loss of royalty to the federal government and to county governments.

For years 1 thru 9 of phased development under Alternative F, the number of state and private APDs issued would be greater than the number of federal/BLM APDs issued. In years 3, 4 and 5 it is predicted that no federal/BLM APDs would be issued. It is this situation that creates the increased potential to drain federal minerals from production on adjoining state and private minerals.

For Alternative F, the Crow and Northern Cheyenne reservations would be protected from drawdown of coal seam aquifers and drainage of tribal CBNG resources from federal CBNG wells by the establishment of a 5-mile buffer zone around the borders of the Crow and Northern Cheyenne reservations, except along the common border of the two reservations. Resource protection protocols that demonstrate protection of Indian groundwater and CBNG would be required to be included in each operator’s POD that includes the development of federal CBNG wells within the 5-mile buffer zone. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops where there would be the increased potential for drainage of federal minerals. CBNG Indian resources could be impacted by development of state and private leases within the 5-mile buffer zone.

Within the 5-mile buffer zone of a reservation boundary, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 acres) within the Billings RMP Area and 64 percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 TCF of gas that may be lost to the federal and county governments [(127,165 acres + 250,565 acres)/1 well per 80 acres * 0.3BCF per well]. These statistics do not take into account the federal minerals administered by the Custer National Forrest, Ashland Ranger District.

The buffer could also cause a reduction in the development of federal leases due to the increased economic investment required to develop CBNG within the zone. Additional costs include installation of added monitoring wells and air monitoring stations and additional geologic engineering work to demonstrate that the CBNG production would have no impact on Indian Trust Assets (ITAs). Furthermore, if companies were required to temporarily or permanently cease production of CBNG wells because of a perceived or established impact to ITAs, the decision could affect production of CBNG from any federal lease within the five mile buffer. It is unlikely that companies would be willing to invest capital in drilling and developing a lease if they are not guaranteed an opportunity to recover the capital investment and make a reasonable profit for their shareholders. This could also result in a scenario where the federal tracts in the buffer area may be leased but would be viewed as having a lesser value than a private or state lease that did not contain these same restrictions/requirements. If the lessees of the federal leases in the buffer area were not allowed to pursue development of the lease, a case might be made for a "taking" of their rights as lessee.

Under this alternative, restrictions applied to the development of federal CBNG in crucial sage-grouse habitat areas would likely lead to some level of drainage of federal CBNG from adjacent state and private wells and may actually cause some drainage impacts to private and State mineral estate. This is because the allowable development within the crucial sage-grouse habitat areas is likely to be less efficient in the recovery of the CBNG resource. If no development were to occur on Federal mineral estate within these areas, some small isolated tracts of private or State minerals would be considered uneconomic to develop and would be subject to drainage, or not developed.

A “no development” outcome would lead to a loss of Federal royalties. For an estimate of Federal royalties lost due to “no development” see the socioeconomic section. Similarly, private and State mineral estates would lose royalties. The no development outcome is considered unlikely and is used for comparing impacts between full development and no development within the crucial sage-grouse habitat areas.

Crow Reservation

CBNG resources of the Crow Tribe would be protected from production of federal CBNG through the establishment of a 5-mile buffer zone on the east, west and north sides of the reservation. The BLM has the responsibility to use reasonable means to prevent drainage of tribal groundwater and CBNG resources. Within the 5-mile buffer zone surrounding the Crow Reservation, BLM would require the operator to demonstrate the protection of Indian resources in the POD. The operator’s analyses would need to demonstrate if Indian minerals and groundwater would be impacted by development of federal CBNG wells. If groundwater and minerals might be impacted, the POD must include resource protection protocols for these assets. If the POD does not show protection of Indian Trust Assets and adequate resource protection protocols are not included, BLM would not approve the APD.

Resource protection protocols could include a requirement for monitoring wells to be installed between the development area and the reservation. If monitoring indicates that Indian minerals are not being protected, then CBNG development wells would be shut-in. If CBNG development occurs on a reservation, this requirement may be modified in consultation with the tribe and other affected parties.

Other resource protection protocols that could be considered to protect reservation groundwater and CBNG resources from drainage include reducing federal CBNG well production rates, establishment of communitization agreements in consultation with the tribe, or adjusting CBNG well spacing requirements. Under this alternative, there would be no drainage of tribal CBNG resources by federal CBNG wells. The potential for drainage of undeveloped federal and Indian leases by development of state and private leases along the exterior boundary would still exist.

Northern Cheyenne Reservation

A buffer zone would be established on the south, north and east sides of the Reservation. The protection of Indian minerals and groundwater for the Northern Cheyenne Tribe would be the same as described for the Crow Tribe with the exception of drainage of Indian CBNG from the drilling of private leases within the reservation because the tribe owns the majority of minerals within the reservation.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative E with the exception that impacts would be dispersed or spread out over time and place due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year. Delays in the development of CBNG resources on federal leases could result in the increased potential for drainage of federal minerals due to the development of CBNG resources on adjoining state or private leases. This alternative could lessen the value of federal leases because of drainage occurring from offsetting private and state wells that would never be recovered. Conflicts could arise between lessees over who can develop first, or at all and the resultant loss of revenue to the lessee. This alternative could also require the federal government to extend leases beyond their primary term without production due to the government not allowing timely development.

Indian CBNG and groundwater would be protected from production of federal CBNG wells through the implementation of a 5-mile buffer zone within which operators would be required to conduct site-specific analyses and develop resource protection protocols that would be included with their PODs for any CBNG wells to be drilled on federal leases. The buffer zone and protection protocols would not apply to wells approved by the state which could result in direct and indirect impacts to groundwater and CBNG located under the reservations.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts to CBNG resources would be similar to Alternative F except that they would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide Document). A limit would also be established on the number of federal APDs that would be approved each year within each 4th Order Watershed. This limit would be set at the total number of wells predicted for each watershed times the predicted rate of development in the Statewide Document These combined limits would serve to level the impacts over a 20-year development period.

Since the annual rate of development would be limited to five percent of the cumulative APDs predicted, the potential for the drainage of federal minerals from production on adjacent or adjoining state or private leases would be the same as for Alternative F. In years 1 through 9, the number of state and private APDs issued would be greater than the number of federal/BLM APDs issued and in years three, four and five when it is predicted that no federal/BLM APDs would be issued. This would create the potential for an increase in the drainage of federal CBNG by production on adjacent state and private leases. Applying the same example as outlined under Alternative F, if five percent of federal CBNG wells are not drilled this would represent approximately 150 wells and a loss of approximately 45 BCF of natural gas from federal leases. This would be a loss of income to the lessees of the federal leases and a loss of royalty to the federal government and the counties and state of Montana.

Imposition of phased development limits may impair the ability of some operators to develop their leases in a timely fashion due to the inability to obtain a sufficient number of APDs within a given year or timeframe to allow for development within a particular lease or area. This could result in a less orderly development of the gas resource and could result in lost or delayed revenue for the operators and other royalty interests. This less orderly development could also result in unintended environmental impacts due to possible increases in surface disturbance necessary to produce the wells. Producing infrastructure for the wells may have to bypass certain areas and then additional infrastructure installed later as wells are drilled.

For Alternative G, a 5-mile buffer zone would be established around the borders of the Crow and Northern Cheyenne reservations. Resource protection protocols and potential impacts, including the increased potential for the drainage of federal minerals due to delayed or restricted development of federal leases, would be the same as for Alternative F.

Crow Reservation

Impacts to the Crow Reservation would be similar to impacts described in Alternative F.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to impacts described in Alternative F.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative F except that they are expected to be less due to approximately 65 percent fewer APDs being issued. Impacts would be dispersed or spread out over time and place due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year. Delays in the development of CBNG resources on federal leases could result in the increased potential for drainage of federal minerals due to the development of CBNG resources on adjoining state or private leases. This alternative could lessen the value of federal leases because of drainage occurring from offsetting private and state wells that would never be recovered. Conflicts could arise between lessees over who can develop first, or at all and the resultant loss of revenue to the lessee. If lessees are not allowed to develop the gas resources this would result in a loss of the resource to the nation. This alternative could also require the federal government to extend leases beyond their primary term without production due to the government not allowing timely development.

ITAs would be protected through the implementation of a 5-mile buffer zone within which operators would be required to conduct site specific analyses and develop mitigation measures and monitoring that would be included with their POD for any CBNG wells to be drilled on federal leases. The buffer zone and mitigation measures would not apply to wells approved by the state which could result in direct and indirect impacts to groundwater and CBNG located under the reservations.

Alternative H—Preferred Alternative - Multiple Screens

Under this Alternative, impacts to federal leases, CBNG resources and federal lessees would be similar to Alternative F. This Alternative manages the pace (rate) and place (geography) of federal CBNG development through protection measures applied to crucial habitat areas and limits to the discharge of untreated produced water from federal CBNG wells and emissions from sources associated with federal CBNG wells. More federal APDs could be approved annually and geographically than under Alternatives F and G as long as other resources are protected. Monitoring data would be required to help BLM determine which (where and when) federal APDs could be approved. These limits and thresholds (see Wildlife Appendix and Hydrology section) would serve to level the cumulative impacts over time. The production of CBNG would continue for a longer overall period of time compared to Alternative E because fewer number of federal CBNG wells may be drilled each year.

The production and venting of CBNG represents the irreversible and irretrievable loss of the resource; although the production of CBNG makes it available in the market place. Drainage of federal CBNG by off-lease CBNG wells represents the irreversible and irretrievable loss of the federal resource and loss of revenue to the operator, lessee, federal government and state of Montana.

Imposition of phased development limits may impair the ability of some operators to develop their leases in a timely fashion due to the inability to obtain a sufficient number of approved APDs within a given year or timeframe to allow for development within a particular lease or area. This could result in a less orderly development of the gas resource and could result in lost or delayed revenue for the operators, lessees, the federal government and state of Montana. This less orderly development could also result in unintended environmental impacts due to possible increases in surface disturbance necessary to produce the wells. Producing infrastructure for the wells may have to bypass certain areas and then additional infrastructure installed later as wells are drilled.

Under this alternative, restrictions applied to the development of federal leases in crucial sage-grouse habitat areas would likely lead to some level of drainage of federal CBNG from adjacent state and private wells and may actually cause some drainage impacts to private and State mineral estate. This is because the allowable development within the crucial sage-grouse habitat areas is likely to be less efficient in the recovery of the CBNG resource. If no development were to occur on federal leases within these areas, some small isolated tracts of private or State minerals would be considered uneconomic to develop and would be subject to drainage, or not developed.

A “no development” outcome would lead to a loss of Federal royalties. For an estimate of Federal royalties lost due to “no development” see the socioeconomic section. Similarly, private and State mineral owners would lose royalties. The no development scenario compares impacts between full development and no development within the crucial sage-grouse habitat areas.

Under Alternative H, the Crow and Northern Cheyenne reservations would be protected from drawdown of groundwater in coal seams and drainage of tribal CBNG from federal CBNG wells by the establishment of a 5-mile buffer zone around the borders of the reservations and implementation of mitigation measures associated with federal CBNG wells within the 5-mile zone. Mitigation measures that demonstrate protection of Indian minerals and groundwater would be required to be included in each operator’s POD that includes the development of federal CBNG wells within the 5-mile buffer zone. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops where there would be the increased potential for drainage of federal minerals. Within the 5-mile buffer zone of a reservation boundary, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 acres) within the Billings RMP Area and 64 percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 to 1.6 TCF of gas[(127,165 acres + 250,565 acres)/1 well site per 80 acres * 0.3 to 0.34 BCF per well site]. If federal leases within the 5-mile zone are not fully developed, the gas resource may be produced by adjacent state and private CBNG wells or not fully recovered. This would also result in lower revenues to the lessee and federal, state and county governments. For an estimate of Federal royalties lost due to “no development” see the socioeconomic section.

The buffer could also cause a reduction in the development of federal leases due to the increased economic investment required to develop CBNG within the zone. Additional costs include installation of added monitoring wells and air monitoring stations and additional geologic engineering work to demonstrate that the CBNG production would have no impact on ITAs. Furthermore, if companies were required to cease production of CBNG wells because of a perceived or established impact to ITAs, the decision could affect production of CBNG from any federal lease within the 5 mile buffer. It is unlikely that companies would be willing to invest capital in drilling and developing a lease if they are not guaranteed an opportunity to recover the capital investment and make a reasonable profit for their shareholders. This could also result in a scenario where tracts in the buffer area may be leased but would be viewed at a lesser value than a private or state lease that did not contain these same restrictions/requirements. If the lessees of the federal leases in the buffer area were not allowed to pursue development of the lease, a case might be made for a "taking" of their rights as lessee.

Impacts on conventional oil and gas resources would be the same as discussed in the *Management Common* section.

Crow Reservation

CBNG resources of the Crow Tribe would be protected through the establishment of a 5-mile buffer zone around the east, west and north sides of the reservation. The BLM has the responsibility to use reasonable means to prevent drainage of tribal CBNG and groundwater resources. Within the 5-mile buffer zone surrounding the Crow Reservation, BLM would require site-specific analyses be included with the operator’s POD. The operator’s analyses would need to demonstrate if Indian minerals and groundwater would be impacted by development of federal CBNG wells. If groundwater and minerals might be impacted, the POD must include resource protection protocols for these assets. If the analyses do not show protection of ITAs and adequate resource protection protocols are not identified during consultation with the tribe, BLM would not approve the APD.

Resource protection protocols could include a requirement for monitoring wells to be installed between the development area and the reservation. If monitoring indicates that Indian minerals or groundwater are not being protected, then consultation with the tribe would be conducted to determine a suitable mitigation measure, or CBNG development wells could be shut-in. If CBNG development occurs on the reservation, this requirement may be modified in consultation with the tribe and other affected parties.

Other resource protection protocols that could be considered to protect reservation groundwater and CBNG resources from drainage include reducing federal CBNG well production rates, establishment of communitization agreements in consultation with the tribe, or adjusting CBNG well spacing requirements. Under this alternative, there would be no drainage of tribal CBNG resources by federal lease operators. The potential for drainage of undeveloped federal minerals by development of private leases within the reservation buffer zone and development of state and private leases along the exterior boundary would still exist.

Northern Cheyenne Reservation

A buffer zone would be established on the south, north and east sides of the Reservation. The protection of Indian minerals and groundwater for the Northern Cheyenne Tribe would be the same as described for the Crow Tribe with the exception of drainage of Indian CBNG from the drilling of private leases within the reservation because the tribe owns the majority of minerals within the reservation.

Conclusion

The cumulative impacts under this alternative would include production of CBNG from more federal wells drilled annually than under Alternatives F and G, but probably fewer federal wells drilled annually than under Alternative E. This would result in an overall longer period of time to produce CBNG in the Planning Area compared to Alternative E and probably a shorter overall period of time compared to Alternatives F and G. CBNG production represents the recovery of the resource for the nation and revenue for federal, state and local governments, companies and individuals.

Delays in the development of CBNG resources on federal leases could result in the increased potential for drainage of federal CBNG due to the development of CBNG resources on adjoining state or private leases. This alternative could lessen the value of federal leases because of drainage occurring from offsetting private and state wells that would never be recovered. Conflicts could arise between lessees over who can develop first or at all and the resultant loss of revenue to the lessee. This alternative could also require the federal government to extend leases beyond their primary term without production due to the government not allowing timely development

The increased number of producing CBNG wells and the associated infrastructure located near coal mine permit boundaries could inhibit the expansion of existing coal mines. This could delay or possibly preclude the mining of coal in certain areas. Areas of new coal mine interest would be excluded from opening new coal mines by the existence of producing CBNG wells and infrastructure. Furthermore, CBNG related impacts particularly from federal wells would be dispersed or spread out over time and place due to the implementation of BLM imposed restrictions or “screens” previously described.

Indian groundwater and minerals would be protected through the implementation of a 5-mile buffer zone within which operators would be required to conduct site-specific analyses and develop resource protection protocols that would be included with their PODs for any CBNG wells to be drilled on federal leases. If the operators cannot demonstrate that there would be no impact to the Indian groundwater and minerals, their APDs would not be approved. This would result in a loss of the gas resource to the nation. The buffer zone and protection protocols would not apply to wells approved by the state which could result in direct and indirect impacts to groundwater and CBNG located under the reservations.

Hydrological Resources

Hydrological Resources
Surface water: Some surface waters in the Powder River Basin are of good quality and frequently used for irrigation. Other rivers are characterized as having fair to poor quality water and may go dry, the waters are used for stock and limited irrigation.

Groundwater: Groundwater is available in stream bottom alluvium, but becomes scarce away from water courses. Coal beds and interlayered sands are the most commonly used aquifers away from riparian areas. Groundwater quality is variable.

Alternative A
No Action (Existing CBNG Management)

- Federal:
  - No impacts to surface or groundwater resources
- State:
  - Negligible changes in Tongue River quality and flow.
  - Groundwater drawdown within the immediate vicinity of the CX Ranch
  - Continued beneficial reuse of produced water at the CX Ranch
- Cumulative Impacts:
  - Surface Water:
    Wyoming CBNG discharges will result in moderate increases in flow and changes in water quality in rivers shared between Montana and Wyoming, however downstream uses will not be diminished
  - Tongue River Railroad construction could lead to localized soil erosion and impact to surface water focused run-off, localized increased stream flow and increased suspended sediment.
  - Groundwater:
    Drawdown from Wyoming CBNG and the CX Ranch may extend several miles from development.
  - Beneficial Reuse:
    Wyoming and CX Ranch discharges may increase opportunities for beneficial use.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Surface Water
  - Similar to Alternative A, potential for increased sediment loads due to soil disturbance and erosion.
- Groundwater:
  - Drawn down will occur over large continuous areas
  - Immediate drawdown will be minor. However, as CBNG production matures, coal seam aquifer drawdown may extend 4 to 5 miles from the edge of production
  - No change in groundwater quality
- Beneficial Reuse:
  - Same as Alternative A
- Cumulative Impacts:
  - Surface water flow and quality will be the same as Alternative A
  - Montana and Wyoming CBNG production will noticeably drawdown coal seam aquifers
  - Groundwater quality in Montana and beneficial reuse will be the same as Alternative A

Alternative C
Emphasize CBNG Development

- Surface Water
  - Water quality in some watersheds will be noticeably altered.
  - Flows will be considerably increased.
- Groundwater:
  - Drawdown similar to Alternative B.
  - Alluvial groundwater quality may be altered due to infiltration of untreated production water
- Beneficial Reuse:
  - Same as Alternative A
- Cumulative Impacts:
  - Surface water quality in some watersheds will be noticeably altered.
  - Flows will be considerably increased.
  - Impacts to groundwater drawdown, quality and beneficial reuse will be the same as in Alternative B

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Surface Water
  - Similar to Alternative A, potential for increased sediment loads due to soil disturbance and erosion.
  - Flows will increase similar to Alternative C
- Groundwater:
  - Drawdown same as Alternative B
  - No groundwater quality impacts
- Beneficial Reuse:
  - Increased beneficial uses, estimated at 20 percent of production
- Cumulative Impacts:
  - Surface water quality will be slightly altered due to Wyoming CBNG discharges.
  - Surface water flows will be similar to Alternative C
  - Groundwater drawdown and quality changes will be the same as in Alternative B

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Surface Water
  - Water quality will be slightly altered, however beneficial uses will not be diminished
  - Flows will be moderately increased
- Groundwater:
  - Drawdown same as Alternative B.
  - Alluvial groundwater quality may be altered due to infiltration of untreated production water
- Beneficial Reuse:
  - Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production
- Cumulative Impacts:
  - Cumulative impacts to surface waters will be reduced dependent on MDEQ numerical standards
  - Surface water quality will be slightly altered however downstream uses will not be diminished
  - Surface water flows will be moderately increased
  - Groundwater drawdown will be similar to Alternative B
  - Shallow groundwater quality may be slightly altered

Alternative F **Phased Development Multiple Screens (High Range)**
• Surface Water: – Water quality will be slightly altered, however beneficial uses will not be diminished – Flows will be moderately increased • Groundwater: – Drawdown same as Alternative B • Beneficial Reuse: – Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production water • Cumulative Impacts: – Cumulative impacts to surface waters will be less than MDEQ standards. – Surface Water quality will be slightly altered,; however downstream uses will not be diminished – Surface water flows will be moderately increased – Groundwater drawdown would be similar to Alternative B – Conditions placed on CBNG federal mineral development within crucial sage-grouse habitat may reduce the overall number of CBNG wells developed. If no development occurs within the crucial sage-grouse habitat, the number of wells and associated produced water, would be reduced by 12.8%.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Surface Water: – Water quality will be slightly altered, however beneficial uses will not be diminished – Flows would slightly increase • Groundwater: – Drawdown effects near CBNG fields would be the same as Alternative B, but fewer CBNG fields would be developed • Beneficial Reuse: – Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production water • Cumulative Impacts: – Cumulative impacts to surface waters will be less than MDEQ standards. – Surface Water quality will be slightly altered,; however downstream uses will not be diminished – Surface water flows will be slightly increased – Drawdown effects near CBNG fields would be the same as Alternative B, but fewer CBNG fields would be developed

Alternative H **Preferred Alternative - Multiple Screens**
• Surface Water: - Water quality will be slightly altered, however beneficial uses will not be diminished - Flows will be moderately increased • Groundwater: - Drawdown same as Alternative B • Beneficial Reuse: - Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production water • Cumulative Impacts: - Cumulative impacts to surface waters will be less than MDEQ standards. - Surface Water quality will be slightly altered,; however downstream uses will not be diminished - Surface water flows will be moderately increased - Conditions placed on CBNG federal mineral development within crucial sage-grouse habitat may reduce the overall number of CBNG wells developed. If no development occurs within the crucial sage-grouse habitat, the number of wells and associated produced water, would be reduced by 12.8%.

The key water quality parameters for predicting the potential effects of CBNG development on irrigated agriculture are sodicity (as sodium adsorption ratio, SAR) and salinity (as electrical conductivity, EC). The MDEQ believes irrigated agriculture is the most sensitive beneficial use for surface waters in the study area, thus protection of irrigated agriculture will be sufficient to protect all other beneficial uses. Instream numerical targets for these parameters are used to model environmental impacts.

The water quality standards for EC and SAR were adopted in 2003 by the Montana Board of Environmental Review (BER) to protect the most salinity-sensitive beneficial use of the streams and rivers in Montana's Powder River Basin, i.e., irrigated agriculture. The standards establish the maximum levels of EC and SAR that may be discharged into the rivers and streams throughout the basin without harming plants and soils. These standards have been approved by the U.S. EPA. As such, all Clean Water Act (CWA) permits issued in Montana must contain provisions that limit EC and SAR, so that the water quality standards will be met. In addition, all CWA permits issued in Wyoming authorizing discharges into streams that flow north into Montana contain conditions to ensure that Montana’s water quality standards are not exceeded at the border. Note Montana’s EC and SAR standards are currently being challenged in both Montana and federal courts.

The MDEQ water quality standards for EC and SAR are listed in Table 3-6.

In March 2006, the Montana BER amended its regulations implementing Montana's nondegradation policy in terms of EC and SAR. The State's nondegradation policy is part of the State's water quality standards program; therefore, any changes to regulations implementing the policy must be approved by EPA. Although the amended nondegradation regulations became effective under state law on May 19, 2006, they will not be enforced until approved by EPA.

Once approved, the new nondegradation requirements will apply to any proposal that would result in a new or increased discharge of EC and SAR into "high quality" waters of the State. State waters are considered high quality if the quality of those waters is better than that required by the water quality standards. Since MDEQ determines whether a water body is high quality on a parameter-by-parameter basis, a water body will be considered high quality in terms of EC and SAR, if the ambient quality of the stream is better than the water quality standards established for those parameters. A waterbody will not be considered high quality if the water is listed on the State's § 303(d) list as impaired because it does not meet the water quality standards for EC and SAR

Under Montana's nondegradation law, any change in the existing quality of high quality waters is prohibited unless an authorization to degrade is obtained from MDEQ, or the change is deemed "nonsignificant" under rules adopted by the Montana BER. Under the newly amended regulation, any change in the existing quality of a high quality stream is deemed "significant" when the ambient quality of the stream is 40 percent of the standard or above. Since all of the high quality streams within the Powder River Basin have ambient water quality that exceeds 40 percent of the standard for EC, any new proposal to discharge into those waters may require an authorization to degrade from MDEQ.

In May 2002, the Northern Cheyenne Tribe adopted numerical water quality standards for SAR and EC applicable to waters within the Reservation. Although these tribal standards do not have Clean Water Act regulatory status until approved by the EPA, the adopted numerical standards do set out the tribe's considered determination of the water quality needed to protect irrigated agriculture on the Reservation (Northern Cheyenne Tribe 2002). Standards for surface water quality proposed by the Northern Cheyenne Tribe are summarized in Table 3-24.

The Montana BER standards adopted by the MDEQ on April 25, 2003 have been used in the analysis. It should also be noted that a non-degradation criterion exists for flow on high quality waters. This flow criterion requires individual discharge permits do not cause a 10 percent increase or decrease in the 7Q10 flow or a 15 percent increase or decrease in mean monthly flow (Administrative Rules of Montana [ARM] 17.30.715.1.a). The non-degradation rules also state MDEQ may determine the change resulting from an activity is "significant" based on cumulative impacts despite it meeting the "nonsignificant" criteria for individual permits (ARM 17.30.715.2.a). It has been suggested a 40 percent increase in minimum mean monthly flow may be an appropriate level at which this cumulative significance threshold is met for flow; however this evaluation will be made based on the specific conditions which exist when each Montana Pollutant Discharge Elimination System (MPDES) permit is requested. Forty percent of minimum mean monthly flow will be used as a comparison analysis threshold for alternatives A-E and as a limiting factor for Montana discharges under alternatives F-H.

More recently, the Montana BER modified these standards by designating EC and SAR as "harmful" parameters. Harmful parameters are regulated under the non-degradation rules, which do not allow a discharge to increase a harmful parameter if ambient water quality is greater than 40 percent of the standard (see Hydrology Appendix for further details). If implemented, the effect of this rule would be that CBNG discharges to surface waters will need to be treated to ambient water quality standards since ambient EC and SAR values are greater than 40 percent of the standards in these watersheds. This modification of the EC and SAR standards has not been approved by EPA, so it does not have CWA standing and is not enforceable upstream into Wyoming. The Wyoming Governor's office has openly opposed this change. As such, it is assumed that CBNG development in Montana would have to be in compliance with these rules and treat all discharges to ambient water quality, but Wyoming development will not. If EPA approves these changes, the non-degradation rules would apply to Wyoming as well and impacts would be less than calculated. Forty percent of the EC and SAR values have been added as criteria for Alternatives A-E and are incorporated into the analysis of Alternatives F-H.

The Ayers and Westcot EC/SAR relationship is used to determine the effect of irrigation waters on the infiltration capacity of soils. This relationship recognizes that as salinity increases the potential impacts of SAR decrease. This relationship is not unbounded, however, because of the potential impact of rainfall on sodic soils. Rainfall can cause SAR problems in surface soil because of the differential way in which EC and SAR respond to a rain event (significant lowering of the EC and little change in the SAR). This rain-on-sodic-soil problem is addressed in a number of the standards proposals (see Hydrology Appendix) through adoption of an absolute maximum SAR (i.e., the standard "caps" the Ayers and Westcot EC/SAR relationship). It will be important to be mindful of an upper bound on the Ayers and Westcot relationship in reviewing the conclusions reached in the alternatives analyses in this document. This may help explain situations where the most restrictive proposed limit (MRPL) (or perhaps, the least [LRPL]) shows a potential effect, where the Ayers and Westcot diagram indicates no reduction in infiltration. This relationship is used as criteria against which the results of the surface water quality are compared.

Another factor to consider in applying these SAR and EC values is the significant distinction between the modeling approach applied to the analysis of alternatives and the approach that eventually will be used in calculating discharge limits for future, specific CBNG projects:

- The modeling approach used in this document begins with an assumed water management method for all the reasonably foreseeable CBNG development in Montana and Wyoming and, applying a series of assumptions (see discussion below), predicts a resultant instream cumulative water quality. Predicted water quality modeling output is then displayed against the full range of proposed SAR and EC limits and other criteria.

- The water quality-based approach that is actually used to calculate future Montana Pollutant Discharge Elimination System (MPDES) permitting requirements will begin with appropriate and specific instream water quality standards. Through the total maximum daily load (TMDL) process, those standards will be translated into discharge limits for specific CBNG projects.

The standards serve as the regulatory basis for controlling CBNG discharges and the water quality-based permitting approach that implements these standards is different from the predictive modeling approach used in this EIS.

The water quality-based approach begins with a desired instream water quality and, using that as the target, calculates the CBNG discharge limits needed to ensure the desired instream water quality is achieved. The TMDL process identifies capacity for a waterbody to assimilate substances (maximum load). That capacity then has to be allocated among the appropriate governmental entities along that waterbody. It should be noted that, where a tribe is one of the appropriate governmental entities, EPA has a trust responsibility to ensure a fair and meaningful portion of the available assimilative capacity is reserved for that tribe.

The spreadsheet model used in the analysis of impacts for the EIS employs a steady state mass balance approach to estimate concentrations of EC and SAR after stream water and CBNG discharged water are mixed. The steady state mass balance approach is commonly used by the EPA in predicting possible effects of point source discharges on receiving waters. Input parameters to the spreadsheet model were developed from analysis of reasonably conservative assumptions, as well as measures of central tendency (typical or mean values).

The Surface Water Quality Analysis Technical Report (SWQATR) lists the input parameters and indicates whether conservative or mid-range values were used in the impact analysis model. The resultant spreadsheet model is considered to provide a conservative, yet reasonable estimate of the impacts of CBNG development on surface water quality in the Powder River Basin. The SWQATR also discusses the problems of manipulating sample SAR values (BLM 2003e). It should be noted this model is meant to be used to compare alternatives, not to predict precise resultant water quality.

Assumptions

CBNG development has the potential to impact surface water, surface aquifers and coal seam aquifers that hold the groundwater resources in the planning and CBNG emphasis area. The following assumptions form the framework for analyzing the impacts:

- Under the expanded development RFD, the maximum volume of CBNG water production and discharge is predicted to occur in year six for alternatives B-E. All surface water impacts are calculated using this maximum CBNG discharge volume.

- Under the phased development alternatives (F, G and H), peak water production occurs at a different time for each watershed. Surface water impacts are calculated using the peak for each watershed.

- All modeling results shown in this EIS are for the minimum mean monthly stream discharges. 7Q10 discharges are also included in the SWQATR analysis.

- SAR and EC were calculated using a simple flow-weighted mass balance equation. This assumption is strictly correct for EC however it results in an overestimation of SAR. This results in a conservative model of impacts due to CBNG discharges.
- To facilitate analysis, a range of water quality criteria was assumed based on the proposals before the Montana Board of Environmental Quality. This analysis has been supplemented by incorporation of the current Montana BER approved standards for EC and SAR.

A complete listing of all model assumptions may be found in the SWQATR.

Impacts From Management Common to All Alternatives

Tongue River Railroad

Construction of this railroad would be in accordance with all state and federal rules and regulations and hydrological impacts are expected to be short-lived and minor. The act of construction in the vicinity of the Tongue River riparian zone will increase the local effects of soil erosion. This soil erosion is expected to deliver increased suspended sediment load to the Tongue and its tributaries. Localized erosion and runoff could cause locally increased streamflow in the river tributary and alter stream geometry. Mitigating measures and best management practices are expected to be required in the EIS for the TRR in order to minimize erosion and control runoff velocity. These impacts are anticipated to be of low intensity and of short duration. Sediment yields will return to natural levels once vegetation is reestablished.

Conventional Oil and Gas Production

Conventional oil and gas production can produce large volumes of water that could impact surface and groundwater resources because of the quality of the produced water. Since 1953, the MBOGC has regulated the use and disposal of water produced in association with the production of oil and natural gas to mitigate the potential for impacts to the environment.

The use of surface impoundments is controlled by BLM and the state. BLM permits water disposal pits (surface impoundments) on federal leases. The permitted surface impoundments are those designed primarily for evaporation. Any impoundments constructed in the state, including those involving federal land or minerals, would require approval from the MBOGC. Further, the MDEQ permits any point-source discharges to surface waters (e.g., streams), including those that could result from surface impoundments.

Conventional oil and gas is typically produced from depths below usable aquifers and below coal seams. Regulations require the isolation of oil and gas producing zones from other reservoirs containing possible hydrocarbons or from aquifers that contain usable water. Underground Injection Control (UIC) regulations also require safeguards to isolate injection zones from other zones that contain hydrocarbons and from aquifers that contain usable or potentially usable quality water (i.e., groundwater containing less than 10,000 mg/l of total dissolved solids).

Produced water that has a total dissolved solids (TDS) concentration of less than 15,000 mg/l, can be discharged to permitted surface impoundments. As a result of the existing regulations, the impact on surface water and groundwater resources from conventional oil and gas production is minimal.

CBNG Groundwater Drawdown and Water Mitigation Agreements

Drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. The drawdown of Powder River Basin coal seam aquifers as a result of CBNG production has been modeled several times. The Montana Bureau of Mines and Geology has performed two studies using Montana field parameters—a two-dimensional model (Wheaton and Metesh 2001) and a three-dimensional model (Wheaton and Metesh 2002). In addition, three-dimensional modeling has been carried out using parameters from the Wyoming portion of the Powder River Basin (BLM 1999b).

The maximum lateral extent of drawdown within coal seam aquifers has been estimated by several methods. Monitoring around dewatered coal mines in the Wyoming portion of the Powder River Basin indicates five feet of drawdown extends from 2 to 14 miles from mined areas after 15 years of mining (BLM 1999b). Three dimensional (3D) groundwater modeling conducted in conjunction with the WYODAK EIS (BLM 1999b) predicted five feet of drawdown at distances from 10 to 22 miles from the edge of production. Two dimensional (2D) groundwater modeling, which should represent the maximum limit of drawdown due to vertical leakage being ignored, was conducted in conjunction with this EIS. This 2D modeling indicated that five feet of drawdown within the Powder River Basin may extend up to 11 miles from the edge of CBNG production (Wheaton and Metesh 2001). 3D groundwater modeling of the East Fork of Hanging Woman Creek was also conducted in conjunction with this EIS. This model indicates the maximum extent of the five-foot drawdown contour extends up to seven miles from the edge of production (Wheaton and Metesh 2002). Based upon this information, the five-foot drawdown contour that would likely result from CBNG development, would extend from 7 to 11 miles from the pumped area. The range of estimates however extends from 2 to 22 miles from the pumped area.

These differences between results are not unexpected and serve to emphasize the site-specific nature of the geology in the Powder River Basin. As the hydrology is fundamentally linked to the geology, it will be critical to manage drawdown-related impacts in an adaptive manner, using site-specific data gathered through monitoring. Management alternatives may include re-supply of water to individuals who have springs or wells affected by drawdown (as required by Montana Code Annotated [MCA] 82-11-175), modification of production plans to limit drawdown impacts to springs where such springs have been determined to be culturally significant or critical to wildlife, or the installation of a hydrologic barrier that will limit the lateral extent of drawdown.

A hydraulic barrier would most likely take the form of a line or system of injection wells. These wells would inject water into the coal aquifer being developed to limit the lateral extent of groundwater drawdown and prevent that drainage of methane and groundwater resources. It should be emphasized the installation of a hydraulic barrier is just one of many methods that may be employed to prevent drainage. The feasibility and necessity of installing such a barrier will be addressed on a case-by-case basis. The water injected by a hydraulic barrier system would most likely be obtained from nearby CBNG production wells completed in the same aquifer as the injection wells. Class V permits for injection of produced water with less than 3, 000 mg/l TDS would generally need to be obtained from EPA Region VIII for such a project. Other permit requirements may apply depending on the quality of the injected water and quality of the water in the target coal seam.

The uncertainty associated with modeling a five-foot drawdown contour is not insignificant since output of this nature is very sensitive to slight changes in the input parameters used for the model. Five feet of drawdown would not, in most cases, impact the usefulness of a well. Since a 20-foot drawdown contour can be modeled with a much higher degree of certainty and it is a more realistic parameter for evaluation of impacts, the 20-foot drawdown contour is used in this analysis to represent the extent of the drawdown which results from CBNG development. Based upon the 3D model prepared in conjunction with this EIS, the 20-foot contour can be expected to extend four to five miles from the edge of CBNG production.

As discussed in Chapter 3, monitoring since the completion of the statewide EIS indicates that “After six years of CBM production, drawdown of up to 20 feet has been measured in the coal seams at a typical distance of roughly one mile and a maximum distance of one and a half miles outside the production areas. These distances are similar to, but somewhat less than predicted in the Montana CBM environmental impact statement.” (Wheaton et al. 2006).

Aquifers other than the produced coal seams, such as alluvium or sandstone bedrock aquifers, are less vulnerable to drawdown from CBNG production due to low vertical hydrologic conductivity in the Tongue River member of the Fort Union Formation. This will limit the vertical movement of groundwater (Wheaton and Metesh 2002, Wheaton and Donato 2004). As discussed in Chapter 3, CBNG drawdown has not been observed in units other than the developed coal seams. Groundwater in units below the Tongue River Member of the Fort Union Formation would not be affected by CBNG development since it is underlain by the Lebo Shale, which is an effective aquitard.

Impacts to wells and springs which derive their water from regional flow within the produced coal seams and are located within the drawdown area would take the form of decreased discharge (yield). Few springs in this area obtain their water from regional flow through coal seams (Wheaton and Donato 2004). Most springs are located at the base of clinker ridges and are fed by local flow systems. These locally-fed springs are not expected to be impacted by coal seam aquifer drawdown. Wells are anticipated to have decreased yields as a result of drawdown; however it is not anticipated they would go dry since the coal would continue to be saturated. For example, a typical PRB coal seam well with an initial head 200 feet above the top of the coal could be pumped at a rate of approximately 25 gpm for six hours. If the head were decreased by 20 feet the rate achievable for six hours would drop to approximately 22.5 gpm and if the head were dropped to five feet above the top of the coal the rate would drop to approximately

2.3 gpm. The five feet above the top of the coal is comparable to conditions anticipated within CBNG fields while the 20-foot drawdown contour may extend four to five miles from the edge of CBNG fields (Wheaton and Metesh, 2002).

Although production of CBNG water enhances cleat within the coal seams, it would not propagate vertical fracturing into the adjacent shale confining units.

Recovery of the coal seam aquifers after production ends is a slow process involving recharge from undrained areas of the aquifer, infiltration of precipitation from the surface in areas where the coal aquifers outcrop and the slow process of infiltration from aquifers above and below the produced coal seams (this is expected to take the longest time because of the confined nature of these units).

Modelers assisting the Wyoming BLM determined coal seams that have experienced substantial drawdown also experience recovery as a two-part process:

"After CBNG development (and water removal) ends, within three to four years water levels in the coal aquifers are expected to partially recover to within 20 to 30 feet of pre-operational conditions. Complete water level recovery will be a long-term process, likely requiring hundreds of years for the removed groundwater to be replaced through the infiltration of precipitation" (BLM 2000b).

A similar recovery process is expected to occur in the Montana area of CBNG interest with most of the recovery happening in a short time but full coal seam aquifer recovery requiring hundreds of years. The 3D computer modeling conducted in conjunction with the statewide EIS estimates recovery schedules for methane-productive coal seams, nonproductive coal seams and surface aquifers in Montana. For productive coals within CBNG fields, the aquifers are expected to recover at least 70 percent of their hydrostatic pressure within five to 12 years. Outside the field, productive coals should regain 90 percent of their pressure within three to five years. Nonproductive coals are predicted to regain 80 percent of their pressure within five years. Surface aquifers that are projected to lose only six feet of pressure, would regain 50 percent of that pressure in less than 10 years (Wheaton and Metesh 2002). Precise local groundwater recovery differs depending on site-specific conditions.

Water mitigation agreements are required in Montana under MCA 82-11-175, which was enacted by the Montana legislature in 2003. MCA 82-11-175 requires CBNG operators offer a reasonable mitigation agreement to each person who holds an appropriation right or a permit to appropriate ground water and for which the point of diversion is within one mile of the coal bed methane well; or one-half mile of a well or spring that is adversely affected by the CBNG well.

Mitigation agreements must address the reduction or loss of water resources and must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the coal bed methane well.

MCA 82-11-175 applies to <u>all</u> wells and springs, not just those which derive their water from the developed coal seams and requires "…prompt supplementation or replacement of water from any natural spring or water well adversely affected by the CBNG project…" Adversely affected could include decreased yields, decreased water pressure, increase or sudden appearance of methane, or a change in water quality. Although the terms of water mitigation agreements are to be "under such conditions as the parties mutually agree upon" the replacement of water required by these agreements is anticipated to take the form of reconfiguring existing wells, re-drilling wells, or drilling new wells. These measures would be effective for replacing water sources since drawdown from CBNG activity is anticipated to primarily affect the produced coal seams and to only minimally affect other aquifers (such as sandstones) within the Tongue River Member of the Fort Union Formation. Any lost or diminished water sources or adversely affected groundwater would be anticipated to be replaced with a permanent source before the termination of the agreement. It is recognized that additional costs (power, moving irrigation piping, etc.) may be associated with the reconfiguration, redrilling, or replacement of impaired water wells and those additional costs are typically paid for by the operator as outlined in the agreements. Furthermore, if a replacement well were required, a *Replacement Well Water Right* might be issued by DNRC, which would retain the priority date of the original well. An example water mitigation agreement is included in the Hydrology Appendix.

The owners of water sources are also protected from impacts from CBNG through the Coal Bed Methane Protection Act (MCA 76-15-9). This act provides for the establishment of the Coal Bed Methane Protection Account which can only be used to compensate landowners and water right holders for damages attributable to coal bed methane development. The text of MCA 76-15-9 is included in the Hydrology Appendix.

As such, the impacts due to ground water drawdown are mitigated by existing state requirements. It should be noted drawdown itself is not eliminated; however affected parties have multiple means by which to be made whole.

Impacts from Management Specific to Each Alternative

Impacts on Hydrological Resources under the management alternatives are summarized in Chapter 2, Table 2-3, Comparison Summary of Impacts. The impacts are discussed in detail for the major watersheds in the following sections.

Alternative A—No Action (Existing CBNG Management)

Alternative A consists of the existing (2003) CBNG management scenario, with the addition of the forecasted future development of CBNG resources in the Wyoming portion of the Powder River Basin that occurs upstream of Montana. The Wyoming BLM has adopted Wyoming's Alternative 2A for CBNG water management (BLM 2003d).

Under Montana's Alternative A, only those producing wells that currently exist in the CX Ranch field will produce CBNG and water in Montana. Other CBNG exploration wells could be drilled on state and private minerals, but would not be allowed to produce gas or water. Rosebud Creek, the Bighorn River and Mizpah Creek would not receive any CBNG produced water under this alternative, as they would not be affected by Wyoming's production. However, an analysis of their flow volumes and water chemistries are included for comparison to other alternatives. The Tongue River, Powder River and Little Powder River watersheds could have impacts from CBNG development due to Wyoming production.

Exploration

CBNG exploration activities on state, private, or BLM-administered mineral estates would result in only slight effects on groundwater and would not affect surface waters. Exploration wells would be tested but not commercially produced. Testing of CBNG exploration wells involves pumping the wells for several weeks; however, the volume of coal seam aquifer groundwater removed is moderate and is not expected to impact nearby water wells or springs. Recovered produced water and drilling wastes would be contained in impoundments or tanks and would be disposed of in accordance with regulations for conventional oil and gas wastes.

Production

CBNG water production would continue to be allowed within the CX Ranch CBNG field, but at a level approximately 20 percent above current conditions; this would constitute a total of 250 producing wells. An increase in soil erosion resulting from the construction of additional well pads and lease roads could occur, adding to the suspended sediment load of area surface waters.

The 250 producing CBNG wells at the CX Ranch field would also affect groundwater resources within the producing coal seam aquifers. Production at this level would result in increases to groundwater drawdown levels within the three coal seam aquifers being produced. Groundwater drawdown within the coal seams currently extends approximately one mile beyond the edge of CBNG production at the CX Ranch field (Wheaton et al. 2006). Increasing the size of the field by approximately 20 percent would add to the drawdown.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Water released to unlined surface impoundments may infiltrate into shallow aquifers, causing measured impacts to the groundwater. The introduction of this water into the aquifer may improve or degrade the usability of these waters, depending on site specific conditions. In general, it would be anticipated that over the short term (<5 years), as soluble salts (calcium-magnesium (Ca-Mg) sulfates) are dissolved from the flow path, the infiltration of this water will cause an increase in EC and a decrease in SAR within the immediate vicinity of the impoundment. Over the long term (>5 years), after soluble salts are flushed from the system, the continued infiltration of this water would cause a decrease in EC and an increase in SAR. These impacts will be localized; however the precise geographic extent will depend on site specific conditions.

Surface Water Analysis

Tongue River

The Tongue River has its headwaters in the Bighorn Mountains to the south. This river could receive CBNG impacts from current and future development in both the Wyoming and Montana portions of the

TABLE 4-33

EFFECTS ON SURFACE WATERS OF THE TONGUE RIVER UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Tongue River at Stateline Near Decker	3	1,000	5	1,500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	3	1,000	5	1,500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Montana	3	1,000	5	1,500	207	1.36	1,016	214	2.5	1,058

Powder River Basin. The detailed input data, calculation of impacts and summary of impacts from Alternatives can be reviewed in the SWQATR. Table 4-33 displays the impacts for the three stream stations analyzed along the Tongue River in Montana. It is assumed that approximately 15 percent of the water discharged into impoundments in the Wyoming portion of the Tongue River watershed would reach the Tongue River. In addition, other impacts to the Tongue River under Alternative A could result from the approximately 250 CBNG wells in the CX Ranch field. For this analysis, the CX Ranch discharge was split between the Decker station and the Birney station.

During the minimum mean monthly flow, these impacts increase the flow volume and EC value in the stream by only a few percentage points, but increase the SAR value in the river water by up to 133 percent (1.4 units). The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

- Northern Cheyenne Standards: Surface water alteration forecasted under Alternative A would be at or below the tribe's proposed limits during the irrigation season (April through October) but would exceed the proposed standard for SAR during the non-irrigating season by up to 0.52 SAR.
- Ayers and Westcot: The SWQATR displays the SAR versus EC plots for the Tongue River. These plots show that at no time would water cause infiltration impacts to soils under irrigation under Alternative A.
- MDEQ Irrigation Season Standards (Mt-Irr): These standards are set at a SAR of 3.0 and an EC of 1000 micro-Siemens per centimeter (μS/cm) for the Tongue River. The forecast surface water quality under Alternative A during minimum mean monthly flows is below these standards for all stations and below these EC standards for all stations except for the station at Brandenburg Bridge. Existing conditions at Brandenburg Bridge during minimum mean monthly flows are also in excess of this standard. The 40 percent non-degradation analysis threshold for EC (400 μS/cm) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (1.2) is exceeded by existing conditions at the Brandenburg station and the resulting surface water quality would cause it to be exceeded at all stations.
- MDEQ Non-Irrigation Season Standards (Mt-Non): These standards are set at a SAR of 5.0 and an EC of 1500 μS/cm for the Tongue River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is below these SAR and EC standards for all stations. The 40 percent non-degradation analysis threshold for EC (600 the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is greater than existing conditions and the resulting surface water quality would cause it to be exceeded at the Birney Day School and Brandenburg stations.
- The 40-percent increase of minimum mean monthly flow analysis threshold (40 percent

MMM): This analysis threshold is not exceeded for any station.

Under Alternative A the surface water quality in the Tongue River would be slightly altered by CBNG development in Wyoming and the untreated discharge occurring in Montana under an existing permit. The numerical standards, which were developed to protect beneficial uses, are not exceeded except for EC at the Brandenburg station. The EC at the Brandenburg station also exceeds this standard under existing conditions. Therefore, it is not anticipated beneficial uses will be altered.

Discharges of CBNG water would only slightly increase surface water flow in the Tongue River, causing negligible changes to physical stream conditions, even during historically low-flow periods.

Powder River

The Powder River has its headwaters in the Wyoming portion of the Powder River Basin and as such would receive CBNG water from development in Wyoming. As no Montana CBNG wells are assumed to discharge into the Powder River under Alternative A, all forecasted alterations would be due to CBNG development in Wyoming. The analysis conducted at the Locate, Montana station includes all CBNG discharges into the Powder, Little Powder and Mizpah, cumulatively. Table 4-34 summarizes these impacts. During MMM flows the Powder River is expected to be affected by Wyoming CBNG development, resulting in an appreciable alteration of surface water chemistry. Only Wyoming CBNG development would affect the river. Flow volumes are forecasted to increase by approximately 54 percent SAR would be increased by approximately 130 percent and EC would be increased by 3 to 4 percent. The resultant mixed stream water quality can be compared to the available surface water criteria:

- Ayers and Westcot: The SWQATR includes SAR vs. EC plots to document that the resultant water quality during minimum mean monthly flows will not cause infiltration impacts to soils under irrigation.
- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 μS/cm for the Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is above the SAR and EC standards. Existing conditions also exceed this EC standard. As such, permitted discharges in Wyoming may have to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (800 μS/cm) and SAR (2) are exceeded by existing conditions and the resulting surface water quality would increase these exceedances.
- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 μS/cm for the Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is above this SAR standard and below the EC standard. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (1000 μS/cm) and SAR (2.6) are exceeded by existing conditions and the resulting surface water quality would increase these exceedances.
- 40 percent MMM: This analysis threshold would be 203 cfs at Moorhead and 200 cfs at Locate. This is exceeded for both stations by discharges in Wyoming.

TABLE 4-34

EFFECTS ON SURFACE WATERS IN THE POWDER RIVER UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min, Mean Monthly)			Resulting Stream Water Quality and Quantity (Min, Mean Monthly)		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	224	10.7	2230
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	236	11.36	2320

Under Alternative A the surface water quality in the Powder River would be noticeably altered by CBNG development in Wyoming. Flows would also substantially increase, potentially leading to noticeable changes to physical stream conditions. The numerical standards for EC and SAR, which were developed to protect beneficial uses, are exceeded at all stations. The EC standards are also exceeded by existing and historic ambient conditions. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standards.

The Little Powder River

The Little Powder River has its headwaters in the Wyoming portion of the Powder River Basin and as such it is expected to receive CBNG water from development in that state. All analyses for this stream are conducted at the Weston, Wyoming, station, near the stateline. At this station, no effects are possible from Montana CBNG under any alternative; however Montana CBNG discharges are addressed by the cumulative analysis of the Powder River at Locate. Table 4-35 illustrates the effects expected on the Little Powder River from CBNG development under Alternative A.

Only Wyoming CBNG discharges affect the river under this alternative. During minimum mean monthly flows, this development will cause the flow to increase by 515 percent, the EC to decrease by 51 percent and the SAR to increase by 50 percent. The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

- Ayers and Westcot: The SWQATR plots suggest that during the mean monthly flows for 2 months of the year (November and December) the mixed water may cause infiltration impacts to soils under irrigation. The elevated SAR may reduce soil permeability, thereby reducing the rate of water infiltration.
- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 μS/cm for the Little Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is well above the SAR standard and below the EC standard. Existing conditions exceed the SAR and EC standards. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (800 μS/cm) is exceeded by existing conditions and the resulting surface water quality would decrease this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance.
- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 μS/cm for the Little Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is well above this SAR standard and below the EC standard. Existing conditions exceed the SAR and EC standards. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (1000 μS/cm) is exceeded by existing conditions and the resulting surface water quality would decrease this exceedance. The 40 percent non-degradation analysis threshold for SAR (2.6) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance.

TABLE 4-35

EFFECTS ON SURFACE WATERS OF THE LITTLE POWDER RIVER UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Little Powder above Dry Creek	5	2000	6.5	2500	3	6.9	3300	16	10.4	1606

- 40 percent MMM: This analysis threshold would be 4.6 cfs at Weston. This is exceeded by forecast Wyoming discharges, with the result being 16 cfs.

Under Alternative A the surface water quality in the Little Powder River would be noticeably altered by CBNG development in Wyoming. The numerical standards for EC and SAR were developed to protect beneficial uses. The numerical EC standard is exceeded by existing conditions, but would not be exceeded by forecasted conditions. The numerical SAR standard is exceeded by existing conditions and this exceedance would be increased by forecasted conditions. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standards.

Wyoming discharges of CBNG water would increase surface water flow into the Little Powder River by more than six times, causing major changes to stream conditions including increased flow, channel erosion and sedimentation during historically low-flow periods.

Mizpah Creek

The Mizpah contains low quality water that has limited irrigation use, but can be used for stock watering and wildlife. This watershed is not expected to be affected by CBNG activity under Alternative A, as shown on Table 4-36. This stream water can be compared to the following surface water criteria:

- Ayers and Westcot: Except for 3 months out of the year, the average existing water exceeds irrigation water quality limits set by Ayers and Westcot.
- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 500 μS/cm for tributaries of the Powder River. Existing surface water quality during minimum mean monthly flows is above these SAR and EC standards. The 40 percent non-degradation analysis thresholds for EC (200 μS/cm) and SAR (1.2) are also exceeded by existing conditions.
- MT-Non: These standards are set at a SAR of 5.0 and an EC of 500 μS/cm for tributaries of the Powder River. Existing surface water quality during minimum mean monthly flows is above these SAR and EC standards. The 40 percent non-degradation analysis thresholds for EC (200 μS/cm) and SAR (2) are also exceeded by existing conditions.
- 40 percent MMM: This analysis threshold would be 0.36 cfs at Mizpah. No discharge is forecast in this watershed under this alternative.

All current uses of these waters would be maintained under Alternative A.

Bighorn and Little Bighorn Rivers

These rivers carry high quality water from the Bighorn Mountains north into Montana. No CBNG wells in Wyoming or Montana are expected to impact these rivers under Alternative A. Stream water quality and flow volume are expected to remain unchanged. As shown on Table 4-37, the following expected results can be compared to the following surface water quality criteria:

- Ayers and Westcot: The monthly average existing water quality at all three stations is within irrigation water quality limits set by Ayers and Westcot.

TABLE 4-36

EFFECTS ON SURFACE WATER OF MIZPAH CREEK UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.26	16.6	3503

TABLE 4-37

EFFECTS ON SURFACE WATERS OF THE LITTLE BIGHORN AND BIGHORN RIVERS UNDER ALTERNATIVE A

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	110	0.53	548
Little Bighorn at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	123	0.99	768
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1523	2.08	962

- EC and SAR standards have not been developed for these waters.
- 40 percent MMM: This analysis threshold would be 154 cubic feet per second (cfs) at Wyola, 172 cfs at Hardin and 2132 cfs at Bighorn. No discharge is forecast in this watershed under this alternative.

All current uses of these waters would be maintained under Alternative A.

Rosebud Creek

This creek drains part of the Powder River Basin in Montana. No CBNG water would be discharged into this creek; therefore, stream water quality and flow is unchanged as shown on Table 4-38. These expected results can be compared to the following surface water quality criteria:

- Ayers and Westcot: The monthly average existing water quality at both stations is within irrigation water quality limits set by Ayers and Westcot.
- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 1,000 µS/cm for Rosebud Creek. Existing surface water quality during minimum mean monthly flows is above the SAR standard at the Rosebud station and above the EC standard for both stations. The 40 percent non-degradation analysis threshold for EC (400 µS/cm) is exceeded at both stations. The 40 percent non-degradation analysis threshold for SAR (1.2) is exceeded by existing conditions at the Rosebud station.
- MT-Non: These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for Rosebud Creek. Existing surface water quality during minimum mean monthly flows is below the SAR standard for both stations and above the EC standards for the Rosebud station. The 40 percent non-degradation analysis threshold for EC (600 µS/cm) is exceeded at both stations. The 40 percent non-degradation analysis threshold for SAR (2) is exceeded by existing conditions at the Rosebud station.
- 40 percent MMM: This analysis threshold would be 2.5 cfs at Kirby and 11.8 cfs at Rosebud. No discharge is forecast in this watershed under this alternative.

All current uses of these waters would be maintained under Alternative A.

Yellowstone River

The Yellowstone River drains all of the Montana watersheds in the Powder River Basin. As such it provides an analysis of the cumulative effects forecasted from CBNG development in Montana and Wyoming in the Bighorn, Rosebud, Tongue, Powder and Yellowstone watersheds.

Only the station at Sidney is expected to receive CBNG related effects under Alternative A. These effects are in the form of discharge from CX Ranch in Montana and Wyoming CBNG wells. After mixing, the flow of the Yellowstone would be increased by 1 percent, the SAR would be increased by 13 percent and the EC would be increased by 1 percent. The resultant mixed stream water, shown on Table 4-39, can be compared to the following surface water criteria:

TABLE 4-38

EFFECTS ON SURFACE WATER OF ROSEBUD CREEK UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	8.42	4.84	1780

TABLE 4-39
EFFECTS ON SURFACE WATER OF THE YELLOWSTONE RIVER UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Yellowstone at Forsyth, Montana	N/A	N/A	N/A	N/A	5820	1.99	745	5820	1.99	745
Yellowstone at Sidney, Montana	N/A	N/A	N/A	N/A	5764	2	870	5805	2.26	881

- Ayers and Westcot: The SWQATR's plots predict that the mixed water would not cause infiltration impacts to soils under irrigation under Alternative A.
- EC and SAR standards have not been developed for these waters.
- 40 percent MMM: This analysis threshold would be 8148 cfs at Forsyth and 8070 cfs at Sidney. This analysis threshold is not exceeded for either station.

Under Alternative A the surface water quality in the Yellowstone River would be slightly altered by CBNG development in Wyoming and the untreated discharge occurring in Montana under an existing permit. The numerical standards, which were developed to protect beneficial uses, are not exceeded. Therefore, it is not anticipated that beneficial uses will be altered.

Discharges of CBNG water would only slightly increase surface water flow in the Yellowstone River, causing negligible changes to physical stream conditions, even during historically low-flow periods.

Abandonment

Abandoned well pads would be restored to their original condition with the only effect being the short-term increase in suspended sediments in area surface waters resulting from the increased erosion of disturbed soil. CBNG wells that are not produced would be abandoned in accordance with existing regulations and with procedures for the abandonment of oil and gas wells to protect groundwater resources, or converted to monitoring wells as deemed necessary.

Crow Reservation

The Crow Reservation can expect few effects from CBNG development within Montana under this alternative. Continued development is expected in the CX Ranch field near Decker. Groundwater drawdown is expected to extend approximately 4-5 miles from the CX Ranch development. This drawdown could impact water wells and springs that receive water from these coal seams on tribal land. Scattered CBNG exploration drilling and testing would have only slight effects on reservation coal seam aquifers.

CBNG development in Montana and Wyoming could drain groundwater and methane from coal seams under the Reservation.

If Wyoming CBNG operators are able to discharge CBNG water into either the Little Bighorn or Bighorn watersheds, there could be effects to surface waters on the Reservation. However, there are currently no proposals to develop CBNG in these watersheds in Wyoming.

Northern Cheyenne Reservation

The Northern Cheyenne Reservation can expect effects to surface water by CBNG development outside the reservation under this alternative. The CX Ranch has a permit to discharge CBNG water to the Tongue River and this would continue under this alternative. Effects to surface water are described in detail in the surface water section of this alternative and in the SWQATR. Groundwater drawdown is expected to extend approximately four to five miles from the CX Ranch development. This groundwater drawdown effect would not reach the Northern Cheyenne Reservation.

CBNG development in Wyoming is not expected to affect groundwater under the Reservation. Permitted outfalls, accidental releases and unintended infiltration under storage ponds could contribute some effect to the Tongue River from Wyoming.

Conclusion

Montana-based CBNG development, conventional oil and gas development, the Tongue River Railroad and surface coal mining would have the potential for effects to surface water and coal seam aquifer groundwater resources in Montana. Few CBNG wells would be drilled and impacts would be limited in both magnitude and geographic extent. CBNG development at the CX Ranch field could expand, although surface discharge volume to the Tongue River would be controlled by an existing permit. Groundwater impacts to methane-productive coal seam aquifers from the CX Ranch are expected to extend 4-5 miles from the edge of development. Scattered CBNG exploration and testing would have a slight effect on static water levels in coal seam aquifers, but would not affect surface waters.

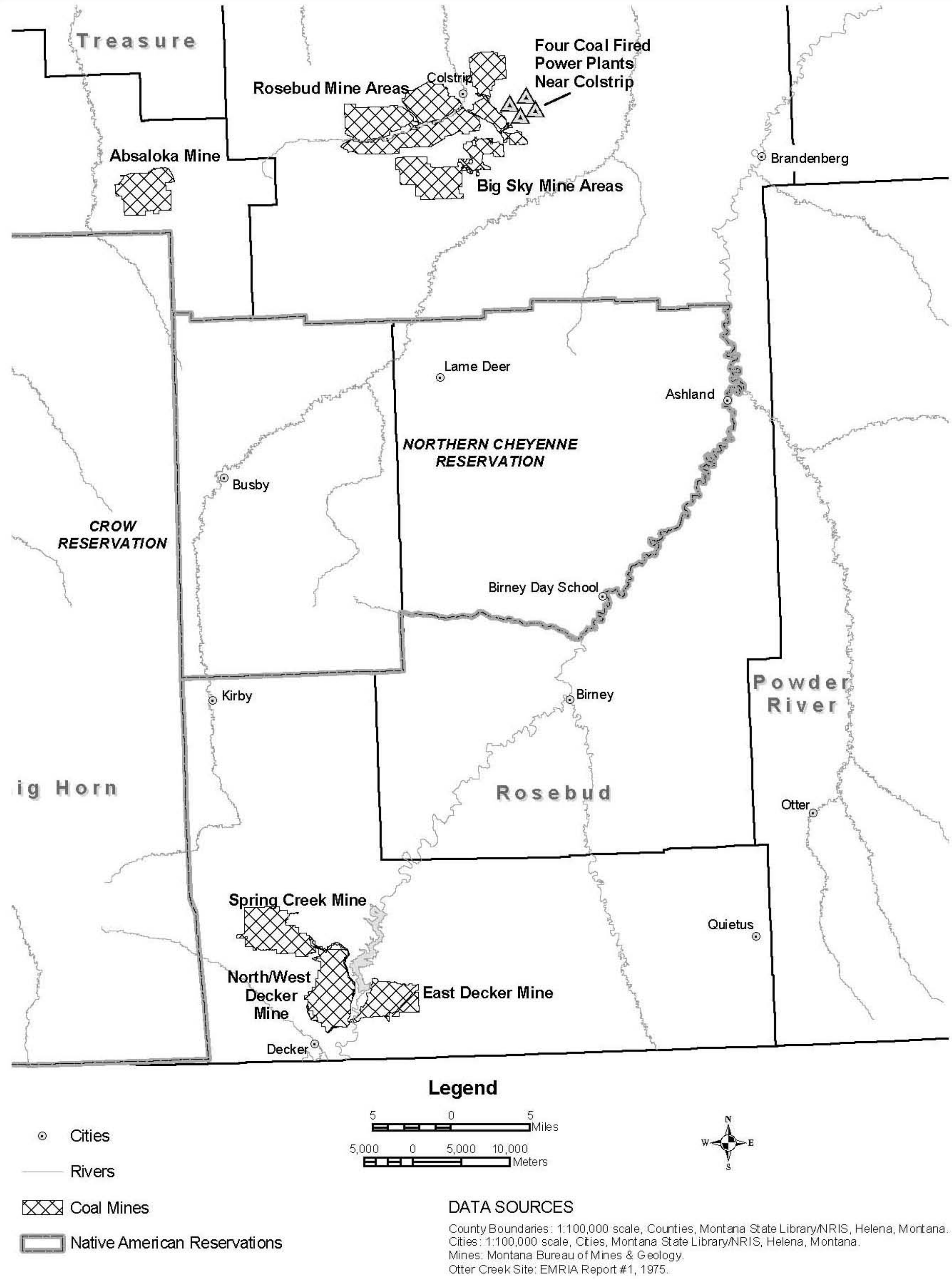
Coal seams that are the targets of surface coal mining operations typically contain groundwater. As a result of the presence of this water, coal mine operators must remove this water as it collects in the bottom of the pits in order to mine the coal. Map 4-2 shows coal mines in the Planning Area. These mines cover approximately 50,000 acres where coal seam aquifers have been impacted either by the removal, partial depletion, or total depletion of groundwater. In the mining areas around Colstrip and Decker, coal seam aquifers have been drawn down by as much as 75 feet near the coal mines, with a radius of impact of up to 4 miles from the mines (Wheaton and Metesh 2001). The discharge of groundwater pumped from mine pits would also affect surface water depending on the quality of groundwater near the mine and the quantity of groundwater discharged. In instances where the mines do not discharge because all of the recovered groundwater is used, there would be no direct impacts to surface water quality. Much of the groundwater pumped from the mine pits would be stored and used to control dust on roads, truck and train car loading areas and the mine face.

Following the release of the Wyodak EIS (BLM 1999b), the RFD for the Wyoming portion of the Powder River Basin was reassessed and a new RFD was issued (BLM 2001a). This more recent study indicates that the total number of CBNG wells in the Wyoming portion of the Powder River Basin may approach 50,000 (BLM 2001a). An EIS using this level of development has been completed for Wyoming.

Groundwater resources in Montana’s coal seam aquifers could be affected by CBNG production in Wyoming. CBNG-producing wells in northern Wyoming would cause a drawdown of coal aquifers on adjacent land, with groundwater drawdown possibly extending northward into Montana. If CBNG fields were located in Wyoming adjacent to the border with Montana, it can be expected that groundwater levels within coal seam aquifers would be drawn down 20 feet at 4-5 miles into Montana. Drawdown impacts of this magnitude would result in impacts on private lands, the Crow Reservation, state-owned lands and federal lands controlled by BLM. Cumulative groundwater impacts to coal seam aquifers would be largest near CX Ranch and close to the Wyoming border.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Map 4-2: Location Map, Regional Coal Mines



The numerical surface water quality limits adopted by the Montana Board of Environmental Review are enforceable upstream under the CWA. As such, both Montana and Wyoming may need to curtail the surface discharge of CBNG water. If Wyoming CBNG development reaches expected levels, Montana watersheds could be impacted to the point where water quality standards could prohibit CBNG discharge. For this impact analysis, it is assumed that the Wyoming Alternative 2A will be implemented; however in some watersheds development in Wyoming may need to proceed differently than assumed under Wyoming's Alternative 2A in order to ensure that Montana's surface water quality standards are not exceeded.

The Montana BER's rule change which made EC and SAR harmful parameters has not been approved by the EPA and so it does not have CWA standing; however if this change is approved by EPA further modification of water management practices in Wyoming would be needed.

Surface water discharge permits that limit the quantity and quality of discharged CBNG water are required in Montana and Wyoming. This permitting process, which incorporates the numerical and non-degradation standards, would mitigate the impacts from Wyoming CBNG production and from expanded CX Ranch production since permitted discharges must be in compliance with the CWA.

Beneficial reuse of CBNG water is expected to continue in the vicinity of the CX Ranch field as well as other areas near the Wyoming-Montana border. The increased flow of water in some streams may allow increased utilization of the mixed water if quality is appropriate.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B consists of full-scale development of CBNG with water produced from CBNG exploration wells stored in tanks or impoundments and all water produced from CBNG production wells to be injected into approved subsurface zones other than the coal seam from which it was produced. No CBNG water would be discharged to the surface. The number of producing CBNG wells being analyzed is 16,500, which is the RFD number minus those wells not covered by this EIS (tribal and USFS wells) minus 10 percent dry holes. The estimated 16,500 CBNG wells would draw down groundwater levels within coal seam aquifers in areas adjacent to CBNG development, affecting water wells and springs that draw water from the productive coal seams. The construction of well pads and lease roads would result in surface disturbances that would increase the potential for soil erosion, consequently increasing short-term surface water suspended sediment loads.

Exploration

Full-scale CBNG exploration would require water generated from the testing of CBNG exploration wells be stored in tanks or impoundments on state and federal lands. Construction permits would require measures to reduce leakage from impoundments. The estimated 2,000 dry CBNG exploration wells would result in the short-term disturbance of approximately 2,000 acres of land at the well sites. These disturbed acres would be vulnerable to soil erosion that would cause run-off water impacted by suspended sediment. BMPs to curtail soil erosion such as water bars across lease roads, relieving and mulching cut-banks and restoration of the surface would serve to mitigate erosion related effects to surface water resources. Short-term testing of CBNG exploration wells would not substantially affect static water levels of area coal seam aquifers

Production

CBNG production is expected to be concentrated in the Powder River Basin, but could also develop locally in other portions of the state. This full-scale level of CBNG development would result in the potential for impacts to surface water resources from increased soil erosion and the accidental releases of produced water. Full-scale development of 16,500 producing CBNG wells would disturb an estimated 54,000 acres, which would increase the potential for soil erosion and the corresponding impact to surface water. However, the implementation of BMPs described in the preceding paragraph would reduce the potential for impacts from soil erosion. Because produced water would be disposed by injection into deep aquifers, surface water quality effects are predicted to be the same as Alternative A.

The projected 16,500 production wells would generate an estimated average of 2.9 billion cubic feet of produced water per year over 20 years. CBNG water produced in Montana is expected to be similar in chemistry to Wyoming CBNG water. The produced water would be expected to have a range of SAR values from 22 to 47 and EC values ranging from 2,077 to 3,042 µS/cm.

Using the assumptions in the RFD and the extrapolated discharge trend line, it is calculated that the maximum annual volume of produced water would occur in year 6 of the plan. During year six, 7,750 wells would be producing with an average rate of 6.2 gpm per well, for a total volume of 3.4 bcf of produced water in that year.

Water management options under this alternative would consist of the injection of CBNG-produced waters into approved subsurface zones. No discharge of CBNG waters would be allowed. Some of the produced water would be temporarily stored in tanks or impoundments prior to injection. These facilities could fail, causing localized impacts to surface water and shallow groundwater. The implementation of BMPs concerning the location and construction of these impoundments would mitigate the potential for impacts to surface water from the stored produced waters. Berms around tank batteries would reduce the potential for impacts from leaks and catastrophic failures.

Localized impacts from impoundments would be similar to those described under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts. During the 20-year planning period for CBNG production, groundwater levels within coal seam aquifers could be drawn down over large, contiguous areas of the state. For example, the Upper Tongue watershed covers 590,000 acres and could hold 5,800 CBNG wells as projected in the RFD. Over the life of the project approximately five percent of the groundwater in the coal seam aquifers could be lost to CBNG production in this watershed. Following methodology detailed in the *Water Resources Technical Report* (ALL 2001b), potential CBNG-producing wells per watershed and potential coal seam aquifer groundwater production estimates for 20 years of production for each of the watersheds have been calculated and are listed in Table 4-40.

In those portions of Montana where CBNG is developed outside of the Powder River Basin, CBNG production is not expected to be as concentrated and hydrological impacts would be less. Limited CBNG production in these areas would result in the localized drawdown of groundwater levels within coal seam aquifers.

An estimated 2.9 bcf of produced water would be injected into deep aquifers annually throughout the state. This process would not affect coal seam aquifers. The injection of CBNG-produced water has not been conducted in Montana, but is commonplace for waters produced from conventional oil and gas activities. In the year 2000, the state of Montana averaged 847 injection/disposal wells that disposed of 0.6 billion cubic feet of water every year (average injection of 128,000 bbl of water per well per year). Injection of CBNG water under this alternative is estimated to increase the number of injection wells to nearly 3,000. These new CBNG injection wells would have an average injection rate of 265,000 barrels of water per well per year. This water would either be injected into shallow aquifers with compatible water quality or into deep aquifers, whose water is not fit for use. Given the effectiveness of current injection regulations, the increase in injected volume resulting from CBNG production is anticipated to have only a minimal effect on surface water or groundwater resources.

The major limitation to injection will be the presence of suitable injection zones. As discussed in Chapter 3, within particular study areas it has been shown suitable shallow sand injection targets underlie approximately 9 percent of the area (Wheaton and Reddish 2005). Injection zones need to be able to transmit water away from the injection well and store it.

Thick channel sandstones and undeveloped coals within the Fort Union Formation are expected to have sufficient transmissivity, would maintain the water quality and would allow the water to be retrieved in the future. Injection into these shallow zones may be limited due to the injection zones already being saturated and pressurized and sandstones being lenticular in nature. These shallow zones may also contain water wells, monitoring wells and boreholes which would provide conduits to the surface for the injected water. Because these zones are shallow the fracture pressure of the zone is low and will not allow much pressure to be applied while injecting, this would limit the amount of water that could be forced into the zone. If the fracture pressure of the zone was exceeded the injected water may be forced into other zones and to the surface through water wells or monitoring wells. These factors may cause these zones to be limited in the volume of water that they may accept.

TABLE 4-40

GROUNDWATER DEPLETION BY CBNG DEVELOPMENT IN THE MONTANA POWDER RIVER BASIN

Watershed	Potential CBNG Producing Wells	Potential Produced CBNG Water in 20 years (billion cubic feet)
Little Big Horn	675	2.5
Little Powder	200	0.7
Lower Bighorn	800	2.8
Lower Tongue	3,450	12.0
Lower Yellowstone	1,700	6.0
Middle Powder	2,100	7.4
Mizpah	125	0.5
Rosebud	3,600	12.6
Upper Tongue	3,850	13.5
Total	**16,500**	**58.0**

Note: Calculated maximum potential coal seam aquifer groundwater production by watershed (billion cubic feet) after 20 years of CBNG production. Details on the method used to calculate these numbers can be obtained from the *Water Resources Technical Report* (ALL 2001b).

Deeper injection zones, such as the Madison Formation, are expected to have sufficient transmissivity and storativity to accept the water; however the saline nature of the existing water in these zones would degrade the injected water to the point where it could not be retrieved and used. The depth to these zones would also prohibit the recovery of the water resource. Injection into deep zones may also be prohibitively expensive, resulting in less CBNG development than predicted in the RFD.

Abandonment

When the estimated 16,500 production wells are abandoned throughout the life of the resource in the Planning Area, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would mitigate the potential for impacts to surface water resources resulting from soil erosion until groundcover and original site conditions are restored. CBNG wells that are not produced, or have reached the end of their productive life would be abandoned in accordance with existing regulations and procedures for the abandonment of oil and gas wells to protect groundwater resources, or converted to monitoring wells, as deemed necessary.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative B would include those impacts noted in Alternative A. Additional impacts from suspended sediment due to soil erosion and runoff from the disturbed acreage are expected near the Crow Reservation from the development of private land within the exterior boundaries of the Crow Reservation, or from development of CBNG on tribal Lands.

Groundwater impacts would include those detailed in Alternative A as well as additional impacts from nearby wells. The tribe can expect 20 feet of drawdown in coal seam aquifers from CBNG wells to extend 4 to 5 miles from CBNG wells near the Reservation boundaries towards the later part of the 20 year production period. The drawdown in producing coal seams may be as high as 10 feet for wells within one to two miles of the boundary during the early stages of production. This drawdown would affect water wells and springs within the reservation that derive water from productive coal seam aquifers.

In addition, because of the large presence of private land within the exterior boundaries of the Crow Reservation, CBNG development on those non-reservation lands could also affect surface water and groundwater in a manner consistent with other areas of the Powder River Basin. The development of CBNG on private lands within the reservation boundary could result in increased suspended sediment loads from surface disturbances in the

Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds.

Northern Cheyenne

Surface water effects on Northern Cheyenne Tribal Lands under Alternative B would include those impacts noted in Alternative A. Additional effects are expected from suspended sediment as a result of soil erosion and runoff from the area upstream of the Northern Cheyenne Reservation. Increased sediment loads would affect both the Tongue River and Rosebud Creek watersheds resulting from the surface disturbances associated with CBNG development. Groundwater drawdown effects on the reservation would be similar to impacts in other areas of the Powder River Basin. The tribe can expect up to 20 feet of drawdown to extend four to five miles in the produced coal seam aquifers from CBNG development near the reservation boundary. This drawdown would affect water wells and springs within the reservation that derive water from the produced coal seam aquifers.

Conclusion

Impacts on surface water and groundwater as a result of Wyoming CBNG development, coal mines and the Tongue River Railroad would be same as discussed under Alternative A. Impacts on surface water would include those impacts listed under Alternative A plus the impact of suspended sediment generated by soil erosion taking place near CBNG development. There would be no substantial increase in surface water flow beyond what was described for Alternative A because all CBNG produced water in Montana would be managed by injection.

CBNG production in Montana under Alternative B would result in the withdrawal of approximately five percent of the groundwater resources contained within the producing coal seams and approximately 0.1 percent to 0.2 percent of the total recoverable groundwater resources that underlie Montana's portion of the Powder River Basin. This withdrawal estimate was derived from Specific Storage values ($3x10^{-4}$ to 9×10^{-4}) from modeling (Wheaton and Metesh 2002) assuming an average of 70 feet of coal and a drawdown of 200 feet needed to release economic volumes of methane. Water wells completed in the developed coals near CBNG fields could experience drops in static water levels.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Alternative C—Emphasize CBNG Development

Alternative C consists of the direct discharge of CBNG-produced waters to the land surface. Impacts to water resources resulting from this alternative would consist of coal seam drawdown-related effects similar to Alternative B and effects due to the large volume of CBNG water being discharged to the ground and allowed to flow into drainages and water bodies.

Discharge to the ground would cause increased soil erosion between the discharge point and the nearest drainage. There would be a corresponding increase in the suspended sediment load in surface waters adjacent to CBNG development. As CBNG water flows along drainages, infiltration of the water would occur, resulting in rising shallow groundwater elevations and shifts in the chemistry of the shallow groundwater. These shifts in groundwater chemistry may improve or degrade the usability of the groundwater, depending on site-specific conditions. In general it would be anticipated that over the short term, as soluble salts (Ca-Mg sulfates) are dissolved from the flow path, the introduction of this water would cause an increase in EC and a decrease in SAR. Over the long term, when the soluble salts are flushed from the system, the continued infiltration of this water may cause a decrease in EC and an increase in SAR since the CBNG water typically has an EC less than the alluvial groundwater and an SAR greater than the alluvial groundwater. The infiltrated water would flow downgradient in the alluvial aquifers until a perennial waterway is reached. In gaining streams, this groundwater would be discharged to surface waters. Within the PRB most streams are losing streams, with alluvial groundwater levels below the base of the streams which results in surface water infiltrating into the groundwater.

CBNG water that does not infiltrate or evaporate en route would reach perennial waterways as point discharges. The addition of CBNG water to drainages and surface water bodies, through both point and diffuse discharges, would result in increased flow volumes and changes in water chemistry. These changes would, in turn, lead to loss of soil structure, increased erosion rates and increased suspended sediment loads. The chemistry of the surface waters would also potentially impact some uses by humans and wildlife.

Exploration

Impacts would be similar to those described in the Alternative B discussion. The moderate volume of water generated by the testing of CBNG exploration wells would be stored in tanks or impoundments to be discharged under the appropriate permits.

Impacts from exploration would be similar to those discussed under alternative B.

Production

Alternative C assumes 80 percent of the volume of CBNG water produced would be discharged directly to the land surface adjacent to the wellhead. Impacts to water resources would consist of those effects of coal seam drawdown described in the impacts common to all alternatives section, soil erosion and the increase in suspended sediments in area rivers and streams, changes in the elevation of groundwater in alluvial aquifers, changes in alluvial aquifer water chemistry and changes in the chemistry of perennial water bodies. The discharge at the CBNG wellhead would result in the erosion of soils, creating gullies that would connect to natural runoff areas where the water would join natural drainage. These natural drainages or ephemeral portions of the water-course would also be impacted by increased erosion and would likely become more nearly perennial as a result of receiving CBNG discharge water. Before the CBNG water reaches surface water, some portion would evaporate or infiltrate into the soil. The portion lost would depend upon season of the year, permeability of the soil and the presence of a shallow, unconfined aquifer connected to surface water.

In addition to direct surface discharge, produced water would also be placed into impoundments for use by livestock and wildlife. Impacts from impoundments would be similar to those described under Alternative A.

Impacts on groundwater under this alternative would be the same as in Alternative B, except that discharged water could infiltrate into soils and underlying shallow alluvial aquifers. The produced water from the only Montana CBNG field (CX Ranch) has an SAR value in excess of the water contained in most shallow aquifers, including the alluvial aquifers (ALL 2001b). If infiltration of CBNG-produced water occurred, the water quality of the alluvium could be adversely impacted.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The following discussion concentrates on watersheds of the Powder River Basin, because the Powder River Basin is the most likely area for major CBNG activity that could impact surface water resources.

Tongue River

The Tongue River could be impacted from current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin. The detailed input data, calculation of effects and a summary of impacts are presented in the SWQATR.

Table 4-41 encapsulates the effects for three stream stations along the Tongue River in Montana for Alternative C.

These results show the combined effects for CBNG water discharged from RFD development for Wyoming and Montana. These discharges would result in a 10 to 27 percent increase in surface water EC, a 211 to 725 percent increase in surface water SAR and a 5 to 28 percent increase in flow. The resultant mixed stream water can be compared to the following surface water criteria:

- Northern Cheyenne Proposed Standards: The resultant mixed water quality at the stateline station would exceed the proposed irrigation season limits for SAR during 5 months out of the year and the 7Q10; the 7Q10 flow would also exceed the EC limit. The resultant water quality is similarly above the non-irrigation season proposed limits.
- The resultant water quality at the Birney Day School station, near the southern boundary of the Reservation, would exceed the SAR limit for 11 months of the year and would only exceed the EC limit during 7Q10 flows. The water quality near the northern end of the Reservation is seen at the Ashland station. The calculated impacts at Ashland demonstrate that the Northern Cheyenne proposed standards would be exceeded for SAR on all but one month while the EC limits would not be exceeded.

TABLE 4-41
EFFECTS ON SURFACE WATERS OF THE TONGUE RIVER UNDER ALTERNATIVE C

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Tongue River at Stateline near Decker	3	100	5	1500	178	0.86	731	187	2.68-2.94	806-812
Tongue River Near Birney Day School	3	1000	5	1500	183	1.09	863	213	6.38-7.43	1055-1080
Tongue River at Brandenburg Bridge near Ashland, Montana	3	1000	5	1500	207	1.36	1016	265	9.51-11.22	1278-1319

- Ayers and Westcot: Impact analyses show that Tongue River water at Decker would not result in impacts to soil except during 7Q10 flow. The resultant water quality at the Birney Day School and Ashland stations would result in some impacts to soil during irrigation use.
- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 1000 μS/cm for the Tongue River. The forecasted surface water quality under Alternative C during minimum mean monthly flows are below these standards for the Stateline station and above these standards for all other stations. As such, an authorization to degrade would be needed from the MDEQ for development to occur in this manner.
- MT-Non: These standards are set at a SAR of 5.0 and an EC of 1500 μS/cm for the Tongue River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is below these standards for the Stateline station. EC values are below these standards for all stations. SAR values at the Birney Day School station and Brandenburg Bridge stations are in excess of these standards. As such, an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.
- 40 percent MMM: This analysis threshold would be 249 cfs at Decker, 256 cfs at Birney Day School and 290 cfs at Brandenburg. This analysis threshold is not exceeded at any station.

The surface water quality of the Tongue River would be degraded, requiring management practice changes by downstream users during part or all of the year under Alternative C. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Moderate increases in flow would also result under this alternative, which may result in slight changes to physical stream conditions.

Powder River

The Powder River has its headwaters in the Wyoming portion of the Powder River Basin and as such would receive CBNG water from development in Wyoming and Montana. The detailed analysis and calculations for the data summarized in Table 4-42 can be found in the SWQATR. Table 4-42 summarizes the impacts for two stations along the Powder River for Alternative C during the minimum mean monthly flow. The analysis conducted at the Locate station includes all CBNG discharge in the Powder, Little Powder and Mizpah watersheds, cumulatively.

The Powder River contains water that is naturally above some of the proposed limits. The Powder River is expected to be affected by Wyoming and Montana CBNG development under this alternative. The resultant water quality is altered by slight changes of 1 percent to 3 percent for EC, but SAR increases by as much as 200 percent. The flow rate is expected to increase between 25 percent and 30 percent. The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

TABLE 4-42

EFFECTS ON SURFACE WATERS IN THE POWDER RIVER UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	231	11.08-11.56	2226-2253
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	250	11.97-13.13	2323-2361

- Ayers and Westcot: The SWQATR displays the SAR vs. EC plots that show that the only time the water quality at the Powder River stations would be likely to cause infiltration impacts to soils under irrigation is during 7Q10 flow.
- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 μS/cm for the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is above the SAR and EC standards. Existing conditions also exceed this EC standard. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.
- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 μS/cm for the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is above this SAR standard and below the EC standard. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.
- 40 percent MMM: This analysis threshold would be 203 cfs at Moorhead and 200 cfs at Locate. This analysis threshold would be exceeded at both stations.

The surface water quality in the Powder River is degraded under Alternative C. These effects would likely require management practice changes by downstream irrigators. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Substantial increases in flow would also result under this alternative, which might result in noticeable changes to physical stream conditions.

Little Powder River

The effects to the Little Powder River station at Weston, Wyoming, would be the same as Alternative A since there are no Montana wells being discharged upstream of this station. The impacts from Montana wells downstream of this station are analyzed in the analysis for the Powder River at Locate station.

Mizpah Creek

Mizpah Creek carries water into the Powder River in Montana. There are no CBNG wells in Wyoming that could affect this watershed. Under Alternative C effects to Mizpah Creek would result from the discharge of Montana CBNG produced water only. Table 4-43 summarizes predicted changes in surface water chemistry in Mizpah Creek just upstream from its junction with the Powder River.

Although CBNG discharge would decrease surface water EC by 10 to 24 percent, the SAR would increase by 25 to 112 percent. The resultant mixed stream water can be compared to the available surface water criteria:

TABLE 4-43

EFFECTS ON SURFACE WATERS IN THE MIZPAH CREEK UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.99	20.43-35.26	2663-3163

- Ayers and Westcot: The SWQATR displays the plots that show the mixed water quality at the Mizpah station would likely cause infiltration impacts to soils under irrigation during all flows except for one or two high flow months a year. Discharge of CBNG waters would cause further exceedance of these criteria.
- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 500 μS/cm for tributaries of the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above these standards. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.
- MT-Non: These standards are set at a SAR of 5.0 and an EC of 500 μS/cm for tributaries of the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above these SAR and EC standards. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.
- 40 percent MMM: This analysis threshold would be 0.42 cfs. This analysis threshold would be exceeded under this alternative.

The surface water quality in Mizpah Creek is degraded under Alternative C. These effects would likely require management practice changes by downstream irrigators. This is a legal option, so long as CBNG producers were granted an authorization to degrade surface waters by the MDEQ. The Additional impact analyses are presented in the SWQATR.

Substantial increases in flow would also result under this alternative, which might result in noticeable changes to physical stream conditions.

Bighorn and Little Bighorn Rivers

These rivers carry water from the Bighorn Mountains north from Wyoming into Montana. No CBNG wells in Wyoming are expected to affect these rivers. Under Alternative C, the effects to these rivers would be the result of discharge from Montana CBNG discharge only. Table 4-44 summarizes the effects for two stations along the Little Bighorn River and one on the Bighorn River, just upstream from its confluence with the Yellowstone River, for the minimum mean monthly flow.

The resultant water quality impacts for these rivers would include an increase in EC by approximately 11 percent to 162 percent and an SAR increase of 27 percent to 400 percent. Flows would increase by 2 to 8 percent. The resultant mixed stream water can be compared to the following surface water criteria:

- Ayers and Westcot: The Technical Report displays the plots that show the mixed water quality at the Wyola and Hardin stations would be likely to cause infiltration impacts to soils under irrigation during several months of the year. The resultant water qualities represent a low EC to SAR relationship and thus the water would likely impact clayey soils if used for irrigation. Water quality at Bighorn would likely cause no infiltration impacts and be adequate to use for irrigation.
- EC and SAR standards have not been developed for these waters.

TABLE 4-44

EFFECTS ON SURFACE WATERS OF THE BIGHORN AND LITTLE BIGHORN RIVERS UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	115	2.26-2.64	623-632
Little Bighorn River at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1542	2.54-2.64	968-970

- 40 percent MMM: This analysis threshold would be 154 cfs at Wyola, 172 cfs at Hardin and 2132 cfs at Bighorn. This analysis threshold is not exceeded at any station.

The surface water quality in the Bighorn rivers in Montana would be degraded, resulting in minor management practice changes by downstream users for continued irrigation use. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Moderate increases in flow would also result under this alternative, which may result in slight changes to physical stream conditions.

Rosebud Creek

Rosebud Creek drains part of the area of the Powder River Basin in Montana. This creek begins on the Crow Reservation, flows through a portion of Montana, flows through the Northern Cheyenne Reservation, then through another portion of Montana prior to joining the Yellowstone River near Rosebud Montana. No CBNG wells in Wyoming could affect the Rosebud. The effects to this stream would be the result of CBNG discharges in Montana. Table 4-45 summarizes the predicted effects for two stations along Rosebud Creek in Montana for the minimum mean monthly flow.

These results show the effects of CBNG discharge on the flow and water quality of Rosebud Creek. Because there is so little water in the Creek naturally, flow increases by an order of magnitude with CBNG discharge and water quality is more representative of the CBNG discharged water than the existing stream water quality. The resultant mixed stream water and CBNG water can be compared to the available surface water criteria:

- Ayers and Westcot: The plots show that the mixed water quality at the Kirby and Rosebud stations would likely cause severe infiltration impacts to soils under irrigation during all months of the year under Alternative C.

TABLE 4-45

EFFECTS ON SURFACE WATER OF ROSEBUD CREEK UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	22	35.62-43.25	2110-2293
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	49	32.85-39.32	2133-2298

- Northern Cheyenne Standards at Southern Boundary (Kirby): These standards are set a SAR of 2.0 and an EC of 1000 µS/cm. The forecasted surface water quality under Alternative C during minimum mean monthly flows would be well above these SAR and EC standards. If these standards are adopted by the EPA, CBNG operators would need to obtain authorizations to degrade from the Northern Cheyenne Tribe for development to occur in this manner.

- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 1,000 µS/cm for Rosebud Creek. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above these standards at both stations. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.

- MT-Non: These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for Rosebud Creek. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above the SAR and EC standards for both stations. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. MDEQ has never approved an authorization to degrade. The non-degradation analysis threshold criteria would also be exceeded.

- 40 percent MMM: This analysis threshold would be 2.5 cfs at Kirby and 11.8 cfs at Rosebud. This analysis threshold would be exceeded at both stations.

Under Alternative C, the surface water quality in Rosebud Creek in Montana would be degraded, resulting in severe curtailment of irrigation use of this water. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Substantial increases in flow would also result under this alternative, which might result in noticeable changes to physical stream conditions. Increased flow may contribute to already impaired stream conditions.

Yellowstone River

The waters of the Yellowstone River are the confluence of all the other watersheds that are expected to receive effects from CBNG development in Montana. The Forsyth station would be affected by CBNG discharges into the Bighorn and Little Bighorn watersheds. The Sidney station would be affected by all Montana CBNG development and that development in Wyoming that occurs in the Tongue, Powder and Little Powder watersheds. Table 4-46 summarizes the impacts for two stations along the Yellowstone River in Montana for the minimum mean monthly flow for Alternative C.

Because of the significant volume of water available in the Yellowstone to dilute the CBNG production water in Montana and Wyoming, the resultant water quality shows only slight changes in both EC and SAR. The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

- Ayers and Westcot: The plots show that the mixed water quality would not cause infiltration impacts to soils under irrigation at any time. Under Alternative C, the surface water quality in the Yellowstone River in Montana is slightly reduced; however, there should be no management practice changes required of downstream users for continued irrigation use of this water. The resultant water quality in the Yellowstone River is sufficient for irrigation even during the months with the lowest flows.

- EC and SAR standards have not been developed for these waters.

- 40 percent MMM: This analysis threshold would be 8148 cfs at Forsyth and 8070 cfs at Sidney. This analysis threshold is not exceeded at either station.

The surface water quality in the Yellowstone River would be noticeably degraded by discharges from Montana and Wyoming under Alternative C; however, beneficial uses would not be impacted. Additional impact analyses are presented in the SWQATR.

Moderate increases in flow would also result under this alternative, which may result in slight changes to physical stream conditions.

TABLE 4-46

EFFECTS ON SURFACE WATERS OF THE YELLOWSTONE RIVER UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Lower Yellowstone-Sunday near Forsyth	N/A	N/A	N/A	N/A	5820	1.99	745	5850	2.18-2.22	753-754
Lower Yellowstone-Sunday near Sidney	N/A	N/A	N/A	N/A	5764	2.00	870	5857	3.12-3.31	912-917

Abandonment

Effects on water resources caused by abandonment operations would be similar to impacts by produced water discharged to the surface. The two activities—soil disturbance at abandonment and 20 years of surface discharge—would combine to increase the suspended sediment load within area surface water streams and rivers.

Crow Reservation

Effects on the Crow Reservation's surface water would be in the form of increased flow volume and changes in water quality. Groundwater impacts would be the same as Alternative B. In addition, potential CBNG development on private land within the external boundaries of the reservation could cause more direct effects that would also be similar to those effects described for the CBNG emphasis area. Surface waters would be affected in terms of both quantity and quality based on the extent of discharge to the watersheds within the reservations boundary (Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds). The effects on these surface waters would place additional impacts onto the tribe's way of life by limiting the uses of effected waters.

Northern Cheyenne

Effects on the Northern Cheyenne Reservation are similar to effects projected for the CBNG emphasis area. Effects to surface water would include increases in flow volume and changes in various water quality parameters in the Tongue River and Rosebud Creek watersheds. The effects to the Tongue River and Rosebud Creek watersheds from Wyoming and Montana CBNG development could affect existing uses of these waters within the reservation boundary. Groundwater effects would be the similar to Alternative B, with additional impacts resulting from the infiltration of produced water into shallow aquifers along the Tongue River and Rosebud Creek watersheds within the reservation boundary.

The effects to these surface waters would limit the uses of affected waters. The changes to groundwater quality that result from infiltration would be site-specific and depend on the quality of the alluvial aquifers. The tribe can expect drawdown of coal seam aquifers from CBNG production in the area surrounding the reservation for distances of approximately four to five miles.

Conclusion

Effects on groundwater include those listed under Alternative B, as well as effects from infiltration of surface water into shallow aquifers from impoundments and drainages.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface water quality in some watersheds would be slightly to severely degraded, resulting in restricted downstream use of some waters. Surface water flows will be considerably increased in some watersheds, causing persistent riparian erosion, changes in watercourses and increased sedimentation. Surface water quality standards and non-degradation analysis thresholds for EC and SAR would be exceeded in most watersheds and beneficial uses would be impaired.

Area surface waters would be affected by an increase in suspended sediments contained in the discharged CBNG water. This increase in suspended sediment load would result from the increased erosion of soils due to surficial disturbances, CBNG water runoff from the point of discharge to drainages and from the increased erosion of stream banks resulting from increased water volume and increased SAR (which causes clays to lose their cohesiveness and erode more easily). The increase in suspended sediment content of surface water could affect its beneficial uses. All of the watersheds in the CBNG emphasis area would be vulnerable to effects from an increase in suspended sediment. Discharge to ephemeral channels would cause deepening and widening of the channels.

Effects on Montana watersheds from Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

An estimated 20 percent of produced water would be used for beneficial uses and the remaining 80 percent would be treated to pre-development surface water chemistry prior to discharge under a MPDES permit.

Discharge would be accomplished by pipeline or constructed watercourse to the nearest body of water to eliminate soil erosion, the generation of suspended sediments and the infiltration of treated CBNG water. The treatment of CBNG-produced waters would eliminate or greatly reduce effects to surface water quality. Treatment may increase the potential for beneficial uses of CBNG water.

The changes in surface water quality shown in Table 4-47 for Alternative D are due to the discharge of untreated CBNG water from Wyoming CBNG development. Changes in flow volume are due to treated and untreated discharges in both Montana and Wyoming. The effects originating from Wyoming would be the same as those detailed under Alternative A. Effects on surface water from Montana CBNG development are due to the increases in baseflow. The stations analyzed would experience a 0.2 percent (Yellowstone at Forsyth) to 1135 percent (Rosebud at Kirby) increase in flow under this alternative. These increases in water flow rates would be likely to cause changes in streambed geometry, flow regime, stream depth distribution, presence and condition of instream vegetation and other physical factors associated with the stream and adjacent riparian zone.

Exploration

Any water generated by drilling and testing would be treated, with 80 percent of the treated water discharged via pipeline under a MPDES permit and 20 percent used for beneficial purposes. Treatment would eliminate potential impacts to water quality. Water quantity impacts would be minor because of the moderate volume produced from the testing of CBNG exploration wells.

Production

Approximately 80 percent of CBNG-produced water would be treated and discharged under this alternative. Because the water is piped to the receiving body of water, no conveyance losses are deducted.

Impoundments may be used to store CBNG water prior to treatment. Impacts from impoundments would be similar to those described under Alternative A.

Peak total field discharge during year six would add about 0.7 percent to the total discharge of the Yellowstone. In detail, every watershed, except the Yellowstone and the Bighorn, experience at least a 10 percent increase in flow in at least one portion of the watershed. Rosebud Creek, the Little Powder and Mizpah Creek would experience the greatest percentage change in baseflow during year 6, with 1,135 percent, 515 percent and 285 percent increases in baseflow respectively. These increases in flow volume would result in increased erosion in affected watersheds.

These changes in flow are in excess of the 40 percent MMM flow analysis threshold in the Rosebud and Powder River (including the Little Powder and Mizpah) watersheds. In the Rosebud watershed this exceedance would be caused by treated discharges in Montana. The exceedance in the Powder and Little Powder rivers would be due to discharges in both Montana and Wyoming. The exceedance in the Mizpah would be due to treated discharges in Montana. An increase in flow of this magnitude would likely be found to be significant under MDEQ's non-degradation rules. As such, permits to degrade would likely be needed before discharge at this scale would be allowed. Additional impact analyses are presented in the SWQATR.

TABLE 4-47

SUMMARY OF SURFACE WATER PARAMETERS BEFORE AND AFTER MIXING[1] UNTREATED CBNG DISCHARGE FROM WYOMING AND TREATED CBNG DISCHARGES FROM MONTANA UNDER ALTERNATIVE D

	Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Tongue River Stateline Near Decker	178	0.86	731	188	1.49	747
Tongue River Near Birney Day School	183	1.09	863	220	1.59	824
Tongue River at Brandenburg Bridge Near Ashland, Montana	207	1.36	1016	278	1.67	904
Little Bighorn River at Wyola	110	0.53	548	117	0.53	548
Little Bighorn River at Hardin	123	0.99	768	135	0.99	768
Bighorn River at Bighorn	1523	2.08	952	1547	2.08	952
Rosebud Creek at Kirby	1.78	0.77	1016	27[2]	0.77	1016
Rosebud Creek at Rosebud	8.42	4.84	1780	59[2]	4.84	1780
Little Powder River Stateline Station Weston, WY (No Montana CBNG wells will impact this station)	2.6	6.94	3300	16[2]	10.41	1606
Powder River at Moorhead	145	4.65	2154	233[2]	11.08	2226
Powder River at Locate	143	4.61	2287	250[2]	10.89	2268
Mizpah Creek at Mizpah	0.26	16.6	3503	1.17[2]	16.6	3503
Yellowstone at Forsyth, Montana	5820	1.99	745	5870	1.99	745
Yellowstone at Sidney, Montana	5764	2	870	5866	2.23	870

[1] Calculations of flow volume and water quality were conducted for low mean monthly stream flows and the maximum calculated levels of CBNG discharge (year 6 discharge). Change in minimum mean monthly flow is greater than 40 percent.

[2] Change in minimum mean monthly flow is greater than 40 percent.

Substantial increases in flow would also result under this alternative in some watersheds, which would result in noticeable changes to physical stream conditions.

Since discharge water would be treated, the water quality of the streams and therefore the beneficial uses of surface waters, would not be directly affected by Montana CBNG development.

The treatment of CBNG-produced waters could result in the generation of residues that would contain concentrated salts extracted from the CBNG water. This residuum would need to be analyzed on a case-by-case basis to determine its character and would need to be disposed of in an appropriate manner.

Impacts on groundwater under this alternative would be the same as in Alternative B. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA-82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Abandonment

Effects on water resources caused by abandonment operations would be similar to the effects identified under Alternative B. When the estimated 16,500 CBNG production wells are abandoned over the 20-year life of the resource, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material would be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would control soil erosion until groundcover and original site conditions are restored.

Crow Reservation Impacts

Surface water impacts on Crow Tribal Lands under Alternative D are expected to include those impacts noted in Alternative B. Because the produced water would be treated prior to discharge, the reservation could expect impacts to surface water in the form of increased flow volume to the Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds from development on private lands within the external boundary of the reservation. Groundwater effects would be similar to those detailed in Alternative B.

Northern Cheyenne Impacts

Surface water impacts on Northern Cheyenne Tribal Lands under Alternative D are expected to include those effects noted in Alternative B with the added effects from the treated surface discharge of 80 percent of the produced water from all of the Montana CBNG wells forecast in the RFD in the Rosebud and Tongue River watersheds. Groundwater effects would include those detailed in Alternative B.

Conclusion

Treatment and discharge of produced water from Montana would not affect surface water quality, but would affect river flow volumes. Flow volumes in some watersheds would change only slightly, but some watersheds would see large flow increases, especially during times of traditionally low flow. The effects of these changes could include bank erosion, riparian area alteration and loss of indigenous habitat. Effects to surface water flow would be similar to but slightly greater than for Alternative C, due to lower conveyance loss. Effects on Montana watersheds due to Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under Alternative A, Wyoming CBNG discharges in some watersheds will cause degradation of surface water quality and the exceedance of numerical standards. Degradation would also be caused due to severe increases in the flows of some streams. This degradation may cause beneficial uses to be impacted. As such, water management in Wyoming and Montana will likely need to be done differently than assumed under this alternative in order to protect Montana's numerical and non-degradation surface water quality standards for EC, SAR and flow. The discharge of treated CBNG water would dilute Wyoming CBNG discharges as these waters flow further into Montana. Cumulative effects on surface water could include localized erosion and stream alteration. These effects would be similar to those caused by major rain events, but they would last for the duration of the producing fields' life.

Effects from surface impoundments would be similar to effects under Alternative A.

Drawdown effects to groundwater would be the same as under Alternative B.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Water produced from CBNG wells could be managed in a much broader fashion than has been analyzed in the previous alternatives by emphasizing beneficial use of CBNG water and MPDES requirements be met. A Water Management Plan (WMP) would be required prior to exploration or production. Water management options would include injection, treatment and discharge, impoundment, direct discharge, or other operator proposed methods, provided they are addressed in the WMP, the plan is approved by the appropriate agency and MPDES requirements are met. The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with Plans of Development (PODs) and would need to be approved prior to or concurrent with the approval of any Applications for permit to Drill (APDs). Under this alternative, the Water Management Plan would be part of an Application for Permit to Drill and include certification that water well or spring mitigation agreements have been entered into with the owner(s) of any water well/spring within one mile. This is more comprehensive and thus more protective of potential impacts to existing groundwater sources. State law requires that an agreement be offered, consistent with existing State of Montana rules (MCA 82-11-175 and MBOGC Order 99-99).

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined (clay or geotextile) impoundments to be disposed of under the appropriate permits.

Impacts would be similar to those discussed under Alternative B.

Production

Water would be produced by each of the 16,500 CBNG wells expected to be developed in the CBNG emphasis area. The maximum volume of CBNG water would be produced during year 6 with lesser volumes before and after this period. Unlike Alternative C, Alternative E allows for wide latitude in produced water management. The combination of emphasizing beneficial use and increased flexibility for managing produced water would likely increase water used for beneficial purposes, such as stock watering, irrigation, dust control, etc. Increases in beneficial use would also result in decreased impacts resulting from surface discharge as compared to Alternative C. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative E assumes 20 percent will be used beneficially.

Impacts on groundwater under this alternative would be the same as in Alternative B. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. Alternative E management options would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin. These beneficial uses will be protected through the MPDES permitting process under the CWA. The Montana BER standards are a part of this process.

The impacts calculated for this alternative are based on the results from the SWQATR, with modifications resulting from the adoption of numerical standards for EC and SAR and for the definition of EC and SAR as harmful parameters. The 40 percent MMM criteria is also used in this analysis to limit flow increases in surface waters. Results are compared to surface water standards for EC and SAR were adopted by the Montana BER and EPA since the completion of the statewide document. Resultant water quality would not exceed these standards, except where existing water quality is in excess of these standards. Comparison to the standards is provided under the analysis for each watershed if appropriate.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin. The impact analysis discussed below is a summary of that analysis, using low mean monthly flows for comparison. This information for the Tongue River is summarized in Table 4-48.

Water quality before and after mixing for the Decker Station is shown graphically in Figure 4-5. In this figure water qualities before and after mixing are shown for low mean monthly flows. The resulting water qualities are plotted against the Ayers and Westcott criteria. The relationship between the resulting mixed waters can be compared to the following criteria:

- Northern Cheyenne Proposed Standards: Set at a SAR of 2.0 and an EC of 1,000 and 2,000 µS/cm at the south boundary of the Reservation. Surface water alteration forecasted under Alternative E would be below the tribe's proposed limits except during 7Q10 flow.

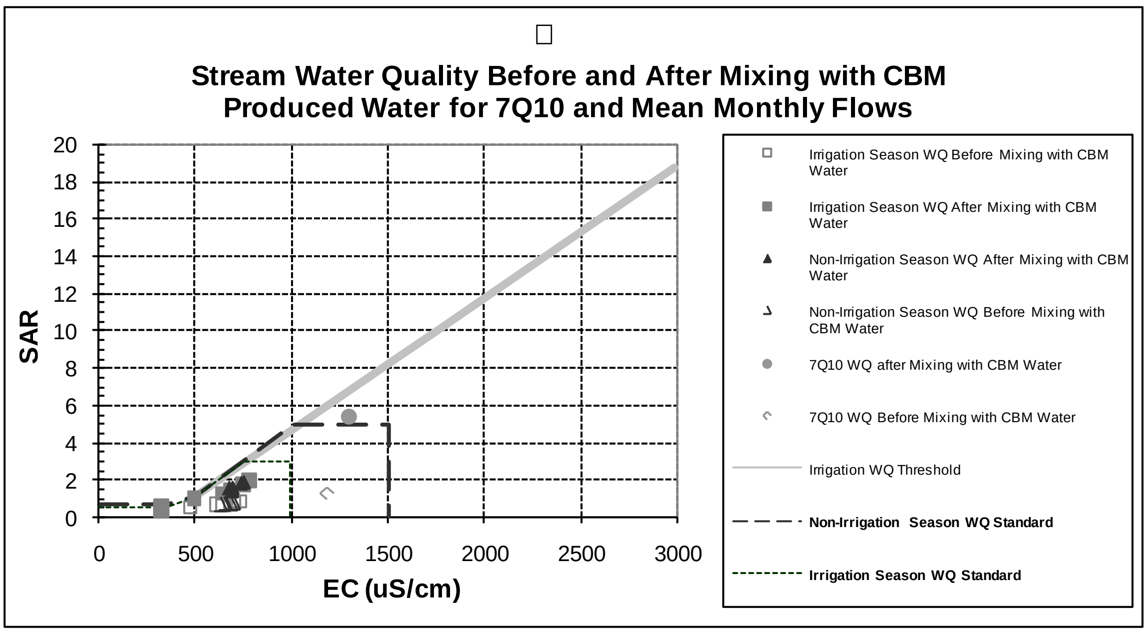
- Ayers and Westcot: The SWQATR discusses SAR versus EC plots as a way of determining potential impacts to soil texture after irrigation. The plot as shown in Figure 4-5 includes the boundary below which no impacts to soil are likely. Predicted water qualities during low mean monthly flows indicate that mixed waters will not cause infiltration impacts to soils under irrigation under Alternative E.

TABLE 4-48

EFFECTS ON SURFACE WATER FORECAST TO THE TONGUE RIVER UNDER ALTERNATIVE E

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Tongue River at Stateline Near Decker	3	1000	5	1500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	3	1000	5	1500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Montana	3	1000	5	1500	207	1.36	1016	214	2.5	1058

FIGURE 4-5
WATER QUALITY PLOT BEFORE AND AFTER MIXING WITH WYOMING'S ALTERNATIVE 2A AND MONTANA'S ALTERNATIVE E CBNG DISCHARGES TONGUE RIVER NEAR DECKER, MONTANA



WQ=Water Quality

Source: Surface Water Quality Analysis Technical Report

- MDEQs Irrigation Season Standards (MT-Irr): These standards are set at a SAR of 3.0 and an EC of 1000 µS/cm for the Tongue River. The forecasted surface water quality under Alternative E during minimum mean monthly flows is below these SAR standards for all stations and below these EC standards for all stations except for the station at Brandenburg Bridge. Existing conditions at Brandenburg Bridge during minimum mean monthly flows are also in excess of this standard. The 40 percent non-degradation analysis threshold for EC (400 µS/cm) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (1.2) is exceeded by existing conditions at the Brandenburg station and the forecasted impacts under this alternative would cause it to be exceeded at all stations.

- MDEQ Non-Irrigation Season Standards (MT-Non): These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for the Tongue River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is below these SAR and EC standards for all stations. The 40 percent non-degradation analysis threshold for EC (600 µS/cm) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is not exceeded by existing conditions at any stations; however the forecasted impacts under this alternative would cause it to be exceeded at the Birney Day School and Brandenburg stations.

- 40 percent MMM: This analysis threshold would be 249 cfs at Decker, 256 cfs at Birney Day School and 290 cfs at Brandenburg. This analysis threshold is not exceeded at any station.

The Tongue River is an important source of irrigation water in the Powder River Basin. The effects on the Tongue River would be the same as those for Alternative A, since no untreated Montana CBNG discharge to the Tongue would be assumed under this alternative analysis, besides discharge in accordance with the existing CX Ranch MPDES permit. This permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. This grandfathered permit causes some degradation of surface water quality. There would be no impact to beneficial uses under this alternative since surface water quality standards are not projected to be exceeded.

Of the 33,282 gpm predicted to be produced during year six of the RFD, approximately 31,682 gpm will need to be managed by means other than untreated surface discharge. As mentioned previously it is assumed that 20 percent of all produced water would be used for beneficial uses. Other water management options, anticipated to be used on a site-specific basis include infiltration basins, injection wells, water treatment and lined evaporation basins. These same water management practices are assumed for all watersheds analyzed. It should be noted that this distribution of water management practices is intended only for use in this analysis and is not intended to prescribe water management practices for any particular project. Any properly permitted water management alternatives can be used. A site specific Water Management Plan will need to be developed for each project under Alternative E and may include any, all, or none of the water management methods listed above.

Surface disturbance from water management activities are covered under the Assumptions section of Chapter Four. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages. Hanging Woman Creek is an impaired waterbody due to siltation; surface discharge of treated water may need to be limited in this drainage.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on Indian Lands and state and private lands in Montana.

The resultant surface water impacts to the Bighorn rivers would be similar to but less than Alternative C. The actual volume of water that is allowed to be discharged will depend on the water quality standards set by the Montana Board of Environmental Review and the MPDES permit program administered by the MDEQ. CBNG discharge volumes will be dependent on site-specific conditions and the approval of a WMP. In order to be approved the WMP would need to show how the produced water could be managed without impacting beneficial uses. These results are shown in Table 4-49 and can be compared to the following surface water criteria:

- Ayers and Westcot: Predicted water qualities would only exceed this criterion during 7Q10 flows and only at the upstream stations under this alternative.
- EC and SAR standards have not been developed for these waters.
- 40 percent MMM: This analysis threshold would be 154 cfs at Wyola, 172 cfs at Hardin and 2132 cfs at Bighorn. This analysis threshold is not exceeded at any station.

Surface water would be degraded under this alternative; however there would not be anticipated impacts to beneficial uses since standards would not be exceeded. Additional impact analyses are presented in the SWQATR.

The water management in the Bighorn Watershed is assumed to be similar to the Tongue; however since discharges would be under the National Pollutant Discharge Elimination System (NPDES) program, some untreated discharge could occur. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no discharge of Montana CBNG water into Rosebud Creek under the analysis of Alternative E. For comparison purposes, these forecasted effects are summarized on Table 4-50.

The effects on Rosebud Creek would be the same as those for Alternative A, since no additional Montana discharges to Rosebud Creek are assumed under this alternative. A comparison to surface water quality criteria is provided in the discussion of Rosebud Creek under Alternative A. As there would be no discharge under this alternative there would be no degradation of beneficial uses.

The water management in the Rosebud Watershed is assumed to be similar to that in the Tongue; however no treated or untreated discharges would occur. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B.

TABLE 4-49

EFFECTS ON SURFACE WATERS OF THE LITTLE BIGHORN AND BIGHORN RIVERS UNDER ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	115	2.26 – 2.64	623-632
Little Bighorn River at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1542	2.54-2.64	968-970

TABLE 4-50

EFFECTS ON SURFACE WATER IN THE ROSEBUD CREEK UNDER ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	8.42	4.84	1780

Little Powder River

The effects on the Little Powder River surface water quality at the Weston, Wyoming, station would be the same as Alternative A, since there are no Montana wells discharging upstream of this station. The effects from Montana wells downstream of this station are calculated in the analysis for the Powder River at Locate station.

The water management in the Little Powder Watershed is assumed to be similar to that in the Tongue. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. Effects from impoundments are discussed under Alternative A. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages.

Powder River

The impacts to the Powder River watershed are shown in Table 4-51; impacts to EC, SAR and flow will come from discharges to the river from Wyoming CBNG development As the increase in flow which result from Wyoming CBNG development are projected to exceed the 40%MMM analysis threshold, it is not anticipated that any discharge of treated or untreated CBNG water will be allowed in Montana. These resulting surface water qualities can be compared to the following surface water criteria:

- Ayers and Westcot: This criterion would only be exceeded during 7Q10 flows under this alternative

- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 µS/cm for the Powder River. The forecasted surface water quality under Alternative E during minimum mean monthly flows would be above the SAR and EC standards. Existing conditions also exceed this EC standard. An authorization to degrade would be needed from the MDEQ for development to occur in this manner. As such, it is anticipated the adopted SAR standard will severely curtail untreated CBNG discharges in the Powder River watershed. In Montana MPDES permits are required and these permits would need to incorporate the Montana BER standards. As such, CBNG discharges which would cause the mean monthly SAR to exceed 5.0 would not be allowed. Wyoming CBNG development may also need to proceed differently than assumed under Wyoming's Alternative 2A in order to prevent violation of the Montana BER standards at the state line. The 40 percent non-degradation analysis threshold for EC (800 µS/cm) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance.

TABLE 4-51

EFFECTS ON SURFACE WATER IN THE POWDER RIVER UNDER ALTERNATIVE E

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	224	10.7	2230
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	236	11.36	2320

- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 µS/cm for the Powder River. The forecasted surface water quality under Alternative E during minimum mean monthly flows is above this SAR standard and below the EC standard. An authorization to degrade would be needed from the MDEQ for development to occur in this manner. MDEQ has never approved an authorization to degrade. As such, it is anticipated the adopted SAR standard will severely curtail untreated CBNG discharges in the Powder River watershed. In Montana MPDES permits are required and these permits would need to incorporate the Montana BER standards. As such, CBNG discharges which would cause the mean monthly SAR to exceed 6.5 would not be allowed. Wyoming CBNG development may also need to proceed differently than assumed under Wyoming's Alternative 2A in order to prevent violation of the Montana BER standards at the state line. The 40 percent non-degradation analysis threshold for EC (1000 µS/cm) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2.6) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance.
- 40 percent MMM: This analysis threshold would be 203 cfs at Moorhead and 200 cfs at Locate. This analysis threshold would be exceeded at both stations.

The Powder River watershed is unique to the PRB in Montana; the existing water is seasonally variable and often of low quality, there is significant CBNG discharge to this river in Wyoming at the present time that does not appear to be impacting the river [see Appendix E in the SWQATR Greystone 2002)] and CBNG water quality data in the Montana portion of the watershed is limited.

CBNG producers in the Wyoming portion of this watershed will be held to the Montana BER standards at the state line since these standards have CWA standing.

There would not be anticipated impacts to beneficial uses under this alternative since MPDES permits must incorporate all applicable surface water standards. The WYDEQ has also modified its permitting process to prevent exceedance of Montana's standards at the stateline.

The water management in the Powder River Watershed is assumed to be similar to the Tongue; however no treated or untreated discharges could occur in Montana. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B.

Mizpah Creek

Table 4-52 illustrates the small amount of water within Mizpah Creek. Only 125 Montana CBNG wells are projected to be productive in this watershed; and there are no Wyoming CBNG wells. Impacts are expected to be similar under Alternative E as under Alternative A, since only CBNG water which had been treated to ambient water quality could be discharged. Beneficial uses would not be reduced.

The water management in the Mizpah Creek Watershed is assumed to be similar to the Tongue. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. Effects from impoundments are discussed under Alternative A. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water may have noticeable effects on stream flow, erosion and sedimentation in this watershed, especially where discharge occurs to ephemeral or intermittent drainages.

Yellowstone River

The Yellowstone River receives the combined flows of all the other watersheds in the Montana portion of the Powder River Basin. The Forsyth station is the upstream station which receives no contribution from Wyoming discharges, but will receive some Montana CBNG discharge. The Sidney station is the downstream station and it will receive discharges from all Montana Powder River Basin wells and approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under Alternative E.

The effects to the Yellowstone River would be less than those indicated for Alternative C as the volume of CBNG water discharged to tributaries of the Yellowstone would be limited. Table 4-53 summarizes the effects of these discharges on the Yellowstone River. These resultant surface water chemistries can be compared to the following criteria.

- Ayers and Westcot: Predicted water qualities would not exceed this criterion even during 7Q10 flows.
- EC and SAR standards have not been developed for these waters.
- 40 percent MMM: This analysis threshold would be 8148 cfs at Forsyth and 8070 cfs at Sidney. This analysis threshold is not exceeded at either station.

Surface water would be slightly altered under this alternative; however there would not be anticipated impacts to beneficial uses. Additional impact analyses are presented in the SWQATR.

TABLE 4-52

EFFECTS ON SURFACE WATERS OF MIZPAH CREEK DRAINAGE UNDER ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC**	**SAR**	**EC**	**Flow**	**SAR**	**EC**	**Flow**	**SAR**	**EC**
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.26	16.6	3503

TABLE 4-53

EFFECTS ON SURFACE WATER IN THE YELLOWSTONE RIVER UNDER ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Yellowstone at Forsyth, Montana	N/A	N/A	N/A	N/A	5820	1.99	745	5851	2.22 – 2.18	753 – 754
Yellowstone at Sidney, Montana	N/A	N/A	N/A	N/A	5764	2	870	5848	2.54 – 2.60	891 – 893

The water management in the Yellowstone River Watershed as a whole is assumed to be similar to the Tongue. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. Effects from impoundments are discussed under Alternative A. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages.

Summary of Surface Water Impacts

A summary of calculated surface water effects by USGS station for Alternative E is shown in Table 4-54. The table summarizes effects of forecast discharges of CBNG water from the Wyoming Alternative 2A and Montana's Alternative E for watersheds in the Montana portion of the Powder River Basin. Surface water quality in some watersheds would be slightly degraded; however, downstream uses would not be diminished. Surface water flow would be moderately increased causing some riparian erosion, as well as increased sedimentation. In some watersheds these increases in flow would be in excess of the 40 percent MMM analysis threshold.

TABLE 4-54

CUMULATIVE IMPACTS ON SURFACE WATERS UNDER WYOMING'S ALTERNATIVE 2A AND MONTANA'S ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Tongue River at Stateline Near Decker	3	1000	5	1500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	3	1000	5	1500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Mt.	3	1000	5	1500	207	1.36	1016	214	2.5	1058
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	115	2.26 – 2.64	623 - 632
Little Bighorn River at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1542	2.54-2.64	968-970
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	8.42	4.84	1780
Little Powder River Stateline Weston,	5	2000	6.5	2500	2.6	6.94	3300	16	10.41	1606
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	224	10.7	2230
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	236	11.36	2320
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.26	16.6	3503
Yellowstone at Forsyth, Montana	N/A	N/A	N/A	N/A	5820	1.99	745	5851	2.18 – 2.22	753 – 754
Yellowstone at Sidney, Montana	N/A	N/A	N/A	N/A	5764	2	870	5848	2.54 – 2.60	891 - 893

The adoption of the Montana BER numerical standards since completion of the Statewide document and the non-degradation rules will reduce impacts to surface water quality from CBNG, particularly in the Powder River watershed. These standards are not anticipated to be exceeded, except where existing conditions exceed these standards. As such, beneficial uses of surface waters will not be impacted.

Abandonment

Impacts to water resources due to abandonment operations would be similar to impacts under Alternative B. When the estimated 16,500 CBNG production wells are abandoned over the 20-year project life, 33,000 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on tribal lands under Alternative E would be similar to, but less than, those effects noted in Alternative C. The wider variety of water management options would lessen the effects from produced water. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases would be restricted.

Northern Cheyenne

Surface water effects to Northern Cheyenne Tribal Lands under Alternative E would be similar to those impacts noted in Alternative A, since no additional direct discharge of CBNG water is assumed to occur in the Tongue River or Rosebud Creek. The beneficial use of the Tongue and Rosebud streams would be maintained under Alternative E.

CBNG developments have the potential to impact groundwater resources under tribal lands. Groundwater impacts within the reservation boundary would be detected and managed by monitoring the magnitude of aquifer drawdown. The monitoring wells would be engineered and placed to best intercept drawdown effects from CBNG development. Nests of monitoring wells will be used to track drawdown of multiple producing coal seams. The USGS has installed six well clusters along the southern boundary of the reservation. The BLM has also installed monitoring well clusters throughout the Montana portion of the Powder River Basin, including areas adjacent to the Northern Cheyenne and Crow reservations. The BLM wells will provide regional hydrological information as well as locally important data. In addition, CBNG operators are required to monitor groundwater levels within CBNG fields. The entire monitoring well network would monitor drawdown of coal seams and surface aquifers. Monitoring well data would be placed in the public record by the USGS, the BLM and responsible state agencies where it can be accessed and used by tribal officials as well as agency staff.

If drawdown is detected on the reservation, the production rate of CBNG wells operated on federal leases would be restricted until mitigation measures can be put into place. Mitigation measures could include curtailment of CBNG production, replacement of affected water wells or springs, or a hydrologic barrier engineered to reduce additional drawdown. The BLM would use all reasonable means to assure that reservation groundwater is not adversely affected by off-reservation CBNG production. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Effects of Alternative E to groundwater will be the same as Alternative B. Minor effects on shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water would also occur. The operator’s WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Cumulative impacts to Montana watersheds due Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts. Anticipated impacts under this alternative include slight degradation of surface water quality, without diminishing downstream use.

Weathered landscape with exposed Fort Union Formation

Alternative F—Phased Development Multiple Screens (High Range)

Water produced from CBNG wells could be managed similar to that in Alternative E by emphasizing beneficial use of CBNG water while assuring MPDES as well as Phased Development requirements are met. Under this alternative statewide and watershed-wide phased development rules limit the timing of development within each watershed. Furthermore, there may be a decrease of 2,333 wells drilled if development does not occur within crucial sage-grouse habitat areas. The decrease in wells would primarily occur within the Upper Tongue watershed and to a lesser degree within the Lower Tongue and Middle Powder watersheds.

In addition to the timing factor, cumulative surface discharge of untreated CBNG water in any watershed is limited to 10 percent of the 7Q10 value. This limit would apply to intermittent and ephemeral tributaries as well as main stems. For example, the 7Q10 value for the Powder River at Locate is 1.6 cfs, so the total CBNG discharge into the Powder River watershed could be no greater than 0.16 cfs (72 gpm). Hanging Woman Creek is an intermittent stream, so its 7Q10 is zero, thus no untreated discharge from federal wells would be allowed in that drainage. For watershed totals see Table 4-55. If untreated discharge from Wyoming CBNG were greater than this limit, no untreated water would be discharged from federal CBNG wells in the Montana portion of the watershed. If pre-existing federal, state and private CBNG wells accounted for more than the untreated discharge limit, there could be no additional untreated discharge from federal CBNG wells. This analysis threshold would not be a limiting factor at this time since EC and SAR have been determined by the Montana BER to be harmful parameters which are regulated by the non-degradation rules. Since ambient water quality is greater than 40 percent of the standards in all watersheds, no untreated CBNG discharge would be allowed in Montana.

A WMP would be required prior to any exploration or production, listing the manner in which forecasted produced water would be managed. MPDES requirements must be met prior to any discharges (treated or untreated). The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with PODs and would need to be approved prior to or concurrent with the approval of any Applications for Permit to Drill (APDs).

TABLE 4-55

WATERSHED UNTREATED DISCHARGE LIMITS

Watershed	Most Downstream Station with Adequate Data	7Q10 (cfs)	10% of 7Q10 (cfs)	10% of 7Q10 (gpm)
Bighorn River	Bighorn near Bighorn	870	87	39,046
Rosebud Creek	Rosebud near Rosebud	0	0	0
Tongue River	Tongue River at Brandenburg Bridge	70	7	3,142
Powder River	Powder River at Locate	1.6	0.16	72

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined impoundments to be disposed of under the appropriate permits.

Impacts from exploration would be similar to those discussed under Alternative B.

Production

Water would be produced by each of the 16,403 CBNG wells expected to be developed in the CBNG Planning Area. Unlike Alternatives B through E, the maximum volume of CBNG water would vary from watershed to watershed depending upon the drilling allowed by the Phased Development plan.

It is assumed that initially, drilling on state and private minerals will account for much of the CBNG drilling allowed. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative F, like Alternative E, assumes 20 percent will be used beneficially.

Produced water could be managed by a variety of means. Any discharges to surface waters would need to meet MPDES requirements. For this analysis it is assumed non-degradation rules for EC, SAR and flow will be applicable. The EC and SAR non-degradation rules will require all Montana CBNG discharges be treated prior to discharge. It is assumed Wyoming development will follow their Alternative 2A, except they will need to meet the numerical surface water quality standards at the stateline. Forty percent of the minimum MMM flow is used for analysis purposes to indicate where cumulative flow changes would trigger a significance determination by the MDEQ under the non-degradation rules for flow. The actual point at which this determination is made will depend on the specific information available at the time when an application is made for a MPDES permit. Water management practices other than treated discharge to surface waters include beneficial use, injection, impoundment and any other properly permitted water management practice.

Impacts from impoundments would be similar to those described under Alternative A; however the amount of surface disturbances would be commensurate with the increased number of potential impoundments similar to Alternative E.

Because of the conditions for development within the crucial sage-grouse habitat areas, a lower level of development is anticipated to occur over approximately 93,529 acres of which 78,982 acres are in the Upper Tongue watershed, 11,820 acres are in the Lower Tongue watershed and 2,727 acres are in the Middle Powder watershed. This would represent a decrease of 1970 wells drilled in the Upper Tongue watershed, 295 wells in the Lower Tongue watershed and 68 wells in the Middle Powder watershed. If development does not occur within the crucial sage-grouse habitat then the quantity of CBNG produced water would be decreased in proportion to the number of fewer wells drilled for the three watersheds which contain crucial sage-grouse habitat. Additionally, if development does not occur within the crucial sage-grouse habitat areas then the drawdown of groundwater would be locally lessened around these areas.

Impacts on groundwater under this alternative would be the same as in Alternative B. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. The Alternative F management option would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin. The number of APDs listed for each watershed is in Table 4-1. Under this alternative the MDEQ's non-degradation analysis thresholds for EC, SAR and Flow would apply to discharges in Montana while Wyoming development would operate under their Alternative 2A. The 10 percent of 7Q10 untreated discharge threshold is maintained for this alternative; however it would not be an issue unless either EC or SAR were determined to be non-harmful parameters since new untreated discharges would not be allowed in Montana due to non-degradation standards. Therefore the 10 percent of 7Q10 untreated discharge threshold is not a part of this analysis, but rather provides an additional level of assurance due to the transitional nature of CBNG rules in Montana at this time. Treated discharges will be held to ambient water quality.

For analysis purposes it is assumed that for this alternative 20 percent of the produced water will be used beneficially and the rest will be treated and discharged unless MPDES permits are limited due to the MDEQ's cumulative non-degradation standard for flow (assumed in this analysis to be encountered at 40 percent MMM). If the flow limit is encountered, the remaining CBNG water would be managed by other options, which this analysis assumed to be split as 40 percent evaporation basins, 30 percent infiltration basins and 30 percent injection. This split is for analysis purposes only and is in no way intended to limit properly permitted water management options.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin. The peak rate of water production from Montana CBNG wells in the Tongue River watershed under Alternative F would occur in year 7 when 29,832 gpm would be produced. Twenty percent of this produced water (5,966 gpm) is assumed to be used for beneficial uses.

Conditions placed on the development of CBNG within crucial sage-grouse habitat may result in less CBNG water being produced and potentially being discharged to the Tongue River. There are 78,982 acres of crucial sage-grouse habitat within the Upper Tongue River watershed and 11,820 acres within the Lower Tongue watershed.

Impacts from water management activities will be similar to E. No additional untreated Montana CBNG surface discharge to the Tongue would be assumed under this alternative. One existing permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. Therefore, the surface water quality impacts will be similar to those listed under Alternative E.

The Tongue River is an important source of irrigation water in the Powder River Basin. The existing permits are anticipated to cause an unnoticeable amount of alteration in water quality and there would not be anticipated impacts to beneficial uses under this alternative since standards would not be exceeded. Any future MPDES permits for untreated discharge would require an authorization to degrade.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on state, private and federal lands in Montana.

The resultant surface water quality impacts to the Bighorn rivers would be between those identified for Alternatives D and E since untreated discharge is anticipated under the Preferred Alternative only on the Crow Reservation. Untreated discharges could occur on the Crow Reservation, provided appropriate NPDES permits were obtained from the EPA. The EPA has not developed standards for EC or SAR and Montana's "harmful" designation for these parameters has not been approved by the EPA, leaving it unenforceable upstream onto the Crow Reservation. NPDES permits issued by EPA would need to meet Montana's numerical standards for EC and SAR (which have been approved under the CWA) at the reservation boundary. The expected discharges would be much less than the 40 percent MMM analysis threshold. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E.

Actual CBNG discharge volumes will be dependent on site-specific conditions and the approval of a

WMP. In order to be approved the WMP would need to show how the produced water could be managed without impacting beneficial uses. MPDES/NPDES permits will be required prior to the approval of WMPs. As such, there would be no impact to beneficial uses under this alternative.

The slight increases in flow which would result from treated discharges may result in slight changes to physical stream conditions.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no untreated discharge of Montana CBNG water into Rosebud Creek under the analysis of Alternative F. Limited discharge of treated water could occur but the 40 percent MMM analysis threshold is the limiting factor. As there would be no untreated discharge under this alternative, the resulting water quality would be the same as Alternative D and there would be no degradation of beneficial uses. Other management practices such as injection, infiltration, beneficial use and evaporation will also need to be utilized.

The moderate increases in flow which would result from treated discharges may result in slight changes to physical stream conditions.

Little Powder River

The Little Powder watershed is the site of CBNG development in Wyoming but the most prospective portion of the Fort Union Formation (the Tongue River Member) is sparsely present under this watershed in Montana. Because of the distribution of the Fort Union, little CBNG exploration and production is expected to occur in the Montana portion of the watershed. The quality of the Little Powder River exceeds the numerical standards of the MDEQ and it is an intermittent stream (7Q10=0). Therefore, no untreated discharges are expected under Alternative F. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E. Impacts would be the same as Alternative A and there would be no degradation of beneficial uses.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Powder River

Alternative F assumes 100 percent of potential CBNG discharge (40 percent MMM) would be taken up by Wyoming development, therefore none of the water produced in Montana would be discharged under this alternative. The impacts to surface water quality under Alternative F will be similar to those identified for Alternative D, except discharges would be limited by the 40 percent MMM analysis threshold. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E.

Conditions placed on the development of CBNG within crucial sage-grouse habitat may result in less CBNG water being produced and potentially being discharged to the Powder River. There are 2,727 acres of crucial sage-grouse habitat within the Middle Powder River watershed.

Mizpah Creek

Impacts to surface waters are expected to be similar to Alternative A since no untreated CBNG produced water could be discharged under this alternative and treated discharges would be limited by the 40 percent MMM analysis threshold. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E. Beneficial uses would not be reduced.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Yellowstone River

The Yellowstone River receives the combined flows of all other watersheds in the Montana portion of the Powder River Basin. The Forsyth, Montana station is the upstream station which receives no contribution from Wyoming discharges, but will receive some Montana CBNG discharge. The Sidney, Montana station is the downstream station and it will receive discharges from all Montana Powder River Basin wells and the approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under Alternative F. The cumulative impact at the Sidney station, however, is expected to be less under this alternative than under Alternative E. The phased development plan of this alternative will space out the drilling and production of wells so that the maximum development will not occur until year 12 rather than year six under Alternative E. Because development is extended out over a longer time period, the maximum development level is less under Alternative F although this peak development level will extend over more time than under Alternative E.

The Yellowstone at the Sidney gauging station will be impacted by a maximum number of wells during year 12 when Montana CBNG wells are forecast to produce 34,961 gpm of water. This is approximately 79.5 percent of the 43,989 gpm forecast for year six under Alternative E. Effects to the Yellowstone at Sidney are predicted to be slightly less than effects under Alternative E in terms of both EC and SAR, although in reality these slight differences will likely be unnoticeable. Although some discernable surface water effects may be detected at the Sidney station, beneficial uses would not be reduced under Alternative F.

Summary of Surface Water Impacts

Impacts to surface water under this alternative will be less than under Alternative E.

Surface water quality in some watersheds would be slightly degraded under Alternative F; however, downstream uses would not be diminished. Surface water flow would be moderately increased causing some localized riparian erosion, as well as locally increased sedimentation. There would not be anticipated impacts to beneficial uses under this alternative since MPDES permits would be required prior to discharge.

Abandonment

Impacts to water resources due to abandonment operations would be similar to impacts under Alternatives B through E. When the estimated 16,403 CBNG production wells are abandoned over the 20-year project life, 33,000 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative F would be less than those effects noted in Alternative E. The peak volume of water discharged to the Little Bighorn River would be reduced and the water would need to be treated prior to discharge. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Northern Cheyenne

Surface water quality effects to Northern Cheyenne Tribal Lands under Alternative F would be similar to those impacts noted in Alternatives A and E, since no additional direct discharge of untreated CBNG water is assumed to occur into the Tongue River or Rosebud Creek. Flows in the Tongue and Rosebud would be moderately increased due to the discharge of treated water. The beneficial use of the Tongue and Rosebud streams would be maintained under Alternative F.

CBNG developments have the potential to impact groundwater resources under Northern Cheyenne Tribal Lands. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Effects of this alternative on groundwater will be the same as Alternative B, with the exception that if CBNG development is lessened or does not occur within crucial sage-grouse habitat then groundwater drawdown would be locally decreased around these habitat areas. Additionally, modeling and monitoring would be required within 5 miles of the reservations in order to protect tribal groundwater. The operator's WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Cumulative Impacts to Montana watersheds due Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Anticipated impacts under this alternative include slight alteration of surface water quality, without diminishing downstream use. MPDES permits will be required prior to the discharge of any CBNG water (treated or untreated). The Montana BER standards are not anticipated to be exceeded and the WDEQ has modified its process to ensure numerical surface water standards are not exceeded at the stateline. As such, beneficial uses of surface waters will not be impacted.

Conditions placed on development within crucial sage-grouse habitat may result in a decreased quantity of CBNG produced water potentially being discharged; primarily to the Upper Tongue watershed and to a lesser degree the Lower Tongue and Middle Powder River watersheds.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, phased development would occur, but only 35 percent of the wells predicted for Alternative F would be drilled over the 23-year life of the resource. Maximum development is forecast to only involve 6,470 APDs and 5,823 CBNG wells. Water produced from CBNG wells could be managed similarly to that in Alternative F by emphasizing beneficial use of CBNG water while assuring that MPDES requirements are met. The distribution of wells under Alternative G is forecast by applying the 35 percent factor to each of the watersheds referred to under Alternative F.

Under Alternative G surface discharge of untreated CBNG water in any watershed is limited to 10 percent of the 7Q10 value. This limit would apply to intermittent and ephemeral tributaries as well as main stems. For watershed totals see Table 4-55. If untreated discharge from Wyoming CBNG were forecast to be greater than this limit, no untreated water would be discharged from federal CBNG wells in the Montana portion of the watershed. If pre-existing federal, state and private CBNG wells accounted for more than the untreated discharge limit, there could be no additional untreated discharge from federal CBNG wells. This analysis threshold would not be a limiting factor at this time since EC and SAR have been determined by the Montana BER to be harmful parameters which are regulated by the non-degradation rules. Since ambient water quality is greater than 40 percent of the standards in all watersheds, no untreated CBNG discharge would be allowed in Montana.

A WMP would be required prior to any exploration or production, listing the manner in which forecasted produced water would be managed. Water management options other than untreated discharge may include beneficial use, injection, or treatment and discharge or any other properly permitted water management option. MPDES requirements must be met prior to any discharges (treated or untreated). The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with PODs and would need to be approved prior to or concurrent with the approval of any APDs.

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined impoundments to be disposed of under the appropriate permits.

Impacts from exploration would be similar to those discussed under alternative B.

Production

Water would be produced by each of the 5,853 CBNG wells expected to be developed in the

CBNG emphasis area; 35 percent of the number of wells forecast under Alternative G. Water will be managed by a number of options available to the operator. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative G, like Alternative F, assumes 20 percent will be used beneficially. The remainder of the water is assumed to be managed as in Alternative F discussed above except that the total volume to be managed would be only 35 percent of the volume forecast under Alternative F.

Impacts from impoundments would be similar to those described under Alternative A.

Impacts on groundwater under this alternative would be similar to Alternative B in that drawdown is anticipated to extend 4-5 miles from CBNG fields after 20 years; however there would be fewer CBNG fields that drawdown would extend from. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. The Alternative G management option would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin. The number of APDs is listed for each watershed in Table 4-2. Under this alternative the MDEQ's non-degradation analysis thresholds for EC, SAR and Flow would apply to discharges in Montana, while Wyoming development would operate under their Alternative 2A. The 10 percent of 7Q10 untreated discharge threshold is maintained for this alternative; however it would not be an issue unless either EC or SAR were determined to be non-harmful parameters since new untreated discharges would not be allowed in Montana due to non-degradation standards. Therefore the 10 percent of 7Q10 untreated discharge threshold is not a part of this analysis, but rather provides an additional level of assurance due to the transitional nature of CBNG rules in Montana at this time. Treated discharges will be to ambient water quality.

For analysis purposes the same process for assuming water management practices as outlined for Alternative F would also be used under Alternative G. This split is for analysis purposes only and is in no way intended to limit properly permitted water management options.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin.

No additional untreated Montana CBNG surface discharge to the Tongue would be assumed under this alternative. One existing permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. Therefore, the surface water quality impacts will be similar to those listed under Alternative E.

The remainder of the water produced in the Tongue River watershed is assumed to be treated and discharged; however other properly permitted managed water management practices would also be allowed. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The Tongue River is an important source of irrigation water in the Powder River Basin. The existing permits are anticipated to cause an unnoticeable amount of alteration in water quality and there would not be anticipated impacts to beneficial uses under this alternative since standards would not be exceeded. Any future MPDES permits for untreated discharge would require an authorization to degrade.

Moderate increases in flow would occur as a result of treated discharges; however these increases would be less than the 40 percent MMM analysis threshold. These moderate increases in flow may result in slight changes to physical stream conditions.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on Indian lands as well as federal, state and private lands in Montana. Only 35 percent of APDs and CBNG wells are expected in this watershed as under Alternative F. This volume of discharge is anticipated to only minimally affect water quality and resultant water quality would be between that calculated for Alternatives A and F. As such there would be no degradation of beneficial uses. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The slight increases in flow that would result from this Alternative would result in unnoticeable changes to physical stream condition.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no untreated discharge of Montana CBNG water into Rosebud Creek under Alternative G; however there would be limited treated discharge. The 40 percent MMM analysis threshold would limit discharges in this watershed therefore impacts would be the same as Alternative F. The treated discharges would not degrade beneficial uses. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The moderate increases in flow caused by these discharges may result in minor changes to physical stream conditions.

Little Powder River

The Little Powder watershed is the site of CBNG development in Wyoming but the most prospective portion of the Fort Union Formation (the Tongue River Member) is sparsely present under this watershed in Montana. Because of the distribution of the Fort Union, little CBNG exploration and production is expected to occur in the Montana portion of the watershed. The quality of the Little Powder River exceeds the numerical standards of the MDEQ and it is an intermittent stream (7Q10=0). Therefore, no untreated discharges are expected under Alternative G. As such, the resultant water quality would be the same as Alternative A and there would be no degradation of beneficial uses. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Powder River

Alternative G assumes none of the produced CBNG water would be discharged under this alternative since the allowable discharge (40 percent MMM) would be used up in Wyoming. The impacts to surface water quality under Alternative G (from Wyoming and Montana) will be less than those forecast under Alternative A due to the development of surface water quality standards which are enforceable at the stateline. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The increases in flow which would result from Wyoming discharges may result in changes to physical stream conditions.

Mizpah Creek

Impacts to surface water quality is expected to be the same under Alternative G as under Alternative A, since no untreated CBNG produced water could be discharged; beneficial uses would not be reduced. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Yellowstone River

The Yellowstone River receives the combined flows of all the other watersheds in the Montana portion of the Powder River Basin. The Forsyth station is the upstream station which receives no contribution from Wyoming discharges, but will receive some MT CBNG discharge. The Sidney station is the downstream station and it will receive discharges from all 5,823 Montana Powder River Basin wells and approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under Alternative G. The effects to the Yellowstone River would be somewhat less than those indicated for Alternative F. Beneficial uses would not be reduced under Alternative G.

The slight increases in flow that would result from this Alternative would result in unnoticeable changes to physical stream condition.

Summary of Surface Water Impacts

Surface water quality in some watersheds would be slightly reduced; however, downstream uses would not be diminished. Surface water flow would be slightly increased, potentially causing some riparian erosion, as well as increased sedimentation. Effects would be similar to, but somewhat less than under Alternative F.

Abandonment

Impacts to water resources due to abandonment operations under Alternative G would be 35 percent of the impacts under Alternative F. When the estimated 5,823 CBNG production wells are abandoned over the 23-year resource life, an estimated 11,550 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless appropriate mitigating measures are employed. The implementation of various suitable mitigating measures would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative G would be similar to those effects noted in Alternative F, except the peak volume of water discharged to the Little Bighorn River would be reduced. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists to impact tribal groundwater, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Northern Cheyenne

Surface water quality effects to Northern Cheyenne Tribal Lands under Alternative G would be similar to those impacts noted in Alternative A, since no additional direct discharge of CBNG water is assumed to occur into the Tongue River or Rosebud Creek. The volume of flow in the Tongue and Rosebud would increase due to treated discharges. In the Tongue this increase would be less than projected under Alterative F. In the Rosebud the increase would be the same as alternative F. Slight alteration of the Tongue River would occur as a result of existing permits, however the beneficial uses of the Tongue and Rosebud would be maintained.

CBNG developments have the potential to impact groundwater resources under Northern Cheyenne Tribal Lands. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists to impact tribal groundwater, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Similar to the other alternatives, drawdown from CBNG developments would be expected to extend 4 to 5 miles from CBNG fields; however, there would be fewer fields to exhibit drawdown.

Cumulative Impacts to Montana watersheds due to Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Minor effects on shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water may also occur as discussed under alternatives A and B. The operator's WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Surface water effects under Alternative G would be the same as, or less than the effects of Alternative F in the individual watersheds. Even where discharge is an available option operators may choose other options when managing their CBNG water with simultaneous reductions in the volume of surface discharge. Consultation with state and federal agencies charged with managing Wyoming's resources have allowed close cooperation and improved estimation of likely impacts to the surface waters of Montana from CBNG and other activities under this alternative. The cumulative impacts to surface water and groundwater further depend upon MDEQ standards. Anticipated impacts under this alternative include slight alteration of surface water quality, without diminishing downstream use. The slight increases in flow which would result from discharges may result in minor changes to physical stream conditions.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative, CBNG development is expected in approximately the same total numbers predicted for Alternative F although development rate is somewhat different due to there being no annual or watershed limit. Water produced from CBNG wells could be managed similarly to that in Alternative F by emphasizing beneficial use of CBNG water while assuring that MPDES requirements are met. The distribution of wells under the Preferred Alternative is forecast by modifying the forecast development within the various watersheds referred to under Alternative F. In the Preferred Alternative, development of the CBNG resource under each watershed is expected to occur in a more discrete, more rapid manner rather than the drilling being drawn out within each watershed. Total wells in the watersheds and total wells in the Planning Area are forecast to be approximately the same.

If untreated discharges within a watershed exceed 10% of the 7Q10 the BLM would coordinate with MDEQ to prepare a surface water monitoring report. If the results of this analysis indicate CBNG discharges have the potential to cause exceedances of surface water quality standards, the BLM would coordinate with MDEQ to develop appropriate mitigation measures to prevent exceedances. Additionally, no future untreated discharge of CBNG water would be allowed from federal wells unless the regional surface water monitoring stations above and below the proposed discharge are active.

If CBNG discharges are causing surface water quality standards to be exceeded no additional CBNG discharges would be allowed from federal wells upstream of the exceedance. Previously approved water management plans may also be modified. Water quality thresholds and the surface water monitoring requirements are detailed in the Monitoring Appendix.

A WMP would be required prior to any exploration or production, listing the manner in which forecast produced water would be managed. Water management options other than untreated discharge may include beneficial use, injection, treatment and discharge or any other properly permitted water management option. MPDES requirements must be met prior to any discharges (treated or untreated). The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with PODs and would need to be approved prior to or concurrent with the approval of any APDs.

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined impoundments to be disposed of under the appropriate permits.

Impacts from exploration would be similar to those discussed under alternative B.

Production

Water would be produced by each of the approximately 16,404 CBNG wells expected to be developed in the CBNG emphasis area under the Preferred Alternative. Water will be managed by a number of options available to the operator. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), the Preferred Alternative, like Alternative F, assumes 20 percent will be used beneficially. The remainder of the water is assumed to be managed as in Alternative F discussed above.

Impacts from impoundments would be similar to those described under Alternative A.

Impacts on groundwater under this alternative would be the same as in Alternative B with the exception that groundwater drawdown would be somewhat reduced if development does not occur or is lessened within crucial sage-grouse habitat areas. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

This analysis will occur following the same rules as Alternative F, except in the event the 10 percent of 7Q10 untreated discharge limit became a factor, there would be the option to wave this criterion if the monitoring identified by the IWG were in place. The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. The Preferred Alternative management option would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin.

No additional untreated Montana CBNG surface discharge to the Tongue would be assumed under this alternative. One existing permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. Therefore, the surface water quality impacts will be similar to those listed under Alternative E.

The remainder of the water produced in the Tongue River watershed is assumed to be treated and discharged; however other properly permitted managed water management practices would also be allowed. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E.

The Tongue River is an important source of irrigation water in the Powder River Basin. The existing permits are anticipated to cause an unnoticeable amount of alteration in water quality and there would not be anticipated impacts to beneficial uses under this alternative since standards would not be exceeded. Any future MPDES permits for untreated discharge would require an authorization to degrade. Additionally, pollutants including salinity, total dissolved solids and nutrients also are frequently associated with agricultural operations.

Moderate increases in flow would occur as a result of treated discharges; however these increases would be less than the 40 percent MMM analysis threshold. These moderate increases in flow may result in slight changes to physical stream conditions.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on state, private and federal lands in Montana under the Preferred Alternative.

The resultant surface water impacts to the Bighorn rivers would be between those identified for Alternatives D and E since untreated discharge is anticipated under the Preferred Alternative only on the Crow Reservation. Actual CBNG discharge volumes will be dependent on site-specific conditions and the approval of a WMP. In order to be approved the WMP would need to show how the produced water could be managed without impacting beneficial uses. MPDES permits will be required prior to the approval of WMPs. As such, there would be no impact to beneficial uses under this alternative.

The slight increases in flow that would result from this Alternative would result in minor changes to physical stream condition.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no untreated discharge of Montana CBNG water into Rosebud Creek under the Preferred Alternative and impacts would be the same as Alternative F. As there would be no untreated discharge under this alternative there would be no alteration of beneficial uses.

The moderate increases in flow caused by these discharges may result in minor changes to physical stream conditions.

Little Powder River

The Little Powder watershed is the site of CBNG development in Wyoming but the most prospective portion of the Fort Union Formation (the Tongue River Member) is sparsely present under this watershed in Montana. Because of the distribution of the Fort Union, little CBNG exploration and production is expected to occur in the Montana portion of the watershed. The quality of the Little Powder River exceeds the numerical standards of the MDEQ and it is an intermittent stream (that is, 7Q10=0). Therefore, no treated or untreated discharges are expected under the Preferred Alternative. Impacts would be the same as Alternative F and there would be no degradation of beneficial uses.

The moderate increases in flow caused by treated discharges may result in minor changes to physical stream conditions.

Powder River

The Preferred Alternative assumes 100 percent of potential CBNG discharge (40 percent MMM) would be taken up by Wyoming development, therefore none of the water produced in Montana would be discharged either in untreated or treated form under this alternative. The impacts to surface water quality under the Preferred Alternative will the same as under Alternative F.

Mizpah Creek

Impacts to surface waters are expected to be the same under the Preferred Alternative as under Alternative F since no untreated CBNG produced water could be discharged under these alternatives and treated discharges would be limited by the 40 percent MMM analysis threshold. Beneficial uses would not be reduced.

The moderate increases in flow caused by these discharges may result in minor changes to physical stream conditions.

Yellowstone River

The Yellowstone River receives the combined flows of all other watersheds in the Montana portion of the Powder River Basin. The Forsyth station is the upstream station which receives no contribution from Wyoming discharges, but will receive some MT CBNG discharge. The Sidney station is the downstream station and it will receive discharges from all Montana Powder River Basin wells and the approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under the Preferred Alternative. CBNG discharges to these streams would be a combination of treated and untreated water. The cumulative impact at the Sidney station, however, is expected to be less under this alternative than under Alternative E.

The Yellowstone at the Sidney gauging station will be impacted by a maximum number of wells during year 12 when Montana CBNG wells are forecast to produce 34,961 gpm of water. Effects to the Yellowstone under the Preferred Alternative are expected to be approximately the same as those under Alternative F. Although some discernable surface water effects may be detected at the Sidney station, beneficial uses would not be reduced under the Preferred Alternative.

The slight increases in flow that would result from this Alternative would result in unnoticeable changes to physical stream condition.

Summary of Surface Water Impacts

Impacts to surface water under this alternative will be essentially the same as under Alternative F.

Surface water quality in some watersheds would be slightly altered due to existing permits and CBNG development in Wyoming; however, downstream uses would not be diminished. Surface water flow would be moderately increased causing some localized riparian erosion, as well as locally increased sedimentation.

Abandonment

Impacts to water resources due to abandonment operations would be similar to impacts under Alternative E. When the estimated 16,403 CBNG production wells are abandoned over the 20-year project life, 33,000 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on Crow Tribal Lands under the Preferred Alternative would be similar to those effects noted in Alternative F, except that the peak volume of water discharged to the Little Bighorn River would be reduced. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. Any proposed federal CBNG development within

5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers resulting from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Northern Cheyenne

Surface water effects to Northern Cheyenne Tribal Lands under the Preferred Alternative would be similar to those impacts noted in Alternative F, since no additional direct discharge of CBNG water is assumed to occur into the Tongue River or Rosebud Creek. The beneficial use of the Tongue and Rosebud streams would be maintained under the Preferred Alternative.

CBNG developments have the potential to impact groundwater resources under Northern Cheyenne Tribal Lands. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Effects of this alternative on groundwater will be the same as Alternative B with the exception that if CBNG development is lessened or does not occur within crucial sage-grouse habitat then groundwater drawdown would be locally decreased around these habitat areas. The operator’s WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Cumulative impacts to Montana watersheds due Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this Preferred Alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Anticipated impacts under this alternative include slight alteration of surface water quality due to existing permits in Montana as well as current and forecast Wyoming CBNG development; however downstream uses will not be diminished. MPDES permits will be required prior to the discharge of any CBNG water (treated or untreated). It is not anticipated MDEQ would allow any untreated discharges due to the non-degradation rules for EC and SAR. The Montana BER standards are not anticipated to be exceeded. As such, beneficial uses of surface waters will not be impacted.

Indian Trust and Native American Concerns

Indian Trust Assets
Indian Trust Assets (ITAs) are official interests in assets held in trust by the federal government for Indian tribes or individuals. The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines ITAs as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians.

Alternative A
No Action (Existing CBNG Management)

- No measurable impacts to Indian trust impacts would occur from the CBNG activities.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - No surface water quality impacts.
  - Potential CBNG drainage, dependent on specific site conditions, delayed by buffer zone.
  - Air Quality impacts to reservation PSD Class I areas.
  - Visibility impacts.
  - Potential cultural resource impacts to TCPs
- State:
  - Groundwater drawdown inward from reservation boundaries.
  - Potential CBNG drainage, dependent on specific site conditions, no delay due to adjacent development.

Alternative C
Emphasize CBNG Development

- Federal:
  - Potential for surface water quality and quantity impacts.
  - Potential CBNG drainage, same as Alternative B.
  - Cultural Resource impacts same as B.
  - Air quality and visibility impacts same as Alternative B.
- State:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality and quantity impacts.
  - Potential CBNG drainage, same as Alternative B.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Federal:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses
  - Increased surface water flow could in increase riparian erosion.
  - Potential CBNG drainage, same as Alternative B.
  - Cultural Resource impacts same as B.
  - Air Quality and visibility impacts reduced.
- State:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality impacts reduced.
  - Potential CBNG drainage, same as Alternative B.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Federal:
  - Effects from groundwater drawdown substantially reduced by resource protection protocols. Potential CBNG drainage mitigated or compensated.
  - Surface water quality impacts reduced, with increased availability of surface waters for irrigation and other beneficial uses.
  - Increased surface water flow could increase riparian erosion.
  - Air Quality impacts mitigated through site specific permits and control measures.
- State:
  - Groundwater drawdown potential on the reservations would be minimized. CBNG drainage minimized by state spacing.
  - Surface water quality protected.

Alternative F
Phased Development Multiple Screens (High Range)

- Federal:
  - Potential effects from groundwater drawdown reduced by implementation of a 5-miles buffer zone. Potential CBNG drainage mitigated or eliminated.
  - Surface water quality impacts reduced.
  - Traditional cultural property (TCP) sites identified sooner through the use of block surveys and tribal consultations.
  - Air Quality impacts mitigated through site specific permits and control measures.
- State:
  - Same as Alternative E

Alternative G
Phased Development Multiple Screens (Low Range)

- Federal:
  - Potential impacts from alternative G would be similar to Alternative F except that they would be approximately 65 percent less due to the reduced number of APDs that are predicted to be issued. A 5-mile buffer zone would still be implemented around the reservation boundaries to protect against CBNG drainage or groundwater drawdown
  - Surface water quality impacts similar to Alternative F although reduced due to the decreased number of APDs that are predicted to be issued.
  - TCP site identified sooner through the use of block surveys and tribal consultations.
  - Air Quality impacts mitigated through site specific permits and control measures.
- State:

Same as Alternatives E and F.

Alternative H **Preferred Alternative - Multiple Screens**
• Federal: – Potential effects from groundwater drawdown reduced by implementation of a 5-miles buffer zone. Potential CBNG drainage mitigated or eliminated. – Surface water quality impacts reduced. – TCP site identified sooner through the use of block surveys and tribal consultations. – Air Quality impacts mitigated through site specific permits and control measures. • State: - Groundwater drawdown potential on the reservations would be minimized. CBNG drainage minimized by state spacing. Surface water quality protected.

Assumptions

The BLM's responsibilities include identifying and protecting tribal resources and trust assets from impacts resulting from BLM actions. The state does not have a trust responsibility similar to the federal governments. The 2-mile buffer zone around the reservations as called for in the management objectives for Alternatives B and D would only apply to federal leases. The 5-mile buffer zone around the reservations as called for in the management objectives for Alternatives F, G and H would only apply to federal leases.

Impacts From Management Common to All Alternatives

While the BLM would not have jurisdiction over Indian lands located on or off the reservation, the BLM would have a trust responsibility that encompasses oil and gas exploration. Indian Trust Assets (ITAs) would be managed following the DOI Secretarial Order 3215, Principles for the Discharge of the Secretary's Trust Responsibility.

The conventional wells expected to be drilled on BLM-administered lands could impact adjacent reservation lands by draining tribal hydrocarbons or groundwater, or even by allowing produced water to impact surface water resources or soil. Drainage by adjacent wells is addressed by 43 CFR Part 3162.2-2, which instructs the BLM on steps to be taken to protect Indian landowners from drainage.

The number of conventional wells estimated for reservation development (12) coupled with the predicted wells (less than 25) adjacent to reservation lands; do not represent a measurable increase in development on or near the reservation for the next 20 years. This level of development would not impact tribal hydrocarbons or effect groundwater resources. The direct land impacts from this small number of wells on reservation lands would be minor (less than 75 total acres impacted) with regard to grazing lands, vegetation and biological resources.

Construction and maintenance of the Tongue River Railroad (TRR) route would not directly impact Indian reservation lands; however, emissions from trains could impact air quality over parts of the reservations. Because of the proximity of the approved TRR route, the two reservations and residents could be indirectly impacted by the construction activities and the train traffic. Impacts to Indian lands along the entire TRR extension route are described, in part, in the follow three reports:

- Potential Cultural Effects on the Northern Cheyenne from the TRR Extension (Deaver and Tallbull 1991)
- Montana Department of Natural Resources Conservation, Tongue River Reservoir EIS (Aaberg and Tallbull 1993, Peterson et al. 1995)
- Draft Economic, Social, Cultural Supplement, Powder River I Regional EIS, (BLM 1989)
- TRR EIS (Surface Transportation Board 2004)

In considering Native American concerns, any Surface Transportation Board decision during construction or operation of the TRR Extension would be subject to the mitigation set forth in the programmatic agreement as detailed in Chapter 4.2.5.3 of the Supplemental EIS for the TRR Extension (STB 2004).

Social and economic impacts identified by the Northern Cheyenne that are associated with the construction of the TRR center primarily on potential in-migration of Native and non-Native Americans in search of construction related jobs. If the regional population was to increase, there are fears that non-Native Americans would settle in reservation communities if off-reservation housing facilities prove inadequate, leading to potential commensurate increase of contact with non-Native Americans. This increased inter-racial contact could increase tribal member exposure to prejudice; intolerance; and divergent ideas, values and behaviors (ICC 1992).

With regards to important wild plants, there are concerns that traditional gathering localities may be disturbed and access to these areas could be precluded by fencing erected along the route (ICC 1992).

As discussed earlier under Alternative C, the Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe.

Mitigation measures would help protect Northern Cheyenne tribal resources and off-reservation sites, such as the Rosebud and Wolf Mountain Battlefields, known to be of special importance to the tribe. A discussion of these mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to help protect resources such as groundwater, CBNG, air quality, wildlife, vegetation and off-reservation cultural resources of special interest to the tribe.

The Northern Cheyenne Tribe also has off-reservation properties held in trust that consist of two, tracts of land, approximately 160 acres each, in the vicinity of the Tongue River Reservoir. The tribe also acquired off-reservation surface estate consisting of the Moreland Ranch property. The mineral estate for the Moreland Ranch property is owned by the Consolidated Coal Company and could be subject to development; however it is currently not leased. The BLM would consult with the tribe to determine what mitigation measures are needed to protect the surface use of the ranch. Tribal buffalo herds are pastured at the Moreland Ranch property.

With regard to off-reservation TCPs and cultural artifacts the BLM has implemented a cultural survey requirement for the majority of CBNG lands to be developed under each POD. The use of these “block surveys” coupled with tribal consultation requirements has demonstrated the ability to identify the majority of sites that could be affected and reduce the potential impacts associated with developing CBNG in the vicinity of cultural resources.

Furthermore, on January 12, 2006, the BLM Montana State Office issued additional cultural resource requirements for oil and gas operations in Montana and the Dakotas. These requirements are intended for both oil and gas operators and cultural resource consultants hired by oil and gas operators. They supplement the *Guidelines for Identifying Cultural Resources H-8110-1* (the handbook) which remains the basic guidance for cultural resource work completed for BLM undertakings. Notice to Lessees, NTL-MSO-1-85, provides guidelines to operators when they are required to conduct cultural resource inventories. The NTL establishes the minimum survey area of 10 acres centered on each proposed well plus the access road, pipeline and ancillary areas subject to surface disturbance. Washington Office Instruction Memorandum (IM) No. 2003-147 (BLM 2003c) recommends block surveys ranging from 40 acres for individual wells to entire lease or full field development areas for large-scale projects to improve the APD process. Block surveys offer many advantages including reducing the probability that multiple surveys will be required to site a single project. Additionally, operators are encouraged to complete cultural resource surveys prior to the onsite inspection. This will allow the well location and/or access route to be sited prior to the onsite in order to avoid adverse effects on cultural resources and reduce the likelihood of having to change a location due to a cultural resource conflict discovered later in the APD review process.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

There would not be any impacts to measurable ITAs from the CBNG activities planned under this alternative.

This is based on the limited development scenario under this alternative, the known locations of production wells (CX Ranch) and the number of exploration wells.

Conclusion

There would not be any impacts to ITAs from management decisions under Alternative A or from management practices common to all alternatives. Cumulative effect impacts could result from the Absaloka Coal Mine and the production and discharge of CBNG production waters from Wyoming.

Mining activities at the 5,400-acre Absaloka Coal Mine facility located just north of the northeastern corner of the Crow Reservation has resulted in the irretrievable loss of the coal mined at approximately 5 million tons per year and has removed or disturbed approximately 3,150 acres of topsoil. Additional impacts have occurred from the dewatering of the coal that lowered the surrounding groundwater by an estimated 75 feet (Wheaton and Van Voast 1998).

Finally, the surface water within the vicinity of the mine has undergone a reduction in quality, resulting in impacts on the local watercourses and subsequent fields using these waters as sources of irrigation.

Development of CBNG in Wyoming during the next 20 years has the potential to impact the surface water, groundwater and methane resources of the Crow and Northern Cheyenne tribes. Drawdown of groundwater levels is an unavoidable impact from CBNG development. Increased groundwater drawdown would be experienced in coal seam aquifers along the southeastern border of the Crow Reservation adjacent to and up to 5 miles north of the Wyoming state line (Wheaton and Metesh 2001). The magnitude of impact to water wells and springs would depend on the location and number of CBNG producing wells south of the state boundary. Depending upon their locations, natural springs and water wells on tribal lands could go dry.

Wyoming CBNG production could also drain methane from tribal mineral resources. As groundwater is drawn down and reservoir pressures decrease, methane is liberated from the coal matrix and becomes free to be produced or migrate. Two-dimensional modeling (Crockett and Meyer 2001) suggests that drainage of methane could occur at distances more than 5 miles from a producing CBNG field. Recent three-dimensional modeling suggests that the methane drainage effect is less than two miles. This is based on the model results indicating that 80 feet of water would be drawn down at two miles from the edge of a producing field (Wheaton and Metesh 2002). In either case, the Crow Reservation is adjacent to the Wyoming boundary and is close enough to be drained by CBNG wells that may be drilled in Wyoming.

Full-scale CBNG production in the Wyoming portion of the Powder River Basin would result in limited surface discharge and infiltration of produced water to streams that flow north into Montana. Expected levels of development would result in volumes of discharged water causing a slight increase in annual flow rates of the Powder, Little Powder and Tongue rivers. A corresponding slight alteration in the quality of surface water would also be felt downstream from these Wyoming discharges. The percent increase in flow volume would be greater during periods of low-flow. This alteration may require downstream users to implement minor management changes. Impacts to the Tongue River would be felt by the Northern Cheyenne and Crow members who use river water for irrigation. Detailed discussions regarding surface water quality and flow changes are presented in the Hydrologic Resources section of this chapter.

The Bighorn and Little Bighorn rivers carry high quality water from the Bighorn Mountains north into Montana. No CBNG wells in Wyoming or Montana would impact these rivers under Alternative A. Stream water quality and flow volume would remain unchanged.

The Northern Cheyenne have a large reserved water right in the Tongue River Reservoir. That stored water represents a marketable commodity and if it were to experience even a slight decrease in quality, it would affect the tribes' ability to market or use the water. Under this full-scale Wyoming development scenario, it is conceivable that the reservoir water quality could be slightly altered.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Based on the development scenario presented in Alternative B and on the management objectives described under this alternative, potential impacts on ITAs include the drawdown of groundwater, alterations in surface water quality, air quality changes, potential social and cultural impacts, potential wildlife adaptation and the drainage of tribal CBNG.

A 20 foot drawdown of the groundwater table within the vicinity of a producing Montana CBNG field has been modeled (3D) by the Montana Bureau of Mines and Geology (MBMG) at between 4 to 5 miles from the edge of production (Wheaton and Metesh 2002). Without site-specific information, it is impossible to predict the degree of drawdown to a neighboring aquifer. In the case of the Crow and Northern Cheyenne, it is conceivable that the reservations' groundwater would be drawn down to some extent along the boundaries by both state and BLM-leased development. The drawdown of groundwater within the reservation could result in impacts on shallow stock and domestic wells and some surface springs. These impacts would reduce water pressure and in some cases could render the complete loss of water from a well or spring.

The recognition of a 2-mile buffer zone around the reservations would effectively reduce and delay the drawdown that would be experienced by the tribes in these areas from BLM leased mineral development. In the case of development on either private or state private lands, the state would not be subject to the same buffer zone restrictions and therefore, the drawdown could be generated earlier and be to a greater horizontal and vertical extent. The effect of these combined drawdowns would create a long-term impact to the groundwater level.

The alteration of surface water quality from the management objectives in this alternative is almost negligible because the alternative calls for the injection of all produced water and the storage of all waters generated during exploration well tests. However, the potential exists for localized, short-term (less than 1 year) impacts from spills and ruptures associated with these water disposal methods. Undetected ruptures along water conduits feeding injection wells also would impact soils and create erosion problems within the immediate vicinity. These impacts are not expected to reach reservation lands under this management objective. Only the spilled or released waters entering associated watersheds near the reservations would be affected.

Numerous social and cultural impacts have been predicted by Native Americans as a result of CBNG development on adjacent private, state and federal minerals. These potential impacts include the lack of access to well-paying energy-related employment contributing to the reduced annual Native American income; over-commitment of tribal revenues; population influx; abridged effectiveness of tribal governments; stressed infrastructure and service-related capacity; altered social organization and social well-being perception; and the further influence of western culture resulting in changes to traditional belief and value systems.

Off-reservation cultural and paleontological artifacts also run the risk of being damaged or lost due to the increased access and land-disturbing activities associated with full-scale development. TCPs may be affected as development expands. These impacts would be minimized through survey and consultation with the tribes.

Wildlife would adapt to the CBNG development infrastructure in ways that could be interpreted as negative or positive. For example, depending on one's perspective, big game migratory paths could shift resulting in greater opportunities for tribal outfitters and tribal hunters or diminished chances for euro-American outfitters and hunters. This scenario could result in reduced herd strength or increased susceptibility could also be viewed as a negative outcome or singularity. Given the various and complex perspectives, wildlife impacts need to be assessed on a case-by-case basis as individual CBNG actions are reviewed.

CBNG development would threaten to drain methane resources under tribal lands in the Planning Area. Drainage of CBNG resources from Native American minerals is dependent upon local reservoir parameters. It is assumed that a single CBNG well would drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin, however, suggests that drainage may be across a broader radius (Crockett and Meyer 2001) from BLM, private, or state lands. The Wyoming BLM estimates that considerable methane drainage happens when 40 percent of the hydrostatic head is removed from the coal aquifer. Modeling by the MBMG (Wheaton and Metesh 2002) suggests that the hydrostatic head of a producing coal seam could be reduced sufficiently to cause methane liberation at a distance of approximately two miles from the edge of a producing CBNG field. The reduction of hydrostatic pressure achieved by lowering the water table within a specific coal seam is necessary for CBNG production. This reduction liberates the methane held in the coal matrix; however, the complex, site-specific aquifer conditions dictate the actual radius of methane drainage. Therefore, conclusions regarding methane drainage from tribal minerals need to be made on a case-by-case basis during development.

The reduction of the hydrostatic pressure in a coal seam and the resulting liberation of CBNG could also cause the methane to migrate along the path of least resistance and appear as an unchecked seepage at the surface. This scenario would be unlikely in view of the depths of the coal seams being explored (greater than 500 feet below the ground surface), the distance of foreseeable producing fields to the reservations and the relatively shallow groundwater wells used on the reservations for water production.

This alternative calls for the directional drilling of deeper coal seams, multiple completions in a single well bore and the simultaneous development of all coal seams within a field. These techniques would increase the likelihood that CBNG would be drawn from adjacent Indian mineral resources. Detailed explanations for these potential impacts can be found in the Hydrology, Geology and Minerals and Air Quality sections of this Chapter.

Mitigation agreements would be used to replace water lost from the drawdown of groundwater within aquifers impacted by CBNG production. These agreements would call for the replacement of the groundwater wells at the operator's expense. Another mitigation measure for large-scale groundwater drainage to the reservations is the installation of a hydraulic barrier between the production field and the reservation boundary. BLM would apply this mitigation measure to reduce and delay any water drainage from the reservations. Although hydraulic barriers have been used successfully to prevent migration of brackish or salty waters into drinking water resources, more research would be required to determine if they could be employed successfully in the coal seam aquifers of the Powder River Basin to prevent loss of groundwater resources.

Surface water discharge permits that limit the quantity of CBNG-produced water that is discharged would mitigate the impacts from Wyoming CBNG production, as well as from expanded CX Ranch production. Potential hydrocarbon migration would be the subject of detailed monitoring and periodic drainage analysis conducted by the BLM as part of their trust responsibility (see Monitoring Appendix for details and frequency of monitoring). Monitoring and conducting drainage analysis would reduce the likelihood for drainage of tribal CBNG resources. Native American development of reservation CBNG resources is another potential mitigation measure that would ensure the tribes receive their fair share of the CBNG revenues.

Conclusion

Impacts from management decisions included in Alternative B would result in impacts to surface water quality, groundwater availability, cultural artifacts and sites, wildlife, air quality, visibility and the irreversible loss of fluid and solid minerals.

The surface water quality impacts would be similar to those described under Alternative A, with only slight alterations to current quality.

The water drawdown from Montana CBNG development under Alternative B, coupled with the development of CBNG on the reservations, would result in a more widespread effect than just adjacent to the reservation boundaries. Considering the location of known coal occurrences, the groundwater drawdown would be experienced generally along the eastern portion of the Crow Reservation and across the entire Northern Cheyenne Reservation. The water drawdown would be contingent on the continuity of the coals, many of which are fractured, crop out, pinch out or have shale stringers. Impacts could not be detailed until the fields are developed. Under any scenario of development, the BLM would take measures to mitigate reservation groundwater drawdown resulting in no contributing influences from federal mineral development.

Associated with the development of full-scale CBNG production across the Powder River Basin are a network of gas compressors and other small emission sources that could contribute to air quality changes in the region. The non-project sources combined with the project sources to form a cumulative effect that contributions to changes in air quality. These changes could add to the pollutant concentration, possibly exceeding the Northern Cheyenne's PSD Class I area for the annual NO_2 and 24-hour PM_{10} increment standards. If site- specific analysis indicates these contributions would add to the pollutant concentration on the Lame Deer nonattainment area resulting in an exceedance, the tribe, state and the Federal Government would require mitigation measures to reduce and control the contributing sources of CBNG emissions.

The Crow Reservation would experience similar changes in air quality, but due to the reservation's classification as a PSD Class II area would not likely experience any exceedance of standards.

With regards to visibility, the air model indicates that the Crow and Northern Cheyenne reservations would experience some form of reduced vision or increased haze. Visibility impacts would increase under predicted cumulative impacts from project and non-project emissions. For more detailed discussions regarding Air Quality changes to the reservations see the Air Quality section of this chapter.

Potential effects to cultural artifacts, TCPs and wildlife would be mitigated by site-specific protective and control measures developed to reduce and/or eliminate detrimental changes.

Alternative C—Emphasize CBNG Development

The differences in management objectives for Alternative C that would affect ITAs are the direct discharge of a portion of untreated production water and to some extent, the removal of the directional drilling and multiple completion requirements. Impacts to air quality, visibility, cultural resources, wildlife and social services and infrastructure would be the same or similar to those described for Alternative B.

Important to note is that, depending on the water quality criteria developed by the MDEQ, various levels of impacts on surface water would occur. If the criteria imposed were to be relatively conservative, the discharge of CBNG produced water would be limited into watersheds of both low and high water quality, resulting in minimal surface water quality impacts and increased treatment and use of alternative disposal methods. On the other hand, if the criteria were to be somewhat liberal and allow untreated discharge of produced CBNG water into watersheds of higher quality, then impacts such as the following would be experienced: increased soil erosion and a corresponding increase in the addition of suspended sediment to surface waters adjacent to CBNG development; the elevation of existing SAR, EC and bicarbonate values for streams and rivers used by the tribes for irrigation; and the increase in flow that would result in riparian erosion and river course changes. These impacts are discussed in further detail in the *Hydrology* section of this chapter.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B. The development of federal minerals near the reservations would increase the rate at which the groundwater is removed and discharged to the surface. Additionally, impacts on shallow aquifers from the infiltration of untreated produced water are expected where the soils have a coarser texture (sandy to loamy) and good internal drainage (ALL 2001a), which would allow infiltration of produced water into subsoil-thereby impacting shallow aquifers. Some of the shallow aquifers adjacent to reservation boundaries would be affected by this type of short-term infiltration.

The discharge of untreated produced water into drainages and ephemeral watercourses adjacent to well sites would cause an overall increase in erosion leading to gullying. Based on the *Soils Technical Report* (ALL 2001a), much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 12). The long-term consequence is an anaerobic, waterlogged, saline/sodic soil that can be reclaimed, but would be very difficult to mitigate.

Drainage of Native American CBNG resources by adjacent production would be similar to that described for Alternative B for adjacent production. Site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case drainage determination is necessary.

Encroachment on the Absaloka Coal Mine by CBNG development would inhibit future coal resource recovery. Impacts associated with the groundwater drawdown would also occur. This is discussed further in the *Geology and Minerals* section of this chapter.

Conclusion

Impacts from management decisions included in Alternative C would result in impacts to surface water quality. State and private development would reduce groundwater availability and cause the irreversible loss of fluid minerals.

The impacts to surface water quality would be greater than described in Alternative B, but the biggest factors influencing water quality would be the creation of a Water Quality Agreement between Montana and Wyoming and the implementation of water quality criteria regarding degradation of Montana watersheds by the MDEQ. CBNG development on reservations would further increase the SAR value of available surface waters, adding to the chain reaction of impacts associated with erosion, sedimentation, riparian damage and land use applications.

Impacts on the Northern Cheyenne’s water right in the Tongue River Reservoir would be as described under Alternative A.

Impacts on groundwater drawdown and availability would be similar to those explained under Alternative B. Drawdown adjacent to the reservations would be increased.

Monitoring and drainage analysis would be necessary to evaluate the case-by-case CBNG drainage of adjacent fields. As stated under Alternative B, the timely development of CBNG on reservations would reduce the potential for adjacent mineral drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

The impacts on lands irrigated by streams and rivers receiving untreated CBNG discharge would be as described in the *Soils Technical Report* (ALL 2001a) and would be greatly dependent on the altered quality of the particular watershed being used. Increased soil erosion leading to gullying would be a result of development on the reservations along with erosion outside reservation boundaries.

Impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure would be the same or similar to those described for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The only differences in management objectives for Alternative D that would have an effect on ITAs is the treatment and piped conveyance of production water. This difference would reduce the impacts to erosion along ephemeral drainages, lower the sediment load in watercourses and limit the water quality impact to both surface water and groundwater. There would be an increase in available surface water for beneficial reuse because of the required treatment and lack of conveyance losses from the piped system of discharge. The lack of conveyance losses would increase the flow in receiving watercourses resulting in course changes and riparian alterations, as identified in Alternative A.

Groundwater drawdown would be as described in Alternative B because of the use of the buffer zone by the BLM. Mineral drainage also would be the same as discussed under Alternative B, with the use of monitoring required to evaluate the case-by-case field conditions. Irrigated lands would be less affected by the use of treated waters, as described in the *Soils* section of this chapter. The Absaloka Coal Mine would experience the same groundwater drawdown impacts as described under Alternative B. Impacts to visibility, cultural resources, wildlife, social services and infrastructure would be the same or similar to those described for Alternative B on all reservations. Impact to air quality on all reservations would be lower than Alternative B.

Conclusion

Impacts from management decisions included in Alternative D, management practices common to all alternatives and from projects evaluated under the cumulative effects analysis would result in increased surface water flow, reduction of groundwater availability and the irreversible loss of fluid minerals.

Impacts on surface water quality would be similar to those discussed under Alternative B with regard to the influence of Wyoming's CBNG production waters entering Montana and affecting the Northern Cheyenne water right in the Tongue River Reservoir. With the increase in flow from the treated waters in Montana, the overall SAR values would be adjusted downward, but only slightly. CBNG development on reservations would further add to available surface waters once treatment is administered; groundwater drawdown would be the same as discussed in Alternative B. Soil erosion would be decreased because of the use of conveyance systems, which would result in the reduction of suspended solids in watercourses and the elimination of gullying. The impacts on lands irrigated by streams and rivers receiving treated CBNG discharge would be reduced. Impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure would be the same or similar to those described Alternative B. Impacts to air quality on all reservations would be lower than those discussed under alternative B.

As stated under Alternative B, the timely development of CBNG on reservations would reduce the potential for adjacent fluid minerals drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

The management objectives for Alternative E would result in surface water, groundwater and potential methane drainage impacts similar to those described under Alternative E in the *Hydrology* section. Noteworthy are the approved Draft Surface Water Quality Standards of the Northern Cheyenne Tribe, which if approved by EPA, could result in restricted discharges in the Tongue River and Rosebud Creek. Regardless of what choice is made, impacts would resemble those described under Alternative E in the *Hydrology* section of this chapter. There would be no discharge of produced water (treated or untreated) into the watershed unless the operator has an approved NPDES permit and can demonstrate in their Water Management Plan how discharge could occur in accordance with water quality laws.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B, however, implementation of the BLM mitigation measures would reduce the likelihood that reservation water resources would be drained from off-reservation CBNG activities.

Water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation and channel stability reducing infiltration impacts to groundwater quality. In addition, impoundments are required to be permitted under the MDEQ General MPDES permit that includes additional conditions to minimize impacts to groundwater (see Hydrology Appendix).

Impacts on Native American hydrocarbons via adjacent production drainage would be similar to those described for Alternative C. As previously mentioned, site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case study is necessary. These studies would be required as part of the APD approval process, along with intensified monitoring to determine when and if tribal CBNG resources would be drained. If drainage is likely, the BLM would require the operator to take appropriate action, in consultation with the tribes, to reduce or eliminate the drainage, or in the case of a federal well, to compensate the tribe for the loss.

As discussed earlier under Alternative C, the Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe.

As for impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure these would be reduced from those described under Alternative B because of the control measures employed with each site-specific Project Plan and the other management features of this alternative discussed in Chapter 2.

Mitigation measures have been developed to protect the Northern Cheyenne Tribal resources, as well as culturally important off-reservation sites. A discussion of these mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to provide the BLM and the tribe with additional information regarding measures that would be used to protect site-specific resources such as groundwater, CBNG, air quality, wildlife, vegetation and cultural resources.

Conclusion

Impacts from management decisions included in Alternative E have the potential to result in a slight decrease to surface water quality and a minimal reduction in groundwater availability.

Impacts to the Northern Cheyenne's water right in the Tongue River Reservoir would be as described under Alternative A.

Potential impacts on reservation groundwater drawdown and availability would be mitigated by the implementation of specific BLM control measures. Potential impacts to groundwater would be identified early by the intensified monitoring planned under Alternative E.

Monitoring and drainage analysis would be conducted by the BLM to evaluate the potential for CBNG drainage. If monitoring indicated tribal resources were impacted measures such as production decreases or well shut-in would be instituted and the appropriate tribal compensation agreement implemented.

The impacts to lands irrigated by streams and rivers receiving CBNG discharge would be minimal as only slight alterations in surface water quality are anticipated.

Impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure would be reduced from those described under Alternative B because of the mitigation measures employed with each site specific Project Plan and the other management features of this alternative discussed in Chapter 2. Cultural resources include important off-reservation hunting, fishing and plant gathering sites.

Impacts to the Northern Cheyenne Reservation resources would be mitigated by the implementation of control measures described by the BLM in the Northern Cheyenne Mitigation Appendix.

Alternative F—Phased Development Multiple Screens (High Range)

Alternative F would result in reduced surface water, groundwater and methane drainage impacts to Indian Trust Assets as compared to Alternative E. This is due to the use of the 5-mile buffer zone, the 10 percent of the 7Q10 discharge threshold for federal minerals and enforcement of additional monitoring requirements for federal mineral development within this zone.

The MDEQ has set numerical criteria for surface water discharges within the Powder River Basin watersheds. These standards are displayed in Table 3-6. Direct, untreated discharge into stream is no longer permitted. Some existing operations obtained permits prior to this ruling and may continue to discharge limited amounts (1,600 to 2,500 gpm) of untreated CBNG produced water directly into the Tongue River. These permits are flow-based and allow increased regulated discharges during certain higher flow conditions. The new permit standards may result in restricted discharge to most rivers and streams in the CBNG emphasis area. This restricted discharge would most likely increase impoundment use, either as a means of disposal or storage prior to treatment. Regardless of what choice is made, impacts would resemble those described under Alternative F in the *Hydrology* section of this chapter. There would be no, or very limited, discharge of produced water (treated or untreated) into the watersheds from federally developed minerals due to the curtailment of the discharge by the threshold limit of 10 percent of the 7Q10.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B; however, implementation of the BLM mitigation measures coupled with the 5-mile monitoring proximity would further reduce the likelihood that any reservation water resources would be drained from off-reservation federal CBNG activities. Current monitoring at the CX field as gauged by 162 monitoring wells indicate that draw-down measurements after more than four years of production are 20 feet extending 1-2 miles (Wheaton and Donato 2004). Groundwater monitoring indicates drawdown is "similar to but somewhat less than expected" from the groundwater modeling conducted for the Statewide Document (Wheaton et al. 2005).

Water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation and channel stability reducing infiltration impacts to groundwater quality. In addition, any impoundments within 5-miles of the reservations would be monitored for infiltration effects to groundwater quality.

Impacts on Native American hydrocarbons via adjacent state or private production drainage would be similar to those described for Alternative C. The required drainage analysis and follow-up studies for operators extracting federal minerals within 5 miles of the reservations would further reduce the likelihood of tribal resources being drained. If drainage is determined to be likely, the BLM would require the operator to take appropriate action. The action would consist of consultation with the affected tribes, implementation of measures to reduce or eliminate the drainage, or in the case of a federal well, shut-in production until a later date when the drainage issue can be mitigated.

As discussed earlier under Alternative C, the Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe.

The potential for impacts to air quality, visibility, wildlife, social services and infrastructure would be less than under Alternative E because of the control measures employed with each site-specific Project Plan and the general leveling out of the development pace for CBNG across the basin. More comprehensive air quality analysis and possibly monitoring would also be required for PODs submitted within 5 miles of the reservation exterior boundary.

Mitigation measures would help protect Northern Cheyenne tribal resources and off-reservation sites, such as the Rosebud and Wolf Mountain Battlefields, known to be of special importance to the tribe. A discussion of these mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to help protect resources such as groundwater, CBNG, air quality, wildlife, vegetation and off-reservation cultural resources of special interest to the tribe.

The Northern Cheyenne Tribe also has off-reservation properties held in trust that consist of two, tracts of land, approximately 160 acres each, in the vicinity of the Tongue River Reservoir. The tribe also acquired off-reservation surface estate consisting of the Moreland Ranch property. The mineral estate for the Moreland Ranch property is owned by the Consolidated Coal Company and could be subject to development; however it is currently not leased. The BLM would consult with the tribe to determine what mitigation measures are needed to protect the surface use of the ranch. Tribal buffalo herds are pastured at the Moreland Ranch property.

With regard to off-reservation TCPs and cultural artifacts the BLM has implemented a cultural survey requirement for the majority of CBNG lands to be developed under each POD. The use of these “block surveys” coupled with tribal consultation requirements has demonstrated the ability to identify the majority of sites that could be affected and reduce the potential impacts associated with developing CBNG in the vicinity of cultural resources.

Furthermore, on January 12, 2006, the BLM Montana State Office issued additional cultural resource requirements for oil and gas operations in Montana and the Dakotas. These requirements are intended for both oil and gas operators and cultural resource consultants hired by oil and gas operators. They supplement the *Guidelines for Identifying Cultural Resources H-8110-1* (the handbook) which remains the basic guidance for cultural resource work completed for BLM undertakings. Notice to Lessees, NTL-MSO-1-85, provides guidelines to operators when they are required to conduct cultural resource inventories. The NTL establishes the minimum survey area of 10 acres centered on each proposed well plus the access road, pipeline and ancillary areas subject to surface disturbance. Washington Office IM No. 2003-147 (BLM 2003c) recommends block surveys ranging from 40 acres for individual wells to entire lease or full field development areas for large-scale projects to improve the APD process. Block surveys offer many advantages including reducing the probability that multiple surveys will be required to site a single project. Additionally, operators are encouraged to complete cultural resource surveys prior to the onsite inspection. This will allow the well location and/or access route to be sited prior to the onsite in order to avoid adverse effects on cultural resources and reduce the likelihood of having to change a location due to a cultural resource conflict discovered later in the APD review process.

Conclusion

Impacts from management actions under Alternative F have the potential to preserve surface water quality and minimize the drawdown of groundwater on the reservations.

Impacts to the Northern Cheyenne Tribe's water right in the Tongue River Reservoir would be as described under Alternative A.

Potential impacts on reservation groundwater drawdown and availability would be mitigated by the implementation of specific BLM control measures. Potential impacts to groundwater would be identified by the use of the 5-mile analysis requirement under Alternative F.

Monitoring and drainage analysis would be conducted by the BLM and operators to evaluate the potential for CBNG drainage. If monitoring indicated tribal resources were to be impacted measures such as production decreases or well shut-in would be instituted.

The impacts to lands irrigated by streams and rivers receiving CBNG discharge would be further reduced as only state and private untreated discharge would be likely.

Impacts to air quality, visibility, wildlife, social services and infrastructure would be reduced from those described under Alternative E because of the pace of development coupled with existing mitigation measures employed with each site specific Project Plan.

Cultural resources, including important off-reservation hunting, fishing and plant gathering sites would be identified within the POD development process due to the use of surveys and tribal consultation efforts.

Alternative G—Phased Development Multiple Screens (Low Range)

Effects under Alternative G would be the same as Alternative F but would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range of state, private and federal CBNG APDs (6,470) predicted to be approved in the Planning Area (as identified in the Reasonably Foreseeable Development scenario in the Statewide Document). This would result in a 65 percent reduction in activities related to CBNG development that could potentially have an effect on tribal resources or off-reservation sites of special interest.

Alternative H—Preferred Alternative - Multiple Screens

Under this Alternative, impacts to federal leases, CBNG resources and federal lessees would be similar to Alternative F. This Alternative manages the pace (rate) and place (geography) of federal CBNG development through protection measures applied to crucial habitat areas and limits to the discharge of untreated produced water from federal CBNG wells and emissions from sources associated with federal CBNG wells. More federal APDs could be approved annually and geographically than under Alternatives F and G as long as other resources are protected. Monitoring data would be required to help BLM determine which (where and when) federal APDs could be approved. These limits and thresholds (see Wildlife Appendix and Hydrology section) would serve to level the cumulative impacts over time. The production of CBNG would continue for a longer overall period of time compared to Alternative E because fewer number of federal CBNG wells may be drilled each year.

Alternative H would result in reduced surface water, groundwater and methane drainage impacts to Indian Trust Assets as compared to Alternative E. This is due to the use of the 5-mile buffer zone and enforcement of additional monitoring requirements for federal mineral development within this zone.

The MDEQ has set numerical criteria for surface water discharges within the Powder River Basin watersheds. These standards are displayed in Table 3-6. Direct stream discharge is no longer permitted on new wells. Existing operations were "grandfathered" in and are discharging directly into streams. Also, proposals are being considered to allow regulated discharges during certain flow conditions. These efforts would result in restricted discharge to most rivers and streams in the CBNG emphasis area and flow based discharge with increased impoundment use. Regardless of what choice is made, impacts would resemble those described under Alternative H in the Hydrology section of this chapter. There would be no or very limited discharge of produced water (treated or untreated) into the watersheds from federally developed minerals due to the curtailment of the discharge by the threshold limit of 10 percent of the 7Q10.

Implementation of the BLM mitigation measures coupled with the 5-mile monitoring proximity would reduce the likelihood that any reservation groundwater resources would be drained from off-reservation federal CBNG activities. Current monitoring at the CX field as gauged by 162 monitoring wells indicates that drawdown measurements after more than four years of production are 20 feet extending 1-2 miles (Wheaton and Donato 2004). Groundwater monitoring indicates that drawdown is "similar to but somewhat less than expected" from the groundwater modeling conducted for the Statewide Document (Wheaton et al. 2005)

Water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation and channel stability reducing infiltration impacts to groundwater quality. In addition, any impoundments within five miles of the reservations would be monitored for infiltration effects to groundwater quality.

Impacts on Native American hydrocarbons via adjacent state or private production drainage would be similar to those described for Alternative B. The required drainage analysis and follow-up studies for operators extracting federal minerals within five miles of the reservations would further reduce the likelihood of tribal resources being drained. If drainage is determined to be likely, the BLM would require the operator to take appropriate action. The action would consist of consultation with the affected tribes, implementation of measures to reduce or eliminate the drainage, or in the case of a federal well, shut-in production until a later date when the drainage issue can be mitigated.

The Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe. Encroachment on the Absaloka Coal Mine by CBNG development would create impacts associated with the groundwater drawdown. Increased coal bed aquifer drawdown could benefit the mine from methane extraction prior to coal removal, but could hinder and complicate aquifer restoration efforts once mining activities cease. In addition, the removal of coal seam water may create a situation where the coal mine would need to purchase water for dust control.

The potential for impacts to air quality, visibility, wildlife, social services and infrastructure would be less than under Alternative E because of the use of the air quality screen. The screen would be used to require modifications be made to existing operations if observed effects and modeled impacts completed for the annual review by MDEQ show that state or federal regulatory standards would be exceeded. Under these circumstances the BLM could disapprove additional CBNG APDs if available monitoring and air modeling of new proposals indicated effects that violate state or federal regulatory standards. In such cases BLM would first consider mitigation measures that would reduce impacts so that actions would comply with such standards. Furthermore, management direction under this alternative requires control measures to be employed with each site-specific Project Plan, maximum number of wells connected to each compressor and use of natural gas or electrical compressors only.

Mitigation measures would help protect Northern Cheyenne Tribal resources and off-reservation sites, such as the Rosebud and Wolf Mountain battlefields, known to be of special importance to the tribe. A discussion of potential mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to help protect resources such as groundwater, CBNG, air quality, wildlife, vegetation and off-reserbation cultural resources of special interest to the tribe.

The Northern Cheyenne Tribe also has off-reservation properties held in trust that consist of two tracts of land, approximately 160 acres each, in the vicinity of the Tongue River Reservoir. The tribe also acquired off-reservation surface estate consisting of the Moreland Ranch property. The mineral estate for the Moreland Ranch property is owned by the Consolidated Coal Company and could be subject to development; however it is currently not leased. The BLM would consult with the tribe to determine what mitigation measures are needed to protect the surface use of the ranch. Tribal buffalo herds are pastured at the Moreland Ranch property.

With regard to off-reservation TCPs and cultural artifacts the BLM has implemented a cultural survey requirement for the majority of CBNG lands to be developed under each POD. The use of these “block surveys” coupled with tribal consultation requirements has demonstrated the ability to identify the majority of sites that could be affected and reduce the potential impacts associated with developing CBNG in the vicinity of cultural resources.

Furthermore, on January 12, 2006 the BLM Montana State Office BLM issued additional cultural resource requirements for oil and gas operations in Montana and the Dakotas. These requirements are intended for both oil and gas operators and cultural resource consultants hired by oil and gas operators. They supplement the *Guidelines for Identifying Cultural Resources H-8110-1* (the handbook), which remains the basic guidance for cultural resource work completed for BLM undertakings. Notice to Lessees, NTL-MSO-1-85, provides guidelines to operators when they are required to conduct cultural resource inventories. The NTL establishes the minimum survey area of 10 acres centered on each proposed well plus the access road, pipeline and ancillary areas subject to surface disturbance. Washington Office IM No. 2003-147 (BLM 2003c) recommends block surveys ranging from 40 acres for individual wells to entire lease or full field development areas for large-scale projects to improve the APD process. Block surveys offer many advantages including reducing the probability that multiple surveys will be required to site a single project. Additionally, operators are encouraged to complete cultural resource surveys prior to the onsite inspection. This will allow the well location and/or access route to be sited prior to the onsite in order to avoid adverse effects on cultural resources and reduce the likelihood of having to change a location due to a cultural resource conflict discovered later in the APD review process.

Conclusion

Impacts from management actions under Alternative H would be the same as under Alternatives F and G.

Potential impacts on reservation groundwater drawdown and availability would be mitigated by the implementation of specific BLM control measures. Potential impacts to groundwater would be identified by the use of the 5-mile analysis requirement.

Monitoring and drainage analysis would be conducted by the BLM and operators to evaluate the potential for CBNG drainage. If monitoring indicated tribal resources were to be impacted measures such as production decreases or well shut-in would be instituted.

The impacts to lands irrigated by streams and rivers receiving CBNG discharge would be further reduced as only state and private untreated discharge would be likely.

Impacts to air quality, visibility, wildlife, social services and infrastructure would be reduced from those described under Alternative E because of the pace of development coupled with existing mitigation measures employed with each site specific Project Plan

Cultural resources, including important off-reservation hunting, fishing and plant gathering sites would be identified within the POD development process due to the use of surveys and tribal consultation efforts.

Lands and Realty

Lands and Realty

Planning Area Land Ownership:
- Private 69%
- Federal 15%
- Tribal 10%
- State 5%

Total Acreage:
19,371,593

Miles of Road:
- Interstate, 386
- US, 675
- State, 409
- Off-System, 24,431

Miles of Railroad:
- Burlington Northern Santa Fe (BNSF), 573
- MontanaRail Link, 146

Alternative A
No Action (Existing CBNG Management)

- Federal:
  – Minimal land area displaced by roads.
  – 400 acres disturbed during CBNG exploration drilling.
- State:
  – Increased motorized access on the CX Ranch.
  – Increase motorized trespass.
  – 1,100 acres disturbed during CBNG exploration and production activities.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  – Increase fire hazard and motorized access.
  – 25,600 acres disturbed during CBNG development activities.
- State:
  – Displace agricultural lands.
  – Disrupt irrigation system, increase cost of farm operation.
  – Reduced property values.
  – Displace community and residential growth.
  – Increase dust and noise impacts on residential use.
  – Increased cost of county road maintenance.
  – Increase long-term motorized access.
  – 29,750 acres disturbed during CBNG development.

Alternative C
Emphasize CBNG Development

- All impacts in Alternative B occur in Alternative C in addition to:
  – The land use displacement from roads and utility lines during lease operations is greatest in Alternative C
  – 70,000 acres would be disturbed by CBNG activities on private, state and federal lands

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- All impacts in Alternative B occur in Alternative D in addition to:
  – Federal: Permanent loss of land use from road network.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Levels of disturbance would be 27 percent greater than Alternative B because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities.
- Impacts from power lines, roads, pipelines and other utilities not requiring transportation corridors would be the same as Alternative C.

Alternative F
High Range Phased CBNG Development

- Federal:
  – 25,600 acres disturbed during CBNG exploration and construction activities (short-term).
  – 15,250 acres disturbed during operation (long-term).
- State:
  – 29,550 acres disturbed during CBNG exploration and construction activities (short-term).
  – 17,600 acres disturbed during operation (long-term).
- 88,170 acres cumulative effects.
- If no development occurs in crucial sage-grouse habitat, cumulative impacts would be reduced to 82,527 acres (6.4% reduction from 88,170 acres).

Alternative G
Low Range Phased CBNG Development

- Levels of disturbance are 65 percent less than Alternative F.
- Federal:
  – 9,100 acres disturbed during CBNG exploration and construction activities (short-term).
  – 5,400 acres disturbed during operation (long-term).
- State:
  – 10,500 acres disturbed during CBNG exploration and construction activities (short-term).
  – 6,250 acres disturbed during operation (long-term).
- 20,450 acres cumulative effects.

Alternative H
Preferred Alternative

- Federal:
  – 25,600 acres disturbed during CBNG exploration and construction activities (short-term).
  – 15,250 acres disturbed during operation (long-term).
- State:
  – 29,500 acres disturbed during CBNG exploration and construction activities (short-term).
  – 17,600 acres disturbed during operation (long-term).
- 88,170 acres cumulative effects.

Assumptions

Gas from CBNG wells is normally measured at the well site or on a collection line before mixing at field compression stations, making it possible for flow lines and compression stations to be shared by different operators to reduce development cost and surface disturbance.

Split estate surface owners have the right to maintain control of non-CBNG related access.

Operators are responsible for communicating requirements and stipulations to independent contractors working on behalf of the operator when performing various phases of CBNG exploration and production development.

There are no expected disruptions to existing fiber optic, phone, gas, electric, or water lines as a result of the construction, production, or abandonment of project alternatives. It is the responsibility of the operator to identify and avoid buried lines within the pathway of new surface-disturbing activities.

According to the Farmland Protection Policy Act, federal agencies involved in proposed projects that may convert farmland to non-agricultural uses must complete a USDA Farmland Conversion Impact Rating Form AD-1006. The form focuses on two farmland designations: prime farmland and agricultural lands of statewide importance. Prime farmland and agricultural lands designations are based on soil type and productivity and are not based on present use. The AD-1006 form would be completed for each APD application or as part of an Environmental Assessment (EA) checklist to assess impacts to agriculture on federal lands.

No physical displacements of residences or commercial property would result from project alternatives.

CBNG-related, human activity increases fire hazards in the Planning Area. The loss of vegetation by fire would impact all land uses including ranching, recreation and agriculture and would limit access to public lands because reclamation would be sensitive to soil disturbance.

The required reclamation plan by the operator would be reviewed and approved by BLM on federal lands, by the state on state lands and by the landowner on private lands.

Impacts from Management Common to All Alternatives

Potential land use impacts would primarily consist of conflicts between conventional oil and gas activities and other uses of property, such as agriculture, residences and coal mines. New authorizations for major gathering lines, major transportation lines and power lines, for example, would impact rights-of-way (ROWs) and land segmenting. The development of oil and gas resources impacts agricultural production by taking land out of production and by soil contamination from drilling and production activities.

Surface disturbance associated with oil and gas activities, such as roads, well pads and battery sites would remove those areas of agricultural production during the life of the road, well pad, or tank battery site. Removal of vegetation would reduce the acreage available for livestock grazing or crop production. Buried flowline and utility line routes would be seeded so the acreage would be temporarily removed from use for grazing or crop production. The infrastructure associated with oil and gas production could affect the movement or area available for livestock and could hinder irrigation systems.

Most existing roads would be lightly traveled by local residents, ranchers and oil and gas workers. Use of unimproved roads would increase because of daily operations for a month at each site during development and testing of exploration wells. This road activity would be increased in general areas targeted for well development. Unimproved roads would be vulnerable to damage in adverse weather conditions. Public and private lands could be impacted by driving on soft or unstable road surfaces.

Residents and public visitors would be impacted by the sights, sounds and delays caused by the construction and testing of exploratory and production wells. An increase in slow-moving vehicles would be an impact in areas not currently experiencing these activities. Creation of a temporary, unimproved, unrestricted access road to an area would allow public access and exposure of the property in a new way and would expand the road system requiring maintenance by federal or state agencies and private landowners.

Public access to most wells would likely be limited because 69 percent of the land area is private; however, there would be conflicts with recreation (see the *Recreation* section of this chapter). Short-term impacts would occur during road building, pad development, drilling and production-related activities. Access for recreation on legally accessible public lands would increase as a result of the increase in unimproved roads. These impacts would be viewed as a benefit to sportsmen, who generally support increased vehicle access. Road densities on private lands would likely increase in the areas targeted for oil and gas wells, but property owners would be responsible for access control.

CBNG development would increase the likelihood of fire because there would be potential incendiary activities occurring where none now occur. Specific causes may include methane leaks, electrical fires from drilling and other construction activities, fires from ruptured gas pipelines, careless smokers, gas migrating from domestic wells contaminated with methane gas and hot catalytic converters on vehicles.

Produced water of quality suitable for livestock could be placed in impoundments in areas currently without such impoundments for livestock. This would enhance or expand livestock grazing. Construction disturbance would also force cattle onto previously unused range, further changing land use (see discussion on Livestock Grazing). Similar displacement would occur for wildlife, disrupting hunting on land designated for controlled or general hunts.

There may be a trespass impact to private landowners from the conversion of unroaded federal lands with a right-of-way that now allows access to private lands.

On private and public lands, road maintenance would be specified in the lease agreement, drilling permit or Right of Way as the responsibility of either the contractor or landowner.

Complete removal of the indication of vehicle passage and revegetation of two-track exploration on public lands would be important to prevent these temporary roads from becoming an established access through consistent misuse by four-wheel-drive and all-terrain vehicles, especially in areas historically not accessed by vehicles. The Vegetation section describes the seeding policy for reclaiming surface disturbances.

Activities other than those associated with CBNG production are expected to result in additional land disturbance. These activities include conventional oil and gas, active coal mines, fires, highway projects, power plants and the proposed Tongue River Railroad.

The proposed Tongue River Railroad would require the acquisition of 447 to 636 acres for the ROW. Land within the ROW would be lost to its present use and some parcels would be intersected by the rail line, possibly resulting in a change in existing use. Construction of the railroad would increase vehicle use and maintenance of local roads in the project area over the short term, while travel along these roads would also be affected over the long term by delays from grade-level train crossings (STB 2004).

Impacts From Management Specific To Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts on multiple uses of public lands would be minimal because there would be no CBNG production development on federal lands. State and private lands would have limited CBNG production activities.

Exploration

The amount of new roads to be built would be minimal relative to other alternatives. The primary land use impacts on federal and state lands are from short-term direct land use displacement by exploratory well pads and the creation of two-track trails across prairie or other lands from exploratory equipment. Impacts on private lands would be largely addressed in the contractual agreement with the private owners of the CX Ranch.

Production

Newly created roads for CBNG production would increase access across the CX Ranch that may displace or change the land use patterns on the land.

Abandonment

Two-track trails and associated motorized access created by CBNG exploration on federal and state lands would be reclaimed after abandonment, unless otherwise authorized. New access created under a ROW may be reclaimed depending on the situation and the BLM and surface owner’s requirements. New motorized access in watersheds targeted for water quality restoration by MDEQ may require road reclamation as part of abandonment. Reclamation based on water quality would be on a case-by-case basis with involvement from MDEQ. Abandonment and reclamation of roads on the CX Ranch could be highly variable according to the agreement with the surface owner. Abandonment impacts on private land cannot be determined because of its variability, but private landowners would be able to negotiate reclamation agreements to avoid long-term impacts to their land. Unwanted roads on the CX Ranch would be obliterated and revegetated according to the agreement with the lease operator.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts to the reservation. Trespassing from CBNG related vehicles might increase because of activities adjacent to the reservation. Traffic is also expected to increase on reservation roads.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Traffic is also expected to increase on reservation roads.

Conclusion

Alternative A would have the least land use impact among alternatives because of the limited number of exploration and production wells within the Planning Area. The greatest potential land use impact would be the ranching disturbance and displacement on the CX Ranch (see the *Livestock Grazing* section of this chapter). Approximately 500 acres of surface area would be disturbed (Table 4-56), which is less than 0.01 percent of the total Planning Area.

Cumulative impacts are estimated to be approximately 41,070 acres of disturbance from CBNG related and other activities within the Planning Area. The cumulative impacts comprise less than 1 percent (0.21 percent) of the entire Planning Area.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Exploration and Production

Short-term impacts of land uses during construction would consist of the physical intrusion by CBNG crews and equipment, the local generation of dust and noise and the limited obstruction of traffic. Long-term impacts include loss of existing land use, increased access from roads and loss of land value.

Some surface landowners are unaware of the severed mineral rights and even though compensated, would be displeased with the possibility of having well facilities located near dwellings. There are no legally required buffer distances between CBNG facilities and residential, community, or government dwellings. Placement of roads and well pads near residential, business and community dwellings may cause direct reduction of property values.

TABLE 4-56

ACRES OF LAND DISTURBANCE FOR CBNG WELL EXPLORATION, CONSTRUCTION AND OPERATION BY ALTERNATIVE

		Acres of Short-term Land Disturbance (Exploration and Construction)			Acres of Long-term Land Disturbance (Operation)			Total Acres of Cumulative Effects[1]
Alternative	**Number of Wells**	**Federal Wells**	**State/Private Wells**	**Total**	**Federal Wells**	**State/Private Wells**	**Total**	
A	675	400	1,100	1,500	0	500	500	**41,070**
B and D[2]	18,275	25,600	29,750	55,350	15,250	17,700	32,950	**88,270**
C[2,3]	18,275	32,400	37,600	70,000	22,000	25,600	47,600	**109,497**
E[2,3]	18,275	34,250	39,750	74,000	20,350	23,650	44,000	**99,370**
F and H[2,4]	18,225	26,600	29,550	55,150	15,250	17,600[4]	32,850	**88,170**
G[2]	6,470	9,100	10,500	19,600	5,400	6,250	11,650	**20,450**

[1] Cumulative effects include long-term acres of disturbance from CBNG well operation (BLM, state and other) and other projects or activities identified in the RFD. Other projects or activities included in the cumulative effects total an additional 41,070 acres as described in the Minerals Appendix.
[2] Ten percent of CBNG wells are predicted to be dry holes. Acres of disturbance for these wells are considered to be the same as for exploration. Consequently, only 90 percent of the predicted wells would result in long-term land disturbance from construction and operation.
[3] The long-term direct impacts and the length of roads and corridors would be 27 percent greater for Alternatives C and E than for Alternatives B, D and F because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities under Alternatives C and E.
[4] Fifty fewer state wells are included for Alternatives F and H because they were predicted to occur in the three counties outside the Billings and Powder River RMP areas. The difference in total acres of land disturbance from these wells is small relative to the total acres of land disturbance from all predicted wells.

Although there may be no statute that covers buffer distances, State of Montana oil and gas leases include a minimum buffer distance of 200 feet. Reasonable additional buffers can be added as needed at the time of site-specific operating plan review, including movement up to 656 feet on Federal leases.

Impacts from placement of roads, utility lines, pipelines and well pads around communities may cause loss of future community development opportunities. These uses displace other surface uses like residential development and location of public parks and schools. There are safety and liability concerns.

Although private landowners and state land managing agencies would help decide road routes on their lands, as described in the Mitigation section, they would likely want to maintain some roads that benefit existing or future uses.

The increase in average daily traffic of U.S., interstate and state highways by action alternatives would be minor and is not expected to decrease their designed level of service within the CBNG Planning Area. Increased highway average daily traffic over the 20-year life of the project would be largely from increases in demographics.

County roads in some portions of the Planning Area would receive substantial CBNG exploration and development traffic volumes. This large influx of CBNG-related traffic on some isolated county and local roads would increase their associated road maintenance cost.

Lease operators would discuss compensation with county and local road and bridge departments when CBNG-related traffic has caused increased road maintenance cost. There may be times when an operator or a group of operators may choose to provide maintenance for a particular road.

Short-term exploration impacts to farming include seasonal loss of crops during construction, interference with irrigation patterns and increased introduction of noxious weeds.

Cropland area converted to production well pads and roads would be lost for the up to 20-year life of the project. Four percent of wells in the Powder River RMP area and 8 percent of the wells in the Billings RMP area would occur in cropland soils. Specific long-term impacts include land displacement; alteration of existing flood and center pivot irrigation systems; modification of farming operations near and around well pads and access roads; potential for proliferation of noxious weeds; surface and groundwater quality losses; farming operations that are no longer commercially viable at certain locations; economic losses associated with all of the above; and lower land values.

Direct impacts on commercial woodlands would be caused by the immediate harvest of timber in ROWs and well pad sites and the loss of timber growth in these areas during the life of production and time of regrowth to merchantable trees. The income loss for the tree growth loss is reflective of time to grow merchantable trees, which is 50 to 100 years after reclamation of ROWs and pad sites. New roads on public forest lands may become part of the existing road system and their ROWs would be a permanent loss of timber production. The increased use of four-wheel-drive and all-terrain vehicles would allow other vehicles to have extensive access once a route is established.

Roads from CBNG development and CBNG-related motorized activity may create conflict with timber cruising, logging and hauling activities of an active timber sale. CBNG-related traffic could increase traffic hazards with log-hauling trucks unless road use coordination occurs.

Indirect impacts from land clearing include wood fuel loading, introduction of noxious weeds; increases in insect population from slash buildup; and increased access for forest and fire management. CBNG-constructed roads may not always be located in the best area for managing forest resources.

Abandonment

On federal and state lands, the access plan would create fewer two-track trails and roads than other development alternatives. Utility reclamation would occur with road reclamation because they are located in the same corridor. Public access would be restricted over the life of the CBNG productions on the road network and would not become part of the permanent public access network. On private lands, road abandonment would be highly variable because each landowner agreement could be different.

Regeneration time of timber to commercial size after CBNG activities or other related land use would likely be 50 to 100 years. Road obliteration would include re-contouring the landscape and planting tree seedlings appropriate to the forest site.

Damage from a fire related to CBNG activities would be the responsibility of the operator. Liability of fire is detailed in Statute 50-63-103 MCA.

Crow Reservation

If there were no CBNG development on tribal Lands, then impacts on the reservation, other than CBNG related traffic discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative B.

Conclusion

Alternative B would have fourth smallest impact to present land use of the seven development alternatives (B, D, C, E, F, G & H). For example, the required use of a transportation corridor for both road and utility lines in a one-way pattern reduces the direct surface disturbance by an estimated one-third compared to a grid pattern, multiple corridor approach.

Common land use impacts from roads, pads, pipelines and utility lines include direct loss of agriculture, timber, grazing, recreation and wildlife habitat and increased potential of wildfire. Indirect impacts include limited road access; dust, noise and reduced property values; and increased local road maintenance cost, production, water storage and ground injection, which reduces the potential direct and indirect impacts to other surface land uses. Residual benefits of the road networks created for CBNG development include increased access for fighting fires and create fuel breaks.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Although minimal impacts due to dust may occur, dust abatement measures would be actively employed to minimize impacts to air quality as well as land resources. Surface owner agreements would be used to prevent avoidable impacts to residents and communities. Impacts minimized by surface owner agreements include, but are not limited to, disruption to irrigation facilities, placement of roads, pipelines and well pads. Unmitigated impacts include displaced, non-monetary uses like public access, fire hazards and noise disturbance to livestock. Alternative B is estimated to cause 32,950 acres of long-term surface disturbance (Table 4-56), which is less than 1 percent of the total Planning Area.

Cumulative impacts for Alternative B include increased fire hazards from CBNG exploration and development, which are the largest potential cumulative economic and environmental impacts to future land uses. The loss of range, timber, habitat, dwellings, access and other impacts would not be recovered for a long time. However cumulative impacts are estimated to be 88,270 acres which is less than 1 percent of the entire Planning Area.

Alternative C—Emphasize CBNG Development

The less stringent access plan, separate placement of pipelines, utility lines, lack of buffers and use of production water, would lead to an increase in surface land disturbance when compared to the other alternatives.

Exploration and Production

New production roads may be placed along existing trails or be placed in the more traditional road grid system, which allows multiple routes from any production intersection. The traditional road grid system used for CBNG production would create the highest density of roads and may increase the size of the public road network. On private lands, road placement would be a contractual agreement with the surface owner and roads may be left in place or reclaimed.

Surface disturbance from roads, pipelines and utility lines is estimated to be approximately 30 percent greater than Alternatives B and D (see Table 2-2 in Chapter 2) because there are not the same road and utility restrictions to this alternative. Surface disturbance and its impact to agriculture is similar to Alternative B because most agriculture is on private lands. The potential impacts from production water discharges are also similar for the same reason.

CBNG production water may have high levels of salinity or sodicity, which can cause negative impacts to agriculture with continued use. The saline level of the average CBNG production water is near the threshold for causing yield reduction. Reduction in yields would be expected in salinity-sensitive crops like alfalfa, corn and clover hay. High SAR production water would reduce water infiltration, especially in clay soils and would increase erosion. CBNG water with combined high SAR and low EC can cause notable reductions in the water infiltration rate of irrigated crops (ALL 2001b). Repeated sprinkler-applied CBNG water high in saline can cause salt accumulation near the soil surface and cause foliar damage to certain crops. Dewatering coal seams may lead to release of methane gas that can contaminate neighboring agricultural and residential wells (ALL 2001b). The contamination of wells is a possibility that cannot be estimated in either amount of methane per well or by proximity of a well to a CBNG field. Any contaminated well could be rendered unusable and if the well is within a closed structure, increased ventilation is required to reduce buildup to explosive quantities.

It must be assumed that the historic road grid system used for CBNG development is a worst-case scenario allowed under this alternative when there are no existing disturbances. The road grid system would create the densest road network and largest surface disturbance by providing multiple access to all the wells in the 80-acre well spacing proposal.

Abandonment

Land use displacement from road disturbances would be an assumed 20-year loss on federal, state and private lands as in Alternative B, except there is more displacement on federal and state lands with this alternative. Land use displacement on private lands would have varying degrees of reclamation based on whether road placements benefit long-term private operations.

There is limited access to many small federal land parcels within the Planning Area. CBNG lease operators would create roads to these parcels and increase access and potential public use of the federal parcels. Neighboring private owners who have contributed access to the federal and state parcels may incur increased trespass problems similar to Alternatives B and D.

Crow Reservation

If there were no CBNG development on tribal lands, then impacts on the reservation, other than increased CBNG-related trespass problems discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative C.

Conclusion

CBNG management under Alternative C would result in the most impacts to present land uses among the seven development alternatives (B, C, D, E F, G & H). The disturbance is estimated to be one-third greater than Alternatives B and D. The two main causes for the increased surface disturbance and land use displacement are from use of a traditional road grid system. Surface owner agreements would be used to minimize surface disturbance due to road placement.

Overall, approximately 47,600 surface acres would be impacted, even with the increased impacts, this area is less than one percent of the Planning Area.

Cumulative impacts including the additional surface impacts total 109,497 acres for Alternative C. The increased cumulative impacts remain below 1 percent of the entire Planning Area.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Short-term transportation impacts on federal and state land uses would be the same as Alternative B. However, the long-term transportation impacts would be greatest because road obliteration and reclamation might not occur under this alternative and would permanently displace present and future land uses. The roads would become part of the public transportation system and would increase vehicle access on federal lands. The existing public road network may receive substantial traffic during production, requiring increased maintenance cost by public agencies. The new roads on federal lands that are not reclaimed would become the maintenance responsibility of the corresponding public agency.

Crow Reservation

Impacts on the Crow Reservation would be primarily the result of vehicle trespassing.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative D.

Conclusion

Alternative D has the same short-term transportation impacts as Alternative B but has the greatest long-term land use displacement impacts from the created permanent roads. The types of land use displacement with this alternative are the same as other development alternatives. Surface owner agreements would be used to minimize impacts due to land use displacement.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Unmitigated impacts include public access, fire hazards and disturbance to livestock. Total permanent surface impacts and cumulative impacts are estimated to be the same as alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Exploration and Production

The type of impacts from roads, pipelines and utility lines in Alternative E are the same as those described in Alternative B. The extent of these impacts would be the same as described in Alternative C. This alternative, like Alternative C, would not require transportation corridors for the placement of roads, utility lines and pipelines. Existing disturbances would be used as much as possible for utility access. Management features of Alternative E include burying power lines in certain locations and requirements of a project plan to minimize impacts.

Land use displacement from road disturbances would be up to 20-years on federal, state and private lands as with Alternatives B and C. CBNG lease operators would create roads to small federal and state parcels never before road accessible to the public. Motorized trespass would be enhanced as a result of the increased road network on federal, state and private lands from CBNG-related exploration and development.

Agricultural-related impacts would be the same as those described in Alternative B.

CBNG activities increase the likelihood of fire. Road networks created for CBNG development would increase access for fighting fires.

Abandonment

Abandonment of roads, utility lines and powerlines would be the same as described in Alternative C.

On private lands, road abandonment would be highly variable as with the other alternatives because each landowner agreement would be different.

Liability of fire is detailed in Statute 50-63-103 Montana Code Annotated.

Conclusion

CBNG operators would be required to submit a Project Plan when the proposed development for an area would exceed one well per 640 acres.

The type of impacts from roads, pipeline and utility lines in Alternative E are the same as those described in Alternative B. The extent of impacts would be the same as described in Alternative C. This alternative, like Alternative C, would not require transportation corridors for the placement or roads, utility lines and pipelines. Existing disturbances would be used as much as possible.

New roads would remain open or closed at the surface owner's discretion. Roads would be reclaimed upon abandonment.

There would be no degradation of watersheds from release of production water. A Water Management Plan would be required for every exploration Permit to Drill. First priority for discharged water would be for beneficial uses.

The potential for fire hazard is the same as Alternatives B, C and D. Surface disturbances associated with Alternative E would impact approximately 44,000 acres long term (Table 4-56). This is equivalent to less than one percent of the Planning Area. The total area of cumulative impacts, including surface disturbances from additional activities described previously, is estimated to be 99,370 acres. This total area is less than 1 percent of the entire Planning Area.

Alternative F—High Range Phased CBNG Development

Exploration and Production

The types of impacts from roads, pipelines and utility lines are the same as those described for Alternatives B and D (Table 4-56). Development would likely have less surface land disturbance, decreased road construction and decreased long-term use due to the following: restrictions on the number of federal permit applications approved annually; consideration of cumulative effects within each 4th Order watershed and crucial habitat polygons during POD development; and the possible discharge of some untreated federal CBNG water to surface water instead of storage or treatment and conveyance. Watershed protection would likely include road obliteration and reclamation to mitigate sensitive wildlife resources, particularly sage-grouse. Thus, this alternative is expected to result in a decrease in open roads and a decrease in road maintenance costs. More roads are expected to be reclaimed under this alternative.

However, over the entire development period, it is expected that the total area disturbed would be most similar to, but slightly less than, Alternatives B and D, including exploration, construction, operation and cumulative effects. Thus, cumulative effects over the entire time period would be similar to Alternatives B, D and F (see Table 4-56). The difference between

Alternative F and Alternatives B and D is primarily the phasing of approved activities rather than the amount and extent of activities. Alternative F would result in a more even level of disturbance activity over the development period. With this phasing, it is likely that slightly less disturbance would occur than Alternatives B and D.

The type of agricultural effects would be similar to Alternative B, although the impacts would be distributed differently over the development period due to phasing of CBNG development.

CBNG activities would continue to increase the likelihood of fire, while road networks created for CBNG development would help to increase access for fighting fires.

Abandonment

Land use displacement from road disturbance is expected to be less considering the extent of displacement in a given year but with a similar total amount as Alternatives B and D over the development period. This is due to a phased development approach of well development and associated road construction, use, operation and maintenance.

Crow Reservation

For development proposed within 5 miles of the Crow Reservation, Alternative F would require the operator to include site-specific groundwater and air quality analyses in the POD to demonstrate no impact to reservation resources. Additionally, groundwater and air quality monitoring may be required during development to ensure that no impacts occur. As a result of this additional level of evaluation, an operator would likely be more cautious regarding its level of disturbance and the tribe would likely have increased opportunity to comment beyond consultation required under all alternatives. Potential mitigation measures reached in agreement with the tribe could include minimizing the amount of surface area disturbance and the extent of new road construction. The tribe could also request increased road abandonment and vegetation restoration following surface disturbance activities, all of which could decrease the overall extent of land disturbance.

Northern Cheyenne Reservation

Land use effects to the Northern Cheyenne Reservation would be similar as described above for the Crow Reservation.

Conclusion

Although the potential amount of surface and road disturbance for Alternative F is similar to Alternatives B and D, surface area disturbance and road construction associated with federal CBNG development would occur in different amounts and within different areas over the development period based on the phasing and watershed-level limitations that are part of this alternative.

With the potential to limit land disturbance and road construction based on watershed-level analysis, the presence of sensitive wildlife habitat and/or the location of development on or adjacent to Northern Cheyenne and Crow reservation lands, this alternative has the potential to have less land use impacts than Alternatives B, C, D and E. However, disturbance to specific areas over the development period is difficult to predict due to the decision to continue to reevaluate development in each watershed over the planning development period and the adaptive management approach that would be used to determine future location and extent of CBNG development.

Alternative G—Low Range Phased CBNG Development

Exploration and Production

The extent of impacts from roads, pipelines and utility lines would be about 65 percent less than Alternative F (Table 4-56). Effects would be phased over time and would have less surface land disturbance and decreased road construction and long-term use than the other development alternatives. Watershed protection would likely include road obliteration and reclamation in the interest of mitigating sensitive wildlife resources, particularly sage-grouse, which is sensitive to human disturbance. Thus, this alternative is expected to result in the lowest open road mileage and least road maintenance costs among all action alternatives. The maximum amount of open roads is expected to be reclaimed under this alternative.

Over the entire development period, it is expected that Alternative G would result in greater land disturbance than Alternative A (no action) but less land disturbance than the other development alternatives (Alternatives B, C, D, E, F and H).

The type of agricultural effects would be similar to Alternative B, although the impacts would be distributed differently over the development period due to phasing of development.

CBNG activities would continue to increase the likelihood of fire, while road networks created for CBNG development would help to increase access for fighting fires.

Abandonment

Land use displacement from road disturbance is expected to be the least amount in any given year and over the development period compared to the other action alternatives. This is due to the lowest number of new wells planned for construction, operation and maintenance, which would result in the lowest amount of road mileage.

Crow Reservation

Similar to Alternative F, Alternative G would have the least effect on Crow Reservation lands because this alternative would also require consultation with the Crow Tribe to minimize overall CBNG development effects. Mitigation measures reached in agreement with the Crow Tribe could include minimizing the amount of surface area disturbed and the extent of new road construction. The Crow Tribe could also request increased road abandonment and vegetation restoration following surface disturbance activities, all of which could decrease the overall extent of land disturbance.

Northern Cheyenne Reservation

Impacts on Northern Cheyenne tribal lands would be similar to that described under the Crow Reservation.

Conclusion

Alternative G would result in the lowest number of new wells and the least amount of total disturbed acres among the development alternatives. Other development effects of Alternative G would be similar to Alternative F since both alternatives would use a phased development approach.

Similar to Alternative F, Alternative G would limit land disturbance and road construction based on a watershed-level analysis, the presence of sensitive wildlife habitat and/or the location of development on or adjacent to Northern Cheyenne and Crow reservation lands. However, disturbance to specific areas over the development period is difficult to predict due to the decision to continue to reevaluate development in each watershed over the development period and the adaptive management approach that would be used to determine future locations and extents of CBNG development.

Alternative H—Preferred Alternative - Multiple Screens

Exploration and Production

The types of impacts from roads, pipelines and utility lines are the same as those described for Alternatives B, D and F (Table 4-56). Development would likely have less surface land disturbance and decreased road construction and long-term use through the use of four resource screens. Similar to Alternative F, mitigation would likely include road obliteration and reclamation in the interest of mitigating sensitive wildlife resources, particularly sage-grouse, as well as water and air resources. Additionally, long-term stakeholder planning within watersheds would likely result in consolidation of infrastructure through coordination and sharing between stakeholders. Thus, this alternative is expected to result in a similar level of open and closed roads, as well as decreased road maintenance costs as Alternative F.

Over the entire development period, it is expected that the total area disturbed would be most similar to Alternative F, including exploration, construction, operation and cumulative effects. The difference between Alternative H and Alternative F is how sensitive resources would be treated (water, wildlife and air), although cumulative land use effects are expected to be similar. Although Alternative H does not include an annual limit on APDs, the rate of development is expected to be similar to Alternative F due to the level of planning and environmental review necessary to address the four resource screens.

The type of agricultural effects would be similar to Alternatives B and F, although the impacts would be distributed over the development period more like Alternative F due to application of the four resource screens to proposed CBNG development.

CBNG activities would continue to increase the likelihood of fire, while road networks created for CBNG development would help to increase access for fighting fires.

Abandonment

Land use displacement from road disturbance is expected to be less, considering the extent of displacement in a given year, but with a similar total amount as Alternatives B, D and F over the development period. This is due to the level of planning necessary to address the four resource screens for proposed well development and associated road construction, use, operation and maintenance.

Crow Reservation

Alternative H includes a Native American Concerns screen, which would likely result in less impacts to the Crow Reservation and its resources than Alternatives B through F. For any POD submitted proposing activities within 5 miles of the reservation, Alternative H would require the operator to demonstrate in the POD that no impacts would occur to reservation resources, as well as monitoring during operations to ensure that no impacts occur (similar to Alternative F). Additionally, operators would be required to consult with affected tribes when proposing development in the vicinity of traditional cultural properties. Consequently, an operator would likely be more cautious on its level of disturbance and the tribe would likely have an increased opportunity to comment, although consultation with the tribe would occur under all alternatives. Potential mitigation measures reached in agreement with the tribe could include minimizing the amount of surface area disturbance and the extent of new road construction. The tribe could also request increased road abandonment and vegetation restoration following surface disturbance activities, all of which could decrease the overall extent of land disturbance.

Northern Cheyenne Reservation

Land use effects to the Northern Cheyenne Reservation would be similar as described above for the Crow Reservation.

Conclusion

The potential amount of surface and road disturbance for Alternative H is similar to Alternatives B, D and F. For alternative H, surface area disturbance and road construction associated with federal CBNG development would occur in different amounts and within different areas over the development period based on the resource screens and watershed-level analysis that are part of this alternative.

This alternative has the potential to have less land use impacts than Alternatives B, C, D and E, but similar effects as Alternative F. Alternative H has the potential to limit land disturbance and road construction based on a screening level analysis for air and water, the presence of sensitive wildlife habitat and/or the location of development on or adjacent to Northern Cheyenne and Crow reservation lands and traditional cultural properties, However, disturbance to specific areas over the development period is difficult to predict due to the decision to continue to reevaluate development in each watershed over the planning development period and the adaptive management approach that would be used to determine future location and extent of CBNG development.

Livestock Grazing

Livestock Grazing *AUM is equal to the amount of forage required to support one cow and her calf or 5 sheep for one month.* *Within the FSEIS Planning Area, BLM-administered surfaces have an estimated 1,389,908 acres of land classified as grazing, capable of supporting 259,554 AUMs.*
Alternative A **No Action (Existing CBNG Management)**
• Exploration wells located within BLM-permitted rangelands would result in the temporary loss of 69 AUMs • State: – The exploration wells and production wells located at CX Ranch would result in a maximum construction loss of 272 AUMs on state and private rangelands.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• Exploration wells would result in the temporary loss of 413 AUMs (BLM 163, State 250). • Production wells would result in a maximum construction loss of 11,960 AUMs (BLM 4,770, State 7,190).
Alternative C **Emphasize CBNG Development**
• Impacts to livestock grazing would be similar to but slightly greater than those in Alternative B due to the discharge of untreated production water on to the ground resulting in increased erosion • CBNG discharge water could be used for livestock watering. • Increased erosion could result in increased surface disturbance, which could lead to disrupted grazing patterns, undermined fencing and reduced forage. • A decrease in forage could occur if discharged produced water is too high in saline content; and possible effects to livestock if produced water is to unsuitable quality for stock watering.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B with some exceptions: disturbed acreage would increase due to the piping of discharge water to the nearest disposal point. There would be less forage losses than Alternative B.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts to livestock grazing would be similar to Alternative B. • Suitable CBNG discharge water could be used for livestock watering. • Managed irrigation of produced water would promote growth of vegetation.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts to livestock grazing would be similar to Alternative B and phased in after watershed analysis. • Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis • Impacts from federal CBNG development would occur primarily in the latter years of the planning period, generally following after state and private development.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F but the land disturbance area would be 65 percent less.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts to livestock grazing would be similar to Alternative B. • CBNG PODs would be screened for four resources, of which water management would have the most potential effects on livestock grazing. • Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis.

Livestock grazing and petroleum development would be generally compatible because exploration activity would be temporary and operational activities require a small area for equipment. Livestock grazing on rangeland would continue during CBNG and conventional oil and gas development.

Assumptions

Affected acres and animal unit months (AUMs) were calculated assuming all CBNG activity would be located on grazing lands. AUM losses were predicted separately for the two BLM RMPs and the state because of differences in permits and land grazing capacities. The analysis is focused on the Planning Area, but applies to similar areas throughout Montana. It is assumed that existing roads and fence crossings would be used for oil and gas operations as much as possible.

Impacts from Management Common to All Alternatives

Impacts on rangeland would occur from the loss of vegetation for livestock grazing; the disruption to livestock management practices; and loss of grazing capacity from construction of well pads and roads. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. With the exception of minimal short-term forage loss, these impacts would only last as long as construction activities were ongoing. Controlling livestock movement by maintaining fence line integrity would be used to preserve efficient livestock and range management. The construction of roads and pipelines would bisect fences, which would require placement and maintenance of cattleguards and gates. The current development of oil and gas and CBNG on state land would require installation of cattleguards on fence lines to prevent livestock escape. The impacts of oil and gas development would result in the loss of about 833 AUMs on BLM-Administered surface in the Billings RMP, 830 AUMs in the Powder River RMP and 359 AUMs on state-permitted rangelands. These losses would be reduced to a total of 735 AUMs during the production phase of oil and gas activities.

While roads, trails and well pads would block traditional cattle trails, this network of new roads would provide livestock producers with improved access to remote livestock facilities and grazing areas. However, road systems would interfere with livestock dispersal and cause decreased forage efficiency because cattle tend to congregate and travel along roads. The relatively high volumes of exploration vehicle traffic would present a hazard to livestock. Heavy traffic on temporary access roads would increase the risk of collision with stock, resulting in injury or death of the animals. Airborne dust stirred up by heavy exploration vehicles would settle on forage along the road. The dust would affect the palatability of grass and forbs up to 1/4 mile from the road. Livestock forage could be killed by accidental spills of crude oil, high saline-produced water, or drilling fluid.

Areas of soil disturbance, such as results from construction, may experience an influx of noxious weeds. Noxious weeds reduce rangeland value to livestock by displacing preferred forage species. Severe infestations would result if weeds are not controlled, decreasing rangeland capacity for grazing. Additionally, some weed species are poisonous to livestock, causing illness, internal injury, or death when ingested.

Loss of AUMs may be reduced somewhat through the beneficial use of produced water, primarily in poorly watered pastures and secondary rangelands. Also, there may be opportunities for surface owners upon well abandonment, to take ownership of CBNG wells and power sources for livestock watering purposes.

Activities other than those associated with CBNG production are expected to result in additional disturbances to livestock grazing. These activities include conventional oil and gas, active coal mines, fires, highway projects, power plants and the proposed Tongue River Railroad.

The proposed Tongue River Railroad would extend between 17.3 and 29.4 miles, traversing grazing lands bordering the valley bottom land. The ROW would include between 447 and 636 acres, most of which is agricultural rangeland (411 to 599 acres). The entire ROW would be fenced to keep domestic livestock off the tracks and livestock passes would be installed to allow continued movement between pastures. However local ranchers are concerned livestock may be reluctant to use the passes, especially those used infrequently and this may increase the time required to herd livestock between pastures. Operations may also increase the potential for railroad-caused range fires (Surface Transportation Board 2004).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Exploration wells located on BLM-permitted rangelands would result in the temporary loss of 30 AUMs for the Billings RMP rangeland and 39 AUMs for the Powder River RMP rangeland. There would be no production activities in BLM planning areas under this alternative and, therefore, no impacts from production. State-permitted exploration and production wells located at CX Ranch would result in a loss of 272 AUMs. Revegetating parts of the well pads during production would reduce the losses to 194 AUMs.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBNG development on the reservation, then reductions in AUMs could occur.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation.

Conclusion

During the next 20 years, disturbances from CBNG development, conventional oil and gas development and other projects considered under the cumulative effects analysis would result in the loss of about 863 AUMs in the Billings RMP, 869 AUMs in the Powder River RMP and 631 AUMs on state-permitted and private rangelands. These losses would be reduced to a total of 929 AUMs during the production phase of CBNG and conventional oil and gas activities. After CBNG production ceases, the lands would be reclaimed. Revegetated areas would be available for livestock grazing.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B considers expanded development of CBNG resources. Table 4-57 presents the predicted AUMs that would be lost from exploration, construction and production on both BLM and state grazing lands. Losses from exploration would be mostly temporary (less than 5 years) and would be reclaimed after exploration activities cease. Revegetating parts of the well pads during production would be used to reduce construction losses to those shown below under operation losses.

Impacts on livestock grazing would be reduced under this alternative through the requirement of transportation corridors, using multiple completions per well bore and directional drilling, injecting produced water instead of storing on-site in impoundments and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances shown in Table 4-57 by up to 35 percent during construction and 40 percent during production, thus reducing the number of AUMs lost.

Crow Reservation

If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBNG development on the reservation, then reductions in AUMs would occur.

Northern Cheyenne Reservation

If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBNG development on the reservation, then reductions in AUMs would occur.

Conclusion

During the next 20 years, disturbances from CBNG development on state, BLM, Native American and USFS lands; along with the cumulative effects of other projects would result in the loss of about 18,500 AUMs. These AUM losses would be partially recovered during the production phase of CBNG and oil and gas activities and after production ceases and the lands are reclaimed. The requirement for transportation corridors, injection of produced water (less land needed for impoundments) and multiple use of drilling pads would help to minimize livestock grazing losses up to 35 or 40 percent.

Alternative C—Emphasize CBNG Development

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and collocation of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-57); suitable CBNG discharge water could be used for livestock watering reducing the amount discharged; and the discharge of produced water to the surface would increase erosion and cause increased surface disturbance to livestock. Other impacts would include the possibility of an increase of noxious weeds and a decrease in forage material if produced water that is too high in saline content is discharged on the land surface and possible health effects if livestock consume produced water that is unacceptable (ALL 2001b).

TABLE 4-57

NUMBER OF PREDICTED ANIMAL UNIT MONTHS (AUMS) LOST TO EXPLORATION, CONSTRUCTION AND PRODUCTION FOR ALTERNATIVE B

	AUMs Lost to Exploration	AUMs Lost to Construction	AUMs Lost to Operation
Billings RMP	11	340	209
Powder River RMP	152	4,430	2,275
BLM Sub-total	163	4,770	2,484
State/Private Lands	250	7,190	4,420
Total	413	11,960	6,904

Generally, water is acceptable for livestock if the TDS is lower than 10,000 mg/l and the EC is less than 16,000 µS/cm. Some CBNG water has also been found to exceed standards for fluoride (2 mg/l) and aluminum (0.2 mg/l) (ALL 2001b). Discharging untreated CBNG-produced water on the ground surface at the well pad would lead to increased localized soil erosion and gullying, which could also lead to disrupted grazing patterns, undermined fencing and reduced forage.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies, fence post disturbance and limited vegetation loss.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies, fence post disturbance and limited vegetation loss.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and collocated wells are not required. Surface discharge of untreated produced water could result in increased forage loss, erosion, gullying, grazing pattern disruptions and fencing undermining. Forage losses could be permanent because of soil sterilization by saline water applications. This amount would vary depending on the quality and quantity of water discharged. Watering livestock represents only a small portion of the estimated 20 percent beneficial reuse assumed under this alternative, but would still result in a small amount of impacts reduction to the other resources.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on livestock grazing would be similar to Alternative C with the following exceptions: impacts from drilling and collocation of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; discharged CBNG-produced water would be treated and not discharged directly at the well site; and there would be a reduction to forage losses from increased managed irrigation of produced water through irrigation applications. This would be a favorable impact from having more treated water available in the winter and arid months available for livestock watering and irrigation of grazing lands. Mitigation measures would be similar to Alternative B.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative C with some exceptions: impacts from drilling and co-location of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; there would be a reduction to forage losses from increased managed irrigation of produced water; and there would be less soil and forage loss from erosion of soils.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and co-location of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-57); suitable CBNG discharge water could be used for livestock watering reducing the amount discharged; Water Management Plans would be designed on a site-specific basis so no degradation would occur to water quality or to beneficial use. Such uses could include livestock watering and irrigation (benefits for livestock). Mitigation measures would be similar to Alternative B.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and co-located wells are not required. There would be less soil and forage loss from erosion of soils. Beneficial use of produced water by watering livestock would reduce, by a small amount, the impacts to other resources.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: surface disturbance would be less since transportation corridors would not be utilized fully (but subject to watershed-level analysis), CBNG-produced water would be managed on a watershed basis and site-specific Water Management Plans would be designed so that no degradation would occur to water quality or to beneficial uses, such as livestock water; and CBNG production on BLM-administered surfaces would be limited on an annual and watershed basis, resulting in impacts being distributed differently over time and among watersheds. Development of federal CBNG wells would occur primarily in the latter years of the planning period, generally following state and private development, but subject to annual and watershed-specific development limits.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance potentially could be less since use of existing transportation corridors or less new road construction may be required as a result of watershed-level analysis. Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis, thereby potentially increasing beneficial uses of discharge water, which could include livestock watering. Impacts from federal CBNG development would occur primarily in the latter years of the planning period, generally following after state and private development, but subject to annual and watershed-specific limits.

Alternative G—Phased Development Multiple Screens (Low Range)

The extent of land disturbance from roads, pipelines and utility lines would be about 65 percent less than Alternative F. Effects to livestock grazing would likely be similarly less than Alternative F overall but would vary by watershed. Effects would be phased over time and would have less surface land disturbance and decreased road construction and long-term use than the other action alternatives. Thus, Alternative G is expected to result in the least effect on livestock grazing of the action alternatives over the entire planning period.

Crow Reservation

Impacts on Crow Reservation lands would be similar to those described for Alternatives B, D and F.

Northern Cheyenne Reservation

Similar to Alternative F, Alternative G would have the least effect on livestock grazing on Northern Cheyenne Reservation lands.

Conclusion

The cumulative effects of Alternative G would result in the lowest number of new wells and the least amount of total disturbed acres among the action alternatives. Other development effects of Alternative G would be similar to Alternative F since both alternatives would result in a phased development approach based on watershed analysis.

Disturbance to specific areas over the 20-year planning period is difficult to predict, because the alternative would reevaluate development in each watershed over the planning period by using an adaptive management approach to determine future location and extent of CBNG development.

Alternative H—Preferred Alternative - Multiple Screens

Alternative H is similar to Alternatives B and F, although four resource screens would be used to evaluate PODs and on-going development, rather than applying specific annual limits on approved APDs. However, the rate of development is assumed to be similar to Alternative F. In addition to applying the resource screens and watershed-level analysis, operators would be required to follow standard operating procedures for all CBNG development projects. Each POD would be developed in consultation with affected tribes, affected surface owner(s), permittees or lessees and other involved permitting agencies. BMPs would also be used in CBNG development.

As a result of the management actions stipulated for this alternative for crucial sage-grouse habitat areas, a lower level of development is anticipated to occur over approximately 93,259 acres. This would reduce the number of lost AUMs from construction and production phases when compared to Alternatives B and F. Overall, the AUMs lost may be reduced by up to 610 during construction and 318 during operation phases. These figures are likely higher than what will occur because some level of development is likely within the crucial sage-grouse habitat areas.

Four resource screens would be used to develop and evaluate PODs: water resources, wildlife, Native American concerns and air resources. The water screen could affect livestock grazing by altering the surface water quality of available stock water. Impacts on livestock grazing would be similar to Alternative F, but Alternative H would have the benefit of additional water protection. Surface disturbance would be reduced by limiting transportation corridors through watershed-level analysis. CBNG-produced water would be managed on a watershed basis and site-specific Water Management Plans would be designed to prevent degradation of water quality or beneficial uses, such as livestock water.

For each Water Management Plan, the BLM would establish a threshold for the volume of untreated water that could be discharged to surface waters from federal CBNG wells. These requirements would be in addition to the surface water quality and discharge volume limitations which are a part of the MPDES discharge permitting process.

If surface water monitoring indicates a water quality threshold would be exceeded, no further untreated discharge would be allowed from federal wells upstream from the monitoring station. Previously approved water management plans could be modified or rescinded if monitoring indicates unacceptable impacts are occurring. Water quality thresholds and surface water monitoring requirements are detailed in the Hydrology Appendix.

Produced water management plans and permits would be approved by BLM or the appropriate agency in consultation with affected surface owners. Surface storage of produced waters would also require an MPDES permit issued by MDEQ. Impoundments proposed as part of a Water Management Plan would be designed and located to minimize or mitigate impacts on soil, water, vegetation and channel stability. The WMP would also include designs to minimize or mitigate impacts to the available grazing forage. Additionally, such impoundments may be sources of water for uses benefiting livestock, such as livestock watering or surface irrigation.

Crow Reservation

The Crow Tribe considers groundwater a critical resource to their tribal health and welfare. Groundwater is used on the reservation for stock watering and drinking water supplies. In response to these concerns, the BLM would require federal lease operators to protect groundwater from loss or degradation. For all proposed CBNG development within 5 miles of the Crow Reservation, the BLM would require site-specific groundwater analyses to demonstrate its protection as part of the operator’s POD. If the analysis indicates impairment to groundwater would occur, the BLM would not approve the APDs. BLM may require an operator to install groundwater monitoring wells between its development area and the reservation to confirm findings of the initial analysis. Protection of reservation groundwater resources would prevent potential impacts to groundwater available for stock watering. Also, development near reservations may provide an additional source of water for beneficial uses on the reservation.

Northern Cheyenne Reservation

The effects to livestock grazing on the Northern Cheyenne Reservation would be the same as those for the Crow Reservation.

Conclusion

Cumulative impacts would be similar to Alternatives B and F. Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis and the water resource screen, thereby potentially increasing beneficial uses of discharge water, which could include livestock water.

Paleontological Resources

Paleontological Resources *Paleontological resources consist of fossil-bearing rock formations that underlie the entire Planning Area. Fossil outcrops are relatively rare throughout the emphasis area, but know areas are protected.*
Alternative A **No Action (Existing CBNG Management)**
• It is unlikely that any of the 1,500 acres disturbed during CBNG development activities would contain noteworthy paleontological resources. The 575-acre Bridger Fossil Area of Critical Environmental Concern (ACEC) (only paleontological resource) would not be disturbed.
Alternatives B, C, D, E and F
• Impacts would be nearly the same based on level of disturbance, known locations of rich fossil areas and distribution of geological formations with paleontological resources. • There would be between 55,400 and 74,000 short term acres disturbed during CBNG development activities increasing the chance of impacts to fossil resources. Cumulative impacts would disturb an additional 33,400 acres increasing the potential for impacts to fossil resources.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F with the exception that they would be reduced by approximately 65 percent due to the lower number of APDs that are predicted to be issued. • There would be between 19,400 and 25,900 short term acres disturbed during CBNG development activities increasing the chance of impacts to fossil resources. Cumulative impacts would disturb an additional 11,700 acres increasing the potential for impacts to fossil resources.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to the other expanded development alternatives based on level of disturbance, known locations of rich fossil areas and distribution of geological formations with paleontological resources. However, the consolidated planning for ROWs would result in decreased surface disturbances. • There would be between 55,400 and 74,000 short term acres disturbed during CBNG development activities increasing the chances that a minor fossil discovery would be made. Cumulative impacts would disturb an additional 33,400 acres increasing the likelihood of additional fossil discoveries. Should no drilling occur within crucial sage-grouse habitat areas, the cumulative impacts to paleontological resources will be less than the other alternatives.

Assumptions

Surface occupancy is prohibited within designated paleontological sites on BLM-administered minerals in the Planning Area. A modification or waiver may be applied for as mentioned for the Cultural Resource section. Provided the paleontological resource values can be protected or undesirable impacts mitigated, the exception would be granted.

The collection of vertebrate paleontological remains on BLM-administered surface would be done under a valid paleontological resources use permit and that reasonable, non commercial collections of invertebrate fossils and fossil plants would be allowed under 43 CFR 8365.1. The collection of petrified wood would be allowed under the terms of 43 CFR 3622.

Impacts from Management Common to All Alternatives

Impacts would occur if paleontological resources were encountered unexpectedly during surface disturbance activities.

The construction of the TRR would not disturb any known paleontological resources in the rocks or soils that exist within the alignment ROW. Construction could result in potential impact on currently unknown paleontological resources. Paleontological localities would be identified during detailed pedestrian surveys of the alignment as required in the Surface Transportation Board's programmatic mitigation agreement. If any paleontological resources are located during surveys, mitigation measures would be carried out that include collection and curation of scientifically significant fossils, additional sampling, or monitoring of excavations.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts from this alternative would be similar to those described in the *Impacts From Management Common to All Alternatives* section above. Other impacts could include vandalism and the illegal removal of fossils by unpermitted fossil collectors resulting from increased accessibility to remote areas.

Crow Reservation

There would not be impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There would not be impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts would include the effects from CBNG development, conventional oil and gas development and surface coal mining activities. Known paleontological resources within the Planning Area would be protected by Section 6 of the lease terms. NSO stipulations applied to known paleontological resources would help protect those sites.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Impacts from Alternative B would be similar to Alternative A, with some exceptions. Development could result in increased access to remote areas. The impacts of increased access could include vandalism or the illegal removal of fossils by unpermitted fossil hunters.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would include increased CBNG development and a potential increase in vandalism or the illegal removal of fossils.

With the development of tribal CBNG resources, it is anticipated some reservation sites would be encountered that may contain important paleontological resources. As the tribes develop their own CBNG resources, it is anticipated tribal monitors would oversee all surface disturbing activities and, therefore, all significant paleontological resources would be protected.

Alternative C—Emphasize CBNG Development

Impacts would be similar to Alternative B with some exceptions. Under this alternative, surface disturbances from ROWs would result in impacts on paleontological resources and increased access to remote areas. The impacts of increased access could include increased vandalism and the illegal removal of fossils by unpermitted fossil hunters.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts would be similar to Alternative B with increased surface disturbance from the lack of ROWs, potential vandalism or removal of fossils because of increased access to remote areas.

The use of tribal monitors overseeing surface disturbing activities on the reservations during tribal CBNG development would prevent most impacts from occurring to paleontological resources.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts would be the same as described under Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts would be similar to Alternative C with some exceptions. Under this alternative, the project plan stipulations could decrease the amount of surface disturbance. Directional drilling may be performed on deeper coal seams and would decrease surface disturbances. The potential for impacts from surface disturbances resulting from the placement of underground utilities would increase impacts to paleontological resources. Where significant paleontological resources are suspected, the operator's plan will include a paleontological component that will address data collection and evaluation methods if paleontological remains are encountered.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative C with the exception of the potential for less surface disturbances. The impacts to paleontological resources would be minimized.

The use of tribal monitors overseeing all land disturbing activities on the reservations during tribal CBNG development would prevent most impacts from occurring to paleontological resources.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, impacts to paleontological resources would be similar to Alternative E with the exception that impacts may be less due to the 5-mile buffer zone for federal development around the Crow and Northern Cheyenne reservation boundaries.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative E with the exception of the potential for less surface disturbances due to the 5-mile buffer zone around the Crow and Northern Cheyenne reservation boundaries. The impacts to paleontological resources would be minimized.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts to paleontological resources would be similar to Alternative F with the exception that the potential impacts to paleontological resources would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the 2003 FEIS)

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative F with the exception that the potential impacts to paleontological resources would be reduced by approximately 65 percent.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative, approximately 320,000 acres could be surveyed during POD development as part of the cultural resource survey efforts. This surveying would enhance the likelihood that paleontological sites would be identified as part of the CBNG location and placement effort. Impacts to paleontological resources would be minimized but resemble those described for Alternative E.

The use of directional drilling may be performed on deeper coal seams and would decrease surface disturbances. The potential for impacts from surface disturbances resulting from the placement of underground utilities may increase impacts to paleontological resources. However under this alternative, surface disturbances from ROWs would be consolidated to reduce the amount of disturbance and minimize the footprint. This consolidated development would also reduce the amount of roads and marginally increase access to remote areas. The impacts from increased access could include vandalism and the illegal removal of fossils by unpermitted fossil hunters. The need for paleontological inventories would be determined using the Potential Fossil Yield Classification System outlined in BLM Instruction Memorandum 2008-2009.

Where significant paleontological resources are suspected, the operator's plan will include a paleontological component that will address data collection and evaluation methods if paleontological remains are encountered.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

The degree of cumulative impacts under this alternative would be similar to those described for Alternative F with the exception of the potential for less surface disturbances due to the consolidated development planning. The impacts to paleontological resources would be minimized.

Recreation

Recreation *Montana's natural features offer a variety of year-round recreational opportunities*
Alternative A **No Action (Existing CBNG Management)**
• Minor loss of land for recreation purposes and the disruption to recreation activities • Exploratory activities such as drilling and testing could temporarily displace game species locally
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• Moderate loss of land for recreation purposes and the disruption to recreational activities • Increased opportunities for access to remote areas
Alternative C **Emphasize CBNG Development**
• Impacts would be similar to Alternative B with the exception that increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts would be similar to Alternative E. • Impacts from federal CBNG development would occur differently than the other alternatives based on annual and watershed-based limits.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F in the sequence of development but would result in lower impacts than the other alternatives.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to or less than Alternative F in the sequence of development, but could result in lower visual impacts than the other alternatives due to the use of resource screens and mitigation and management plans for development.

Assumptions

Recreation uses and areas are described in Chapter 3. Most of the recreation resources in the study area consist of dispersed activities such as hunting and fishing. BLM stipulations would be applied. Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. In general, the demand for recreational activities would increase proportionately with the increase or decline of regional populations.

Impacts from Management Common to All Alternatives

Recreation areas are potentially impacted by surface-disturbing activities. The activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) would result in changes to the natural landscape, which would cause the most surface disturbance and have the greatest impact on recreation areas. Other activities, such as increased travel and vandalism resulting from access improvements and increased erosion from surface disturbances, can also impact recreation areas. These activities can produce indirect impacts to recreation areas such as fires, hazardous waste spills and cleanups, changes in livestock grazing patterns and changes in wildlife habitats.

BLM has stipulations to protect developed recreation areas and undeveloped recreation areas receiving concentrated public use The state also has stipulations for protection of recreation areas including prohibiting activity within 100 feet of streams, ponds, lakes, or other water facilities. Additional state stipulations include a 1/8-mile buffer for rivers, lakes, or reservoirs and a sensitive areas stipulation that may be used when field staff receive comments regarding recreation areas. Most of the recreation resources in the study area are dispersed activities, such as hunting and fishing and are not developed recreation sites. Exploratory activities such as drilling and testing would temporarily displace game species locally. Installation of oil and gas production facilities in areas used for hunting, hiking and other dispersed recreational activities would infringe on the solitude and rural characteristics of the area. The oil and gas infrastructure and activities would reduce the number of game animals in the area or force some game animals to leave the area which would reduce or eliminate certain hunting activities. Hunters would be concerned about shooting around facilities and equipment.

Exploration and production would create new roads that would provide easier motorized access to areas that may not have been accessible before. Motorized recreation user groups would see this as a benefit to their sports and would appreciate increased access to streams, lakes and hunting areas. Non-motorized recreational enthusiasts who seek solitude and quiet, including backpackers, hikers and some hunters and anglers, would not benefit from road development. As formerly remote areas become more accessible and competition for limited resource escalates, conflicts among these user groups would occur.

Increased human access and increased human activity associated with exploration and development would result in increased legal and possibly illegal harvest of fish from nearby drainages. Increased legal harvest would be a recreation benefit as fishing opportunities are more accessible to a wider range of people and game regulations are adapted to accommodate the increased fishing pressure. However, if increased illegal harvest causes fish populations to drop below a sustainable level, fishing as a recreational resource could be affected.

Increased access typically causes an increase in vandalism and the need for law enforcement. As recreation in public lands becomes more popular, undeveloped recreation sites would generally require more time and attention and have the potential to become developed sites, if use becomes concentrated to that level. Exploration and production activities may cause some ranches to be closed to hunting access via surface agreements.

While impacts related to human access would likely increase in areas of CBNG development, public access is limited within much of the area, so that such impacts are expected to be small for most of the public. Current development has limited access by the use of locked gates and not granting public access to development areas.

Effects on recreation from the proposed Tongue River Railroad would vary, depending on the alignment constructed. The Original Preferred Alignment ROW would run through the Tongue River Reservoir State Park and the second-home subdivision of Cormorant Estates and affect access to the park and reservoir shoreline. The Western Alignment would be located between one and two miles from public camping areas at the state park, but the line would be constructed in cuts through most of this area to provide both a visual barrier and sound buffer from the camping areas. This alignment would avoid Cormorant Estates. The Four Mile Creek Alternative would also avoid Cormorant Estates and be located farther from the state park (STB 2004).

Recreational fishing opportunities are available at public access points along the Tongue River, although access for much of the river is controlled by private landowners. During construction, the quality of recreational fishing may be affected by additional turbidity or modified fish behavior. Access to the river may also be impaired in those areas where the railroad is between the river and the Tongue River Road (STB 2004).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Construction of roads, well pads and facility sites in designated recreation areas or immediately adjacent to them would detract from the quality of the recreation areas and diminish the quality of the recreational experience. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. Since there would be no production activities in BLM planning areas under this alternative, there would not be direct impacts from production occurring on BLM-administered surface.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for recreation in general. If there were no CBNG development on tribal Lands, then there would be minimal impacts on recreation on the reservation. Impacts to hunting and fishing from trespassing could impact Native Americans who rely on these resources for subsistence purposes.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusion

Cumulative impacts would include the effects of Alternative A combined with conventional oil and gas development and other projects discussed in the Minerals Appendix. These would include impacts from nearby activities such as mining or power generation facilities, which can result in increased use due to increases in population associated with additional available jobs. (Note: surface mining is preparing to expand by 4,000 acres under permit request now. See this chapter's *Introduction* section.)

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B would allow development with single-lane roads and turnouts. Upon abandonment, new roads would be rehabilitated and closed. Impacts from this alternative would be similar to Alternative A with the addition of increased CBNG development resulting in increased access, resulting in increased impacts on dispersed recreation activities such as hunting and fishing.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impact of this alternative is increased CBNG development, which could result in increased access to remote areas and increased vandalism.

Cumulative impacts under this alternative would be greater than those described under Alternative A.

Alternative C—Emphasize CBNG Development

Impacts on recreation areas would be similar to Alternative B, but an increased number of disturbed acres and opportunities for access. Discharge of produced water directly to the ground could increase erosion. Increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies and limited vegetation loss that could further alter wildlife habitat and change hunting opportunities.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies and limited vegetation loss that could further alter wildlife habitat and change hunting opportunities.

Conclusion

The residual impacts of this alternative are similar to Alternative B. The greater surface disturbance from roads could increase the opportunity for access to remote areas. The discharge of water could increase erosion and damage lands used for recreation.

Cumulative impacts would be greater than those described under Alternative B, but on a large scale because of the emphasis on CBNG development.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on recreation resources would be similar to Alternative B, but less because of water management measures to eliminate soil erosion by piping discharged water to the nearest body of water.

New oil and gas roads would remain open or closed at the surface owner's discretion. Open roads would create impacts; closed roads would prevent impacts.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impacts of this alternative would be similar to those described under Alternative B. Cumulative impacts would be greater than those described under Alternative A because of the expanded CBNG development.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Alternative E would allow CBNG development subject to existing planning restrictions and balances CBNG development and the protection of the natural environment. Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. Impacts from surface disturbance would be minimized by using existing disturbances where possible. Because transportation corridors are not required, the number of disturbed acres and opportunities for access would be greater than Alternative B.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impacts of this alternative are similar to Alternative B. Surface disturbance from roads would be greater than Alternative B, increasing the opportunity for access to remote areas.

Cumulative impacts would be similar to those described under Alternative B.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts on recreation areas would be similar to Alternative E, including the loss of land for recreation purposes and disruption of recreation activities. However, surface disturbance from roads and utilities would be similar to or less than those discussed under Alternative B, because transportation and utility corridors may be required based on watershed-level planning. Corridors planned at the watershed-level would require actions to minimize resource impacts from federal CBNG development.

During the first several years of the planning period, the number of disturbed acres and opportunities for access from federal CBNG development would be less than Alternative E, resulting in lower initial impacts to recreation. However, the number of disturbed acres and opportunities for access could be similar to Alternative E during the latter half of the planning period as the predicted annual limits on federal CBNG wells increase.

Recreation impacts under Alternative F could be less than the other alternatives because each proposal for development would be subject to review against the four resource screens (air, water, wildlife and Native American concerns) and planning and mitigation requirements. This review process would balance CBNG development with protection of the natural environment. Recreation is not an individual screen for the POD review process, but is considered in individual analyses. Additionally, key environmental and wildlife resources are subject to the screening process. Protection of these resources would help maintain some wildlife habitat. The anticipated lower level of development intensity in the crucial sage-grouse habitat areas is an example of how wildlife protection measures may influence impacts to recreation opportunities. Specifically, fewer roads within the sage-grouse habitat areas may reduce access to some lands, which may increase the quality of some hunting opportunities. Conversely, increased road density could aid guides in increasing hunter success rates.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife distribution patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife distribution patterns, which could affect on-reservation hunting. However, there appears to be little or no seasonal migration of mule deer in southeastern Montana (BLM 1984b).

Conclusion

The residual impacts of this alternative would be similar to Alternative E. Surface disturbance from federal CBNG development would be less than Alternative E and similar to Alternative B because watershed-level analysis would further limit the amount of surface disturbance and the disposal of produced water.

The amount of cumulative impacts would eventually be similar to that expected under Alternative E. Impacts may include the loss of land for recreation purposes, disruption of recreation activities and increased use due to increases in population associated with additional available jobs. These impacts would result from CBNG-related activities under this alternative, as well as other activities existing or proposed within the area, such as conventional oil and gas development, coal mining, power generation plants and the Tongue River Railroad.

Alternative G—Phased Development Multiple Screens (Low Range)

Overall impact to recreation at the end of the 20-year development cycle would be noticeably less than that of the other action alternatives because Alternative G would result in approximately one-third the number of wellheads. Alternative G would be similar to Alternative F in the sequence of development predicted and impacts would accumulate each year as the number of developed wells increases. Since development would be distributed over several watersheds, those with the greatest number of wellheads could experience the greatest impacts from federal CBNG development.

Crow Reservation

Impacts on the Crow Reservation would be similar in nature to those described for Alternative F; however, the amount of impacts would be less than the other action alternatives due to the limited number of wells that would be developed.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Overall impacts of this alternative would be similar in nature to Alternative F. Surface disturbance from federal CBNG development would be less than the other action alternatives due to the limited number of wells that would be developed. Additionally, watershed-level analysis could further limit the amount of surface disturbance and the disposal of produced water. Discharge of produced water directly to surface waters could increase erosion which could lead to a reduced amount of land available for recreation activities or disrupt habitat for game species.

As with Alternative F, short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would be less than those described under the other action alternatives because fewer total wells would be developed.

Alternative H—Preferred Alternative - Multiple Screens

Overall impacts to recreation would be similar to or less than Alternatives E and F. Based on a rate of development similar to that predicted for Alternative F, impacts from federal CBNG development under Alternative H would be lower during the first few years of the planning period than Alternatives B, C, D and E. Impacts would accumulate each year thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of developed wells could experience the greatest impact to recreation activities. The greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds based on the anticipated resource availability and level of development these areas are anticipated to receive the greatest number of CBNG wells..

Recreation impacts under Alternative H could be less than the other alternatives because each proposal for development would be subject to review against the four resource screens (air, water, wildlife and Native American concerns) and planning and mitigation requirements. This review process would balance CBNG development with protection of the natural environment. Recreation is not an individual screen for the POD review process, but is considered in individual analyses. Additionally, key environmental and wildlife conditions are subject to the screening process. Implementation of these conditions would help maintain wildlife habitat.

Impacts on recreation areas may include the loss of land for recreation purposes and the disruption to recreation activities. Exploratory activities such as drilling and testing would temporarily displace game species locally.

BLM would require a water management plan and use watershed-based thresholds for the volume of untreated water that could be discharged to surface waters from federal CBNG wells. These requirements would be in addition to the surface water quality and discharge volume limitations already included in the MPDES discharge permitting process.

Disturbance to movement of big game species due to new roads could be less than Alternatives E and F because there would be minimal road construction. Transportation corridors (proposed roads, flowline routes and utility line routes) would be located to follow existing routes, or areas of previous surface disturbance, where possible.

Cumulative impacts to water quality and quantity would result within the watersheds as both federal and state/private development occurs. However, Alternative H includes watershed-level analysis as part of POD development and review to evaluate and address cumulative impacts as they are identified.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. The Native American concerns screen would provide an additional level of resource protection for development proposed within 5 miles of the reservation and in the vicinity of traditional cultural properties through consultation with the tribe and monitoring during development.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Additionally, the Native American concerns screen would provide an additional level of resource protection for development proposed within 5 miles of the reservation and in the vicinity of traditional cultural properties through consultation with the tribe and monitoring during development.

Conclusion

The residual impacts of this alternative are similar to Alternatives E and F. Development could result in increased access to remote areas and increased vandalism. Short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would be similar to those described under Alternative B and would result over time and within the watersheds as both federal and state/private CBNG well development occurs. Cumulative impacts would include the effects of CBNG development combined with other existing or proposed activities, such as conventional oil and gas development, coal mining, power generation plants and the Tongue River Railroad. These activities could result in increased use due to increases in population associated with additional available jobs.

Social and Economic Values

Social and Economic Values
Socio-economics address the changes in demographics; social organization, including housing, attitudes and lifestyles; economics, such as employment, unemployment, and per capita income; and government revenue sources, including taxes, state oil and gas lease income, federal mineral revenues and private landowner revenues.

Alternative A
No Action (Existing CBNG Management)

- Few social impacts (only small changes in employment, population, demand for services, etc.).
- Small impact on economic conditions as a result of new production wells.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- It is expected that most new CBNG jobs would be filled by CBNG workers commuting from Wyoming. If this occurs, social benefits and impacts could be less than described below.
- Social impacts would include new jobs and new population moving to the area.
- Economic benefits include generation of new personal and government income.
- Additional disposal costs associated with injection of produced water.
- Additional demands on public services.

Alternative C
Emphasize CBNG Development

- Social impacts same as Alternative B. Increase in impacts on lifestyles and values.
- Economic impacts same as Alternative B. Increase in impacts to water resource users.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Social impacts same as Alternative B. Small increase in impacts on lifestyles and values.
- Economic impacts same as Alternative B. Small increase in impacts to water resource users.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Social impacts same as Alternative B. Public burden to maintain roads may increase depending on landowner access decisions.
- Economic impacts same as Alternative B, except that oil and gas income may be less depending on water treatment costs.

Alternative F
Phased Development Multiple Screens (High Range)

- Because development is phased, it is likely that most new CBNG jobs would be filled by CBNG workers commuting from Wyoming.
- Social impacts similar to Alternative E and less than Alternatives B through D during certain years, but longer in duration due to phased development.
- Economic benefits and impacts lower than Alternatives B through E, but longer in duration due to the evening out of CBNG activities over the phased development period.
- The potential for 2,333 fewer wells to be drilled in crucial sage-grouse habitat would have little discernible impact on the number of jobs or duration of the overall project.
- Reduction of wells or resource recovery in crucial sage-grouse habitat will reduce the revenues to operators, royalties and taxes paid to the Federal, State and local government, as well as potentially affecting some private mineral estate owners.

Alternative G
Phased Development Multiple Screens (Low Range)

- Social impacts less than other development alternatives, with duration of impacts similar to Alternative F due to phased development.
- Economic benefits and impacts lower than Alternatives B through F, with duration of impacts similar to Alternative F due to phased development.

Alternative H
Preferred Alternative - Multiple Screens

- Social and economic impacts similar to Alternative F due to similar rate of CBNG well development.

Assumptions

It is assumed that the average CBNG production well in Montana produces about 125,000 cubic feet per day (MBOGC 2001a). Using a gas price of about $4.00 per thousand cubic feet, the average well would generate about $182,500 per year in total income. Income-producing wells on average are expected to last between 10 and 20 years, with an average production life of 15 years. Exploration wells do not produce income.

The social and economic analysis in this chapter is based on the RFD rate of development over a 20-year period for Alternatives A through E and up to a 23-year period for Alternatives F, G and H. During this 20- or 23-year period, all CBNG wells would be drilled and production would peak. However, because CBNG wells typically produce for 10 to 20 years, a well drilled in year 20 would continue to produce until year 40. Thus, social and economic consequences of production and abandonment would continue for up to 20 more years beyond the period assessed here.

The number and type of jobs related to CBNG development would vary with the project phase, exploration, development, production, or abandonment. During exploration and development, the majority of jobs created would be for well drillers and pipeline installers along with specialty positions such as land surveyors, supervisors and geologists. A number of related support personnel (e.g., truck drivers and material handlers) would also be required during these activities. During production, most new jobs would be for maintenance and repair workers and their supervisors. During abandonment, field workers, support workers and their supervisors would be in demand. Average numbers and types of jobs and their associated wages are estimated based on a recent report on the economic impacts of CBNG development in the Powder River Basin (ZurMuehlen 2001), which assumes the following ratios: 49 jobs per 160 wells for exploration/development; 9 jobs per 160 wells for production; and 12 jobs per 160 wells for abandonment.

Based on interviews with CBNG operators currently working in the Planning Area, it is likely that workers from Sheridan, Buffalo and Gillette, Wyoming would fill most of the new jobs related to CBNG and described in the alternatives (Langhus 2006). Most of the CBNG companies and related service companies have offices located in these Wyoming cities while one CBNG company has an office in Billings, Montana and service companies have offices located in Billings, Forsyth and Miles City.

For most of the well sites, CBNG workers would commute on a daily basis from their homes in Wyoming. See Map 4-3 for a depiction of existing CBNG well sites, proposed development areas (based on existing coal deposits) and roads CBNG workers would use to access development areas. The first years of CBNG development would likely be near the Wyoming border and the Tongue River (Big Horn County), just north of Sheridan. In later years, development would likely move east into Powder River County, north of Gillette. The last wells to be developed would likely be those to the north in Rosebud County and in the counties west of the reservations. The number of wells to be developed in the western portion of the Planning Area would be much lower than in the eastern portion. Some workers who would be unwilling to commute would likely share or bring their own camping facilities. Motels may provide temporary housing for CBNG workers.

Recent interviews with operators indicate they would be able to meet the CBNG labor demand for the alternatives within their existing organizations. One reason this will be feasible is that work on each well during each phase of development would be short-term and often part-time. For example, installation of each well would require a crew of 7 to 8 workers over 3 to 5 days for drilling, with an additional 2 to 3 days for completion work. Rather than have multiple crews install many wells at the same time, the same crew would move from site to site installing wells over a longer period of time. The abandonment phase would work in a similar manner. During the operational phase, only a few workers would be needed to monitor wells since, due to automated systems, only short and periodic visits to the wells would be needed. A small number of workers would be needed for water management. Most water treatment technologies are automatically operated and assembled from modular components.

To simplify this analysis, all dollar amounts (e.g., wages and other project-related income) are reported in 2002 dollars, as originally used in the Statewide Document, with no adjustment for inflation over time.

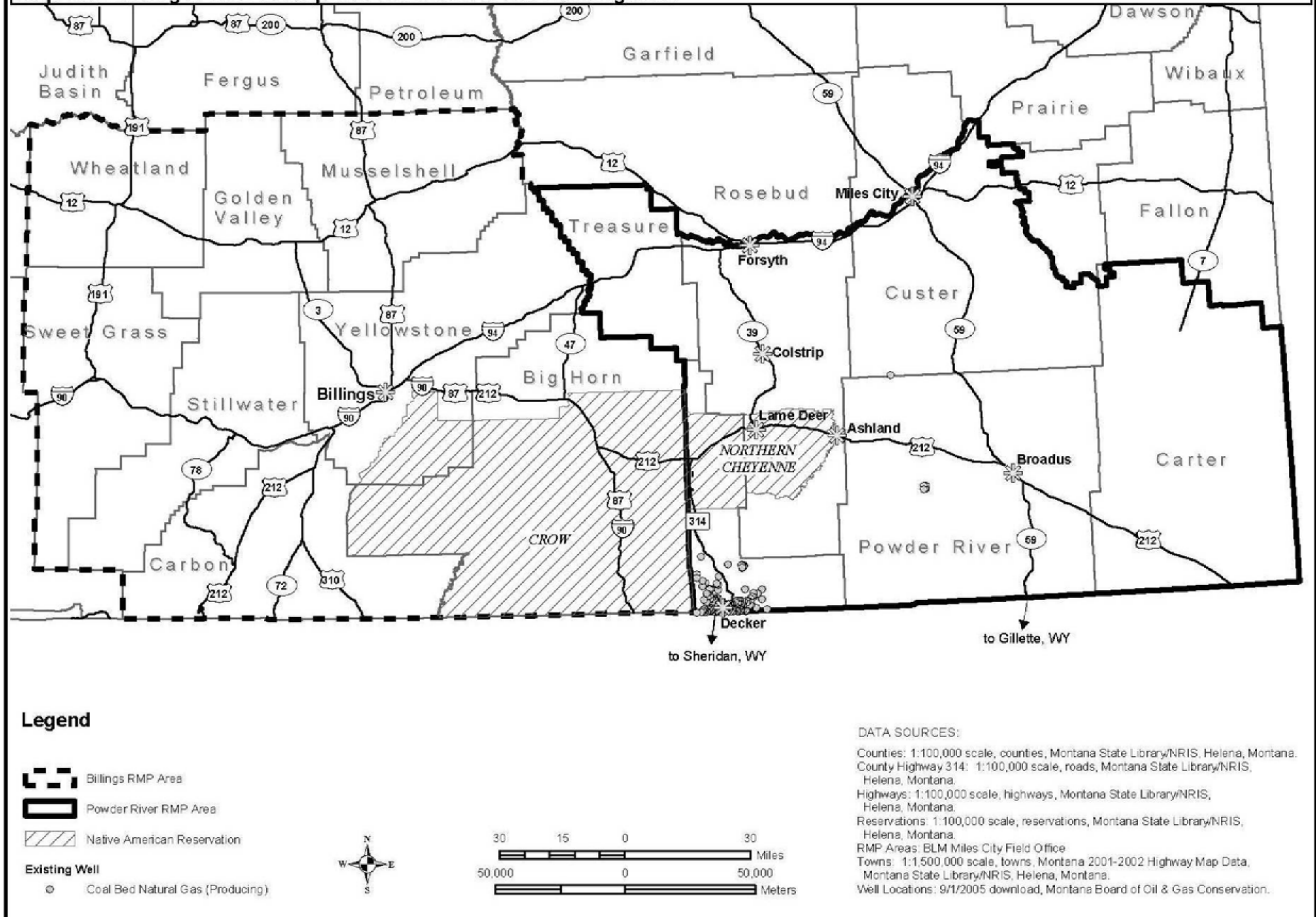
Impacts From Management Common to All Alternatives

Although many jobs are estimated to be created by CBNG development, the socioeconomic impacts of this development would depend to a great extent on how the operators distribute employment. If current CBNG industry employees from Wyoming fill the jobs created by the proposed CBNG development as expected, the economic benefits of the wages earned would mainly go to Wyoming. Some indirect benefits in the Planning Area would be realized due to expenditures near CBNG sites (gas stations, restaurants, stores, etc.).

There are few towns and commercial establishments between Sheridan or Gillette and the Montana CBNG sites where workers would be able to spend their wages or purchase supplies. For that reason, most indirect employment and income from support expenses would occur in Wyoming. Most of the CBNG employees working in Montana commute from Wyoming (BLM 2003).

Impacts on social conditions would include changes in the services provided by governments due to increased funds from CBNG development; the effects of drilling and related activities on rural lifestyles in the project area; and changes in levels of traffic, noise, visual resource impacts and psychological stress levels, as described below. Employment and population would

Map 4-3: Existing CBNG Development Within the CBNG Planning Area



not likely change because CBNG workers would be supplied by the existing workforce in Wyoming. This would limit both the employment opportunities and adverse effects of population change on local housing, schools and services.

The information reflected in the public comments and newspaper reports summarized in Chapter 3 indicate a range of attitudes and beliefs with respect to the development of CBNG and its relationship to the lifestyles and values of area residents.

As discussed in Chapter 3, the majority of public comments received during scoping related to concerns about impacts on the environment and water quality and quantity in particular. The possibility of unfavorable economic impacts resulting from environmental impacts are also a concern. Other concerns include possible increases in traffic levels, noise, visual resource impacts and psychological stress associated with changes to the surrounding built and natural environment.

Numerous social and cultural impacts have been predicted by Native Americans as a result of CBNG development on adjacent private, state and federal minerals. These potential impacts include: the lack of access to energy-related employment, population influx, over-commitment of tribal revenue, abridged effectiveness of tribal governments, stressed infrastructure and service related capacity, altered social organization and social well being perception and the further influence of western culture resulting in changes to traditional beliefs and value systems.

Direct economic impacts of the project would include lease, royalty and production payments; taxes and other government levies; impacts resulting from changes in environmental quality; and related changes in the fiscal health of county, state and federal governments. Changes in personal income resulting from new employment of CBNG workers and purchases of services from vendors are more likely to occur in Wyoming than the Planning Area. Similarly, indirect impacts including induced economic activity from local purchases of equipment, supplies and services and induced economic activity from purchases of goods and services by project workers would also be most likely to occur in Wyoming. The largest economic benefit from CBNG development is the methane itself, measured by the revenues obtained by the companies involved in developing the resource. It is assumed that most of these revenues would go to out-of-state companies. Montana's share of that benefit would come mostly in the form of natural gas taxes and royalties, discussed below.

Conventional oil and gas development would have economic impacts on landowners, communities, county governments, reservations and the state and Federal governments. When hydrocarbons are produced and sold, the operator is responsible for paying the mineral owner and governmental entities in the form of taxes and royalties.

Property values would be affected by full field development. Full-size ranches would be impacted by the increase in activity accompanying development. This could include such factors as the change in rural character of the land. Ranchers choosing to sell their ranches would receive less monetarily if the ranch sells without mineral rights attached. Outfitting would be impacted from the visual intrusion of increased road and CBNG facility development, causing a decline in outfitting income.

Conventional well development is projected at between 595 to 2,325 additional oil and gas wells over the next 20 years. This level of industrial activity (average 116 wells per year) would have negligible impact on the social and economic resources of the area.

It is expected that development will occur first within the southern portion of the Planning Area along the Montana/Wyoming border and then expand to the north and to the east of the CX Field. CBNG workers that come from Sheridan, Buffalo or Gillette, Wyoming to work in the existing CBNG fields and the areas most likely to be developed next in Montana will not travel across the Northern Cheyenne or Crow reservations on their journey to work.

When the wells to the north of the Northern Cheyenne Reservation are developed, CBNG workers may need to drive across the Northern Cheyenne Reservation to reach some of the sites. Although the number of wells predicted in the RFD to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts on the reservation could occur. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, with any of the alternatives, there would be little reason for CBNG workers to stop on the reservation, because few services are offered on the reservation routes that would be used. Interaction with commuting workers is not expected.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely drive from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana.

Cumulative effects of coal development in Wyoming, including CBNG development, is discussed in the Task 3C Report for the Powder River Basin Coal Review Cumulative Social and Economic Effects Report (BLM 2005e). The analysis projects employment in the Wyoming Powder River Basin to increase by one-third (more than 2,300 jobs) compared to 2003 levels, with the largest growth occurring by 2010. The increase in employment is expected to increase income to individuals and government agencies in the area, but would also stimulate migration to the area, resulting in shortages in housing and community services. Effects to communities would depend on how well they can absorb the increase in population. Development of CBNG in Montana would increase these cumulative effects because CBNG operators are expecting to use the same workforce in Wyoming to develop CBNG wells in Montana.

If the Tongue River Railroad is built, there would be cumulative socioeconomic effects in areas where the railroad is near CBNG sites. Construction of the railroad would create primary and secondary jobs and promote purchases of equipment and material from local vendors. However, construction labor requirements raise the potential for creating temporary (2- or 3-year) demands on limited local services. The increased taxable revenues would benefit local governments and school districts. Land use effects from construction of the railroad would include permanent acquisition of land for railroad right-of-way and short-term acquisition of land for construction areas. Some parcels would be severed, which could interfere with cattle and wildlife movement and irrigated agriculture. Presence of the railroad through or near recreational home sites could reduce the market value of the individual tracts. Construction of the railroad would increase in vehicle travel on local roads.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

As explained under the *Assumptions* section, most jobs created for CBNG development in Montana would likely be filled by Wyoming CBNG workers. This is true for Alternative A as well. In general, the scenario below lists greater economic benefits and greater social impacts than would likely occur.

Employment and Unemployment

The location and distribution of the exploratory wells by county is not known and therefore, this analysis assumes the wells in the two RMPs are distributed across those areas and the wells to be drilled statewide are also distributed geographically in proportion to the RFD estimates for development. The production wells are assumed to be confined to the CX Ranch in Big Horn County.

Average numbers and types of jobs and their associated wages are estimated based on a recent report on the economic impacts of CBNG development in the Powder River Basin (ZurMuehlen 2001), which assumes the following ratios: 49 jobs per 160 wells for exploration/development; 9 jobs per 160 wells for production; and 12 jobs per 160 wells for abandonment. As shown in Table 4-58, the estimated number of jobs created under Alternative A would range between 175 (Year 1) and 14 (Years 8 through 19), for an average of about 32 jobs per year over the period. This change would be small compared to the total employment in the Planning Area (122,000 in 1998). For Alternative A, it is assumed that all wells would be abandoned by year 20 of the project.

Measurable indirect changes to local employment would not be anticipated for Alternative A. The purchase of equipment, supplies and services related to the proposed wells would have some impact but likely would not be distinguishable from the existing economic activity in the Planning Area and in the state.

Thus, few or no new jobs would be created indirectly. New employment created directly and indirectly for Alternative A would be small in relation to total employment in the Planning Area (122,000 in 1998) and therefore, it would not be expected to result in changes to current county or state unemployment rates.

Demographics

Employees who would fill the CBNG jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment opportunities from around the region. It is assumed that local labor (i.e., those within commuting distance of the CBNG well locations) would be used to the extent available; however, many of the new jobs would likely be filled by new migrants to the region. The degree to which the jobs would be filled by current residents would depend on a number of factors, including job skills. The extent

TABLE 4-58

ALTERNATIVE A: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[2]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	525	161	$4,662,656	250	14	$539,063				175	$5,201,719
2	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
3	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
4	100	31	$888,125	250	14	$539,063	375	28	$972,656	73	$2,399,844
5				250	14	$539,063	100	8	$259,375	22	$798,438
6				250	14	$539,063	100	8	$259,375	22	$798,438
7				250	14	$539,063	100	8	$259,375	22	$798,438
8				250	14	$539,063				14	$539,063
9				250	14	$539,063				14	$539,063
10				250	14	$539,063				14	$539,063
11				250	14	$539,063				14	$539,063
12				250	14	$539,063				14	$539,063
13				250	14	$539,063				14	$539,063
14				250	14	$539,063				14	$539,063
15				250	14	$539,063				14	$539,063
16				250	14	$539,063				14	$539,063
17				250	14	$539,063				14	$539,063
18				250	14	$539,063				14	$539,063
19				250	14	$539,063				14	$539,063
20				250	14	$539,063	250	19	$648,438	33	$1,187,500
20-Year Total	**925**	**283**	**$8,215,156**	**250**	**14**[3]	**$10,781,250**	**925**	**69**	**$2,399,219**	**634**	**$21,395,625**

NOTES:

[1]Data for jobs per well and wages (ZurMuehlen 2001).

[2]Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001)

[3]The same number of jobs are assumed to last for the duration of the planning period.

to which workers who move to the region for new jobs would bring families with them would depend on a number of factors, most notably the duration of the job in a given location. Assuming a mixture of single employees and those with families, it is estimated that, on average, each new employee would bring one additional person to the region. Even if all the jobs (175 during Year 1) were filled by new migrants to the region and resulted in new persons moving to the area, the total new population (perhaps 350 persons) would be small compared to the total regional population (196,000 in 2000). There would likely be some concentration of new residents associated with jobs in Big Horn County related to the CX Ranch. Given that any new population would be spread over both time and geographic area, no change in demographics would be anticipated from Alternative A.

Social Organization

Housing Units and Vacancy

Only small changes in the supply or demand of permanent or temporary housing are anticipated as part of Alternative A. This follows from the small changes in employment and population discussed above. However, there could be short term localized housing shortages depending on the size of the population increase in Big Horn County.

Public Services and Utilities

The relatively small scale of CBNG well development would not result in any substantial changes in the ability of county, state, or Federal governments to provide public services or utilities. The basis for this conclusion is the lack of additional temporary or permanent population and the associated lack of demand for additional public services. However, there could be short term localized increases in public services demands depending on the size of the population increase in Big Horn County.

Attitudes, Beliefs, Lifestyles and Values

The limited development of CBNG proposed for Alternative A likely would be experienced by the communities in the Planning Area as a continuation of existing oil and gas development practices in the region and in the state. As a result, these actions by themselves would likely be perceived as generally consistent with the attitudes, beliefs, lifestyles and values of most population groups (e.g., ranchers, Native Americans, small town residents).

Personal Income

Wages paid to project employees would contribute to the total personal and per capita income of every county where employees reside. As shown in Table 4-58, total direct wages from Alternative A over 20 years are estimated at about $21 million and would range from a high of $5.2 million (Year 1) to a low of $539,000 (Years 8 through 19).

Any of the producing wells proposed for operation on the CX Ranch would generate new personal income, depending on ownership. Individuals who own the mineral rights to their land and lease those rights to developers as part of the existing management scenario would receive additional income from rents or royalties. Although only a small percentage of landowners own mineral rights, the royalty income to any one individual would still be substantial over many years if a given well is highly productive. Individuals on whose land CBNG is developed but who do not own the mineral rights to their land would receive one-time payments as compensation for land disturbance. However, given the small scale of production anticipated, these changes to personal income likely would have only a small effect on the per capita income of the Planning Area or the state as a whole.

Additional personal income for residents of the counties and the state would be generated by circulation and re-circulation of dollars paid out as business expenditures and as state and local taxes.

Government Revenues

The primary source of government revenues generated by the project would be from taxes levied on property, equipment, income and natural gas output generated by production wells. Exploratory wells would generate government income only to the extent the associated temporary facilities are subject to local property taxes.

Oil and Gas Income

Royalties of 12.5 percent are typically earned for oil and gas production on state and federal lands. About 50 percent of royalties paid to the federal government are generally returned to the state from which they originate. Assuming the 250 production wells on the CX Ranch proposed for Alternative A each generate about $182,500 in gross production income per year (assuming production of 125,000 cubic feet per day and a price of $4.00 per thousand cubic feet), the total annual gross income would be about $45.6 million per year for an average of 15 years. About 12.5 percent, or $5.7 million, of this new income would accrue to the state, federal, or private mineral owner annually.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of leases on the CX Ranch; however, it is assumed that additional income would accrue to the state and federal government.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income and land disturbance payments) generated by Alternative A would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 32 jobs per year discussed under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-58), the average annual salary per job would be about $34,000. Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 32 jobs at $34,000 would range from $21,800 (2 percent tax rate) to $119,700 (11 percent tax rate), with a likely amount closer to $32,600 (3 percent tax rate) based on recent history. The project would result in an increase in state tax revenues to the extent that new income is created that didn't previously exist in the state.

Property Taxes

Both real and personal property are subject to property taxes. Personal property would consist of structures, equipment and materials used for the proposed exploration and production of CBNG. Taxes on real property would be based on changes in the assessed value that result from improvements to the property. Each county in which facilities were located would assess tax levies and apply them to the taxable value of the relevant facilities. The levy would be based on the total value of property multiplied by a tax rate or rates specific to the property location (i.e., county and special service districts). Any such additional property taxes would contribute new income directly to both the county tax base and the local economy. It should be noted that property taxes on business equipment (e.g., drilling equipment) would likely be phased out by 2006, reducing the total taxes that would be collected.

Given the limited nature of CBNG exploration and development proposed in Alternative A, changes in taxes are not expected to be substantial for any given county. The exception is Big Horn County, where the new production wells are proposed. Additional county tax revenues would be anticipated. Property tax revenues would be a cost to CBNG development companies and landowners and a benefit to the counties and the state.

Natural Resources Taxes

The products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas generated by the 250 production wells in Big Horn County would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

In general, the local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, local sales of goods and services associated with CBNG development would not generate increases in tax revenues because there is no sales tax in Montana.

Water Resource Values

The purpose of a discussion of water resource values in the *Economics* section of this report is to acknowledge that the existing surface and groundwater resources in the Planning Area have an economic value that is part of the overall economy of the area and that alterations to these resources, would have economic impacts to water users or to the regional economy. Affected users would include those who depend on surface water or groundwater for irrigation, ranching, municipal water needs, home water needs, landscape needs and any other business and household need of water from a surface water body or well.

Given the relatively limited scale of CBNG development proposed for Alternative A, effects on water resources and water resources economics would be relatively limited (see the analysis in the *Hydrological Resources* section). For Alternative A, untreated water from exploration would be placed in holding facilities for beneficial re-use, which would provide an economic benefit to affected water users. No discharge to waters of the United States would be allowed for BLM-authorized exploration wells; the state has permitted discharge for the CX Ranch field of

3,300 to 4,200 gpm of untreated and treated production water. Because of the small scale, no economic impacts to downstream surface water users would be anticipated.

Localized groundwater depletion would result over time (more than 5 years) from the CBNG wells proposed for Alternative A. However, state law (MCA 82-11-175) requires CBNG operators to offer a reasonable mitigation agreement to each person who holds an appropriation right or a permit to appropriate groundwater and for which the point of diversion is within one mile of a CBNG well; or one-half mile of a well that is adversely affected by CBNG well. These mitigation agreements must address the reduction or loss of water resources and must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the coal bed natural gas well.

Crow Reservation

Impacts to social and economic values on the Crow Reservation would be small because it is assumed that no CBNG wells would be developed on the Reservation initially. Social impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects potential. Few, if any, tax revenues would accrue to tribal governments as a result of off-reservation CBNG development. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer impacts from CBNG development.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be small because it is assumed that no CBNG wells would be developed on the Reservation. Social impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects potential. Few, if any, tax revenues would accrue to tribal governments as a result of off-reservation CBNG development. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer impacts from CBNG development.

Conclusions

The Alternative A management scenario is a continuation of existing oil and gas industry practices in the Planning Area and would not result in social impacts. They would be only a small effect on economic conditions in the Planning Area, as well as environmental and social conditions. However, there could be short term localized impacts to housing and services in Big Horn County.

The new jobs and related social and economic impacts from Alternative A would be small, with the exception of the proposed production wells in Big Horn County, which would result in positive economic impacts in that county. Future development in the area, such as further expansion of existing surface coal mines, would likely have larger social and economic impacts (e.g., creation of more jobs and income) than those impacts from Alternative A.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

As explained under the *Assumptions* section, most jobs created for CBNG development in Montana would likely be filled by Wyoming CBNG workers. In general, the scenario below lists greater economic benefits and greater social impacts than would likely occur.

Employment and Unemployment

Estimated direct employment from CBNG under the development scenario for the 20-year project life is presented in Table 4-59. (Wage information is discussed under *Economics*.) The number and type of jobs involved would vary with the project phase. The types of jobs would be the same as those described for Alternative A.

As shown in Table 4-59, development (drilling of about 18,300 wells over 20 years) would result in an estimated average of 851 jobs per year, with a range from 334 (Year 1) to 943 (Year 18) for all project phases combined. The actual number of jobs in a given year would depend on the actual number of wells drilled, in production, or abandoned in that year. Abandonment of wells during years 21-40 would result in an estimated 1,054 additional jobs, for an average of about 53 jobs per year during that period.

TABLE 4-59

ALTERNATIVES B, C, D, and E: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1, 2]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[3]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	900	276	$7,993,125	510	29	$1,099,688	390	29	$1,011,563	334	$10,104,375
2	1,100	337	$9,769,375	1,220	69	$2,630,625	390	29	$1,011,563	435	$13,411,563
3	2,000	613	$17,762,500	2,830	159	$6,102,188	390	29	$1,011,563	801	$24,876,250
4	2,200	674	$19,538,750	4,640	261	$10,005,000	390	29	$1,011,563	964	$30,555,313
5	2,000	613	$17,762,500	6,250	352	$13,476,563	390	29	$1,011,563	993	$32,250,625
6	1,500	459	$13,321,875	7,750	436	$16,710,938	0	0	$0	895	$30,032,813
7	1,300	398	$11,545,625	9,050	509	$19,514,063	0	0	$0	907	$31,059,688
8	900	276	$7,993,125	9,950	560	$21,454,688	0	0	$0	835	$29,447,813
9	900	276	$7,993,125	10,850	610	$23,395,313	0	0	$0	886	$31,388,438
10	700	214	$6,216,875	11,550	650	$24,904,688	0	0	$0	864	$31,121,563
11	550	168	$4,884,688	11,900	669	$25,659,375	200	15	$518,750	853	$31,062,813
12	550	168	$4,884,688	12,250	689	$26,414,063	200	15	$518,750	873	$31,817,500
13	550	168	$4,884,688	12,600	709	$27,168,750	200	15	$518,750	892	$32,572,188
14	550	168	$4,884,688	12,950	728	$27,923,438	200	15	$518,750	912	$33,326,875
15	550	168	$4,884,688	13,300	748	$28,678,125	200	15	$518,750	932	$34,081,563
16	450	138	$3,996,563	13,550	762	$29,217,188	200	15	$518,750	915	$33,732,500
17	450	138	$3,996,563	13,800	776	$29,756,250	200	15	$518,750	929	$34,271,563
18	450	138	$3,996,563	14,050	790	$30,295,313	200	15	$518,750	943	$34,810,625
19	400	123	$3,552,500	14,100	793	$30,403,125	350	26	$907,813	942	$34,863,438
20	300	92	$2,664,375	14,050	790	$30,295,313	350	26	$907,813	908	$33,867,500
20-Year Total	18,300	5,604	$162,526,875		11,090	$425,104,688		319	$11,023,438	17,013	$598,655,000
Annual Average	915	280	$8,126,343.75		554	$21,255,234.38		16	$551,171.88	851	$29,932,750

NOTES:

[1]Data for jobs per well and wages (ZurMuehlen 2001).

[2]The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBM wells. This would result in an increase in jobs and wages of about 10% over those reported in this table.

[3]Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001).

The additional jobs created would be small compared to the total employment in the Planning Area (122,000 in 1998). However, given that most of the CBNG wells would be located in three counties (Big Horn, Powder River and Rosebud), a large number of the jobs would be concentrated in those counties. Because some of these jobs would go to non-local residents, the actual number of new jobs in the study area would be less.

The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBNG wells. This would result in an increase in jobs and wages of about 10 percent over those reported in Table 4-59 for all phases of the project combined.

In addition to the direct jobs created by the project, some additional jobs would be created indirectly through additional work for persons in related support industries such as truckers, material suppliers, inspectors and various other specialists. One estimate is that one indirect job would be created for every four direct jobs created (ZurMuehlen 2001).

The effect of the new jobs on current unemployment rates in the area would be moderate. Although the new direct jobs would help boost total employment in the Planning Area, the increases would be limited to those sectors and individuals with the appropriate skills for the jobs and to those geographic locations where the jobs are located. For example, the relatively high unemployment rates (about 9 percent) in the mining sector in Big Horn and Rosebud counties would be decreased if unemployed persons gain employment from the new CBNG development.

Any new jobs filled by new residents (see the *Demographics* section) would increase the number of employed persons in a given county but would not decrease the number of unemployed persons. To the extent that indirect jobs are created by the project, some increased employment in other service industries also would occur.

Demographics

As with Alternative A, employees who would fill the CBNG jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment opportunities from around the region. It is assumed that local labor would be used to the extent it is available; however, for Alternative B it is likely that many additional workers (e.g., drill rig crews) from outside the area would be needed, especially during the peak employment years of the project. It is assumed that drill rigs from a variety of locations-both Montana and Wyoming-would be used, depending on supply and demand at any given time. The potential for new population is greatest in the counties where the number of CBNG wells to be drilled is greatest: Big Horn, Powder River and Rosebud counties (about 90 percent of proposed CBNG wells would be drilled in these three counties; see Table 4-60). As with Alternative A, it is estimated that, on average, each new employee would bring one additional person to the region. Assuming, for example, that all of the jobs were filled by new migrants to the area, as many as 1,986 people (993 x 2) might be added to the region during the peak employment year (Year 5). An increase of this magnitude would be small compared to the total regional population (196,000 in 2000). However, the new population could be concentrated in the three counties with the most CBNG wells (see Table 4-60).

Because these three counties have a relatively small combined population (about 24,000), population change within these counties could be substantial. Of the approximately 24,000 persons in the three counties, about 10,400 or 44 percent are Native American (see Chapter 3).

Social Organization

Housing Units and Vacancy

Depending on the type and duration of the jobs (e.g., long-term production supervisor versus drill rig crew member), new employees in the area would seek either temporary housing (hotels, apartments, trailer parking) or permanent housing (homes to purchase or to rent long-term). Individual choices about where to live are hard to predict and vary with personal preference, in addition to the supply of housing and availability of services in a given location and the mobility demands of a given job. The relatively limited supply of temporary and permanent housing in the smaller communities in the Planning Area would limit the number of new employees (and families, if applicable) who would be able to live there without additional housing and related services. The larger communities, such as Billings or Gillette and Sheridan, Wyoming, have a greater supply of temporary and permanent housing and would be likely settlement locations for people employed by the CBNG industry. In part because of the general trend of migration within Montana from the east to the west during recent years, vacant housing is available in a number of communities. As discussed in Chapter 3, vacancy rates for both temporary and permanent housing are adequate to high in the Planning Area. This information, combined with the large size of the geographic area and the dispersed nature of the new

TABLE 4-60

TOTAL PROJECTED WELLS AND PERCENT BY COUNTY

	Alternatives B, C, D and E		Alternatives F and G	
County	**Wells to be Drilled**	**Percent of Total**	**Wells to be Drilled[1]**	**Percent of Total**
Big Horn	7,000	38.3%	7,000	38.4%
Blaine	10	0.1%	0	0.0%
Carbon	400	2.2%	400	2.2%
Carter	0	0.0%	0	0.0%
Custer	300	1.6%	300	1.6%
Gallatin	15	0.1%	0	0.0%
Golden Valley	0	0.0%	0	0.0%
Musselshell	150	0.8%	150	0.8%
Park	25	0.1%	0	0.0%
Powder River	6,700	36.6%	6,700	36.7%
Rosebud	2,800	15.3%	2,800	15.3%
Stillwater	700	3.8%	700	3.8%
Sweetgrass	25	0.1%	0	0.0%
Treasure	25	0.1%	25	0.1%
Wheatland	0	0.0%	0	0.0%
Yellowstone	150	0.8%	150	0.8%
Subtotal	18,300	100.0%	18,225	100.0%
Combined Total: Big Horn, Powder River, and Rosebud counties	16,500	90.2%	16,500	90.4%

[1]The number of wells to be drilled under Alternative G is approximately 65 percent less than Alternative F. However, the percent of total is the same for both alternatives.

job opportunities and associated new population, suggest that adequate housing opportunities would be available in the larger communities but might not be available in some of the smaller communities.

Public Services and Utilities

Impacts on the ability of local governments to provide public services and utilities would be related to the ability of the service providers to adapt to relevant fiscal or physical changes from CBNG development. Affected services typically include police and fire protection, emergency medical services, schools, public housing, park and recreation facilities, water supply, sewage and solid waste disposal, libraries, roads and other transportation infrastructure. Given the large geographic scale of the CBNG development scenario, it is infeasible to quantitatively assess the relationship of the project to these individual services. Effects would be greatest in the three counties (Big Horn, Powder River and Rosebud) where most of the CBNG wells are proposed to be drilled; however, these counties would also receive the greatest amounts of property tax and other government revenues (see the *Economics* section) that would fund improvements or other changes to services.

The alternatives being considered include varying management objectives with respect to the construction of roads and utilities. The construction and maintenance of utilities would be funded by the users. The decision as to whether to maintain roads upon abandonment of CBNG facilities would be up to the land owner, which could be either a public or private entity. To the extent local governments opt to maintain these roads after this time, additional revenue would be required to balance the additional costs required to do so.

Attitudes, Beliefs, Lifestyles and Values

The large scale development of a large number of CBNG wells in the Planning Area would likely conflict with the attitudes, beliefs, lifestyles and values of many individuals and population subgroups in the area (e.g., farmers, ranchers, small town residents, Native Americans, retirees, etc.). Drilling, testing and operation of CBNG wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They would likely find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River and Rosebud counties where the majority of the wells would be developed. Large-scale CBNG development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. A smaller group of people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Large-scale CBNG development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as they affect locations and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

The subsurface discharge of produced water would likely be seen as consistent or somewhat inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. Impacts on groundwater would be the same for Alternatives B, C, D, E, F and H with the primary impact being the drawdown of groundwater.

Personal Income

Wages paid to CBNG workers would contribute to the total personal income in the county where the employees reside. As shown in Table 4-59, wages would be generated from all three project phases. Over the first 20 years of the project, total wages paid for all phases of the project would be an estimated $598 million. Estimated annual wages would range from $10 million in Year 1 to almost $35 million in Years 18 and 19. Although this much estimated personal income would be generated by the project, it would not all be experienced as “new” income within a given county or the state. New income would be the difference between the income of workers before CBNG development and the income after CBNG development.

A number of the producing wells in the development scenario would generate new personal income for those who own the land or the mineral rights, as stated under Alternative A. The circulation and re-circulation of direct income (including royalties to private owners) generated by the project would generate additional (indirect) personal income throughout the region.

Government Revenues

Oil and Gas Income

Assuming each of the approximately 16,500 production wells anticipated for Alternative B generate about $182,500 in gross production income per year of operation, the total annual gross income would vary depending on the number of wells in production in a given year. As shown in Table 4-59, the estimated number of producing wells ranges from 510 in Year 1 to 14,100 in Year 19. It follows that the estimated annual gross income would range from $93 million (Year 1) to $2.5 billion (Year 19). Most of this revenue would go to methane companies and would accrue to the companies in the states where they are located. The 12.5 percent royalty collected on this annual income would range from about $12 million (Year 1) to $322 million per year. It is estimated that about one-half the well sites would be permitted on minerals administered by the federal government (BLM), about 5 to 10 percent on state (private) minerals and the remaining 40 to 50 percent on private minerals. As a result, about half of the royalty income would initially go to the federal government, with about half of the federal half being returned to the state. Thus, an estimated 30 to 35 percent of royalty income, between $4 million and $113 million in a given year, ultimately would accrue to the state. Given that total state revenues received from minerals management on state lands in FY 2000 was $11.6 million and total federal mineral revenues collected on Montana lands and disbursed to the state were $20.4 million in FY 2000 (see Chapter 3), new state revenues from CBNG would be substantial, especially during the peak years of the project.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of the leases. It is assumed that additional income would accrue to the state and federal government from these rents.

Net government revenues would be reduced by costs incurred for monitoring and regulating CBNG activity. These costs would be relatively small compared to the revenues generated.

Water treatment costs for Alternative B would be greater than for Alternatives D, E and F and much greater than for Alternative C.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income and land disturbance payments) generated by Alternative B would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 851 jobs per year discussed above under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-59), the average annual salary per job would be about $35,000 (does not account for inflation over time). Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 851 jobs at $35,000 would range from $596,000 (2 percent tax rate) to $3.3 million (11 percent tax rate), with a likely amount closer to 894,000 (3 percent tax rate) based on recent history. As discussed above, the project would generate new income tax revenue for the state to the extent that revenue generated by new jobs, for example, exceeds existing tax revenues. The income tax sums are already included in the estimates of personal income.

Property Taxes

See general discussion of property taxes for Alternative A. Only at the time when a given property is improved (i.e., a CBNG well or other facilities are developed there) would estimated new property tax revenues be calculated. However, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the vast majority of new wells; therefore, they would be anticipated to experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services and other county assets, after any new costs associated with CBNG are accounted for.

Natural Resources Taxes

Natural resources taxes would be greater than described under Alternative A because they would be based on 18,000 wells.

Other Taxes

Other taxes would be the same as described under Alternative A.

Water Resource Values

Surface discharge of produced water would be prohibited and therefore surface water impacts such as erosion and water quality would be avoided. In the absence of surface water impacts, no associated economic impacts to surface water users would occur.

The primary impact to groundwater resources is removal of groundwater in the Powder River Basin affecting wells and springs.

Crow Reservation

Social and economic impacts from off-Reservation development in Alternative B would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Some additional demands on public services also would result.

See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on effects to Native Americans.

As shown in the RFFA, 4,000 wells could be developed on the Crow Reservation. If this entire number of wells were developed, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, a drawdown in groundwater and additional personal income and revenues from CBNG development and production.

Indian allottees and the Crow Tribe would receive access, damage payments, royalties and possible tax revenues.

Northern Cheyenne Reservation

Social and economic impacts from off-Reservation development in Alternative B would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Some additional demands on public services also would result.

See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on effects to Native Americans.

As shown in the RFFA, 4,000 wells could be developed on the Northern Cheyenne Reservation. If this entire number of wells were developed, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, a drawdown in groundwater and additional personal income and revenues from CBNG development and production.

Indian allottees and the Northern Cheyenne Tribe would receive access, damage payments, royalties and possible taxes revenues.

Conclusion

The primary social impacts identified from Alternative B would be the new jobs created in the Planning Area as a result of development and change from a predominantly rural and agricultural based lifestyle. These new jobs would result in some demographic shifts as a result of people moving to the area. It is anticipated the impact of added employment and population on social conditions would be small overall but that impacts in the three counties with the most CBNG activity could be greater. Alternative B would result in the generation of new personal and government income. New personal income would include the wages from both direct and indirect jobs created by the project, as well as income from land disturbance payments and mineral leases. Similarly, new local, state and federal government income would be generated through the variety of means discussed. Over the long term, there is the possibility of a “boom and bust” cycle as CBNG activity rises and falls.

As shown in the RFD scenario presented in the Minerals Appendix, in addition to the 18,300 CBNG wells considered for Alternative B, an additional 8,200 CBNG wells would be developed in this area in the future: 4,000 on the Northern Cheyenne Reservation, 4,000 on the Crow Reservation and about 200 wells on USFS land. This number is about 44 percent of those proposed for Alternative B. If this entire number of wells was developed over the same 20-year period as the other 18,300 wells, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, additional population, additional demands on public services, a drawdown in groundwater and additional personal income and government revenues from CBNG development and production. Potentially large social and economic impacts also would result from other developments proposed for the area, including expansion of existing surface coal mines. The impacts from these other developments would be additive to those identified above for Alternative B.

Alternative C—Emphasize CBNG Development

Employment And Unemployment

Employment and unemployment would be the same as described under Alternative B, except that there would be no additional jobs created from installation of injection wells, which would not be required for this alternative.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Alternative C would allow discharge of untreated water to the land surface. As indicated in the *Hydrological Resources* section, this discharge would result in erosion and water quality impacts. Such impacts would be inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. The primary reasons for this conclusion include the potentially large scale of this discharge, the potential for degraded water to negatively affect farming and ranching operations (e.g., reduce economic viability), increased noise, loss of natural scenery and the inconsistency of this approach with the rural lifestyles and values discussed in Chapter 3.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming or ranching income as a result of water quality and erosion impacts. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to lifestyles and Values.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described under Alternative B. Water treatment costs would be less than for Alternative B due to the allowance of discharge to the land surface (see *Water Resource Values* below).

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See the discussions for Alternative B. Alternative C would allow discharge of untreated water to the land surface. As indicated in the *Hydrological Resources* section elsewhere in this document, this discharge would result in erosion and water quality impacts. In turn, some downstream surface water users who depend on surface water resources for their livelihood would be affected (for example, if suitable irrigation water were no longer available or if ranch land were lost to erosion). See further discussion under *Attitudes, Beliefs, Lifestyles and Values*, above. Groundwater impacts would be similar to Alternative B. A difference is that no groundwater would be reinjected as it would for Alternative B, possibly increasing the risk of groundwater drawdown in some locations.

Crow Reservation

Impacts from Alternative C would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Crow Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Somewhat greater impacts on water resource users and on lifestyles and values would occur compared to Alternative B. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Social and economic impacts from development in Alternative C would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Northern Cheyenne Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Somewhat greater impacts on water resource users and on lifestyles and values would occur compared to Alternative B. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Conclusions

Residual impacts would be similar to those for Alternative B, except for impacts to lifestyles and water resource values, which would be greater for Alternative C than for Alternative B.

Cumulative impacts would be greater than for Alternative B, given the water resource impacts.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Employment and Unemployment

Employment and unemployment would be the same as described for Alternative B.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Treatment of most produced water and discharge via pipeline or other constructed water courses would eliminate most of the erosion and water quality impacts.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming area ranching income as a result of water quality and erosion impacts. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to lifestyles and Values.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be the same as described under Alternative B. Water treatment costs would be greater than for Alternative C and much less than for Alternative B.

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See discussion for Alternatives B and C. Most discharge would be treated and carried over land in pipes. Surface water impacts and the potential for resulting economic impacts to surface water users would be less than for Alternative C and greater than for Alternative B. Groundwater impacts would be the same as Alternative C.

Crow Reservation

Impacts from Alternative D would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Crow Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Additional impacts on water resource users and on lifestyles and values would occur but they would be less than for Alternative C. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Social and economic impacts from Alternative D would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Additional impacts on water resource users and on lifestyles and values would occur but they would be less than for Alternative C. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Conclusions

Residual impacts would be similar to those for Alternative B, except with respect to impacts on water resource economics and related lifestyle impacts, which would be less than Alternative C but greater than Alternative B.

Cumulative impacts would be less than Alternative C and somewhat greater than Alternative B, given the differences in water resource impacts.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Employment and Unemployment

Employment and unemployment would be the same as described under Alternative B. It is assumed that the approximate number of additional jobs created from installation of injection wells required for Alternative B would also occur for Alternative E, except that some of the jobs would be associated with the variety of site-specific produced water management options.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B, except that the oil and gas roads would remain open or be closed at the surface owner's discretion, potentially increasing or decreasing the burden on public jurisdictions to maintain these roads.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups would be the same as for Alternative B.

Alternative E would have impacts on water resources and water resource values that are similar to the impacts of Alternative B and Alternative D (see *Hydrological Resources* section).

Personal Income

Personal income would be the same as described under Alternative B.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described for Alternative B, although water treatment costs could be greater, thus potentially decreasing the net income to producers.

Taxes

Income Taxes

Income taxes would the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resource Taxes

Natural resource taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

Alternative E would have impacts on water resources and water resource values that are similar to the impacts of Alternative B and Alternative D (see discussion in *Hydrological Resources* section). The activities proposed to prevent the degradation of surface and groundwater resources would substantially reduce erosion and surface water quality impacts.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative E. Social and economic impacts would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Compared to other alternatives, oil and gas income could be less, depending on water treatment costs. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described above for Alternative E. Social and economic impacts would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Compared to other alternatives, oil and gas income could be less, depending on water treatment costs. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Social and economic impacts from CBNG development on federal lands would be mitigated as described in the Northern Cheyenne Mitigation Appendix. However, most measures focus on preventing the loss of tribal resources such as CBNG water. The BLM would consult with the tribe where site-specific analysis identifies social or economic impacts on the Reservation.

The Northern Cheyenne Tribe can require their special socioeconomic mitigation measures in tribal leases on the reservation.

Conclusions

Residual impacts would be similar to those for Alternative B, with the exception of the reduced impacts on lifestyles and values and water resource values that would result from the proposed measures to prevent the degradation of water resources.

Cumulative impacts would be somewhat less than for Alternative B, given the greater variety of control measures that would be used to prevent water resource impacts.

Alternative F—Phased Development Multiple Screens (High Range)

Because Alternative F would create fewer jobs annually and through completion of development than Alternatives B through E although wells would be drilled over a longer period of time, it is even more likely that jobs created under Alternative F would be filled by CBNG workers from Wyoming, as described in the *Assumptions* section.

The following discussion quantifies impacts associated with full development within the crucial sage-grouse habitat areas. If no development occurs in these areas, the socioeconomic impacts such as jobs and revenues would be approximately 12.8 percent lower. While this scenario would reduce revenues and jobs to some degree, there would be less demand placed on infrastructure, schools and other public services. The overall effect of reducing development impacts in the crucial sage-grouse habitat are expected to be less than the 12.8 percent reduction.

Employment and Unemployment

Employment changes resulting from Alternative F are shown in Table 4-61 and are expected to be lower than Alternatives B through E. Employment for Alternative F may be slightly higher than shown, since a small number of additional jobs would be created to manage produced water from the federal CBNG wells. While the types of jobs generated under this alternative would be similar to those generated under Alternatives B-E, the number of jobs and rate of jobs created per year are predicted to vary from the other alternatives. The number of wells drilled per year under Alternative F would be more constant than for the Alternatives B-E and H and would extend for an additional three years. This would result in fewer new jobs created annually, but new jobs created annually over a longer period of time compared to Alternatives B-E and H.

The numbers of jobs presented in Table 4-61 have been calculated on an annual basis. In year 1 of the development period, 217 new jobs are expected to be created to implement approved APDs. In year 2, 354 jobs would be required; however, 217 of these jobs would likely be filled by the workers employed in year 1. Consequently, the maximum number of workers needed in any one year would gradually increase over the development period from 217 to a peak of 1,039 in year 20, then gradually decrease as wells are abandoned.

Over the 23-year phased development period, an annual average of 774 jobs would be created by this alternative. This breaks out to an annual average of 243 initial development jobs, 523 production jobs and 8 well abandonment jobs created. There would be additional abandonment jobs after the development period (years 24 through 46). The total number of jobs created during the 23-year phased development period under Alternative F would be 14,707, as compared to 17,013 jobs during the 20-year development period for Alternatives B through E. The difference is mainly in the number of production jobs, which would be lower due to fewer producing wells per year as compared to other alternatives.

The effect of Alternative F on current unemployment rates in the area would be less than for Alternatives B through E. There would be a potential for some residents in the Planning Area to obtain these new jobs if they have the appropriate skills, which would directly reduce unemployment. However, most of the jobs created would likely go to Wyoming CBNG workers. Consequently, most of the indirect effects of this new employment (wages spent on support services) are expected to occur in Wyoming.

Demographics

Employees working in the CBNG industry in the Montana portion of the Powder River Basin would likely be commuting from Wyoming. Most of the existing CBNG operations in Montana are located near Decker, Montana, with Sheridan, Wyoming (located approximately 20 miles away), the closest community with a population large enough to support CBNG operations. In addition, much of the proposed drilling

TABLE 4-61

ALTERNATIVES F AND H: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION and ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Develop-ment Jobs[1]	Initial Development Wages[1]	Wells Producing Per Year[2]	Production Jobs[1]	Production Wages[1]	Wells Abandoned per Year[2]	Abandon-ment Jobs[1]	Abandon-ment Wages[1]	Estimated Total Jobs	Estimated New Jobs per Year	Estimated Total Wages
1	607	186	$5,390,919	546	31	$1,177,313	0	0	$0	217	217	$6,568,231
2	910	279	$8,081,938	1,336	75	$2,880,750	0	0	$0	354	137	$10,962,688
3	1074	329	$9,538,463	2,333	131	$5,030,531	0	0	$0	460	106	$14,568,994
4	1170	358	$10,391,063	3,386	190	$7,301,063	0	0	$0	549	89	$17,692,125
5	1074	329	$9,538,463	4,352	245	$9,384,000	0	0	$0	574	25	$18,922,463
6	910	279	$8,081,938	5,171	291	$11,149,969	0	0	$0	570	-4	$19,231,906
7	910	279	$8,081,938	5,991	337	$12,918,094	0	0	$0	616	46	$21,000,031
8	910	279	$8,081,938	6,810	383	$14,684,063	0	0	$0	662	46	$22,766,000
9	910	279	$8,081,938	7,628	429	$16,447,875	0	0	$0	708	46	$24,529,813
10	910	279	$8,081,938	8,447	475	$18,213,844	0	0	$0	754	46	$26,295,781
11	910	279	$8,081,938	9,266	521	$19,979,813	0	0	$0	800	46	$28,061,750
12	906	277	$8,046,413	10,081	567	$21,737,156	0	0	$0	845	45	$29,783,569
13	824	252	$7,318,150	10,823	609	$23,337,094	0	0	$0	861	17	$30,655,244
14	824	252	$7,318,150	11,565	651	$24,937,031	0	0	$0	903	42	$32,255,181
15	824	252	$7,318,150	12,307	692	$26,536,969	0	0	$0	945	42	$33,855,119
16	704	216	$6,252,400	12,941	728	$27,904,031	0	0	$0	944	-1	$34,156,431
17	703	215	$6,243,519	13,574	764	$29,268,938	0	0	$0	979	35	$35,512,456
18	654	200	$5,808,338	14,163	797	$30,538,969	0	0	$0	997	18	$36,347,306
19	543	166	$4,822,519	14,652	824	$31,593,375	0	0	$0	990	-6	$36,415,894
20	444	136	$3,943,275	15,052	847	$32,455,875	0	0	$0	983	-8	$36,399,150
21	509	156	$4,520,556	14,964	842	$32,266,125	546	41	$1,416,966	1,039	56	$38,203,647
22	496	152	$4,405,100	14,590	821	$31,459,688	819	61	$2,124,281	1,034	-5	$37,989,069
23	499	153	$4,431,744	14,072	792	$30,342,750	967	72	$2,507,119	1,017	-17	$37,281,613
23-Year Total	18,225	5,121	$161,860,781		9,586	$461,545,313	2,332	175	$6,048,366	14,707		$629,454,459
Annual Average	792	243	$7,037,425		523	$20,067,188	101	8	$262,972	774		$27,367,585

NOTES:

[1]Numbers of jobs and wages were calculated using the same method as Table 4-58. The numbers of jobs have been calculated on an annual basis. The maximum number of workers needed in any one year would gradually increase over the development period from 217 to a peak of 1.039 in year 20, then gradually decrease as the wells are abandoned.

[2]Numbers of production and abandonment wells are based on the assumption that 10% of all wells drilled would be dry holes.

in Montana would occur in four watersheds: Middle Powder River, Lower Powder River, Upper Tongue River and Lower Tongue River. These areas are located in the general vicinity of Sheridan, Buffalo and Gillette, Wyoming.

New temporary jobs related to CBNG could be created by drilling and construction activities, or the application of technology that requires additional employees, while new permanent jobs could be created to oversee additional production wells and facilities. The available jobs range from laborers and other field positions to technical/professional positions, such as geologists and engineers and other office staff positions. Additional support jobs could include surveyors and research scientists.

Most of the subcontracting companies used by CBNG companies operating in Montana are based in Wyoming. A small number of subcontracting companies and individual workers are from Montana. Job opportunities related to CBNG are advertised in both the Wyoming and Montana state job databases.

Social Organization

Housing Units and Vacancy

Most employees would commute from Wyoming, thus there would be little additional demand for housing in the Planning Area due to implementation of Alternative F.

Public Services and Utilities

Similarly, this alternative would have little effect on public services and utilities in the Planning Area, since most of the workers would be living in Wyoming rather than the Planning Area. The communities of Sheridan, Gillette and Buffalo, Wyoming, would most likely be affected by additional employees needed to support CBNG operations in the area of Montana with the greatest potential for CBNG development. Cumulative impacts to Wyoming communities are discussed in the *Impacts from Management Common to All Alternatives* section.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups such as farmers, ranchers, small town residents, Native Americans and retirees, would be similar but are likely to have less effect than Alternatives B through E, particularly in the short-term (years 1-5 of the development period). Effects could include conflict with the attitudes, beliefs, lifestyles and values of many individuals. Drilling, testing and operation of CBNG wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves, as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They could find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River and Rosebud counties where the majority of the wells would be developed. Large-scale CBNG development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. Some people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Large-scale CBNG development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as these affect locations and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would require mitigation to minimize impacts. Exploratory activities, such as drilling and testing, would temporarily displace game species locally. Less recreation area would likely be disturbed under Alternative F because the maximum level of federal well development would be limited in each watershed and habitat disturbance would be limited.

The use of watershed-level analysis, water management plans and water balance projections as part of PODs would reduce the amount of erosion and water quality impacts expected from surface discharge of produced water. By use of watershed-level management of surface discharged water (i.e., 10 percent of 7Q10), impacts to surface water would be less than Alternative C and likely less than Alternative E.

The main difference under Alternative F would be that by limiting the number of federal wells approved each year per watershed, the overall rate of well development would be slower than for Alternatives B through E, especially in those areas where the greatest level of drilling would occur (the Upper Tongue, Lower Tongue and Middle Powder watersheds). For example, in year 4 (the year with the highest number of predicted wells), 2,200 wells would be drilled under Alternatives B through E versus 1,170 wells under Alternative F. While initial development under Alternatives B through E would likely be concentrated near areas that have already been developed, watershed-based limits under Alternative F would require development to be more dispersed among watersheds. Based on this more even development over time and among watersheds, combined with the 20/20 crucial habitat screen, the amount of habitat disturbance and fragmentation from federal wells would also be limited within each watershed.

This more even pace of development and restricted place of development may help residents adjust to the influx of CBNG development, but the impacts could last longer than under Alternatives B through E. Early in the phased development period, specific sources of noise, visual intrusion and surface disturbance would be less each year per watershed under this alternative than under Alternatives B through E because of the limits placed on approval of federal wells. In the later years of the development period, the sources of disturbance would be greater for this alternative as more federal wells would be developed than under Alternatives B through E. However, residents in the areas of CBNG development would still be impacted by any activities approved by the state.

Personal Income

Estimated CBNG wages for Alternative F are shown in Table 4-61. These wages would add to the total personal income mainly in the localities where employees reside (Wyoming). Wages would be produced from the development, production and abandonment phases. The estimated total wages over the phased development period would be $629,454,459. Annual wages are estimated to be $27,367,585, but would range from $6.6 million in year 1 to $38.2 million in year 21.

Income would also be generated by those who own the land or the mineral rights as described for Alternative A. Purchases made with CBNG income would produce some additional indirect income in the region as wages circulate through the economy. Most income from wages would likely be spent in Wyoming, where most CBNG workers live and income from land and mineral rights would likely be spent in Montana, where landowners live.

Government Revenues

Oil and Gas Income

Assuming that of the 18,225 wells drilled, approximately 10 percent would be dry holes leaving approximately 16,403 wells to generate production income. Production income under Alternative F would be expected to be lower than Alternatives B through E for years 3 through 17 and higher in the other years due to the limited number of APDs allocated per year.

Using the same production income as Alternative B, gross production income per year of operation would be approximately $182,500 per well. The number of producing wells would range from 546 in year 1 to 15,052 in year 20 (see Table 4-61). It follows that estimated annual gross income would range from $100 million (year 1) to $2.7 billion (year 20). Royalty income of 12.5 percent would range from $12 million (year 1) to $343 million (year 20), as compared to $12 to $322 million for Alternatives B through E. The maximum annual number of producing wells for this alternative would be higher than for Alternatives B through E (15,052 in year 20 versus 14,100 in year 18).

Distribution of production and royalty income to BLM, state (private) minerals and private minerals and income from rents and leases for oil and gas development would be similar to Alternative B. Generally, new state revenues from CBNG would be substantial. This source of state revenue would be more evenly spread over the phased development period under Alternative F as compared to Alternatives B through E. This would be a more constant source of income for the state, rather than a large infusion of revenue early in the program (years 1-5) that would dwindle over time.

Similar to Alternative B, government revenue from oil and gas would be reduced by costs for monitoring and regulating CBNG activity and water treatment. However, these costs are relatively small as compared to the generated revenue.

Under Alternative F, the Crow and Northern Cheyenne reservations would be protected from drawdown of coal seam aquifers and drainage of tribal CBNG and groundwater resources by the establishment of a 5-mile buffer zone around the borders of the reservations. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops where there would be the increased potential for drainage of federal minerals. Within the 5-mile buffer zone of reservation boundaries, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 acres) within the Billings RMP Area and 64 percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 to 1.6 TCF of gas that may be lost to the federal, state and county governments [(127,165 ac + 250,565 ac)/1 well site per 80 acres * 0.3 to 0.34 BCF per well site]. The loss of royalties to the Federal government would be approximately $1.2 billion at current gas prices.

Alternative F differs from other alternatives in that Federal revenues and the associated state revenues, could be reduced if operators and BLM cannot find economic means of developing within the crucial sage-grouse habitat areas. If this transpires, then overall Federal royalties would be reduced by approximately $299,000,000 over the life of the field development. Similarly, private and State mineral estates may lose approximately $100,000,000 in royalties, assuming a similar royalty rate is paid to these mineral estate owners.

Taxes

Income Taxes

Income taxes would be somewhat lower than Alternative B due to the lower average number of estimated jobs (851 versus 774 jobs per year). However, since most of the workers are expected to come from Wyoming, it is likely that most of the income taxes generated by CBNG development would be paid in Wyoming.

Property Taxes

Like Alternatives B through E, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the vast majority of new wells; therefore, they would be anticipated to experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services and other county assets, after accounting for any new costs associated with CBNG. There could be some slight difference between these alternatives related to which counties would accrue these taxes. This may be caused by focusing CBNG development by watersheds instead of other jurisdictional boundaries.

Natural Resources Taxes

Like the other alternatives, the products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

The local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, local sales of goods and services associated with CBNG development would not generate increases in tax revenues because there is no sales tax in Montana. In addition, most of the purchases associated with CBNG would likely be made in Wyoming.

Water Resource Values

Alternative F would have impacts on water resources and water resource values similar to Alternative E. However, disposal under this alternative would be managed on a watershed basis to reduce water quality impacts that may adversely affect downstream water users. Alternative H would allow limited discharge of untreated water under certain conditions. The volume of discharge from federal wells would be based on 10 percent of the 7Q10 flow calculated from all CBNG wells at the downstream end of the watershed. If this 10 percent limit is being used by state or private wells, then no additional discharge of untreated water would be allowed from federal wells. Water produced by federal wells may be treated, used for beneficial uses, or re-injected into the ground if the 10 percent allowable discharge has already been exceeded.

Discharge of produced water into state waters would be allowed only under an approved State permit which would protect existing uses. Produced water put to beneficial use would provide an economic benefit to affected water users.

As for Alternatives B though E, localized groundwater drawdown would occur over time. The risk of such drawdown would likely be greater than Alternative B, since reinjection of all produced water is not required under this alternative. However, water well mitigation agreements would address the potential reduction or loss of water resources and provide for prompt supplementation or replacement of water from any nearby natural spring or water well adversely affected by a CBNG well.

Crow Reservation

With lower numbers of jobs expected, Alternative F would result in somewhat lower social and economic impacts on the Crow Reservation as compared to Alternatives B through E. Similar to other Montana residents, unless Crow tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by Alternative F.

Alternative F requires monitoring of federal CBNG development within 5 miles of the Crow Reservation. Site-specific groundwater and air quality analysis and mitigation measures would be required and implemented through the operator's Plan of Development. ITAs would be protected from federal CBNG wells located within 5 miles of the Crow Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APDs. BLM would require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely avoid traveling across the Crow Reservation by driving from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana. However, if CBNG development occurs on the Crow Reservation workers from Wyoming would enter the Crow Reservation.

Northern Cheyenne Reservation

Due to a lower number of new jobs expected and the fact that CBNG workers will not be crossing the Northern Cheyenne Reservation on their journey to work, except for the wells developed in the northern portion of the Planning Area, Alternative F would likely result in somewhat lower impacts on the Northern Cheyenne Reservation related to population, employment and social conditions as Alternatives B through E. Like other Montana residents, unless Northern Cheyenne tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by Alternative F. Some off-site members may be encouraged by perceived job opportunities to return to the Reservation, which could increase demand for public services. Some tribe members are concerned that increased stress caused by social changes due to CBNG development may also increase the likelihood of alcoholism, drug abuse and family violence.

Alternative F would require monitoring of federal CBNG development within 5 miles of the Northern Cheyenne Reservation. These requirements would protect ITAs and include site-specific groundwater and air quality analysis. This analysis would be included in the operator's Plan of Development. ITAs would be protected from federal CBNG wells located within 5 miles of the Northern Cheyenne Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APDs. BLM would require groundwater and air monitoring between the federal well field development area and the Reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

CBNG operators and subcontractors may need to drive across the Northern Cheyenne Reservation to reach some well sites in the northern part of the Planning Area (Rosebud County). Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts could occur on the reservation. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, there is little reason for CBNG workers to stop on the reservation, as few services are offered on the reservation routes that would be used. Interaction with commuting workers would be of short duration and sporadic.

Conclusions

Social and economic impacts, such as employment, income, demographic migration, taxes, changes in lifestyle and social conditions would likely be less than to those for Alternative B through E and there is less likely to be a "boom and bust" cycle associated with Alternative F. Like the other alternatives, new jobs would likely be filled by CBNG workers from Wyoming. Under this alternative, CBNG development would be relatively steady over the phased development period, provided development continues and the demand for natural gas remains. Under the other development alternatives, CBNG development would increase rapidly, peaking over a 5-year period and then decrease over the remainder of the development period. In addition, the social and economic impacts are likely to vary slightly from the other alternatives because development would occur based on watersheds, which may further spread CBNG development outside the three main counties most affected under Alternatives B through E (Big Horn, Powder River and Rosebud). This may reduce the overall impacts on social conditions and lifestyles.

The cumulative reduction in federal royalties due to the conditions placed on development within crucial sage-grouse habitat areas coupled with the 5-mile buffer development delay/restriction around reservations would result in a $1.5 billion loss to the federal government at current gas prices.

Cumulative water resource impacts from Alternative F would be less than Alternative C and E and more than Alternative B.

Alternative G—Phased Development Multiple Screens (Low Range)

Under Alternative G, fewer jobs would be created annually and through completion of development of all the Alternatives considered. Although wells would be drilled over a longer period of time, it is even more likely that jobs created under Alternative G would be filled by CBNG workers from Wyoming, as described in the *Assumptions* section.

Employment and Unemployment

CBNG employment under Alternative G is shown in Table 4-62 and would be similar (in the types of job opportunities) to Alternatives B through F. However, this alternative would result in a substantially lower number of new jobs, approximately 65 percent fewer jobs on average. The numbers of jobs presented in Table 4-62 have been calculated on an annual basis. In year 1 of the development period, 77 new jobs are expected to be created to implement approved APDs. In year 2, 126 jobs would be required; however, 77 of these jobs would likely be filled by the workers employed in year 1. Consequently, the maximum number of workers needed in any one year would gradually increase over the development period from 77 to a peak of 369 in year 21, then gradually decrease as wells are abandoned.

Under Alternative G, over the phased development period, an annual average of 275 jobs would be created. This breaks out to an annual average of 86 initial development jobs, 186 well production jobs and 3 well abandonment jobs. After the 23-year development period (years 24 through 46), there would be additional abandonment jobs. The total number of jobs created during the 23-year phased development period under Alternative G would be 6,323, as compared to 14,707 jobs during the 23-year phased development period under Alternative F and 17,013 jobs during the 20-year development period under Alternatives B through E.

Similar to other alternatives, limited phased CBNG development would create some new jobs for persons with the appropriate skills. However, the number of jobs created would be substantially less than the other development alternatives and it is not likely that this alternative would have a large effect on unemployment in the area as compared to other development alternatives.

Demographics

The type of effects from this alternative on demographics would be similar to Alternative F, while the amount of change would be less due to substantially fewer new jobs. As described under Alternative F, employees working in the CBNG industry in the Montana portion of the Powder River Basin would likely commute from Wyoming.

Most of the subcontracting companies used by CBNG companies operating in Montana are based in Wyoming. A small number of subcontracting companies and individual workers are from Montana. Job opportunities related to CBNG are advertised in both the Wyoming and Montana state job databases.

Social Organization

Housing Units and Vacancy

Like Alternative F, most employees under Alternative G would commute from Wyoming; thus, there would be little additional demand for housing in the Planning Area.

Public Services and Utilities

Similarly, this alternative would have little effect on public services and utilities within the Planning Area, since most of the workers would be living in Wyoming rather than the Planning Area. The highway connecting Sheridan to Decker would receive the most vehicle traffic related to CBNG operations in Montana.

The types of effects on public services and utilities would be similar to Alternative F, but less due to the lower number of expected new jobs. The communities of Sheridan, Gillette and Buffalo, Wyoming, would most likely be called upon to provide public services.

TABLE 4-62

ALTERNATIVE G: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION and ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Develop-ment Jobs[1]	Initial Development Wages[1]	Wells Producing Per Year[2]	Production Jobs[1]	Production Wages[1]	Wells Abandoned per Year[2]	Abandon-ment Jobs[1]	Abandon-ment Wages[1]	Estimated Total Jobs	Estimated New Jobs per Year	Estimated Total Wages
1	215	66	$1,909,469	194	11	$418,313	0	0	$0	77	77	$2,327,781
2	323	99	$2,868,644	486	27	$1,047,938	0	0	$0	126	50	$3,916,581
3	381	117	$3,383,756	829	47	$1,787,531	0	0	$0	163	37	$5,171,288
4	415	127	$3,685,719	1,204	68	$2,596,125	0	0	$0	195	32	$6,281,844
5	381	117	$3,383,756	1,547	87	$3,335,719	0	0	$0	204	9	$6,719,475
6	323	99	$2,868,644	1,838	103	$3,963,188	0	0	$0	202	-1	$6,831,831
7	323	99	$2,868,644	2,129	120	$4,590,656	0	0	$0	219	16	$7,459,300
8	323	99	$2,868,644	2,420	136	$5,218,125	0	0	$0	235	16	$8,086,769
9	323	99	$2,868,644	2,711	152	$5,845,594	0	0	$0	251	16	$8,714,238
10	323	99	$2,868,644	3,002	169	$6,473,063	0	0	$0	268	16	$9,341,706
11	323	99	$2,868,644	3,294	185	$7,102,688	0	0	$0	284	16	$9,971,331
12	322	99	$2,859,763	3,583	202	$7,725,844	0	0	$0	300	16	$10,585,606
13	293	90	$2,602,206	3,846	216	$8,292,938	0	0	$0	306	6	$10,895,144
14	293	90	$2,602,206	4,110	231	$8,862,188	0	0	$0	321	15	$11,464,394
15	293	90	$2,602,206	4,373	246	$9,429,281	0	0	$0	336	15	$12,031,488
16	250	77	$2,220,313	4,598	259	$9,914,438	0	0	$0	335	-1	$12,134,750
17	250	77	$2,220,313	4,823	271	$10,399,594	0	0	$0	348	13	$12,619,906
18	232	71	$2,060,450	5,033	283	$10,852,406	0	0	$0	354	6	$12,912,856
19	193	59	$1,714,081	5,206	293	$11,225,438	0	0	$0	352	-2	$12,939,519
20	158	48	$1,403,238	5,347	301	$11,529,469	0	0	$0	349	-3	$12,932,706
21	181	55	$1,607,506	5,316	299	$11,462,625	194	15	$501,891	369	20	$13,572,022
22	176	54	$1,563,100	5,182	291	$11,173,688	291	22	$754,003	367	-2	$13,490,791
23	177	54	$1,571,981	4,998	281	$10,776,938	343	26	$889,397	361	-6	$13,238,316
23-Year Total	6,470	1,982	$57,470,569		4,279	$164,023,781	827	62	$2,145,291	6,323		$223,639,641
Annual Average	281	86	$2,498,720		186	$7,131,469	36	3	$93,274	275		$9,723,463

NOTES:

[1]Numbers of jobs and wages were calculated using the same method as Table 4-58. The numbers of jobs have been calculated on an annual basis. The maximum number of workers needed in any one year would gradually increase over the development period from 77 to a peak of 369 in year 21, then gradually decrease as the wells are abandoned.

[2]Numbers of production and abandonment wells are based on the assumption that 10% of all wells drilled would be dry holes.

emergency services and support services for employees and their families.

Cumulative impacts to Wyoming communities are discussed in the *Impacts from Management Common to All Alternatives* section

Attitudes, Beliefs, Lifestyles and Values

The type of impacts on population subgroups such as farmers, ranchers, small town residents, Native Americans, retirees under Alternative G would be similar to Alternative F. However, this alternative is anticipated to have a greatly reduced effect on attitudes, values, beliefs and lifestyles as compared to other alternatives (see below for details). Not only is the location of development more restricted than Alternatives B through E (Alternative G is similar to Alternative F in that well location development is restricted by watershed), but the pace of development is greatly reduced even over Alternative F. Thus, under Alternative G, noise, visual impacts and surface disturbance would be minimized as compared to the other alternatives. In addition, less recreational or habitat areas would be disturbed.

Although Alternative G would have fewer effects on attitudes, values, beliefs and lifestyles, the development of CBNG wells would still result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They could find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports, although they may find Alternative G more acceptable. Some people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Alternative G may be more acceptable with Native Americans and may conflict less with traditional Native American values, which emphasize preservation of cultural heritage and a reverence for the natural environment. However, Native American groups could still be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as these affect locations and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would require mitigation to minimize impacts. Exploratory activities, such as drilling and testing, would temporarily displace game species locally. Less recreation area would likely be disturbed under Alternative G than the other Alternatives.

As for Alternative F, the use of watershed-level analysis, water management plans and water balance projections as part of PODs would reduce the amount of erosion and water quality impacts expected from surface discharge of produced water. By use of watershed-level management of surface discharged water (i.e., 10 percent of 7Q10), as well as a lower level of development, impacts to surface water would be less than Alternatives C, E and F.

More than any other alternative, Alternative G limits the number of federal wells approved each year per watershed, so the overall rate of well development would be slower than for Alternatives B through F, especially in those areas where the greatest level of drilling would occur, such as the Upper Tongue, Lower Tongue and Middle Powder watersheds. For example, in year 4 (the year with the highest number of predicted wells), 2,200 wells would be drilled under Alternatives B through E versus 416 wells under Alternative G. The number of federal wells and the amount of habitat disturbance and fragmentation from federal wells would also be limited in each watershed.

This lower level and more even pace of development and restricted place of development may help residents adjust to the influx of CBNG development, but the impacts could last longer than under Alternatives B through E. Throughout the phased development period, specific sources of noise, visual intrusion and surface disturbance would be less each year per watershed under this alternative than the other development alternatives. However, residents in the areas of CBNG development would still be impacted by any activities approved by the State.

Personal Income

The estimated wages for Alternative G are shown in Table 4-62. Similar to other development alternatives, the wages earned from CBNG development would directly increase personal income for those working in the CBNG industry and indirectly increase personal income for persons working in other economic sectors where CBNG workers may spend income. Like the other alternatives, most of the direct and indirect income would go to workers in Wyoming. The predicted total wages over the phased development period for Alternative G would be $223,639,641. As compared to Alternative F, this alternative would produce approximately 35 percent as much personal income ($629,454,459 versus $223, 639,641). Income would also be generated by persons who own the land or mineral rights where drilling would occur similar to Alternative A.

Government Revenues

Oil and Gas Income

Assuming that 10 percent of the 6,470 wells drilled under this alternative would be dry holes, approximately 5,822 wells would remain to generate production income. Using the same production income ratio as Alternative B, gross production income per year of operation would be approximately $182,500 per well. The number of producing wells would range from 194 in year 1 to 5,341 in year 20 (see Table 4-62). It follows that estimated annual gross income would range from $35 million (year 1) to $976 million (year 20). Royalty income of 12.5 percent would range from $4.4 million (year 1) to $12 million (year 20). The oil and gas income generated under Alternative G would be significantly less than other development alternatives as income for other development alternatives is as high as $2.7 billion.

Taxes

Income Taxes

The estimated average yearly income tax revenue generated by Alternative G would be $289,000, assuming a three percent tax rate. Alternative G would generate $605,000 less tax revenue than Alternatives B through E and $524,000 less than Alternative F. However, since most of the jobs are expected to be filled by workers living in Wyoming, most of these taxes would likely be paid in Wyoming.

Property Taxes

Like Alternatives B through F, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the majority of new wells; therefore, they would be anticipated to experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services and other county assets, after accounting for any new costs associated with CBNG. Property taxes would be lower for Alternative G than the other alternatives because fewer wells would be developed. Similar to Alternative F, which would focus CBNG development by watershed instead of other jurisdictional boundaries, there could be some differences related to which counties accrue the taxes.

Natural Resources Taxes

Like the other alternatives, the products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies. Natural Resources taxes would be lower for Alternative G than the other alternatives because fewer wells would be developed. There could be some slight difference between these alternatives related to which counties would accrue these taxes. This may be caused by limiting CBNG development by watershed instead of other jurisdictional boundaries.

Other Taxes

The local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, local sales of goods and services associated with CBNG development would not generate increases in tax revenues because there is no sales tax in Montana. In addition, most of the purchases associated with CBNG would likely be made in Wyoming

Water Resource Values

Alternative G would produce less water, but due to discharge limitations, it would likely have impacts on water resources and water resource values similar to Alternatives C, D, E and F. Like Alternative F, this alternative would allow limited discharge of untreated water under certain conditions. The volume of discharge from federal wells would be based on 10 percent of the 7Q10 flow calculated from all CBNG wells at the downstream end of the watershed. If this 10 percent limit is being used by state or private wells, then no additional discharge of untreated water would be allowed from federal wells. Water produced by federal wells may be treated, used for beneficial uses, or re-injected into the ground if the 10 percent allowable discharge has already been exceeded.

Discharge of produced water into State waters would be allowed only under an approved State permit which would protect existing uses. Produced water put to beneficial use would provide an economic benefit to affected water users.

As for Alternatives B though F, localized groundwater drawdown would occur over time. The risk of such drawdown would likely be greater than Alternative B, since reinjection of all produced water is not required under this alternative, but less than Alternatives C through F due to the reduced level of development. Water well mitigation agreements would address the potential reduction or loss of water resources and provide for prompt supplementation or replacement of water from any nearby natural spring or water well adversely affected by a CBNG well.

Crow Reservation

The types of social and economic impacts of Alternative G on the Crow Reservation would be similar to Alternative F. However, the magnitude of impacts would be lower with fewer expected new jobs. Similar to other Montana residents, unless Crow tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill jobs created by Alternative G.

Similar to Alternative F, Alternative G would require monitoring of federal CBNG development within 5 miles of the Crow Reservation. Site-specific groundwater and air quality analysis and mitigation measures would be required and implemented through the operator’s Plan of Development. ITAs would be protected from federal CBNG wells located within 5 miles of the Crow Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM may require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely avoid traveling across the Crow Reservation by driving from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana. However, if CBNG development occurs on the Crow Reservation, workers from Wyoming would enter the Crow Reservation.

Northern Cheyenne Reservation

The types of social and economic impacts of Alternative G on the Northern Cheyenne Reservation would be similar to Alternative F, although the amount of impacts would be lower due to fewer expected new jobs. Similar to other Montana residents, unless Northern Cheyenne tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill jobs created by Alternative F. Some off-site members may be encouraged by perceived job opportunities to return to the Reservation, which could increase demand for public services. Some tribe members are concerned that increased stress caused by social changes due to CBNG development may also increase the likelihood of alcoholism, drug abuse and family violence.

Similar to Alternative F, Alternative G would require monitoring of federal CBNG development within 5 miles of the Northern Cheyenne Reservation. Site-specific groundwater and air quality analysis and mitigation measures would be required and implemented through the operator’s Plan of Development. ITAs would be protected from federal CBNG wells located within 5 miles of the Northern Cheyenne Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM may require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

Like Alternative F, CBNG operators and subcontractors may need to drive across the Northern Cheyenne Reservation to reach some well sites in the northern part of the Planning Area (Rosebud County). Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts could occur on the reservation. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, there is little reason for CBNG workers to stop on the reservation, as few services are offered on the reservation routes that would be used. Interaction with commuting workers would be of short duration and sporadic.

Conclusions

Generally, the social and economic impacts resulting from Alternative G would be less than the other alternatives because of the greatly reduced number of federal wells that would be drilled. Also, a “boom and bust” cycle would be less likely as compared to the other alternatives, since CBNG development would be relatively steady over the phased development period, provided that development continues and the demand for natural gas remains.

Cumulative water resource impacts from Alternative G would be similar in nature to those expected from Alternative F. However, the magnitude of impacts would be less than Alternative F, as well as all the other development alternatives, due to the lower number of federal wells developed.

Alternative H—Preferred Alternative - Multiple Screens

Under this Alternative, impacts would be similar to Alternative F. Alternative H manages the pace (rate) and place (geography) of federal CBNG development through protection measures applied to crucial habitat areas and limits to the discharge of untreated produced water from federal CBNG wells and emissions from sources associated with federal CBNG wells. More federal APDs could be approved annually and geographically than under Alternatives F and G to the extent that full field development could eventually occur under Alternative H as long as other resources are protected. Monitoring data would be required to help BLM determine which (where and when) federal APDs could be approved. These limits and thresholds (see Wildlife Appendix and Hydrology section) would serve to level the cumulative impacts over time. The production of CBNG would continue for a longer overall period of time compared to Alternative E because fewer number of federal CBNG wells may be drilled each year.

With these screens, the overall rate of well development would likely be about the same as Alternative F and slower than for Alternatives B through E, especially in those areas where the greatest level of drilling would occur, such as the Upper Tongue, Lower Tongue and Middle Powder watersheds. If no development occurs in the screen areas as a result of monitoring data, socioeconomic impacts including jobs and revenues could be reduced by as much as 12.8 percent. However, if monitoring data allows for the full field development of the screen areas, jobs and revenues could reach the levels predicted under the full field development alternative.

Employment and Unemployment

The development of wells for Alternative H is expected to follow the same pattern as Alternative F; therefore, employment for this alternative would be similar to Alternative F. Employment for Alternative F is shown in Table 4-61. Like Alternative F, Alternative H employment is expected to be lower than Alternatives B through E, but higher than Alternatives A and G. As for Alternative F, employment for Alternative H may be slightly higher than shown in Table 4-61, since a small number of additional jobs would be created to manage produced water from the federal CBNG wells. While the types of jobs generated under this alternative would be similar to those generated under the other development alternatives, the number of jobs and rate of jobs created per year are predicted to vary from the other alternatives. The number of wells drilled per year under Alternative H would be limited by the application of the four resource screens and watershed-level analysis, rather than a specific annual numerical limit on number of approved APDs. Therefore the number of wells developed each year could vary somewhat from what is predicted under Alternative F.

The numbers of jobs presented in Table 4-61 have been calculated on an annual basis. In year one of the development period, 217 new jobs are expected to be created to implement approved APDs. In year two, 354 jobs would be required; however, 217 of these jobs would likely be filled by the workers employed in year one. Consequently, the maximum number of workers needed in any one year would gradually increase over the development period from 217 to a peak of 1,039 in year 20, then gradually decrease as wells are abandoned.

Over the 23-year development period, there would be an annual average of 774 jobs created. This breaks out to an annual average of 243 initial development jobs, 523 production jobs and 8 well abandonment jobs created. Additional abandonment jobs would be created after the development period. Like Alternative F, the total number of jobs created during the 23-year phased development period under Alternative H would be 14,707, as compared to 17,013 jobs during the 20-year development period for Alternatives B through E.

The effect of Alternative H on current unemployment rates in the area could be less than for Alternatives B through E. There is a potential for some residents in the Planning Area to obtain these new jobs if they have the appropriate skills, which would directly reduce unemployment, but most of the jobs created would likely be filled by CBNG workers living in Wyoming. Since most jobs created would go to Wyoming residents, most of the indirect effects of this new employment (wages spent on support services) would also occur in Wyoming.

Demographics

Employees working in the CBNG industry in the Montana portion of the Powder River Basin would likely commute from Wyoming. Most of the existing CBNG operations in Montana are located near Decker, Montana, with Sheridan, Wyoming (located approximately 20 miles away), the closest community with a population large enough to support CBNG operations. In addition, much of the proposed drilling in Montana would occur in four watersheds: Middle Powder River, Lower Powder River, Upper Tongue River and Lower Tongue River. These areas are located in the general vicinity of the towns listed above.

New temporary jobs related to CBNG could be created by drilling and construction activities, or the application of technology that requires additional employees, while new permanent jobs could be created to oversee additional production wells and facilities. The available jobs range from laborers and other field positions to technical/professional positions such as geologists and engineers and other office staff positions. Additional support jobs include surveyors and research scientists.

Most of the subcontracting companies used by CBNG companies operating in Montana are based in Wyoming. A small number of subcontracting companies and individual workers are from Montana. Job opportunities related to CBNG are advertised in both the Wyoming and Montana state job databases.

Social Organization

Housing Units and Vacancy

Effects on housing would be similar to Alternative F. Most employees would commute from Wyoming, thus there would be little additional demand for housing in the Planning Area due to implementation of this alternative.

Public Services and Utilities

Similarly, this alternative would have little effect on public services and utilities since most of the workers would be living in Wyoming rather than the Planning Area. The highway connecting Sheridan to Decker would receive the most vehicle traffic related to CBNG operations in Montana. The communities of Sheridan, Gillette and Buffalo, Wyoming, would most likely be affected by additional employees needed to support CBNG operations in the area of Montana with the greatest potential for CBNG development. These communities, especially Sheridan, would continue to be called upon to provide public services, emergency services and support services for employees and their families.

Cumulative impacts to Wyoming communities are discussed in the *Impacts from Management Common to All Alternatives* section.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups such as farmers, ranchers, small town residents, Native Americans and retirees, would be similar to Alternative F. Effects could include conflict with the attitudes, beliefs, lifestyles and values of many individuals. Drilling, testing and operation of CBNG wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves, as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They could find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River and Rosebud counties where the majority of the wells would be developed. Large-scale CBNG development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. Some people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

CBNG development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as these affect locations and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would require mitigation to minimize impacts. Exploratory activities, such as drilling and testing, would temporarily displace game species locally. Less recreation area would likely be disturbed compared to Alternatives B through E because the level of federal well development would likely be lower in each watershed and habitat disturbance would be limited.

As for Alternative F, the use of watershed-level analysis, water management plans and water balance projections as part of PODs would reduce the water quality impacts expected from surface discharge of produced water. By use of watershed-level management of surface discharged water (i.e., 10 percent of 7Q10), impacts to surface water would be less than Alternative C and likely less than Alternative E.

The rate of development may not be as even as Alternative F if the screens allow more development. This may concentrate the effect of development in earlier years more than Alternative F, but likely still less than Alternatives B through E. Residents in the areas of CBNG development would still be impacted by any activities approved by the State.

Personal Income

Estimated CBNG wages for Alternative H would be about the same as shown in Table 4-61 for Alternative F. These wages would add to the total personal income mainly in the localities where employees reside (Wyoming). Wages would be produced from the development, production and abandonment phases. The estimated total wages over the phased development period would be $629,454,459. Annual wages are estimated to be $27,367,585, but would range from $6.6 million in year 1 to $38.2 million in year 21.

Income would also be generated by those who own the land or the mineral rights as described for Alternative A. Purchases made with CBNG income would produce some additional indirect income in the region as earnings circulate through the economy. Most of this would likely be spent in Wyoming, where workers are expected to reside.

Government Revenues

Oil and Gas Income

Assuming that of the 18,225 wells drilled, approximately 10 percent would be dry holes, then approximately 16,403 wells would be left to generate production income. Production income under Alternative H would be expected to be about the same as Alternative F and lower than Alternatives B through E.

Using the same production income as Alternative B, gross production income per year of operation would be approximately $182,500 per well. The number of producing wells would range from 546 in year 1 to 15,052 in year 20 (see Table 4-61). It follows that estimated annual gross income would range from $100 million (year 1) to $2.7 billion (year 20). Like Alternative F, royalty income of 12.5 percent would range from $12 million (year 1) to $343 million (year 20), as compared to $12 to $322 million for Alternatives B through E. There is no maximum annual number of producing wells for this alternative, although the screens would limit well development.

Distribution of production and royalty income to BLM, state (private) minerals and private minerals and income from rents and leases for oil and gas development would be similar to Alternatives B and F. Generally, new state revenues from CBNG would be substantial. This source of state revenue could be more evenly spread over the development period like Alternative F. If this occurs, this would be a more constant source of income for the state, rather than a large infusion of revenue early in the program (years 1-5) that would dwindle over time.

Similar to Alternative B and F, government revenue from oil and gas would be reduced by costs for monitoring and regulating CBNG activity and water treatment. However, these costs are relatively small as compared to the generated revenue.

Under Alternative H, the Crow and Northern Cheyenne reservations would be protected from drawdown of coal seam aquifers and drainage of tribal CBNG and groundwater resources by the establishment of a 5-mile buffer zone around the borders of the reservations. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops where there would be the increased potential for drainage of federal minerals. Within the 5-mile buffer zone of reservation boundaries, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 acres) within the Billings RMP Area and 64 percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 to 1.6 TCF of gas that may be lost to the federal, state and county governments [(127,165 acres + 250,565 acres)/1 well site per 80 acres * 0.3 to 0.34 BCF per well site]. The loss of royalties to the Federal government would be approximately $1.2 billion at current gas prices.

These statistics do not take into account the federal minerals administered by the Custer National Forest, Ashland Ranger District.

Taxes

Income Taxes

Income taxes generated from CBNG development would be similar to Alternative F and they would likely be paid in Wyoming, since most workers are expected to come from that state.

Property Taxes

Like the other alternatives, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the vast majority of new wells; therefore, they would likely experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services and other county assets, after accounting for any new costs associated with CBNG. There could be some slight difference between the alternatives related to which counties would accrue these taxes. This may be caused by limiting CBNG development by watersheds instead of other jurisdictional boundaries.

Natural Resources Taxes

Like the other alternatives, the products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

The local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, local sales of goods and services associated with CBNG development would not generate increases in tax revenues because there is no sales tax in Montana. In addition, most of the purchases associated with CBNG development would likely be made in Wyoming.

Water Resource Values

Due to the water screen, Alternative H would have impacts on water resources and water resource values similar to or less than Alternatives C through F. This alternative would allow limited discharge of untreated water under certain conditions. The volume of discharge from federal wells would be based on 10 percent of the 7Q10 flow calculated from all CBNG wells at the downstream end of the watershed. The 10 percent limit would not apply if surface water monitoring is being conducted above and below the proposed outfalls. If surface water monitoring indicates a water quality threshold would be exceeded, no further untreated discharge would be allowed from federal wells upstream from the station. Previously approved water management plans may be modified or rescinded if monitoring indicates unacceptable impacts are occurring. Water quality thresholds and the surface water monitoring requirements are detailed in the Hydrology Appendix. Water produced by federal wells may be treated, used for beneficial uses, or re-injected into the ground if the 10 percent allowable discharge has already been exceeded.

Discharge of produced water into State waters would be allowed only under an approved State permit which would protect existing uses. Produced water put to beneficial use would provide an economic benefit to affected water users.

As for Alternatives B though F, localized groundwater drawdown would occur over time. The risk of such drawdown would likely be greater than Alternative B, since reinjection of all produced water is not required under this alternative. However, water well mitigation agreements would address the potential reduction or loss of water resources and provide for prompt supplementation or replacement of water from any nearby natural spring or water well adversely affected by a CBNG well.

Crow Reservation

Alternative H would result in similar social and economic impacts on the Crow Reservation as

Alternative F. Similar to other Montana residents, unless Crow tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by Alternative H. Alternative H requires monitoring of federal CBNG development within 5 miles of the Crow Reservation. Site-specific groundwater and air quality analysis and mitigation measures would be required and implemented through the operator's Plan of Development. Indian Trust Assets (ITAs) would be protected from federal CBNG wells located within 5 miles of the Crow Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM would require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely avoid traveling across the Crow Reservation by driving from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana. However, if CBNG development occurs on the Crow Reservation, workers from Wyoming would enter the Reservation.

Northern Cheyenne Reservation

Alternative H would likely result in similar impacts on the Northern Cheyenne Reservation related to population, employment and social conditions as identified under Alternative F. Like other Montana residents, unless Northern Cheyenne tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by Alternative F. Some off-site members may be encouraged by perceived job opportunities to return to the Reservation, which could increase demand for public services. Some tribe members are concerned that increased stress caused by social changes due to CBNG development may also increase the likelihood of alcoholism, drug abuse and family violence.

Alternative H includes a Native American Concerns screen that would protect groundwater and air resources and would require monitoring of federal CBNG development within 5 miles of the Northern Cheyenne Reservation. These requirements would protect ITAs and include site-specific groundwater and air quality analysis. This analysis would be included in the operator's Plan of Development. Indian Trust Assets (ITAs) would be protected from federal CBNG wells located within 5 miles of the Northern Cheyenne Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM would require groundwater and air monitoring between the federal well field development area and the Reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

Like the other alternatives, CBNG operators and subcontractors under Alternative H may need to drive across the Northern Cheyenne Reservation in order to reach some well sites in the northern part of the Planning Area (Rosebud County). Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts could occur on the reservation. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, there is little reason for CBNG workers to stop on the reservation, as few services are offered on the reservation routes that would be used. Interaction with commuting workers would be of short duration and sporadic.

Conclusions

Social and economic impacts, such as employment, income, demographic migration, taxes, changes in lifestyle and social conditions would likely be similar to Alternative F. Like the other alternatives, new jobs would likely be filled by CBNG workers from Wyoming. Depending on limitations set by the four resource screens and watershed-level analysis, CBNG development could be relatively steady over the development period, provided development continues and the demand for natural gas remains. Under Alternatives B through E, CBNG development would increase rapidly, peaking over a 5-year period and then decrease over the remainder of the development period.

The social and economic impacts are likely to vary slightly from the other alternatives because development would occur based on watersheds, which may further spread CBNG development outside the three main counties most affected under Alternatives B through E (Big Horn, Powder River and Rosebud). This may reduce the overall impacts on social conditions and lifestyles.

The cumulative reduction in federal royalties due to the 5-mile buffer development delay/restriction around reservations would result in a $1.2 billion loss to the federal government at current gas prices.

Cumulative water resource impacts from Alternative H would be less than Alternative C and E and more than Alternative B.

Environmental Justice

Environmental Justice
Executive Order 12898 requires the non-discriminatory treatment of minority and low-income populations for projects under the jurisdiction of a federal agency

Alternative A
No Action (Existing CBNG Management)

- Few adverse impacts with the exception of the undetermined Wyoming discharge influence.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved.

Alternative C
Emphasize CBNG Development

- Same as Alternative B except for adverse environmental effects would be expected from downstream water quality changes resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.

Alternative F
Phased Development Multiple Screens (High Range)

- With mitigation, no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative E.
- Project Plan and watershed-level analysis requirements would help to mitigate potential impacts.
- Project Plan consultation with tribes and on-going monitoring for developments within 5 miles of a Reservation would help to protect Indian Trust Assets.

Alternative G
Phased Development Multiple Screens (Low Range)

- Impacts would be less than other development alternatives due to fewer federal wells being developed.
- With mitigation, no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.
- Project Plan and watershed-level analysis requirements would help to mitigate potential impacts.
- Project Plan consultation with tribes and on-going monitoring for developments within 5 miles of a Reservation would help to protect Indian Trust Assets.

Alternative H
Preferred Alternative - Multiple Screens

- Impacts would be similar to Alternative F due to similar number of wells developed. With mitigation, no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.
- Project Plan, resource screens and watershed-level analysis requirements would help to mitigate potential impacts.
- Project Plan consultation with tribes and on-going monitoring for developments within 5 miles of a Reservation would help to protect Indian Trust Assets.

Assumptions

The purpose of this analysis is to report whether high and adverse human health or environmental effects of the proposed alternatives are likely to fall disproportionately on minority or low-income populations. This analysis focuses on the populations that are located within the areas potentially affected by the alternatives. It examines where expected high and adverse impacts, if any, fall relative to minority and low-income populations. In order to make a finding that a proposed project is inconsistent with the Environmental Justice policy established in Executive Order (EO) 12898 and described in Section 4.10.1.7, two situations must occur at the same time: 1) there must be a minority or low-income population; and 2) that population must receive a disproportionately high and adverse environmental or human health impact.

Two options are considered depending on what the impacts are:

- If adverse impacts are identified in the resource analyses, the individual occurrence potential is analyzed for disproportionate effects on minority and/or low-income populations.

- If no adverse impacts are identified in the resource analyses, then no environmental justice issues would be expected as a result of the alternative. Therefore, it can be concluded that no adverse human health or environmental effects would fall disproportionately on minority or low-income populations. Consequently, none of the impacts of the alternative can be described as having a high and adverse impact in the context of EO 12898. The proposed alternatives are therefore consistent with the policy established in EO 12898.

Scoping comments indicated that analysis from the Economic, Social and Cultural Supplement to the Powder River I Regional EIS (BLM 1989) was relevant to the analysis of impacts to the reservations. The analysis found that although coal development activities would be off-reservation, economic, social and cultural impacts could occur on the reservation. Economic and social impacts would occur primarily due to tribal members moving back to the reservation to seek employment and people living off-reservation coming to the reservation to seek recreation and services. Impacts identified by the supplement included increased demand for services such as housing, water, health services, education and emergency services, as well as increased stress associated with social change potentially leading to increases in alcoholism, drug abuse, family violence, crime and feelings of deprivation because the reservation would receive negative impacts, but few benefits, from regional coal development.

This type of effect is not expected to occur because, unlike the development of coal, which employs many Montana workers, CBNG development would not provide many employment opportunities for people in Montana. Most of the jobs would be filled by workers currently employed by the CBNG industry based in Wyoming. These workers would have little to no affect on the reservation because they will not be driving across it on a routine basis. Similar to other Montana residents, unless tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by the alternatives. In addition, the area of high interest for CBNG is located further away from the Northern Cheyenne Reservation than some of the possible coal mines projected in the 1989 Coal SEIS.

In addition to the concern listed above, the increased need for coordination and interaction with local, state and federal governments is a concern for tribal resources. See the *Indian Trust and Native American Concerns* section in this chapter for further discussion of cultural impacts.

Impacts from Management Common to All Alternatives

Social and Economics Values

Although none of the alternatives propose CBNG development on the reservations, the Crow and Northern Cheyenne tribes could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular, as these affect locations and resources used for spiritual or religious purposes.

It is expected that development will occur first within the southern portion of the Planning Area; this is where CBNG development is currently occurring within the CX Ranch Field. CBNG workers that come from Sheridan or Gillette in Wyoming to develop wells within the southern portion of the Planning Area will not cross the Northern Cheyenne or Crow Reservations on their journey to work.

When the wells to the north are developed, CBNG workers may need to drive across the Northern Cheyenne Reservation to reach some of those sites. Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts on the reservation could occur. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, as with any of the alternatives, there would be little reason for CBNG workers to stop on the reservation, as few services are offered on the reservation routes that would be used. Interaction with commuting workers is not expected

CBNG workers needing to travel from Sheridan or Gillette to the relatively small number of potential CBNG sites in the western part of the Planning Area would likely drive across the Crow Reservation on I-90. Because this is a heavily traveled interstate, the incremental increase in traffic would not adversely affect the Crow Reservation.

There is a small Amish community in Rosebud County that may be a low-income population. Well development under any of the alternatives would adversely affect this community if well sites are located nearby. However, with the measures to mitigate effects on groundwater and other measures to reduce effects, CBNG development is not expected to have disproportionately high and adverse effects on this community.

Under management common to all alternatives, the EO and BLM policy guidance would continue to provide for minority participation in future BLM management decisions.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Areas that require further analysis for disproportionate effects to minorities or low-income populations include water quality (potential impact of CBNG-produced waters being discharged into the Little Bighorn River and the Tongue River Reservoir from Wyoming CBNG activities) and social and economic effects. See discussions below.

Water Quality

Crow Reservation

The Little Bighorn River, which originates in Wyoming and flows onto the Crow Reservation, could experience impacts to its water quality. The changes in water quality would be dependent upon the terms of the Final Water Quality Agreement signed between Montana and Wyoming. The current interim agreement does not address the Little Bighorn watershed. Impacts could range from a negligible effect to a modest increase in SAR, TDS, EC and bicarbonate. If the agreement allows for some CBNG-produced water to be discharged into the Little Bighorn River, the resulting downstream water would increase SAR, EC, TDS and bicarbonate, thus the tribe's beneficial use of that water may be diminished, as well as the tribe's ability to market their water as a commodity. No health effects are foreseen from the change in water quality or the consumption of downstream fish present in the Little Bighorn River.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne's Water Right in the Tongue River Reservoir would be the result of Wyoming allowing CBNG-produced waters to be discharged into the Tongue River, altering the water quality of the reservoir. The range of water quality changes would be dependent upon the Final Water Quality Agreement between Montana and Wyoming. Current policy in Wyoming is that there would be no discharge of CBNG-produced water into the Tongue River. The scenarios for possible impact ranges are described in detail in the Hydrological Resources section of this chapter. Worth mentioning though, is that even a slight change in water quality to the reservoir could impact the Northern Cheyenne's ability to market their water as a commodity and reduce their own beneficial uses.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative A. However, there would be fewer CBNG workers driving across the reservation than for Alternatives B thru H; thus, the potential traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be less.

Conclusion

The potential impacts to the surface water concerns of both tribes would be somewhat alleviated by their participation in the state-to-state discussions regarding the Water Quality Agreement. If either tribe were to obtain self-governance over their water quality, they could act with the authority of a state and set their own water quality or non-degradation standards and negotiate with Wyoming for an altered agreement more in line with their specific needs and concerns. Currently, the Northern Cheyenne are working with the EPA to adopt draft water quality standards and obtain primacy for their surface water. The lower number of jobs associated with this alternative would lead to fewer people driving across the reservations.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

A review of the resource analyses conducted for Alternative B identifies the following impacts that warrant further review for disproportionate effects on minority or low-income populations. The impacts included in this evaluation are the drawdown of groundwater; air quality changes; changes to vegetation and soils; and social and economic values.

Groundwater Drawdown

CBNG production in Montana would result in the depletion of an estimated 23 percent (ALL 2001b) of the groundwater resources in the productive coal seams beneath Montana's Powder River Basin. This drawdown would be basinwide and correspond to the geographical distribution of production wells. The occurrence potential is not localized and would not impact segregated portions of the population; the impact would be felt evenly across the region. Furthermore, the drawdown has the potential to reduce surface water flows in some drainages depending on specific site conditions. The availability of groundwater is important, as many rural families depend on the supply of groundwater for their household and ranch/agricultural (irrigation) applications.

Air Quality Changes

CBNG development in the Powder River Basin would necessitate the construction of minor emission sources spread out over a very large area. The air quality modeling shows potential air quality impacts at downwind mandatory Federal PSD Class I areas and that other "sensitive receptors" would exceed the PSD Class I NO_2 increment; cause nitrate and sulfate atmospheric deposition (and their related impacts) in sensitive lakes; and cause perceptible visibility impacts (regional haze). Additionally, there is the potential for the NAAQS to be exceeded for NOx in the Spring Creek Coal Mine area. However, it should be noted that these findings are representative of the maximum potential air quality impacts.

Generally, the potential changes in air quality from development would be within acceptable limits, widespread and distributed across the region. The impacts associated with the dispersion of air pollutants across the region would not be disproportionately distributed upon any minority or low-income groups.

Crow Reservation

Under this alternative, a 2-mile buffer zone would be enforced on federal mineral development around the reservation to restrict development of minerals adjacent to these boundaries. This buffer zone would delay some of the groundwater drawdown impact associated with federal pumping but would not prevent state and private mineral estates from being developed adjacent to the reservation. Therefore, drawdown could affect Indian populations within the Crow Reservation adjacent to off-reservation development.

The Crow tribal government derives some of its income from operator lease fees: ranchers and irrigators operating both on private and reservation lands. If these operators were to experience a reduction in available groundwater that impacted their operations and the Crow Tribe subsequently had to reduce their fees, the tribe would lose a portion of their income. Trust agencies might be needed to resolve conflicts. The form of resolution most desirable would be the replacement of water resources and the according adjustment in fees. If the replacement of water resources could not be achieved because of site-specific conditions or other variables, the loss in potential income generation from reduced fees and limited new private opportunities would have to be made up for or this could be an environmental justice issue.

Northern Cheyenne Reservation

The Northern Cheyenne Tribe would experience similar groundwater drawdown and potential operator lease private issues as discussed under the Crow Reservation section above.

As described under the above Air Quality Changes section, the air quality modeling shows potential air quality impacts at downwind mandatory Federal PSD Class I areas and the Northern Cheyenne's PSD Class I area, as well as causing a small increase in perceptible visibility impacts (regional haze). However, these findings are representative of the maximum potential air quality impacts.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative B. There would be more CBNG workers driving across the reservations to reach well sites due to the larger number of wells to be developed; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be more than Alternative A, but are not expected to be substantial, as described in *Impacts from Management Common to All Alternative*s. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Conclusions

If the Northern Cheyenne and Crow tribes elected to develop their CBNG resources the federal buffer zone would not be used to limit the effect on the reservation. An additional percentage of drawdown would be experienced across the basin watersheds from the Northern Cheyenne and Crow tribal developments (see Hydrological Resources section for details). If the tribe's CBNG resources were drilled to the degree estimated in the RFFA (4,000 wells for each reservation), the depletion of the coal seam aquifer groundwater resource could increase across the region and cause a hardship on numerous low-income and minority populations, which are prevalent throughout the area. However, water well and spring mitigation agreements required by the MBOGC, BLM and TLMD would provide alternate sources of water due to groundwater lost to the drawdown of resources within the coal seam aquifers. Drawdown in non-producing coal seams aquifers is not anticipated. Replacement may not be possible in some areas with concentrated CBNG production. This represents a possible environmental justice issue if the non-replacement areas are adjacent to reservation boundaries and no suitable water is available for mitigation.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be more than Alternative A, but are not expected to be substantial.

Alternative C—Emphasize CBNG Development

The resource analyses performed for Alternative C indicate that groundwater drawdown, social and economic values and changes to the surface water quality and the subsequent impacts on vegetation, wildlife and aquatic resources would have effects that warrant further review for disproportionate effects on minority or low-income populations.

Groundwater Drawdown

The drawdown of groundwater within the Powder River Basin would have greater effects than described under Alternative B. Without the federal development buffer zone around reservations, drawdown effects could be amplified and appear sooner on reservation properties than under Alternative B.

Surface Water Quality

Under Alternative C, the quality and quantity of surface waters in the Powder River Basin could be altered depending on the outcome of the statewide water quality standards. The MDEQ is in the process of setting statewide water quality standards that would likely include the framework for managing surface discharge of CBNG-produced water throughout the state. The watersheds would most likely experience increases in SAR values, sedimentation, TDS and a marginal increase in base flow as described in the Hydrological Resources section of this chapter. Based on SAR values, the addition of untreated CBNG-produced waters with high SAR values under the least restrictive extreme criteria would not exceed an SAR value of 12. High-quality watersheds in the FSEIS Planning Area would have adequate assimilative capacity to accept expected discharges from full-scale development of CBNG. All other watersheds should only experience a slight increase in SAR, which would remain below the suggested not to exceed a value of 3 for some soils and possibly as high as 12 for others.

It is assumed that the sodium content of produced CBNG water is the target contaminant that determines the usefulness of the water for crop irrigation. Irrigation uses the majority of water resources in those watersheds thought to have the greatest potential for CBNG development. Sodium causes osmotic stress to plants and destroys the texture of clayey soils; these combined effects make sodium content and especially SAR, a point of emphasis when gauging impacts to water resources from CBNG water. Other parameters such as TDS, nitrogen and barium concentration may be locally important in determining restrictions to beneficial use. It is assumed that discharge to high-quality watersheds would be limited during the irrigation season and managed on a flow-based discharge scenario. Under these circumstances, high-quality watersheds in the FSEIS Planning Area would have sufficient capacity to meet the current irrigation needs. Flow-based discharge would however, require additional storage of produced water during the irrigation season for later discharge when stream flows are less sensitive to being impacted by produced water discharges.

The consequential downstream effects of increased SAR and base flow would result in the erosion of riparian areas along rivers, the reduction of both vegetation and wildlife habitat and the impairment of fish populations. These consequential effects are mentioned because of the large number of Native Americans who have a traditional reliance on the natural agriculture for sacred plants used in medicines and for their hunting and fishing way of life. If these combined water quality impacts are realized, there could be a disproportionate effect felt by the Native Americans as it reduces their ability to gather sacred plants and limit their hunting and fishing opportunities. A large percentage of the population in Big Horn (61 percent) and Rosebud (33 percent) counties are Native Americans and constitutes a sizeable minority population within the FSEIS Planning Area.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the FSEIS Planning Area. The reservation can expect impacts to Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds, such as increased flow volume, changes to water quality parameters, including SAR, EC and bicarbonate. The Crow Tribe could experience drawdown of groundwater in coal seam aquifers from Wyoming and Montana CBNG production. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the FSEIS Planning Area. The Northern Cheyenne Reservation could experience impacts to the Tongue River and Rosebud Creek in the form of increased flow volume and changes to water quality parameters, including SAR, EC and bicarbonate. The reservation could also experience drawdown of coal seam aquifers from CBNG production in the area surrounding the reservation. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative C. The number of CBNG workers driving across the reservations to reach well sites would be similar to Alternative B; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBNG development activities in Wyoming, would further increase the SAR value, base flow and other potential constituents of concern in the, Powder and Little Powder rivers. The combined decrease in water quality would necessitate the use of flow-based discharge to avoid limiting the resource for use as a source of irrigation. The resulting impacts may still impair tribal government leasing activities. This could create an environmental justice issue to tribes as described under Alternative B.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming’s discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. It is concluded that adverse environmental effects could occur from downstream water quality changes, resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative.

Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be similar to Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Air Quality, Surface Water Quality and Groundwater Drawdown

A review of the resource analyses for Alternative D revealed that similar potential effects would be felt as described under Alternative B for groundwater drawdown and air quality changes and under Alternative C for surface water quality but at a reduced impact because of water treatment and discharge conveyance. The same trickle-down effects would be experienced under Alternative D as described in Alternative C but, again, at a reduced level because of water treatment.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts described under Alternative C with the exception of Montana CBNG surface water quality impacts. Surface water impacts would be limited to changes due to increased quantity of surface discharge but treatment prior to discharge would reduce impacts to water quality compared to Alternative C. Groundwater impacts would be the same as Alternative B.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation would be similar to impacts described under Alternative C with the exception of Montana CBNG surface water quality impacts. Surface water impacts to the Tongue River and Rosebud Creek would result from increases in quantity of surface discharge but treatment prior to discharge could reduce impacts to water quality. Groundwater impacts would be the same as Alternative C.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative D. The number of CBNG workers driving across the reservations to reach CBNG sites would be similar to Alternatives B and C, thus the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Conclusions

The surface water quantity effects, when combined with the increases projected from similar current and planned CBNG development activities in Wyoming, would be less than those described in Alternative C because of the treatment of discharge water. Water would be available for irrigators and tribal government leasing activities and would not be impaired. The drawdown of groundwater and subsequent availability would be as described in Alternative B. If the Northern Cheyenne and Crow Tribes elected to develop their CBNG resources, impacts would occur as described under Alternative B.

Social and economic effects on the Crow and Northern Cheyenne Tribes under this alternative would be similar to Alternatives B and C.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Air Quality, Surface Water Quality and Groundwater Drawdown

The impact analyses for Alternative E shows that impacts on surface water quality would be slightly altered; however, downstream uses would not be diminished nor would the State's water quality standards be exceeded. Alternative E stresses the beneficial uses of produced water from CBNG wells and requires a Water Management Plan be developed that demonstrates how an operator can discharge without degrading the surface water quality before any discharge can occur. Similar potential effects would occur as described under Alternative B for groundwater drawdown and air quality changes.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the region under Alternative E with the exception of groundwater impacts. Operators are required to conduct site-specific hydrological studies prior to APD approval. If the site-specific studies determine there would be an effect to Reservation groundwater, the operator must develop and apply measures to prevent the impact of groundwater withdrawal and monitor the effectiveness of such measures. These measures would be approved by BLM in consultation with the tribe. Furthermore, operators must modify federal CBNG production if production is resulting in an effect on groundwater or CBNG on the Reservation. BLM requirements could include reducing production rates, shutting in the well or wells, or providing compensation to the tribe. The operator must correct the impact of groundwater withdrawal prior to resuming full production.

For lands under the jurisdiction of the State, the operator would be required to follow recommendations in the Technical Advisory Committee's guidance document for meeting the requirements of the MBOGC Order No. 99-99. The order requires an evaluation of pre-development groundwater conditions, plus monitoring and evaluations, including procedures for monitoring and reporting the effects of CBNG development on water users. Based on the implementation of these measures tribal groundwater resources would be protected and potential impacts eliminated.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the region under Alternative E with the exception of groundwater impacts. Operators are required to conduct site-specific hydrological studies prior to APD approval. If the site-specific studies determine there would be an effect to Reservation groundwater, the operator must develop and apply measures to prevent the impact of groundwater withdrawal and monitor the effectiveness of such measures. These measures would be approved by BLM in consultation with the tribe. Furthermore, operators must modify federal CBNG production if monitoring shows production is resulting in an effect to groundwater or CBNG on the Reservation. BLM requirements could include reducing production rates, shutting in the well or wells, or providing compensation to the tribe. The operator must correct the impact of groundwater withdrawal prior to resuming full production.

For lands under the jurisdiction of the State, the operator would be required to follow recommendations in the TAC guidance document for meeting the requirements of the MBOGC Order No. 99-99. The order requires an evaluation of pre-development groundwater conditions, plus monitoring and evaluations, including procedures for monitoring and reporting the effects of CBNG development on water users. Based on the implementation of these measures, tribal groundwater resources would be protected and potential impacts eliminated.

Surface water impacts on the Tongue River and Rosebud Creek would also be reduced. The surface water quality in these two waterbodies would be slightly altered; however, downstream uses would not be diminished nor would the proposed Northern Cheyenne water quality standards be exceeded.

With regards to air quality, operators would be required to provide the information necessary for BLM to conduct an analysis of air quality impacts for all relevant parameters when submitting their exploration APDs or field development project plans. BLM would use the information to determine the individual and cumulative impact on the reservations' air quality, disclose the analysis results in the appropriate NEPA document and consult with the tribes when the analysis shows impacts from a specific drilling or development proposal.

Approval of exploration APDs and field development plans and the air quality new source review process would include conditions to prevent violations of applicable air quality laws, regulations and standards. Mitigating measures may include surfacing roads and well locations, applying dust suppressants, requiring operators to develop and enforce speed limits on project roads, minimizing construction of roads, requiring use of natural gas-fired and electric compressors and optimizing the number of wells connected to one compressor.

Operators near the Reservation may be required to restrict the timing or location of CBNG development if monitoring or modeling by the air quality regulatory authority finds their CBNG development is causing or threatening to cause non-compliance with applicable local, state, tribal and federal air quality laws, regulations, standards and implementation plans.

To protect important hunting, fishing and plant gathering sites, the BLM would require operators in the area east of the Tongue River between Ashland and Birney to inventory BLM-administered surfaces for traditional plant gathering sites near the proposed drilling locations. APD approvals may include avoidance or timing restrictions to prevent impacts to identified important hunting, fishing and plant gathering sites depending on the developments' location. These measures would prevent potential impacts to subsistence living methods for tribal members. Migratory paths traditionally used by game to cross the Northern Cheyenne Reservation would be monitored as part of the Wildlife Monitoring and Protection Plan. If these impacts to migration routes result in a reduction of available game measures would be developed in consultation with the tribe to provide for wildlife migration.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative E. The number of CBNG workers driving across the reservations to reach well sites would be similar to Alternatives B, C and D; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBNG development activities in Wyoming, would be less than those described in Alternative C. Water would be available for irrigators and tribal government water leasing activities would not be impaired. The groundwater would be protected as described in the Northern Cheyenne Mitigation Appendix.

If the Northern Cheyenne and Crow tribes elected to develop their CBNG resources, impacts as described under Alternative B above would occur.

Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be similar to Alternatives B, C and D.

Alternative F—Phased Development Multiple Screens (High Range)

Air Quality Changes

Review of the air resource analysis indicated that Alternative F would have impacts on air quality similar, but less than Alternative E. The sources of CBNG generated emissions would be minor and widespread under Alternative F, particularly since development would be limited within any given watershed. There would be a more dispersed pattern of development across the region, thus the emissions would be less concentrated and more apt to disperse with little effect on human health and thus on environmental justice populations.

Groundwater Drawdown

Potential effects on groundwater drawdown would be similar to Alternatives B through E. Under Alternative F, federal APDs would be more dispersed throughout the region and limited in a given watershed in any given year. Thus, groundwater drawdown would not likely be concentrated in any one area and affect low income or minority populations.

Surface Water Quality

Surface water quality impacts under Alternative F would be similar or less than those described under Alternative E. While some discharge of untreated water would be allowed, the volume would be limited to 10 percent of the 7Q10. If volumes exceed the allowable amount per watershed, then any additional federally produced water would be required to be injected, treated (including using impoundments), or put to a beneficial use.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative F. The number of CBNG workers driving across the reservations to reach well sites would be less than Alternatives B through E and similar to Alternative H because of phased development; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Avoidance and Mitigation Measures

In addition to the enhanced mitigation requirements listed for Alternative E that include conducting site-specific hydrological studies, development of mitigation measures, monitoring techniques for water and air quality and POD preparation prior to APD approval, Alternative F would extend these requirements to any areas within 5 miles of the Reservation.

The analysis and monitoring data would be required to demonstrate that Indian Trust Assets on the Crow and Northern Cheyenne Reservations would not be affected by development of federal CBNG wells. If the analysis does not show protection of these assets, the BLM would hold tribal consultations to determine appropriate mitigation measures, which may include denying the APDs.

The potential loss of royalties to the Federal government from a 5-mile buffer would be approximately $1.2 billion at current gas prices.

Monitoring wells and air monitoring stations may be required between the well development area and the reservations to ensure protection of reservation air and groundwater resources. If monitoring indicates impacts to ITAs on the Crow and Northern Cheyenne reservations, wells would be shut in. If CBNG development occurs on a reservation, this monitoring requirement may be modified in consultation with the tribes and other affected parties. Thus, Alternative F would be less likely than Alternative E to affect environmental justice populations, given the CBNG development requirements for resource analysis, mitigation and monitoring.

Implementation of the wildlife screen could lead to a situation where no CBNG development would occur within crucial sage-grouse habitat. This would lead to a loss of royalties to the Federal government of approximately $290 million at current gas prices.

Conclusions

Surface water quality and quantity impacts when combined with undesirable effects from CBNG development in Wyoming would be less than those described under Alternative E. Generally, groundwater would be protected and impacts to ground and surface water quality/quantity would be limited.

Social and economic effects on the Crow and Northern Cheyenne Tribes under this alternative would be similar to Alternatives B through E.

Overall there is likely to be limited impacts on low income or minority populations under Alternative F. If the Crow and Northern Cheyenne tribes decided to develop their CBNG resources, potential impacts would occur as described under Alternative B.

Alternative G—Phased Development Multiple Screens (Low Range)

Air Quality, Surface Water Quality and Groundwater Drawdown

Air quality, groundwater drawdown, surface water quality and social and economic impacts would be similar to Alternative F; however, the magnitude of the impacts would be greatly reduced because of the lower number of wells that would be developed (approximately 65 percent fewer wells). Some watersheds would still experience more well development than other watersheds, but compared to Alternative F, the level of impact across the watersheds would be less under Alternative G. Since Alternative F is not anticipated to impact environmental justice populations, Alternative G also would have little effect on these populations.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative G. This alternative would employ fewer workers because of the reduced number of wells that would be developed under Alternative G. This may result in fewer CBNG workers driving across the Northern Cheyenne Reservation than under Alternatives B thru E and F and H, thus the traffic, noise, safety, road maintenance and worker interaction impacts on the reservation would be less. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Avoidance and Mitigation Measures

Mitigation measures for well development on or in close proximity (within 5 miles) to the reservations would be the same as for Alternative F. However, due to the reduced number of wells that would be developed under this alternative, the potential loss of royalties to the Federal government from a 5-mile buffer would be about 65 percent less than for Alternative F (approximately $420 million).

Conclusions

While air quality, groundwater drawdown and surface water quality impacts would be similar to Alternative F, the magnitude of these impacts would be greatly reduced under this alternative, due to significantly less well development.

Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be similar to but less than Alternatives B through F.

Alternative H—Preferred Alternative - Multiple Screens

Air Quality Changes

Review of the air resource analysis indicated that Alternative H would have impacts on air quality similar to Alternative F. The sources of CBNG generated emissions would be minor and widespread under Alternative H, particularly since development would be limited within any given watershed. There would be a more dispersed pattern of development across the region, thus the emissions would be less concentrated and more apt to disperse with little effect on human health and thus on environmental justice populations.

Groundwater Drawdown

CBNG production in Montana would result in the depletion of approximately 23 percent of the groundwater resources in the productive coal seams beneath Montana's Powder River Basin (ALL 2001b). This drawdown would be basinwide and correspond to the geographical distribution of production wells. By implementing watershed-level analysis, water management planning and water balance projections as part of PODs, federal CBNG well development under Alternative H would be more dispersed throughout the region and limited in a given watershed in any given year as compared to Alternatives B through E.

As for the other development alternatives, the occurrence potential is not localized and would not impact segregated portions of the population; the impact would be felt evenly across the region. Furthermore, the drawdown has the potential to reduce surface water flows in some drainages depending on specific site conditions. The availability of groundwater is important, as many rural families depend on the supply of groundwater for their household and ranch/agricultural (irrigation) applications.

Surface Water Quality

Due to the water screen, Alternative H would have impacts on water resources and water resource values similar to or less than the other development alternatives. This alternative would allow limited discharge of untreated water under certain conditions. The volume of discharge from federal wells would be based on 10 percent limit of the 7Q10 flow calculated from all CBNG wells at the downstream end of the watershed. The 10 percent would not apply if surface water monitoring is being conducted above and below the proposed outfalls. If surface water monitoring indicates a water quality threshold would be exceeded, no further untreated discharge would be allowed from federal wells upstream from the station. Previously approved water management plans may be modified or rescinded if monitoring indicates unacceptable impacts are occurring. Water quality thresholds and the surface water monitoring requirements are detailed in the Hydrology Appendix. If volumes exceed the allowable amount per watershed, then any additional federally produced water would be required to be injected, treated (including using impoundments), or put to a beneficial use.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative H. The number of CBNG workers driving across the reservations to reach well sites would be less than Alternatives B through E and similar to Alternative F because of phased development; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Avoidance and Mitigation Measures

Alternative H incorporates the enhanced mitigation requirements from Alternative F, which include conducting site-specific hydrological studies, development of mitigation measures, monitoring techniques for water and air quality, watershed-level analysis and additional air and groundwater analysis and tribal consultation for development proposed within 5 miles of the Crow or Northern Cheyenne reservations. Alternative H would also require the BLM to use the four resource screens, including air quality and Native American concerns, to evaluate PODs and on-going development prior to approval of additional APDs.

Within 5 miles of either reservation, analysis and monitoring data would have to demonstrate how ITAs on the Crow and Northern Cheyenne reservations would be affected from development of federal CBNG wells. If the analysis does not show protection of these assets, the BLM would hold tribal consultations to determine appropriate mitigation measures, which may include denying the APDs.

The potential loss of royalties to the Federal government from a 5-mile buffer would be approximately $1.2 billion at current gas prices.

Monitoring wells and air monitoring stations may be required to be installed between the well development area and the reservations. If monitoring indicates that Trust Assets on the Crow and Northern Cheyenne reservations are not being protected, wells would be shut in. If CBNG development occurs on a reservation, this monitoring requirement may be modified in consultation with the tribe and other affected parties. Thus, Alternative H would be less likely than Alternative E to affect environmental justice populations given the CBNG development requirements for resource analysis, mitigation and monitoring.

If no development were to occur within crucial sage-grouse habitat, then the socio-economic effect would be similar to that described under Alternative F.

Conclusions

Surface water quality and quantity impacts, when combined with undesirable effects from CBNG development in Wyoming, would be less than those described under Alternative E. Generally, groundwater would be protected and impacts to ground and surface water quality/quantity would be limited. Social and economic effects on the Crow and Northern Cheyenne Tribes under this alternative would be similar to Alternatives B through F.

If either the Northern Cheyenne Tribe or Crow Tribe elects to develop their CBNG resources, the federal 5-mile buffer zone would not be used to limit the effect on the reservation. An additional percentage of drawdown would be experienced across the basin watersheds from the Northern Cheyenne or Crow tribal developments (see *Hydrological Resources* section for details). If each tribe's CBNG resources were drilled to the degree estimated in the RFFA (4,000 wells for each reservation), the depletion of the coal seam aquifer groundwater resource could increase across the region and cause a hardship on numerous low-income and minority populations, which are prevalent throughout the area. However, water well and spring mitigation agreements required by the MBOGC, BLM and TLMD would provide alternate sources of water due to groundwater lost to the drawdown of resources within the coal seam aquifers. Drawdown in non-producing coal seam aquifers is not anticipated. Replacement may not be possible in some areas with concentrated CBNG production. This represents a possible environmental justice issue if the non-replacement areas are adjacent to reservation boundaries and no suitable water is available for mitigation.

Soils

Soils
Montana has a wide mix of geologic parent material, which produces a vast array of different soil types

Alternative A
No Action (Existing CBNG Management)

- There would be minor occurrences of soil erosion, runoff and sedimentation, mostly during construction activities.
- Approximately 1,500 acres would be disturbed short term during CBNG exploration and construction activities.
- 500 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- CBNG development would result in 55,400 acres being disturbed.
- 32,950 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.
- No impacts would occur to soils from CBNG waters.

Alternative C
Emphasize CBNG Development

- CBNG development activities would disturb 70,000 acres.
- Surface discharge and irrigation of produced water could result in detrimental impacts to soils.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge and not injected.
- More water would be available for irrigation of agricultural land.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B. There would be a slight increase in the level of disturbance due to the increased use of impoundments to contain produced water.
- Produced water would be available for beneficial use, including irrigation.

Alternative F
Phased Development Multiple Screens (High Range)

- Impacts would be similar to Alternative E, although some impacts would not occur or be delayed due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year.
- Produced water would be available for beneficial use, including irrigation
- CBNG development would result in approximately 55,150 acres being disturbed. If no development occurs within the crucial sage-grouse habitat, then approximately 48,091 acres of disturbance would occur.
- An estimated 32,850 acres would be disturbed longer term during production, with a majority of the land reclaimed after production has ceased. Alternatively, if development does not occur in crucial sage-grouse habitat, then the acres of long-term disturbance is reduced to 28,645.

Alternative G
Phased Development Multiple Screens (Low Range)

- Impacts would be similar to Alternative F, although impacts would be about 65 percent less due to the limit on the number of federal CBNG APDs (323 versus 910) approved per year.
- Produced water would be available for beneficial use, including irrigation

Alternative H
Preferred Alternative - Multiple Screens

- Impacts to soils would be similar to Alternative F.
- CBNG development would result in approximately 55,150 acres being disturbed.
- An estimated 32,850 acres would be disturbed longer term during production, with a majority of the land reclaimed after production has ceased.

Assumptions

Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. This analysis is focused on the CBNG emphasis area, but can be used by inference on similar areas in Montana. A more detailed discussion of soils is presented in the *Soils Technical Report* (ALL 2001a).

Impacts From Management Common to All Alternatives

Impacts on soils would occur from various activities during the exploration, construction, operation and abandonment of conventional oil and gas wells developed resulting in a loss of either soil resources or soil productivity. These impacts would include soil compaction under disturbed areas such as well sites and lease access roads, soil erosion in disturbed areas and chemical impacts from spills of liquids. Some impacts would be unavoidable, such as those resulting from the construction of well sites. Other impacts would be mitigated by standard oil field practices, such as the use of berms around production facilities. Short-term impacts would occur typically during construction phases, including reclamation of construction sites.

Soils disturbed by the building of access roads, drill pads and pipelines would be prone to accelerated erosion because of the removal of protective vegetation and litter cover during construction activities. This protective cover would bind the soil, provide desirable surface texture for infiltration of water and air and protect the surface from water and wind erosion. Accelerated soil erosion would occur during the production phase in high traffic areas of the well pad or along access roads or in portions of the well pad that have not been properly graded. In areas where soils have high to severe erosion potential and are unstable, disturbance would result in accelerated erosion to the extent that damage to facilities and roadways may occur. Wind and water erosion on bare soil surfaces would cause more sedimentation in streams from runoff following rainfall or snowmelt.

Impacts would be greatest on shallow soils of low productivity and on soils on moderately sloping to steep landscapes. Project activities would have minimal effect on slope stability because surface disturbance on slopes in excess of 30 percent would be avoided where possible. Where such disturbances cannot be avoided, mitigation measures required by MBOGC and BLM through the APD authorization process would be implemented to reduce erosion and protect watershed resources. BLM and TLMD lease stipulations would also be used to mitigate soil erosion. Eastern Montana suffers from excessive wind erosion primarily from dry soil, sparse vegetative cover and erodible soils.

Drilling activity-especially equipment transport-would cause soil compaction. The degree of compaction would be influenced by soil texture, moisture content, organic matter and soil structure. Soils with a mixture of sand, silt and clay compacts more than a soil with more uniform particle size. Coarse-textured sandy soils generally would be more compactable than fine-grained soils. Soil moisture would be the most critical factor in compaction. At field capacity, which is the amount of soil moisture remaining after a soil mass is saturated and allowed to drain freely for 24 hours, sufficient water remains in the pores to provide particle-to-particle lubrication and maximum compaction potential under load. Thus, moist but not wet soils would be most susceptible to compaction.

Organic matter such as roots and humus would help reduce soil compaction. In general, the greater the organic matter content, the less compaction. Compaction would severely affect plant growth by inhibiting root penetration, limiting oxygen and carbon dioxide exchange between the root zone and the atmosphere and severely limiting the rate of water infiltration into the soil. Compaction of soils would inhibit reclamation and natural revegetation of disturbed areas. Loss of topsoil and a decrease in soil productivity from soil layer mixing and compaction would impact the natural vegetation supported in the area, which in turn may affect forage and habitat for wildlife and livestock. The use of off-road vehicles and heavy equipment would cause soil compaction, which will lead to increased surface runoff and subsequent erosion. Effects will be most severe when off-road vehicles and heavy equipment are used during moist and wet soils conditions.

With development, the potential for impacts to soil from drilling and produced fluids would increase. Soil contamination from conventional oil and gas development in Montana would result mainly from leaking and improperly reclaimed reserve/brine pits. Produced hydrocarbons and fuel spills would occasionally cause impacts. Spills generally would not be large and the materials would be relatively immobile. Toxic and saline concentrations from the spilled fluids would be capable of sterilizing the soil.

Construction disturbances from conventional oil and gas production would lead to the disturbance of approximately 12,650 acres (9,817.5 acres of BLM-administered surfaces and 2,832.5 acres of state lands) during the next 20 years. Revegetating parts of the well pads during production would reduce the area of disturbance to 4,600 acres. Most of these acres would be remediated after the hydrocarbons have been produced.

When siting impoundments, there are different soil characteristics one should consider before choosing a location. Understanding the existing soil conditions, both at the surface and at depth, will aid operators during impoundment siting and design. Site-specific soils analyses, including soil salinity, soil K- factors, textures, slope, soil classification, Atterberg limits, location and extent of rock strata and permeability, can assist operators to determine the areas most suited for construction of impoundments.

Information should be obtained regarding the types of soils present near impoundments, relative to the clay content, cation-exchange capacity and the percentage of certain soluble mineral assemblages in the soils, each of which can cause changes to the infiltrating water chemistry. Clay mineralogy can affect impoundment design considerations. For instance, within the Powder River RMP, the clays that compose the surface soils are predominantly smectite clays (montmorillonite family), a clay mineral commonly referred to as a “swelling” clay. The swelling nature of smectite is a result of its ability to take water into the clay’s internal structure resulting in the expansion or swelling of the clay mineral. This swelling can result in decreased porosity and permeability of the soils which could cause infiltration rates under impoundments to decrease considerably.

Cation exchange capacity (CEC) is a soil property attributed to the type and quantity of clay minerals and organic matter present in a soil and is the degree to which the soil particles are capable of attracting and holding positively charged (cation) ions on their surface. Soils with lower CEC potential would result in greater geochemical changes to infiltrating water. Gypsum and $CaCO_3$ (calcite) can affect the quality of infiltrating water. Soils analyses, including soil salinity, soil K- factors, textures, slope, soil classification, Atterberg limits, location and extent of rock strata and permeability, can assist operators to determine the areas most suited for construction of an impoundment. The Soils Appendix provides additional information about soils in the Planning Area.

Areas would be reclaimed as prescribed by an approved reclamation plan that includes revegetation to reduce soil erosion. Most soil disturbances and related erosion would begin to be mitigated within 25 days after drilling the well. Exceptions would be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation. These impacts may result in a loss of either soil resources or soil productivity.

Saline water would have a more persistent and detrimental effect on soil productivity. There would be some loss of soil through erosion as a result of surface disturbance, but this would be minimized with an approved surface use plan.

Additional disturbances would occur from coal mining in the CBNG emphasis area, which is estimated at a total of 49,500 acres.

Prime Farmland

If prime farmland exists on federal or state surface where CBNG development is proposed, the same type of reclamation plan would be developed. A difference would be that more topsoil probably would be available for reclamation purposes on a prime farmland site and would be identified in the reclamation plan prior to development.

If the site proposed for development were private surface, then the reclamation plan would be developed in consultation with and according to the wishes of the private landowner. Most likely, the reclamation plan on Federal versus state and private surface would be very similar.

No prime farmlands are known to exist on the federal surface. Privately owned prime farmlands over federal and state leases that are impacted by roads or site development would be reclaimed in accordance with consultation with the private surface owner. This situation would be same for all alternatives.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts on soils may occur from various activities during the exploration, construction, operation and abandonment of CBNG wells developed for the project and may result in a loss of either soil resources or soil productivity. The primary concerns include increased soil erosion, loss of topsoil, mixing of soil horizons, compaction and contamination of soils from various pollutants. These impacts may result in a loss of either soil resources or soil productivity.

Under this alternative, all CBNG water on BLM-administered land would be contained or beneficially used at the well site, while all CBNG water on private lands would be discharged under the existing MPDES permit into the Tongue River (up to 1,600 gpm), impounded, or used for dust control at on-site coal mines.

Exploration

Under Alternative A for BLM-administered surfaces, approximately 400 acres would be disturbed for exploratory wells. On state and private lands, approximately 275 acres would be disturbed during exploration. All produced CBNG water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications.

Production

There will be no CBNG production on BLM-administered surfaces and therefore no impacts from production. Only state and private lands will have CBNG production. During the construction of the well sites, access roads, utilities and other facilities, 812 acres of soils will be disturbed. Revegetating parts of the well pads during production would reduce the state and private soil disturbances to 500 acres. Production water may be discharged to surface waters in accordance with the existing MPDES Discharge Permits that allow discharge between 3,300 and 4,200 gpm into the Tongue River. This small increase in flow volume is not considered sufficient to cause added erosion to stream banks or streambeds. Produced water may also be used beneficially by industry and landowners, or stored in impoundments onsite. If the quality of the water were acceptable (not too high in SAR or salinity), there would be little or no additional impacts to soils from managed irrigation. If the quality of land-applied water were detrimental, further mitigation measures would need to be implemented to reduce the impacts to soils (ALL 2001a).

Abandonment

After reclaiming the exploratory wells, there will be 500 acres of soil disturbed long-term-all on state and private lands. The area will be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be stabilized by vegetative cover and erosion eliminated within 2 to 5 years following the beginning of reclamation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation.

There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan. Soil beneath unlined surface impoundments would also require extensive reclamation because of accumulation of sodium during infiltration of water. The soils structure could be damaged severely, plant growth would be minimal and accumulation of salt in the soils would likely lead to the soil being treated in-situ or removed and disposed.

Crow Reservation

There would be no impacts to the soils on the Crow Reservation from regional CBNG development.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation soils from regional CBNG development.

Conclusion

During the next 20 years, disturbances from limited CBNG development and exploration, conventional oil and gas development, coal mining and other projects considered under the cumulative effects analysis would result in the disturbance of about 37,500 acres of soil. These disturbances would be reduced to about 36,500 acres during the production phase of CBNG, conventional oil and gas activities and coal mining.

After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff and sedimentation, mostly during construction activities. If the qualities of land-applied or impounded waters were acceptable, there would be little or no impacts to soils; but if water quality is detrimental, additional mitigation measures would need to be implemented.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Impacts to soils would be reduced under this alternative by requiring transportation corridors; using a single trench for utilities and piping; using multiple completions per well bore and directional drilling; using temporary tank storage and injection of all produced CBNG water; and rehabilitating new roads at the end of the well lifetime. All of these mitigation measures would help to minimize the area of surface disturbances, which would be up to a 35 percent or higher reduction in soil disturbances.

Exploration

Under this alternative, approximately 850 acres of BLM-administered surfaces would be disturbed for exploratory wells. On state and private lands, approximately 1,000 acres would be disturbed during exploration. All produced CBNG water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications. Losses from exploration would be mostly temporary and would be reclaimed after exploration activities cease.

Production

During the construction of the well sites, access roads, utilities and other facilities, 25,600 acres of

BLM-administered soils and 29,750 acres of state and private soils will be disturbed. Revegetating parts of the well pads during production would reduce the BLM soil disturbances to 15,250 acres and state and private soil disturbances to 17,700 acres. Production water will be injected; therefore, no impacts to soils from CBNG waters will occur.

Abandonment

Reclaiming all of the exploratory wells would provide vegetation cover to 1,850 acres of disturbed soils. Additional reclamation activities at the production wells and utility right-of-ways (ROWs) would further establish vegetation cover to these previously disturbed soils. The disturbed areas would be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be recovered and erosion halted within 2 to 5 years, following the beginning of reclamation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils). There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan.

Crow Reservation

There are no tribal sponsored CBNG developments anticipated for the reservation; however, there is the possibility of on-reservation private or private lands being developed in small pockets. These small on-reservation developments are expected to impact the soils in proximity to the wells and associate infrastructure in a similar fashion as describe above in general for Alternative B.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation soils from regional CBNG development. It is not anticipated there would be any tribal sponsored CBNG development on the reservation nor areas of private development.

Conclusion

During the next 20 years, disturbances from CBNG development, conventional oil and gas development, coal mining and other projects considered under the cumulative effects analysis would result in the disturbance of about 117,150 acres of soil. These disturbances would be reduced to about 84,700 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff and sedimentation, mostly during construction activities.

Development of the Crow and Northern Cheyenne reservations would disturb an initial 24,200 acres or 12,100 acres per reservation. Following the same reclamation measures as commercial CBNG development, the disturbances would be reduced by nearly 10,000 acres. Each reservation would have a residual 7,200 acres of disturbed soils around well pads, access roads, utility corridors and water management facilities.

Alternative C—Emphasize CBNG Development

Under this alternative, impacts on soils would be similar to Alternative B with the following exceptions:

- Untreated CBNG discharge water could be used for managed irrigation
- The discharge of produced water to the ground surface would increase erosion
- There would be a 35 percent increase in impacted soils due to specific management practices for transportation routes

The long-term impacts of using CBNG water or diluted discharge water for agricultural purposes include crop effects, farming practice changes, irrigation management and direct effects to soils. Based on the generally fine texture of the surface soils (clayey) in the emphasis area, much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 3 for some soils and greater than 12 for others). If sodic water is applied to these soils, the probability of soil dispersion (deflocculation) is high, causing infiltration and drainage decreases. The long-term consequence is an anaerobic, waterlogged, saline/sodic soil, which would be difficult to reclaim. Those soils with a coarser texture (sandy to loamy) and good internal drainage will be the least susceptible to increasing sodicity and salinity.

Dispersed soil would also be subject to accelerated erosion leading to gullying, increased sedimentation and harm to riparian vegetation and aquatic habitats. The native species composition in these affected areas also will change. CBNG water discharge will have the cumulative effect of encouraging the establishment and proliferation of non-native and noxious weed species. As noted in the *Soils Technical Report* (ALL 2001a), there are fewer irrigated than non-irrigated acres along the Tongue and Powder Rivers, which, based on the RFD, is where a majority of the potential CBNG activity would reside. However, if adequate water and suitable agricultural soils were available in areas adjacent to production, more irrigated land would be available for production and use.

The use of high salinity/sodium CBNG water may have long-term effects on crops, limiting crops to those that are more salt tolerant. Additional irrigation water would be required for leaching to ensure salts are moved out of the root zone. Increasing the frequency of irrigation may also need to be implemented to maintain soil water content and to decrease the effects of applying saline water (lower water-holding capacity and higher salinity levels). These increases in irrigation water amounts would lead to producers having to file for additional water rights or finding other sources of lower salinity water for leaching, as well as a potential for more saline seeps in areas irrigated with CBNG water. The *Soils Technical Report* (ALL 2001a) discusses the impacts of discharging CBNG waters to soils in more detail.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except water generated by testing CBNG wells could be discharged to surface waters and the land surface-with impacts as discussed above.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except untreated water generated during production could be discharged to surface water with appropriate permits and to the land surface at the well pad. Impacts of managed irrigation of CBNG waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would be rehabilitated and closed. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in general for Alternative B. In addition, impacts associated with direct discharge practices as described for Alternative C would be expected for these wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be expected to soils being irrigated with waters from the Tongue River and Rosebud Creek. Since these waterbodies would experience increases in their SAR and EC values, it is conceivable that tribal irrigators would also experience the types of soil impacts described in general for Alternative C. Soils impacts from tribal sponsored development on the reservation are not anticipated for this alternative.

Conclusion

Cumulative impacts would be similar to Alternative B, except that the surface disturbances would increase by up to 35 percent and surface discharge and irrigation of produced water would increase detrimental impacts to soils. Saline water has a more persistent and detrimental effect on plants’ ability to extract water. Cumulative disturbances from all regional projects would result in the disruption of about 138,360 short-term acres of soil. These disturbances would be reduced to about 105,900 acres during the production phase of CBNG, conventional oil and gas activities and coal mining.

One advantageous side effect would be that more water would be available for irrigation if acceptable agricultural land is available, but if acceptable qualities of water are not used, there could be an increased detrimental impact on additional soils.

Soil disturbance levels on the Crow and Northern Cheyenne Reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres); however, they are expected to be somewhat increased due to the surface discharge of production water.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Under this alternative, impacts on soils would be similar to Alternative B except that produced water would be treated prior to discharge onto the surface or for irrigation and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBNG wells would be treated prior to discharge to surface waters and the land surface (instead of injection), which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be treated prior to discharge to the land surface and to surface water-with appropriate permits. Impacts of the managed irrigation of CBNG waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The only soils impacted on the Crow Reservation would be from on-reservation private developments similar to those previously described in Alternative B.

Northern Cheyenne Reservation

There would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted, since production water will be treated prior to discharge.

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge onto the surface and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Soils disturbance levels on the Crow and Northern Cheyenne reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres).

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Under this alternative, impacts on soils would be similar to Alternative B except produced water would be managed per a site-specific Water Management Plan with first priority being beneficial use of produced water; impoundments designed to minimize or mitigate impacts to soil, water and vegetation; an option for injection of CBNG water; and no degradation of a watershed. All of these factors would reduce the detrimental impacts caused by application of high-SAR water to soils. There would be a 35 percent increase in impacted soils over alternatives B and D due to specific management practices for transportation routes-this percent will vary depending on site-specific Project Plans for ROWs agreed upon with the surface owners.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBNG wells would not be allowed to degrade the watershed, which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be beneficially used, stored in impoundments, or discharged without impacts to the watershed. Impacts of the managed irrigation of CBNG waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in general for Alternative B.

Northern Cheyenne Reservation

There would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted, since only slight alterations in surface water quality are anticipated.

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be managed per a site-specific Water Management Plan that would be geared toward minimizing impacts to soil, water and vegetation and surface owners would have more input in the Project Plan for the transportation corridors. Cumulative disturbances from all regional projects would result in the disruption of about 135,600 short-term acres of soil. These disturbances would be reduced to about 95,800 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. Soils disturbance levels on the Crow and Northern Cheyenne reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres). It is anticipated the tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, impacts on soils would be similar to Alternative B except the impacts to soils would be delayed due to the phased approach used by the BLM in the approval of APDs based on the number of federal APDs approved each year and within each 4th Order Watershed. These combined limits would serve to level the impacts over a 23 year development timeframe thus eliminating periods of high impact due to peak development. The leveling of development resulting from a phased approach would reduce the overall detrimental impacts caused by the application of high SAR water to soils.

Soils on the Crow and Northern Cheyenne reservations would not be impacted by CBNG development off of the reservations unless the tribes approved certain activities, such as irrigation or impoundment construction, to occur on the reservations. Impacts to soils from such activities would be the same as described in Alternative C.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except the impacts would be spread over a longer period of time and the restrictions on volumes of untreated discharge waters in 4th Order watersheds may slightly reduce impacts to soils in the riparian zone.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B, except for the impact being spread out over a longer period of time.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in general for Alternative B.

Northern Cheyenne Reservation

Similar to Alternative B, there would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted since limits would be in place on the volume of untreated CBNG water that could be discharged from the development of federal minerals.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative B with the exception that impacts would be delayed due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year. Cumulative disturbances from all regional projects would be similar to Alternative B which would result in the disruption of about 117,050 short-term acres of soil. These disturbances would be reduced to about 84,600 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. Soils disturbance levels on the Crow and Northern Cheyenne reservations would be similar to those discussed in the Conclusions section of Alternative B (12,100 – 7,200 acres). It is anticipated the tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

As with most other impacts described under this alternative, if crucial sage-grouse habitat areas are not developed, the overall impacts to soils would be reduced by a factor of approximately 12.8 percent within the development area. While some level of development is anticipated within these areas, it is likely to be less dense than the 80-acre spacing accounted for in other alternatives.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts on soils would be similar to Alternative F except they would be reduced by approximately 65 percent based on the fewer number of APDs predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide document). A limit would also be established on the number of federal APDs approved each year within each 4th Order Watershed. This limit would be set at the total number of wells predicted for each watershed times the predicted rate of development in the Statewide document. These combined limits would serve to level the potential impacts to soils over a 23 year development period.

Soils on the Crow and Northern Cheyenne reservations would not be impacted by CBNG development off of the reservations unless the tribes approved certain activities, such as irrigation or impoundment construction, to occur on the reservations. Impacts to soils from such activities would be the same as described in Alternative C.

Exploration

Under this alternative, impacts on soils would be similar to Alternative F.

Production

Under this alternative, impacts on soils would be similar to Alternative F except that they would be reduced by approximately 65 percent due to the lower level of predicted development.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative F except that they would be reduced by approximately 65 percent due to the lower level of predicted development.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in Alternative F.

Northern Cheyenne Reservation

Similar to Alternative F, there would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted since limits would be in place on the volume of untreated CBNG water that could be discharged from the development of federal minerals.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative F with the exception that impacts would be reduced by approximately 65 percent due to the lower level of predicted development.

As in Alternative F, it is anticipated the tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative, impacts on soils would be similar to Alternative F; however, the use of the multiple screens would serve to level the impacts over the development period thus eliminating periods of high impact due to peak development. The leveling of development would reduce the overall detrimental impacts caused by the application of high SAR water to soils.

Impacts to soils would be further reduced under this alternative by requiring long-term planning for transportation corridors and utility ROWs; using multiple completions per well bore and directional drilling; and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances, which would result in an approximate 25 percent reduction in soil disturbances.

Under this alternative produced water would be managed per a site-specific Water Management Plan with first priority being beneficial use of produced water; impoundments designed to minimize or mitigate impacts to soil, water and vegetation; an option for injection of CBNG water; and no degradation of a watershed. All of these factors would reduce the detrimental impacts caused by application of high-SAR water to soils.

Soils on the Crow and Northern Cheyenne reservations would not be impacted by CBNG development off of the reservations unless the tribes approved certain activities, such as irrigation or impoundment construction, to occur on the reservations. Impacts to soils from such activities would be the same as described in Alternative C.

Exploration

Under this alternative, approximately 850 acres of BLM-administered surface would be disturbed for exploratory wells. On state and private lands, approximately 1,000 acres would be disturbed during exploration. All produced CBNG water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications. Losses from exploration would be mostly temporary and would be reclaimed after exploration activities cease.

Production

Under this alternative, impacts on soils would be spread over a slightly longer period of time, development would occur at a more level rate and the restrictions on volumes of untreated discharge waters in 4th Order watersheds would be imposed, resulting in a marked reduction of impacts to soils. Furthermore, consolidated transportation and utility planning for the construction of the well sites, access roads, powerlines, pipelines and other facilities, would reduce the amount of soils disturbed. Revegetating parts of the well pads during production would further reduce the BLM soil disturbances. Water generated during production would be beneficially used, stored in impoundments, or discharged without impacts to the watershed.

Abandonment

Under this alternative, impacts on soils would be spread out over a longer period of time thus delaying some reclamation activities. Reclaiming all of the exploratory wells would provide initial vegetative cover to disturbed soils. Additional reclamation activities at the production wells and utility ROWs would further establish vegetative cover to these previously disturbed soils. The disturbed areas would be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be recovered and erosion minimized within two to five years, following the beginning of reclamation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation. There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan.

Soil beneath unlined surface impoundments would require extensive reclamation because of the accumulation of sodium during infiltration of water. The soils structure could be damaged severely, plant growth would be minimal and accumulation of salt in the soils would likely lead to the soil being treated in-situ or removed and disposed.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands are expected to impact the soils in proximity to the wells and associated infrastructure in a similar fashion as described above in general.

Northern Cheyenne Reservation

Similar to Alternative F, there would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted since limits would be in place on the volume of untreated CBNG water that could be discharged from the development of federal minerals. It does not appear there would be any tribally-sponsored CBNG development on the reservation nor areas of private development in the near future. However, if development were to be initiated on the reservation soil impacts would be in proximity to the wells and associated infrastructure in a similar fashion as described under this alternative in general.

Conclusion

Cumulative disturbances from all regional projects would be similar to Alternative F which would result in the short-term disruption of about 117,050 acres of soil. These disturbances would be reduced to about 84,600 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff and sedimentation, mostly during construction activities.

Produced water would be managed per a site-specific Water Management Plan geared toward minimizing impacts to soil, water and vegetation and surface owners would have more input in the Project Plan for the transportation corridors.

Development of CBNG on the Crow and Northern Cheyenne reservations would disturb an initial 24,200 acres or 12,100 acres per reservation. Following the same reclamation measures as commercial CBNG development, the disturbances would be reduced by nearly 10,000 acres. Each reservation would have a residual 7,200 acres of disturbed soils around well pads, access roads, utility corridors and water management facilities. It is anticipated the tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

Solid and Hazardous Waste

Solid and Hazardous Wastes *Solid and hazardous wastes are under the jurisdiction of the MDEQ for RCRA wastes, MBOGC for RCRA exempt wastes and the EPA for wastes generated on tribal lands*
Alternative A **No Action (Existing CBNG Management)**
• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission. • Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities
Alternatives B, C, D, E, F and G
• Impacts for Alternative B, C, D, E, F and G would include increased quantities of waste requiring onsite disposal or transport to commercial landfills. • Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain SPCC plans and immediately remove any spilled or unused non-exempt wastes from the sites. • No long term impacts to private, state or federal lands would occur from waste products associated with CBNG development.
Alternative H **Preferred Alternative - Multiple Screens**
• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission. • Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities • Impacts would include increased quantities of waste requiring onsite disposal or transport to commercial landfills. • Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain Spill Prevention Control and Countermeasures (SPCC) plans and immediately remove any spilled or unused non-exempt wastes from the sites. • No long term impacts to private, state or federal lands would occur from waste products associated with CBNG development.

Assumptions

All wastes generated by oil and gas operations including CBNG that are Resource Conservation and Recovery Act of 1976 (RCRA)-classified wastes, such as paint wastes or RCRA-exempt wastes such as drilling wastes, would be disposed of in accordance with regulations. Any release of a hazardous material would be reported in a timely manner to the relevant agency or to the BLM via a Report of Undesirable Event (NTL-3A). Any release of a CERCLA substance would be reported in accordance with regulations.

Impacts From Management Common to All Alternatives

Typical solid waste refuse would be generated by oil and gas drilling operations and can be disposed of in local landfills. The largest volume of waste generated from drilling activities would be from the drilling mud and cuttings generated. These drilling wastes would be exempt from RCRA and are considered non-hazardous. Drilling mud containing less than 15,000 mg/l TDS can be disposed of on-site with the landowner's permission. The amount of waste generated should not exasperate the landfills in the area. Other impacts would result from spills of waste during maintenance activities, including waste oil from generators, paint waste from construction activities and other solid wastes from construction activities. Impacts would also occur from the use of pesticides and herbicides during access and construction activities.

The TRR plans to principally transport coal; any potentially hazardous chemicals and materials would only be those associated with its operation of the railroad as a coal transporter. Petrochemicals, such as diesel fuel and lubricants, would be the primary hazardous materials involved in operating such a train. Given the route of the TRR and the sparse population and no industry, there is little expectation hazardous materials would be transported. In the event the TRR should decide to transport these types of materials, it would undertake the plans and procedures required by state and federal laws to insure their safe handling and storage including training of employees. The TRR would operate in full compliance with Hazardous Materials Transportation Act (49 U.S.C. 1080 et seq.), governing regulations and rail industry guidelines for the transportation of hazardous materials. It is not anticipated these materials would cause any impact to regional landfills or exposure to the surrounding environment.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts from Alternative A would be similar to the impacts described in the previous *Impacts From Management Common to All Alternatives* section. The solid and hazardous waste generated during CBNG exploration, production and abandonment would be similar to conventional oil and gas. The drilling muds would be of lesser quantity because of the shallow drilling depths for CBNG wells compared to conventional oil and gas.

Crow Reservation

There are no CBNG developments anticipated on tribal Lands under this alternative and therefore no impacts are expected. Furthermore, there would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBNG operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBNG developments.

Conclusion

The cumulative impacts of this alternative would include the solid and hazardous waste generated from conventional oil and gas, surface mining activities and CBNG development. These other activities would result in increased production of both solid and hazardous waste that occur as part of general operation activities. Mitigation would include the disposal of all wastes in accordance with applicable federal, state and local regulations.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

The impacts from this alternative would be similar to the impacts under Alternative A. However, CBNG development would result in larger quantities of solid and hazardous waste production.

Crow Reservation

There are no tribal sponsored CBNG developments anticipated on the reservation under this alternative; however, private lands on the reservation could have private CBNG developments. These small developments are expected to generate solid and hazardous wastes in the same proportions as their off-reservation counterparts. These wastes will need to be disposed of in accordance with applicable tribal and EPA regulations.

There would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBNG operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBNG developments.

Conclusion

The cumulative impacts from this alternative would be similar to Alternative A. However, the increased scale of CBNG development, including the potential development of CBNG on the Crow and Northern Cheyenne reservations and USFS lands, would increase the volume of solid and hazardous waste generated. The increased volume of solid and hazardous wastes would result in local landfills reaching capacity sooner, which would generate the need for the construction of new landfills that would further disturb lands. The additional trucks used for hauling waste would increase traffic and air emissions.

Wastes generated on the reservations from tribal development would need to be disposed of following EPA regulations and tribal laws, if any. This may necessitate the construction of a non-hazardous landfill for the acceptance of solid wastes from the RFFA estimate of 4,000 wells per reservation.

Alternative C—Emphasize CBNG Development

The impacts under Alternative C would be the same as for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The impacts under Alternative D would be the same as for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

The impacts under Alternative E would be the same as for Alternative B.

Alternative F—Phased Development Multiple Screens (High Range)

The impacts under Alternative F would be similar to those described for Alternative B, however local landfills would receive solid and hazardous wastes at a reduced pace resulting in the capacity of the landfills to extend further. Construction of new landfills would also be delayed. Traffic and air emissions from trucks hauling CBNG generated wastes would be reduced.

Alternative G—Phased Development Multiple Screens (Low Range)

The impacts under Alternative G would be similar to those described for Alternative F but reduced by approximately 65 percent based on the fewer number of APDs predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide document).

Alternative H—Preferred Alternative - Multiple Screens

Typical solid waste refuse would be generated by oil and gas drilling operations and can be disposed of in local landfills. The largest volume of waste generated from drilling activities would be from the drilling mud and cuttings generated. These drilling wastes would be exempt from RCRA and are considered non-hazardous. Drilling mud containing less than 15,000 mg/l TDS can be disposed of on-site with the landowner's permission. The amount of waste generated should not overwhelm the landfills in the area. Other impacts would result from spills of waste during maintenance activities, including waste oil from generators, paint waste from construction activities and other solid wastes from construction activities. Impacts would also occur from the use of pesticides and herbicides during access and construction activities.

The solid and hazardous waste generated during CBNG exploration, production and abandonment would be similar to conventional oil and gas. The drilling muds would be of lesser quantity because of the shallow drilling depths for CBNG wells compared to conventional oil and gas. However, CBNG development would result in larger quantities of solid and hazardous waste production due to the number of wells predicted.

Crow Reservation

The tribal sponsored CBNG developments anticipated on the reservation under this alternative coupled with the private lands on the reservation would generate solid and hazardous wastes in the same proportions as their off-reservation counterparts. These wastes will need to be disposed of in accordance with applicable tribal and EPA regulations. There would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBNG operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBNG developments. It is not anticipated the Northern Cheyenne would develop any CBNG wells on the reservation for the foreseeable future.

Conclusion

The cumulative impacts from this alternative would result in drilling wastes and construction debris being generated as previously described. However, the increased scale of CBNG development, including the potential development of CBNG on the Crow and Northern Cheyenne reservations and USFS lands, would increase the volume of solid and hazardous waste generated. The increased volume of solid and hazardous wastes would result in local landfills reaching capacity sooner than originally planned. Eventually new landfills would need to be constructed to manage the county and tribal wastes as typical domestic and commercial waste generation will continue. These new landfills would disturb lands but are anticipated, in long-term plans.

The Tongue River Railroad plans to principally transport coal; any potentially hazardous chemicals and materials would only be those associated with operation of the railroad as a coal transporter. Petrochemicals, such as diesel fuel and lubricants, would be the primary materials involved in operating such a train. It is not anticipated these materials would cause any impact to regional landfills or exposure to the surrounding environment.

Wastes generated on the reservations from tribal development would need to be disposed of following EPA regulations and tribal laws. This may necessitate the construction of a non-hazardous landfill for the acceptance of solid wastes from the RFFA estimate of 4,000 wells per reservation.

Vegetation

Vegetation
Acreages by land classification overlaying coal beds:
- Grasslands, 3.55 million (2.56 million in RMP areas)
- Shrublands 1.8 million, (1.66 million in RMP areas)
- Forests, 1.36 million (1.29 million in RMP areas)
- Riparian Areas, 378,000 (268,000 in RMP areas)
- Barren Lands, 372,000 (297,000 in RMP areas)
87,400 acres overlaying coal beds currently contain non-native plants and noxious weeds (37,000 acres in the Planning Area).

Alternative A
No Action (Existing CBNG Management)

- 1,142 acres of native habitat would be impacted under this Alternative, more than half (580 acres) in grasslands.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- 55,400 acres of native habitat could be impacted under this Alternative, with 21,450 acres in grasslands.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Alternative C
Emphasize CBNG Development

- 70,000 acres of native habitat could be impacted under this Alternative, with 27,300 acres in grasslands.
- If SAR values exceed 10 in water, riparian vegetation would be impacted, affecting as many as 3,535 acres of riparian habitat.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- 55,400 acres of native habitat could be impacted under this Alternative, with 21,450 acres in grasslands.
- Hydrology changes may affect as much as 2,776 acres of riparian habitat due to increased stream flow.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Impacts would be similar to those for Alternative D, however no riparian habitat would be affected.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Alternative F
Phased Development Multiple Screens (High Range)

- Impacts would be similar to those for Alternative B.
- Resource impacts from proposed development projects would be evaluated on a watershed-level basis.
- Annual and watershed-based limits on federal CBNG development would result in a different spatial and temporal distribution of impacts than the other development alternatives.
- Watershed-based analysis would limit the amount of disturbed habitat on BLM-administered surface or on private surface overlying federal minerals within each 4th Order watershed, based on the potential to affect species of special concern from habitat fragmentation.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Alternative G
Phased Development Multiple Screens (Low Range)

- Impacts would be similar to Alternative F but the land disturbance area would be 65 percent less.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Alternative H
Preferred Alternative - Multiple Screens

- Impacts would be similar to those for Alternative B.
- Resource impacts from proposed development projects would be evaluated on a watershed-level basis.
- Use of resource screens and watershed-based limits on federal CBNG development would result in a spatial and temporal distribution of impacts similar to Alternative F.
- Watershed-based analysis would limit the amount of disturbed habitat on BLM-administered surface or on private surface overlying federal minerals within each 4th Order watershed, based on the potential to affect species of special concern from habitat fragmentation.
- No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Assumptions

The Miles City BLM *Seeding Policy*, dated October 27, 1999 (BLM 1999c), lists guidelines for seeding practices by typical Montana soil types; it is assumed this policy will be implemented where appropriate. Recommended species are identified for quick coverage of disturbed soils, to discourage invasion of noxious weeds and to attenuate soil erosion. Reclamation work will be considered complete when the disturbed area is stabilized, soil erosion is controlled and at least 60 percent of the disturbed surface is covered with the prescribed vegetation.

Under all alternatives, most riparian areas and certain wildlife habitats (see the *Wildlife* section) are protected from direct impact under current stipulations on BLM-administered surface that restrict surface occupancy but not road crossings (BLM 1994).

Although, no federal threatened or endangered plant species are known to occur in the Planning Area, surveys to confirm the absence of federally listed species would occur on BLM-administered surface or minerals. The APD requires that BLM determine if the proposed development plan would affect any species listed as threatened or endangered.

Formal consultation with the FWS would occur for site-specific federal CBNG projects developed under this EIS if a federally listed threatened and endangered (T&E) species or candidate or proposed species may be affected. Section 7(a) of the Endangered Species Act (ESA) requires that federal actions "are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or undesirable modification of its habitat." BLM policy for proposed and candidate species is to avoid actions that would jeopardize a species and require formal listing under the ESA.

Special management attention is given by state and federal agencies to state and BLM Species of Concern. Agencies approve actions to avoid areas that would jeopardize a species and thereby require federal protection in the future.

The MBOGC environmental review includes an assessment of potential impacts to vegetation during construction and drilling operations. MBOGC policies require the operators to minimize the size of drilling pads and require complete restoration of the area once operations are complete (Administrative Rules of Montana [ARM] 36.22). Mitigation plans are included with the environmental review to notify operators of requirements prior to construction.

For federal actions, FWS is required to provide consultation or provide comments to federal agencies if the potential for taking occurs. They do not have this same requirement for state agencies. Even if a state agency requests a consultation, the FWS does not have the authority to provide it. If a state or private CBNG project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the federal agency.

The FWS would be consulted under Section 10 of the ESA if a federally related action is triggered.

On BLM-administered surfaces, where specific stipulations do not exist or do not currently apply, there is a presumption that impacts on T&E plant species would be avoided through development and observation of specific conservation measures developed through consultation with FWS intended to avoid impacts on T&E species as required under the ESA.

Impacts on T&E plants on non-federal lands are less likely to be avoided through conservation measures because they are not protected.

Species of concern on all lands would likely receive a relatively high degree of protection at a regional scale because federal and state agencies are committed to avoiding measures that would require listing protection under ESA. However, this would likely not protect all individuals or perhaps some populations within the region.

BLM field clearances and other required pre-exploration activities developed through this EIS process and which are intended to identify site-specific occurrence of T&E species, would be conducted as specified, leading to knowledge of specific resources and implementation of appropriate avoidance actions and conservation measures discussed above.

Federal and state agency monitoring of exploration, development and production activities are assumed to be adequate to ensure all lease conditions and ESA requirements are followed.

Preventing the spread of noxious weeds is easier, more successful and less costly and time-consuming than reclamation or mitigation. Stipulations for current exploration authorizations within the Billings and Powder River RMP areas cover weed management and riparian/wetland management (BLM 1992). Under these stipulations, all categories of noxious weeds must be managed.

Stipulations and options for containment of noxious weeds on state lands are listed in the Minerals Appendix, Table MIN-5.

The BLM has co-developed an action plan for weed containment and eradication practices that will be implemented for all alternatives (BLM 1996). Pertinent sections of Appendix 3 from that document are reproduced in Table 4-63. The action plan applies to the State of Montana's list of weed species of concern (see Table VEG-7, Vegetation Appendix). This list includes species that are considered to be highly invasive and disruptive to natural systems. It is assumed that these weed-prevention activities will be required for CBNG exploratory and production sites, roadways, pipelines, utility corridors and other disturbed sites on BLM-administered surface except as specifically noted for some of the alternatives.

TABLE 4-63

EXAMPLE: PARTIAL BLM DISTRICT-WIDE WEED PREVENTION SCHEDULE

Prevention Activity	When	Who Is Responsible
Clean off-road equipment with powerwash or high-pressure to remove all mud, dirt and plant parts before moving into relatively weed-free areas.	All Year	Equipment Operators; Fire Crew
Re-establish vegetation on all disturbed soil from construction, reconstruction and maintenance activities.	Spring/Fall	Project Proponent
Inspect gravel pits and fill sources to identify weed-free sources. Gravel and fill to be used in relatively weed-free areas must come from weed-free sources.	Spring/Summer	Surface Protection Specialist; Equipment Operator
Retain bonds (for mineral activity) for weed control until the site is returned to desired vegetative conditions.	All Year	Mineral Specialist
Include weed-risk considerations for environmental analysis for habitat improvement projects.	All Year	Wildlife Biologist
Provide weed identification training for field-going employees and managers.	Winter/Summer	Weed Coordinator
Distribute public information/brochures.	Spring/Summer	Public Affairs Officer
Include weed risk factors and weed prevention considerations in Resource Advisor (Environmental Specialist) duties on all Incident Overhead Teams and Fire Rehabilitation Teams.	Summer	Resource Advisor

Note: Revised from BLM 1996.

Wetlands are legally protected by Section 404 of the Clean Water Act. Therefore, all such wetlands must be surveyed and delineated before any drilling can take place. If wetlands will be impacted by proposed drilling or road alignments, they must be avoided or mitigation measures must be developed to compensate for impact. This compensation may include the development of replacement wetlands. In some instances, Nationwide 404 Permits may apply to CBNG projects. Applicable permits include Utility Line Activities and Linear Transportation Crossings. The producers must meet all terms and conditions of the Nationwide 404 Permit for it to apply.

On private lands, it is assumed that the private landowner will negotiate with the producer before exploration and development and come to an agreement as to what measures the producer will instigate for weed control, site restoration and as to what criteria constitutes successful site restoration and proper weed control.

Impacts From Management Common to All Alternatives

Construction of facilities and roads would cause the primary effects on vegetation. For a developed well site, about 40 percent of the original drill site would remain disturbed for the life of the well (20 years). However, unsuccessful exploratory sites would be reclaimed. Reclamation generally includes spreading topsoil and reseeding according to the landowner's request (private land) or the BLM *Seeding Policy* (BLM 1999c). The BLM *Seeding Policy* and site restoration stipulations do not extend beyond the borders of their lands. Therefore, it is essential that private landholders negotiate with the producer prior to exploration and development on private lands and come to an agreement as to what measures the producer must instigate for weed control and site restoration. This includes what criteria will be used to assess adequate site restoration and proper weed control. Pre-development agreements are the responsibility of the landowner.

Small areas of vegetation would be lost to roads and drill sites for each well. Dust and vehicle emissions could reduce growth of vegetation adjacent to roads and drill sites. If disturbed areas are prepared and seeded properly, reclamation may further reduce the effects of dust. The effects of drilling on vegetation would be of particular concern under the following circumstances:

- When drill sites or roads are proposed within or cross riparian areas, wooded drainages, or wetlands
- Where drill sites or roads would cause sedimentation or channel down-cutting in riparian areas
- When drill sites or roads would be in areas that contain populations of special status plants
- Where operations could spread or encourage the growth of weeds
- In case of reserve pit leakage
- In the event of blowouts or wildfire

Drilling sometimes may occur in or near areas that support riparian vegetation or special status plants. If located in or at the head of drainages, drill sites and access roads can add sediment to streams and wetlands. Channel degradation can also occur. Heavy sediment loads or severe degradation would affect riparian vegetation. Roads and facilities are supposed to avoid sensitive areas "to the extent practicable." Therefore many, but not all, sensitive areas such as riparian areas and wetlands would be avoided.

Soil disturbance associated with drilling can cause weeds to spread. Of even greater concern is the long-distance transport of certain weed species by drilling equipment and vehicles. Weed spread is reduced if disturbed areas are re-vegetated during the season of disturbance or the next growing season as recommended (Table 4-63). All well drilling operations are covered by the County Noxious Weed Control Act, which holds landowners responsible for weed control. The contribution of oil and gas drilling to weed spread is comparable to other types of construction.

Because of the legal restrictions placed on the harm or take of federally listed species, direct impacts to these listed species would not occur on federal land. Indirect impacts to federally listed species such as habitat destruction will be addressed on a species-by-species basis. Federally listed plant species on non-federal land ownership may be impacted through conventional oil and gas activities because threatened and endangered plants on private lands are generally not surveyed and their presence may not be known.

Mitigation

Site clearance surveys would be conducted prior to disturbance. Where necessary, operator plans would be adjusted as appropriate to avoid impacts to federally listed species.

Review of Montana Natural Heritage Program data on a case-by-case basis for TLMD Montana Oil and Gas lease sale may indicate areas of plant locations on state lands. A vegetation survey stipulation is used on the lease. For site-specific proposals, the TLMD field staff may consult with DNRC biologists and Montana-NHP botanists as needed. The TLMD stipulation (see Table MIN-5), reads as follows: "Plant species of concern have been identified on or near this tract. A vegetation survey in areas of proposed activity will be required prior to disturbance. Identified rare plant species will be avoided, unless authorized by the TLMD."

Conclusions

There would be no impact on federal land to federally listed species. There may be impacts to federally listed plants on non-federal land and to other species of concern.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Previous authorizations have allowed selected CBNG exploration in the Powder River and Billings RMP areas as well as selected well development and exploration on state lands.

Disturbance to vegetation is of concern because wildlife habitat and livestock production capabilities may be diminished or lost over the long-term through direct loss of vegetation (including direct loss of both plant communities and specific plant species). Indirect impacts, such as noxious weed invasion erosion could result in loss of desirable vegetation. Under the No Action Alternative, only riparian habitat types and certain wildlife habitats (see *Wildlife* section) are protected under current stipulations (BLM 1995).

Direct impacts on vegetation would occur during land-disturbing activities associated with installation of exploratory or development CBNG wells that remove vegetation to construct a facility (e.g., roads, drilling pads, mud pits). All direct impacts from exploratory wells are for the life of the well, then rehabilitated. Both temporary and permanent impacts would occur with installation of development wells.

DNRC, TLMD uses buffer stipulations and use of the no-surface-occupancy of navigable riverbeds and related acreage stipulation on its oil and gas leases on a case-by-case basis for protection of riparian habitat. Table 4-64 summarizes the acreage that could be potentially impacted in the two RMP areas and the three counties under state-permitting jurisdiction.

Vegetation types to be potentially impacted were determined based on the extent of each vegetation type overlying coal beds. Impacts to specific vegetation types were assigned in proportion to their total acreage within an ownership (see Table 4-64). For example, there are 1,537,000 acres of grassland in the Powder River RMP area or 40 percent of the total area. Assuming that 200 acres would be permanently disturbed in the Powder River RMP area, 80 acres (40 percent) of permanent, direct impacts would be expected to occur in grassland. If natural communities from Table 4-65 are considered, grasslands would be expected to experience the largest permanent loss (580 acres), based on occurrence. Shrubland would be the next most permanently impacted habitat (174 acres), followed by forest land (114 acres), barren land (46 acres) and riparian habitat (56 acres). Of the 56 permanently impacted riparian acres, 20 are on BLM-administered surface and most are protected by stipulation during exploration. Indirect impacts may be as important as direct impacts for plants and habitats. As noted earlier, indirect impacts would include the effects of erosion, changes in wildlife and livestock distribution, riparian community changes and the spread of noxious weeds.

Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring the plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the level of enforcement of stormwater management plans. Plant community impacts would be in the same proportions as discussed under direct impacts. The basis of this analysis is formed from the assumption that installation of erosion-control procedures and effective enforcement of stormwater management plans would occur. Implementation of erosion-control measures and stormwater management plans would result in no long-term impacts from erosion. Short-term impacts are still likely to occur from thunderstorms during first few years and from 20 years of active roadbeds.

A total of 250 acres may be reclaimed following temporary disturbance at state-permitted wells. Failure to adequately restore these acres to pre-disturbance conditions would result in a loss of native habitat. Typical seeding mixes only include herbaceous species. Therefore, after reclamation and reseeding, there would be a change in the vegetative composition of the disturbed areas.. If reseeding is successful, it would potentially reduce noxious weed invasion, erosion and dust through restoration of plant cover.

TABLE 4-64

AMOUNT OF ACREAGE WITH UNDERLYING COAL BEDS IN EACH HABITAT TYPE (BY RMP AREA AND STATE LAND)[1]

Area	Grassland	Shrubland	Forest Land	Barren Land	Riparian[2]	Agricultural or Other Land Not Included as Native Vegetation
Powder River RMP area	1,537,000 (40%)	920,000 (24%)	908,000 (23%)	210,000 (5%)	170,000 (4%)	138,000 (4%)
Billings RMP area	1,022,000 (40%)	737,000 (29%)	377,000 (15%)	87,000 (3%)	98,000 (4%)	207,000 (8%)
MBOGC-regulated land	990,000 (56%)	152,000 (9%)	89,000 (5%)	75,000 (4%)	93,000 (5%)	359,000 (20%)

[1]Figure in parentheses indicates percentage of total acreage within the RMP area and MBOGC-regulated land.

[2]These acres are exempt from CBNG development as a result of stipulations that omit this type from consideration for CBNG exploration and development; they may be affected by water pollution and increased salinity.

TABLE 4-65

ACREAGE POTENTIALLY IMPACTED IN EACH HABITAT TYPE FOR ALTERNATIVE A (BY RMP AREA AND STATE-PERMITTED LAND[1])

Area	Grassland		Shrubland		Forest Land		Barren Land		Riparian		Other Areas	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Powder River RMP	80	0	48	0	46	0	10	0	8	0	8	
Billings RMP	80	0	58	0	30	0	6	0	8	0	16	
MBOGC-regulated land	420	140	68	23	38	13	30	10	38	13	150	50
Total*	580	140	174	23	114	13	46	10	54	13	174	50

*These estimates were arrived at using GIS data. Sweet Grass and Carter counties did not have enough bituminous coal beds to show up on those layers, therefore CBNG well data for those two counties are not included in these estimates. The total acres of impact using GIS data are 1,391 acres. Total real impacts for all counties are estimated to be 1,488 acres.

[1] MBOGC regulated

CBNG exploration activities could result in the recruitment of noxious weeds by disturbing present vegetative cover, compacting soil, exposing mineral soil to seed fall and aiding the migration of seeds through movement of vehicles and drilling equipment from site to site. Noxious weeds can indirectly impact native vegetation by out-competing native plants for scarce nutrient, light and water resources, thereby displacing the native species. Sites with the greatest potential for noxious weed invasion, erosion, or difficulty in restoring to pre-disturbance vegetation are generally sites with pre-existing weed problems or drier sites, such as those designated as barren land. Noxious weeds introduced into a forest environment would be very difficult to control because of access restrictions when weeds spread into deep drainages and timbered hills where chemical control would be difficult. Control of noxious weeds is addressed under current BLM stipulations or state law. The increase in the number and potential for spread of noxious weeds with disturbance is an important consideration even at the current level of exploration and development. This concern is related to other indirect impacts, such as lack of successful reclamation and erosion.

Roads are considered a major contributing factor to the continuing spread of exotic plant species. Improved roads can provide the means by which adjacent natural habitats are converted to ecosystems highly vulnerable to invasion by exotic plants. Various factors influence the susceptibility of communities farther from roads versus those along roads, including dominant vegetation, soil moisture, nutrient levels, soil depth, disturbance and topography. Plant communities appearing most vulnerable are those that are both physically conducive to invasion (e.g., having deep or fertile soils) and disturbed (Gelbard and Belnap 2003).

Species of concern include federally listed T&E and candidate species; Montana species of concern; BLM species of concern, and Montana Natural Heritage Program species of concern. For the state, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. The Vegetation Appendix, Table VEG-6 describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there are no known federally listed threatened or endangered plant species in the Planning Area. In accordance with the ESA, any identified federally listed species and their habitat must be protected from possible impact by oil and gas and CBNG development on federal land, but not on state or private land. Additionally, 69 species are classified as "species of special concern" by the Montana BLM and the Montana Natural Heritage program. By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status.

Crow Reservation

CBNG development on the Crow Reservation is expected to be very limited. To the extent that it does occur, impacts to plant communities and natural vegetation would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands.

Northern Cheyenne Reservation

CBNG development on the Northern Cheyenne Reservation is expected to be very limited. A study of methane gas development on Northern Cheyenne lands concluded that it would be uneconomical (Little Coyote 2001; Herco-Hampton 1989). To the extent development does occur, impacts to plant communities and natural vegetation would be similar to those described for private lands and would occur on a much smaller scale than on BLM-administered or State lands.

State Species of Concern

Direct and indirect impacts on other species of concern would be expected to some degree.

Conclusions

Up to 1,105 acres of native vegetation (excluding up to 20 riparian acres on BLM-administered surface) would be lost through CBNG exploration activities and an additional 250 acres would be temporarily disturbed. Unspecified impacts to native vegetation through livestock grazing would occur if displaced animals concentrate in certain areas. Shrub, forested and barren lands would not be adequately restored using the existing recommended seeding mix, which reseeds only grasses. For all habitats, some reclamation efforts may fail. Strict adherence to reclamation policies would result in no impact to vegetation from noxious weed infestations. However, these guidelines and regulations have been in place for many years and weeds continue to spread across central and eastern Montana. Therefore, some further infestations of noxious weeds would be expected. User-created roads would result in additional loss of vegetation and increased potential spread of noxious weeds (USDI and USDA 2001). No impacts on the Ute ladies'-tress would be expected.

Cumulative Impacts

Cumulative impacts may occur from coal mining operations. Coal mining occurs within the same area covered by this EIS. Vegetation will be destroyed within the disturbed area of a coal mine. As the mine area is reclaimed, topsoil is redeposited and reseeded to reestablish vegetation. Reseeding during reclamation activities will generally result in an increase in grasslands with less plant diversity than was present under pre-mining conditions.

Construction of the proposed Tongue River Railroad would result in the removal or disturbance of 328 to 456 acres of vegetation within the ROW. Vegetation within each of the three ROWs is a mixture of pine/juniper, grassland/sagebrush, agricultural, deciduous tree/shrub and breaks habitat. Revegetation would reduce the area of permanent disturbance (STB 2004).

During operations, principal impacts to vegetation would be caused by the use of herbicides to control weeds, range fires and possibly coal dust. The use of herbicides could damage native plant species and could increase the likelihood of range fires due to the presence of dead and dying vegetation. Local ranchers have expressed concern regarding the propagation of noxious weeds by passing trains, as well as the potential for railroad-caused range fires. In addition to being a fire hazard, weeds can reduce crop production (Surface Transportation Board 2004).

About 92 percent of the coal volume located in the Powder River basin occurs within Wyoming (Ellis et al. 1999b) and as many as 50,000 CBNG wells may be developed in the Wyoming portion of the basin. The direct and indirect effects of Wyoming CBNG development would far surpass the effects of CBNG development in Montana under Alternative A because of so many wells. Some rivers entering Montana from Wyoming would be expected to have higher flows, resulting in potential erosion of wetland and riparian communities and habitat degradation.

ESA provisions applied to other projects should avoid cumulative impacts to T&E wildlife species when considered in conjunction with CBNG exploration and development.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

As listed under Alternative A, four habitat types (grassland, shrubland, forest land and barren land) will be affected in varying amounts depending on the alternative and the amount of habitat with underlying coal beds. Well development is estimated at 18,300 wells in the RFD, but only 16,470 of these will be production wells. If these wells are distributed evenly over habitats by the proportion of habitats with bituminous coal beds, a total of approximately 55,360 acres would be directly impacted by production wells and dry hole drilling. Approximately 48,864 acres would occur on land with native vegetation: 21,446 acres of grassland vegetation, 13,214 acres of shrubland, 11,680 acres of forest land and 2,523 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A.

Table 4-66 estimates the acres of direct impact for each action alternative based on information in Chapter 2.

TABLE 4-66

ACRES OF LAND AND LENGTH OF ROADS AND UTILITY CORRIDORS DIRECTLY IMPACTED BY NEW CBNG CONSTRUCTION

	Alternative				
	B and D	**C**	**E**	**F and H**	**G**
Area disturbed per well[1, 2]	3.25 acres	4.14 acres	4.14 acres	3.25 acres	3.25 acres
Length of roads per well[2]	0.237 miles	0.365 miles	0.365 miles	0.237 miles	0.237 miles
Length of utility corridor per well[3]	0.734 miles	1.13 miles	1.13 miles	0.734 miles	0.734 miles
Number of wells[2]	18,300	18,300	18,300	18,225	6,470
Total area directly disturbed[3,4]	55,360 acres	70,015 acres	73,860 acres	59,045 acres	21,035 acres
Length of CBNG roads per square mile[2, 4]	2.9 to 8.8 miles	3.9 to 11.9 miles	3.9 to 11.9 miles	2.9 to 8.8 miles	2.9 to 8.8 miles
Total length of CBNG roads[1, 2]	6,680 miles	9,018 miles	9,018 miles	6,662 miles	2,375 miles
Length of pipeline and utility corridors per square mile[3,5]	9.04 to 27.12 miles	12.2 to 36.61 miles	12.2 to 36.61 miles	9.04 to 27.12 miles	9.04 to 27.12 miles
Total length of pipeline and utility corridors[1, 3]	20,679 miles	27,917 miles	27,917 miles	20,623 miles	7,345 miles

[1]The land area disturbed and the length of roads and corridors would be 27 percent greater for Alternatives C and E than for Alternatives B, D, F and H because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities under Alternatives C and E.

[2] Short-Term.

[3] Long-Term.

[4] Area of direct disturbance for Alternative E is greater than Alternative C to account for the 3,700 wells requiring water basin impoundment structures. Alternatives F, G and H also account for water basin impoundment structures.

[5]Length of roads, pipelines and utility corridors per square mile covers the range of 8 to 24 wells per square mile of land overlying 1 to 3 coal seams, respectively. At an average of 8 wells per square mile, 2,287 square miles (2281 square miles for Alternative F and H, 813 for Alternative G) would be impacted by intensive CBNG development. At 24 wells per square mile, 762 square miles (760 square miles for Alternative F, 271 for Alternative G) would be impacted by intensive CBNG development. Additional wildlife habitat surrounding well fields would be indirectly impacted by human activities and presence.

Direct vegetation loss by habitat type is assumed to be proportional to the relative amount of each habitat type shown in Table 4-64.

As discussed in the *Wildlife* section, water production and roads can alter the distribution of wildlife and livestock. As wildlife or livestock use is concentrated due to those factors, plant communities can be altered through overgrazing. Overgrazing tends to favor establishment and reproduction of annual and invasive plant species. These species tend to displace native plant assemblages. To the extent grazing animals concentrate in smaller areas, plant communities would change to less diverse, introduced plant communities. Most county weed control efforts focus on herbicide spraying, which reduces plant diversity even more.

Indirect effects include changes in wildlife and livestock distribution patterns as a result of machinery disturbance or removal of habitat.

When disturbance removes vegetative cover from soil, it is open to erosion from wind and water. Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the stormwater management plans. Types of plant community impacts would be in the same proportions as discussed above but on a much greater scale than for Alternative A.

Existing hydrology and riparian vegetation would not be affected by build-up of salts with this alternative because of the use of injection and holding tanks for production water. The potential for spreading noxious weeds is substantially greater than under Alternative A because 20 times as much land would be disturbed.

Species of Concern-Federally Listed Species

Direct impacts to federally protected species are prohibited by law and would not occur under Alternative B, which is the same as under Alternative A, because none have been reported in the Planning Area.

The potential for direct and indirect impacts on other species of concern would be much greater under this alternative because of the much larger amount of habitat that will be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads, pipelines and utility lines. More roadways provide greater access and more potential for disturbance of protected species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. If there were no CBNG development on tribal Lands, then there is expected to be minimal, impacts on vegetation for the reservation. If there is CBNG development on the reservation, then the acres of disturbed habitat could be inferred to the reservation using the same approach used in this section.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusions

The impacts of CBNG development under Alternative B would be substantially greater than under Alternative A because 20 times as many wells would be developed and 20 times as much area would be disturbed.

Reclamation after well abandonment on 44,000 acres may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Cumulative Impacts

Cumulative impacts would be the same as described for Alternative A except that Montana CBNG development impacts would be greater.

Alternative C—Emphasize CBNG Development

A total of approximately 70,015 acres would be directly impacted. Approximately 62,238 of this acreage would be on sites with native vegetation cover. Approximately 27,316 acres of grassland vegetation, 16,831 acres of shrubland, 14,877 acres of forest land and 3,214 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A. In addition, although no wells will be authorized in riparian areas under any alternative, the discharge of untreated water from exploration and production onto the surface could affect riparian vegetation, perhaps as much as 3,535 acres. This is the estimated average total acreage of habitat with riparian vegetation that is underlain by bituminous coal bed (BLM and state).

Indirect impacts would include the impacts noted earlier of noxious weed invasion, erosion and changes in wildlife and livestock distribution. In addition, indirect impacts would include increased SAR and salinity levels, which could result in riparian community changes and increased erosion potential for wetland and riparian communities.

Alternative C has the greatest potential for erosion because of the increased disturbance area with no restrictions on corridors for pipelines, utilities and roadways and no requirements for directional drilling or multiple completions in a single well. The extent of erosion would be determined by the effectiveness of erosion-control measures and the stormwater management plans. This alternative will potentially increase the area of disturbance over Alternatives B or D by approximately 15,000 acres (Table 4-66). This acreage increase will increase the potential for erosion.

With discharge of the CBNG water to surface drainages and streams, erosion could occur, which could damage or destroy instream and streambank riparian vegetation (Regele and Stark 2000). The erosion could result in increased sediment loads that, along with the potential high salinity and sodicity, could degrade the stream and impact riparian vegetation. Impacts of discharging CBNG waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian vegetation. This is also the time when this vegetation is naturally stressed because of low water. The potential for impacts on riparian vegetation exists along drainages and streams throughout the CBNG development area.

CBNG groundwater discharge has an SAR capable of killing vegetation (Regele and Stark 2000). Plant growth is affected in sodic soils due to decreased soil permeability, increased pH (which lowers nutrient availability) and accumulation of certain elements (sodium, boron and molybdenum) at a level toxic to plants. Because of the typically low flows of the CBNG wells (approximately 5 to 10 gallons per minute), it is likely that these SAR impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells.

Species of concern have a higher potential for direct and indirect impacts compared to Alternative B because of more surface disturbance.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusion

Reclamation of vegetation after well abandonment may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Localized increases in salinity and SAR values may be the most important aspect of this alternative. Salinity can have long-term effects on vegetation, including changes in species composition to more salt-tolerant species and high concentrations of salt in riparian soils. Soil impacts may last long after a given project site has been abandoned. Increased SAR values may prevent nonhydrophytic reclamation vegetation from succeeding. Increased roads result in more land being disturbed, more wildlife and livestock forage will be removed and more area for noxious weed invasion being present.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads and/or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative Impacts

The types of cumulative impacts are the same as discussed under Alternative A. Disturbed habitat quantities would be similar to those described in Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts

Impacts on habitat types under this alternative would be the same as Alternative B except for the potential for riparian impacts. Although no wells will be authorized in riparian areas on BLM-administered surface under any alternative, the discharge of water from exploration and production onto the surface could create riparian areas that will be abandoned and could affect the hydrology of current riparian areas, perhaps as much as 2,776 acres.

Under this alternative, indirect impacts could include the impacts noted earlier of noxious weed invasion, erosion and changes in wildlife and livestock distribution. In addition, indirect impacts would likely include increased water being added to riparian systems, which could affect riparian vegetation. Reservoirs that are used in this alternative for holding treated water could produce problems when they are abandoned. Riparian vegetation that developed during the operation dies after abandonment and the bed of the drying reservoir tends to become infested with noxious weeds (Lahti 2001).

Erosion potential may increase under this alternative because there are no reclamation requirements for roadbeds. This is offset somewhat by the stipulation that no slopes greater than 30 percent can be used for CBNG construction.

Discharge of water from exploration and production onto the surface could affect the hydrology of as much as 2,776 acres of current riparian vegetation.

Species of concern could be impacted as described for Alternative B and by discharge of CBNG water.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusions

There is no requirement for road abandonment so long-term impacts caused by removal of vegetation for roadways is not known, but would occur. Stipulations concerning slope of land for potential CBNG sites are likely to protect such slopes from failure and mass wasting problems. A secondary effect is that such areas will remain in their existing habitat and plant communities. Reclaimed areas may revegetate adequately, but this will not restore the sites to previous native vegetation or habitats. There is potential for habitat loss because of the lack of requirements for roadbed reclamation or for abandoned reservoirs. Areas that are not reclaimed would represent a permanent loss of native vegetation and be subject to noxious weed infestations.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through user-created roads, or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative Impacts

Cumulative impacts from Alternative D would be the same type of impacts as described for Alternative A. The quantity of disturbed habitat would be the same as discussed under Alternative C.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts

The same types of impacts to vegetation and species of concern described for Alternative C would occur under Alternative E because no additional specific mitigation measures will be required and because transportation corridors will not be required. There will be additional impacts in addition to those for Alternative C for the 3,700 wells that will have water basin impoundment structures. This will increase area of total impacts to approximately 73,860 acres. Of this, approximately 66,457 acres of native vegetation will be impacted, 29,168 acres of grassland, 17,972 acres of shrubland, 15,885 acres of forest land and 3,432 acres of barren land.

This Alternative would require a Water Management Plan for every well exploration APD on a site-specific basis for management of production water. There would be no discharge of produced water, either treated or untreated, into the watershed under this alternative unless the operator can demonstrate in the Water Management Plan how discharge could occur without damaging the watershed in accordance with water quality laws. Water quality laws will not protect riparian vegetation from inundation and other changes in the water level as a result of production.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Specific mitigation measures proposed by the Northern Cheyenne Tribe that will be implemented by the BLM are described in the Northern Cheyenne Tribe Mitigation Appendix.

Conclusions

Residual impacts would be the same as described for Alternative C. All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered after well abandonment and by increased access through increased road densities, which may cause greater disturbance and noxious weed infestations.

Cumulative Impacts

The cumulative impacts from Alternative E would be the same types of impacts as described for Alternative A. The quantity of disturbed habitat would be the same as discussed under Alternative C.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts

The area of surface disturbance for Alternative F, in which vegetation and species of concern could be impacted, is expected to be approximately 59,100 acres, which is slightly higher than Alternative B but less than Alternative E (Table 4-66). As under Alternative E, this alternative would require development of PODs in consultation with tribes, surface owners and other involved permitting agencies. Each of these Project Plans would include a site-specific Reclamation Plan, Wildlife Monitoring Plan, Surface Use Plan, Noxious Weed Management Plan and Water Management Plan. Unlike Alternative E, this alternative would use watershed-level analysis to evaluate resource effects from CBNG and other activities occurring within the affected watersheds.

The allowable development in the crucial sage-grouse habitat areas would likely be less dense than the typical 80-acre well-site spacing and if no development were to occur in these areas, overall impacts to vegetation would be reduced by approximately 12.8 percent. This would reduce the amount of disturbed vegetation by approximately 7,565 acres.

Additionally, annual and watershed-specific limits on the number of federal CBNG wells developed would reduce the impacts that would otherwise occur under the other development alternatives during the initial years of the planning period. The resultant rate of development would provide a more even level of impacts as most of the predicted state wells are developed in the first half of the planning period and more of the predicted federal CBNG wells are developed in the latter half. Additionally, vegetation disturbance may be reduced based on results of the watershed-level analysis used to evaluate development proposals. Disturbance in individual watersheds would be limited to prevent the potential for fragmentation of habitat for species of concern.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative F. Project Plans of Development requiring consultation with tribes, resource protection protocols based on watershed-level analysis and monitoring of development within a 5-mile buffer around the Reservation would provide additional opportunities for protection of Reservation resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation.

Specific mitigation measures proposed by the Northern Cheyenne Tribe that could be implemented by the BLM are described in the Northern Cheyenne Tribe Mitigation Appendix.

Conclusions

Residual impacts would be similar to Alternative B, except that they would occur more evenly during the 20-year planning period. Site-specific Project Plans of Development and watershed-level of analysis would likely reduce potential effects to species of concern under Alternative F relative to Alternatives B through E.

Cumulative Impacts

The cumulative impacts from Alternative F would have similar types of impacts as described for Alternative B. However, the quantity of disturbed habitat would be slightly higher than Alternative B, because of additional water basin impoundment structures required for Alternative F (Table 4-66). However, the timing and location of habitat disturbance would vary for this alternative versus Alternatives B through E due to the annual and watershed-based limits imposed on federal well development.

Alternative G—Phased Development Multiple Screens (Low Range)

Impacts

The area of surface disturbance for Alternative G, in which vegetation and species of concern may be impacted, is expected to be approximately 21,100 acres, which is less than Alternative F because the number of wells and the resulting area of disturbance would be approximately 65 percent less. The types of impacts of Alternative G would be similar to Alternative F, because both alternatives would use watershed-level analysis to evaluate resource effects from CBNG and other activities occurring within the affected watersheds.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative G.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation.

Conclusions

The impacts from Alternative G would be the same types of impacts as described for Alternative F, but would occur over a 65 percent smaller area.

Cumulative Impacts

The cumulative impacts from Alternative G would be the same types of impacts as described for Alternative F, but would be less because of the smaller affected area.

Alternative H—Preferred Alternative - Multiple Screens

Impacts

Alternative H is the BLM's Preferred Alternative for the development of CBNG resources on BLM-administered lands. Alternative H will review CBNG proposals against four resource screens. This Alternative would also require PODs that include mitigation measures. The resource screens would be applied to water resources, wildlife, Native American concerns and air resources. The screens would be implemented with the goal of monitoring impacts and developing a decision-making process to control and reduce impacts before they become unsustainable.

Of the four screens only the wildlife and water screens would directly affect vegetation. The air screen would not affect vegetation, while the Native American screen could indirectly affect vegetation on Native American lands by addressing discharge of groundwater onto surface vegetation and protecting Indian Trust Assets.

The area of surface disturbance for Alternative H, in which vegetation and species of concern could be impacted, is expected to be approximately 59,100 acres, which is similar to Alternative F, higher than Alternative B, but less than Alternative E. As under Alternatives E and F, the PODs would be developed in consultation with tribes, surface owners and other involved permitting agencies. Each of the PODs would include a site-specific Reclamation Plan, Wildlife Monitoring Plan, Surface Use Plan, Noxious Weed Management Plan and Water Management Plan. BLM would continue to implement the concept of adaptive management by using data from studies, monitoring and inspections to guide approvals of federal lease operations. POD requirements, the use of state and federal permits, lease stipulations, as well as the use of surface owner agreements and other management actions as described in Alternative E would also be features of this alternative.

Like Alternative F, Alternative H would use watershed-level analysis to evaluate resource effects from CBNG and other activities occurring within the affected watersheds. Vegetation disturbance may be reduced based on results of the watershed-level analysis used to evaluate development proposals. Disturbance in individual watersheds would be limited to prevent the potential for fragmentation of habitat for species of concern.

The combined numerical limits for cumulative and watershed development, coupled with the disturbed habitat limit would necessitate a varied geographical development and corresponding vegetation disturbance pattern across the CBNG Planning Area. Only a few watersheds (Upper Tongue, Lower Tongue, Middle Powder and Little Powder) would likely be developed in the initial three to five year period, while the remaining watersheds would be developed in later years.

Operators would be required to include noxious weed management plans in their PODs to prevent the spread of noxious weeds. The noxious weed management plans must include measures to prevent the spread of weed seeds from any vehicles and equipment from or prior to mobilization to the project area. In the reclamation plans, early serial plants would be specified for revegetation to provide a quick cover before noxious weeds could become established.

Indirect effects to vegetation would be similar to Alternative B through F, but would be reduced by the mitigation measures included in the PODs. Habitat could be disturbed or lost with the vegetation disturbance associated with well pads, roads, pipelines and utility lines. Roadways would provide greater access and more potential for disturbance, illegal harvest, or harassing of protected species.

Crow Reservation

Impacts to the Crow Reservation would be similar to those described in general for Alternative H. Operator PODs requiring consultation with tribes would be developed for all proposed CBNG development within 5 miles of the Crow Reservation. BLM would require site-specific groundwater and air analyses submitted as part of the operator's POD. Resource protection protocols and mitigation measures based on watershed-level analysis and monitoring of development would provide additional opportunities for protection of reservation resources.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Specific mitigation measures proposed by the Northern Cheyenne Tribe that could be implemented by the BLM are described in the Northern Cheyenne Tribe Mitigation Appendix.

Conclusions

Residual impacts would be similar to Alternative F. Site-specific PODs, watershed-level of analysis and multiple screens would likely reduce potential effects to species of concern under Alternative H relative to Alternatives B through F. Reclamation after well abandonment may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Cumulative Impacts

The area of habitat disturbance and the types of cumulative impacts from Alternative H would be the same as described for Alternative F. However, the timing and location of habitat disturbance would vary for this alternative versus Alternatives B through E due to the watershed-based limits and multiple screens imposed on federal well development for Alternative H. Cumulative impacts may occur from coal mining operations within the Planning Area and the proposed Tongue River Railroad in addition to proposed CBNG development. Vegetation would be destroyed within the disturbed area of each coal mine and reclamation will generally result in an increase in grasslands with less plant diversity than was originally present. The proposed TRR would result in the disturbance of approximately 513 to 542 acres of vegetation. CBNG development in Wyoming may increase flows of rivers entering Montana, resulting in potential erosion of wetland and riparian communities and habitat degradation.

Visual Resource Management

Visual Resource Management *Visual resources include Montana features such as landform, water, vegetation, color, adjacent scenery, uniqueness, structures and man-made features of aesthetic value*
Alternative A **No Action (Existing CBNG Management)**
• Federal and State: – Dust emissions would reduce visibility to a small degree near active field operations – Well pads, roads and compressors would disrupt the visual landscape. Semi-permanent structures are designed to blend into the surrounding environment – Drill rigs, two-track trails, heavy road-making equipment and generators would disrupt the visual landscape short-term
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• There would be impacts to BLM VRM Class III and IV areas only. • Type of impacts common to Alternative A would occur under Alternative B, at a scale commensurate with development. • View shed impacts from road network could last for 20 years until reclamation occurs.
Alternative C **Emphasize CBNG Development**
• Impacts common to Alternative B would occur with Alternative C, in addition to the following: – Above ground power lines would greatly impact skyline and viewshed. – Visual impacts from roads and utility lines are greatest with this alternative.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Impacts common to Alternative B would occur with Alternative D, in addition to the following: – Production related roads that are not reclaimed and made part of the permanent road network would result in permanent visual impact.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts would be reduced by the mitigation measures in the Project Plan for visual resources.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts would be similar to Alternative E. • Locations and amounts of impacts would vary compared to the other alternatives based on annual and watershed-based federal CBNG development limits.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F in the sequence of development but would result in lower impacts than the other action alternatives.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to or less than Alternative F in the sequence of development, but could result in lower visual impacts than the other alternatives due to the screening process and use of mitigation and management plans for development.

Assumptions

Based on the Visual Resource Management (VRM) class, BLM stipulations and conditions of approval would require special design, including location, painting and camouflage, to blend with the natural surroundings and meet visual quality objectives for the area. A standard component typically includes painting facilities to camouflage them and a standard color may be specified.

Impacts From Management Common to All Alternatives

Visual resources would be impacted to varying degrees by oil and gas exploration and production activities. Exploration would involve minor visual impacts from clearing operations for access to exploratory sites. The majority of this impact would be expected to result from access road construction, site construction, drill rig operations and on-site generator use. Short-term visual impacts would occur where construction and drilling equipment is visually evident to observers. Long-term impacts would occur from construction of roads and pads, installation of facilities and equipment, vegetation removal and change in vegetation communities. These would produce changes in landscape line, form, color and texture.

Impacts would occur locally on a case-by-case basis as the native vegetation is disturbed and small structures are erected. Landscape line, form, color and texture would all be expected to change. The view to travelers throughout much of the Powder River area is a high plain with low-lying scrub-shrub vegetation and periodic rock outcrops. In the Castle Rock Project, there is rough terrain, high hills and buttes and timber present. Much of the area is very scenic and quite a contrast to the landscape of open prairie that might be found in other areas of the Powder River Basin. Visual impacts may include building roads in rough terrain or cutting timber.

Introducing man-made structures into this landscape, although small and painted for camouflage, changes the overall nature of the visual resource.

Four thousand acres of surface mining expansion under permit consideration may be approved this year. This mining activity may affect some visual resources in those areas for the next 20 to 30 years.

Construction and operation of the Tongue River Railroad would result in additional cumulative impacts to visual resources. The overall purpose of the proposed rail line is to transport coal from mines in the Powder River Basin and Tongue River Valley to markets in the Midwest and northeastern states. Analysis of the proposed project concluded that there would be very low to moderate long-term impacts to the scenic quality of the landscape along much of the approximately 130 miles of proposed route. Visual impacts would result from construction of fill prisms in several locations and from visibility of trains from sensitive areas. Impacts from construction of fill prisms would be designed so that the cuts would fit with natural contours and surrounding environment and then planted. Additional short-term impacts would occur as a result of construction activities.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

CBNG production well activities would have visual impacts. CBNG wells, typically covered in a box, or “housing” for protection from weather, are isolated structures approximately 4 feet high by 4 feet wide by 4 feet long. The wells are scattered across a wide area and are connected to field compressors. The compressors are larger and create more of a visual impact-although in a much smaller area because these structures are more widely distributed. Compressors range in size from field compressors at 8x12x8 (width, length, height; in feet) to sales compressors at 12x18x10. Visual impacts also would arise from construction activities related to developing access to the sites. Exploration well activities may have short-term visual impacts if the exploration wells are not converted to production wells. These short-term impacts (approximately 2 months) would be from the visual effects of the drill rig, portable generator and access road.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBNG development on tribal lands, then there is expected to be minimal, if any, impacts on visual resources for the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Exploration wells would cause short term impacts and impacted areas will be repaired on an as-needed basis. Minimal permanent visual impacts (approximately 500 acres) are anticipated within the CX Ranch due to well houses, compressor stations, power lines and associated roads.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Visual impacts would occur from the development of CBNG wells in this alternative for lands in VRM Classes III and IV. VRM Class I and II lands would not be developed and the No Surface Occupancy stipulation applies. The Controlled Surface Use stipulation would be applied to Class III and IV lands. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation. Impacts from utilities would be minimal as power lines are buried and other utilities are concentrated within roadway corridors.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations. Cumulative impacts would include the visual impact of additional roads when combined with existing roads and new roads being constructed for other uses.

Alternative C—Emphasize CBNG Development

For Alternative C, visual impacts would occur from the development of CBNG wells for lands in VRM Classes II, III and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III and IV lands. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation.

Power lines would be aboveground in this alternative and roads would be allowed to be placed according to operator plans. This would result in power lines where none now exist, as well as a wider expanse of roads.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations. There also would be a network of power lines visible from many places.

Cumulative impacts would be the same as described for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Visual impacts would be the same as described for Alternative B.

Conclusions

Residual and cumulative impacts are the same as described for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Visual impacts would occur from the development of CBNG wells for lands in VRM Classes II, III and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III and IV lands providing options for lessening the visual impact through design and landscape features. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation. Visual contrast Ratings would be completed at the APD or POD stage to identify site specific impacts and determine mitigation.

This alternative does allow for installation of pipelines, power lines and roads where there are none now. But, it also requires that the operator minimize or mitigate impacts from these activities in the Project Plan and state how the surface owner was consulted for input on the location of roads, pipeline and utility line routes. It also allows, at the surface owner's discretion, the closing and rehabilitation of roads or the option of leaving them open, after well abandonment.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Use of the mitigation plan as part of the Project Plan would lessen many of the visual impacts but would not eliminate them. New roads and power lines would be a residual visual impact from this alternative.

There would be cumulative visual impacts from the combination of new and existing roads and utilities.

Alternative F—Phased Development Multiple Screens (High Range)

Overall visual impacts at the end of the 20-year development cycle would be similar to Alternative E because both alternatives will have approximately the same cumulative level of development. Based on the sequence of development predicted for this alternative, visual impacts from federal CBNG development would be lower during the first few years of the planning period than any of the other action alternatives. Impacts would accumulate each year thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of developed wells would experience the greatest visual impacts from federal CBNG development. The greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds. Cumulative impacts will result over time and within the watersheds as both federal and state/private CBNG well development occurs.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Use of management and mitigation plans would lessen many of the visual impacts but would not eliminate them. New roads and aboveground power lines would be a residual visual impact from this alternative. As with Alternative E, short-term construction impacts would be greater than the long-term impacts because the footprint of each well is smaller than the necessary construction footprint.

Cumulative impacts would be similar to those described under Alternative E.

Alternative G—Phased Development Multiple Screens (Low Range)

Overall visual impacts at the end of the 20-year development cycle would be noticeably less than those of Alternative F because Alternative G would result in approximately one-third the number of developed wells. Alternative G would be similar to Alternative F in the sequence of development predicted for this alternative. Impacts would accumulate each year thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of wellheads would experience the greatest visual impacts from federal CBNG development. As with Alternative F, the greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds. Cumulative impacts will result over time and within the watersheds as both federal and state/private development occurs.

Crow Reservation

Impacts on the Crow Reservation would be similar in nature to those described for Alternative F; however the amount of impacts would be approximately one-third of Alternative F due to limited well development under Alternative G.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Use of management and mitigation plans would lessen many of the visual impacts but would not eliminate them. New roads and aboveground power lines would be a residual visual impact from this alternative. As with Alternative F, short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would be less than those described under Alternative F due to the reduced amount of well development.

Alternative H—Preferred Alternative - Multiple Screens

Overall visual impacts would be similar to or less than Alternatives E and F. Based on a sequence of development similar to that predicted for Alternative F, visual impacts from federal CBNG development under Alternative H would be lower during the first few years of the planning period than Alternatives B through E. Impacts would accumulate each year thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of developed wells would experience the greatest visual impacts from federal CBNG development. The greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds. Cumulative impacts will result over time and within the watersheds as both federal and state/private CBNG well development occurs.

Visual consequences under Alternative H could be less than the other alternatives because each proposal for development would be subject to review against the four resource screens (air, water, wildlife, Native American concerns), as well as planning and mitigation requirements. This review process would balance CBNG development with protection of the natural environment. While visual resources do not have an individual screen for the review process, it is considered in the individual analyses. Additionally, key environmental and wildlife conditions are subject to the resource screens. Protection of these conditions would contribute to a more natural-appearing visual character.

Visual impacts due to erosion from CBNG-produced water could be less than Alternatives C, D and E and similar to Alternative F because the BLM would require a water management plan and use watershed-based thresholds for the volume of untreated water that could be discharged to surface waters from federal CBNG wells.

Visual disturbance could be less than Alternatives E or F because there would be minimal road construction. Transportation corridors (proposed roads, flowline routes and utility line routes) would be located to follow existing routes, or areas of previous surface disturbance, where possible. In addition, low-voltage distribution power lines would be buried.

Cumulative impacts would result within the watersheds as both federal and state/private development occurs. However, Alternative H includes watershed-level analysis as part of POD development and review to evaluate and address cumulative impacts as they are identified.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative H. If there were no CBNG development on tribal lands, then there are expected to be minimal, if any, impacts on visual resources for the reservation. The Native American concerns screen would provide an additional level of resource protection for development proposed within 5 miles of the reservation and in the vicinity of traditional cultural properties through consultation with the tribe and monitoring during development.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusion

Use of the screening process and management and mitigation plans would lessen many of the visual impacts, but would not eliminate them. A limit on new roads construction and putting power lines underground would help maintain the natural-appearing landscape.

As with the other alternatives, short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would include the visual impact of additional roads, if any, when combined with existing roads and new roads being constructed for other uses.

Wilderness Study Areas

Wilderness Study Areas *There are 6 WSAs within the CBNG emphasis area*
Alternative A **No Action (Existing CBNG Management)**
• BLM WSAs are closed to oil and gas leasing so there would be no direct impact to WSAs. Because there would be no production activities in BLM planning areas under this alternative, there would be no impacts.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• No direct impact to WSAs from CBNG development.
Alternative C **Emphasize CBNG Development**
• No direct impact to WSAs from CBNG development.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• No direct impact to WSAs from CBNG development.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• No direct impact to WSAs from CBNG development.
Alternatives F & G **High and Low Range Phased CBNG Development**
• No direct impacts to WSAs from phased CBNG development.
Alternatives H **Preferred Alternative - Multiple Screens**
• No direct impacts to WSAs from CBNG development.

Assumptions

Wilderness Study Area (WSA) policy prohibits leasing of WSA lands for resource extraction subject to rights associated with valid claims and leases existing at the time of designation.

Impacts From Management Common to All Alternatives

BLM leasing restrictions are designed to protect WSAs from considerable impact. The WSA policy prohibits leasing of these lands for resource extraction. It is expected that WSAs will not be impacted through conventional oil and gas development under current management. Remote areas may be accessed as CBNG development proceeds, but this does not mean that WSAs will be impacted. Specific potential impacts to WSAs cannot be quantified until specific development proposals are received.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

State and private lands would be impacted by CBNG production activity. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from CBNG activities.

Conclusion

Impacts from this alternative would be similar to management common to all alternatives. Since stipulations for WSAs prevent leasing of these lands for resource extraction, there are expected to be no major impacts to WSAs.

There are no cumulative impacts from CBNG development.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B would allow development while emphasizing the protection of natural and cultural resources. Under this alternative development would result in increased access to remote areas. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative C—Emphasize CBNG Development

Alternative C would emphasize CBNG exploration and development with minimal restrictions. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Alternative D would encourage CBNG development while maintaining existing land uses and protecting downstream water consumers. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Alternative E would allow CBNG development subject to existing planning restrictions and balances CBNG development and the protection of the natural environment. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

There are no cumulative impacts from CBNG development.

Alternative F—Phased Development Multiple Screens (High Range)

Alternative F would allow CBNG development subject to watershed level planning coupled with phased development. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

There are no cumulative impacts from CBNG development.

Alternative G—Phased Development Multiple Screens (Low Range)

Alternative G would be the same as Alternative F in that it would allow CBNG development but at a lower number of allowed federal APDs.

Conclusion

There are no cumulative impacts from CBNG development.

Alternative H—Preferred Alternative - Multiple Screens

Alternative H would allow CBNG development subject to multiple screens, increased monitoring and long-term corridor planning.

BLM leasing restrictions are designed to protect WSAs from considerable impact. The WSA policy prohibits leasing of these lands for resource extraction. It is expected that WSAs will not be impacted through CBNG development.

Mitigation

There are no mitigation measures necessary since no development is current allowed within WSAs.

Conclusion

There are no cumulative impacts to WSAs from regional projects as forecasted at this time.

Wildlife

Wildlife

Mammal Species: 10 bats. 8 shrews, 34 small mammals and lagomorphs, 17 predators, 4 big game,
Bird Species: 32 waterfowl, 33 shore & wading birds, 18 diurnal & 11 nocturnal raptors, 8 gallinaceous, 8 wood peckers, 137 songbirds
Reptiles and Amphibian species: 1 salamander, 4 frogs, 4 toads, 3 turtles, 2 lizards, 9 snakes
Species of Concern consist of 16 mammals, 9 reptiles and amphibians, and 22 birds, including: Sage-grouse, Mountain Plover, Bald Eagle, Interior Least Tern, Peregrine Falcon, Gray Wolf, Black-tailed Prairie Dog, Canada Lynx, Black-footed Ferret, Grizzly Bear

Alternative A
No Action (Existing CBNG Management)

- Direct impacts include habitat loss, death from vehicle collisions and effects associated with greater human access into previously untraveled areas.
- Indirect impacts on wildlife include disturbance and displacement, stress, power lines, noxious weed invasion, user-created roads, habitat fragmentation, water quality degradation from road runoff and increased livestock grazing.
- Indirect impacts on wildlife would occur on 33,840 to 84,000 acres.
- Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles, would be low because of the limited number of CBNG wells permitted.
- Species of concern that are not federally protected may be impacted by habitat loss, disturbance and habitat changes.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Same as Alternative A but on a much larger scale. Twenty-five times as many wells, roads and utility corridors as under Alternative A. 6,680 miles of roads (2.9 to 8.8 miles per square mile). 20,697 miles of utility corridors (9 to 27.1 miles per square mile). Indirect impacts to wildlife on 884,000 to 4.7 million acres from:
- Loss of high value habitats such as prairie dog towns, sage-grouse leks and big game winter range.
- Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal.
- Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles could occur, but impact would be less than Alternatives C or D with the restricting of utilities and roadways to the same corridor.
- All species of concern that are not federally protected may be impacted by habitat loss, disturbance and habitat changes.

Alternative C
Emphasize CBNG Development

- Similar impacts as Alternative B. Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres from:
  - Discharge of untreated CBNG water into drainages would impact riparian and wetland habitat and associated species because of poor water quality and erosion.
  - Increased livestock grazing within two miles of CBNG discharges that occur in areas without summer water
  - Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles, are greater under this alternative than any other because of the increased number of CBNG well permits.
  - Potential indirect impacts to T&E species from changes in riparian habitat. Bald Eagles and Interior Least Terns may also be affected if SAR changes affect forage fish.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B:
  - Discharged treated CBNG water would erode riparian and wetland habitat
  - Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles would occur at a level less than Alternative C.
  - Potential indirect impacts to T&E species from hydrology changes caused by increased water levels may impact nesting Interior Least Terns. If hydrology changes from surface water runoff, cause riparian vegetation changes, other T&E species may be impacted as well, such as nesting Bald Eagles.
  - Species of concern that are not federally protected may be impacted by habitat loss, disturbance and habitat changes.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Direct and indirect impacts would occur similar to Alternative B.
- Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres depending on development spacing.
- Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal.
  - This alternative would not directly impact any T&E listed wildlife species.
  - Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles could occur.
  - Species of concern not federally protected may be impacted by habitat loss, disturbance and habitat changes. These impacts may be less than under Alternatives B, C, & D through the implementation of the Wildlife Monitoring and Protection Plan. However, this alternative would include more holding ponds than any other development alternative and consequently, Alternative E would include a greater risk of West Nile virus infection to sage-grouse than any other development alternative. The risk would be minimized by implementing BMPs to control mosquito populations associated with holding ponds.
- More water would be available for wildlife and livestock as a result of CBNG production.
- An adaptive management strategy, included in the Wildlife Monitoring and Protection Plan, would help to minimize impacts to wildlife and habitat by:
  - Utilizing and evaluating new information to change

or form additional conditions of approvals. – Monitoring habitat use/wildlife populations and reclamation activities that will allow mitigation measures and stipulations to be evaluated for effectiveness.
Alternative F **Phased Development Multiple Screens (High Range)**
• Direct impacts are expected to be less than Alternatives B, C, D and E during the time when fewer wells are being drilled and fewer production facilities are installed. • If habitat thresholds are met and well development is restricted, acreages of indirect impacts would be the less than Alternatives B, C, D and E. • Indirect effects from new roads and new utility lines would be similar to Alternatives B and D, but less than Alternatives C and E while federal restrictions are applied. • Loss of wildlife habitat associated with streams as a result of groundwater withdrawal. • Thresholds for important sagebrush-steppe habitat impacts could result in slightly less impacts to wildlife than under Alternative E particularly sage-grouse and other sagebrush and grassland associated species • Species may be impacted by habitat loss, disturbance and habitat changes. These impacts may be less than under the other development alternatives due to established habitat and well development thresholds and the implementation of the Wildlife Monitoring and Protection Plan. However, this alternative would include a greater risk of West Nile virus infection to sage-grouse than Alternatives B, C, D, or G. • Potential impacts to sage-grouse and other sagebrush dependant species would be lessened due to conditions placed on development within crucial sage-grouse habitat areas. • Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest, or collisions with vehicles are present, but less so than other development alternatives due to implementation of the Wildlife Monitoring and Protection Plan and established habitat and well development thresholds. • An adaptive management strategy, as described under Alternative E above, would help to minimize impacts to wildlife and habitats.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Acres of direct and indirect impacts would be less than all other development alternatives. • Indirect effects from new roads and new utility lines would less than all other development alternatives. • Species may be impacted by habitat loss, disturbance and habitat changes. These impacts would be less than under the other development alternatives due the less amount of well, road and utility line development, as well as the implementation of the Wildlife Monitoring and Protection Plan. However, the risk of West Nile Virus to sage-grouse would be greater than Alternatives B, C and D, but less than Alternatives E or F. • Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest, or collisions with vehicles, but less so than Alternatives B, C, D, E and F. • An adaptive management strategy, as described under Alternative E above, would help to minimize impacts to wildlife and habitats.
Alternative H **Preferred Alternative - Multiple Screens**
• There would be less potential for displacement of sage-grouse as Alternative H calls for maintaining sage-grouse populations consistent with control populations. • Rate of development managed by the number of Federal APDs that would be approved per year to protect other resources. • Geographic development of CBNG resources managed by the location of federal APDs approved to protect other resources. • Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells • Protection of tribal resources from federal wells within 5 miles of reservation boundaries • BLM would require wildlife monitoring and use adaptive management techniques to protect wildlife Less potential for the displacement of sage-grouse from crucial habitat areas due protecting source populations

Assumptions

CBNG exploration, production and abandonment on BLM-administered minerals is subject to the stipulations summarized in Table 4-67. These stipulations are recommended for, but do not necessarily apply to, CBNG-related activities on non-BLM-administered surfaces. Therefore, the stipulations would avoid some of the potential impacts on BLM-administered surfaces, but may or may not avoid impacts on non-BLM-administered surfaces. The success of these stipulations in avoiding impacts would require collection of site-specific information regarding the resources to be protected in relation to exploration, production and abandonment plans, followed by strict adherence to the terms of the stipulations. For the purposes of this analysis it is assumed that the stipulations offer some protection to wildlife species on BLM-administered lands. It is further assumed that these stipulations which are very species specific, offer some degree of protection to many other species that use the same habitat during the same time period.

The assumption is made that existing stipulations would provide some protection to sage-grouse habitat including lek areas, nesting habitat and winter range. It is recognized that these actions would not completely protect this species. Mitigation measures within the Wildlife Monitoring and Protection Plan (WMPP) located in the Wildlife Appendix will provide additional protective measures. Lease stipulations and terms and conditions would provide protection to

TABLE 4-67

EXISTING WILDLIFE-RELATED LEASE STIPULATIONS COVERING CBNG EXPLORATION AND DEVELOPMENT ON BLM-ADMINISTERED SURFACES

Resource	No Surface Use	No Surface Occupancy	No Surface Use or Occupancy
Riparian areas		X	
100-year floodplains of major rivers, streams and water bodies		X	
Water bodies and streams		X	
Crucial big game and sage-grouse winter range*	December 1 - March 31		
Elk calving areas*	April 1 - June 15		
Powder River Breaks bighorn sheep range		Within designated bighorn sheep range	
Grouse leks			Within ¼ mile of lek
Grouse nesting zones*	Within 2 miles of leks from March 1 - June 15		
Raptor nests*	Within ½ mile from March 1 to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ¼ mile of nest
Bald eagle nests and nesting habitat	Within ½ mile from March to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ½ mile of nests active in the last 7 years and within riparian area nesting habitat
Peregrine falcon			Within 1 mile of nests
Ferruginous hawk			Within ½ mile of nests active within 2 years
Piping plover			Within ¼ mile of wetlands identified as piping plover habitat
Interior least tern			Within ¼ mile of wetlands identified as Interior Least Tern habitat
Prairie dog colonies > 80 acres	Controlled surface use		

Note: These stipulations are attached to leases and can affect exploration and construction

*Stipulation does not apply to operation and maintenance of production facilities.

Please refer to Table MIN-5, Minerals Appendix, for a listing of resource mitigation.

raptors and the mountain plover. Protective measures contained in the WMPP (if fully implemented) would help reduce, but cannot avoid all impacts to all species of wildlife.

The DNRC TLMD may apply the following stipulations on a case-by-case basis to school trust lands leased for oil and gas exploration, development and production. The noxious weed stipulation is placed on all oil and gas leases issued by TLMD. Some of the stipulations indirectly relate to wildlife, while others are more specific. The dates on the timing restriction stipulation vary depending on the wildlife species to which it applies.

- **Notification:** Lessee shall notify and obtain approval from the DNRC's TLMD prior to constructing well pads, roads, power lines and related facilities that may require surface disturbance on the tract. Lessee shall comply with any mitigation measures stipulated in TLMDs approval.
- **Weeds:** The lessee shall be responsible for controlling any noxious weeds introduced by Lessee's activity and shall prevent or eradicate the spread of those noxious weeds onto land adjoining the lease premises.
- **Sensitive Areas:** This lease includes areas that may be environmentally sensitive. Therefore, if the lessee intends to conduct any activities on the lease premises, the lessee shall submit to TLMD one copy of an Operating Plan or Amendment to an existing Operating Plan, describing in detail the proposed activities. No activities shall occur on the tract until the Operating Plan or Amendments have been approved in writing by the Director of the Department. TLMD shall review the Operating Plan or Amendment and notify the lessee if the Plan or Amendment is approved or disapproved.

  After an opportunity for an informal hearing with the lessee, surface activity may be denied or restricted on all or portions of any tract if the Director determines in writing that the proposed surface activity would be detrimental to trust resources and therefore not in the best interests of the trust.
- **Wildlife Restrictions:**
  - To protect certain wildlife during periods important to their survival, surface occupancy or other activity shall be restricted from March 15 through July 15 of each year unless otherwise authorized in writing by the TLMD.
  - Potential wildlife conflicts have been identified for this tract. The TLMD would contact either the Montana Department of Fish, Wildlife and Parks office or the FWS office in the area for advice on alleviating any possible conflicts caused by lessee's proposed activities. Additional mitigation measures may be required.
  - Wildlife species of concern have been identified on or near this tract. A survey in areas of proposed activity may be required prior to disturbance. Identified species would be avoided, unless otherwise authorized by the TLMD. Additional mitigation measures may also be required.
- **Miscellaneous Restrictions:**
  - Plant species of concern have been identified on or near this tract. A vegetation survey in areas of proposed activity would be required prior to disturbance. Identified rare plant species would be avoided, unless otherwise authorized by the TLMD.
  - A critical weed problem exists on this tract. Additional mitigation measures would be required to prevent further spread of noxious weeds. The department may require such measures as power washing of vehicles, car pooling, timing restrictions for seismic, etc. to facilitate this prevention.
  - This tract contains biological weed-control sites, which must be avoided unless otherwise authorized by TLMD.
- **Other:**
  - Any activity within 1/8 mile of the river or lake/reservoir on or adjacent to this tract must be approved in writing by the TLMD prior to commencement. No surface occupancy would be allowed within the bed of the river, abandoned channels, the bed of the lake/reservoir, or on islands and accretions associated with the river or lake/reservoir.
  - 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.
  - Wooded areas on this tract would be avoided unless otherwise authorized by the TLMD.

In addition to these stipulations, motorized vehicle use for recreationists on state trust lands is restricted by current policy to federal, state and dedicated county roads or other roads regularly maintained by the county, or to other roads that have been designated open by DNRC. Off road use is prohibited. Increased posting efforts, i.e., Walk-In Only signs, may be implemented by the TLMD to reduce unauthorized use of two-track trails and roads by recreationists to alleviate increased pressure on wildlife. Exploration for and development of CBNG wells would cause a wide range of both direct and indirect impacts on wildlife. The extent and duration of effects on wildlife would depend on the animal species, the type and quantity of vegetation removed, the nature and period of disturbance and the success of stipulations in reducing or avoiding some impacts. The impacts described below assume that the site-specific natural resource information and the stipulations discussed above are successfully used to avoid certain impacts on BLM-administered and state lands.

As previously described, the No Action Alternative includes exploration for and development of a relatively small number of CBNG wells (compared to the other alternatives) and the associated roads, pads, power lines, pipelines, utility corridors, facilities and human activities and presence. Many of the direct and indirect impacts of CBNG development on wildlife described for Alternative A would occur regardless of the number of CBNG wells developed, with the extent of impacts roughly proportional to the number of wells. These direct and indirect impacts are discussed below under the No Action Alternative and referenced as appropriate in the discussion of the impacts of Alternatives B through H. Additional ecosystem-level impacts associated with the substantially larger number of CBNG wells that would be developed under Alternatives B through H are discussed under those alternatives.

For Alternatives A thru E, sage-grouse habitat would be managed in accordance with the current BLM policy for management of BLM sensitive species and as outlined in the FSEIS and WMPP; specifically, BLM sensitive species management cannot impact these species in a way that may cause further declines in the species population status. For Alternatives F and G, a wildlife screen is included for the protection of wildlife habitat. For Alternatives F and G, additional sage-grouse population management prescriptions could also be implemented with the goal of maintaining the current sage-grouse populations (see WMPP for specifics). For Alternative H, BLM would apply broad or universal BMPs within crucial sage-grouse habitat, coupled with monitoring to determine the success of these BMPs. Development within sage grouse habitat would only be allowed if the operator can show the development will not result in the decrease in sage-grouse populations, when compared to control leks. Further restrictions could be implemented if monitoring shows the management is not effective in maintaining sage-grouse in the development areas.

Impacts From Management Common to All Alternatives

The responses of wildlife to facilities and activities associated with oil and gas development are complex but well documented (Wisdom et al. 2000; USDI and USDA 2001; Trombulak and Frissell 2000). Tolerance of various types of environmental disturbances varies among species and among individuals of the same species. The potential for impact is related to the timing and nature of the disturbance, severity of winter, habitats and species present, physiological status of the animal, hunting pressure and other disturbance factors and predictability of the disturbance. The scale of oil and gas development, number and length of associated roads and other facilities and implementation of measures to avoid or reduce impacts also influence the probability and severity of impacts on wildlife.

Direct and indirect impacts of road construction and use on wildlife and wildlife habitat have been well documented for oil and gas projects and other natural resource developments. Impacts include a wide range of biological effects, such as habitat loss, displacement because of noise and human disturbance and stress. The types of impacts expected to result from oil and gas development would be similar to those described in detail under Alternative A for CBNG development. The extent of the impacts would vary depending on the level of development.

A detailed discussion of impacts and mitigation measures for wildlife is included in the remainder of this section and in the Wildlife Appendix. This discussion addresses the direct and indirect quantitative and qualitative impacts that would likely result from CBNG development in the Powder River and Billings RMP areas. The impacts from conventional oil and gas development would be similar to those anticipated for CBNG but at a scale associated with conventional oil and gas development as identified in the Miles City District's *Oil and Gas Final EIS* (BLM 1992).

Construction and operation of the proposed TRR would directly and indirectly affect wildlife in the project area, primarily big-game species (deer and pronghorn) and birds (upland, waterfowl, songbirds and raptors). Direct impacts would include the loss of some wildlife habitat within the ROW and displacement of some wildlife within or near the ROW. Other wildlife impacts could include elimination of relatively nonmobile species; loss of animals due to collision with trains or maintenance vehicles; creation of a barrier to some species; potential damage or elimination of habitat by dust, herbicides, fuel or other hazardous material spills and fire; and disturbances to nearby animals. Indirect impacts would include general demands on the environment associated with increased human population, such as increased county road wildlife-vehicle collisions, displacement of wildlife by recreationists and increased illegal harvest and hunting (STB 2004). Construction and operation of the TRR would be in accordance with all state and federal rules and regulations and would use mitigation measures and BMPs to minimize impacts to wildlife.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

CBNG exploration and production includes development of roads, pads, power lines, pipelines, utility corridors and facilities as well as human activities and regular human presence. Much of this activity would occur in the relatively undisturbed native short grass prairie of eastern Montana, resulting in both direct and indirect impacts on wildlife. Those impacts would be localized around CBNG exploration and production sites and proportional to the level of activity at a particular location. The following discussion documents the types of impacts that would be expected from CBNG-related actions. These impacts would occur on BLM, state and private lands.

While the types of impacts described below would occur under all of the alternatives, the extent of the impact would be roughly proportional to the extent of CBNG development under each alternative. The number of CBNG exploratory and development wells under the No Action Alternative is 1/20th the number that would be developed under the other alternatives. Therefore, the extent to which these impacts would occur under the No Action Alternative is relatively minor compared to the other alternatives.

With a few exceptions, the same types of impacts to wildlife would occur under all of the alternatives. Therefore, they are described under Alternative A below. Differences in the type or extent of impacts between alternatives are noted for Alternatives B through H.

Direct habitat loss and direct and indirect impacts because of habitat disruption and wildlife disturbance caused by roads, pipelines and utility corridors would cause the bulk of the impacts on wildlife. Numerous studies have documented the direct and indirect impacts on wildlife from road development, human presence in formerly remote areas and facilities construction (Trombulak and Frissell 2000, Wisdom et al. 2000). The nature of these impacts and how they relate to exploration, development and maintenance of CBNG wells is discussed in the text that follows. In most instances, the impacts would occur during all CBNG phases. Exceptions are noted as appropriate.

Direct impacts would include loss of habitat to accommodate project features. They would persist for the duration of CBNG activities and, in the case of loss of habitat value, beyond that time. Some degree of habitat loss and degradation would continue following CBNG abandonment because of ecological differences between reclaimed sites and native vegetation.

The amount and types of habitat that would be directly lost from exploration and development are described in the *Vegetation* section. The species that would be affected by direct habitat loss would depend on the location of CBNG exploration and development and the types of habitat affected. Based on the average area expected to be disturbed by exploration and development of each CBNG well, about 675 acres would be impacted during exploration, a total of 1,500 acres would be impacted in the short term by well development (including the 675 exploration acres) and 500 acres would be subject to long term impacts during operations under Alternative A. Direct impacts on wildlife would also include mortality as relatively less mobile small mammals, reptiles and amphibians are killed during road and other site construction. Smaller mammals, reptiles and amphibians are most likely to be directly killed by vehicles and are vulnerable when crossing roadways (USDI and USDA 2001). Amphibians are especially vulnerable to being killed on all types of roads because their life histories often involve migration between wetland and upland habitats and individuals are often inconspicuous and slow-moving. Inexperienced juveniles of many raptor species experience high rates of mortality from collisions with vehicles (Trombulak and Frissell 2000). Grouse are particularly susceptible to collision mortality during the spring because they often fly to and from leks near the ground. Also, higher CBNG-related traffic volumes on existing paved roads would result in higher mortality rates for reptiles that seek out roads for thermal cooling and heating (Vestjens 1973).

Direct mortality from vehicle collisions would be expected to increase for all wildlife along both new and existing roads used for CBNG exploration and well construction and maintenance (Groot et al. 1996). Collision mortality would be most injurious to small and declining populations with limited distribution. Direct impacts from collision and crushing would continue for the duration of the project along roads until they are successfully closed and reclaimed. Some additional mortality would continue indefinitely because some new CBNG roads would not be closed and reclaimed.

Additional direct impacts would occur on private lands because state and federal lease stipulations are recommended but not required. State requirements would lessen direct impacts on state lands compared to private lands. These impacts include greater potential loss of riparian vegetation and other floodplain habitats valuable for wildlife, abandonment of raptor nests because of direct habitat loss and disturbance and habitat loss for a wide range of species that occupy prairie dog towns.

Table 4-68 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts. Most indirect impacts on wildlife would occur during all CBNG phases on BLM, state and private lands. The duration of effects would correspond with the duration of each phase and the intensity of activity during that phase. The relative magnitude of impacts would be directly related to the nature and extent of activities associated with each phase of CBNG development. Some indirect effects would persist beyond abandonment because continued human use of some CBNG and user-created roads that are not closed and reclaimed (USDI and USDA 2001).

While roads do not affect all species and ecosystems equally, the overall presence of roads correlates highly with changes in species composition, population size and hydrologic and geomorphic processes that shape aquatic and riparian systems. All types of roads affect terrestrial species in several ways:
(1) increased mortality from road construction,
(2) increased mortality from collisions with vehicles,
(3) modification of animal behavior, (4) alteration of the physical environment, (5) alteration of the chemical environment, (6) spread of exotic species and (7) increased alteration and use of habitats by humans (Trombulak and Frissell 2000).

CBNG-developed roads and two-track trails would provide access into previously roadless areas and would result in additional user-created roads and trails branching off from CBNG roads (USDI and USDA 2001). Access to most CBNG roads on private lands would be restricted by the surface owner. Public access would be restricted on most CBNG roads on BLM-administered surfaces through the use of fences and gates. This is expected to be successful in limiting the majority of public access. However, the open rolling nature of the terrain in the project area combined with the proliferation of four-wheel-drive trucks and all-terrain vehicles would allow the creation of user-created roads (USDI and USDA 2001). This would cause additional road-related direct and indirect impacts over large open areas because of the great sight distances in central and southeastern Montana.

Some CBNG roads would continue to be used by the public throughout the entire production phase because road closures are difficult to implement and enforce in flat to rolling short grass prairie habitat. This continued use would hamper reclamation efforts on some CBNG roads while others would remain open to the public by choice. Some portion of CBNG roads, as well as user-created roads, would become permanent, with all of the associated direct and indirect impacts on wildlife and habitat.

Human use of all types of roads is a source of stress for many species (Knick et al. 2003). Roads also may affect an animal's reproductive success (Gutzwiller 1991). Golden eagles prefer to nest away from human disturbances, including roads and have reduced nesting success in nests located closer to roads than in nests farther from roads (Fernandez 2001). Chronic physiological stress on wildlife can result in increased sickness, a decrease in individual productivity (Knight and Cole 1991 Anderson and Keith 1980, Yarmoloy et al. 1988) and eventually result in population declines (Anderson and Keith 1980).

The increased access provided by both CBNG and user-created trails and roads over the span of all CBNG phases and beyond would result in additional legal and illegal harvest of game animals (Cole et al. 1997), recreation shooting of animals such as prairie dogs or other species (Ingles 1965) and chasing and harassing of animals (Posewitz 1999, USDI and USDA 2001). Human-caused fires are likely to increase in areas not regularly accessed by the general public before CBNG and user-created roads were present.

Indirect impacts of road development and use as would occur during exploration, development and production on wildlife and wildlife habitat have been well documented for a variety of natural resource extraction and development projects (Trombulak and Frissell 2000, USDI and USDA 2000, Wisdom et al. 2000, Braun et al. no date listed). Indirect impacts of CBNG exploration and development on certain species of wildlife more sensitive to development and human disturbance would occur over much larger areas than the direct impacts.

The *Oil and Gas Development on the Southern UTE EIS* (BLM 2002c) suggested human presence associated with exploration and development of oil and gas wells disturbed wildlife at distances up to 1/2 mile and that operation and maintenance activities caused disturbance within 1/4 mile of wells and roads. The disturbance results both from the presence of people and from the noise associated with exploration and development. There are numerous studies documenting wildlife avoidance of roads and facilities and wildlife disturbance at distances of 1,650 feet (Madsen 1985), 6,600 feet (Van der Zande et al. 1980) and as far as two miles or more for sage-grouse (summarized in Connelly et al. 2000) and raptors (Fyfe and Olendorff 1976).

Impacts to mule deer habitat use, movements and populations are also a concern and have recently been examined by the Wyoming Cooperative Fish and Wildlife Research Unit in the Pinedale Anticline Project area in western Wyoming. This area has been identified as important winter range for mule deer and concerns exist regarding potential effects conventional gas field development may have on the deer population. Conclusions in the most recent progress report show there have been considerable interruptions in movement patterns and shifts in habitat areas used, resulting in population declines of approximately 48 percent in the wintering deer population. While no studies have been done in Montana evaluating CBNG impacts on mule deer movements and habitat use, it is reasonable to conclude mule deer in southern Montana, which do not exhibit migratory behavior, would be impacted by CBNG development. The types of impacts would be similar to those identified in the Wyoming study.

Elk avoidance of roads has been documented in many studies throughout the West (Lyon 1979 and 1983, Perry and Overly 1976, Rost and Bailey 1979, Ward et al. 1973). Human presence along roads displaces big game species such as elk as well as other species sensitive to human presence from otherwise useable habitat, especially during the day. Elk in Montana prefer spring feeding sites away from visible roads (Grover and Thompson 1986) and both elk and mule deer in Colorado prefer areas greater than 660 feet from roads during the winter (Rost and Bailey 1979). Lyon (1983) studied the effects of roads on elk distribution and habitat use. He reported that within blocks of available elk habitat, road densities of only two miles of primitive (undeveloped) road open to vehicle traffic per square mile resulted in elk displacement from over 50 percent of the available habitat in the areas with roads present. The avoidance was due to human disturbance and the resulting lack of security for the elk. This type of disturbance would be greatest in open country such as much of the Planning Area where line-of-sight distances are relatively long and escape cover is often limited.

Displacement from habitat because of roads, CBNG facilities and human disturbance may result in any of a number of individual and population level impacts on wildlife (Trombulak and Frissell 2000, Wisdom et al. 2000). These include stress, disruption of normal foraging and reproductive habits, abandonment of unique habitat features and increased energy expenditure. These factors contribute to reduced over-winter survival for individuals, poor condition entering the breeding season, reduced reproductive success and recruitment and eventually population declines (Trombulak and Frissell 2000, Wisdom et al. 2000). For example, many raptor species that nest along prominent landscape features such as cliffs in open country are easily disturbed during the nesting season, often resulting in nest abandonment (Fyfe and Olendorf 1976).

Overhead power lines constructed for production wells pose problems for a variety of wildlife species. Raptors sage-grouse and other species of birds occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines can benefit some raptors in open country by providing hunting perches. However, the additional perches also result in local population declines in prey species. For example, overhead power lines constructed in the vicinity of grouse leks and wintering areas can substantially increase predation rates on grouse. The risk of electrocution on federal and state lands is small because the BLM and State require power lines and poles be constructed to standards that would avoid raptor electrocution. Raptor and sage-grouse collisions with power lines have also been noted throughout the west including eastern Montana. Bevanger (1998) noted growing empirical evidence of the high risk of collision with powerlines for birds with heavy bodies and small wings that are characterized by rapid flight. These birds, including grouse, have a restricted ability to react swiftly to unexpected obstacles, such as powerlines (Bevanger 1998).

Another wildlife disturbance factor associated with CBNG exploration, development and operation is noise. The highest noise levels and greatest impacts would be expected during exploration and development, with lower noise levels during production operations. Noise levels would be similar on BLM and other lands. Animals react differently to noises, but noise is especially troublesome for birds.

Many neotropical birds that occur in the project area, such as western meadowlark, lark bunting, grasshopper sparrow, vesper sparrow, Brewer's sparrow, burrowing

TABLE 4- 68

VULNERABILITY OF WILDLIFE TO TYPES OF CBM IMPACTS, ALTERNATIVE A

(The relatively low impact probabilities in this table reflect the fact that the no action alternative includes a small number of CBM wells compared to the other alternatives)

Species/Groups Affected [1]

	Big Game/Large Predators [2]		Sage and Sharp-tailed Grouse [2]		Raptors [2]		Waterfowl/ Shorebirds		Song Birds		Prairie Dog Colonies		Small Mammals		Reptiles and Amphibians		Bats		Small Predators	
Type of Impact	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**	**Exploration**	**Devel/Ops**
Direct Impacts																				
Habitat loss	1	2	1	2	1	2	0	0	1	2	2	3	1	2	1	1	2	2	1	2
Vehicle collision / crushing	1	2	2	3	1	1	0	0	1	1	1	2	3	3	3	3	0	0	0	1
Greater public access (increased poaching, fire, and legal hunting)	1	3	1	2	1	2	1	1	0	0	1	2	0	1	0	1	0	1	2	3
Indirect Impacts																				
Disturbance and displacement from CBM-associated human presence and activities.	3	3	3	3	3	3	2	2	2	2	1	1	2	2	1	1	0	1	1	2
Noise disturbance/displacement/stress	2	2	3	3	1	1	1	1	3	3	0	0	1	1	1	1	1	1	1	2
Above-ground power lines	0	0	0	3	0	3	0	2	0	2	1	2	0	1	0	0	0	0	0	0
Noxious weed habitat degradation	0	2	0	2	0	2	0	0	0	2	0	1	1	2	0	1	0	0	0	1
Presence of new CBM and user-created roads	0	3	0	3	0	2	0	1	0	2	0	2	0	2	0	2	0	0	1	2
Habitat fragmentation	0	1	0	2	0	1	0	0	0	1	0	1	0	1	0	1	0	0	1	2
Sediment runoff from roads and excess CBM water/water quality degradation	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	2	0	0
Altered surface hydrology (springs and small stream flows reduced)	0	1	0	2	0	0	0	1	0	1	0	0	0	1	0	2	0	1	0	1
Increased livestock use of range due to CBM water sources	0	2	0	3	0	2	0	2	0	3	0	0	0	2	0	2	0	0	0	1

Notes:

Vulnerability of wildlife to categories of impacts are based on the nature of impact, species involved, and relative number of wells.

0 = little or no vulnerability

1 = low vulnerability

2 = moderate vulnerability

3 = high vulnerability

[1] Relative vulnerability assumes collection of site-specific data needed to follow stipulations during exploration and development on BLM lands, and strict adherence to stipulations.

[2] Vulnerability would be slightly lower for certain habitat components on BLM lands during exploration, than on non-BLM lands.

owl and short-eared owl, may be affected by energy development. There is little research identifying impacts of energy development to these sagebrush/grassland migratory species. However, there is research documenting negative impacts of noise to many species. Most species are vulnerable to activities that reduce or fragment sagebrush/grassland habitats.

Direct impacts include destruction of nests during construction of roads, pipelines, power lines (buried and overhead), well pads and retention ponds; and displacement of birds from the construction area. Increased mortality of migratory birds would be likely from increased road traffic associated with operation and maintenance of these facilities.

Indirect impacts would include physical disturbances and physiological stresses on migratory birds from increased human activity in the area, as well as increased habitat fragmentation leading to reduced nesting for species that require large habitat areas.

CBNG activities that reduce or fragment sagebrush/grassland habitat would impact nesting migratory birds in the project area. Although average territory size for grasshopper sparrows, for example, is small (less than 2 hectares), they are area-sensitive and prefer large grassland areas over small areas (Dechant et al. 1998).

When construction is completed and human presence has decreased, some displaced migratory birds would return to suitable habitats.

Male neotropical migrant birds that breed in short grass prairie, sagebrush and riparian communities use songs to establish and defend breeding territories and attract females. Noise interferes with this ability, with the level of interference related to the volume and frequency of the noise (Luckenbach 1975, Luckenbach 1978, Memphis State University 1971, Weinstein 1978). Other noise-related problems for birds around CBNG exploration and production wells and compressors include interference with the ability to recognize warning calls and calls by juveniles, both of which can result in higher predation rates. The area of disturbance would vary by species and CBNG activity. Producing wells would be relatively quiet once production is underway. Compressors would be limited to 50 decibels at a distance of 1/4 mile.

Stipulations prohibit surface occupancy in riparian areas and on floodplains of major rivers. However, they do not prohibit crossing of streams or construction of roads through riparian areas. Roads constructed through riparian areas and other forest and shrub stands for CBNG development and operation create edge effects and alter the physical environment (Trombulak and Frissell 2000). Roads create drier conditions in the vicinity of the road, thereby altering habitat for many species. In grassland and shrubland habitats, trails and roads create edge habitat for predators and reduce patch size of remaining habitat for area-sensitive species (USDI and USDA 2001, Ingelfinger 2001). Swihart and Slade (1984) found prairie voles (*Microtus ochrogaster*), which occur in the Planning Area, were reluctant to cross tire tracks running through an open field. Reluctance to cross narrow gravel roads has also been observed in white-footed mice (*Peromyscus leucopus*), which also occur in the Planning Area and many other rodent species (Mader 1984, Merriam et al. 1989, Oxley et al. 1974). Consequently, roads can function as barriers to population dispersal and movement for small mammals that occur in the Planning Area.

Many amphibians annual life cycles require migration between habitats with different ecological properties. These species' populations depend on dispersal connections and landscape links (Gibbs 1998). Simple linear structures such as roads of all types can act as physical and psychological barriers for amphibian movement (Mader 1984, Gibbs 1998). Furthermore, motorized off-highway travel may disrupt reptile and amphibian habitat to the point where it becomes unusable (Busack and Bury 1974). Pronghorns and mountain lions have also demonstrated reluctance to crossing roads (Bruns 1977, Van Dyke et al. 1986).

Noxious weeds and exotic plants rapidly colonize disturbed sites, prevent native species from being re-established following ground disturbance, spread into undisturbed areas reducing habitat value on additional lands and provide very poor quality wildlife habitat or forage. Mitigation measures discussed under vegetation are intended to avoid, reduce and control new infestations of noxious weeds through a variety of actions. Consistent and successful application of these mitigation measures would reduce potential habitat degradation. However, use of chemicals to control noxious weeds usually also kills non-target beneficial native plants, contributing to habitat loss.

Roads are sources of fine sediment that can enter wetlands and intermittent and perennial drainages, especially following thunderstorms. Effects include increased turbidity (Reid and Dunne 1984), smothering wetland vegetation and degradation of habitat for amphibians and other aquatic life (Newcombe and Jensen 1996).

There are no apparent differences between indirect impacts on wildlife on BLM-administered and state lands. Impacts on private lands may be more substantial because stipulations and mitigation measures are not mandated on private lands.

Species of Concern

Species of concern include federally listed T&E and candidate species; Montana species of concern; BLM species of concern, and MNHP species of concern. For the State of Montana species of concern, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. Chapter 3 of the EIS describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there are 9 federally listed threatened, endangered and proposed species; and 3 federal candidate species. In accordance with the ESA, listed wildlife must be protected from possible impact by oil and gas and CBNG development on all lands. ESA protected plants are not protected on private lands. Additionally, there are many species classified as "species of special concern" by the Montana BLM and Montana Natural Heritage program (MNHP). By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status. These include 68 plant, 16 mammal, 9 herptile and 22 bird species and are listed by the state and BLM. This section will address federally listed wildlife species protected under the ESA. General recommendations for other species of concern wildlife species can be found within the general Wildlife impact sections. Federally listed species are discussed individually because of the need for species-specific mitigation measures to avoid extensive impacts. Conclusions are summarized after all of the species are discussed.

For sensitive species, displacement from important habitat features is often effectively equal to loss of habitat for the individuals that occupied that habitat. Wildlife cannot generally just move to unoccupied habitat in response to disturbance and survive there, as other suitable habitat is occupied by other individuals of the same species or by similar species using the available resources.

Federally Listed Species

Mountain Plover

Mountain plover are most susceptible to disturbance during the nesting season, which occurs between mid-April and early July. Construction activity and operations and maintenance could disturb the nesting/courting birds during this period. Noise and the presence of humans and equipment would be the main causes of disturbance. The absence of stipulations to protect mountain plover nesting areas (prairie dog towns smaller than 80 acres) would result in impacts on this species if exploration or development occurs in or near occupied nesting habitat. Prairie dog towns often are located on flat, topographically low areas.

Interior Least Tern

As with mountain plover, this species is susceptible to disturbance during the nesting period.

Gray Wolf

Roads and the presence of humans would increase the threat from shooting, either on purpose or accidental (when mistaken for a coyote). The potential density of roads in occupied wolf areas could force wolves from occupied areas and could increase stress on wolves and result in the loss of some individuals.

Canada Lynx

Canada lynx would be expected mainly in western and south-central Montana, where high-elevation, dense, old-growth forests are most likely to be found. Although possible, exploration and development of CBNG are not expected to occur in these habitats. Therefore, there would be no impacts to Canada lynx.

Black-Footed Ferret

Black-footed ferrets are exclusively found associated with their main prey species: prairie dogs. Prairie dogs are found throughout the project area. Any activity affecting prairie dog colonies has the potential to impact the ferret. Prairie dog colonies are frequently located on level to slightly sloping ground. Two BLM leasing stipulations address black-footed ferret concerns. The first states that exploration in prairie dog colonies within potential black-footed ferret reintroduction areas comply with the Draft Guidelines for Oil and Gas Activities in Prairie Dog Ecosystems Managed for Black-footed Ferret Recovery (FWS 1988, BLM 1992). If these guidelines are accepted, they specify that conditions of approval depend on the type and duration of the proposed activity, proximity to occupied ferret habitat and other site-specific conditions. Exceptions or waivers of this stipulation may be granted if the Montana Black-Footed Ferret Coordination Committee determines that the proposed activity would have no disagreeable impacts on ferret reintroduction or recovery. The status of the Fort Belknap population allows them to be treated as a proposed species, which may require a conference with FWS if impacts are expected in the vicinity of the reservation.

The second stipulation requires that all prairie dog colonies or complexes greater than 80 acres in size be surveyed for black-footed ferret absence or presence prior to ground disturbance. Prairie dog complexes may consist of several smaller colonies located near one another. The results of the survey determine if restrictions or denial of use are appropriate for the site. Permits issued by MBOGC do not have the same stated requirements for protection of prairie dog towns of certain sizes; however, the ESAs protection of listed wildlife does apply to state and private land. Operators are prohibited from causing harm to the ferret. As appropriate, state leases would include a survey stipulation or contact MFWP stipulation for species of concern.

Implementation of stipulations in potential and occupied habitat would avoid impacts to the ferret on BLM-administered surface.

Grizzly Bear

Threats to grizzly bears mainly result from human-bear interactions, which occasionally end in the death of the grizzly bear. If exploration moves into sparsely settled areas or previously roadless areas within grizzly bear range, the possibility of bear-human interaction increases.

Federal Candidate Species

One candidate species may potentially be found in the project area: the black-tailed prairie dog. Although not subject to the substantive or procedural provisions of the ESA, FWS encourages no action be taken that could impact candidate species and contribute to the need to list the species. The state also has a policy that the state should take no action that could contribute to these species being listed. The USFWS issued a “not warranted” finding for black-tailed prairie dogs in 2004.

Black-Tailed Prairie Dog

As discussed under black-footed ferret above, BLM has stipulations governing activities that could impact black-tailed prairie dog towns larger than 80 acres if ferrets are found to be present. However, these protections do not apply if the ferret is not present. The MFWP through a working group composed of state, federal and private individuals is developing a Prairie Dog Conservation Plan to address how to avoid continuing impacts, which are resulting in population declines. There are no special protective measures being implemented by the state or BLM at this time, although an evaluation including associated impacts to other listed species, in order to identify measures to avoid impacts is required. Construction of CBNG exploration and production wells on all land ownerships is expected to impact black-tailed prairie dog towns.

BLM, USFS and Montana Species of Concern

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBNG wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed and the nature and period of disturbance. Leasing stipulations as discussed above and in the *Wildlife* section would offset or offer some protection to federally listed species. However, there are no stipulations for most species of concern.

Alternative A presents a discussion of impacts to all wildlife species, of which species of concern are a subset. That discussion is not repeated here and the reader should refer to the *Wildlife* section for an understanding of impacts to wildlife species of concern. Some of these species are particularly vulnerable because of their scarcity or narrow habitat niche.

Guidelines recently developed by Connelly et al. (2000) to manage sage-grouse populations and their habitat indicate that the stipulations stated above that are intended to avoid impacts on sage-grouse leks and nesting areas during exploration are not adequate to do so. Sage-grouse are extremely sensitive to human disturbance and habitat alteration and breeding populations have declined dramatically throughout much of their range (Connelly and Braun 1997) including south-central and southeastern Montana (Eustace 2001). MFWP has been monitoring certain sage-grouse leks in south-central Montana since the early 1980s. There has been an approximate 50 percent reduction in the number of these active leks since the monitoring began. Eustace attributes this decline to habitat loss and human disturbance and stated that he believes similar declines have occurred in other portions of Montana. Connelly et al. (2000) indicate energy-related facilities should be located at least two miles from sage-grouse leks. Connelly et al. further note sage-grouse populations display four types of migratory patterns: 1) distinct winter, breeding and summer areas; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated breeding and summer areas; and 4) non-migratory populations. Furthermore, recent studies in eastern Idaho have found that sage-grouse wintering areas may vary considerably from year to year depending on snow accumulation (Kemner and Lowe 2002).

Avoiding impacts on sage-grouse requires protecting the integrity of all seasonal ranges. Average distances between leks and nests vary from 0.7 to 3.9 miles (Autenreith 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000) and movements between seasonal ranges may exceed 45 miles (Dalke et al. 1963, Connelly et al. 1988). Furthermore, sage-grouse have high fidelity to all seasonal ranges (Keister and Willis 1986, Fischer et al. 1993). Females return to the same area to nest each year (Fischer et al. 1993) and may nest within 660 feet of their previous year's nest (Gates 1983). However, other studies by Lyon 2000, Fischer et al. 1993 and Berry and Eng 1985 found average distances of 683 meters (2,240 feet), 740 meters (2,427 feet) and 552 meters (1,811 feet), respectively. Therefore, while important, protecting a 1/4-mile (1,320 feet) radius area around leks as specified in the stipulations, may be inadequate to avoid impacts on displaying and nesting birds. Furthermore, this stipulation does not provide sufficient protection of the breeding area or any wintering areas. This stipulation is not adequate to avoid all the impacts on sage-grouse from CBNG activities. Sage-grouse would be impacted by CBNG activities that occur within two miles of sage-grouse leks or within winter range.

Elevated noise levels might interfere with the ability of female sage-grouse to hear the booming of cock sage-grouse on the lek (USFWS 2005b). This might result in reduced lek attendance and reproductive success near CBNG locations, particularly where compressors that produce relatively loud noise levels are present. Researchers at University of California, Davis, are currently conducting a study on the effects of noise from CBNG development on sage-grouse in Wyoming (personal communication, G. Patricelli, 2005). Once complete, this study should provide additional information on the effects of noise on these birds.

Montana's Comprehensive Fish and Wildlife Conservation Strategy identifies the need to quantify impacts of energy development and determine ways to reduce, eliminate, or mitigate negative effects (MFWP, 2005d). Recent and ongoing research has focused on these issues.

In a recent research study conducted by Holloran and Anderson from the University of Wyoming, findings suggest natural gas development causes displacement of male sage-grouse from lek sites, ultimately contributing to localized sage-grouse extirpations, with negative, but less severe, influences on regional population levels (Holloran and Anderson 2004, Holloran 2005). Three levels of natural gas well development were evaluated in the study. Leks with fewer than 5 wells within the 5-km (3.2 miles) radius buffer were considered lightly impacted (control leks); leks with 5 to 15 wells within 5 km were moderately impacted; and leks with more than 15 wells within 5 km were heavily impacted. On heavily impacted leks, the maximum number of males declined by 51 percent from the year before impact. Furthermore, the maximum number of males on three heavily impacted leks situated centrally within the developing field declined 89 percent and two of the three leks were essentially inactive in 2004.

At a regional level, the number of strutting males counted on leks declined annually by an average of 13 percent (Holloran 2005). The study also indicated that female sage-grouse avoided nesting near the infrastructure of natural gas fields and natural gas related impacts negatively influenced female population growth. While this study was conducted in a conventional natural gas development field and not in CBNG areas, the types of impacts are expected to be similar.

Habitat fragmentation negatively impacts population persistence, both short and long term, with more fragmentation increasing habitat isolation and possibly changing population response to habitat modification (Patten et al. 2005). Fuhlendorf and others (2002) noted that large-scale patterns of land use and fragmentation have been associated with the decline of many imperiled wildlife populations. Their study of scale-dependent relationships between landscape structure and change, as well as long-term population trends for lesser prairie-chicken populations in the southern Great Plains, indicated that modifications in landscape structure over the past several decades resulted in stronger relationships with lesser prairie-chicken population dynamics than current landscape structure. Wisdom and others (2002) indicated the sage-grouse has been extirpated from five states and one province. Breeding populations have declined an average of 35 percent since 1985, due to a variety of detrimental land uses. These studies suggest that local populations have to be viewed at a landscape-level. Future conservation efforts should address effects of fragmentation on natural populations, including dispersal, colonization and extinction patterns (Fuhlendorf et al. 2002, Patten et al. 2005, Wisdom et al. 2002).

Beginning in 2003, Montana and Wyoming BLM have worked cooperatively with the University of Montana and other partners to determine the potential impacts of CBNG development in the Powder River Basin. The research being conducted has evolved into three phases that are expected to answer management questions about development impacts on sage-grouse and effectiveness of BLM mitigation measures. Final reports are scheduled to be completed during January 2007 and January 2008.

In 2006, Dr. David E. Naugle, associated with the University of Montana and his researchers used satellite imagery on a landscape level to identify priority habitats for sage-grouse in the PRB. This information identified areas of high value sage-grouse habitats. This mapping used several components, including roughness, sagebrush coverage (height/abundance) and distance from conifers. In general, Dr. Naugle determined suitable long-term sage-grouse habitat must contain a minimum of 1,000 contiguous acres of sagebrush and must be at least 400 meters from visible conifers. Dr. Naugle's findings showed that sage-grouse avoided disturbance associated with CBNG development. Males on leks within areas of heavy CBNG development declined dramatically, while leks on the edge of development had increased numbers of males (Naugle, et al 2007). This increase is interpreted as an indication that those males previously using leks within areas of development were displaced to leks on the edge of disturbance. Leks outside of areas of disturbance followed the regional trend.

While the aforementioned studies provided compelling evidence of impacts, long-term studies in the Pinedale Anticline Project Area gave the most complete picture of cumulative impacts of energy development to sage-grouse populations. Lyon and Anderson (2003) showed that early in the development process, nest sites were farther from disturbed leks than from undisturbed leks, that nest initiation rate for females from disturbed leks was 24% lower than for birds breeding on undisturbed leks, and that 26% fewer females from disturbed leks initiated nests in consecutive years. As development of the Pinedale Anticline progressed, Holloran (2005) reported that adult female sage-grouse remained in traditional nesting areas regardless of increasing levels of development, but yearling females that had not yet imprinted on habitats inside the gas field avoided development by nesting farther from main haul roads. Kaiser (2006) and Holloran et al. (2007) later confirmed that yearling females avoided infrastructure when selecting nest sites and that yearling males that avoided leks inside of development were displaced to those nearer the periphery of the gas field. Recruitment of males to leks also declined as distance within the external limit of development increased, indicating the likelihood of lek loss near the center of development.

Perhaps the most important finding from studies in the Pinedale Anticline was that sage-grouse declines are at least partially explained by lower survival of female sage-grouse, and that impacts to survival resulted in a true population-level decline (Holloran 2005). The population-level decline observed in sage-grouse (Holloran 2005) is similar to that observed in Kansas in the Lesser Prairie-chicken (Tympanuchus pallidicinctus) (Hagan 2003), a federally threatened species that also avoided otherwise suitable sand-sagebrush (Artemisia filifolia) habitats proximal to oil and gas development (Pitman et al. 2005, Johnson et al. 2006). High site fidelity but low survival of adult sage-grouse combined with lek avoidance by younger birds (Kaiser 2006, Holloran et al. 2007) resulted in a time lag of 3-4 years between the onset of development activities and lek loss (Holloran 2005). The time lag observed by Holloran (2005) in the Pindeale Anticline matched that for leks that became inactive 3-4 years following intensive coal bed natural gas development in the Powder River Basin (Walker et al. 2007).

Overhead power lines pose several problems for sage-grouse. Sage-grouse occasionally collide with power lines, especially during periods of relatively poor visibility, such as flying to and from the leks. Overhead power lines provide hunting perches for raptors. Predation rates on sage-grouse increase dramatically when these lines are located in the vicinity of sage-grouse leks and wintering areas, resulting in population declines (Connelly et al. 2000, Milodrgovich 2001, Braun et al. no date listed).

As discussed in the *Hydrological Resources* section, surface water bodies would not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event that there is a very localized connection between a spring-fed stream and groundwater withdrawals, effects on wildlife and habitat would include drying of springs and reduced flow and duration in intermittent and small perennial drainages. Sage-grouse could be severely impacted, as broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage-grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

Bald Eagle

Bald eagles are sensitive to human presence. Based on the assumptions listed in the introduction to the *Wildlife* section, protection of nests and nesting habitat should prevent eagles from abandoning traditional nesting sites in the project area, but periodic or complete abandonment of non-nesting habitat may occur depending on the level of human use and noise. Above-ground transmission facilities could result in the death of some bald eagles because of electrocution.

However, the risk of electrocution on federal and state lands is small because the BLM and State require power lines and poles be constructed to standards that would avoid raptor electrocution (Table MIN-5). Power lines also pose strike hazards for bald eagles, especially near perennial rivers and water bodies that support fish and waterfowl. Removal of large trees in wintering areas, particularly at established roost sites, would also displace bald eagles by removing perch and roost sites.

Crow Reservation

Off reservation CBNG development would not indirectly impact wildlife on the Crow Reservation.

Northern Cheyenne Reservation

There would be fewer impacts to wildlife on the reservation resulting from off-reservation CBNG development, as the buffer between development and the reservation should mitigate most impacts..

Mitigation

Agency-applied mitigation measures for BLM and state lands related to natural resources are presented in Chapter 2 and Table MIN-5 of the Minerals Appendix. Agency-applied measures would be implemented as needed and enforced during all CBNG phases. Agency-applied mitigation measures are intended to compensate after-the-fact for some impacts not avoided through standard lease stipulations. Residual impacts are those that remain after implementation of mitigation measures.

BLM would include and enforce agency applied mitigation (described in Chapter 2 and the Minerals Appendix) through application of standard lease stipulations during the site-specific plan approval stage. Measures to further avoid or reduce impacts in addition to those included at the plan approval stage may be recommended. The state would apply additional mitigation measures on a case-by-case basis through the use of field rules.

Species of Concern Mitigation Measures

Bald Eagle

Before construction begins, a wildlife biologist would survey the construction zone in a 0.5-mile radius for bald eagles and bald eagle nests and identify any locations found. The use of no surface occupancy within 0.5 miles of known nests would reduce but not eliminate potential impacts to nesting, foraging and roosting bald eagles.

Mountain Plover

Surveys would be made within suitable mountain plover habitat within the roadway corridor and pad sites prior to exploration. FWS survey protocol for mountain plover would be followed. See the Wildlife Appendix Biological Assessment for Mountain Plover Survey Guidelines. This includes surveying from May 1 through June 15 for presence or absence on potential sites. Exploration and Construction would be avoided in these areas during this time period to assure that potential nesting mountain plovers are not prevented from setting up territories as a result of the presence of equipment and humans.

Interior Least Tern

The likelihood of encountering least terns within the SEIS area is remote. Should nest tern locations be identified, exploratory drilling and construction sites would be identified and appropriate surveys would be conducted for this species. Surface occupancy and use is prohibited within 1/4 mile of wetlands used by nesting interior least terns during exploration. This stipulation would minimize impacts to interior least tern. Occupied wetlands and water levels would be protected in all phases of drilling and construction and no discharge of produced water into occupied wetlands would be permitted.

Gray Wolf

Prior to construction in potential gray wolf habitat, surveys would include specific searches for this animal, occupied dens, or scat. The corridor would be surveyed in the spring, prior to construction, by a wildlife biologist for scat. If scat is found, the site would be surrounded by a buffer zone recommended through consultation with an FWS biologist. If wolves or other wolf indicators are found, FWS would be consulted and proper protocols followed.

Canada Lynx

Any construction areas or drilling pads located in high elevation, old growth forested areas considered potential Canada Lynx habitat, would be surveyed prior to construction for scat and individuals following established protocols. If found, the site would be avoided and surrounded by a buffer zone recommended by FWS biologists.

Black-Footed Ferret

Implementation of stipulations on occupied habitat would avoid impacts to the ferret on BLM-administered surface.

Grizzly Bear

Garbage and other human refuse would be removed from drilling and construction sites on a daily basis in potential bear habitat to avoid attracting bears. Surveys for scat and other sign of grizzly bears in remote, sparsely roaded areas would be conducted prior to construction. If found, protocol would be established after consultation with FWS biologists.

Black-Tailed Prairie Dog

Development of mitigation measures for the prairie dog depends upon the recommendations developed in the *Conservation Plan for Black-Tailed and White-Tailed Prairie Dogs in Montana (January 2002)*. This plan would address how to avoid continuing impacts.

Conclusions

If a state or private CBNG project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the Federal agency.

Stipulations would avoid some impacts for some species. However, these stipulations would not be 100 percent effective for all species because of limits on available biological information, some stipulations do not apply to operations and the stipulations are not meant to eliminate all negative impacts. The potential for impacts is relatively low under Alternative A compared to the other alternatives because of the limited number of CBNG wells. Mitigation measures (Table MIN-5, Minerals Appendix) generally focus on vegetation reclamation and related efforts to reduce erosion and water pollution. Measures intended to reduce surface disturbance in sensitive habitats are to be implemented “to the extent practicable.” Therefore, it is likely some sensitive habitats and species could be directly impacted by CBNG development under Alternative A. The intent of reclamation, as identified in Miles City Field Office (MCFO) policy is to re-establish a vegetative cover on disturbed areas rather than to restore native plant communities as they existed prior to disturbance. Plant species diversity would be lower on reclaimed sites than before disturbance, reducing overall wildlife habitat values. Existing mitigation measures would not effectively compensate for impacts on wildlife.

Some wildlife species and habitat may be disturbed or lost during construction. Individual animals may be lost through collisions with vehicles and indirect impacts as described previously for general wildlife. Indirect impacts also could result in displacement or abandonment of habitat or to increased legal and illegal hunting pressure. Species of concern on all lands do not have the same level of protection as ESA-protected species. Therefore, some direct and indirect impacts on individuals or even populations within metapopulations would be expected. This alternative would have the least impact on all species because of the limited number of wells and (500 long-term acres) associated disturbances.

If habitat degradation is minimized, mitigation measures applied and appropriate surveys conducted prior to construction, ensuring these species are not found within the project area and, if found, are buffered by suitable no construction zones and work restrictions, wildlife species would be affected but the impacts should be mitigatable.

There could be some displacement of bald eagles in non-nesting habitat. Black-tailed prairie dogs would be impacted by this alternative on or adjacent to prairie dog towns where CBNG development occurs.

Species not federally protected may be impacted by habitat changes caused by vegetation removal, changes in vegetation species composition, increased access because of more roads, increased noise levels and conflicts with CBNG infrastructure and increased human pressure. Changes in stream or spring hydrology and increased SAR and salinity values in water and soil could also have adverse impacts.

Cumulative Impacts

The cumulative impacts on wildlife resulting from the effects of Alternative A include the direct loss of wildlife habitat, habitat fragmentation and wildlife mortality from collisions. Noise and human presence would disturb wildlife species over large areas near developed well fields, causing local population declines for some species. This would be particularly problematic for sensitive species such as raptors, sage-grouse and other birds dependent on sagebrush habitats.

Impacts from Wyoming CBNG development on wildlife and wildlife habitat would be similar to those described under Alternative A, but at a far larger scale. More than 2.5 times as many CBNG wells may be developed in the Powder River basin of Wyoming than the 18,300 considered under Alternatives B, C, D and E in Montana. The magnitude of direct and indirect Wyoming CBNG impacts on wildlife and wildlife habitat would be about 2.5 times greater than described for Alternatives B, C and D (described in the following sections). CBNG development in Wyoming would cumulatively impact many species in Montana.

The increase in water volume at certain times has the potential to cover sandbars and other open areas. There would be potential cumulative impacts for bald eagles and interior least tern present in this river habitat, as flow fluctuations and alterations in SAR values could affect the food chain these species rely on and because it may affect their nesting habitat.

Cumulative impacts of other activities, including the Tongue River Railroad, conventional oil and gas, active coal mines and fires are expected to result in the long term loss of an additional 41,070 acres. Types of indirect impacts on wildlife would be similar to those described above and would affect an area much larger than 37,000 acres. Some impacts on sensitive and protected species would be expected from development on this scale.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Generally, the same types of impacts on wildlife described for Alternative A would occur under Alternative B. However, Alternative B includes development or the drilling of 18,300 CBNG wells. This is about 20 times as many wells; miles of roads, pipelines and utility corridors and facilities and 20 times more human activity than for Alternative A. It is important to recognize the development would take place over a 20-year period and the initiation of well development (20 times) would not occur all at once. However, production at any given well is expected to continue for 20 years so there would be substantial overlap between wells developed early and those developed later in the 40-year time frame between development of the first wells and closure of the last ones. Because of this level of CBNG development, Alternative B would have widespread ecosystem-level types of impacts on wildlife and wildlife habitat as discussed at length for Alternative A.

Virtually every wildlife species that occurs within CBNG development areas would be impacted to some degree, with sensitive species suffering the greatest impacts because of their already precarious status. For example, wintering and nesting sage-grouse and nesting golden eagles would be expected to suffer large-scale impacts. It is likely that, at this scale of development, some species would become locally rare or vacate large areas. All of the wildlife groups listed in Table 4-68 would have a high probability of being impacted throughout the CBNG development area under Alternative B because of the scale of the development.

Table 4-66 in the Vegetation section notes the number of acres of direct impact (habitat loss) and the number of miles of roads, pipelines and utility corridors that would result from CBNG development under Alternatives B, C, D and E. Development under Alternative B would result in the direct short term loss of about 55,400 acres of wildlife habitat to well pads, roads (6,680 miles) and pipeline and utility corridors (20,679 miles). Long term impacts would persist on about 33,000 acres after reclamation of exploration disturbance. However, as noted for Alternative A, plant species diversity would be lower on reclaimed lands than before disturbance, resulting in reduced habitat value for many species and habitat fragmentation for some species. Additional vegetation would be disturbed by multiple exploration vehicles moving across the landscape searching for suitable locations to drill exploratory wells. Direct and indirect impacts on wildlife from this scale of development would be widespread.

The discussion of impacts for Alternative A indicated mule deer, elk, sage-grouse, raptors and other species are particularly sensitive to human disturbance associated with CBNG development and related roads. Not all wildlife species are as sensitive to roads and disturbance as these species. However, those that are the most sensitive often include species that are declining in numbers and distribution because of this sensitivity, such as sage-grouse and raptors, including ferruginous hawks (*Buteo regalis*). With respect to sage-grouse, recent research by Doherty, et. al. (2007) outlines the sensitivity of this species to CBNG development. CBNG development in Wyoming has displaced sage-grouse from crucial habitat and their population continues to decline as CBNG activity expands into previously undeveloped areas. These impacts are also likely to occur in the Montana portion of the PRB, even when timing limitations and avoidance areas are applied as BMPs. Table 4-69 provides estimates of the area of habitat within which species sensitive to disturbance and roads may be affected both within and around the perimeter of CBNG well fields. The table presents data on the size of areas which potentially are affected at both 1/2-mile and 2-mile perimeters around well fields (Fyfe and Olendorff 1976, Lyon 1983, Connelly et al. 2000).

Table 4-69 assumes well field development would include 8, 16, or 24 wells per square mile and that each well field would include 200 wells. CBNG well development is projected to occur over a 20-year period with an average well life of 20 years. Therefore, the information presented in Table 4-69 represents the maximum area of disturbance for sensitive wildlife species in year 20 when all wells would be developed and none closed. Approximately 44 percent of the wells and associated disturbance would be in place in year 5, 72 percent in year 10 and 87 percent in year 15. By year 20, indirect impacts of CBNG development would affect sensitive species of wildlife on between 880,000 and 4.7 million acres. Sagebrush obligate song birds, which are suffering range-wide population declines, are also sensitive to disturbance and habitat fragmentation. They avoid pipeline and road corridors even when the roads are unpaved and receive little use (Ingelfinger 2001). His research in Wyoming natural gas fields found that the density of sagebrush obligates including Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*) and sage thrasher (*Oreoscoptes montanus*) were

TABLE 4-69

AREA OF DIRECT IMPACTS AND INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT[1] WITHIN AND AROUND CBNG WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES FOR ALTERNATIVES B THROUGH G AND H

(ASSUMES 200 WELLS PER WELL FIELD, 8, 16, OR 24 WELLS PER SQUARE MILE[2])

		Indirectly Affected Area Within 1/2 Mile		Indirectly Affected Area Within 2 Miles	
		Additional Area Affected Around Perimeter of Each Well Field	Total Affected Area Within Well Fields and Within 1/2 Mile of Well Field Perimeters[3]	Additional Area Affected Around Perimeter of Each Well Field	Total Affected Area Within Well Fields and Within 2 Miles of Well Field Perimeters[3]
Number of Wells Per Square Mile	Acres Per Well Field	Acres	Acres	Acres	Acres
Alternatives B Through F and H[4]--18,300 Wells and 91.5 Well Fields					
8	16,000	7,040	2,108,160	35,840	4,743,360
16	8,000	5,120	1,200,480	28,160	3,308,640
24	5,312	4,352	884,256	25,152	2,787,456
Cumulative Impact of CBNG Development Only for Alternatives B Through F and H--26,500 Wells and 132.5 Well Fields					
8	16,000	7,040	3,052,800	35,840	6,868,800
16	8,000	5,120	1,738,400	28,160	4,791,200
24	5,312	4,352	1,280,480	25,152	4,036,480
Alternative G--6,470 Wells and 32.4 Well Fields					
8	16,000	7,040	746,496	35,840	1,679,616
16	8,000	5,120	425,088	28,160	1,171,584
24	5,312	4,352	313,114	25,152	987,034
Cumulative Impact of CBNG Development Only for Alternative G--14,670 Wells and 73.4 Well Fields					
8	16,000	7,040	1,691,136	35,840	3,805,056
16	8,000	5,120	963,008	28,160	2,654,144
24	5,312	4,352	709,338	25,152	2,236,058

[1]See text for discussion of individual and population level consequences of displacement.

[2]A larger average number of wells per field would reduce the affected area. For example, fields averaging 1,000 wells per field and 8 wells per square mile would impact 1,738,061 acres instead of 2,108,160 acres.

[3]Affected area around well fields assumes there is no overlap between affected areas of adjacent well fields. Overlap would reduce affected perimeter area.

[4]Although Alternatives F and H include 75 fewer predicted wells than Alternatives B through E, the total area of indirect disturbance is only slightly less. Consequently, Alternatives F and H are considered to have the same amount of indirect disturbance as Alternatives B through E.

reduced by 50 percent within 100 meters of lightly traveled unpaved roads compared to densities in undisturbed sagebrush communities. Sage sparrow density along a natural gas pipeline route with no traffic was 64 percent lower within 100 meters of the route compared to densities in nearby undisturbed sagebrush. Ingelfinger (2001) attributed these declines to noise (along the roads), habitat fragmentation, edge avoidance and possibly inter-specific competition with horned larks, a species that forages along roads. At full development there would be 6,680 miles of new roads. Assuming no overlap, 100 meters on each side of these roads would include over 530,000 acres and additional effective habitat loss would occur along pipelines. These lands are included in the information presented in Table 4-69.

Some additional direct and indirect impacts not described for Alternative A would be expected to occur under Alternative B because of the much greater scale of CBNG development. Prairie dog colonies tend to be located on relatively flat ground and often in valleys. Prairie dog towns also support much higher densities of birds and mammals and greater avian species richness than adjacent prairie (Agnew et al. 1986). Various studies have reported 163 vertebrate species using black-tailed prairie dog colonies in Montana including several species of concern such as burrowing owl and mountain plover (Reading et al. 1989, Tyler 1968, Clark et al 1982, Agnew 1986). Prairie dog colonies larger than 80 acres are protected from surface occupancy only if black-footed ferrets are found and this protection applies on BLM administered surface only.

Smaller colonies and larger colonies without ferrets would effectively receive no special protection on any lands. Considering the ferrets extreme rarity, it is unlikely that any prairie dog towns would be protected from impacts from CBNG development. However, due to the anticipated release of black-footed ferrets onto the Northern Cheyenne Reservation in 2008, the level of protection could increase. Road, well pad, pipeline and utility line placement across prairie dog towns would result in direct mortality and impact large numbers of species through habitat loss and displacement to unsuitable habitat, which would result in the loss of displaced individuals.

As discussed in the Hydrological Resources section, surface water bodies would not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event there is a localized connection between a spring-fed stream and groundwater withdrawals, effects on wildlife and habitat would include reducing or even drying of springs and reduced flow and duration in intermittent and small perennial drainages. Reduced surface water would result in more xeric vegetation and would impact all types of wildlife, but would be especially important for amphibians and certain bird species that depend on mesic plant communities. Sage-grouse could suffer substantial impacts because broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage-grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

There would be no differences between the direct and indirect impacts on BLM and state lands. Impacts on private lands could be much more substantial because stipulations and mitigation measures would not apply.

Federally Listed Species

Direct impacts to federally protected species are prohibited by law and would be the same as under Alternative A.

The potential for indirect impact would be greater under this alternative because of the much larger amount of habitat that would be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads and utility lines. Increased roadways for more wells would result in greater human access, with the potential for more illegal harvest, indirect disturbance, or harassing of protected species. As many as 4.7 million acres of habitat for species sensitive to human disturbance may be indirectly affected by CBNG development (Table 4-69). Since federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

The same agency-applied mitigation measures described for Alternative A would apply to Alternative B. The effect of these mitigation measures on impacts would also be the same as under Alternative A.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative B and be the result of developments in close proximity to reservation boundaries.

Within the boundaries of the reservation, regulations related to wildlife would be under the jurisdiction of tribal Laws and not state or federal laws. Full-scale development forecast under this alternative would increase the risk of impacts to wildlife on the reservation.

Wildlife vulnerability to impacts would be similar to that presented in Table 4-69. Indirect impacts of this level of CBNG development on the Crow reservations on species sensitive to human disturbance are shown in Table 4-69 under cumulative impacts.

Northern Cheyenne Reservation

There would be no direct impacts to wildlife on the Northern Cheyenne Reservation from off-reservation development. Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B and be the result of developments near reservation boundaries.

Conclusions

The same types of impacts described for wildlife and species of concern under Alternative A would be expected. However, the extent of impacts would be about 20 times greater in area and scope because of greater CBNG well development and associated direct and indirect impacts. Stipulations would avoid some impacts for certain species. However, they would not be 100 percent effective because some stipulations do not apply to operations and non-CBNG human activities that would be facilitated by new CBNG roads. The potential for impacts is high under Alternative B because of the large number of CBNG wells.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative A except that the impacts from Montana CBNG development would be substantially greater. Additionally if CBNG development were to occur on the Crow and Northern Cheyenne Reservations and in the Custer National Forest the development is expected to result in the direct short-term loss of an additional 25,000 acres and long term loss of about 14,750 acres. Degraded habitat value of reclaimed lands would be similar to that described for Alternative A. Other actions considered to be cumulative impacts would result in the long term loss of an additional 41,000 acres.

Table 4-69 estimates additional cumulative indirect impacts of more CBNG development on species sensitive to human activities and development. It is estimated cumulative indirect impacts of CBNG development in Montana could affect sensitive wildlife on between 1.28 and 6.87 million acres. Since sensitive and federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

Alternative C—Emphasize CBNG Development

The same types of impacts on wildlife described for Alternatives A and B would occur under Alternative C. However, Alternative C would have direct impacts on more acres of wildlife habitat than Alternative B because Alternative C includes fewer measures to reduce impacts. Table 4-66 in the *Vegetation* section notes the number of acres of direct impact (habitat loss) and the number of miles of roads and pipeline and utility corridors that would result from CBNG development under Alternative C. Development under Alternative C would result in the direct short term loss of about 70,000 acres of wildlife habitat to well pads, roads (9,018 miles versus 6,680 miles for Alternative B) and pipeline and utility corridors (27,917 miles versus 20,679 miles for Alternative B). More land would be directly impacted because roads would not be required to follow existing corridors and there would be no requirement to place pipelines and utilities in corridors. Long term habitat loss would affect about 47,600 acres and reclaimed areas would have reduced habitat value. Direct and indirect impacts on wildlife from this scale of development would be widespread.

Table 4-69 estimates the area on which sensitive species of wildlife would be disturbed by CBNG development under Alternative C. Indirect disturbance and effective habitat loss for sensitive species would be the same as under Alternative B and would indirectly affect sensitive wildlife on between 880,000 and 4.7 million acres. Effects of disturbance were described under Alternative A.

CBNG development produces excess surface water that has not been available in the past. It is unlikely that this water would go unused. Information in the *Water Resources Technical Report* (ALL 2001b) indicates that virtually all of the water produced during CBNG extraction would be suitable for livestock or wildlife use. Cattle typically move up to 0.6 mile from water to graze in steep terrain, but will move up to two miles in relatively flat areas (Stoddart et al. 1975). CBNG development areas that are greater than 0.6 to two miles from natural or currently developed perennial water sources, depending on terrain, are either not used or used lightly by livestock on a seasonal basis. Increased stock water availability from CBNG-produced water would permit private land owners and state and BLM grazing permittees to adjust the distribution and management of their herds to use more of the forage within 0.6 to two miles of CBNG wells. Each CBNG production well field that is located in an area without current perennial water sources could make up to several thousand acres available to more intensive cattle grazing. Utilization would be most intensive in the immediate vicinity of the water discharge location wells. Increased livestock grazing reduces forage otherwise available for wildlife and degrades habitat value for many species of wildlife (Saab et al. 1995). The additional CBNG water would also be available for wildlife use.

The release of untreated CBNG water to surface drainages and streams could result in serious erosion, damaging or destroying instream and stream bank riparian vegetation that constitutes valuable wildlife habitat (Regele and Stark 2000). The erosion can result in increased sediment loads, which along with the potential high salinity and sodicity, can degrade the stream and impact riparian vegetation. Impacts of discharging sodic CBNG waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian habitat and sensitive wildlife species such as amphibians. This is also the time when this vegetation is naturally stressed because of low water and amphibians are confined to remaining water or are burrowed into shallow mud. The potential for impacts on riparian habitat and amphibians exists along drainages and streams throughout the CBNG development area.

Because of the typically low flows of the CBNG wells (approximately 5 to 10 gallons per minute), it is likely that these impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells, which may occur. There are no apparent differences between the direct and indirect impacts on BLM-administered and state lands. Impacts on private lands would be much more substantial because stipulations and mitigation measures would not apply.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternatives A and B.

The potential for indirect impacts or modification to habitat would be greater under this alternative than for Alternative B (Table 4-69) because fewer potential impacts would be avoided. Reclamation of disturbed areas would not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. This alternative would have the greatest acreage of disturbance from roadways, pipelines and utilities of any alternative. Power line strike hazards are highest with this alternative. This alternative may affect SAR levels in rivers that would affect BLM and state species of concern and bald eagle foraging, interior least tern foraging success and nesting habitat. Production water disposal could also develop riparian areas that would be lost after abandonment. If listed species come to rely on these areas of developed habitat, this would lead to future declines when the water source for them no longer exists.

Crow Reservation

Impacts to the Crow Reservation would be similar to the indirect impacts described in general for Alternative C. These indirect impacts would occur in areas adjacent to off-reservation CBNG developments.

Northern Cheyenne Reservation

Since there is no tribally sponsored CBNG development, impacts to the Northern Cheyenne Reservation would be similar to the indirect impacts described in general for Alternative C. These indirect impacts would occur in areas adjacent to off-reservation CBNG developments.

Conclusions

The same types of impacts described for Alternatives A and B for wildlife and the same as described for Alternative B for sensitive species would be expected. However, impacts would be at a greater level due to the emphasis on CBNG production under Alternative C. Approximately 21,000 more acres would be directly impacted in both the short and long term compared to Alternative B.

Cumulative Impacts

The types of cumulative impacts would be the same as described for Alternatives A and B. CBNG development is expected to result in the direct short and long term loss of an additional 21,000 acres compared to Alternative B. Degraded habitat value of reclaimed lands would be similar to that described for Alternative A. Other actions considered to be cumulative impacts would result in the long term loss of an additional 41,000 acres.

Table 4-69 estimates additional cumulative indirect impacts of more CBNG development on species sensitive to human activities and development. It is estimated cumulative indirect impacts of CBNG development in Montana could affect sensitive wildlife on between 1.28 and 6.87 million acres. Since sensitive and federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The same types of direct and indirect impacts on wildlife described for the Alternatives A and B and in Tables 4-68 and 4-69 would occur under Alternative D. Areas affected by direct and indirect impacts would be similar to those reported for Alternative B with the additions noted below. The impacts of the beneficial use of water for livestock grazing described for Alternative C would also occur under Alternative D. Unlike Alternative C, CBNG water discharged under Alternative D would be treated before release. Additional treated water provided to intermittent and small perennial streams may result in both impacts and benefits, depending mostly on the volume of discharge water relative to the natural flow, the steepness of the terrain and the erodibility of the soil. Relatively high volumes of water discharged into smaller drainages could erode the channel, destroying riparian vegetation either directly or as a result of channel down-cutting, which would reduce water availability to plants. Intermittent water sources that become perennial because of CBNG discharge would attract grazing livestock for longer periods of the year, resulting in reduced forage and cover for wildlife. Increased flows may also result in improved and more extensive riparian vegetation in intermittent drainages where seasonal water stress limits the current extent or condition of the vegetation and in more widespread water availability for wildlife. However, this benefit would be offset if more livestock grazing occurs in the vicinity and downstream of the discharge points. Lack of a requirement to reclaim roads and abandoned reservoirs would increase the potential for noxious weed occurrence and resulting habitat degradation.

There are no apparent differences between the types of direct impacts on BLM or state lands. Furthermore indirect impacts would have very little difference between BLM and state managed lands. Impacts on private lands would be much more substantial because stipulations and mitigation measures would not apply.

The same agency-applied mitigation measures described for Alternative B would apply to Alternative D. The effect of these mitigation measures on impacts would also be the same as under Alternative B.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternative A. The potential for indirect impacts or modification to habitat would be greater under this alternative than Alternatives A or B, but less than Alternative C. As with those alternatives, reclamation of disturbed areas would not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. There would be increased roadways with this alternative over either Alternatives A or B. As with Alternative C, production water disposal, which would be treated under this alternative, could develop riparian areas that would be lost following abandonment.

Mitigation is the same as for Alternative B.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative B. However, since there would be no tribal sponsored development, impacts would be limited to adjacent boundaries from off-reservation development. Small areas of private development on the reservation would cause direct impacts similar to those described in Alternative D, but adjusted for the limited scale of development.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B and are expected to occur in areas adjacent to off-reservation development. No tribal sponsored CBNG development is anticipated for this alternative and therefore no direct impacts to wildlife are expected to occur on the Reservation.

Conclusions

Direct, indirect and residual impacts on wildlife would be similar to those described for Alternative B.

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBNG wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed and the nature and period of disturbance. Leasing stipulations as discussed above would reduce or avoid some impacts to federally listed and other sensitive species. However, there are no stipulations for most species of concern.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

The types of impacts on wildlife under Alternative E would be similar to those described in Alternative A. However, the magnitude of the impacts would be substantially higher because the level of development would be much higher, as shown on Table 4-69. Examples of types of impacts similar to Alternative A follow:

- Direct habitat loss and direct and indirect impacts because of habitat disruption and wildlife disturbance caused by roads, pipelines and utility corridors would cause the bulk of the impacts on wildlife.
- Direct impacts would include loss of habitat to accommodate project features. They would persist for the duration of CBNG activities and, in the case of loss of habitat value, beyond that time. Some degree of habitat loss and degradation would continue following CBNG abandonment because of ecological differences between reclaimed sites and native vegetation.
- Based on the average area expected to be disturbed by exploration and development of each CBNG well, Alternative E would result in the direct disturbance of 73,860 acres resulting from development of 18,300 wells, 9,018 miles of roads and 27,917 miles of utility corridors (Table 4-66). Direct impacts on wildlife would also include mortality as relatively less mobile small mammals, reptiles and amphibians are killed during road and other site construction. Smaller mammals, reptiles and amphibians are most likely to be directly killed by vehicles and are vulnerable when crossing roadways (USDI and USDA 2001).
- Additional direct impacts would occur on private lands because state and federal lease stipulations are recommended but not required.
- Table 4-68 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts. Most indirect impacts on wildlife would occur during all CBNG phases on BLM, state and private lands. The duration of effects would correspond with the duration of each phase and the intensity of activity during that phase. The relative magnitude of impacts would be directly related to the nature and extent of activities associated with each phase of CBNG development. Some indirect effects would persist beyond abandonment because continued human use of some CBNG and user-created roads that are not closed and reclaimed (USDI and USDA 2001).
- Table 4-68 provides estimates of the area of habitat within which species sensitive to disturbance and roads may be affected both within and around the perimeter of CBNG well fields. Potentially affected areas are estimated for both 1/2-mile and 2-mile perimeters around well fields and related activity (Fyfe and Olendorff 1976, Lyon 1983, Connelly et al. 2000). The information presented in Table 4-69 represents the maximum area of disturbance for sensitive wildlife species in year 20 when all wells would be developed and none would have been closed. By year 20, indirect impacts of CBNG development would affect sensitive species of wildlife on between 880,000 and 4.7 million acres. Species sensitive to indirect impacts at this scale were discussed under Alternative A.
- Overhead power lines constructed for production wells pose problems for a variety of wildlife species. Raptors, sage-grouse and other species of birds occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines can benefit some raptors in open country by providing hunting perches. However, the additional perches also result in local population declines in prey species. For example, overhead power lines constructed in the vicinity of sage-grouse and sharp-tailed grouse leks and wintering areas can substantially increase predation rates on the grouse. The risk of raptor electrocution on federal and state lands is small because the BLM and State require power lines and poles be constructed to standards that would avoid raptor electrocution (APLIC 2006). Raptor and sage-grouse collisions with power lines have also been noted throughout the west including eastern Montana.
- Stipulations prohibit surface occupancy in riparian areas and on floodplains of major rivers. However, they do not prohibit crossing of streams or construction of roads through riparian areas. Roads constructed through riparian areas and other forest and shrub stands for CBNG development and operation create edge effects and alter the physical environment (Trombulak and Frissell 2000). Roads create drier conditions in the vicinity of the road, thereby altering habitat for many species. In grassland and shrubland habitats, trails

and roads create edge habitat for predators and reduce patch size of remaining habitat for area-sensitive species (USDI and USDA 2001, Ingelfinger 2001). Swihart and Slade (1984) found that prairie voles (*Microtus ochrogaster*), which occur in the Planning Area, were reluctant to cross tire tracks running through an open field. Reluctance to cross narrow gravel roads has also been observed in white-footed mice (*Peromyscus leucopus*), which also occur in the Planning Area and many other rodent species (Mader 1984, Merriam et al. 1989, Oxley et al. 1974). Consequently, roads can function as barriers to population dispersal and movement for small mammals that occur in the Planning Area.

- The assumption is made that existing stipulations would provide some protection to sage-grouse habitat including lek areas, nesting habitat and winter range. It is recognized that these actions would not completely protect this species. Mitigation measures within the WMPP will provide additional protective measures. Lease stipulations and terms and conditions would provide protection to raptors and the mountain plover. Implementation of protective measures contained in the WMPP would help reduce, but cannot avoid all, impacts to all species of wildlife including sagebrush-obligate birds.

See Alternative A for a complete discussion of the types of impacts on wildlife expected from CBNG development, including impacts on threatened and endangered and candidate species.

Alternative E has the potential to have a greater magnitude of impacts than Alternatives B and D, due to the larger area directly disturbed and the higher mileage of road, pipeline and utility corridors constructed. However, implementation of BLM required Conditions of Approval and the WMPP would help to reduce wildlife impacts.

Project Plans would be developed and approved using the programmatic guidance outlined in the WMPP. They would include baseline inventory for sensitive wildlife and habitats in areas where such inventories have not been completed. Certain broad landscape level inventories would be conducted by the BLM. The BLM or Operators would conduct additional, more detailed inventories and monitoring. Operators would be required to submit plans that demonstrate how their project design minimizes or mitigates impacts to surface resources and meets objectives for wildlife before exploration and approval of the APD. The WMPP would be a cooperative approach that incorporates adaptive management principles to try to deal with impacts as they occur. The WMPP also establishes a framework that encourages industry, landowners and agencies to work together constructively to incorporate conservation measures into CBNG development. All CBNG development would follow the programmatic guidance to address wildlife concerns and each individual Project Plan would include a site-specific Monitoring and Protection Plan which includes mitigation specific to species or local habitats. Over the life of the CBNG project, monitoring and evaluation through area specific WMPPs would offer some insight as to the effectiveness and failures of management actions and therefore encourage adaptive strategies to address specific and unforeseen problems.

Some examples of how the WMPP would be applied are described below. It must be recognized however, that because of the scale of CBNG development proposed under this alternative, it would only be possible to reduce or lessen impacts to important wildlife habitats utilizing measures described in the WMPP.

As discussed in alternative A, the primary objective of reclamation is to restore vegetative cover to the disturbed site. With the required seed mixes, restoration to near-native conditions is not likely to occur. However, flexibility provided by the WMPP allows for more creative options in reclamation plans to restore important wildlife habitats. An example would be to focus on restoration of sagebrush stands on big game winter ranges as opposed to establishing herbaceous cover only.

As part of the approval process for project protection plans, location and use of roads would be a very high focus. Project design would include locating roads in such a manner as to avoid crucial big game and sage-grouse winter ranges (i.e. south facing slopes, sagebrush flats and valley floors), raptor nesting areas and prairie dog towns. Additionally, stipulations may be applied that preclude use of these roads during critical time periods of the year (seasonal restrictions) or day (timing restrictions) that would apply to all CBNG activities.

The power infrastructure associated with CBNG development is identified as a major wildlife impact. Agencies already require all powerlines to be raptor proof according to accepted standards. However, additional stipulations may be required based on site specific needs. Examples of this may be locating powerlines away from sage-grouse leks and winter concentration areas, burying powerlines in crucial areas and applying more aggressive raptor-proofing options than previously required.

Mandatory mitigation measures are listed in Chapter 2.

Species of Concern

The types of direct and indirect impacts would be similar to the other development alternatives. Alternative E has the potential to have a greater magnitude of impacts to species of concern than Alternatives B and D, due to the larger area that would be directly disturbed and the higher mileage of road, pipeline and utility corridors to be constructed. However, implementation of BLM required COAs and the WMPP would help to reduce impacts to species of concern.

The WMPP addresses guidance for developing Plans of Development. Project Plans and conservation measures applied as Conditions of Approval provide a full range of practicable means to avoid or minimize harm to wildlife species or their habitats. Operators would minimize impacts on wildlife by incorporating applicable WMPP programmatic guidance into Project Plans. Not all measures may apply to each site-specific development area and means to reduce harm are not limited to those identified in the WMPP. BLM and MFWP would work together to collect baseline information about wildlife and sensitive habitats possibly containing special status species.

The WMPP is intended to reduce potential impacts on a variety of sensitive species by requiring inventories prior to exploration. This action would likely reduce potential direct impacts on sensitive species and may also reduce potential indirect impacts in some cases. However, given the scale of CBNG development, it is very unlikely that all direct and indirect impacts on species of concern can be avoided. Monitoring findings may result in additional conditions of approval and mitigation measures for CBNG development that occurs after initial monitoring data are collected and analyzed, which could further reduce, but not eliminate, potential impacts on sensitive species.

Alternative E does include indirect potential West Nile virus impacts to sage-grouse that would not occur under Alternatives B, C and D. Specifically, Alternative E would include approximately 8,285 infiltration and evaporation ponds, each assumed to be about 5 acres in size that could serve as sources for the mosquito (*Culex tarsalis)* responsible for the spread of the West Nile virus. An on-going study by researchers at Montana State University has indicated this mosquito thrives in CBNG holding ponds in northern Wyoming (Montana State University News Service 2005). Measures to minimize the exploitation of the CBNG ponds by breeding mosquitoes are included in the WMPP and would be implemented under Alternative E.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative E. Impacts would be limited to adjacent boundaries from off-reservation development.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative E. Specific mitigation measures proposed by the Northern Cheyenne Tribe that would be implemented by the BLM are described in the Northern Cheyenne Mitigation Appendix.

Conclusions

The types of direct, indirect, residual and cumulative impacts would be generally the same as those noted for Alternatives A and B. Discharge of treated water to intermittent and small perennial streams would result in both impacts and benefits to aquatic/riparian vegetation, amphibians, aquatic wildlife and invertebrates; depending mostly on the volume and quality of discharge water relative to the natural flow.

Impacts to wildlife from habitat loss, wildlife disturbance and mortality, including illegal harvest, have the potential to be greater under this alternative than either Alternatives B or D (Table 4-66). However, as mentioned earlier, implementation of the WMPP would reduce direct and indirect effects to wildlife.

All wildlife species would be impacted at some level by habitat changes caused by the replacement of pre-disturbance vegetation with lesser diversity of vegetation following reclamation, increased access through increased roads and other indirect effects. However, implementation of stipulations, the WMPP and adaptive management should ensure species do not decline to the point they need protection of the ESA. Recent research (Holloran and Anderson 2004, Holloran 2005); and ongoing studies specific to CBNG development in the Powder River Basin indicate potential for declining local populations of sage-grouse under this alternative. For federally-listed species, some effects may occur, but effects are not likely to cause adverse population responses.

The magnitude of cumulative impacts would be similar to those described for Alternative C.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, the type of impacts to wildlife would be similar as the other development alternatives. However, the magnitude of direct impacts is expected to be less than the other action alternatives for the following reasons: (1) as with Alternatives B and D, Alternative F provides restrictions on the amount of surface disturbance on federal leases within crucial habitat areas; (2) Alternative F (as with Alternative E) includes additional conservation measures described in the WMPP; (3) Alternative F includes thresholds on impacts to crucial habitats, which would reduce impacts to sagebrush and grassland obligated species; (4) Alternative F includes sage-grouse habitat conditions for protecting crucial habitat areas and avoiding the displacement of sage-grouse; and (5) Alternative F includes phasing of development that would result in a lesser magnitude of impact for a particular area over time.

The threshold component of Alternative F would limit the amount of impacted habitat on BLM-administered surface or on private surface overlaying federal minerals within each 4th Order watershed. The threshold value would allow no more than 20 percent of any crucial habitat area within to be directly impacted over a 20-year period within the watershed. This would include removal of crucial habitat (e.g., nesting, brood-rearing and wintering habitats), resulting from the proposed project activities, a 400 meter corridor along major travel routes (12 or more vehicles per day) and other unrelated projects that result in habitat removal. Best available science (including any information available from ongoing research, modeling and other sources), combined with documentation specific to POD-level analysis, would be used to document existing crucial habitat and impact areas. Research is currently being conducted within the Powder River Basin of Montana and Wyoming, specifically on sage-grouse and habitat use.

Implementation of this threshold would have little effect on protecting species or habitats, as it is unlikely disturbance would reach the 20 percent threshold over a 20-year period. In addition, seasonal restrictions do little to protect wildlife beyond the time period development takes place. Operation and maintenance of wells are not precluded by this stipulation, which often result in impacts to habitat in which the stipulations were intended to protect. The “adaptive management” feature (identified in Chapter 2 and expanded in the Wildlife Monitoring and Protection Plan in the Wildlife Appendix) would increase BLM’s ability to modify the threshold percentage if needed, to reduce the magnitude and level of habitat impacts. The adaptive management approach would include utilizing and evaluating new information to form additional or to change conditions of approvals. Important information such as the on-going sagebrush/sage-grouse research in CBNG (pre and post) development areas in Montana and Wyoming, would be utilized.

BLM would manage sage-grouse habit using a combination of the stipulations attached to the oil/gas leases, management identified in the 20/20 wildlife screen and stipulations identified in the WMPP. This alternative, while developed using the best information available at the time, would likely result in a significant loss of sag-grouse habitat in the areas of and directly development.

For indirect impacts, new information (relative to the Statewide Document) is presented in Table 4-70. The table provides information by watershed, as Alternative F includes maximum thresholds for impacts based on the watershed scale. For the entire Planning Area, total acres of indirect impacts are different between Table 4-69 and Table 4-68 because Table 4-69 is based on slightly different assumptions regarding well development. Specifically, the indirect impacts (calculated in Table 4-69) assume all wells will be developed at the same density (8, 16, or 24 wells per square mile) while Table 4-70 incorporates recent experience indicating that well site density can vary depending on the available coal layers. Well site density is a more accurate measurement because existing well sites may have as many as five wells.

Taken together, Tables 4-69 and 4-70 provide a range of expected indirect impacts from the development alternatives. Note that in all cases, the tables indicate total acres of indirect impacts are the same under all action alternatives. In reality, acreages of indirect impacts from Alternative F are expected to be less, given the habitat and development thresholds that are part of this alternative. In addition, note that indirect effects from new utility lines, pipelines and roads would not be the same under each alternative. Specifically, Alternatives B, D and F would have fewer indirect impacts from utility lines, pipelines and roads, since these alternatives include more restrictions on their development than the other action alternatives. Types of indirect effects on wildlife from roads, pipelines and utility lines are described above in the discussion of Alternative A.

Species of Concern

For the same reasons as described above, Alternative F would include the same types of direct and indirect impacts to species of concern as described in the other development alternatives (B, C, D and E) but at a lesser magnitude. Under Alternative F, thresholds for impacts to crucial habitat would provide unique protection compared to the other development alternatives. Fragmentation of habitat, dispersal, colonization and extinction patterns would be reduced under this alternative. In addition, Alternative E discussed potential indirect effects to sage-grouse from holding ponds and risk of West Nile virus infection.

TABLE 4-70

AREA OF POTENTIAL INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT WITHIN AND AROUND STANDARD-SIZED[1] CBNG WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES BY 4TH ORDER WATERSHED, ALTERNATIVES B, C, D, E, F AND H

Watershed	Acres in Montana	Number of Production Wells per Watershed (Assuming 10% are Dry Holes)	Well Fields per Watershed[2]: 200 Wells per Field, 8 Wells per Square Mile	400 Wells per Field, 16 Wells per Square Mile	600 Wells per Field, 24 Wells per Square Mile	Total Number of Standard Sized Well Fields	Additional Acreage of Indirect Disturbance within 1/2 mile of Well Field Perimeters[3,4]	Total Indirect Disturbance[1] within Well Fields	Total Indirect Disturbance from CBNG Development[4]	Percentage of Watershed in Montana Indirectly Disturbed
Clark's Fork Yellowstone	978,374	405	2.0	0.0	0.0	2.0	14,256	32,400	46,656	4.77%
Little Bighorn	830,773	608	3.0	0.0	0.0	3.0	21,402	48,640	70,042	8.43%
Little Powder	416,598	180	0.9	0.0	0.0	0.9	6,336	14,400	20,736	4.98%
Lower Bighorn	1,266,927	720	3.6	0.0	0.0	3.6	25,344	57,600	82,944	6.55%
Lower Tongue	1,835,479	3,105	7.8	3.9	0.0	11.6	81,972	186,300	268,272	14.62%
Lower Yellowstone-Sunday	3,062,384	1,530	7.7	0.0	0.0	7.7	53,856	122,400	176,256	5.76%
Middle Musselshell	1,223,591	90	0.5	0.0	0.0	0.5	3,168	7,200	10,368	0.85%
Middle Powder	454,527	1,890	6.6	1.4	0.0	8.0	56,549	128,520	185,069	40.72%
Mizpah	510,281	113	0.6	0.0	0.0	0.6	3,978	9,040	13,018	2.55%
Rosebud	834,998	3,240	12.2	2.0	0.0	14.2	99,792	226,800	326,592	39.11%
Stillwater	521,362	90	0.5	0.0	0.0	0.5	3,168	7,200	10,368	1.99%
Upper Musselshell	2,570,399	68	0.3	0.0	0.0	0.3	2,394	5,440	7,834	0.30%
Upper Tongue	586,044	3,465	0.0	4.3	2.9	7.2	50,820	115,500	166,320	28.38%
Upper Yellowstone-Lake Basin	1,003,984	720	3.6	0.0	0.0	3.6	25,344	57,600	82,944	8.26%
Upper Yellowstone-Pompey's Pillar	1,279,948	180	0.9	0.0	0.0	0.9	6,336	14,400	20,736	1.62%
TOTAL		16,403	50.0	11.7	2.9	64.6	454,714	1,033,440	1,488,154	

[1] For this table, a standard-sized well field is considered to be 200 well sites with an 80-acre spacing, which results in a total standard field size of 16,000 acres. Number of wells and acres of disturbance for Alternative F represent the maximum development for this alternative. In reality, Alternative F may include a lesser acreage of effect, due to the threshold limits and implementation of the WMPP that is part of this alternative.

[2] When more than one layer of coal is present, wells can be co-located on the surface within the same 80-acre spacing. The following watersheds have multiple coal layers: Lower Tongue, 50% with 2 layers; Middle Powder, 30% with 2 layers; Rosebud, 25% with 2 layers; and Upper Tongue, 50% with 2 layers, 50% with 3 layers.

[3] The additional acreage within 1/2 mile of a standard-sized well field (16,000 acres) is approximately 7,040 acres (see Table 4-68).

[4] These acreages assume there is no overlap between affected areas of adjacent well fields. Overlap would reduce the total area of indirect disturbance outside well field perimeters.

Note that Alternative F could include as many holding ponds as Alternative E only if the development thresholds were not met under Alternative F.

Crow Reservation

Types of indirect impacts to wildlife on the Crow Reservation would be similar to those described in general for the development alternatives. However, the phased aspect of development, the threshold on disturbance of crucial habitats and adaptive management techniques would result in reduced indirect impacts to Crow Reservation wildlife, relative to Alternatives B, C, D and E.

Northern Cheyenne Reservation

Effects to Northern Cheyenne Tribe wildlife resources would be similar to that described for the Crow Reservation.

Conclusion

Under this alternative, cumulative impacts would be less than Alternative E, primarily due to the implementation of cumulative and watershed-specific numerical limits on the number of federal CBNG APDs approved per year.

All wildlife species would be impacted at some level by habitat changes caused by vegetation removal not reclamation to predisturbance conditions, increased access through increased roads and other indirect effects. However, implementation of stipulations, the WMPP, development thresholds and adaptive management would help ensure species do not decline to the point needing protection of the ESA. An exception to this finding is uncertainty concerning declines of sage-grouse populations. Recent research (Holloran and Anderson 2004, Holloran 2005); and ongoing studies specific to CBNG development in the Powder River Basin indicate potential for declining local populations of sage-grouse under this alternative. Most significantly is the finding related to the need to minimize disturbance to large tracts of remaining high quality sagebrush communities. For federally-listed species, some effects may occur, but are not likely to cause adverse population responses.

Alternative G—Phased Development Multiple Screens (Low Range)

This alternative would include the same type of impacts as the other development alternatives. However, the magnitude of direct and indirect effects to wildlife would be less than all other development alternatives (Alternatives B, C, D, E and F), due to the lower level of well development. As with Alternative F, Alternative G includes conservation measures as described in the WMPP that would also reduce direct and indirect effects to wildlife. Alternative G also includes the same thresholds levels for impacts as Alternative F. However, given the relatively low level of development under Alternative G, these thresholds may never be met under this Alternative. Alternative G would directly affect 19,665 acres, compared to 55,210 acres to 73,860 acres that would be directly affected under Alternatives B through F (Table 4-66). Total acres of habitat indirectly disturbed under Alternative G would be approximately one-third that of the other development alternatives (Tables 4-70 and 4-71).

As with Alternatives B, D and F, Alternative G would have fewer indirect impacts from utility lines and pipelines than Alternatives C and E. Alternative G includes fewer CNBG road miles than any other development alternative and consequently, direct and indirect effects to wildlife from roads would be less under this alternative.

Species of Concern

Given the lower level of well development and roads and the inclusion of the WMPP conservation measures under Alternative G, this alternative would have less direct and indirect effect on species of concern than Alternatives B, C, D, E, or F. However, the risk of West Nile virus to sage-grouse would be greater than Alternatives B, C and D, but less than Alternatives E or F.

Crow Reservation

Types of indirect impacts to wildlife on the Crow Reservation would be similar to indirect effects described in the other development alternatives. However, the magnitude of indirect impacts would be less than all other development alternatives due primarily to the lower level of well development under Alternative G.

Northern Cheyenne Reservation

Effects on Northern Cheyenne Tribe wildlife resources would be the similar to those described for the Crow Tribe.

TABLE 4-71

AREA OF POTENTIAL INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT WITHIN AND AROUND STANDARD-SIZED[1] CBNG WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES BY 4TH ORDER WATERSHED UNDER ALTERNATIVE G

Watershed	Acres in Montana	Number of Production Wells per Watershed (Assuming 10% are Dry Holes)	Well Fields per Watershed[2]: 200 Wells per Field, 8 Wells per Square Mile	400 Wells per Field, 16 Wells per Square Mile	600 Wells per Field, 24 Wells per Square Mile	Total Number of Standard Sized Well Fields	Additional Acreage of Indirect Disturbance within 1/2 mile of Well Field Perimeters[3,4]	Total Indirect Disturbance[1] within Well Fields	Total Indirect Disturbance from CBNG Development[4]	Percentage of Watershed in Montana Indirectly Disturbed
Clark's Fork Yellowstone	978,374	153	0.8	0.0	0.0	0.8	5,386	12,240	17,626	1.80%
Little Bighorn	830,773	216	1.1	0.0	0.0	1.1	7,603	17,280	24,883	3.00%
Little Powder	416,598	63	0.3	0.0	0.0	0.3	2,218	5,040	7,258	1.74%
Lower Bighorn	1,266,927	252	1.3	0.0	0.0	1.3	8,870	20,160	29,030	2.29%
Lower Tongue	1,835,479	1,089	2.7	1.4	0.0	4.1	28,750	65,340	94,090	5.13%
Lower Yellowstone-Sunday	3,062,384	540	2.7	0.0	0.0	2.7	19,008	43,200	62,208	2.03%
Middle Musselshell	1,223,591	36	0.2	0.0	0.0	0.2	1,267	2,880	4,147	0.34%
Middle Powder	454,527	666	2.3	0.5	0.0	2.8	19,927	45,288	65,215	14.35%
Mizpah	510,281	36	0.2	0.0	0.0	0.2	1,267	2,880	4,147	0.81%
Rosebud	834,998	1,143	4.3	0.7	0.0	5.0	35,204	80,010	115,214	13.80%
Stillwater	521,362	36	0.2	0.0	0.0	0.2	1,267	2,880	4,147	0.80%
Upper Musselshell	2,570,399	27	0.1	0.0	0.0	0.1	950	2,160	3,110	0.12%
Upper Tongue	586,044	1,215	0.0	1.5	1.0	2.5	17,820	40,500	58,320	9.95%
Upper Yellowstone-Lake Basin	1,003,984	270	1.4	0.0	0.0	1.4	9,504	21,600	31,104	3.10%
Upper Yellowstone-Pompey's Pillar	1,279,948	81	0.4	0.0	0.0	0.4	2,851	6,480	9,331	0.73%
TOTAL		**5,823**	**17.9**	**4.1**	**1.0**	**23.0**	**161,893**	**367,938**	**529,831**	

[1] For this table, a standard-sized well field is considered to be 200 well sites with an 80-acre spacing, which results in a total standard field size of 16,000 acres.

[2] When more than one layer of coal is present, wells can be co-located on the surface within the same 80-acre spacing. The following watersheds have multiple coal layers: Lower Tongue, 50% with 2 layers; Middle Powder, 30% with 2 layers; Rosebud, 25% with 2 layers; and Upper Tongue, 50% with 2 layers, 50% with 3 layers.

[3] The additional acreage within 1/2 mile of a standard-sized well field (16,000 acres) is approximately 7,040 acres (see Table 4-68).

[4] These acreages assume there is no overlap between affected areas of adjacent well fields. Overlap would reduce the total area of indirect disturbance outside well field perimeters.

Conclusion

Under this alternative, cumulative impacts would be less than the other development alternatives, primarily due to the reduced level of well development under Alternative G.

All wildlife species would be impacted at some level by habitat changes caused by vegetation removal not fully recovered with reclamation to predisturbance conditions, increased access through increased roads and other indirect effects. However, implementation of stipulations, the WMPP, development thresholds and adaptive management would help ensure species do not decline to the point of needing protection under the ESA. For federally-listed species, some effects may occur, but effects are not likely to cause adverse population responses.

Alternative H—Preferred Alternative - Multiple Screens

For wildlife, restrictions on CBNG development would be similar to Alternative F, but would incorporate adaptive management to identify conditions of approval (COAs), BMPs and alternative development schemes, based on available science and monitoring information (see the WMPP). BLM would work with CBNG operators, surface owners, Native American tribes, FWS and MFWP to identify any additional protection measures necessary. On split estate lands, BLM recognizes that achieving the objectives of this alternative would require cooperation with surface owners.

Specifically, this alternative includes (1) changes in management if mule deer or pronghorn populations decline by more than 30 percent in a 3-year period, (2) management modification if monitoring data indicate a change in wildlife species populations within crucial habitats on or adjacent to POD areas where federal mineral ownership occurs for Tier 1 species identified in the Montana Comprehensive Fish and Wildlife Strategy (2005c), (3) sage-grouse would be managed to maintain populations trends consistent with adjacent “control” populations, (4) through the use of BMPs, adaptive management, etc. management changes will be made if populations decline by 25 percent over a five year period, (5) siting surface disturbance proposals to meet objectives for sage-grouse habitat management within 1 mile of a lek (6) restrictions on new roads and utilities (either explicitly or through watershed-level resource analysis; (7) burying all powerlines in sage-grouse habitat, where feasible and (8) conservation measures described in the WMPP. As research and monitoring continued, BLM and partners might develop new COAs and BMPs to supplement those already contained in the WMPP and other BLM publications.

While Alternative F includes a phased development component that would limit the number of APDs approved each year, Alternative H would require POD development and approval be based on the four resource screens and watershed-level impact analysis so that the rate of APD approval is expected to be similar to that of Alternative F.

Alternative H would allow CBNG to occur, with strict application of COAs and monitoring of populations to with a goal of managing habitat to ensure populations remain consistent with adjacent control populations. In addition, even with the application of the best science, BMPs etc. population may be negatively impacted. Monitoring will focus on these changes and if sage-grouse populations decline by 25 percent or more over 5 years or if populations appear to be headed in this direction, BLM would implement changes in management designed to maintain sage-grouse populations at a level consistent with adjacent populations. Alternative H would start with more restrictions and increase restrictions if monitoring showed BMPs were unsuccessful at meeting the objectives of this alternative. Recent research (Holloran and Anderson 2004, Holloran 2005); and ongoing studies specific to CBNG development in the Powder River Basin indicate potential for declining local populations of sage-grouse unless large quality habitat areas are maintained that provide suitable habitat for all critical life cycle periods (i.e., brood rearing, breeding and wintering).

As noted previously, Alternative H has the following objectives: maintaining the connectivity of sage-grouse habitat within the PRB and adjacent regions, maintenance of source populations for repopulation of areas from which displacement may have occurred due to CBNG development and maintain sage-grouse habitat so that population trends follow the general magnitude of decline or increase as that occurs on the control leks.

Even with the possibility of a slower pace of development in crucial sage-grouse habitat under this alternative, there is a potential that sage-grouse may be displaced from some of the habitat before the impacts become evident in the monitoring data, which would reduce sage-grouse populations. However, the monitoring and adaptive management may limit the extent of decline and allow BLM to modify management to stabilize populations.

Consequently, effects of Alternative H on wildlife would be similar to Alternative F, except for sage-grouse and sagebrush obligate species.

General Effects to Wildlife

As with the other development alternatives, CBNG development and construction and use of related facilities (i.e., roads, pipelines and utility corridors) can cause numerous direct and indirect effects to wildlife. The primary effects include: (1) direct mortality (from crushing by construction equipment, collision with vehicles and collision with powerlines); (2) habitat loss, degradation (e.g., invasion of noxious weeds, changes in water quantity and quality) and fragmentation; (3) noise and visual disturbance; (4) increased legal and illegal hunting; and (5) barriers to dispersal and movement. Effects to individual species depend on extent, location and timing of the activity and sensitivity of the species, among other factors. Table 4-68 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts.

As under Alternative F, the threshold component of Alternative H would limit the amount of impacted habitat on BLM-administered surface or on private surface overlaying federal minerals. BLM would manage disturbance in crucial habitats (e.g., crucial brood rearing/breeding/wintering habitat) where federal mineral ownership occurred. Crucial habitat for additional species, particularly Tier 1 species identified in the Montana Comprehensive Fish and Wildlife Strategy (MFWP 2005d), might be identified and existing crucial habitats modified based on additional habitat monitoring/surveys.

A requirement for each proposed POD would be to identify crucial habitat polygons during project implementation. Management might be modified if monitoring data indicated a change in wildlife species populations within crucial habitats on or adjacent to POD areas. The “adaptive management” feature (identified in Chapter 2 and expanded in the Wildlife Monitoring and Protection Plan in the Wildlife Appendix) would increase the BLM’s ability to modify the threshold percentage, if needed, to reduce the magnitude and level of habitat impacts.

Tables 4-66, 4-68 and 4-70 provide quantitative information on acres of direct and indirect impacts under the development alternatives. Assuming full CBNG development, Alternative H would result in the direct disturbance of up to 59,045 acres, resulting from development of 18,225 wells, 6,662 miles of roads and 20,623 miles of pipeline and utility corridors (Table 4-66). Taken together, Tables 4-70 and 4-71 provide a range of expected indirect impacts from the development alternatives. In all cases, the tables indicate that the total acres of indirect impacts are the same under all action alternatives. In reality, acreages of indirect impacts from Alternative H are expected to be less, given the habitat and development thresholds that are part of this alternative. In addition, note that indirect effects from new utility lines, pipelines and roads would not be the same under each alternative. Specifically, Alternatives B, D, F and H would have fewer indirect impacts from utility lines, pipelines and roads, since these alternatives include more restrictions on their development than the other action alternatives.

Lower-intensity development, or no development, within the crucial sage-grouse habitat areas would further reduce the overall impacts to other species that occupy these habitat areas.

As with Alternatives E, F and G, PODs under Alternative H would be developed and approved using the programmatic guidance outlined in the WMPP, BMPs, adaptive management and the stipulations identified in this document. These PODs would include baseline inventories for sensitive wildlife and habitats in areas where such inventories have not been completed as well as certain broad landscape-level inventories. Operators would be required to submit plans demonstrating how their project design minimizes or mitigates impacts to surface resources and meets objectives for wildlife before exploration and approval of the APD. The WMPP would be a cooperative approach incorporating adaptive management principles to try to address impacts as they occur. Over the life of the CBNG project, monitoring and evaluation through area-specific WMPPs would offer some insight as to the effectiveness of management actions and therefore encourage adaptive strategies to address specific or unforeseen problems.

Species of Concern

The types of direct and indirect impacts would be similar to the other development alternatives and to those described in the “General Effects to Wildlife” section under Alternative H above. However, implementation of the sage-grouse population change threshold combined with the WMPP would reduce impacts of CBNG development for most sensitive species compared to Alternatives B, C, D and E. Fragmentation of natural populations, including sage-grouse; and dispersal, colonization and extinction patterns would be reduced under this alternative. As with Alternative F, Alternative H could include approximately 8,286 infiltration and evaporation ponds (if not limited by development thresholds) with each pond assumed to cover about five acres and serving as a potential source for West Nile virus. Measures to minimize the exploitation of the CBNG ponds by breeding mosquitoes are included in the WMPP and would be implemented under Alternative H.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative H. Impacts would be reduced from federal CBNG wells by implementation of mitigation and monitoring requirements within 5 miles of the Reservation boundary.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for the Crow Reservation

Conclusions

The types of direct, indirect, residual and cumulative impacts would be generally the same as those noted for the other development alternatives.

Given the threshold limits on development and the implementation of the WMPP, impacts to wildlife from habitat loss, wildlife disturbance and mortality are expected to be less than Alternatives B through E, and between Alternatives F and G.

All wildlife species would be impacted at some level by habitat changes caused by the replacement of predisturbance vegetation with a different composition of vegetation following reclamation after well abandonment, increased access through increased roads and other indirect effects. However, implementation of stipulations, the WMPP, development thresholds, crucial sage-grouse habitat area objectives and adaptive management would ensure species do not decline to the point they need protection of the ESA as a result of BLM approved actions. For federally-listed species, some effects may occur, but effects are not likely to be adverse. Note that the Biological Assessment (see the Wildlife Appendix) provides additional information on effects to federally-listed species.

Aquatic Resources

Wildlife (Aquatic Resources)
Fish species vary between watersheds within the FSEIS Planning Area from 8 in the Little Big Horn River to 47 in the Yellowstone River.
Special Status Aquatic Species: Pallid sturgeon, Blue sucker, Northern redbelly X Finescale dace, Paddlefish, Pearl dace, Sauger, sturgeon chub and Yellowstone cutthroat trout.

Alternative A
No Action (Existing CBNG Management)

- Minor short-term impacts on aquatic resources during CBNG exploration and production may result from increased sediment delivery and its effects on aquatic habitat and organisms, possible impedance of fish movements, potential for accidental spills of petroleum products and possibly increased fish harvest.
- Relatively minor long-term increases in river flow and TDS concentration from production water discharge would not be expected to impact aquatic resources.
- Conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges.
- Impacts from CBNG abandonment would be minor and subside over time.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- The same types of impacts described for Alternative A (No Action) would occur under Alternative B, except as noted in the following two bullets.
  - The scale of potential impacts associated with sediment delivery, fish movements, petroleum spills and fish harvest would be greater under Alternative B because of the development of over 18,000 CBNG wells across a much larger geographic area.
  - No CBNG production water would be discharged to surface drainages under Alternative B.
- Based on fish species, fisheries management policies, fisheries resource values and projected intensity of CBNG development, the drainages most sensitive to the effects of CBNG development would be the Lower Bighorn, Upper Tongue and Little Bighorn; then the Lower Tongue, Little Powder and Rosebud; followed by the Mizpah.
- The potential for affecting aquatic resources, particularly in sensitive drainages, would be less under Alternative B than under Alternatives C or D.

Alternative C
Emphasize CBNG Development

- The same types of impacts described for Alternative A would occur under Alternative C, but they would occur on a far greater scale because of the development of over 18,000 CBNG wells.
- A total of 0.67 billion cubic feet of untreated CBNG production water would be discharged to drainages each year. Resultant flow and TDS increases could potentially impact aquatic organisms, especially in smaller drainages during dry times of the year.
- Conditions of MPDES Permits would provide legally enforceable assurances preventing the degradation of water quality, aquatic resources and the beneficial uses of receiving waters.
- The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative C than under Alternatives B or D.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- The same types of impacts described for Alternative A would occur under Alternative D, but they would occur on a far greater scale because of the development of over 18,000 CBNG wells.
- The annual discharge of 2.24 billion cubic feet of treated CBNG production water through pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year.
- The treatment of CBNG production water prior to its discharge would greatly reduce the potential for elevated TDS and salinity impacts on aquatic resources.
- MPDES Permits would provide legal assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected.
- The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative D than under Alternative B but less than under Alternative C.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- The same types of impacts described for Alternative A would occur under Alternative E, but the impacts would occur on a far greater scale because of the development of over 18,000 CBNG wells.
- The potential for affecting aquatic resources would be greater under Alternative E than under Alternatives B or D but less than under Alternative C.
- Pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year.
- About 2.24 billion cubic feet of CBNG production water managed through flexible options, but allows no degradation of water quality (including thermal criteria).
- The required Water Management Plans and MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected.
- The potential for affecting aquatic resources in sensitive drainages would be greater than Alternatives B and D but less than under Alternative C.

Alternative F Phased Development Multiple Screens (High Range)
• The same types of impacts described for Alternative A would occur under Alternative F, but the impacts would occur on a far greater scale because of the development of over 18,000 CBNG wells. • The potential for affecting aquatic resources would be more than Alternatives B and G, similar to Alternatives D and E but less than under Alternative C. • About 2.24 billion cubic feet of CBNG production water managed through flexible management options, but limits the volume of untreated water discharged to surface waters. • MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • Limits CBNG development and total disturbed habitat annually and by watershed. • Sequential and controlled development schedule, combined with watershed-level analysis, provides a framework for assessing potential impacts through a systematic monitoring program. • Incorporates Adaptive Management approach in the phased development process that uses the monitoring data.
Alternative G Phased Development Multiple Screens (Low Range)
• The approximate 6,500 CBNG wells are about 65 percent fewer than the other action alternatives, resulting in less overall impacts. • The effects on aquatic resources would be similar in nature to Alternative F, but substantially less than Alternative F. • About 0.78 billion cubic feet of CBNG production water managed through flexible management options, but limits the volume of untreated water discharged to surface waters. • MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • Limits CBNG development and total disturbed habitat annually and by watershed. • Sequential and controlled development schedule, combined with watershed-level analysis, provides a framework for assessing potential impacts through a systematic monitoring program • Incorporates Adaptive Management approach in the phased development process that uses the monitoring data.
Alternative H Preferred Alternative - Multiple Screens
• The same types of impacts described for Alternative A would occur under Alternative H, but the impacts would occur on a far greater scale because of the development of over 18,000 CBNG wells. • The potential for affecting aquatic resources would be similar to Alternative F . • About 2.24 billion cubic feet of CBNG production water managed through flexible management options, but limits the volume of untreated water discharged to surface waters based on water quality monitoring. • MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • Unlike alternatives F and G, which set specific limits on the number of CBNG development by watershed, Alternative H uses water quality and quantity criteria to manage the number of CBNG wells in the various watersheds • Incorporates Adaptive Management approach in the development process that uses the monitoring data.

Assumptions

The BLM has identified numerous mitigation measures in Chapter 2 that would be implemented to avoid or minimize impacts on biological resources and hydrological features resulting from CBNG exploration, production and abandonment activities on BLM-administered surfaces. These measures are common to all of the alternatives being analyzed in this EIS and are derived from current BLM leasing stipulations (contained in Minerals Appendix, Table MIN-5), standard operating procedures and BMPs and State of Montana field orders. Several of the mitigation measures related to aquatic resources are briefly reviewed here for reader reference prior to discussing potential impacts and impacts that would be avoided or minimized, assuming the successful implementation of these mitigation measures.

A key mitigation measure that directly affects aquatic resources is that the Montana and Wyoming Water Quality Agreement, which is pending final approval, would preserve the current water quality in the Tongue River and prevent Wyoming operators from discharging poor quality production water into the Tongue River. Examples of other mitigation measures related to aquatic resources that are referenced in Chapter 2 and described in Table 4-67 of the Wildlife section include a prohibition on the surface occupancy or use of water bodies and streams, riparian areas and 100-year floodplains of major rivers, streams and water bodies. In addition, surface occupancy and use is prohibited within 1/4 mile of designated reservoirs with fisheries, to protect the fisheries and recreational values of reservoirs.

Specific mitigation measures are directed at protecting water quality and aquatic resources in drainages by controlling erosion and sediment delivery, particularly on steep slopes and during wet times of the year; minimizing the number of stream crossings;

reclaiming, reseeding and revegetating disturbed areas; and maintaining a Spill Prevention Control and Countermeasures (SPCC) Plan to deal with accidental spills and control storm water run-off. A number of mitigation measures that would be applied on a case-by-case basis, as needed, are described in Appendix Table MIN-5. Examples of mitigation measures associated with aquatic resources, some of which are directed at special status species, include considerations of the location and timing of stream crossings as they relate to fish spawning periods and habitat and the minimization or avoidance of in-channel activities to reduce the potential for habitat loss. The reader is referred to Chapter 2, Table 4-67 and Minerals Appendix, Table MIN-5 for a complete listing of all mitigation measures.

These mitigation measures would avoid some of the impacts that may otherwise occur on BLM-administered surfaces in the absence of such measures, but they do not apply to CBNG-related activities on non-BLM-administered surfaces and therefore would not avoid impacts on non-BLM-administered surfaces. The only management objective that applies to BLM-administered surfaces and lands subject to state regulations is the required placement of untreated waters from exploration activities in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

CBNG exploration, production and abandonment activities would potentially impact aquatic resources in a number of ways. The likelihood of these impacts occurring depends on the exact nature, location and timing of CBNG activities; the proximity of CBNG activities to water bodies and the presence of sensitive species and/or sensitive life stages in these water bodies; and the nature of mitigation measures that would be implemented to minimize, avoid, or mitigate the potential occurrence of impacts. The success of these actions requires and assumes a site-specific understanding of the resources to be protected and adherence to mitigation measures during CBNG activities. The assumptions stated in the Hydrological Resources section of this chapter also form a portion of the framework for analyzing potential impacts from CBNG activities on aquatic resources.

The discussion of impacts in the following text for the No Action Alternative first describes the types of impacts that would result from CBNG activities in the absence of mitigation measures. It then assesses the likelihood of such impacts occurring based on the nature and magnitude of CBNG activities, the proximity of those activities to aquatic resources and the rigor of mitigation measures that would be implemented on lands managed by BLM and on lands subject to state regulations. Conclusions address the residual impacts that would remain following the implementation of mitigation measures. Conclusions also address the cumulative impacts that would result from the residual impacts of CBNG development combined with the potential effects of other projects in the area.

Many of the same types of direct and indirect impacts on aquatic resources would occur regardless of the number of CBNG wells developed, although the magnitude of impact would vary. Many of the same types of mitigation measures also would be implemented. Therefore, the detailed discussions of types of impacts first presented for the No Action Alternative are referenced, as appropriate, in subsequent discussions of impacts for Alternatives B through H. The potentially greater magnitude and geographic extent of impacts on aquatic resources because of the substantially greater number of CBNG wells that would be developed under Alternatives B through H are discussed under those alternatives.

Impacts from Management Common to All Alternatives

Types of impacts on aquatic resources, including fish, aquatic invertebrates and their habitat, potentially resulting from CBNG development activities would be similar to those described for oil and gas exploration and development activities (MBOGC 1989). These include direct removal of habitat, habitat degradation from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish from accidental spills or pipeline ruptures releasing harmful substances, increased legal harvests of fish because of increased human access and reduced stream flows because of removing water for drilling activities. These potential types of impacts are common to all alternatives and are described further under Alternative A (the No Action Alternative). An additional impact on aquatic resources that would only occur under all alternatives except B is the potential for altered stream water quality and/or increased flows in those instances when production water is discharged to drainages. This impact also is described under the No Action Alternative. However, no impacts would result from conventional oil and gas activities because of protection of reservoirs on 1,844 acres.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Numerous irrigation-related or naturally occurring dewatering problems that affect aquatic resources have been identified for drainages in the Billings RMP and Powder River RMP areas that would continue under the No Action Alternative. These problems were described in discussions of the affected environment and are not CBNG-related. In the Billings RMP area, these include periodic dewatering of portions of the Yellowstone River and downstream sections of the Clarks Fork and Bighorn rivers and chronic dewatering of the Boulder River, the upstream section of the Clarks Fork, portions of the Musselshell River and Careless Creek. In the Powder River RMP area, dewatering problems include periodic dewatering of the downstream section of the Tongue River and chronic dewatering of the Powder River. Dewatering indicates a reduction in streamflow, usually during the irrigation season (July through September), beyond the point where stream habitat is adequate for fish. Periodic dewatering indicates a crucial problem in drought or water-short years and chronic dewatering indicates a critical problem in virtually all years (Montana State Library NRIS 2005).

The two most common forms of water quality effects in the Billings RMP and Powder River RMP area drainages are from elevated sediment and salinity concentrations, primarily from non-point sources related to agricultural practices (MBOGC 1989). Levels of dissolved solids in drainages tend to increase proceeding downstream because of contributions from irrigation return flows, increased base flows that have been in contact with soil and rocks for long periods of time and effects of human activities. Water in intermittent and ephemeral drainages often is of poor quality because of the sudden and highly variable nature of discharge (snowmelt, intense rainstorms) that would result in elevated turbidity, dissolved solids and suspended sediment levels in these and in downstream perennial drainages (MBOGC 1989). These water quality conditions would likely continue under the No Action Alternative.

Fish populations and habitat in perennial and intermittent streams in the Billings RMP and Powder River RMP areas are impacted by drought, high temperatures, prolonged cold, heavy icing and flooding (BLM 1995). Pond habitat and fisheries in the RMP areas also would be affected by dry, low-water years when excessive water temperatures and reduced dissolved oxygen levels during summer would kill fish and by extended periods of ice and snow and subsequent oxygen depletion during winter that would kill fish (BLM 1995).

Previous studies have summarized the ways in which aquatic resources, including fish, aquatic invertebrates and their habitat, would potentially be impacted, either directly or indirectly, by CBNG activities (BLM 1992; USDI 2000; Regele and Stark 2000). Many of these impacts are the same as described for oil and gas exploration and development activities (MBOGC 1989). They include the following effects:

- Loss of aquatic and riparian habitat at stream crossings and near well sites
- Habitat degradation and loss from increased sediment delivery and sedimentation
- Altered spawning and seasonal migrations of fish because of stream obstructions
- Direct loss of fish and aquatic invertebrates from accidental spills, leakage and runoff of harmful substances into drainages
- Increased legal and possibly illegal harvests of fish because of increased human presence
- Altered water quality and increased stream flows from discharging CBNG production water into nearby drainages

While roads do not affect all species and ecosystems equally, the overall presence of roads is highly correlated with changes in species composition, population sizes and hydrologic and geomorphic processes that shape aquatic and riparian systems. All types of roads affect aquatic ecosystems in several general ways: (1) increased mortality from road construction, (2) alteration of the physical environment, (3) alteration of the chemical environment, (4) spread of exotic species and (5) increased alteration and use of habitats by humans (Trombulak and Frissell 2000).

Crossing streams and placing facilities such as culverts, bridges and cattle guards during the construction or upgrading of access roads to well sites would result in the localized loss of aquatic and riparian habitat. Depending on stream location and hydrology, drainages may provide year-round (perennial) or seasonal (intermittent or ephemeral) habitat for a variety of fish species and their life stages, including spawning, incubating, rearing, holding and over-wintering. Drainages also provide habitat for aquatic macro- and micro-invertebrates that are typically important fish foods, such as aquatic insects, zooplankton, clams, snails and worms, as well as habitat for aquatic plants, including periphyton, phytoplankton and vascular macrophytes. Instream activities also would alter habitat characteristics such as water depth, velocity and habitat types that are important to native and introduced fish species as well as benthic invertebrates.

The loss of riparian habitat would be especially important in smaller drainages because of its many influences on the quality of aquatic habitat. Murphy and Meehan (1991) reported that riparian habitat can form a protective canopy that provides overhead cover for fish and moderates the extreme effects of air temperatures during summer (helps to cool streams) and winter (helps to insulate streams). Riparian habitat also helps reduce soil erosion and filters sediment before it enters streams, stabilizes streambanks and allows for the formation of undercut banks that provide cover for fish. In addition, riparian habitat contributes litter (nutrients and food for invertebrates) and woody debris (instream cover) to drainages and it provides habitat for insects that fall to the water's surface and are consumed by fish (Murphy and Meehan 1991). The loss of these riparian functions would result in impacts on aquatic resources.

Soil disturbance, erosion and runoff during CBNG activities would result in increased sediment delivery to streams and the degradation or loss of aquatic habitat. Examples of such activities include the construction, upgrading, use, maintenance and retirement of access roads; the installation of culverts, bridges and cattle guards at stream crossings; other instream activities such as fording streams; site preparation, well drilling and related onsite facilities; and the construction and placement of pipelines for gas delivery. The potential for erosion and runoff would be greatest where wet or moist soils on steep slopes with little or no vegetative cover have been compacted by heavy equipment (BLM 1992).

Increased sediment delivery to drainages would affect aquatic resources through the sedimentation of habitat and increased levels of turbidity and suspended sediment in the water column. Increased sedimentation would cause a reduction or elimination of stream bottom habitat used by aquatic insects such as caddisflies, mayflies and stoneflies; a subsequent reduction in aquatic insect abundance and diversity; a reduction in the permeability among interstitial spaces within spawning gravels that inhibits the flow of well-oxygenated water and the removal of metabolic wastes; a subsequent reduction in spawning success, hatching success and fish production; and a reduction in the interchange of surface and subsurface waters in the hyporheic (mixing) zone beneath the stream channel (Nelson et al. 1991; USDI 2000). Substantially increased sedimentation would eliminate or reduce the depths of pools that provide important year-round cover for juvenile, sub-adult and adult fish and would cause the premature siltation of beaver ponds, which often provide year-round habitat for trout (MBOGC 1989). If severe enough, increased sediment loads would cause the erosion and migration of stream channels (Chamberlin et al. 1991) and the degradation of aquatic and riparian habitat.

Elevated turbidity and suspended sediment levels caused by increased sediment delivery would have sublethal and acute effects on fish. Nelson et al. (1991) reported that suspended sediment concentrations of 1,200 mg/l can cause mortalities in under yearling salmonids, while suspended sediment concentrations as low as 100 mg/l up to 1,000 mg/l are sometimes associated with a general reduction in fish activity, impaired feeding, reduced growth, downstream displacement and decreased resistance to other environmental stressors. MBOGC (1989) reported fish and fish food production would be affected by the abrasive effects of very fine sediment on fish embryos and fry and on immature aquatic insects. In addition, very turbid waters would exhibit increased temperatures because of the water's capacity to retain more heat. This would affect those fish and invertebrate species with the most restrictive cold-water or cool-water thermal requirements.

The most severe aquatic impacts resulting from increased sediment delivery would be to trout, whitefish and grayling. These species have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated water and/or gravels for spawning, egg incubation, rearing and adult success (Bjornn and Reiser 1991). The MBOGC (1989) generally concluded that in Montana, increased sediment delivery would have a greater impact on aquatic resources in high-gradient mountain streams than in low-gradient prairie streams. Mountain streams typically support the very sensitive and highly valued species of salmonids, which are generally much less tolerant of increased sediment and turbidity levels than are the warm water fish species found in the lower-gradient prairie streams and rivers in Montana. The MBOGC (1989) also noted that the potential for impacts from sediment delivery to drainages may be greatest in mountainous terrain because roads and pipelines are typically constructed close to streams where slopes are less steep.

Fish spawning migrations and localized movements would be affected in the event of improper placement, misalignment, or construction of culverts and bridges. Improperly designed facilities would block fish passage directly or constrain fish movements by creating hydraulic barriers caused by excessive water velocities or insufficient water depths. Furniss et al. (1991) reported that unless properly designed, stream crossings would be considered dams that are designed to fail, with subsequent impacts on fish passage and the sedimentation of habitat. Four aspects of culvert design, including diameter, length, slope and vertical drop to the water's surface, can potentially affect fish passage, especially of smaller fish. The MBOGC (1989) reported that perched culverts or small-diameter culverts with high water velocities effectively block trout spawning migrations. Bell (1986) stated that improperly designed culverts may preclude the passage of small fish and possibly discourage larger fish from attempting passage.

Accidental spills, leakage and runoff or leaching of petroleum products, drilling fluids stored in reserve pits and other potentially harmful substances such as CBNG production water (discussed further below) to surface water drainages may have acute and chronic effects on fish and their foods (BLM 1992; USDI 2000). These effects are influenced by the nature of the substance including its persistence and fate, volume of spill, distance from surface water and likelihood of entry, the volume and diluting ability of the receiving water and sensitivity of organisms exposed to the substance. Direct effects can include mortalities of aquatic organisms, while indirect effects may be exhibited through chemically induced changes in densities and community structures of aquatic organisms (Norris et al. 1991). Examples include alteration of environmental characteristics such as cover, food, or some other variable important to the well-being of fishes. Effects would be comparatively greater during low-flow than high-flow periods and in smaller rather than larger water bodies. The MBOGC (1989) concluded that the potential for impacts from accidental spills may be greatest in headwater mountain streams with relatively low flows because soils in such areas are often porous and runoff to streams is direct and rapid.

Increased human access because of new roads and increased human activity associated with CBNG exploration and production may result in increased legal and illegal harvest of fish from nearby drainages (MBOGC 1989). Besides angling mortalities of game species, legal fishing activities may result in the trampling of eggs and recently emerged fry from wading in streams and walking on or next to streambanks may cause increased bank erosion and habitat sedimentation.

As discussed in the *Hydrological Resources* section, surface water bodies should not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event that there is a very localized connection between a spring-fed stream and groundwater withdrawals, examples of resultant habitat modifications that could impact fish and invertebrates include reduced water depths; slower water velocities; fewer and/or shallower pools and riffles; increased water temperatures during summer; exposed stream channel bottom and stream banks; reduced habitat for spawning, rearing, holding and refugia; reduced riparian habitat quantity, quality and function; and reduced fish and invertebrate production.

Several examples illustrate the potential effects, or in the case of the proposed project, the anticipated absence of effects, of groundwater withdrawals on surface water hydrology and aquatic resources. The *Southern Ute DEIS* (USDI 2000) noted the potential for decreased surface water flows because of CBNG production water withdrawals from groundwater aquifers on the Southern Ute Reservation in New Mexico and Colorado. That analysis estimated that between 1,600 and 2,500 acre-feet of water may be lost from instream flows and concluded that this was not anticipated to impact fish habitat. This is equivalent to a 2.2 to 3.5 cfs reduction in instream flows spread evenly over a year. Under other circumstances and depending on the size of the drainage potentially affected, a flow reduction of about 3 cfs would have substantive effects on very small perennial and intermittent drainages, but negligible effects on very large perennial drainages. Studies also were conducted for the Deer Creek Coal Bed Methane Project, which is in the Tongue River watershed in the northwestern part of the Powder River Basin (BLM 2000a). Hydrologic analysis of the Deer Creek Project, like the hydrologic analysis in this EIS, indicated that because of the sealing effect of the overlying aquitards, water levels in shallow aquifer zones and in shallow wells in the Planning Area would not be impacted by water level drawdowns caused by CBNG well operations (BLM 2000a). The Deer Creek analysis concluded that flows and aquatic habitat in Planning Area drainages should not be depleted or aquatic habitat degraded. Similar findings were presented for studies of the Castle Rock Project, which concluded that cumulative impacts on the surface water resources of the exploration area, which include the Powder River and Pumpkin Creek, are expected to be minimal to nonexistent in the short term (BLM 2000b).

Aquatic resources would be affected by the discharge to surface waters of groundwaters that are withdrawn during CBNG production activities. The discharge of groundwaters would alter surface water quality and increase flows, potentially impacting aquatic habitat and biota. The effects of production water discharge would be most evident in smaller drainages during low-flow times of the year, particularly in those drainages with low levels of TDS. The specific ionic constituents comprising TDS are also important determinants of a water body's effect on aquatic organisms. For purposes of comparison, fresh water usually has a salinity of less than 500 mg/l while sea water has an average salinity of 35,000 mg/l. The surface discharge and runoff of production water also would cause erosion of soils and even higher concentrations of solids. Examples of TDS concentrations in groundwater found in coal aquifers of the Powder River Basin were presented previously in the *Hydrological Resources* section of this document and ranged from 401 to 2,646 mg/l.

Based on the mitigation measures and assumptions described earlier, relatively few impacts on aquatic resources would be expected from exploration activities at 400 CBNG wells on BLM-administered lands under Alternative A. However, short-term impacts on aquatic resources resulting from CBNG exploration activities on BLM-administered lands would include increased sediment delivery to nearby drainages during runoff events. Fish passage would also be impeded if culverts or bridges are used to cross drainages and are inappropriately placed. In addition, there is the potential for the accidental spill or leakage and entry of petroleum products into drainages associated with vehicles using the access roads and present at exploration sites. Increased access and human presence during exploration activities also may result in some increased harvest of game fish. There would be no anticipated change in streamflow volumes by exploration activities since these activities would not discharge production waters into surface drainages. Any untreated waters from exploration would be placed in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

As noted in the earlier discussion of wildlife resources, nearly all of the mitigation measures for CBNG activities on BLM-administered surfaces do not apply to CBNG activities on non-BLM-administered surfaces (i.e., lands subject to state regulations). Therefore, the absence of mitigation measures that prohibit the occupancy or use of water bodies, floodplains and riparian areas on lands subject to state regulations increases the likelihood that exploration activities at 275 CBNG wells on state-regulated lands within or immediately adjacent to these habitats would have a greater potential for impacting aquatic resources than on BLM-managed lands. These impacts would be in addition to those described in the preceding text for exploration activities on BLM-administered surfaces. However, the magnitude of these impacts would probably still be minor because of the somewhat limited nature of exploration activities. There would continue to be the potential for increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products and possibly increased fish harvest. However, there would be no effect on stream flow volume. In addition, as noted for exploration activities on BLM-administered surfaces, there would be requirements for placing untreated exploration water in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

The State of Montana has stressed the importance of protecting high-value recreational fish populations that occur in drainages in the CBNG Planning Area. It is expected that the state would not allow exploration activities to be conducted in a manner that would impact these highly valued fisheries. They include trout fisheries and populations of other important species of game fish, particularly in those drainages in each county that have been judged by the State of Montana to support a resource of national renown and to have outstanding, high, or substantial fisheries resource values.

Under the No Action Alternative, CBNG production would only occur on the CX Ranch, where there are no specific mitigation measures for CBNG production activities. Because of this, potential impacts from the development of 250 producing CBNG wells on the CX Ranch would generally include the same impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time. Discharge of production water from these wells would be regulated by the MDEQ via a MPDES permit, which would allow 1,600 gallons per minute (gpm) discharge into the upper Tongue River from up to 11 discharge points. During Water Year 2005, the average CBNG produced water discharge to the Tongue River in Montana was approximately 1,067 gpm upstream of the Tongue River Reservoir (MBMG 2005). However, current permits (as of February 2006) allow 3,300 to 4,200 gpm upstream of the reservoir (varying by season) and an additional 1,122 gpm downstream of the reservoir (see the *Hydrological Resources* section in Chapter 3).

The TDS concentration in CBNG-produced water from the CX Ranch is about 1,400 mg/l, while Regele and Stark (2000) reported the average TDS concentration for the Tongue River is 284 mg/l. The resultant TDS concentration from discharging 3.6 cfs (approximately 1,600 gpm) of production water (1,400 mg/l TDS) to the Tongue River with a flow of 39 cfs (284 mg/l TDS) would be 378 mg/l TDS. This represents a 94 mg/l increase in TDS over background levels, but it is still well below the TDS guideline of 1,000 mg/l associated with possible effects on fish. Resultant water temperatures would likely be similar to that of the

Tongue River upstream of the mixing zone because of the predominance of river flow. This would not be the case when there is very low or sometimes no background flow in the Tongue River, as is the case during critical drought periods. Under the very worst-case conditions, the only flow in the river would theoretically consist of CBNG produced water with a TDS concentration of approximately 1,400 mg/l that has been discharged to the river. While this TDS value would exceed the 1,000 mg/l TDS concentration associated with possible effects on aquatic organisms, it would be the only source of water in the drainage and probably provide at least some refuge for aquatic organisms until background flows return. Water temperatures may initially be somewhat cooler than would normally occur during low-flow periods, but they would likely increase proceeding downstream in response to local climatic conditions.

This same type of analysis can be done by evaluating the effect of produced water and the dilution effect of Tongue River water using bioassays and predictive modeling. However, the results of bioassays differ substantially from and show far fewer effects on aquatic organisms than suggested by predictive modeling. The Mount et al. (1997) model would predict that the produced water from the CX Ranch wells would be lethal to 100 percent of fathead minnows. Once the water is discharged to the Tongue River, the dilution would be such that there would be no increase in toxicity to fish in the river. The model would indicate that if there was no or very little dilution of this discharge by either flowing or standing river water, it would be toxic to fish and aquatic invertebrates.

Results of actual whole effluent toxicity testing using fathead minnows and a cladoceran (water flea), *Ceriodaphnia dubia*, showed far fewer or no mortalities than predictive modeling. A representative sample of effluent from Fidelity Exploration & Production Company coal bed natural gas wells that discharges to the Tongue River and of Tongue River receiving water collected immediately upstream of the effluent outfall were used in whole effluent toxicity testing. Acute toxicity tests (96 hours for fathead minnows and 48 hours for *Ceriodaphnia*) were conducted at Energy Laboratories, Inc. (2001) in Billings Montana, from March 22 through March 26, 2001, in accordance with Region VIII EPA guidelines. Six dilutions were used during whole effluent toxicity testing with percent effluent in each dilution at 0 percent (pure receiving water control), 12.5 percent, 25 percent, 50 percent, 75 percent and 100 percent (pure effluent). The effluent passed the 50 percent mortality test for both species tested, indicating there would be no mortalities at equal parts of effluent (or less) and receiving river water. At effluent levels of 75 and 100 percent, fathead minnow survival after 96 hours was 85 percent and 60 percent, respectively. *Ceriodaphnia* survival after 48 hours at effluent levels of 75 and 100 percent was 95 and 80 percent, respectively (Energy Laboratories, Inc. 2001). These test results generally indicate some mortalities of fish and insects could occur when the volume of effluent constitutes more than 50 percent of the flow in a drainage.

Experiments have shown that increased bicarbonate concentrations (sodium bicarbonate from CBNG produced water) appears to have greater toxicity to some fish than was previously estimated (Skarr et al 2005). Studies of newly hatched fathead minnows showed mortality when exposed to waters with bicarbonate concentrations greater than 400 mg/l. While white suckers show improved hatching and early survival rates at bicarbonate concentrations as high as 1,400 mg/l when compared to control groups. However, at higher concentrations (between 4,049 and 6,678 mg/l) the percent mortality of white suckers was as much as 50 percent (Skarr et al 2005). CBNG produced waters in the Tongue and Powder River watersheds have average bicarbonate concentrations of approximately 1,000 to 1,500 mg/l (Skarr, 2006).

In addition to untreated produced water discharge volumes, two additional permits were submitted to MDEQ for the discharge of treated water to the Tongue River (MBMG 2005) and subsequently approved. One of these permits would allow for discharge upstream of the Tongue River Reservoir (1,700 gpm) and the other for discharge downstream of the reservoir (1,122 gpm). The combined CBNG water discharges would result in a total of 7.6 cfs of increased flows to the river, or about 10 percent of the 7Q10 flow at Brandenburg Bridge.

The abandonment of exploratory and producing wells would have few, if any, direct or indirect impacts on aquatic resources. Activities that impact aquatic habitat and biota during CBNG exploration and production phases would cease with CBNG abandonment. Any associated long-term effects on aquatic resources from these discontinued activities, such as sediment delivery from roads, would gradually subside as disturbed areas are reclaimed.

Special Status Species

The federally endangered pallid sturgeon and one federal candidate species (Montana Arctic grayling) are present in portions of the Planning Area. Also present in portions of the Planning Area are seven BLM-sensitive and/or state fish species of special concern, including sturgeon chub, blue sucker, sauger, northern redbelly dace x finescale dace hybrid, paddlefish, pearl dace and Yellowstone cutthroat trout.

Distribution of these species was described in Chapter 3 discussions of the affected environment for aquatic resources. The affected environment for special status amphibians and aquatic dependent reptiles is discussed in the wildlife section of Chapter 3 and the potential impacts to these species from the project alternatives are presented in the wildlife section of Chapter 4.

Because of their scarcity or narrow habitat niche, these special status species may be somewhat more vulnerable to potential project effects than were described above for all aquatic resources. However, the potential for affecting any of the federally listed, candidate, significant concern, BLM-sensitive, or state species of concern would generally be similar to that described in the preceding text for other aquatic species and would either be low or absent. For example, all water from exploration activities would be captured in tanks and not discharged to rivers. In addition, conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges. Some impacts could potentially occur, however, during extreme low or no flow conditions. Release of adequate quality water from production may improve habitat that has been degraded through water withdrawals. The range and type of other potential effects discussed above for aquatic resources also apply to special status species since they are a subset of aquatic resources. Special status species could be minimally affected through construction of stream crossings, erosion generated by construction activities and effects of other activities discussed above for aquatic resources.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. However, regulations mentioned above related to aquatic resources would be under the jurisdiction of tribal laws and not state or federal laws. CBNG development on the Crow Reservation is expected to be very limited. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands. If there were no CBNG development on tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation. CBNG development in Wyoming could impact surface waters on the reservation and could have an effect on aquatic life.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative A. CBNG development on the Northern Cheyenne Reservation is expected to be very limited. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands and would occur on a much smaller scale than on BLM-administered or State lands. If there were no CBNG development on tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation. CBNG development in Wyoming could impact surface waters on the reservation and could have an effect on aquatic life. However, the pending Montana and Wyoming Water Quality Agreement would preserve the current water quality in the Tongue River and prevent Wyoming operators from discharging poor quality production water into the Tongue River. The Tongue River borders the reservation on the east.

Conclusions

Relatively few residual impacts on aquatic resources, including the special status species, would be expected from exploration activities on BLM-managed lands. Some minor, short-term impacts on aquatic resources on BLM-administered surfaces may result from increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products and possibly increased fish harvest. Residual impacts on aquatic resources from exploration activities on lands subject to state regulations would be similar to these impacts, although possibly slightly greater in magnitude because of the lack of mitigation measures prohibiting surface occupancy or use of water bodies, floodplains, riparian areas and steep slopes. Expected impacts on aquatic resources on state-regulated lands would still be relatively minor because of the limited nature of exploration activities and their dispersed pattern over a large geographic area. Residual impacts from developing 250 CBNG wells on the CX Ranch would include the same potentially minor kinds of impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time. The effects of discharging production water from these wells to the upper Tongue River drainage basin would cause river flow to increase from about 39 cfs to 43 cfs and river TDS concentration to increase from 284 mg/l to 378 mg/l. These increases would not be expected to impact aquatic habitat or organisms in the Tongue River. In addition, the conditions of the MPDES Permit would provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges. Discharges of CBNG produced water during extreme drought conditions of no background flow (worst-case conditions) would probably provide some refuge for aquatic organisms, even though TDS concentration would be approximately 1,400 mg/l and water temperatures would initially be cool but increase. There also could be some mortalities of aquatic organisms, as indicated by results of whole effluent toxicity WET testing, under these extreme conditions. The abandonment of CBNG wells would have few, if any, direct or indirect residual impacts on aquatic resources. Long-term effects on aquatic resources associated with discontinued activities, such as sediment delivery from roads, would subside as disturbed areas are reclaimed. Agency mitigation measures implemented during abandonment would reduce erosion potential, prevent water quality degradation, facilitate reclamation of disturbed lands and further reduce the potential for long-term impacts on aquatic resources, including special status species.

Cumulative Impacts

This assessment considers the potential cumulative impacts on aquatic resources resulting from the effects of the No Action Alternative together with the effects from five coal mines, two minerals/metals mines, five existing power plants, four oil and gas refineries, two manufacturing facilities and the proposed Tongue River Railroad that are present within the Planning Area. The greatest potential for impacts on aquatic resources from these other projects is probably from coal mines, both through the direct loss of habitat and the degradation of water quality. Surface water quality near coal mines is impacted by increased sediment load because of increased erosion during mining. This is mitigated by the use of sediment settling ponds and the vegetation of overburden and topsoil storage areas. The discharge of groundwater pumped from mine pits also may affect surface water quality and quantity, depending on the quality of groundwater within the mine vicinity and the quantity of groundwater discharged. Aquatic resources associated with nearby springs and surface streams within the area could be impacted by the lowering of water tables from mining activities. In some instances, mining activities impact aquatic resources by diverting streams or drainage areas that are within the area to be mined. Original topography, including stream channels and drainage areas, are restored during mine reclamation activities. Some of these same types of impacts also may occur at minerals/metals mines, but would be less likely to occur at the power plant, oil and gas refinery and manufacturing sites.

Other possible impacts on aquatic habitat and biota from these projects include sediment delivery from access roads located near drainages, loss of riparian habitat and function along streams and reduction in water-based recreational activities such as fishing with the loss of aquatic habitat. The nature of effects on aquatic resources from these activities would be similar to those described for potential impacts under the No Action Alternative for CBNG development. Most of these impacts would be limited in area given the generally localized nature of these other projects. Their effects are typically mitigated by following standard construction and operating procedures and BMPs and by implementing reclamation activities during or following project construction, operation and/or abandonment—the same as described for CBNG development under the proposed project. For these reasons, the effects from these other projects would not be expected to result in substantive cumulative impacts on aquatic resources potentially affected by CBNG development.

Regele and Stark (2000) discussed some of the possible biological issues associated with CBNG gas development in Montana, including the effects of pumping and discharging production water from CBNG wells into surface drainages. They reported that much of the groundwater being produced from more than 3,000 CBNG-producing wells in the Wyoming portion of the Powder River Basin is being discharged into rivers that flow directly into southeastern Montana. These include the Powder and Little Powder rivers and their tributaries. Some potential short-term and long-term CBNG developmental effects identified by Regele and Stark (2000) include decreased surface water availability in some areas because of groundwater pumping; increased surface water flows in areas receiving CBNG discharges in other areas; and water quality effects of CBNG development discharges on waters and biota receiving the CBNG discharges. However, Wyoming EISs and EAs found no decrease in surface water because of aquitards between production coals and surface waters.

The *Hydrological Resources* impact analysis presented in this chapter evaluated the potential cumulative effects of full-scale CBNG development and discharge of produced water to the Powder River Basin in Wyoming. That analysis recognized the substantial flow increases and associated hydrologic and water quality impacts that would occur in the Powder, Little Powder and Tongue rivers in Montana as a result of those discharges. Impacts on aquatic habitat and biota from that magnitude of discharge also would be substantial. The *Hydrological Resources* analysis noted, however, that the WYDEQ and MDEQ have pledged to maintain water quality in these three rivers and that surface water discharge permits limiting the quantity of CBNG-produced waters that would be discharged would mitigate impacts from Wyoming CBNG on Montana rivers. This action also would mitigate the potential for cumulative impacts on aquatic resources from the effects of Wyoming CBNG on Montana rivers.

The proposed Tongue River Railroad could impact aquatic invertebrates and fish through habitat disturbance and water quality impacts, such as temporary increases in sediment loading and TSS, caused by construction of bridges and portions of the rail line adjacent to the Tongue River. Increases in TSS may temporarily increase downstream drift of aquatic invertebrates, resulting in lower invertebrate populations in the construction area and deter fish movement through the construction zone. Increased sediment loading may also cause the irritation of the gills of sensitive fish species. One spawning area for smallmouth bass may be temporarily or permanently lost and spawning habitat for northern pike may also be impacted. During operation of the railroad, impacts to aquatic resources may caused by loss of aquatic habitat from alteration of the flood plain, use of herbicides and fuel or other hazardous material spills. However, construction and operation of the railroad will be in accordance with all state and federal rules and regulations and will use mitigation measures and best management practices to minimize impacts to aquatic resources.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Most but not all of the same types of impacts on aquatic resources described for CBNG activities under Alternative A (No Action Alternative) would occur under Alternative B. These impacts and some of their effects include the direct removal of aquatic and riparian habitat at stream crossings and near well sites, habitat degradation and loss from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish and aquatic invertebrates from accidental spills or pipeline ruptures releasing harmful substances and increased harvests of fish because of increased human access. The magnitude and geographic extent of these impacts would potentially be greater under Alternative B than Alternative A because of the activities associated with the development of an estimated 23,850 CBNG production wells and 2,650 CBNG dry holes. There would be an estimated 7,621 production wells and 847 dry holes on BLM-administered land, 8,849 production wells and 983 dry holes on state-regulated land, 7,200 production wells and 800 dry holes on tribal land and 180 production wells and 20 dry holes on USFS-administered land.

Impacts described under the No Action Alternative that are associated with the discharge of production water to drainages and resultant increases in stream flows and elevated levels of TDS and constituents would not occur under Alternative B. There would be a potential for the accidental spill, release, or seepage of production waters temporarily stored in holding ponds or tanks prior to their injection. However, as noted in the *Hydrological Resources* impact analysis, berms around these facilities would be designed to contain and prevent the accidental runoff to nearby drainages of stored production waters, which should minimize the potential for impacting aquatic habitat and resources.

The *Hydrological Resources* impact analysis indicates based on the estimated groundwater depletions, those watersheds that may experience the greatest CBNG development activity. The most active watersheds are projected to be the Little Bighorn and Lower Bighorn, Upper Tongue and Lower Tongue, Little Powder and Middle Powder, Mizpah and Rosebud, where an estimated 14 to 50 percent of the groundwater resource in the coal seams within a watershed would be depleted after 20 years. Even though few impacts on aquatic resources are projected under Alternative B, data on fish species present, fisheries management policies and fisheries resource values would be used to identify those watersheds and drainages that are probably most sensitive to the effects of CBNG development and should be monitored closely during CBNG activities. Based on these fisheries criteria, drainages probably most sensitive to the effects of CBNG development are the Lower Bighorn, Upper Tongue and Little Bighorn. The Lower Bighorn and Upper Tongue are managed as trout fisheries and have high fisheries resource values, while the Little Bighorn is managed for warm/cool water fish species and trout and has a moderate fisheries resource value. The Lower Tongue, Little Powder and Rosebud are probably less sensitive from a fisheries perspective, being managed as non-trout or undesignated fisheries, but they have high to substantial fisheries resource values. The Mizpah is probably the least sensitive of these drainages, being managed as a non-salmonid (warm water) fishery with a moderate to limited fisheries resource value.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative B would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternative A. However, they would be greater in magnitude and extent because of considerably more production wells and would primarily result from construction-related activities. No production water would be discharged to drainages under Alternative B and there would be no resultant potential for affecting special status species. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for Alternative A, these species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were in fact no CBNG development on the Crow Reservation, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative B to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B. CBNG development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a much smaller scale than on BLM or State lands. If there were no CBNG development on the Northern Cheyenne Reservation, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative B to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Conclusions

The types of residual impacts that would persist for Alternative B are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative B than Alternative A. Also, no CBNG-produced water would be discharged under Alternative B and there would be no potential for resultant residual impacts on aquatic resources, including special status species, from that particular activity.

When compared to Alternative A, there would be an increased risk for cumulative effects from CBNG activities associated with Alternative B, but the impacts would be less than Alternative C. In addition, the 1-mile-wide buffer around active coal mines under Alternative B would reduce the potential for cumulative groundwater drawdown impacts to result from coal mine projects.

Alternative C—Emphasize CBNG Development

Impacts on aquatic resources associated with Alternative C would include all of those CBNG-related impacts described for Alternatives A or B, but they would be greater in magnitude. The intensity and geographic extent of CBNG exploration, production and abandonment under Alternative C would be the same as described for Alternative B. However, Alternative C emphasizes CBNG exploration and development with minimal restrictions and it would disturb many more acres (101,000 acres short-term, 69,000 acres long-term) than Alternative B (80,000 acres short-term, 48,000 acres long-term). Alternative C contains the same set of mitigation measures as Alternative B, whose benefits were described earlier and which were listed in Chapter 2. However, unlike Alternative B, CBNG exploration and production water under Alternative C would be discharged, untreated, onto the ground's surface where it would subsequently enter surface water drainages. There would be no requirement for injecting CBNG production water into the ground, for treating water prior to its discharge, or for preparing a site-specific water management plan. Discharged CBNG water would be available for beneficial uses by industry, landowners, agriculture and for wildlife if of suitable quality.

The effects of increased TDS concentrations would probably be greater on the more sensitive species of salmonids in headwater mountain streams than on native fish species in prairie streams that have evolved in an environment of naturally higher TDS levels. In addition, sensitive species of salmonids and non-native warm water fish that have not evolved in highly saline water but that now reside in prairie streams also would be at risk. These species may be particularly vulnerable because TDS levels are generally already high in prairie streams, thereby increasing the potential for TDS-related impacts from CBNG production.

Regele and Stark (2000) discussed impacts on aquatic resources resulting from CBNG effects on drainage hydrology and water quality that would probably have the greatest likelihood of occurring under Alternative C. Potential impacts from reduced surface water availability would probably be limited to the unlikely event of a localized connection between a spring-fed stream and groundwater withdrawals. This could possibly result in the reduction or loss of springs and flowing reaches of stream channels that provide habitat for native flora and fauna in southeastern Montana. Regele and Stark (2000) cited studies by the MFWP that recognized the importance of perennial and intermittent prairie streams in the life history of native fishes, by providing spawning and rearing habitat for mainstem fish species. The effects of increased flows from CBNG discharges would include channel erosion, soils and vegetation loss, increased sediment load and sedimentation and degraded water quality; these effects would directly and indirectly impact fish, amphibians, aquatic invertebrates and algae. Also, if great enough, increased TDS and salinity levels in streams receiving CBNG discharges would affect fish and aquatic invertebrates, especially those species not well adapted to high TDS levels, such as salmonids found in higher-elevation streams. Regele and Stark (2000) cited studies that showed TDS concentrations should not be increased above 1,200 micromhos if a water's "excellent biological health characteristics are to be preserved." The potential development of saline seeps down-gradient of CBNG holding ponds also would affect aquatic resources present in streams receiving these discharges. Regele and Stark (2000) cited the MFWP, which concluded that because of the limited fisheries habitat available in the arid environment of southeastern Montana, great care must be taken where there is a potential to degrade aquatic resources.

The *Hydrological Resources* impact analysis in this chapter estimated that 0.67 billion cubic feet of CBNG water would be discharged to the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 21 cfs and assumes a 70 percent conveyance loss prior to discharges reaching drainages. The *Hydrological Resources* impact analysis showed that resultant flow increases over base flows would average less than 1 percent in most of the Powder River Basin drainages. The largest percent base flow changes would occur in the Little Powder and Rosebud drainages, which are managed as non-trout, undesignated fisheries and have high or substantial fisheries resource values. Rosebud Creek has been proposed to be classified as a cold water fishery by the Northern Cheyenne Tribe. It supports northern pike and rainbow trout (FWS 1980). This additional volume of water in Powder River Basin drainages would not be expected to impact larger drainages or their water temperatures, but it would impact smaller perennial, intermittent and ephemeral drainages, especially if peak discharges of CBNG water to smaller drainages greatly exceed this annual average. Water quality would be impacted much more than water quantity from CBNG discharges because of the considerably higher TDS and constituent concentrations typically found in CBNG-produced water than in surface drainages. The *Wildlife* impact analysis in this chapter notes that the potential for impacting water quality by discharging CBNG production water with high salinity and sodicity would be greatest in smaller perennial and intermittent drainages during low-flow periods of the year. The effects of high TDS and constituent concentrations on aquatic organisms were discussed under Alternative A.

The temperature of the smaller perennial, intermittent and ephemeral receiving water bodies may also be affected by the increased groundwater discharge associated with this alternative. The resultant temperature change and potential for affecting aquatic resources would depend on a number of variables that would have to be determined on a site-specific basis, such as volume and temperature of production and receiving water, time of year, species present and their thermal tolerances and life history considerations. In the event of reduced water temperatures in receiving waters, any resultant adverse effects would tend to be greater in those systems or portions of systems (for example, downstream reaches) dominated by species with warm water thermal preferences.

Surface discharges of CBNG-produced water would be subject to MDEQ MPDES Permit requirements and limitations for discharge into identified watersheds. The volume of CBNG production water potentially discharged to the Powder River Basin drainages in Montana that were listed in the *Hydrological Resources* impact analysis has a greater potential for causing sediment, flow and water quality-related impacts on aquatic resources than the effects of Alternatives A or B. However, these effects would be within the range of acceptable limitations stipulated under the various MPDES Permits that would have to be issued under Alternative C. For this alternative to be viable, conditions of the MPDES permits must be able to provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on federally listed, candidate, significant concern, BLM-sensitive and state species of concern under Alternative C would generally be similar to those described in the preceding text for aquatic resources under this alternative. Special status species would potentially be affected by changes in the quantity and quality of receiving waters from discharges of CBNG-production water, construction of stream crossings, erosion generated by construction activities and effects of other activities discussed above for aquatic resources. Since production water would not be held in tanks or improved in quality, that which reaches the Tongue, Little Powder and Powder rivers would likely have increased SAR values that could affect the quantity and quality of receiving waters, especially during low or no flow conditions, as well as food sources for special status species. One special status species possibly present in downstream reaches of several of these drainages and found in the Yellowstone River within the Powder River RMA that is potentially at risk is the federally-listed, endangered pallid sturgeon. Other special status species occupying similar habitat types in these particular waters also may be at risk. There also is the potential for affecting Montana Arctic grayling because of the nature of CBNG exploration and development activities that would occur under Alternative C. However, the likelihood of risk is probably low because grayling are generally found at relatively high, cold headwater locations within the Planning Area. Minimizing or avoiding activities in these specific types of areas to the extent possible would minimize the potential for affecting this species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were in fact no CBNG development on tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Unlike Alternative B, there would be no restrictive buffer zone around the reservation under Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative C. CBNG development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. Unlike Alternative B, there would be no restrictive buffer zone around the reservation under Alternative C.

Conclusions

The types of residual impacts that would persist for Alternative C are the same as described for Alternative A, but they would occur on a far greater scale. In addition, a large volume of CBNG-produced water would be discharged under Alternative C and there would be a potential for resultant residual impacts on aquatic habitat and organisms, including special status species, from that particular activity. One of the most noteworthy potential effects of this alternative on special status aquatic species would be possible risks to the endangered pallid sturgeon.

There would be an increased risk for cumulative effects from CBNG activities associated with Alternative C, when compared to all the other alternatives, because of the substantial number of wells that would be developed.

Unlike Alternative B, there would be no buffers around active coal mines or Indian reservations to minimize the potential for inter-related effects.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on aquatic resources associated with Alternative D would include all of those CBNG-related impacts described for Alternatives A and/or B, but they would be greater in magnitude. The intensity and geographic extent of CBNG exploration, production and abandonment and the acres of land disturbed in the short-term and long-term under Alternative D would be the same as described for Alternative B. However, Alternative D encourages CBNG development while maintaining existing land uses and protecting downstream water consumers. Alternative D, like Alternative B, contains the same set of mitigation measures designed to avoid, minimize, or mitigate the impacts of CBNG development activities on aquatic resources. However, unlike Alternative B, CBNG-produced water (depending on water quality) would be treated, prior to its discharge or storage in holding facilities, so that the effluent meets standards established by the MDEQ for downstream uses. Beneficial uses of produced water would be allowed and treatment would vary based on industrial, municipal, agricultural and wildlife uses. Treated, produced water would be discharged to drainages by pipeline or constructed watercourses to avoid the potential for erosion and sediment-related impacts on aquatic resources. The treatment of produced water prior to its discharge to surface drainages through constructed facilities would greatly reduce the potential for elevated TDS, salinity and sodicity levels described for Alternative C.

The *Hydrological Resources* impact analysis estimated that 2.24 billion cubic feet of CBNG water would enter the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 71 cfs and assumes no conveyance losses because of the use of pipelines or constructed water courses to convey discharges. The *Hydrological Resources* impact analysis showed that resultant flow increases over base flows would average 1 percent in Powder River Basin drainages. The greatest increase in base flows (approximately by a factor of 4) would occur in the Little Powder and Rosebud drainages, which would impact aquatic habitat and organisms through the same mechanisms described under Alternative A. This volume of water would not be expected to impact larger drainages, but it would impact other smaller perennial, intermittent and ephemeral drainages, especially if peak discharges of CBNG water to smaller drainages greatly exceed this annual average. There would also be a potential for adverse temperature-related effects on warm water fish species if there is a reduction in receiving water temperature in these smaller drainages. Otherwise, water quality of these streams would not be impacted by discharged water since it would have been treated. As noted for Alternatives A, B and C, conditions of the MPDES permits issued under Alternative D must be able to provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative D would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternatives A and B, except they could be greater in magnitude because of the discharge of treated production water to drainages under Alternative D. Special status species potentially most vulnerable to project-related effects would include those in smaller perennial and intermittent drainages within the Powder River Basin. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for the other alternatives, special status species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were no CBNG development on tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative D to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative D. CBNG development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Northern Cheyenne Tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were no CBNG development on tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative D to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Conclusions

The types of residual impacts that would persist for Alternative D are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative D than Alternative A. Also, CBNG production water discharged under Alternative D would be treated. Except for possible water temperature changes in smaller drainages, there would be no potential for residual water quality impacts on aquatic resources, including special status species, from that particular activity.

When compared to Alternative A, there would be an increased risk for cumulative effects from CBNG activities associated with Alternative D, but the effects would be less than Alternative C (based on the total number of wells developed). In addition, the 1-mile-wide buffer around active coal mines and the 2-mile-wide buffer around reservations under Alternative D would reduce the potential for cumulative inter-related impacts to occur.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts on aquatic resources associated with Alternative E would generally be comparable to the CBNG-related impacts described for Alternative B, which emphasizes the protection of natural and cultural resources. The number of CBNG wells developed would be the same as under Alternative B although more land would be disturbed under Alternative E in the short-term (99,000 acres) and the long-term (59,000 acres).The objective of Alternative E is to manage CBNG development in an environmentally sound manner while sustaining existing land uses. To meet this objective, Alternative E contains requirements designed to protect hydrologic resources by combining management options of CBNG-produced water so that no degradation of water quality, including thermal criteria, would be allowed in any watershed. These options include, but are not limited to, industrial, municipal, agricultural and wildlife beneficial uses, as well as injection, treatment, impoundment and discharge of CBNG water. CBNG operators would be required to develop a Water Management Plan as part of their overall Project Plan that describes how impacts on surface resources resulting from exploration and production activities would be minimized or mitigated and how a discharge (if proposed by the operator) could occur without damaging the watershed-in accordance with a required and approved MPDES Permit and MDEQ water quality laws. The Project Plan would be prepared in consultation with the affected Indian tribes, affected surface owners and other involved permitting agencies according to guidelines to be developed by the BLM and State of Montana.

The lack of transportation corridor requirements under Alternative E would result in greater surface disturbances and possibly increased sediment delivery to nearby drainages compared to Alternative B. However, because of the overall beneficial effect of protective measures, including the mitigation measures described earlier, relatively few impacts on aquatic resources would be expected under Alternative E. Aquatic resources in the same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative E.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative E would generally be similar to those described in the preceding text for aquatic resources under this alternative. Requirements designed to protect hydrologic resources by combining management options of CBNG-produced water so that no degradation of water quality would be allowed in any watershed would benefit special status species. The lack of transportation corridor requirements under this alternative would result in comparatively greater surface disturbances than under Alternative B and possibly increased sediment delivery to nearby drainages. However, because of the overall beneficial effect of protective measures, relatively few impacts on special status species would be expected under Alternative E. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative E.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBNG development on tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation. To determine potential impacts to the Crow Reservation from CBNG development on lands adjacent to the reservation, monitoring wells would be installed during the exploration phase on all BLM-administered oil and gas estates that adjoin reservation boundaries in Montana. If monitoring indicates drawdown would occur on the reservation, mitigation such as the operator providing a hydrologic barrier, communitization agreement, or spacing that would protect Indian minerals from drainage, would be required.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative E. CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBNG development on tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative E are similar to those for Alternative B. These impacts would be essentially the same as described for Alternative A, except that impacts would occur on a greater scale.

When compared to Alternative A, there would be an increased risk for cumulative effects from CBNG activities associated with Alternative E, but the effects would be less than Alternative C.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts on aquatic resources associated with Alternative F (Phased Development) would generally be comparable to the CBNG-related impacts described for Alternatives B and E, which emphasize the protection of natural and cultural resources. The acres of land disturbed in the short term and long term under this alternative would be about the same as described for Alternative E.

The objective of Alternative F is to manage CBNG development in a phased or sequential manner within 4th Order watersheds, while maintaining limits on surface discharge of untreated produced water and surface area disturbances. To meet this objective, Alternative F is designed to protect hydrologic resources by establishing numerical limits on development rates within individual 4th Order watersheds while combining management options for CBNG-produced water to minimize water quality impacts. These produced water management options include, but are not limited to, industrial, municipal, agricultural and wildlife beneficial uses, as well as injection, treatment, impoundment and discharge of CBNG water. However, it is assumed that untreated CBNG discharge from state-permitted wells will exceed the limits established under Alternative F, so no untreated discharge is likely from BLM development under this alternative. For example, current discharge permits for untreated CBNG-produced water in the Tongue River drainage (including permits approved in 2006) is approximately equal to the total allowable untreated discharge volume for the entire watershed under Alternative F (10 percent of 7Q10 flow) (see the Hydrological Resources section in Chapter 3). This limitation is established to minimize impacts on surface resources resulting from exploration and production activities while adhering to the required and approved MPDES Permit stipulations and MDEQ water quality laws.

The possibility that transportation corridors would not be utilized fully (subject to watershed-level analysis) under Alternative F coupled with the increased handling or processing requirements of production water, would result in greater surface disturbances and possibly increased sediment delivery to nearby drainages compared to Alternative B. However, because of the protective measures and the gradual development rate within each 4th Order watershed, relatively few impacts on aquatic resources would be expected under Alternative F. Aquatic resources in the same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also would be monitored closely during CBNG activities under Alternative F using an adaptive management approach.

The phased development and adaptive management aspects of Alternative F are likely to provide a substantial level of protection for aquatic resources. There is considerable uncertainty regarding the specific effects of CBNG development activities on aquatic resources because of limited data, unknown influences of other environmental factors (e.g., drought conditions and other land use activities) and the variability and uncertainty concerning baseline (pre-development) conditions. Given these uncertainties, the systematic and gradual increases in CBNG development under Alternative F provide opportunities to monitor potential changes occurring in watersheds where CBNG development is occurring, as well as baseline conditions in watersheds scheduled for initial development activities.

While all of the action alternatives would likely be implemented in a sequential manner, similar to Alternative F, they do not include specific schedules for overall development or development within specific watersheds. The scheduling uncertainties of the other alternatives decrease the likelihood of obtaining accurate and quantifiable data concerning potential changes in aquatic resources as a result of

CBNG development. For example, Alternative F establishes a sequential order of development for the various watersheds, which is expected to limit the variability of other environmental factors that can increase the uncertainty of monitoring results.

The adaptive management process would use the information obtained from monitoring baseline conditions and conditions occurring during sequential CBNG development in a watershed to make appropriate adjustments to the extent or schedule for CBNG development in specific watersheds and the overall Planning Area.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative F would generally be similar to those described in the preceding text for aquatic resources under this alternative. Requirements designed to protect hydrologic resources by combining management options of CBNG-produced water to minimize water quality/quantity impacts in each watershed would protect special status aquatic species. The possibility that transportation corridors would not be utilized fully (subject to watershed-level analysis) under this alternative would result in comparatively greater surface disturbances than under Alternative B and possibly increased sediment delivery to nearby drainages. However, because of the protective measures, relatively few impacts on special status species would be expected under Alternative F. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative F.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative F. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow Tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. However, it is assumed that CBNG development would also occur in a similar incremental fashion for watersheds on the reservation to maintain economic viability of development activities. In addition, any developments on the Crow Reservation would be included in the total number of allowable wells (either annually or cumulatively) for each 4th Order watershed. If there were no CBNG development on or upstream of tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation.

To determine potential impacts to the Crow Reservation from CBNG development within 5 miles of the reservation boundary in Montana, groundwater monitoring wells and analyses would be required to demonstrate the protection of Indian Trust Assets. If such protection could not be demonstrated, BLM would not approve the APD(s) in that area or would stop on-going development activities and shut in wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative F. CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBNG development on tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative F are similar to those for Alternative B. These impacts would be essentially the same as described for Alternative A, except that impacts would occur on a far greater scale. However, the annual and cumulative watershed development limits would result in gradual environmental changes (if changes occur as a result of CBNG development) and the adaptive management approach would likely result in less overall impacts than the other action alternatives.

As some untreated production water could be discharged under Alternative F, there would be a potential for resultant residual impacts on aquatic resources, including special status species. However, such impacts would be limited by the constraints of the MPDES permit and the cumulative limit of untreated discharge from all CBNG developments within each 4th Order watershed.

Cumulative effects from this activity would be similar to the effects described in Alternative A. However, an increased risk for cumulative effects would occur from CBNG activities associated with Alternative F, but would be less than Alternative C.

Alternative G—Phased Development Multiple Screens (Low Range)

Impacts on aquatic resources associated with Alternative G (Limited Phased Development) would be similar in nature to the CBNG-related impacts described for Alternative F, which emphasizes the same phased development approach. However, with 65 percent fewer wells developed under Alternative G, the overall impacts to aquatic resources are expected to be substantially lower than all the other alternatives.

The objective of Alternative G is the same as Alternative F, which is to manage CBNG development in a phased or sequential manner within 4th Order watersheds, while maintaining limits on surface discharge of untreated produced water and surface area disturbances. Thus, Alternative G is designed to protect hydrologic resources by establishing numerical limits on development rates within individual 4th Order watersheds, while combining management options for CBNG-produced water to minimize water quality impacts.

Like Alternative F, it is assumed that untreated CBNG discharge from state-permitted wells will exceed the limits established under Alternative G, so no untreated discharge is likely from BLM development under this alternative.

Also similar to Alternative F, transportation corridors might not be utilized fully under Alternative G. In addition, the increased handling or processing requirements of production water, could result in greater surface disturbances and possibly increased sediment delivery to nearby drainages on an average (per well) basis, compared to the other alternatives. However, because of the adaptive management approach, the gradual development rate and the reduced overall development within each 4th Order watershed, relatively few impacts on aquatic resources would be expected under Alternative G. Aquatic resources in the most sensitive watersheds would also be monitored closely under the adaptive management approach.

While there is considerable uncertainty regarding the specific effects of CBNG development on aquatic resources, the phased development and adaptive management aspects of Alternative G (along with the overall reduced development) are likely to provide substantial protection for aquatic resources.

While all of the action alternatives would also likely be implemented in a sequential manner, Alternatives F and G include specific schedules for overall development or development within specific watersheds. The scheduling increases the likelihood of obtaining accurate and quantifiable data concerning potential effects of CBNG development on aquatic resources because it facilitates adaptive management. The adaptive management process would use the information obtained during sequential CBNG development in a watershed to make appropriate adjustments to the extent or schedule of additional CBNG development in that watershed or the overall Planning Area.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative G would be similar in nature to Alternative F, although the overall effects are expected to be less because 65 percent fewer CBNG wells would be developed within each 4th Order watershed. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative G.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described for Alternative F. As in Alternative F, CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow Tribal lands. Any developments on the Crow Reservation would be included in the total number of allowable wells (either annually or cumulatively) for each 4th Order watershed. If there were no CBNG development on or upstream of tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation.

To determine potential impacts to the Crow Reservation from CBNG development within 5 miles of the reservation boundary in Montana, groundwater monitoring wells and analyses would be required to demonstrate the protection of Indian Trust Assets. If such protection could not be demonstrated, BLM would not approve the APD(s) in that area or would stop on-going development activities and shut in wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Total CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative G are similar to those for Alternative F, except that impacts would occur on a smaller scale, due to the restricted overall development. Also, the annual and cumulative watershed development limits would result in gradual environmental changes (if changes occur as a result of CBNG development) and the adaptive management approach would likely result in less overall impacts than the other action alternatives.

As some untreated production water could be discharged under Alternative G, there would be a potential for resultant residual impacts on aquatic resources, including special status species. However, such impacts would be limited by the constraints of the MPDES permit and the cumulative limit of untreated discharge from all CBNG developments within each 4th Order watershed. Cumulative effects from this activity would be similar to the effects described in Alternative F, but less extensive.

Alternative H—Preferred Alternative - Multiple Screens

For aquatic resources, restrictions on CBNG development would likely be similar to Alternative F, as both alternatives assume a similar extent of CBNG development. While Alternative F uses restrictions on the overall and geographic extent of CBNG development to protect aquatic resources, Alternative H relies on specific screening criteria. Of the four screening criteria, the water resources criteria principally relates to aquatic resources. Thus, alternatives F and H provide mechanisms for controlling the cumulative effects of CBNG development within the CBNG project area, using an adaptive management approach. However, Alternative H would minimize the potential effects of CBNG development on aquatic resources by also relying on actual water quality monitoring data, rather than just limiting or gradually increasing CBNG development. Although monitoring and the actual rate of CBNG development would likely be similar for both of these alternatives, Alternative H uses specific monitoring criteria to facilitate the adaptive management decision-making process. However, because of the similarities between these two alternatives, their overall effects on aquatic resources would likely be similar. The type and magnitude of such effects are summarized below.

Unlike Alternative F, where it is assumed that untreated CBNG discharge from state-permitted wells would exceed the MPDES discharge limits and allow no additional untreated BLM discharges, Alternative H could result in additional BLM discharges so long as water quality criteria are not exceeded. This approach places more emphasis on specific water quality criteria, rather than relying on total discharge limitations to protect aquatic habitat. The water quality criteria under Alternative H would also encompass potential indirect effects of off-line reservoirs or surface applications of produced water on aquatic resources.

In addition to applying the water resources screening process, Alternative H would require operators to prepare Project PODs for well densities greater than 1 per 640 acres. This is expected to control the rate of CBNG development in specific geographic regions and provide a process for adaptive management review. While there is still considerable uncertainty regarding the specific effects of CBNG development on aquatic resources, the adaptive management and water quality monitoring aspects of Alternative H are likely to provide additional protection for aquatic resources compared to other alternatives.

While all of the action alternatives would likely be implemented in a sequential manner, Alternatives F, G and H include specific adaptive management criteria to control overall development, development rate, or development within specific watersheds. The scheduling and/or monitoring components increase the likelihood of obtaining accurate and quantifiable data concerning potential effects of CBNG development on aquatic resources, thereby facilitating the adaptive management process. This process would use the information obtained during sequential CBNG development in a watershed, or overall Planning Area, to make appropriate adjustments to the extent or schedule of additional CBNG development. As a result, few impacts on aquatic resources are expected under Alternative H, however, this alternative is expected to have more impacts on aquatic resources than Alternatives B and G.

The construction and use of CBNG-related facilities (i.e., roads, pipelines and utility corridors) can also cause direct and indirect effects to aquatic resources. The primary effects include direct loss of habitat (e.g., road crossing culverts), effects on water quantity and quality from changes in runoff characteristics and migration barriers or habitat fragmentation. The effects of these development-related facilities under Alternative H would be similar to Alternative F, as both alternatives have provisions to limit such facilities. However, the specific water quality monitoring requirements of Alternative H are expected to incorporate these potential additional effects on aquatic resources.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative H would be similar to Alternative F, as both alternatives assume a similar extent of CBNG development and both include measures to control the rate of development. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative H.

Crow Reservation

Impacts on the Crow Reservation would be similar to alternatives F and G, as CBNG development within 5 miles of the reservation boundary in Montana would require groundwater monitoring wells and analyses to demonstrate the protection of Indian Trust Assets. In addition, the maximum extent of CBNG development on the Crow Reservation would be the same for all these alternatives. If no CBNG development occurs on or upstream of tribal lands, minimal impacts to reservation aquatic resources are expected.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Total CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative H are similar to those for Alternative F. Although Alternative H has no specific annual or cumulative watershed development limits, CBNG development is expected to be about the same as Alternative F. This is expected to result in gradual environmental changes (if changes occur as a result of CBNG development) and the monitoring and adaptive management aspects would likely result in less overall impacts than the other full-field development alternatives.

As some untreated production water could be discharged under Alternative H, there would be a potential for greater residual impacts on aquatic resources, including special status species. However, such impacts would be limited by the constraints of the MPDES permit and water quality monitoring requirements. Cumulative effects from this activity would also be similar to the effects described in Alternative F.