4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discloses the potential environmental consequences that may result from implementing the Proposed Action, Alternative 1 (the No-Action Alternative), Alternative 2, and Alternative 3. The effect or impact a consequence will have on the quality of the human environment is also discussed. For instance, the consequence of an action may be to greatly increase the number of roads in an area. If the number of roads in an area is increased, opportunities for road-based recreation would be increased but opportunities for primitive recreational activities and solitude would be decreased. Evaluation of the impact would depend on an individual's (or a group's) preferred use of that area.

If the North Jacobs Ranch LBA[1] Tract is leased to the applicant as a maintenance tract under one of the action alternatives, the permit area for the adjacent mine would have to be amended to include the new lease area before it could be disturbed. Table 4-1 shows the area to be mined and disturbance area for the existing Jacobs Ranch Mine (which represents the No-Action Alternative), and how the mine area would change under the Proposed Action, Alternative 2, and Alternative 3. If the tract is leased, the area that would have to be added to the existing permit area would be the LBA tract plus an adjacent strip of land that would be used for highwall reduction after mining and such mine-related activities as construction of diversions, flood- and sediment-control structures, roads, and stockpiles. Portions of the LBA tract that are contiguous to the existing leases will be disturbed under the current mining plans in order to recover the coal in the existing leases. The environmental consequences of implementing either the Proposed Action, Alternative 2, or Alternative 3 would be similar in nature, but in general Alternative 3 would have less impact because it would disturb a smaller area than the Proposed Action or Alternative 2.

Surface mining and reclamation have been ongoing in the PRB for over two decades. During this time, effective mining and reclamation technologies have been developed and continue to be refined. Mining and reclamation operations are regulated under SMCRA and Wyoming statutes. WDEQ technically reviews all mine permit application packages to ensure that the mining and reclamation plans comply with all state permitting requirements and that the proposed coal mining operations comply with the performance standards of the DOI-approved Wyoming program. BLM attaches special stipulations to all coal leases (Appendix D), and there are a number of federal and state permit approvals that are required in order to conduct surface mining operations (Appendix A). The regulations are designed to ensure that surface coal mining impacts are

[1] Refer to page viii for a list of abbreviations and acronyms used in this document.

Table 4-1. Comparison of Existing and Proposed Jacobs Ranch Mine Disturbance Area and Mining Operations.

	No Action Alternative (Existing Permit Area)	**Proposed Action**	**Alternative 2**	**Alternative 3**
Additional Lease Area (Acres)	—	4,821.2	4,982.2	3,363.6
Total Lease Area (Acres)	6,955	11,776.2	11,937.2	10,318.6
Increase in Lease Area	---	69.3%	71.6%	48.4%
Estimated Total Disturbance Area (Acres)[1]	8,122	13,486	13,587	11,811
Increase in Estimated Disturbance Area	---	66%	67%	45%
Estimated Recoverable Coal Remaining as of 1/01[2] (Million Tons)	172	651.7	655.3	465.4
Increase in Estimated Recoverable Coal as of 1/01	---	279%	281%	171%

Notes: [1] Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, railroad facilities, stockpiles, etc.

[2] Estimated Recoverable Coal Resources = tons of in-place coal x recovery factor. For the North Jacobs Ranch LBA Tract, in-place coal = 533 millions tons (Proposed Action), 537 million tons (Alternative 2) or 326 million tons (Alternative 3) and JRCC's estimated recovery factor = 90 percent, based on historic operations.

mitigated. The impact assessment that follows considers all measures required by federal and state regulatory authorities as part of the Proposed Action and Alternatives. Section 4.1 analyzes the direct and indirect impacts associated with leasing and mining the LBA tract under the Proposed Action, Alternative 2, and Alternative 3. Section 4.2 presents the probable environmental consequences of the No-Action Alternative (Alternative 1, not issuing a lease for the tract). Section 4.3 discusses regulatory compliance, mitigation, and monitoring in terms of what is required by federal and/or state law (and is therefore part of the Proposed Action and alternatives) and any additional mitigation and monitoring that may be required. Section 4.4 summarizes the residual effects of the Proposed Action, Alternative 2, and Alternative 3. Section 4.5 discusses the cumulative impacts that would occur if these lands were mined when added to other past, present, and reasonably foreseeable future actions. The cumulative impact analysis includes a discussion of other projects that are in progress, or are proposed in the area of the LBA tract and that would occur independently of leasing the LBA tracts. Projects that have proceeded beyond preliminary planning phases include: 1) construction and operation of the

Two Elk power plant, which has been proposed east of the Black Thunder Mine; 2) construction of Wygen #1 power plant which has been proposed at the Wyodak Mine site; 3) the construction of the proposed DM&E Railroad line; and 4) the ongoing development of CBM resources west of the area of active coal mining. Projects that are in preliminary planning stages include the Two Elk Unit Two Power Plant, also adjacent to the Black Thunder Mine; and the Middle Bear Power Plant, to be located east of the Cordero-Rojo Mine Complex. Section 4.6 analyzes the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. Section 4.7 presents the irreversible and irretrievable commitments of resources that would occur with implementation of the Proposed Action, Alternative 2, or Alternative 3.

4.1 Direct and Indirect Impacts of Action Alternatives

Impacts can range from beneficial to adverse, and they can be a primary result of an action (direct) or a secondary result (indirect). They can be permanent, long-term (persisting beyond the end of mine life and reclamation), or short-term (persisting during mining and reclamation and through the time the reclamation bond is released). Impacts also vary in terms of significance. The basis for conclusions regarding significance are the criteria set forth by the Council on Environmental Quality (40 CFR 1508.27) and the professional judgement of the specialists doing the analyses. Impact significance may range from negligible to substantial; impacts can be significant during mining but be reduced to insignificance following completion of reclamation.

4.1.1 Topography and Physiography

Surface coal mining would permanently alter the topography of the LBA tract. Topsoil would be removed from the land and stockpiled or placed directly on recontoured areas. Overburden would be blasted and stockpiled or directly placed into the already mined pit, and coal would be removed. The existing topography on the LBA tract would be substantially changed during mining. A highwall with a vertical height equal to overburden plus coal thickness would exist in the active pits. If necessary, Mills and Shipley Draws would be diverted into temporary channels or blocked to prevent flooding of the pits.

Typically, a direct permanent impact of coal mining and reclamation is topographic moderation. After reclamation, the restored land surfaces are generally gentler, with more uniform slopes and restored basic drainage networks. The original topography of the North Jacobs Ranch LBA Tract is relatively flat. As a result, the expected post-mining topography would be similar to the pre-mining topography. Following reclamation, the average surface elevation would be approximately 36 ft lower due to removal of the coal. (The removal of the coal would be partially offset by the swelling that

occurs when the overburden and interburden are blasted and removed.) The land surface would be restored to the approximate original contour or to a configuration approved by WDEQ/LQD during the permit revision process.

Direct adverse impacts resulting from topographic moderation include a reduction in microhabitats (e.g., cutbank slopes) for some wildlife species and a reduction in habitat diversity, particularly a reduction in slope-dependent shrub communities and associated habitat. A potential indirect impact may be a long-term reduction in big game carrying capacity. A direct beneficial impact of the lower and flatter terrain would be reduced water runoff, which would allow increased infiltration and result in a minor reduction in peak flows. This may help counteract the potential for increased erosion that could occur as a result of higher near-surface bulk density of the reclaimed soils (Section 4.1.3). It may also increase vegetative productivity, and potentially accelerate recharge of groundwater. As discussed above, there would be little topographic moderation on the North Jacobs Ranch LBA Tract after reclamation because the original topography on the tract is relatively flat.

The approximate original drainage pattern would be restored, and stock ponds and playas would be replaced to provide livestock and wildlife watering sources. These topographic changes would not conflict with regional land use, and the postmining topography would adequately support anticipated land use.

These impacts are occurring on the existing Jacobs Ranch Mine coal leases as coal is mined and mined-out areas are reclaimed. Under the Proposed Action, Alternative 2, or Alternative 3, the area that would be permanently topographically changed would increase as shown in Table 4-1.

4.1.2 Geology and Minerals

Within the North Jacobs Ranch LBA Tract, mining would remove an average of 214.2 ft of overburden, 2.8 ft of interburden, and 64 ft of coal on about 4,798 acres under the Proposed Action. The coal reserves beneath an area of approximately 24 acres within the Proposed Action lease area (4,821.2 acres) have been burned. Mining would remove an average of 211.6 ft of overburden, 2.8 ft of interburden, and 63.5 ft of coal on about 4,873 acres under the Alternative 2 tract configuration. The coal reserves beneath an area of approximately 109.4 acres within the Alternative 2 lease area (4,982.2 acres) have been burned. Under Alternative 3, mining would remove an average of 203.3 ft of overburden, 3.1 ft of interburden, and 57.5 ft of coal on about 3,254 acres. The coal reserves beneath an area of approximately 109.4 acres within the Alternative 3 lease area (3,363.6 acres) have been burned. These acreage figures represent the estimated area of actual coal removal under the Proposed Action and Alternatives 2 and 3. Table 4-2

Table 4-2. Comparison of Existing and Proposed Jacobs Ranch Mine Coal, Overburden, and Interburden Thicknesses.

	No Action Alternative (Existing Permit Area)	**Proposed Action as Applied for LBA Tract**	**Alternative 2 Tract**	**Alternative 3 Tract**
Average Overburden Thickness (feet)	133.2	214.2	211.6	203.3
Average Total Mineable Coal Thickness (feet)	57.1	64.0	63.5	57.5
Average Interburden Thickness (feet)	6.9	2.8	2.8	3.1

compares the estimated coal, overburden, and interburden thicknesses for the existing Jacobs Ranch Mine permit area with estimated coal, overburden and interburden thickness for the North Jacobs Ranch LBA Tract as applied for, and Alternatives 2 and 3.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 240 ft in thickness under the Proposed Action and Alternatives 2 and 3. Approximately 479.7 million additional tons of coal would be recovered under the Proposed Action, compared to 483.3 million tons under Alternative 2, or 293.4 million tons under Alternative 3.

The geology from the base of the coal to the land surface would be subject to permanent change on the LBA tract under the Proposed Action or the action alternatives. The subsurface characteristics of these lands would be radically changed by mining. The replaced overburden and interburden (spoil) would be a mixture of the geologically distinct layers of sandstone, siltstone, and shales that currently exist. The resulting physical characteristics would also be significantly altered.

Drilling and sampling programs are conducted by all mine operators to identify overburden material that may be unsuitable for reclamation (i.e., material that is not suitable for use in reestablishing vegetation or that may affect groundwater quality due to high concentrations of certain constituents such as selenium or adverse pH levels). As part of the mine permitting process, each mine operator develops a management plan to ensure that this unsuitable material is not placed in areas where it may affect groundwater quality or revegetation success. Each mine operator also develops backfill monitoring plans as part of the mine permitting process to evaluate the quality of the replaced overburden. These plans are in place for the

existing Jacobs Ranch Mine and would be developed for the North Jacobs Ranch LBA Tract if it is leased.

During mining, other minerals present on the tract could not be developed however, some of these minerals could be developed after mining. Conventional oil and gas wells would have to be plugged during mining, but could be recompleted after mining if the remaining reserves economically justify the expense of the recompletion. As discussed in Sections 3.3 and 3.11, the North Jacobs Ranch LBA Tract overlies part of the Hilight Oil and Gas Field, which was discovered in 1969. Prior to mining, the active conventional wells in the tract (21 under the Proposed Action and Alternative 2, and 12 under Alternative 3) would have to be abandoned. All production equipment would have to be removed to a level below the coal. The reservoir which these wells produce from will not be disturbed by removal of the coal. The oil and gas lessee could recomplete or redrill wells to recover remaining oil and gas resources from any subcoal oil and gas reservoirs following mining. This would only occur if they believe that the value of the remaining reserves would justify the expense of reestablishing production.

CBM resources that are not recovered prior to mining would be irretrievably lost when the coal is removed. As discussed in Sections 3.3 and 3.11, CBM wells are being drilled on the North Jacobs Ranch LBA Tract. As many as 58 CBM well locations are present on the LBA tract. Rim Operating, Inc., is the owner of most of the CBM drilling rights on the tract. They report drilling 33 CBM wells on the North Jacobs Ranch LBA Tract as of January 2001. Thirteen of these wells began producing in December 2000, and thirteen wells began producing in January 2001. Rim plans more drilling.

In comments submitted to BLM, Rim has estimated that the recoverable CBM resource in the North Jacobs Ranch LBA Tract is 15.4 billion cubic feet (see Appendix I, Comment Letter 4). In comments submitted to the BLM, JRCC has estimated that the recoverable CBM resource in the tract is 5.1 billion cubic feet (see Appendix I, Comment Letter 14). BLM's oil and gas Reservoir Management Group has evaluated methane adsorptive capacity for coal core samples taken near the North Jacobs Ranch LBA Tract, measured bottom hole pressures from wells drilled in the central and eastern part of the LBA tract, and reviewed production histories from 133 CBM wells that started producing before 1999 (see Appendix I, Response to Comment Letter 4). These 133 wells are completed in the same coal as the wells on the North Jacobs Ranch LBA Tract and they have similar depths as wells on the tract (250 to 400 feet). BLM's estimate of the recoverable CBM resources in the North Jacobs Ranch LBA Tract is similar to or less than the 5.1 billion cubic feet estimated by JRCC.

CBM will be produced by the existing 33 wells and other wells, if more are

drilled, during the time it takes to lease and permit the LBA tract and, on a case by case basis, until mining activity approaches each well. Average well life was calculated to be 4.6 years for the 133 wells BLM reviewed. These wells typically recovered 2/3 of their reserves in the first half of their lives. Therefore, BLM estimates that most of the CBM reserves could be recovered prior to initiation of mining activity on the North Jacobs Ranch LBA Tract under the Proposed Action or Alternatives 2 or 3. CBM reserves that are not recovered prior to mining would be lost. This arrangement, which is dependent on cooperation between the oil and gas lessees and the coal lessees, allows for optimizing recovery of both resources.

4.1.3 Soils

Under the currently approved mining and reclamation plan, approximately 8,122 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the Jacobs Ranch Mine (Table 4-1). Disturbance related to coal mining would directly affect an additional 5,364 acres of soil resources on and adjacent to the LBA tract under the Proposed Action, 5,465 acres under Alternative 2, or 3,689 acres under Alternative 3. The reclaimed soils would have different physical, biological, and chemical properties than the premining soils. They would be more uniform in type, thickness, and texture. Average topsoil thickness would be 24 to 36 inches across the entire reclaimed surface. Soil chemistry and soil nutrient distribution would be more uniform, and average topsoil quality would be improved because soil material that is not suitable to support plant growth would not be salvaged for use in reclamation. This would result in more uniform vegetative productivity on the reclaimed land. The replaced topsoil would support a stable and productive vegetation community adequate in quality and quantity to support the planned postmining land uses (wildlife habitat and rangeland). Specific impacts to soil resources would include an increase in the near-surface bulk density of the reclaimed soil resources. As a result, the average soil infiltration rates would generally decrease, which would increase the potential for runoff and soil erosion. Topographic moderation following reclamation would potentially decrease runoff, which would tend to offset this potential increase in runoff due to decreased soil infiltration capacity. The change in soil infiltration rates would not be permanent because revegetation and natural weathering action would form new soil structure in the reclaimed soils, and infiltration rates would gradually return to premining levels.

Direct biological impacts to soil resources would include a short-term reduction in soil organic matter, microbial populations, seeds, bulbs, rhizomes, and live plant parts for soil resources that are stockpiled before placement.

Sediment control structures would be built to trap eroded soil, revegetation would reduce wind erosion, and soil

or overburden materials containing potentially harmful chemical constituents (such as selenium) would be specially handled. These measures are required by state regulations and are therefore considered part of the Proposed Action and action alternatives.

4.1.4 Air Quality

WDEQ/AQD issued an air quality permit (MD-425) for the Jacobs Ranch Mine on September 13, 1999. JRCC's current air quality permit allows up to 38 mmtpy to be mined through year 2001, and 50 mmtpy to be mined in 2002 through 2004. The actual production rate depends on market conditions and contracts. In 1999, JRCC's production was 29.1 million tons, and in 2000 the mine produced approximately 28.3 million tons. As shown on Table 2-1 of Chapter 2, anticipated annual production on the Jacobs Ranch Mine, including the North Jacobs Ranch LBA Tract, is 21 million tons. JRCC plans to keep operating with current equipment and manpower. As discussed in Chapter 2, post 2000 coal production without the North Jacobs Ranch LBA Tract is expected to be 24.5 mmtpy for seven years.

Figure 4-1 was prepared using the air quality modeling analysis that was included in a Section 21 Permit Application to modify the Jacobs Ranch Mine Air Quality Permit MD-224 (JRCC 1999c). This air quality permit modification application was submitted to the WDEQ/AQD in 1999 as part of a request to allow Jacobs Ranch Mine's permitted coal production be increased from 35 mmtpy to 50 mmtpy. The application provided demonstrations that, if Jacobs Ranch Mine increases coal production to the permitted rates, the operation would remain in compliance with applicable state and federal air quality regulations. Figure 4-1 illustrates the maximum modeled annual average PM_{10} and NO_X concentrations in 2003, which is the predicted worst-case scenario year based on maximum particulate emissions from the Jacobs Ranch Mine. At this time, the mine is not proposing to mine the North Jacobs Ranch LBA Tract at the levels analyzed in the current permit.

Figure 4-1 indicates that at a coal removal rate of 50 mmtpy, the highest predicted annual mean PM_{10} concentration is 34.73 $\mu g/m^3$ (including 15 $\mu g/m^3$ background concentration) at the model receptor location shown. The predicted PM_{10} concentrations at all other model receptor locations are less than 34.73 $\mu g/m^3$. Short-term concentrations above 50 $\mu g/m^3$ are predicted in the active pit areas, although the state standard requires only that annual average particulate concentrations above 50 $\mu g/m^3$ not be exceeded at the mine's permit boundary.

According to the air quality permit modification application, increase in coal production at the Jacobs Ranch Mine to 50 mmtpy did not require any new controls or changes in the coal preparation plant sources over and above those already permitted for 35 mmtpy. The application presented an

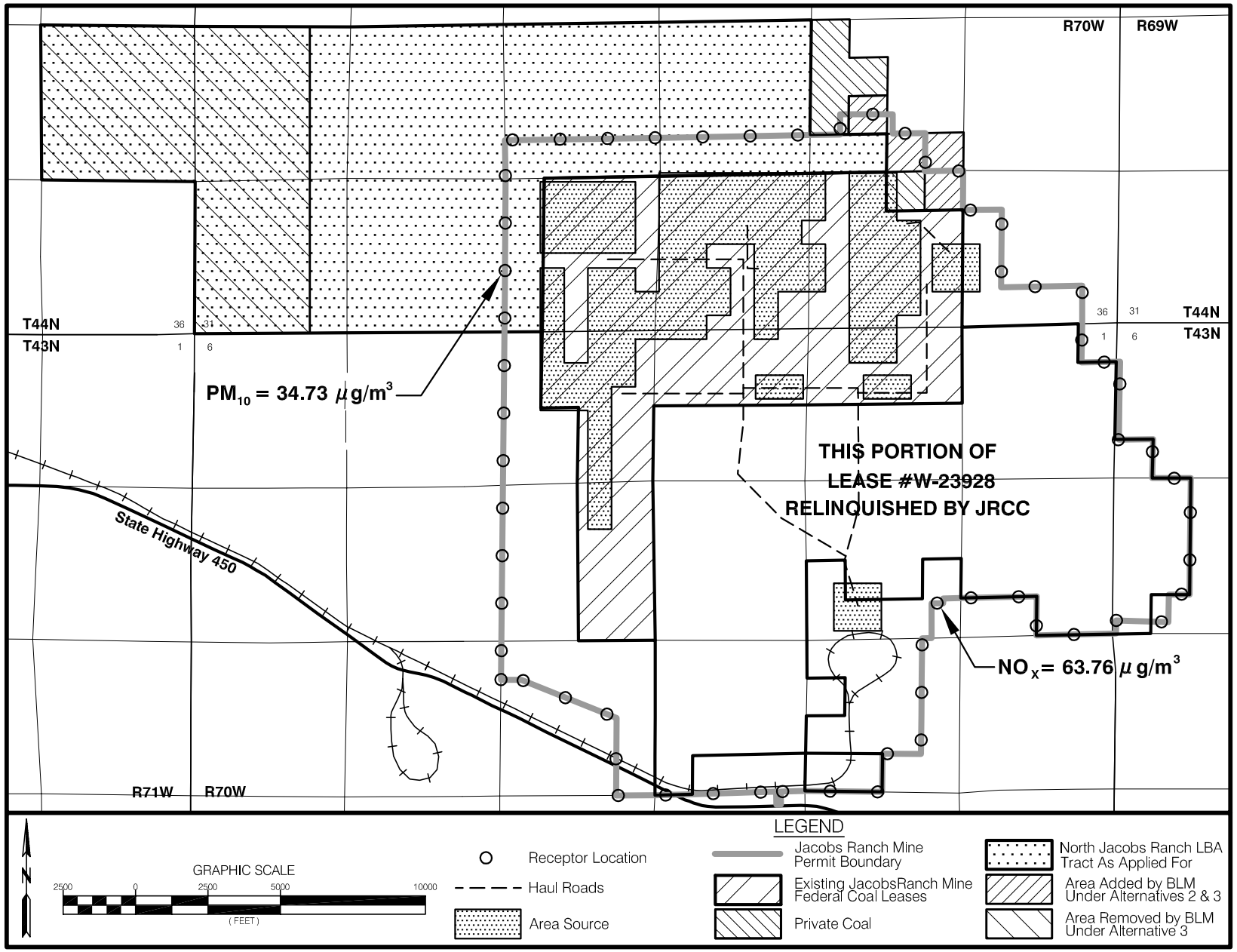


Figure 4-1. Modeled Maximum PM_{10} and NO_X Concentrations at Jacobs Ranch Mine Permit Boundary, Year 2003 Worst-Case Scenario Resulting from 50 Million Tons Per Year of Coal Removal from Existing Leases.

emissions inventory for all sources within the Jacobs Ranch Mine, from neighboring sources (Black Thunder Mine, North Rochelle Mine) and proposed neighboring sources (Two Elk power plant and ENCOAL power plant) for each year of mine life. These sources were input to the dispersion modeling analysis to determine potential air quality impacts in the vicinity.

Since February 2, 1996, AQD has required mines to model for NO_X. The NO_X inventory in the model must include mine-related vehicular tailpipe emissions, emissions from blasting, and emissions from locomotive engines while these engines are on the mine property. In JRCC's 1999 Section 21 Permit Application, modeling predicted the 2003 annual average NO_X concentration of 63.76 $\mu g/m^3$ (background concentration = zero) at the model receptor location shown in Figure 4-1, and the predicted NO_X concentrations at all other model receptor locations are less. Therefore, the maximum modeled annual average NO_X concentrations at all receptor locations are well below the Wyoming Annual Ambient Air Quality Standard of 100 $\mu g/m^3$.

Modeling and permit approval is done with the understanding that BACT will be applied. For the Jacobs Ranch Mine, BACT includes watering and/or chemical stabilization on haul roads and access roads; watering topsoil removal and laydown areas; minimizing overshoot and stemming in blasting areas; minimizing fall distance in overburden and coal removal areas; prompt and contemporaneous reclamation; stilling sheds for coal truck dumps; and covered conveyors, silos, water sprays, baghouses and other dust control systems for coal handling and storage.

Blasting is not a major source of particulate emissions at PRB mines (PM_{10} emissions inventories show that overburden and coal blasting comprise less than 1 percent of the total emissions). Overburden removal, wind erosion, and coal haul roads generate the majority of dust.

A surface coal mine is not a named facility under Wyoming's PSD regulations and therefore is not considered a "major emitting facility" unless it has the potential to emit 250 tons or more per year of any regulated pollutant. Fugitive dust emissions are not considered in determining potential to emit. Because the maximum annual mass emission rate of PM_{10} or NO_X from all point sources at the Jacobs Ranch Mine will be less than 250 tons per year (NO_X is negligible, and PM_{10} from truck dumps plus coal preparation facility sources is 82.3 tons per year), the mine was not subject to an increment analyses under PSD regulations. The maximum annual average PM_{10} concentrations need only be compared to the Wyoming annual average ambient air quality standard of 50 $\mu g/m^3$.

Jacobs Ranch Mine's air quality permit (MD-425) is based on the results of computer modeling that predicted no violation of air quality

standards and demonstrated that emissions would have no significant cumulative effect when added to emissions from neighboring sources. If JRCC acquires the North Jacobs Ranch LBA Tract, they would be required to modify their WDEQ/AQD air quality permit to include the LBA tract before it could be mined. Provided the maximum production rate remains at 50 mmtpy and emissions from all considered sources do not increase, modeling may or may not be required for the revision. Fugitive dust and gaseous pollutant emissions would be expected to remain within levels allowed by the current permit. If JRCC acquires the LBA tract, they would mine it and their existing leases using basically the same equipment with similar BACT emission controls. The PM_{10} concentrations predicted along the edges of the existing Jacobs Ranch Mine permit area would be shifted to the edges of the amended permit area, and mining at the Jacobs Ranch Mine would be extended from 14 years (under Alternative 3) to about 23 years (under the Proposed Action or Alternative 2). As a result, there would be a continuation of the existing permitted impact.

As discussed in Section 3.5, there is public concern over the releases of NO_x from overburden blasting, which can form a low-lying, gaseous orange cloud that can be transported by wind. Exposure to NO_x can cause adverse health effects. Appendix F provides information about nitrogen dioxide and its potential health effects. In the Powder River basin, individuals have complained of health effects after exposure to visible clouds. EPA has expressed concerns that NO_x levels in some blasting clouds may be sufficiently high at times to cause human health effects (see Comment Letter 13). In the summer of 1999 a collaborative group of PRB mines, under the Air Quality Subcommittee of the WMA, collected background air quality data and developed a monitoring program to collect information on the contents of post-blast clouds. A report prepared by the subcommittee and titled *Powder River Basin Short-term exposure NO_2 Study* provides a summary of that data, and a brief discussion of its contents is included in Section 4.5.4.

As a result of these incidents, WDEQ has directed some mines to take steps designed to mitigate the effects of NO_2 emissions occurring from overburden blasting. The steps that may be required include: public notifications (in the form of warning signs along public roadways for example); temporary closure of public roadways near a mine during and after a blast; establishment of safe set-back distances from blasting areas; prohibiting blasting when wind direction is toward a neighbor; prohibiting blasting during temperature inversions; establishment of monitoring plans; estimation of NO_2 concentrations; and development of blasting procedures that will protect public safety and health. To date, none of the incidents of concern have occurred at the Jacobs Ranch Mine. There have been no complaints to the mine or the WDEQ about blasting clouds

produced from the mine. Based on the size and nature of their blasting, the WDEQ has not directed the Jacobs Ranch Mine to take any of these steps to mitigate or prevent blasting clouds. Jacobs Ranch Mine has voluntarily established warning signs along public roadways in the vicinity of the mine.

Currently, JRCC anticipates that production would decrease from current levels if they acquire the North Jacobs Ranch LBA Tract; therefore, current mining techniques and blasting procedures would be expected to be continued. If the North Jacobs Ranch LBA Tract is leased as a maintenance tract, the blasting processes and required mitigation measures would be reviewed when the mining and reclamation permit is amended to include the new lease. At that point, the blasting plan would be reviewed and modified to incorporate the procedures and protection measures that are in effect at that time.

Air quality impacts resulting from, or associated with, mining operations would be limited primarily to the operational life of the mine. During the time the LBA tract is mined, the elevated levels of particulate matter in the vicinity of the mining operations would continue, as would the elevated concentrations of gaseous emissions due to fuel combustion. Compliance with all state and federal air quality standards would be maintained. As with current operations, mining would occur near State Highway 450, the Hilight Road and the Keeline Road making dust visible to the public. The required mitigation measures, which are discussed in Section 4.3, would minimize this impact.

Air quality impacts from the No Action Alternative, the Proposed Action, Alternative 2, and Alternative 3 would not be expected to be substantially different. Under the No Action Alternative, coal production is projected to be 24.5 mmtpy, and under the Proposed Action, Alternative 2, and Alternative 3, production is projected to be 21 mmtpy, which is a 14.3 percent production decrease. Modeling indicates production could increase to 50 mmtpy without exceeding compliance levels for air pollutants. PM_{10} and TSP data collected from 1995 through 1999 at air quality monitoring stations located upwind and downwind of the Jacobs Ranch Mine are shown in Figure 3-5 and discussed in Section 3.5. These data indicate that TSP levels at both the predominantly upwind and predominantly downwind monitoring stations remained relatively constant while coal and overburden production also remained relatively constant from 1995 through 1998. The mine's overburden production increased from 57.8 million cubic yards in 1998 to 82.3 million cubic yards in 1999 and the TSP at both the predominantly upwind and predominantly downwind monitoring sites also increased. However, as the rate of overburden production increased there was not a proportionate increase in TSP measured at the predominantly downwind mine boundary relative to the predominantly upwind mine

boundary as might be expected. In fact, the annual average TSP concentration was greater at the predominantly upwind site than the predominantly downwind site. Distances from the air quality monitoring stations (Figure 3-4) to the active pits may be a factor in this apparent discrepancy. The mining operation has progressed into the northern extent of the permit area and is consequently nearer to the predominantly upwind monitoring station than the predominantly downwind monitoring station. Therefore, the TSP levels along the predominantly upwind side of the mine would be expected to remain as high as the levels along the predominantly downwind side of the mine for as long as the active pits are within the north and west (predominantly upwind) side of the permit area. The average annual TSP levels at both the predominantly upwind and predominantly downwind sites did not exceed the former air quality standard from 1995 through 1999, nor was the current PM_{10} standard exceeded during that time.

Based on the Jacobs Ranch Mine's air quality monitoring information, the average annual PM_{10} levels are expected to remain within the current air quality standards with the increased coal production projected to occur under the Proposed Action, Alternative 2, and Alternative 3. Haul distances from the pit to the crushing facilities would be increased, so dust emissions may increase in proportion to the increased haul distance.

The nearest Class I area is located approximately 80 miles east at Wind Cave National Park in southwestern South Dakota. Mines are not considered to be major emitting facilities in accordance with Section 24 of WDEQ/AQD Rules and Regulations. Therefore, mines are not required by the State of Wyoming to evaluate their impacts on that Class I area. However, BLM evaluates such issues for leasing. For this EIS regional air quality impacts are evaluated under cumulative impacts (Section 4.5).

4.1.5 Water Resources

Surface Water

Changes in runoff characteristics and sediment discharges would occur during mining of the LBA tract as a result of the destruction and reconstruction of drainage channels as mining progresses. Erosion rates could reach high values on the disturbed area because of vegetation removal. However, both state and federal regulations require that all surface runoff from mined lands be treated as necessary to meet effluent standards. Generally, the surface runoff sediment is deposited in ponds or other sediment-control devices inside the permit area.

Due to its location in the headwater area of Mills and Shipley Draws, along with numerous closed basins, runoff within the LBA tract is not expected to be significant. During mining, hydrologic control will most likely consist of allowing runoff to accrue to the mine pit, where it will

be treated and discharged according to the standards of WDEQ/WQD. Large flood control reservoirs or drainage diversions are not anticipated for the LBA tract.

Sediment produced by large storms (i.e., greater than the 10-year, 24-hour storm) could adversely impact downstream areas. Since the tract would be mined as an extension of the existing Jacobs Ranch Mine under the action alternatives, there would not be a large increase in the amount of area disturbed and not reclaimed at any given time. WDEQ/LQD would also require a monitoring program to assure that ponds would always have adequate space reserved for sediment accumulation.

The loss of soil structure would act to increase runoff rates on the LBA tract in reclaimed areas. The general decrease in average slope in reclaimed areas, discussed in Section 4.1.1, would tend to counteract the potential for an increase in runoff. Soil structure would gradually reform over time, and vegetation (after successful reclamation) would provide erosion protection from raindrop impact, retard surface flows and control runoff at approximately premining levels.

After mining and reclamation are complete, surface water flow, quality, and sediment discharge from the LBA tract would approximate premining conditions. The impacts described above would be similar for both the Proposed Action and Alternatives 2 and 3, and they are similar to the expected impacts for currently permitted mining.

Groundwater

Mining the LBA tract would impact the groundwater resource quantity in two ways: 1) Mining would remove the coal aquifers and any overburden aquifers on the mined land and replace them with unconsolidated spoils; and 2) water levels in the coal and overburden aquifers adjacent to the mine would continue to be depressed as a result of seepage and dewatering from the open cut on the LBA tract. The area subject to lower water levels would be increased roughly in proportion to the increase in area affected by mining.

Mining the LBA tract would remove shallow aquifers on an additional 5,364 acres (Proposed Action), 5,465 acres (Alternative 2), or 3,689 acres (Alternative 3) and replace the separate aquifer units with spoil composed of an unlayered mixture of the shale, siltstone, and sand that make up the existing Wasatch Formation overburden and Fort Union Formation interburden. Impacts to the local groundwater system resulting from mining include completely dewatering the coal, overburden and interburden within the area of coal removal, and extending drawdowns some distance away from the active mine area. The extent that drawdowns will propagate away from the mine pits is a function of the water-bearing properties of the aquifer materials. In materials with high transmissivity and low storativity, drawdowns will extend

further from the pit face than in materials with lower transmissivity and higher storage. In general, due to the geologic makeup of the Wasatch Formation overburden (discontinuous sands in a matrix of shale), overburden drawdowns do not extend great distances from the active mine pit (Hydro Engineering 1997, 1998, 1999). Of the three overburden wells monitored by JRCC during 1999-2000, no significant water level changes were observed.

Because of the regional continuity and higher transmissivity within the Wyodak coal seam, drawdowns propagate much further in the coal aquifer than in the overburden. Within the vicinity of Jacobs Ranch Mine, however, coal transmissivity is generally low, and the coal aquifer is unconfined. The combination of unconfined water levels in a low transmissivity aquifer results in very little drawdown in the Wyodak coal seam in the vicinity of Jacobs Ranch Mine. Coal drawdowns from 1980 to 1995 are generally less than five ft within one mile of the active pits at the Jacobs Ranch Mine (Hydro-Engineering 1996a).

In 1999 JRCC monitored water levels in 4 monitor wells in the Wyodak coal seam, one well completed in both coal and underburden, and three wells completed in clinker adjacent to the Wyodak coal. Water levels and maps showing drawdowns in the immediate vicinity of the pit are included in each year's annual report to WDEQ/LQD (JRCC 1995-1999). As expected, drawdowns in the coal seam are a function of distance from the pit as well as geologic and hydrologic barriers and boundaries such as crop lines, fracture zones, and recharge sources. The maximum drawdown measured in a coal monitor well is about 18 feet; no drawdown has been recorded in the coal/underburden monitoring well or in any of the scoria monitoring wells.

JRCC used the MODFLOW model to predict the extent of water drawdown in the Wyodak coal seam as a result of mining at the Jacobs Ranch Mine. The results of the groundwater modeling are reported in the Baseline Hydrology Section in Addendum D6G of the Jacobs Ranch Mine 271-T4 permit document (JRCC 1999a). Predicted drawdowns over the life of mine are shown on Figure 4-2. These predictions are approximate and were based on extrapolation of JRCC's earlier predictions by extending the drawdowns westward and northward by the dimensions of the North Jacobs Ranch Tract. More precise predictions of the extent of drawdowns will be required in order to amend the North Jacobs Ranch LBA Tract into the WDEQ/LQD permit area.

Wyoming SEO records indicate a total of 368 permitted water wells located within three miles of the LBA tract. The majority (192) are owned by coal mining companies and are used for groundwater monitoring and water supply. Of the 176 non mine-related wells, 56 are permitted for stock watering only, 45 are permitted for both CBM development and stock watering, 34 are permitted for CBM development only, 28 are permitted

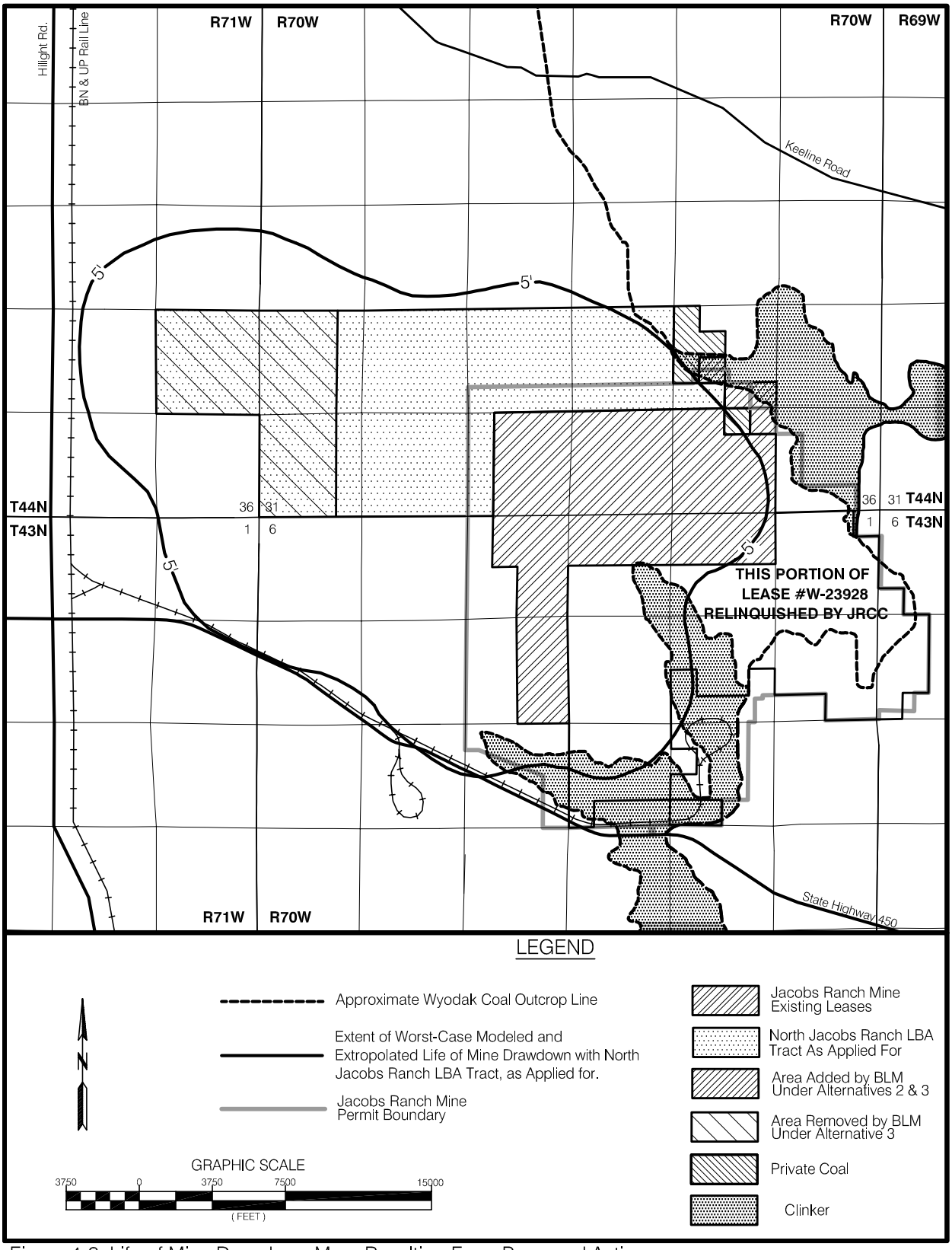


Figure 4-2. Life of Mine Drawdown Map, Resulting From Proposed Action.

for miscellaneous uses, eight are permitted for either stock or domestic use, two are for industrial use and one is permitted for irrigation use.

Some of these wells will likely be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining operations occurring at Jacobs Ranch and the adjacent mines. In compliance with SMCRA and Wyoming regulations, mine operators are required to provide the owner of a water right whose water source is interrupted, discontinued, or diminished by mining with water of equivalent quantity and quality; this mitigation is thus part of the action alternatives. The most probable source of replacement water would be one of the aquifers underlying the coal.

For the current mine area (without the North Jacobs Ranch LBA Tract), JRCC determined that the effects of the predicted drawdown on possible neighboring groundwater users would be negligible. This determination was based on the finding that there were no known water users withdrawing water solely from the Wyodak coal seam within the area of the 5-foot drawdown contour (JRCC Permit 214 T-4 Permit Document, Mine Plan, Section MP4.5.4.10, November 1999).

In May 2000 the files of the SEO were searched to determine whether the preceding statement would still be true for the 5-foot drawdown as extrapolated on Figure 4-2 to consider mining of the North Jacobs Ranch LBA Tract. As within the current mine area, no permitted water supply wells were found within the expanded 5-foot drawdown contour with completion depths that indicated they produce water from the Wyodak coal seam (this excludes wells constructed only for the purpose of monitoring or CBM production). During the permitting process, the mine operator would be required to update the list of potentially impacted wells and predict impacts to these and other water-supply wells within the 5-foot drawdown contour. The operator would be required to commit to replacing these water supplies with water of equivalent quality and quantity if they are affected by mining.

The subcoal Fort Union aquifers are not removed or disturbed by coal mining, so they are not directly impacted by coal mining activity. JRCC has five water supply wells completed in aquifers below the coal. If the LBA tract is leased by the applicant, water would be produced from these wells for a longer period of time, but JRCC would not require additional sub-coal wells to mine the LBA tract.

Mining would also impact groundwater quality; the TDS in the water resaturating the backfill is generally higher than the TDS in the groundwater before mining. This is due to the exposure of fresh overburden surfaces to groundwater that moves through the reclaimed spoils. Research conducted by the Montana Bureau of Mines and Geology on the coal fields of the

northern PRB (Van Voast and Reiten 1988) indicates that upon initial saturation, mine backfill is generally high in TDS and contains soluble salts of calcium, magnesium and sodium sulfates. As the backfill resaturates, the soluble salts are leached by groundwater inflow and TDS concentrations tend to decrease with time, indicating that the long term groundwater quality in mined and off-site lands would not be compromised (Van Voast and Reiten 1988).

Groundwater quality within the backfill aquifer at the North Jacobs Ranch LBA Tract would be expected to be similar to the groundwater quality measured in existing wells completed in the backfill at the Jacobs Ranch Mine. To date, three wells have been installed to monitor water level and water quality in backfilled spoils at the Jacobs Ranch Mine. In February 1999 TDS concentrations in the three wells were, 4,370, 4,800 and 4,750 mg/L. TDS concentrations observed in the Jacobs Ranch Mine backfill monitoring wells are generally higher than those found in the undisturbed Wasatch Formation overburden or Wyodak coal aquifers. Using data compiled from ten surface coal mines in the eastern PRB, Martin et al. (1988) concluded that backfill groundwater quality improves markedly after the backfill is leached with one pore volume of water. The same conclusions were reached by Van Voast and Reiten (1988) after analyzing data from the Decker and Colstrip Mine areas in the northern PRB. Postmining groundwaters are therefore expected to be of better quality after one pore volume of water moves through the backfill than what is observed in the backfill today. In general, the mine backfill groundwater TDS can be expected to range from 3,000 - 6,000 mg/L, similar to the premining Wasatch Formation aquifer, and meet Wyoming Class III standards for use as stock water.

The hydraulic properties of the backfill aquifer reported in permit documents of the nearby Black Thunder Mine are comparable to the Wasatch Formation overburden and Wyodak coal. At the Black Thunder Mine, the backfill aquifer has been tested at two wells, and the hydraulic conductivity in both wells is 1.1 ft/day, which exceeds the average hydraulic conductivity (0.14 ft/day) reported for the Wyodak coal in the vicinity of the Jacobs Ranch Mine. The data available indicate that the hydraulic conductivity of the backfill would be greater than or equal to premining coal values, suggesting that wells completed in the backfill would provide yields greater than or equal to premining coal wells.

Direct and indirect impacts to the groundwater system resulting from mining the LBA tract would add to the cumulative impacts that will occur due to mining existing leases. These impacts are discussed in section 4.5.5.

4.1.6 Alluvial Valley Floors

The North Jacobs Ranch LBA Tract has not yet been evaluated for the

presence of AVF's. However, based on previous non-AVF declarations made on Mills and Shipley Draws downstream of the North Jacobs Ranch LBA Tract, it is unlikely that these channels would receive AVF declarations in their headwater areas, where the drainages are immature and AVF characteristics are negligible. The nearest declared AVF is located on North Prong Little Thunder Creek more than 2 miles downstream from the confluence of Mills and Shipley Draws.

Impacts to designated AVF's are generally not permitted if the AVF is determined to be significant to agriculture. AVF's that are not significant to agriculture can be disturbed during mining, but they must be restored as part of the reclamation process. In order to restore the AVF, the physical and hydrologic characteristics of the AVF must be determined.

If the LBA tract is mined as an extension of existing operations, the mining would extend upstream on streams already in active mine areas. Therefore, no direct, indirect, or cumulative impacts are anticipated to off-site AVF's through mining of the LBA tract.

4.1.7 Wetlands

As discussed in Chapter 3, JRCC has completed a wetlands inventory and submitted it to COE. This inventory identified the acres of jurisdictional wetlands on the North Jacobs Ranch LBA Tract (Section 3.8). A total of 5.22 acres of jurisdictional wetlands comprised of 2.81 acres of manmade stockponds and 2.41 acres of portions of ephemeral stream channels were identified within the LBA tract under the Proposed Action. Existing wetlands located in the LBA tract would be destroyed by mining operations. COE requires replacement of all impacted jurisdictional wetlands in accordance with Section 404 of the Clean Water Act. Replacement of functional wetlands on privately-owned surface may occur in accordance with agreements with the private landowners; no federal surface lands are included in the North Jacobs Ranch LBA Tract. During the period of time after mining and before replacement of wetlands, all wetland functions would be lost. The replaced wetlands may not duplicate the exact function and landscape features of the premine wetlands, but replacement would be in accordance with the requirements of Section 404 of the Clean Water Act, as determined by COE.

As a result of recent court directives, playas may no longer be identified as jurisdictional waters of the U.S. under Section 404 of the Clean Water Act. These non-jurisdictional wetland features, having significant biological and hydrological functions, cover approximately 43.3 acres within the LBA tract. Although COE may not require their replacement as a result of the recent court directive, JRCC plans to continue establishing playa/depressional features within the reclaimed topography if the LBA tract is mined as an extension of the existing operation. If no special

segregation and placement of overburden and soils is necessary, reclamation costs incurred to restore playa/depressional features are not increased. However, if special handling of materials is necessary the reclamation costs generally increase on a site-specific basis.

4.1.8 Vegetation

Under the Proposed Action, mining of the LBA tract would progressively remove the native vegetation on 5,364 acres on and near the LBA tract. Acreage disturbed under Alternative 2 would be 5,465 acres, and acreage disturbed under Alternative 3 would be 3,689 acres. Short-term impacts associated with this vegetation removal would include increased soil erosion and habitat loss for wildlife and livestock. Potential long-term impacts include loss of habitat for some wildlife species as a result of reduced species diversity, particularly big sagebrush, on reclaimed lands. However, grassland-dependent wildlife species and livestock would benefit from the increased grass cover and production.

Reclamation, including revegetation of these lands, would occur contemporaneously with mining on adjacent lands, i.e., reclamation would begin once an area is mined. Estimates of the time elapsed from topsoil stripping through reseeding of any given area range from two to four years. This would be longer for areas occupied by stockpiles, haulroads, sediment-control structures, and other mine facilities. Some roads and facilities would not be reclaimed until the end of mining. No new life-of-mine facilities would be located on the LBA tract under the Proposed Action or Alternatives 2 and 3, in which the LBA tract would be mined as an extension of the existing Jacobs Ranch Mine. Grazing restrictions prior to mining and during reclamation would remove up to 100 percent of the LBA area from livestock grazing. This reduction in vegetative production would not seriously affect livestock production in the region, and long-term productivity on the reclaimed land would return to premining levels within several years following seeding with the approved final seed mixture. Wildlife use of the area will not be restricted throughout the operations.

Re-established vegetation would be dominated by species mandated in the reclamation seed mixtures (to be approved by WDEQ). The majority of the approved species are native to the LBA tract. Initially, the reclaimed land would be dominated by grassland vegetation which would be less diverse than the premining vegetation. At least 20 percent of the area would be reclaimed to native shrubs at a density of one per square meter as required by current regulations. Estimates for the time it would take to restore shrubs to premining density levels range from 20 to 100 years. An indirect impact of this vegetative change could be decreased big game habitat carrying capacity. Following completion of reclamation (seeding with the final seed mixture) and before release of the reclamation bond (a minimum of ten years), a diverse, productive, and

permanent vegetative cover would be established on the LBA tract. The decrease in plant diversity would not seriously affect the potential productivity of the reclaimed areas, and the proposed postmining land use (wildlife habitat and rangeland) should be achieved even with the changes in vegetation composition and diversity. Private landowners (Figure 3-9) would have the right to manipulate the vegetation on their lands as they desire once the reclamation bond is released.

On average, about 460 acres of surface disturbance per year of mining would occur on the LBA tract at the proposed rate of production regardless of which action alternative is selected. By the time mining ceases, over 75 percent of these disturbed lands would have been reseeded. The remaining 25 percent would be reseeded during the following two to three years as the life-of-mine facilities areas are reclaimed.

The reclamation plans for the existing mine include steps to control invasion by weedy (invasive nonnative) plant species. The reclamation plans for the North Jacobs Ranch LBA Tract would also include steps to control invasion from such species. Native vegetation from surrounding areas would gradually invade and become established on the reclaimed land.

The climatic record of the western U.S. suggests that droughts could occur periodically during the life of the mine. Such droughts would severely hamper revegetation efforts, since lack of sufficient moisture would reduce germination and could damage newly established plants. Same-aged vegetation would be more susceptible to disease than would plants of various ages. Severe thunderstorms could also adversely affect newly seeded areas. Once a stable vegetative cover is established, however, these events would have similar impacts as would occur on native vegetation.

Changes expected in the surface water network as a result of mining and reclamation would affect the reestablishment of vegetation patterns on the reclaimed areas to some extent. The postmining maximum slope would be 20 percent in accordance with WDEQ policy. The average reclaimed slope will not be known until WDEQ's technical review of the permit revision application is complete. No significant changes in average slope are predicted.

Following reclamation, the LBA tract would be primarily mixed prairie grasslands with graminoid/forb-dominated areas, and the overall species diversity would be reduced, especially for the shrub component. As indicated previously, following reclamation bond release, management of the privately-owned surface would revert to the private surface owner, who would have the right to manipulate the reclaimed vegetation.

Jurisdictional wetlands would fall under the jurisdiction of the COE. Detailed wetland mitigation plans

would be developed at the permitting stage to ensure no net loss of jurisdictional wetlands on the project area. Functional wetlands may be restored in accordance with the requirements of the surface landowner; there are no public lands included in the North Jacobs Ranch LBA Tract.

The decrease in plant diversity would not seriously affect productivity of the reclaimed areas, regardless of the alternative selected, and the proposed postmining land use (wildlife habitat and rangeland) would be achieved even with the changes in vegetative species composition and diversity.

4.1.9 Threatened, Endangered and Candidate Plant Species

Refer to Appendix G.

4.1.10 Wildlife

Local wildlife populations are directly and indirectly impacted by mining. These impacts are both short-term (until successful reclamation is achieved) and long-term (persisting beyond successful completion of reclamation). The direct impacts of surface coal mining on wildlife occur during mining and are therefore short-term. They include road kills by mine-related traffic, restrictions on wildlife movement created by fences, spoil piles and pits, and displacement of wildlife from active mining areas. Displaced animals may find equally suitable habitat that is not occupied by other animals, occupy suitable habitat that is already being used by other individuals, or occupy poorer quality habitat than that from which they were displaced. In the second and third situations, the animals may suffer from increased competition with other animals and are less likely to survive and reproduce. The indirect impacts are longer term and may include a reduction in big game carrying capacity and microhabitats on reclaimed land due to flatter topography, less diverse vegetative cover, and reduction in sagebrush density.

These impacts are currently occurring on the existing leases as mining occurs. If the LBA tract is leased under the Proposed Action, Alternative 2, or Alternative 3, the area of mining disturbance would be extended onto the LBA tract and mining would be extended by up to 12.3 years at the Jacobs Ranch Mine.

Under the Proposed Action, Alternative 2, or Alternative 3, big game would be displaced from portions of the LBA tract to adjacent ranges during mining. Pronghorn would be most affected; however, none of the area within two miles of the LBA tract has been classified as crucial or critical pronghorn habitat. Mule deer would not be substantially impacted, given their infrequent use of these lands and the availability of suitable habitat in adjacent areas. Elk would not be affected, although they have been observed wintering on grasslands southeast of the LBA tract in recent years. Big game displacement would be incremental, occurring over several years and allowing for gradual changes in distribution patterns. Big game

residing in the adjacent areas could be impacted by increased competition with displaced animals. Noise, dust and associated human presence would cause some localized avoidance of foraging areas adjacent to mining activities. On the existing leases, however, big game have continued to occupy areas adjacent to and within active mine operations, suggesting that some animals may become habituated to such disturbances.

Big game animals are highly mobile and can move to undisturbed areas. There would be more restrictions on big game movement on or through the tract, however, due to additional fences, spoil piles, and pits related to mining. During winter storms, pronghorn may not be able to negotiate these barriers. WDEQ guidelines require fencing to be designed to permit pronghorn passage to the extent possible.

Recently, the WGFD reviewed monitoring data collected on mine sites for big game species and the monitoring requirements for big game species on those mine sites. Their findings concluded that the monitoring had demonstrated the lack of impacts to big game on existing mine sites. No severe mine-caused mortalities have occurred and no long-lasting impacts on big game have been noted on existing mine sites. The WGFD therefore recommended that big game monitoring be discontinued on all existing mine sites. New mines will be required to conduct big game monitoring if located in crucial winter range or in significant migration corridors, neither of which apply to the LBA tract.

Road kills related to mine traffic would be extended in the area by up to 23 years.

After mining and reclamation, alterations in the topography and vegetative cover, particularly the reduction in sagebrush density, would cause a decrease in carrying capacity and diversity on the LBA tract. Sagebrush would gradually become reestablished on the reclaimed land, but the topographic changes would be permanent.

Medium-sized mammals (such as rabbits, coyotes, and foxes) would be temporarily displaced to other habitats by mining, potentially resulting in increased competition and mortality. However, these animals would quickly rebound on reclaimed areas, as forage developed and small mammal prey species recolonized. Direct losses of small mammals would be higher than for other wildlife, since the mobility of small mammals is limited and many retreat into burrows when disturbed. Therefore, populations of such prey animals as voles and mice would decline during mining. However, these animals have a high reproductive potential and tend to re-invade and adapt to reclaimed areas quickly. A research project on habitat reclamation on mined lands within the PRB for small mammals and birds concluded that reclamation objectives to encourage the decolonization of small mammal communities are being achieved

(Shelley 1992). The study evaluated sites at five mines including Jacobs Ranch.

Sage grouse are yearlong residents and are found on lands adjacent to the LBA tract. An active lek was observed in April and May of 1999 at a location near the northern border of the LBA tract (Figure 3-8, Section 3.10). The two-mile radius from the lek, which identifies the area in which most hens will nest, overlaps onto the LBA tract. This lek has been active from 1993 through 1999. Sage grouse were rarely observed using the LBA tract during the July 1999 field survey, but were observed on adjacent lands. The impacts from mining the LBA tract would be the temporary loss of nesting habitat and some disturbance to breeding activities when the mining operations are within close proximity to the birds' strutting ground. Monitoring of sage grouse activities indicates that the birds frequently change lek sites. It is likely that if mining activities disturb a lek, sage grouse will use an alternate lek site for breeding activities. Should the sage grouse establish a lek on the proposed lease area, the lessee would be required to take appropriate mitigation steps prior to mining. Effort will also be made to reestablish shrubs on reclaimed lands, grading of reclaimed lands to create swales and depressions, and continued monitoring of sage grouse activity in the area before, during and after mining. These and other measures will be further developed in the WDEQ/LQD Permit to Mine application.

Mining the LBA tract will not impact regional raptor populations; however, individual birds or pairs may be impacted. Due to a lack of suitable nesting habitat (cliffs and tall trees), very few raptor species have been observed nesting on or near the proposed lease area. As noted in Section 3.10.4, a total of five raptor species (the burrowing owl, great horned owl, ferruginous hawk, Swainson's hawk and American kestrel) have been identified nesting within two miles of the LBA tract. In 1999 five nest sites in this area were active and included one ferruginous hawk nest, two Swainson's hawk nests and two burrowing owl nests. Two species (the Swainson's hawk and the ferruginous hawk) have been recorded nesting on the LBA tract under the Proposed Action. In 1999, the ferruginous hawk had the most nest sites, but all of those nests belonged to the same pair of birds. Mining activity could cause raptors to abandon nests proximate to disturbance. USFWS recommends a 1-mile buffer around all ferruginous hawk nests. USFWS and WDEQ/LQD approval will be required before mining may occur within buffer zones for future or adjacent active raptor nests. The Jacobs Ranch Mine annually monitors territorial occupancy and nest productivity. Raptor nesting activity has frequently occurred in active mining and construction areas and Jacobs Ranch Mine has successfully executed state-of-the-art mitigation techniques to protect nest productivity. There is an approved raptor mitigation plan for the existing Jacobs Ranch Mine. This monitoring

and mitigation plan, as required by the USFWS and WDEQ/LQD, will be amended to include the North Jacobs Ranch LBA Tract if it is leased. Mining near raptor territories will minimally impact availability of raptor forage species. At the adjacent Jacobs Ranch Mine, lack of nesting habitat, not a lack of forage area, has been determined to be the most important factor limiting raptor density. During mining, nesting habitat is created by the excavation process (highwalls), as well as through enhancement efforts (nest platforms and boxes). After mining, the reclamation plan will reestablish the ground cover necessary for the return of a suitable prey base.

Displaced songbirds would have to compete for available adjacent territories and resources when their habitats are disturbed by mining operations. Where adjacent habitat is at carrying capacity, this competition would result in some mortality. Losses would also occur when habitat disturbance coincides with egg incubation and rearing of young. Impacts of habitat loss would be short-term for grassland species, but would last longer for tree- and shrub-dependent species. Concurrent reclamation would minimize these impacts. A diverse seed mixture planted in a mosaic with a shrubland phase would provide food, cover, and edge effect. Other habitat enhancement practices include the restoration of diverse land forms, direct topsoil replacement, and the construction of brush piles, snags and rock piles. A research project on habitat reclamation on mined lands within the PRB for small mammals and birds concluded that the diversity of song birds on reclaimed areas was slightly less than on adjacent undisturbed areas, although their overall numbers were greater (Shelley 1992).

Waterfowl and shorebird habitat on the LBA tract is minimal, and production of these species is very limited. Mining the LBA tract would thus have a negligible effect on migrating and breeding waterfowl. Sedimentation ponds created during mining would provide interim habitat for these fauna. WDEQ and the COE would also require mitigation of any disturbed wetlands during reclamation, which would minimize impacts. If the replaced wetlands on the North Jacobs Ranch LBA Tract do not duplicate the exact function and/or landscape features of the premine wetlands, waterfowl and shorebirds could be beneficially or adversely affected as a result.

No fish habitat will be impacted on the proposed lease.

The impacts discussed above would apply to the three action alternatives. The assessment of impacts to wildlife by mining the LBA tract will be addressed during the WGFD's and the WDEQ/LQD's review of the mine permit application, and within the WDEQ/LQD's permit approval process.

4.1.11 Threatened, Endangered, and Candidate Wildlife Species

Refer to Appendix G.

4.1.12 Land Use and Recreation

The major environmental consequences of leasing the North Jacobs Ranch LBA Tract on land use would be reduction of livestock grazing, loss of wildlife habitat, and curtailment of oil and gas development on about 5,364 acres (Proposed Action), or about 5,465 acres (Alternative 2), or about 3,689 acres (Alternative 3) during active mining. Wildlife (particularly big game) and livestock (cattle and sheep) use would be displaced while the tract is being mined and reclaimed.

Sections 3.11 and 4.1.2 of this document discuss the oil and gas wells and facilities that are present on the LBA tract. Federal oil and gas ownership and federal oil and gas lessee information are presented in Figure 3-10 and Table 3-8. If a coal lease is issued for the North Jacobs Ranch LBA Tract, all of the oil and gas production and transportation facilities on the lease would have to be removed from the surface to the base on the coal prior to mining. Wells that are completed in producing zones below the coal would be capped in accordance with the requirements for abandoning wells.

BLM has issued a policy statement on conflicts between CBM and coal development (BLM Instruction Memorandum No. 2000-081). That policy advocates optimizing the recovery of both coal and CBM resources to ensure that the public receives a reasonable return for the publicly owned resources. CBM is currently being produced on the North Jacobs Ranch LBA Tract, and the BLM estimates that a large part of the CBM resource can be recovered before the tract would be mined. Negotiations are ongoing between JRCC and the oil and gas lessees on how to resolve the conflict if a coal lease is issued. Royalties would be lost to both the state and federal governments if conventional oil and gas wells are abandoned prematurely, if the CBM is not recovered prior to mining, or if coal is not recovered due to conflicts. State and federal governments can also lose bonus money when the costs of the agreements between the lessees are factored into the fair market value determinations.

As discussed in Section 1.2 of this document, none of the lands included in the LBA tract under any of the alternatives are managed by the USFS, no federal land would be removed from public access if the tract is leased.

Hunting on the LBA tract would be eliminated during mining and reclamation. Pronghorn, mule deer, and elk occur on and adjacent to the tract. Sage grouse, mourning dove, waterfowl, rabbit, and coyote also inhabit the tract.

Following reclamation, the land would be suitable for grazing and wildlife uses, which are the historic land uses. There are no BLM or USFS public lands included in the LBA tract, but the reclamation standards required by SMCRA and Wyoming State Law meet the standards and guidelines for healthy rangelands for

public lands administered by the BLM in the State of Wyoming. Following reclamation bond release, management of the privately-owned surface would revert to the private surface owner.

4.1.13 Cultural Resources

All portions of the Proposed Action area and buffer zone were subjected to a Class III inventory and assessment in 1999.

Table 3-9 (Section 3.12) summarizes the distribution of cultural sites by type. Data recovery plans are required for those sites recommended eligible to the National Register following testing and consultation with the SHPO. Until consultation with SHPO has occurred and agreement regarding NRHP eligibility has been reached, all sites should be protected from disturbance.

Full consultation with SHPO will be completed prior to approval of the MLA mining plan. Those sites determined to be unevaluated or eligible for the NRHP through consultation would receive further protection or treatment. Impacts to eligible or unevaluated cultural resources cannot be permitted. If unevaluated sites cannot be avoided, they must be evaluated prior to disturbance. If eligible sites cannot be avoided, a data recovery plan must be implemented prior to disturbance. Ineligible properties may be destroyed without further work.

The eligible sites on the North Jacobs Ranch LBA Tract which cannot be avoided or which have not already been subjected to data recovery action would be carried forward in the mining and reclamation plan as requiring protective stipulations until a testing, mitigation or data recovery plan is developed to address the impacts to the sites. The lead federal and state agencies would consult with Wyoming SHPO on the development of such plans and the manner in which they are carried out.

Cultural resources adjacent to the mine areas may be impacted as a result of increased access to the areas. There may be increased vandalism and unauthorized collecting associated with recreational activity and other pursuits outside of but adjacent to mine permit areas.

4.1.14 Native American Concerns

No sites of Native American religious or cultural importance have been identified on the LBA tract. If such sites or localities are identified at a later date, appropriate action must be taken to address concerns related to those sites.

4.1.15 Paleontological Resources

No unique or significant paleontological resources have been identified on the LBA tract, and the likelihood of encountering significant paleontological resources is small. Lease and permit conditions require that should previously unknown, potentially significant paleontological sites be discovered, work in that area shall stop and measures be taken to

assess and protect the site (see Appendix D).

4.1.16 Visual Resources

Mining activities on most of the North Jacobs Ranch LBA Tract would not be visible from any major travel routes and would be partly concealed by surrounding terrain. Mining of some parts of the LBA tract would be visible from State Highway 450.

Mining would affect landscapes classified by USFS as "common" and landscape character would not be significantly changed following reclamation. No unique visual resources have been identified on or near the North Jacobs Ranch LBA Tract.

Reclaimed terrain would be almost indistinguishable from the surrounding undisturbed terrain. Slopes might appear smoother (less intricately dissected) than undisturbed terrain to the north and west, and sagebrush would not be as abundant for several years; however, within a few years after reclamation, the mined land would not be distinguishable from the surrounding undisturbed terrain except by someone very familiar with landforms and vegetation.

4.1.17 Noise

Noise levels on the LBA tract would be increased considerably by mining activities such as blasting, loading, hauling, and possibly in-pit crushing. Since the LBA tract would be mined as an extension of existing operations under the action alternatives, no rail car loading would take place on the LBA tract. The Noise Control Act of 1972 indicates that a 24-hour equivalent level of less than 70 dBA prevents hearing loss and that a level below 55 dBA, in general, does not constitute an adverse impact. OSM prepared a noise impact report for the Caballo Rojo Mine (OSM 1980) which determined that the noise level from crushers and a conveyor would not exceed 45 dBA at a distance of 1,500 ft. Explosives would be used during mining to fragment the overburden and coal and facilitate their excavation. The air overpressure created by such blasting is estimated to be 123 dBA at the location of the blast. At a distance of approximately 1,230 ft, the intensity of this blast would be reduced to 40 dBA. Since the nearest occupied dwelling is roughly one mile away from the LBA tract, there should be no major noise impacts. The nearest occupied dwelling to the Jacobs Ranch Mine permit boundary is approximately 1.25 miles away.

Because of the remoteness of the site and because mining is already ongoing in the area, noise would have little off-site effect. Wildlife in the immediate vicinity of mining may be adversely affected; however, observations at other surface coal mines in the area indicate that wildlife generally adapt to increased noise associated with active coal mining. After mining and reclamation are completed, noise would return to premining levels.

4.1.18 Transportation Facilities

No new or reconstructed transportation facilities would be required under the Proposed Action or Alternatives 2 and 3. Essentially all of the coal mined on the LBA tract would be transported by rail. Vehicular traffic to and from the mine would continue at existing or slightly higher levels for an additional 14 to 23 years, depending on which alternative is selected.

Active pipelines currently cross the LBA tract, and any relocation of these pipelines would be handled according to specific agreements between the coal lessee and the pipeline owners if the need arises. The Wyoming Department of Transportation routinely monitors traffic volumes on area highways, and if traffic exceeds design standards improvements are made. Burlington Northern-Santa Fe and Union Pacific have upgraded and will continue to upgrade their rail capacities to handle the increasing coal volume projected from the southern PRB with or without the leasing of the proposed LBA tract.

4.1.19 Socioeconomics

Leasing and subsequent mining of the LBA tract would extend the life of the already permitted Jacobs Ranch Mine by 14 to 23 years, depending on which alternative is selected.

Although spot coal prices have risen recently, WSGS is currently predicting that average coal prices will remain relatively constant over the next 5 to 6 years (WSGS 2001). Conservatively assuming a price of $4.00 per ton, the revenue from the sale of the recoverable coal from the LBA tract would total $1.92 billion for the Proposed Action (479.7 million tons of coal), or $1.93 billion for Alternative 2 (483.3 million tons of coal), or $1.17 billion for Alternative 3 (293.4 million tons of coal). Some of this money from the sale of this federal coal would be paid to federal, state and local governments in the form of taxes and federal production royalties, as discussed below.

The federal government would collect a royalty at the time the coal is sold. This royalty is 12.5 percent of the sale price of the coal. At a coal price of $4.00 per ton, this would amount to approximately $240 million under the Proposed Action, $241 million under Alternative 2, or $146 million under Alternative 3. This money would be split equally between the state and federal governments. The federal government would also collect black lung and reclamation taxes based on the sale of the coal.

According to a study done by the University of Wyoming (UW 1994), the State of Wyoming received about $1.10 per ton from the sale of PRB coal produced in 1991. The taxes and royalties included in this calculation were severance taxes, ad valorem taxes, sales and use taxes, and the state's share of federal royalty payments on production (discussed above). Under this scenario, the estimated total direct return to the State of Wyoming from the production of this federal coal, in current dollars, would be $527.7 million under the

Proposed Action, $531.6 million under Alternative 2, or $322.7 million under Alternative 3. This figure includes half of the federal royalty discussed above.

The federal government also receives a bonus payment at the time the federal coal is leased. Bonus payments on the federal coal leases issued in the Powder River Basin since 1990 have ranged from 11.1 cents per ton to 38.3 cents per ton. This range of bonus payments would represent a potential bonus payment range of $32.6 million to $185.1 million for the estimated federal coal tonnage in the North Jacobs Ranch LBA Tract. The actual amount the federal government would receive would depend on the alternative selected and the actual bonus bid if the tract is leased. The bonus payment would be payable over five years and would be divided equally with the State of Wyoming.

If the LBA tract is leased under an action alternative and annual coal production is decreased to 21 million tons as projected, JRCC anticipates that the average number of employees at the Jacobs Ranch Mine would remain 333 over the 14 to 23 years the tract is being mined. These 333 persons represent about 1.2 percent of the 26,946 persons in the January 2001 labor force in Campbell and Converse Counties (Wyoming Department of Employment, Employment Resources Division, March 2001). The January 2001 unemployment in these counties was about 708. No additional demands on the existing infrastructure or services in these communities would be expected because no influx of new residents would be needed to fill new jobs. The economic stability of the communities of Douglas, Wright, and Gillette would benefit by having the Jacobs Ranch Mine employees living in their communities employed for an additional 14 to 23 years.

Issues relating to the social, cultural, and economic well-being and health of minorities and low-income groups are termed Environmental Justice issues. In reviewing the impacts of the Proposed Action and Alternatives 2 and 3 on socioeconomic resources, surface water and groundwater quality, air quality, hazardous materials, or other elements of the human environment in this chapter, it was determined that potentially adverse impacts do not disproportionately affect Native American tribes, minority groups and/or low-income groups.

With regard to Environmental Justice issues affecting Native American tribes or groups, the general analysis area contains no tribal lands or Native American communities, and no treaty rights or Native American trust resources are known to exist for this area.

Implementing any of the alternatives would have no effects on Environmental Justice issues, including the social, cultural, and economic well-being and health of minorities and low income groups within the general analysis area.

4.1.20 Hazardous and Solid Waste

If JRCC acquires the North Jacobs Ranch LBA Tract, the wastes that would be generated in the course of mining the tract would be similar to the wastes that are currently being generated by the existing mining operation. The procedures that are used for handling hazardous and solid waste at the existing Jacobs Ranch Mine are described in Chapter 2. Wastes generated by mining the LBA tract would be handled in accordance with the existing regulations using the procedures currently in use at the Jacobs Ranch Mine, as described in Chapter 2.

4.2 No-Action Alternative

Under the No-Action Alternative, the coal lease application would be rejected and the area contained in the application would not be offered for lease at this time. The tract could be nominated for lease again in the future but, for the purposes of this analysis, the No-Action Alternative assumes that these lands would never be mined. However, the approved mining operations for the existing Jacobs Ranch Mine would not be changed if this alternative is chosen. The impacts described on the preceding pages and in Table 2-2 to topography and physiography, geology and minerals, soils, air quality, water resources, alluvial valley floors, wetlands, vegetation, wildlife, threatened, endangered and candidate species, land use and recreation, cultural resources, Native American concerns, paleontological resources, visual resources, noise, transportation, and socioeconomics would occur on the existing Jacobs Ranch coal lease under the No-Action Alternative, but these impacts would not be extended onto the LBA tract.

The general nature and magnitude of cumulative impacts as summarized in Table 2-3, which would occur from implementation of the Proposed Action or Alternatives 2 or 3, would not be substantially different under the No-Action Alternative. However, coal removal and the associated disturbance and impact would not occur on the 5,364, 5,465 or 3,689 additional acres disturbed in the Proposed Action, Alternative 2, or Alternative 3, respectively. Portions of the North Jacobs Ranch LBA Tract adjacent to the existing Jacobs Ranch and Black Thunder Mines would be disturbed to recover the coal in the existing leases. The economic benefits that would be derived from mining the LBA tract during an additional 23 years of mining would be lost. If a decision is made not to lease this tract at this time, it could be leased and mined as a maintenance lease in the future, while the existing adjacent mines are in operation. If it is not leased while the existing adjacent mines are in operation, it may or may not be leased in the future. The tract is potentially large enough to be leased and mined by a new operation in the future.

4.3 Regulatory Compliance, Mitigation, and Monitoring

In the case of surface coal mining, SMCRA and state law require a

considerable amount of mitigation and monitoring. Measures that are required by regulation are considered to be part of the Proposed Action and Alternatives 2 and 3. These requirements, mitigation plans, and monitoring plans are in place for the No-Action Alternative, as part of the current approved mining and reclamation plan for the existing Jacobs Ranch Mine. If the North Jacobs Ranch LBA Tract is leased, these requirements, mitigation plans, and monitoring plans would be part of a mining and reclamation plan covering the North Jacobs Ranch LBA Tract. This mining and reclamation plan would have to be approved before mining could occur on the tract, regardless of who acquires the tract. The major mitigation measures and monitoring measures that are required by state or federal regulation are summarized in Table 4-3. More specific information about some of these mitigation and monitoring measures and their results at the North Jacobs Ranch Mine are described in the following sections of this document:

- Section 4.1.2, handling of unsuitable overburden material;
- Section 4.1.4, air quality monitoring practices and results and application of BACT for mitigation of air quality impacts;
- Section 4.1.5, surface water hydrologic control measures;
- Section 4.1.5, groundwater quantity and quality monitoring measures and results;
- Section 4.1.5, mitigation for interruption, discontinuation, or diminishment of existing water well rights by mining operations;
- Section 4.1.6, restoration of AVF's impacted by mining;
- Section 4.1.7, identification and replacements of wetlands impacted by mining;
- Section 4.1.8, plans for control of invasive, nonnative plant species;
- Section 4.1.10, fencing designed to permit pronghorn passage;
- Section 4.1.10, notification and mitigation measures to protect active raptor nests and nest productivity;
- Section 4.1.10, mitigation measures to minimize habitat loss impacts to songbirds;
- Section 4.1.13, protection of cultural resources that are recommended eligible for or of undetermined eligibility for the National Register of Historic Places; and
- Appendix G, protection of threatened and endangered species.

If impacts are identified during the leasing process that are not mitigated by existing required mitigation measures, BLM can include additional mitigation measures, in the form of stipulations on the new lease, within the limits of its regulatory authority. In general, the levels of mitigation and monitoring required for surface coal mining by SMCRA and Wyoming state law are more extensive than those required for other surface disturbing activities; however, concerns are periodically identified that are not monitored or mitigated under existing procedures.

Table 4-3. Regulatory Compliance, Mitigation and Monitoring Measures required under the Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3.

RESOURCE	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	MONITORING[1]
Topography & Physiography	Restoring to approximate original contour or other approved topographic configuration	LQD checks as-built vs. approved topography with each annual report.
Geology & Minerals	Identifying & selectively placing or mixing chemically or physically unsuitable overburden materials to minimize adverse effects to vegetation or groundwater	LQD requires monitoring in advance of mining to detect unsuitable overburden.
Soil	Salvaging soil suitable to support plant growth for use in reclamation; Protecting soil stockpiles from disturbance and erosional influences; Selectively placing at least 4 ft of suitable overburden on the graded spoil surface below replaced topsoil to meet guidelines for vegetation root zones	Monitoring vegetation growth on reclaimed areas to determine need for soil amendments. Sampling regraded overburden for compliance with root zone criteria.
Air Quality	Dispersion modeling of mining plans for annual average particulate pollution impacts on ambient air; Using particulate pollution control technologies; Using work practices designed to minimize fugitive particulate emissions; Using EPA- or state-mandated BACT, including: Fabric filtration or wet scrubbing of coal storage silo and conveyor vents, Watering or using chemical dust suppression on haul roads and exposed soils, Containment of truck dumps and primary crushers; Covering of conveyors, Prompt revegetation of exposed soils	On-site air quality monitoring for PM_{10} or TSP; Off-site ambient monitoring for PM_{10} or TSP; On-site compliance inspections
Surface Water	Building and maintaining sediment control ponds or other devices during mining; Restoring approximate original drainage patterns during reclamation; Restoring stock ponds and playas during reclamation	Monitoring storage capacity in sediment ponds; monitoring quality of discharges; monitoring streamflows and water quality.
Groundwater Quantity	Evaluating cumulative impacts to water quantity associated with proposed mining; Replacing existing water rights that are interrupted, discontinued, or diminished by mining with water of equivalent quantity	Monitoring wells track water levels in overburden, coal, interburden, underburden, & backfill

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing Jacobs Ranch Mine in its current approved mining and reclamation plan (the No-Action Alternative). If the North Jacobs Ranch LBA Tract is leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the North Jacobs Ranch LBA Tract that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

Table 4-3. Regulatory Compliance, Mitigation and Monitoring Measures required under the Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3. (Continued)

RESOURCE	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	MONITORING[1]
Groundwater Quality	Evaluating cumulative impacts to water quality associated with proposed mining; Replacing existing water rights that are interrupted, discontinued, or diminished by mining with water of equivalent quality	Monitoring wells track water quality in overburden, coal, interburden, underburden, & backfill
Alluvial Valley Floors	Identifying all alluvial valley floors that would be affected by mining; Determining significance to agriculture of all identified alluvial valley floors affected by mining (WDEQ); Protecting downstream alluvial valley floors during mining; Restoring essential hydrologic function of all alluvial valley floors affected by mining.	Monitoring to determine restoration of essential hydrologic functions of any declared AVF
Wetlands	Identifying all wetlands that would be affected by mining; Identifying jurisdictional wetlands (COE); Replacing all jurisdictional wetlands that would be disturbed by mining Replacing functional wetlands as required by surface managing agency or surface land owner	Monitoring of reclaimed wetlands using same procedures used to identify premining jurisdictional wetlands.
Vegetation	Permanently revegetating reclaimed areas according to a comprehensive revegetation plan using approved permanent reclamation seed mixtures consisting predominantly of species native to the area; Reclaiming 20% of reclaimed area with native shrubs at a density of one per square meter; Controlling erosion on reclaimed lands prior to seeding with final seed mixture using mulching, cover crops, or other approved measures; Chemically and mechanically controlling weed infestation; Direct hauling of topsoil; Selectively planting shrubs in riparian areas; Planting sagebrush; Creating depressions and rock piles; Using special planting procedures around rock piles; Posting reclamation bond covering the cost of reclamation	Monitoring of revegetation growth & diversity until release of final reclamation bond (minimum 10 years). Monitoring of erosion to determine need for corrective action during establishment of vegetation. of controlled grazing during revegetation Use evaluation to determine suitability for postmining land uses.

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing Jacobs Ranch Mine in its current approved mining and reclamation plan (the No-Action Alternative). If the North Jacobs Ranch LBA Tract is leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the North Jacobs Ranch LBA Tract that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

Table 4-3. Regulatory Compliance, Mitigation and Monitoring Measures required under the Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3. (Continued)

RESOURCE	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	MONITORING[1]
Wildlife	Restoring premining topography to the maximum extent possible; Planting a diverse mixture of grasses, forbs and shrubs in configurations beneficial to wildlife; Designing fences to permit wildlife passage; Raptor-proofing power transmission poles; Creating artificial raptor nest sites; Increasing habitat diversity by creating rock clusters and shallow depressions on reclaimed land; Cottonwood plantings along reclaimed drainages; Replacing drainages, wetlands and alluvial valley floors disturbed by mining; Reducing vehicle speed limits to minimize mortality; Instructing employees not to harass or disturb wildlife; Preparing raptor mitigation plans	Baseline & annual wildlife monitoring surveys; Monitoring for Migratory Birds of High Federal Interest
Threatened, Endangered, & Candidate Species	Avoiding bald eagle disturbance; Restoring bald eagle foraging areas disturbed by mining; Restoring mountain plover habitat disturbed by mining; Using raptor safe power lines; Surveying for Ute ladies' tresses; Surveying for mountain plover; Searching for black-footed ferrets if prairie dogs move onto tract;	Baseline and annual wildlife monitoring surveys
Land Use	Suitably restoring reclaimed area for historic uses (grazing and wildlife);	Monitoring of controlled grazing prior to bond release evaluation.
Cultural Resources	Conducting Class I & III surveys to identify cultural properties on all state and federal lands and on private lands affected by federal undertakings; Consulting with SHPO to evaluate eligibility of cultural properties for the NRHP; Avoiding or recovering data from significant cultural properties identified by surveys, according to an approved plan; Notifying appropriate federal personnel if historic or prehistoric materials are uncovered during mining operations; Instructing employees of the importance of and regulatory obligations to protect cultural resources	Monitoring of mining activities during topsoil stripping; cessation of activities and notification of authorities if unidentified sites are encountered during topsoil removal.

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing Jacobs Ranch Mine in its current approved mining and reclamation plan (the No-Action Alternative). If the North Jacobs Ranch LBA Tract is leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the North Jacobs Ranch LBA Tract that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

Table 4-3. Regulatory Compliance, Mitigation and Monitoring Measures required under the Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3. (Continued)

RESOURCE	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	MONITORING[1]
Native American Concerns	Notifying Native American tribes with known interest in this area of leasing action and request for help in identifying potentially significant religious or cultural sites	No specific monitoring program
Paleontological Resources	Notifying appropriate federal personnel if potentially significant paleontological sites are discovered during mining	No specific monitoring program
Visual Resources	Restoring landscape character during reclamation through return to approximate original contour and revegetation with native species	No specific monitoring program
Noise	Protecting employees from hearing loss	MSHA inspections
Transportation Facilities	Relocating existing pipelines, if necessary, in accordance with specific agreement between pipeline owner and coal lessee.	No specific monitoring program
Socioeconomics	Paying royalty and taxes as required by federal, state, and local regulations.	Surveying and reporting to document volume of coal removed.
Hazardous & Solid Waste	Disposing of solid waste and sewage within permit boundaries according to approved plans; Storing and recycling waste oil; Maintaining of files containing Material Safety Data Sheets for all chemicals, compounds, and/or substances used during course of mining; Ensuring that all production, use, storage, transport, and disposal of hazardous materials is in accordance with applicable existing or hereafter promulgated federal, state, and government requirements; Complying with emergency reporting requirements for releases of hazardous materials as established in CERCLA, as amended; Preparing and implementing spill prevention control and countermeasure plans, spill response plans, inventories of hazardous chemical categories pursuant to Section 312 of SARA, as amended; Preparing emergency response plans;	No specific monitoring other than required by these other regulations and response plans.

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing Jacobs Ranch Mine in its current approved mining and reclamation plan (the No-Action Alternative). If the North Jacobs Ranch LBA Tract is leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the North Jacobs Ranch LBA Tract that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

One issue of current concern is the release of NO_x from blasting, and the resulting formation of low-lying orange clouds that can be carried outside the mine permit areas by wind. As a result of this concern, industry and agency representatives have met and discussed possible causes and solutions, including improving blasting techniques or explosives and reducing powder factors. A monitoring program measuring NO_2 concentrations in areas accessible to the public near coal mining operations was conducted in 1999 (see discussion in Section 4.5.4). In addition, WDEQ has directed some mines to take steps designed to mitigate the effects of NO_2 emissions occurring from overburden blasting. The steps that may be required include: public notifications (in the form of warning signs along public roadways for example); temporary closure of public roadways near a mine during and after a blast; establishment of safe set-back distances from blasting areas; prohibiting blasting when wind direction is toward a neighbor; prohibiting blasting during temperature inversions; establishment of monitoring plans; estimation of NO_2 concentrations; and development of blasting procedures that will protect public safety and health.

After reviewing the required mitigation and monitoring in the current Jacobs Ranch Mine Mining and Reclamation Permit and the historical monitoring results in the Jacobs Ranch Mine annual mine reports, the BLM has not identified additional special stipulations that should be added to the BLM lease or areas where additional or increased monitoring measures are recommended.

4.4 Residual Impacts

Residual impacts are unavoidable impacts that cannot be mitigated and would therefore remain following mining and reclamation.

4.4.1 Topography and Physiography

Topographic moderation is a permanent consequence of mining. The indirect impacts of topographic moderation on wildlife habitat diversity would also be considered permanent.

4.4.2 Geology and Minerals

Geology from the base of the coal to the surface would be subject to significant, permanent change. CBM resources not recovered prior to mining would be permanently lost.

4.4.3 Soils

Existing soils would be mixed and redistributed, and soil-forming processes would be disturbed by mining. This would result in long-term alteration of soil characteristics.

4.4.4 Air Quality

No residual impacts to air quality would occur following mining.

4.4.5 Water Resources

The area where groundwater drawdowns and replacement of coal and overburden with spoils occur would be increased under the action alternatives compared to what would occur without the addition of the LBA tract. The postmining backfill may take in excess of 100 years to reach equilibrium water levels and water quality. Less time would be required near the mining boundaries. Water level and water quality in the backfill would be suitable to provide water to wells for livestock use, but would be different from premining conditions.

4.4.6 Alluvial Valley Floors

No residual impacts to alluvial valley floors would occur following mining.

4.4.7 Wetlands

Replaced wetlands (jurisdictional or functional) may not duplicate the exact function and landscape features of the premining wetland.

4.4.8 Vegetation

Reclaimed vegetative communities may never completely match the surrounding native plant community.

4.4.9 Wildlife

Although the LBA tract would be reclaimed to be as near original condition as possible, there would be some residual wildlife impacts. The topographic moderation would result in a permanent loss of habitat diversity and a potential decrease in slope-dependent shrub communities. This would reduce the carrying capacity of the land for shrub-dependent species.

4.4.10 Threatened, Endangered, and Candidate Species

No residual impacts to T&E or candidate species are expected.

4.4.11 Land Use and Recreation

No residual impacts to land use and recreation are expected.

4.4.12 Cultural Resources

Cultural sites that are determined to be eligible for the NRHP and that cannot be avoided are destroyed by surface coal mining after data from those sites is recovered. Sites that are not eligible for the NRHP are lost.

4.4.13 Native American Concerns

No residual impacts to Native American concerns have been identified.

4.4.14 Paleontological Resources

No residual impacts to significant paleontological resources are expected.

4.4.15 Visual Resources

No residual impacts to visual resources are expected.

4.4.16 Noise

No residual impacts to noise are expected.

4.4.17 Transportation Facilities

No residual impacts to transportation facilities are expected.

4.4.18 Socioeconomics

No residual impacts to socioeconomics are expected.

4.5 Cumulative Impacts

Cumulative impacts result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions, regardless of who is responsible for such actions. Cumulative impacts can result from individually minor, but collectively significant, actions occurring over time.

This section briefly summarizes the cumulative impacts that are occurring as a result of existing development in the area being mined and considers how those impacts would change if the North Jacobs Ranch LBA Tract is leased and mined and if other proposed development in the area occurs.

Important points to keep in mind include: 1) the total areas of all mines would not be disturbed at once; 2) the number of acres, type of vegetation, etc., disturbed would vary from year to year; 3) the impacts to groundwater would vary as mining progresses through each permit area (depending on saturation, how close the next mine pit is, etc.); and 4) the intensity and extent of CBM development is speculative.

Since decertification of the Powder River Federal Coal Region in 1990, the Wyoming State Office of the BLM has held thirteen competitive coal lease sales and issued ten new federal coal leases containing approximately 2.747 billion tons of coal using the LBA process (Table 1-1). This leasing process has undergone the scrutiny of two appeals to the Interior Board of Land Appeals and one audit by the General Accounting Office.

The Wyoming BLM has pending applications for eight additional maintenance tracts for existing mines containing about 2.3 billion tons of coal (Table 1-2). All of the pending applications have been reviewed and recommended for processing by the PRRCT.

BLM completed one exchange in the Powder River Basin in 2000, authorized by Public Law 95-554. Under this exchange, EOG resources (formerly Belco) received a federal lease for a 106-million ton portion of the Hay Creek Tract adjacent to the Buckskin Mine in exchange for the rights to a 170-million ton coal lease near Buffalo, Wyoming that is unmineable due to construction of Interstate Highway 90 (BLM 1999b).

The Wyoming and Montana BLM state offices completed a study entitled "*Powder River Basin Status Check*" in 1996 (BLM 1996f). The purpose of this study was to

document actual mineral development impacts in the PRB from 1980 to 1995 and compare them with mineral development impacts that were predicted to occur by 1990 in the five previously prepared PRB regional EIS's. Portions of the status check were updated prior to the 1997 and 1999 PRRCT public meetings in Casper, Wyoming and Billings, Montana.

Four of the previously prepared regional EIS's evaluated coal development in the PRB in Wyoming. They are:

Final Environmental Impact Statement, Eastern Powder River Basin of Wyoming, BLM, October 1974;

Final Environmental Impact Statement, Proposed Development of Coal Resources in the Eastern Powder River Basin of Wyoming, BLM, March 1979;

Final Powder River Regional Coal Environmental Impact Statement, BLM, December, 1981; and

Draft Environmental Impact Statement for Round II Coal Lease Sale in the Powder River Region, BLM, January 1984.

For Wyoming, the status check compared actual development in Campbell and Converse counties with predictions in the 1979 and 1981 Final EIS's, and USGS Water Resources Investigations Report 88-4046, entitled "*Cumulative Potential Hydrologic Impacts of Surface Coal Mining in the Eastern Powder River Structural Basin*" (Martin, et al., 1988), which is frequently referred to as "the CHIA."

Since 1989, coal production in the Powder River Basin has increased by an average of 6.8 percent per year. The increasing state production is primarily due to increasing sales of low-sulfur, low-cost PRB coal to electric utilities who must comply with Phase I requirements of Title III of the 1990 Clean Air Act Amendments. Electric utilities account for 97 percent of Wyoming's coal sales.

The currently operational mines in Campbell and northern Converse Counties are shown in Figure 1-1. Their current status and ownership are shown in Table 4-4. There have been numerous changes in mine ownership during the last decade, and this has resulted in mine consolidations and mine closings within the basin.

The mines are located just west of the outcrop of the Wyodak coal, where the coal is at the shallowest depth. The mines in Campbell and Converse counties produce 85 to 95 percent of the coal produced in Wyoming each year. Table 4-5 summarizes predicted coal mining activity (from the 1979 and 1981 regional EIS's) with actual activity that has occurred since the EIS's were prepared.

Campbell and Converse counties' oil production decreased to 17.9 million barrels of oil in 1999 from 32.8 million barrels in 1992, a 45.4 percent decrease. Currently, oil prices are increasing and it is unclear

Table 4-4. Status of Wyoming Powder River Basin Coal Mines.

2000 Mine	1994 Mine Operator	Coal Production [1] 1993 Actual[2]	Coal Production [1] 1994 Permitted[4]	1999 Mine Operator	Coal Production [1] 1999 Actual[3]	Coal Production [1] 2000 Permitted[4]	Status/Comments
Buckskin	SMC (Zeigler)	11.18	24.0	Vulcan Coal	15.59	22.0	Active
Clovis Point	Kerr-McGee	0	4.0	Wyodak Resources	0	4.0	Mine shut down/leases relinquished or sold; facilities sold; Wyodak has AQD permit
Dry Fork	Phillips/WFA	3.28	15.0	WFA	1.22	15.0	Active
Eagle Butte	Cyprus-Amax	16.70	29.6	RAG American	17.42	35.0	Active
Fort Union	Fort Union Ltd	0.06	9.3	Kennecott/Kfx	0.03	9.4	Inactive
Rawhide	Carter (Exxon)	9.86	24.0	Peabody	0.81	24.0	Inactive
Wyodak	Wyodak Resources	3.03	10.0	Wyodak Resources	3.18	10.0	Active
NORTHERN MINE GROUP TOTALS		**44.11**	**115.9**		**38.25**	**119.4**	
Belle Ayr	Cyprus-Amax	15.59	25	RAG American	17.89	45	Active
Caballo/N. Caballo	Carter (Exxon)/ Western Energy	15.42	40	Peabody	26.47	40	Active/Caballo Mine + former Rocky Butte & West Rocky Butte leases
Cordero Rojo	Kennecott/ Drummond	21.01	44	Kennecott	45.67	65	Active/Cordero + Caballo Rojo Mines
Coal Creek	ARCO	0.11	18	Arch	11.23	18	Inactive
CENTRAL MINE GROUP TOTALS		**52.13**	**127**		**101.26**	**168**	
Antelope	Kennecott	7.29	12	Kennecott	22.69	30	Active
Black Thunder	ARCO	34.32	36	Arch	48.67	100	Active
Jacobs Ranch	Kerr-McGee	18.39	25	Kennecott	29.08	50	Active
N. Antelope/ Rochelle	Peabody	32.94	50	Peabody	38.87	75	Active/North Antelope Mine + Rochelle Mine
N. Rochelle	SMC (Zeigler)	0.02	8	Vulcan Coal	8.17	35	Active/facilities constructed in 1998-99
SOUTHERN MINE GROUP TOTALS		**92.96**	**131**		**177.48**	**290**	
TOTALS FOR 3 MINE GROUPS		**189.2**	**373.9**		**316.99**	**577.4**	

[1] Actual production (million tons) on left, permitted production (million tons) on right.
[2] Source: Wyoming State Geological Survey *GEO-NOTES*, August 1994.
[3] Source: Wyoming State Inspector of Mines *ANNUAL REPORT* for 1999.
[4] Source: Judy Shamley, WDEQ/AQD, personal communication November 6, 2000. Figures are permitted capacity as of October 1, 2000.

Table 4-5. Coal Production and Development Levels, Campbell and Converse Counties, Wyoming.

	Coal Production (Million Tons)	Number of Active Coal Mines	Number of Existing Power Plants	Number of Active Coal Enhancement Facilities	Direct Coal Employment	Average Price-NE Wyoming
1979 Predictions for 1990	174.3	15	2	1	3,889	na
1981 Predictions for 1990	318.4	37	3	1	11,900	na
Actual 1990	162.6	18	3	1	2,862	$6.86
Actual 1994	216.9	19	4	1	3,126	$5.62
Actual 1995	246.5	19	4	1	3,177	$5.60
Actual 1996	261.1	18	4	2	3,274	$5.40
Actual 1997	264.1	18	4	2	3,164	$5.03
Actual 1998	297.5	16	4	2	3,348	$4.73
Actual 1999	319.9	15[1]	4	2	3,362	$4.66

Existing Power Plants: PP&L Dave Johnson, PP&L Wyodak, Black Hills Simpson #1, and Black Hills Simpson #2

Proposed New Power Plants: NAPG Two Elk, NAPG Two Elk Unit Two, Zeigler ENCOAL, Calpine & Black Hills Wygen #1 and NAPG Middle Bear

Existing Coal Enhancement: ENCOAL-Buckskin (inactive), KFx-Fort Union (active), and Wyodak Eartheo (active)

[1] Includes the Dave Johnson Mine, which is not included in Table 4-4.

Sources: 1979 and 1981 BLM Powder River Basin Regional EISs, Wyoming State Geological Survey Geo-notes-1996-99, and Wyoming State Inspector of Mines Annual Reports, 1990-99.

if this trend of decreasing oil production will continue in the foreseeable future.

Natural gas production has been increasing, particularly in Campbell County, due to the development of shallow CBM resources west of the coal mines. CBM exploration and development is currently ongoing throughout the PRB in Wyoming, and it is estimated that as of October 2000 there were more than 5,000 productive wells in place. Most of these wells have been drilled in Campbell County. Since the early 1990's, the BLM has completed numerous EAs and two EISs analyzing CBM projects. The last EIS was the Wyodak CBM Project EIS, which was completed in 1999. The Wyodak EIS project area included 3,600 square miles of mixed federal, state, and private lands. The EIS analyzed the impacts of drilling and producing up to 5,000 new federal, state, and private CBM wells in addition to the 890 wells that had been evaluated in previous NEPA documents. BLM recently completed an EA to analyze the impacts of drilling as many as 2,500 additional federal drainage protection wells within the Wyodak EIS project area. These wells will be drilled and produced to prevent the loss of federal CBM resources and corresponding royalties from undrilled federal oil and gas leases that are adjacent to and potentially being drained by wells drilled on private or state oil and gas leases. BLM is also preparing an EIS to analyze the cumulative impacts of reasonably foreseeable CBM and conventional oil and gas development within the Wyoming portion of the PRB. The EIS will analyze the potential impacts of proposed additional CBM development in the Wyoming portion of the basin and update the BLM planning documents in the area of CBM development interest. The regional coal EIS's (BLM 1974, 1979, 1981, 1984) and the Buffalo RMP (BLM 1985) analyzed oil and gas development, but did not anticipate that the oil and gas development would include production of CBM resources.

Under the current process for approving CBM drilling, CBM wells can be drilled on private and state oil and gas leases after approval by the Wyoming Oil and Gas Conservation Commission and the Wyoming State Engineer's Office. On federal oil and gas leases, BLM must analyze the individual and cumulative environmental impacts of all drilling, as required by NEPA, before CBM drilling on the federal leases can be authorized. In many areas of the PRB the coal rights are federally owned, but the oil and gas rights are privately owned. A June 7, 1999 Supreme Court decision (98-830) assigned the rights to develop CBM on a piece of land to the owner of the oil and gas rights.

Other mineral development levels in the Wyoming PRB are currently lower than predicted in the EIS's. In the 1970's, significant uranium development was anticipated in southwest Campbell County and northwest Converse County. This development did not materialize

because the price of uranium dropped in the early 1980's. There are currently two *in situ* uranium operations in Converse and Johnson counties, but no mines and no mills. There were three active *in situ* operations in the PRB in 1999, but one of them, located in southeastern Johnson County, has since ceased operations. Uranium production has been increasing in recent years, but is expected to decrease this year because prices are decreasing due to international purchases of Russian uranium from stockpiles and decommissioning of uranium-based weapons (WSGS 2000).

Scoria is quarried for use as road surfacing material, primarily by coal mines but also by a few excavation and construction firms. Bentonite is mined in parts of the Wyoming PRB, but not in Campbell or Converse Counties.

The proposed North Jacobs Ranch LBA Tract is situated within a nearly continuous corridor of five coal mines (counting the North Antelope/ Rochelle Complex as one mine) in northern Converse and southern Campbell counties, Wyoming (see Figure 3-1). This southern mine corridor is approximately 24 miles long and eight miles wide. Production of coal in this southern mine group began in 1977 at the Black Thunder Mine. The current maximum permitted production rate for these five mines is 290 million tons per year (Table 4-4). Eight maintenance leases, including approximately 20,954 acres of federal coal, have been issued to mines in this southern group since decertification (Jacobs Ranch, West Black Thunder, North Antelope/Rochelle, Antelope, North Rochelle, Powder River, Thundercloud, and Horse Creek--see Table 1-1). There are also five pending maintenance leases including approximately 17,400 acres of federal coal in the southern group of mines (North Jacobs Ranch, NARO, Little Thunder, West Roundup, and West Antelope--see Table 1-2).

CBM wells have been drilled around the Jacobs Ranch, Black Thunder, and North Antelope/Rochelle mines. CBM drilling and production is expected to continue in the areas around the coal mines, and on the LBA's. Due to the proximity of the coal mining and CBM production operations, cumulative impacts to groundwater, surface water, air quality and wildlife are likely to occur as more CBM resources are developed adjacent to existing surface coal mines. These potential impacts are discussed in the following cumulative impact discussion for these resources.

In addition to the ongoing coal mining and leasing and the CBM development, other projects are in progress or planned in the vicinity of the southern mine group, including construction and operation of the North American Power Group's Two Elk and Two Elk Unit 2 Power Plants east of the Black Thunder Mine; construction of Wygen #1 power plant which has been proposed at the Wyodak Mine site; construction and operation by North American Power Group of a 500-megawatt coal fired

power plant at the Cordero Rojo Complex; and construction and use of the proposed DM&E rail line. One project, the ENCOAL facility, which at one time was scheduled for construction at the North Rochelle Mine, has been indefinitely delayed. The Two Elk and DM&E projects, due to their locations, could have directly overlapping impacts with the impacts of mining the North Jacobs Ranch LBA Tract. The proposed Wygen#1 plant would be located at the Black Hills Corporation energy complex near Gillette, Wyoming, and the proposed North American Power Group plant would be located at the Cordero Rojo Complex. The impacts of mining the North Jacobs Ranch LBA Tract would not be expected to overlap with the impacts of building and operating these power plants.

Two Elk would be a coal-fired power plant located east of Black Thunder Mine and would generate 310 Mw. The plant would burn low-Btu "waste coal" and coal fines from nearby mines as well as sub-bituminous coal in a pulverized coal boiler. This ability to burn low Btu waste coal and fines would allow the Two Elk plant to recover fuel values that might otherwise be lost and thereby generate electric power more efficiently than existing coal-fired plants. Coal and waste coal would be transported from the mine to the power plant by direct truck haul on unpaved roads, and ash would be returned to the mine by enclosed, 4-wheel off-highway trucks. An application for an air quality Permit to Construct was submitted to WDEQ and was deemed administratively complete on August 5, 1997. The Two Elk project received a Permit to Construct from WDEQ/AQD on February 27, 1998. On February 17, 2000 the applicant was granted a permit modification by WDEQ/AQD. The modification allows for relocation of the plant based on soils and geotechnical considerations and also changes the original power plant design. The permittee has two years from the date of issuance to begin construction. No final decisions have been made as to how much water would be used, or where it would be obtained. Various scenarios for "wet" and "dry" operations are being evaluated at this time. Other permits that will be obtained include a wastewater permit from WDEQ and various construction and waste disposal permits from the state and county. An EIS will also be necessary to address the transmission line and access road, which both cross lands under USFS jurisdiction. According to a recent article in the Gillette News Record, construction could begin on this plant in 2000 (Gillette News Record 2000a).

The Black Hills Wygen #1 power plant would be a coal-fired power plant located near Gillette, Wyoming which would generate 80 Mw. According to a September 27, 2000 press release, the plant would burn approximately 500,000 tons of low-sulfur coal annually. The coal could be mined at the adjacent Wyodak Mine. The plant is expected to be operational by January 2003, and Black Hills estimates that the project will employ about 300 people during the construction period.

North American Power Group recently announced plans to build a second power plant adjacent to the Black Thunder Mine as well as a 500-megawatt coal fired power plant next to the Cordero Rojo Complex Mine south of Gillette (Casper Star-Tribune April 9, 2001). The plant would burn about 3 million tons of coal per year and will be completed by about 2005 if all permits are approved.

The Surface Transportation Board preliminarily approved the DM&E Railroad expansion plan (to build 262 miles of new track in the Powder River Basin and to rehabilitate 650 miles of track across South Dakota and Minnesota) on December 11, 1998. The approval was made pending the completion of an analysis of the environmental impacts of the project. The Surface Transportation Board released the draft EIS for public comment in September 2000, and the public comment period for the draft EIS ended on March 6, 2001. The DM&E had proposed to start construction in 1999 and complete the new railroad line in 2001; however, final approval and construction cannot take place until after the environmental analysis is completed. The proposed route in Wyoming will generally follow along the Cheyenne River valley.

The status check identified one part of the coal mining process where the actual levels of development did not agree with the predictions, and this was the number of acres reclaimed. In general, coal mine reclamation efforts have been successful in both the Wyoming and Montana portions of the basin; however, reclamation has not proceeded as rapidly as predicted in the regional EIS's (see Table 4-6).

Table 4-6 compares the 1979 and 1981 predictions of surface coal mining disturbance and reclamation areas with actual disturbance and reclamation areas. The 1979 and 1981 EIS estimates exclude acres of disturbance occupied by mine facilities. Information about the number of acres of disturbance occupied by facilities is available for most mines and has been subtracted from the total disturbance area in Table 4-6. Reclamation is a process involving many steps, and seeding with the final seed mixture happens near the end of the process. Table 4-6 shows the area for which reclamation has proceeded to the stage of backfilling and grading.

The development of reclamation schedules for PRB mines must take into account various unique factors:

- Very thick coal seams;
- Diverse premining topography;
- Surface-mining methods using trucks and shovels combined with draglines; and
- Large-volume material movements.

These factors affect the amount of reclamation that can be accomplished at any given time.

Achievement of final postmine topography immediately following mining is not always possible. The mining plan dictates the backfill placement and timing sequence and

Table 4-6. Predicted and Actual Coal Mine Disturbance and Reclamation, Campbell and Converse Counties, Wyoming.

Year	Cumulative Surface Coal Mining Disturbance (Acres)	Long-Term Mining or Reclamation Facilities (Acres)	Disturbance Area Available for Reclamation (Acres)	Acres Backfilled and Graded	Percent Reclaimed
1979 EIS Prediction for 1990	na	na	22,794	12,666	55.57%
1981 EIS Prediction for 1990	na	na	48,400	34,100	70.45%
Actual 1990	31,797	na	na	6,994	22.00%
Actual 1996	47,018	na	na	12,165	25.87%
Actual 2000	56,707	16,540	40,177	17,234	42.90%

Source: Mark Humphrey, OSM, Casper.

must take into account changing strip ratios which create material surpluses or deficits. Stockpiling, which may be required to fill final pit voids or store new pit boxcut material, affects the backfill material balance. Operating changes can also affect the backfill placement timing and sequence. Some examples include changing the pit direction to conform to lease configuration, changing plans to accommodate production growth and changes in technology or mining method. The achievement of contemporaneous reclamation is evaluated on a site-by-site basis by the WDEQ taking the mining complexities unique to each mine into account.

Currently, WDEQ/LQD suggests to operators that only large, contiguous areas such as drainage basins be considered for bond release, with the assurance that the area will not be disturbed in the future. Because many mine plans cross a drainage basin several times during the life of mine, final reclamation of the drainage may not occur until late in the life of mine. This issue is further complicated when two operators are mining in the same drainage on different reclamation schedules, in that bond release for the first operator to mine the basin could be held until the second operator's portion of the basin is reclaimed. Due to the uncertainties involved the process of applying for and receiving final bond release, most companies are electing to postpone the initiation of bond release until late in the life of mine.

For the southern group of mines, approximately 40 percent of the area of disturbance has been backfilled and graded. At Jacobs Ranch Mine, 413.7 acres were disturbed in 1999 and 259.1 acres were seeded to the permanent vegetation species. As of September 30, 2000, 74 percent of the disturbed area available for reclamation had been backfilled and graded and 67 percent had been soiled, seeded and planted.

4.5.1 Topography and Physiography

Following surface coal mining and reclamation, topography will be modified in an elongated corridor east of and paralleling Highway 59 from just north of Gillette, Wyoming, south for about 75 miles. The topography in the PRB is characterized by relatively flat or rolling topography. After reclamation, these characteristics will be emphasized in the reclaimed area. In general, in the mining corridor, premining features that were more topographically unique (e.g., steeper hills and gullies, rock outcrops, etc.) will generally be smoothed. As indicated in Section 4.1.1, the premining topography of the North Jacobs Ranch LBA Tract is relatively flat, and for this tract, the expected post-mining topography is expected to be similar to the pre-mining topography. The overall reduction in topographic diversity in the mining corridor may lower the carrying capacity for big game in the reclaimed areas; however, big game ranges are generally very large and mining activities are, in general, not located in habitats defined as crucial. The overall flattening and lowering of

the topography would result in increased infiltration of surface water and reduced peak flows from the drainages. These changes would not be significant because the streams typically flow from west to east across the area rather than north to south along the entire corridor. Therefore, only a small part of each stream's drainage area would be disturbed (see Section 4.5.5). There would be no significant cumulative impacts to topography and physiography due to the proximity of coal mining, CBM development, and the proposed construction of the railroad line and ENCOAL and Two Elk power plants in this area because the construction and operation of those projects would cause minimal topographic and/or physiographic changes.

4.5.2 Geology and Minerals

The PRB coalfield encompasses an area of about 12,000 mi^2. Finley and Goolsby (2000) estimate that there are approximately 587 billion tons of coal in beds thicker than 20 feet and deeper than 200 feet in the basin. The Wyodak coal bed is estimated to contain 17.9 billion tons of strippable coal reserves with 200 feet or less of overburden (Glass 1997). Converse County has a total area of 4,050 mi^2 of which slightly less than 1 percent is within current permit boundaries. Campbell County has a total area of about 4,760 mi^2, of which approximately 4 percent is within current mine permit boundaries. Coal mining in this area disturbs about 2,000 acres annually with about 1,850 acres reclaimed annually (BLM 1996g). Mining and reclamation rates are expected to continue to increase through the year 2015, but the balance between reclamation and mining should remain about the same. In the PRB, the coal reserves currently leased represent a small percentage of the total coal reserves but a large percentage of the shallowest (hence the most economical to recover) coal reserves. Within the five southern mines, approximately 42,600 acres of federal coal are currently leased. This is about a 57 percent increase over the 27,160 acres of federal coal that were leased in the southern group of mines in 1990, prior to decertification. Under the Proposed Action, approximately 4,821 additional acres of federal coal would be leased, which would represent an 11 percent increase in the area of leased federal coal in the southern group of five mines. The area of disturbance associated with mining these leases, which would be greater than the leases themselves, is discussed in other parts of this analysis (e.g., section 4.5.3).

Coal and CBM are non-renewable resources that form as organic matter decays and undergoes chemical changes over geologic time. The CBM and coal resources that are removed to generate heat and power would not be available for use in the future. No potential damages to the coal resulting from removal of the CBM and water prior to mining have been identified. The CBM operators generally do not completely dewater the coal beds to produce the CBM because that could damage fractures in the coal and limit CBM production.

Construction of the proposed railroad line and power plants would not impact the geology or mineral resources in the area, so there would be no overlapping impacts related to these projects.

4.5.3 Soils

The five existing southern mines would disturb approximately 63,500 acres throughout their combined lives (they would disturb about 1,200 acres annually during active mining at the currently planned mining rates). This estimate includes the North Rochelle, Powder River, Thundercloud and recently leased Horse Creek LBA tracts. If the North Jacobs Ranch LBA Tract is leased and mined, the disturbance area in the southern group of mines would increase to approximately 69,000 acres. This would represent an additional 8.6 percent increase in disturbance. Assuming ten years from initial disturbance to utilization of a parcel of reclaimed land by domestic livestock, approximately 12,000 acres (16.6 percent disturbed by Jacobs Ranch) would be unavailable for such use at any given time during active mining. However, the replaced topsoil would support a stable and productive native vegetation community adequate in quantity and quality to support planned postmining land uses (i.e., rangeland and wildlife habitat).

Additional, although less extensive, soil disturbance would be associated with the proposed CBM development west of the mines, and with construction of the proposed power plants and railroad line.

4.5.4 Air Quality

According to current regulatory standards by which air quality is defined, surface mining and CBM development in the PRB have not resulted in impacts to air quality that have exceeded federal or state standards.

Based on predictive models conducted for PRB mines, mining operations do not have significant off-site particulate pollution impacts, even when production and pollution from neighboring mines are considered. However, this prediction has been based on the assumptions that mining activities are sufficiently removed from the permit boundaries and that neighboring mines are not actively mining in the immediate vicinity (within 0.6-2.5 miles). Previous modeling (BLM 1992a) has shown that incremental particulate pollution impacts decrease to insignificant levels (<1 $\mu g/m^3$ PM_{10} annual average) within six miles of active mining.

In cases where mines are in close proximity (within two miles), WDEQ follows a modeling protocol which accounts for all mine-generated particulate air pollutants from all nearby mines to determine impacts to ambient air quality. Known as the "Mine A/Mine B" modeling procedure, this model evaluates the total impacts of a given mining operation, including those impacts from and on neighboring mines. In past modeling

conducted in support of Jacobs Ranch Mine's air quality permit, the Jacobs Ranch Mine has been subject to Mine A/Mine B protocol. If the LBA tract is leased under the Proposed Action or Alternatives 2 or 3 and past procedures are followed, WDEQ would require that ambient air quality modeling be conducted at the Jacobs Ranch and Black Thunder Mines for consideration of incorporation of the North Jacobs Ranch LBA Tract on air quality. The modeling protocol is restricted as a matter of state regulatory policy to evaluation of the average annual impacts with respect to the ambient standard of <50 $\mu g/m^3$ PM_{10}. The Wyoming air quality standard is 50 $\mu g/m^3$ which includes 15 $\mu g/m^3$ background concentration.

Gaseous clouds produced by overburden blasting are a recent air quality concern related to surface coal mining activities in the PRB. These clouds contain nitrogen oxides (NO_x), and exposure to NO_x that is present in the atmosphere above certain levels can have human health consequences (see Appendix F.) In response to the need for information about the levels of NO_x present in these clouds, a collaborative group of PRB mines under the Air Quality Subcommittee of the WMA collected information on the contents of post-blast gas clouds in the summer of 1999. The report on the August 1999 WMA NO_x monitoring is titled *Powder River Basin - Short-term Exposure NO_2 Study*. During that study six monitors were placed at the following mines to obtain a basin-wide data set: Eagle Butte, Wyodak, Belle Ayr/Caballo, Cordero Rojo Complex, Black Thunder, and North Antelope/Rochelle Complex. Roads adjacent to mining activity were selected because they were areas where the public exposure would be most likely to occur. The Jacobs Ranch Mine did not have a specific monitor on site; the nearest monitor was the one placed at the Black Thunder Mine. A 15 minute average was chosen to be the monitored increment for this study based on similar time intervals used for National Institute for Occupational Safety and Health and OSHA NO_2 work place standards. A summary of the data includes the following:

- Approximately 95 percent of the valid data points were readings of 0 ppm NO_2.
- The maximum one-minute average valid values observed for each of the six monitors ranged from 0 to 8.0 ppm NO_2.
- The maximum one-minute average reading at Monitor 5, the closest to Jacobs Ranch Mine, was 1.7 ppm NO_2.
- The maximum 15-minute average valid values observed for each of the six monitors ranged from 0 to 1.65 ppm NO_2.
- The maximum 15-minute average reading at Monitor 5 of 1.65 ppm NO_2 demonstrated a strong direction correlation between NO_2 readings and temperatures. This correlation

indicates that these NO_2 readings may have been inflated due to temperature considerations.

The OSHA Immediately Dangerous to Life and Health threshold is 20 ppm (37,600 µg/m^3) and the EPA Significant Harm Level threshold is 2 ppm (3,760 µg/m^3). The report also includes summaries of historic annual and 24-hour monitoring that has been conducted in the PRB and other locations within the region.

Another air quality concern is the venting of methane that occurs when coal is mined. As discussed in Section 3.3, methane (CBM) is generated from coal beds. When coal is mined, by surface or underground methods, the methane that is present in the coal is vented to the atmosphere. Methane is a greenhouse gas which contributes to global warming. According to the *Methane Emissions* section of Energy Information Administration/ Department of Energy (EIA/DOE) report 0573(99), *Emissions of Greenhouse Gases in the United States 1999*, U.S. anthropogenic methane emissions totaled 28.8 million metric tons in 1999. U.S. 1999 methane emissions from coal mining were estimated at 2.88 million metric tons (10.0 percent of the total anthropogenic methane emissions in 1999). According to Table 15 of this report, surface coal mining was estimated to be responsible for about 0.54 million metric tons of methane emissions in 1999. This represents about 1.88 percent of the estimated U.S. anthropogenic methane emissions in 1999, and about 18.75 percent of the estimated methane emissions attributed to coal mining of all types.

Table 7.2 of the EIA/DOE Coal Industry Annual Energy Review for 1999 estimated that 688.3 million short tons of coal were produced by surface mines in the U.S. in 1999. Surface mines in Wyoming PRB produced approximately 320 million short tons in 1999, or about 46.5 percent of the total production. Jacobs Ranch Mine's 1999 production was about 29.1 million short tons, or about 4.1 percent of U.S. 1999 surface mine production. Using these numbers, it is estimated that the Wyoming PRB coal mines were responsible for approximately 0.9 percent of the estimated U.S. 1999 anthropogenic methane emission, and Jacobs Ranch Mine was responsible for approximately 0.08 percent of estimated U.S. 1999 anthropogenic methane emissions.

In many areas, including the PRB, CBM is being recovered from the coal and sold. On a large scale, recovery of CBM from the coal prior to mining by both surface and underground methods could potentially gradually reduce U.S. emissions of CBM to the atmosphere. In the PRB, CBM is being produced from the coal areas adjacent to and generally downdip of the mines. CBM is currently being produced from the coal included in the North Jacobs Ranch LBA Tract as well as the surrounding area. As discussed in Section 4.1.2, BLM estimates that a large portion of the CBM reserves could be recovered

prior to initiation of mining activity on the North Jacobs Ranch LBA Tract under the Proposed Action or Alternatives 2 or 3. CBM reserves that are not recovered prior to mining would be vented to the atmosphere.

A regional cumulative impact analysis was performed in 1999 for the Horse Creek LBA EIS to estimate impacts on air quality in the year 2015 from the Proposed Action and all other reasonably foreseeable actions. This analysis, which is summarized in the following discussion, consisted of an update and modification to the May 1999 Wyodak CBM Project DEIS far-range cumulative air quality analysis (BLM 1999a, Greystone 1999). The cumulative air quality impacts were further updated in the recently released Draft EIS for the DM&E Railroad Powder River Basin Expansion Project (Surface Transportation Board 2000), which modeled the potential impacts for several alternative proposed routes for the railroad. A brief summary of the results of that analysis are summarized in Appendix H. The changes in air emissions due to mining the North Jacobs Ranch lease as an extension of Jacobs Ranch Mine would be a change in the location of Jacobs Ranch Mine emissions, and a longer duration of mining activity at the Jacobs Ranch Mine. Currently, the mine does not propose to increase production if they acquire the tract. In fact, at the current time, JRCC anticipates that production would decrease from current levels when the North Jacobs Ranch LBA Tract is mined, unless additional coal and overburden removal equipment is acquired. Therefore, no significant change in long-term cumulative air impacts are anticipated if the North Jacobs Ranch LBA Tract is leased and mined as a maintenance lease for the Jacobs Ranch Mine.

The regional (far-range) cumulative air quality analysis was carried out using the CALMET/CALPUFF Version 5 model. Modeling was performed to estimate impacts of NO_x, SO_2 and particulate matter emissions on air quality, regional haze, and air quality related values (AQRVs) at Class I and sensitive Class II areas within approximately 150 miles (240 km) of Gillette, Wyoming. The area included in the model analysis is shown in Figure 4-3. The model analysis results presented in this section represent an indication of potential impacts based on currently available modeling technology and anticipated levels of activity in the year 2015 (see discussion below).

Cumulative Emissions Inventory

An inventory of incremental air pollutant emissions was prepared using 1995 as the base year and 2015 as the analysis year. The inventory utilized data assembled for the Wyodak CBM Project cumulative analysis, but included a number of updates and revisions to incorporate newly available information. The inventory included a breakdown of particulate matter emissions into three sub-groups: elemental carbon particles (EC), organic carbon particles (OC), and other undifferentiated particles, including

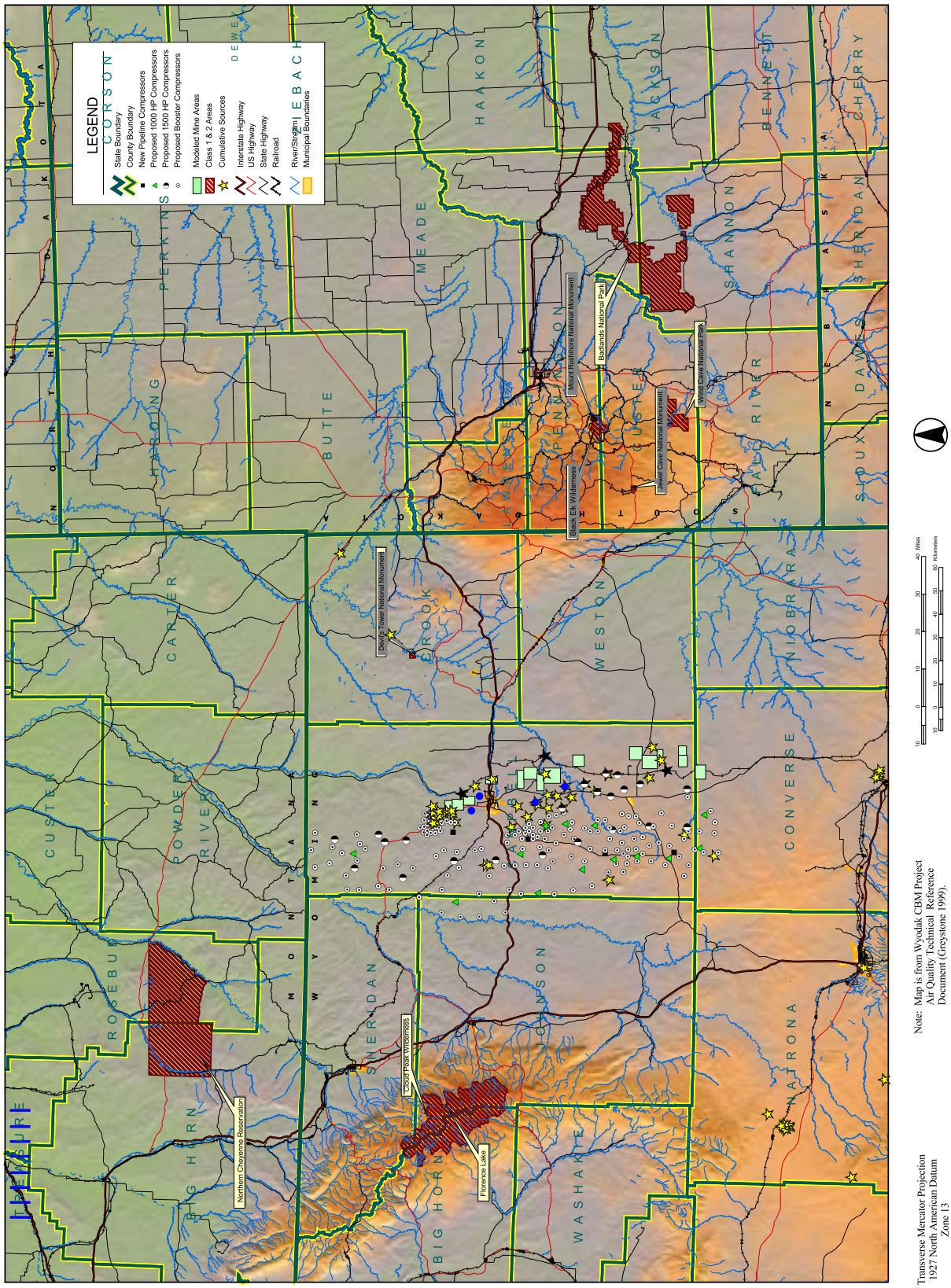


Figure 4-3. Cumulative Air Quality Modeling Domain.

fugitive dust (PM_{10}). The carbon particles, which are emitted primarily from diesel engines (mine equipment and trains), were treated separately because of their potential impact on regional haze. SO_2 emissions from blasting, trains and other diesel engines were also included, again because of potential regional haze impacts.

The four groups of air emission sources that were inventoried and the sources of emissions data relied upon are described below.

- All stationary point sources that began operation after 1995 and/or are permitted and reasonably expected to be operating after 1995. All permitted point source information was based upon state agency files, as obtained for the Wyodak CBM Project DEIS (BLM 1999a).

- Potential incremental increase in surface coal mining emissions. Coal production in the year 2015 is projected to total 387 million tons per year for the PRB mines listed in Table 4-5 (Resource Data International 1998). This is about 15 percent more than the 1999 production and about 71 percent of the 1999 permitted production for active mines shown in Table 4-4. The permitted production is the regulatory limit based on present air quality permits. Thus, the reasonably foreseeable 2015 coal production assumed for the analysis represents about 71 percent of 1999 maximum permitted production.

  Incremental coal production from 1995 to 2015 was calculated for each of the 14 PRB mines active after 1999 (Table 4-4) by assuming each mine would produce 71 percent of 1999 permitted production. Emission increases for each pollutant were estimated based on the ratio of emissions to coal production as shown by the most recent air quality evaluation for each mine, or for a similar mine if recent data were unavailable. Planned major changes in mine plans (e.g. use of conveyors to replace haul trucks) were taken into account where applicable.

  NO_x is produced at mines by blasting, diesel equipment, and on-site locomotives. The expected decrease in NO_x emissions from diesel equipment engines due to new federal emission standards was taken into account in estimating 2015 incremental emissions.

  SO_2 emissions originate from blasting, diesel equipment, and locomotives at each mine. Incremental emissions were calculated from projected increases in fuel use, based on data in recent mine analyses for fuel use per unit of coal production.

Particulate matter is generated at mines as fugitive dust (PM_{10}), and as engine emissions (a combination of PM_{10}, EC, and OC). Fugitive PM_{10} emissions per unit of coal production were calculated from recent data for each mine and used to estimate incremental emissions for 2015 production. Incremental emissions of PM_{10}, EC, and OC from engines were calculated from projected fuel use, using the proportions of each particulate component in diesel exhaust as given by EPA's source composition library.

- Coal transportation locomotive emissions. Emissions of NO_x, SO_2, and particulate matter (EC, OC, and PM_{10}) from coal train operations were calculated using EPA emission factors, locomotive fuel use, and the reasonably expected coal production for 2015. The proposed DM&E Railroad line was included in the analysis, using a potential route and number of trains suggested by DM&E. Fuel use and the fraction of total traffic on each of the existing BN and UP rail routes were provided by the railroads. Emissions assumptions and calculations were provided to BN, UP, and DM&E representatives for review prior to use for modeling. EPA's Tier I and Tier II emission standards for new and rebuilt locomotives were taken into account in calculating year 2015 emissions by use of EPA's projected fleet average emission factors for that year.

- Wyodak CBM sources. Emissions for the CBM development will originate from compressor engines (NO_x), vehicle tailpipe emissions (NO_x), road dust from vehicle traffic (PM_{10}), and fugitive dust from disturbed areas (PM_{10}). Total emissions from all of these sources were taken from the Wyodak CBM DEIS analysis (BLM 1999a).

Total emissions from all sources and operations are shown in Table 4-7 and Figure 4-4. These emissions were modeled as point and area sources, as appropriate, using the CALMET/CALPUFF modeling system, to estimate air quality impacts at the Class I and sensitive Class II areas shown on Figure 4-3.

Cumulative Air Quality Impacts

Based on the emission increase inventories for all regional sources, maximum 3-hour, 24-hour, and annual SO_2 impacts, 24-hour and annual PM_{10} impacts, and annual NO_2 impacts were modeled and compared to the PSD Class I increments at the Class I areas and to the NAAQS at each sensitive Class II area. It is important to note that this is not a formal PSD increment analysis, and the references to PSD increments and NAAQS are intended only as a basis for comparison. The comparison does not constitute an air

Table 4-7. Cumulative Pollutant Emissions for Far-Range Air Quality/AQRV Analysis.

Source	Emissions after 1995 (tons/year)					Percent of Total				
	NO_x	SO_2	EC	OC	PM_{10}	NO_x	SO_2	EC	OC	PM_{10}
Coal Mine Sources										
Coal Mines Incremental Increase (NO_x from blasting, trains, vehicles)	2,475					12.2	0.0	0.0	0.0	0.0
Coal Mines Incremental Increase of Fugitive Dust					4,234	0.0	0.0	0.0	0.0	24.2
Coal Mines Incremental Increase from Mining Vehicles		698	193	73	86	0.0	10.6	55.0	54.5	0.5
Coal Trains Incremental Increase	7,262	888	158	61	70	35.9	13.4	45.0	45.5	0.4
Wyodak CBM Sources and Other Point Sources										
Proposed Compressors	2,806					13.9	0.0	0.0	0.0	0.0
Road Dust from Vehicle Traffic					11,224	0.0	0.0	0.0	0.0	64.2
Fugitive Dust from Disturbed Areas					956	0.0	0.0	0.0	0.0	5.5
Project Vehicle Exhaust	18					0.1	0.0	0.0	0.0	0.0
Other Point Sources	7,662	5,032			917	37.9	76.0	0.0	0.0	5.2
Total	20,223	6,618	351	134	17,487	100	100	100	100	100

quality regulatory determination. Air quality standards are most stringent at Class I areas (National Parks and large designated wildernesses) to afford the most protection for these pristine areas. The results of the air quality analysis for each area are provided in Table 4-8 and Figure 4-5, which demonstrates that maximum projected cumulative impacts are much smaller than regulatory standards and increments.

Visibility Impacts

Visibility impacts were calculated based on cumulative emissions impacts (modeled concentrations of nitrate, sulfate, carbon, and other particulate matter) within the CALPUFF modeling domain. Extinction coefficients were computed and their effect on visibility assessed by comparison to background extinction coefficients corresponding to the mean of the cleanest 20 percent IMPROVE (Interagency Monitoring of Protected Environments) visibility data from

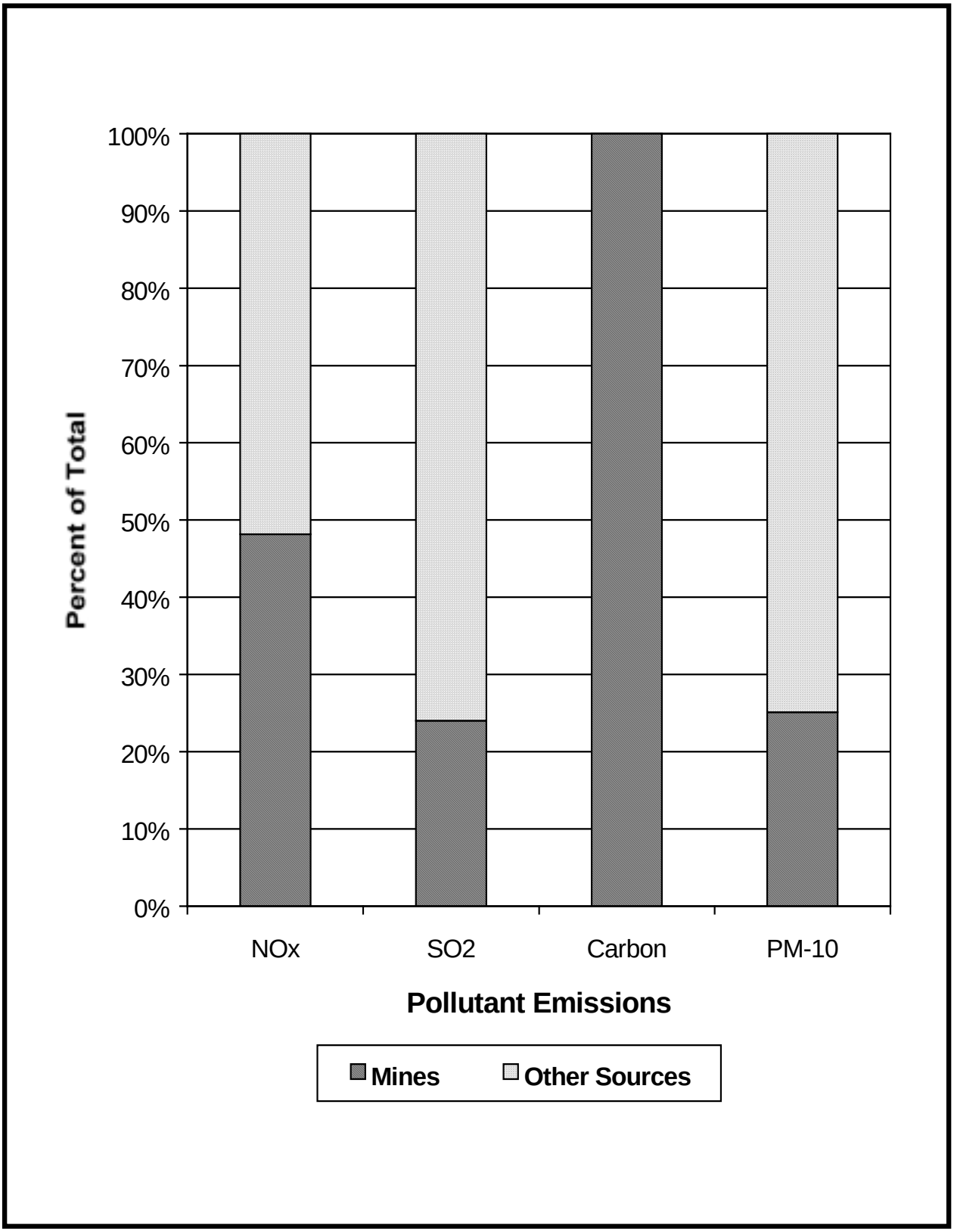


Figure 4-4. Cumulative Pollutant Emissions from Mines and Other Sources.

Table 4-8. Cumulative Far-Field Concentrations (percent of NAAQS).

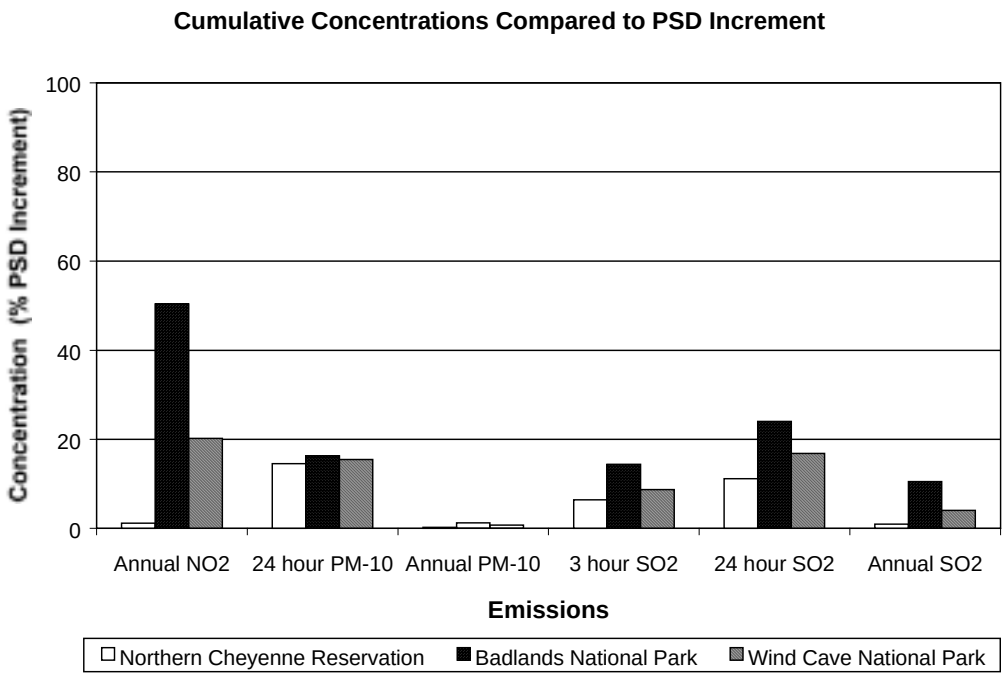
Area	Annual NO_2	24-hr PM_{10}	Annual PM_{10}	3-hr SO_2	24-hr SO_2	Annual SO_2
CUMULATIVE IMPACTS						
Northern Cheyenne Reservation, MT	1.20	14.5	0.25	6.40	11.20	1.00
Badlands National Park, SD	50.40	16.25	1.25	14.4	24.00	10.50
Wind Cave National Park, SD	20.20	15.5	0.75	8.7	16.80	4.00
Class I PSD Increment (µg/m$_3$)	**2.5**	**4**	**8**	**25**	**5**	**2**
Black Elk Wilderness, SD	0.09	0.69	0.10	0.19	0.22 (0.30)	0.09 (0.12)
Jewel Cave National Monument, SD	0.13	0.51	0.16	0.30	0.24 (0.34)	0.13 (0.17)
Mt. Rushmore National Monument, SD	0.08	0.67	0.10	0.15	0.15 (0.21)	0.08 (0.10)
Cloud Peak Wilderness, WY	0.01	0.60	0.08	0.08	0.09 (0.12)	0.01 (0.02)
Devils Tower National Monument, WY	0.13	0.53	0.32	0.22	0.14 (0.19)	0.09 (0.12)
National Ambient Air Quality Standard (µg/m$_3$)	**100**	**150**	**50**	**1300**	**365**	**80**
Wyoming Ambient Air Quality Standard (µg/m$_3$)	**100**	**150**	**50**	**1300**	**260**	**60**

Note: Values shown within parentheses are the percentages of Wyoming's standards for SO_2.

Badlands National Park and the Bridger Wilderness. Seasonal average relative humidity values were used for the comparison.

Results of the visibility analysis are shown in Table 4-9. Potential visibility reductions greater than the threshold values of 0.5 and 1.0 deciviews are indicated for all Class I and sensitive Class II areas. The number of days with an indicated potential change of one deciview or more ranges from four days in the Cloud Peak Wilderness to 70 days in Badlands National Park. It should be recognized that the analysis results reflect potential impacts at any one or more receptors in each area (not at all receptors), and that the indicated change is relative to the 20 percent of best visibility days in each area. On many of the days for which model-predicted impacts occur, natural atmospheric conditions and/or background air quality levels would result in lower background visibility.

The model predicts that Badlands National Park would experience the most significant visibility impacts in 2015. The indicated impacts in Badlands National Park are strongly influenced by the close proximity of the modeled DM&E rail route. The modeled route is only one of a number of potential routes, and may not be representative of the actual route to be selected, nor is the modeled number of daily trains necessarily realistic of 2015 DM&E traffic. The results of the air quality



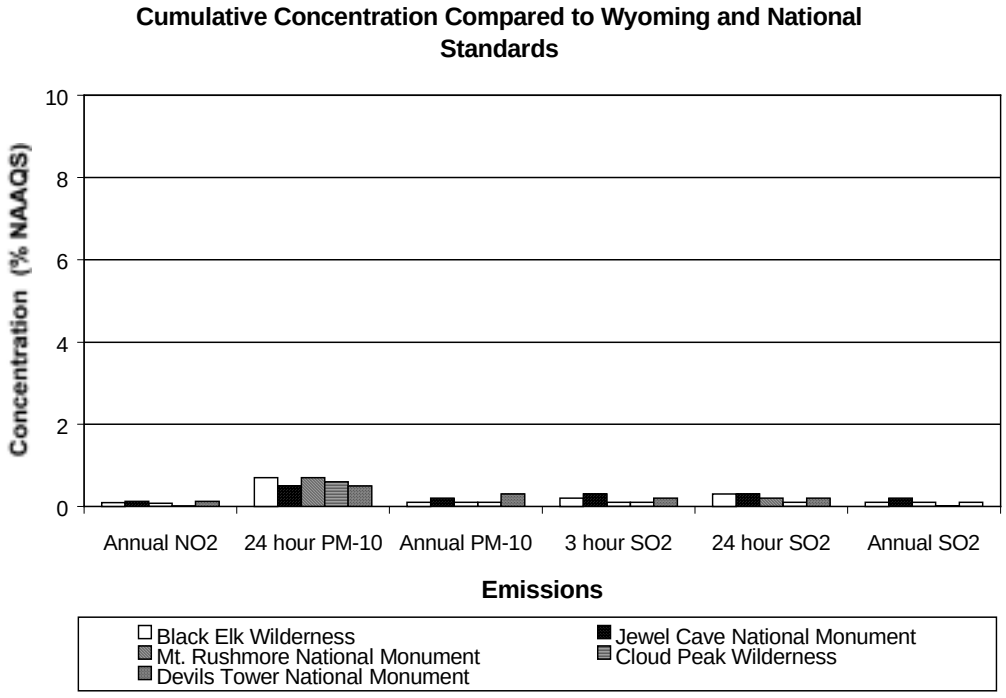


Figure 4-5. Cumulative Far-Field Concentrations.

Table 4-9. Predicted Annual Days of Visibility Reductions at Class I and Class II Sensitive Areas from Cumulative Sources.

Location	Type of Area	Number of Days Deciview Change >0.5	Number of Days Deciview Change >1.0
Northern Cheyenne Reservation	Class I	18	8
Badlands National Park	Class I	173	70
Wind Cave National Park	Class I	94	45
Black Elk Wilderness	Class II	66	28
Jewel Cave National Monument	Class II	72	32
Mt. Rushmore National Monument	Class II	58	22
Cloud Peak Wilderness	Class II	15	4
Devils Tower National Monument	Class II	70	28

Note: The Northern Cheyenne Reservation is a redesignated Class I area and is not addressed by existing visibility regulations which apply to the federally mandated Badlands and Wind Cave Class I areas.

modeling update that was prepared for the DM&E Railroad Powder River Basin Expansion Project were recently released in the Draft EIS for that project (Surface Transportation Board 2000). A brief summary of the results of that air quality analysis is included in Appendix H. The Badlands National Park results in Table 4-9 reflect data for those areas of the Park more than 20 km (12 mi) from the modeled rail route. The CALPUFF modeling system in the version applied in the present analysis is not appropriate for definition of impacts at shorter distances from linear sources such as railroads.

AQRV Impact (Acid Deposition)

In addition to evaluating potential impacts to visibility in Class I and sensitive Class II areas, an assessment of potential impacts to other AQRVs in these areas was performed. The AQRVs of concern for the Class I and sensitive Class II areas include soil, water, flora, and fauna. For impacts to AQRVs, other than visibility, acid deposition of nitrates and sulfates is of primary interest due to its effects on lake acidification, as well as possibly affecting flora and fauna.

The cumulative acid deposition analysis evaluated potential impacts to AQRVs by computing the amount of nitrogen and sulfur that would be deposited on land masses within the Class I and II areas. Additionally, the potential effects of acid deposition on Florence Lake (a sensitive lake located within Cloud Peak Wilderness, Wyoming) were also evaluated at the request of the FS. Nitrogen would originate from wet and dry deposition of nitrates and nitric acid, as well as dry deposition of NO_x. Sulfur would

originate from wet and dry deposition of sulfates and SO_2.

To evaluate potential impacts to AQRVs, the wet and dry deposition of the nitrogen and sulfur- containing chemicals were computed using the CALPUFF model. Annual fluxes (mass per unit area) calculated for the Class I and sensitive Class II areas were compared to the limits of acceptable change (2.7 to 4.5 lb/acre/year) for evaluating effects on soil, flora, and fauna. The acid deposition calculations used in this analysis followed the procedures outlined in the IWAQM Phase 2 Report (USEPA 1998) and FS guidance.

To evaluate the impacts to aquatic systems (Florence Lake) from acid deposition, the loss of acidification neutralization capacity (ANC), in micro-equivalents per liter (µeq/L), was computed using FS methods (USFS 1987). Since the baseline ANC at Florence Lake is 37.6 µeq/L (USDA FS 1999), the limit of acceptable change in the ANC is 10 percent.

The results of the AQRV analysis for effects from acid deposition are summarized in Table 4-10 and illustrated as Figure 4-6. The maximum annual deposition fluxes of nitrogen and sulfur due to cumulative emissions are shown for each Class I and II area. As the data show, the highest nitrogen deposition would be 0.24 lb/acre/year (Badlands National Park), a value that is only 8.82 percent of the lower limit of acceptable change.

The ANC calculation for Florence Lake showed that the expected change in ANC due to cumulative acid deposition impacts would be 0.07 percent, a value much lower than the limit of acceptable change (10 percent).

Discussion

The Horse Creek cumulative air quality impact analysis indicates that impacts in Class I and sensitive Class II areas, based on reasonably expected pollutant emission increases through the year 2015, will be quite

Table 4-10. Predicted Levels of Acid Deposition from Cumulative Sources (Limit of Acceptable Change from 2.7 to 4.5 pounds/acre/year).

Area	Total Nitrogen Deposition (%LAC)	Total Sulfur Deposition (%LAC)
Northern Cheyenne Reservation	2.48	0.41
Badlands National Park	8.82	2.78
Wind Cave National Park	2.44	2.26
Black Elk Wilderness	1.74	2.19
Jewel Cave National Monument	1.89	2.82
Mt. Rushmore National Monument	1.11	1.85
Cloud Peak Wilderness	0.15	0.22
Devils Tower National Monument	1.63	2.04

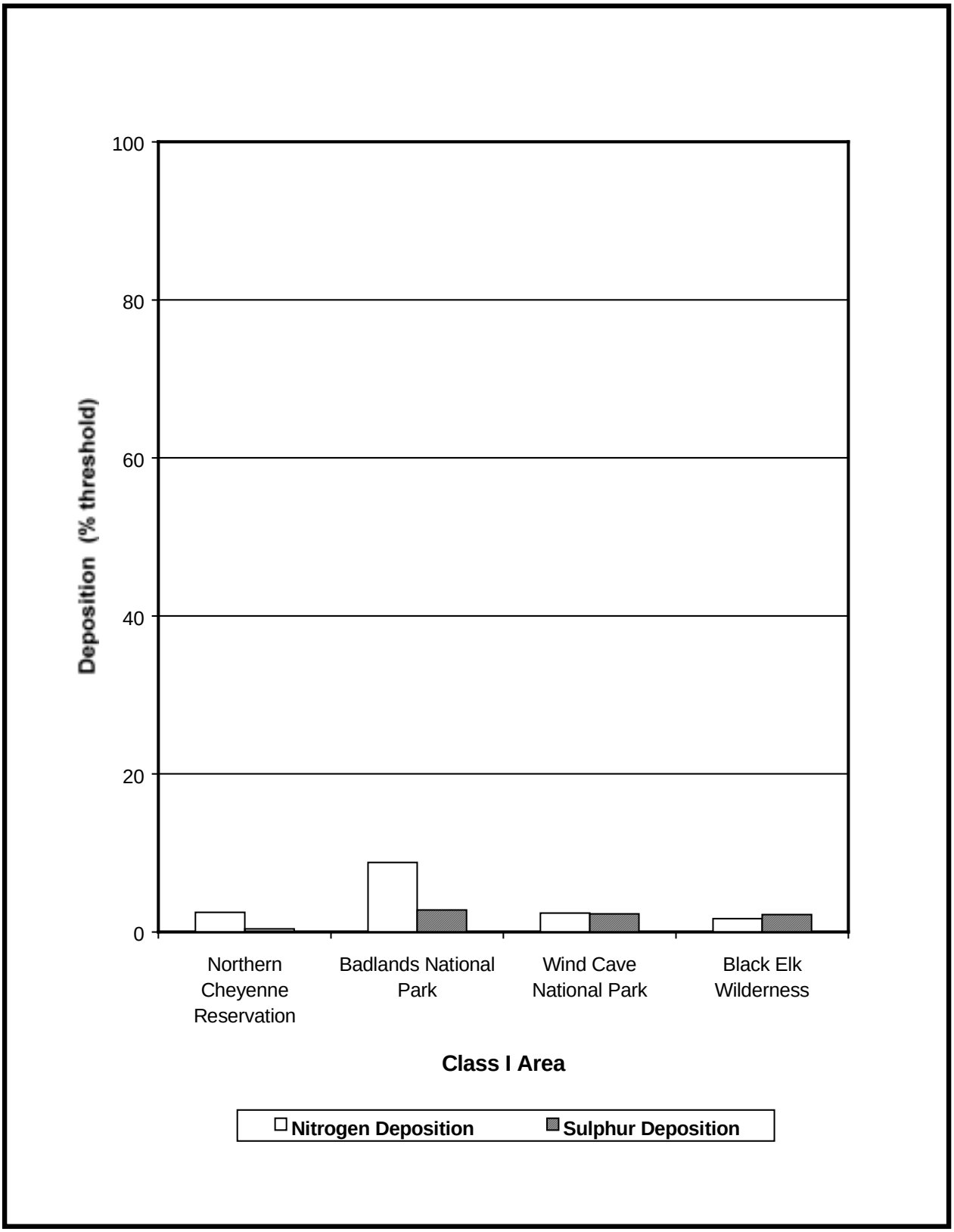


Figure 4-6. Cumulative Acid Deposition as Percent of Lower Limit of Acceptable Change.

through the year 2015, will be quite small with the exception of impacts on visibility. The DM&E modeling analysis summarized in Appendix H also predicts that there will be impacts to visibility (Figure H-6). In both analyses, the model results suggest that visibility impacts may exceed LACs on some days in all areas evaluated. Model-predicted impacts in these analyses are affected by proximity to the modeled route of the DM&E railroad. The LACs for visibility impacts, as well as those for other AQRVs, are not regulatory limits, but represent federal land managing agency polices for evaluating impacts.

The model-predicted numbers of days of visibility impacts are an indication of possible impacts. There are many uncertainties involved in air quality model projections, particularly for long-range transport modeling over large areas with widely varying terrain and land surface characteristics. The CALPUFF modeling system is relatively new and its calculation algorithms and methods of application are still evolving. Results are subject to wide variability with the quality and quantity of input meteorological data, the accuracy of emission estimates, the form of representation of different types of sources, chemical reaction and particle size assumptions, and other factors.

4.5.5 Water Resources

Surface Water

Streamflows may be reduced during surface coal mining because SMCRA and Wyoming state regulations require capture and treatment of all runoff from disturbed areas in sedimentation ponds before it is allowed to flow off the mine permit areas. Also, the surface coal mine pits in the PRB are large, and these pits, together with ponds and diversions built to keep water out of the pits, can intercept the runoff from significant drainage areas.

Changes in drainage patterns and surface disturbance are decreasing and will continue to decrease flows in most of the ephemeral and intermittent drainages exiting at the mine sites. Development of CBM resources in the area west of the mines could potentially increase surface flow in some drainages. Currently, there is methane production occurring in the general analysis area. (CBM development was not considered in the CHIA (Martin et al. 1988)). The amount of CBM produced water that ultimately reaches the major channels is reduced by evaporation, infiltration into the ground, and surface landowners, who sometimes divert the produced water into reservoirs for livestock use because it is of relatively good quality. The Wyodak CBM Project EIS (BLM 1999a, 1999c) evaluated impacts of CBM production within a much larger project area, extending from over 30 miles north of Gillette to over 60 miles south of

Gillette, and extending westward from the PRB coal mine areas for a distance of 18 to 36 miles. The Wyodak CBM project evaluated 3,000 to 5,000 CBM wells that would each generate 12 gpm of water. This water would be discharged at an estimated 500 to 1,000 different locations over a period of 10 to 20 years. These water discharges would double the annual yield from the Upper Cheyenne drainages, in which the southern mine cluster, including the Jacobs Ranch Mine, is located. These CBM water discharges would be constant, as opposed to naturally occurring flows which fluctuate widely on a seasonal and annual basis. Most streams in the area are naturally dry throughout most of each year.

The PRB Oil and Gas EIS, which is currently in preparation, will include an evaluation of the surface water impacts if 50,000 CBM wells are drilled in the PRB in the next ten years. The project area for this EIS covers all of Campbell, Sheridan, and Johnson counties, as well as the northern portion of Converse County.

The USGS has predicted that, after reclamation, major streams in the PRB will exhibit increased runoff ranging from 0.4 percent in the Cheyenne River to 4.3 percent in Coal Creek due to cumulative disturbance as a result of existing surface coal mining (Martin et al. 1988). This is based on the assumption that unit runoff rates will be increased after reclamation due to soil compaction, and the percentage changes in runoff are based on permitted mine acreages in 1981. The additional leases since that time have increased the permitted acreage by about 40 percent and would, under the same assumptions, increase the USGS's estimates of runoff increase by the same incremental amount. This minor increase in runoff is small compared to seasonal and annual variability of runoff in the PRB.

Drainage from all five southern mines combines where Black Thunder Creek enters the Cheyenne River. The drainage area of the Cheyenne River at this point is approximately 2,430 mi^2. The entire area of disturbance from these five mines as currently permitted would impact approximately 2 percent of the drainage basin of the Cheyenne River, and this disturbance would occur over about 50 years. Proposed LBA's and recently issued leases would raise this disturbance acreage to roughly 4 percent of the Cheyenne River drainage basin at Black Thunder Creek.

Sediment concentrations should not increase significantly in area streams even with the addition of mining the pending and recently issued LBA tracts because, as discussed in Section 4.1.5, state and federal regulations require that all surface runoff from mined lands pass through sedimentation ponds. The potential for cumulative adverse impacts to the Cheyenne River drainage is also minimal because it is typically dry for a substantial portion of the year.

The CBM discharges could result in erosion and degradation of small drainages, which could affect water quality and channel hydraulic characteristics. From a surface water standpoint, the increased flows due to CBM discharges and the reduced flows due to surface coal mining will tend to offset each other. However, conflicts could also result. The CBM development takes place upstream from the mines. Provisions the mines have taken to prevent water from entering the pits (e.g., storage ponds or diversions) could be adversely affected by having to deal with flows that were not included in designs or that change conditions for future designs.

Groundwater

As a result of statutory requirements and concerns, several studies and a number of modeling analyses have been conducted to help predict the impacts of surface coal mining on groundwater resources in the Wyoming portion of the PRB. Some of these studies and modeling analyses are discussed below.

In 1987, the USGS, in cooperation with the WDEQ and OSM, conducted a study of the hydrology of the eastern PRB. The resulting description of the cumulative hydrologic effects of all current and anticipated surface coal mining (as of 1987) was published in 1988 in the USGS Water-Resources Investigation Report entitled "*Cumulative Potential Hydrologic Impacts of Surface Coal Mining in the Eastern Powder River Structural Basin, Northeastern Wyoming*", also known as the "CHIA" (Martin, et al. 1988). This report evaluates the potential cumulative groundwater impacts of surface coal mining in the area and is incorporated by reference into this EIS. The CHIA analysis included the proposed mining of all the 1987 leases at all of the existing mines in the southern mine group. It did not evaluate potential groundwater impacts related to additional coal leasing in this area and it did not consider the potential for overlapping groundwater impacts from coal mining and CBM development.

Each mine must assess the probable hydrologic consequences of mining as part of the mine permitting process. The WDEQ/LQD must evaluate the cumulative hydrologic impacts associated with each proposed mining operation before approving the mining and reclamation plan for each mine, and they must find that the cumulative hydrologic impacts of all anticipated mining would not cause material damage to the hydrologic balance outside of the permit area for each mine. As a result of these requirements, each existing approved mining permit includes an analysis of the hydrologic impacts of the surface coal mining proposed at that mine. If revisions to mining and reclamation permits are proposed, then the potential cumulative impacts of the revisions must also be evaluated. If the North Jacobs Ranch LBA Tract is leased to the applicant, the existing mining and reclamation permit for the Jacobs Ranch Mine must be revised and approved before the tract can be mined.

Additional groundwater impact analyses have also been conducted to evaluate the potential cumulative impacts of coal mining and CBM development. One example of these analyses is the report entitled A Study of Techniques to Assess Surface and Groundwater Impacts Associated with Coal Bed Methane and Surface Coal Mining, Little Thunder Creek Drainage, Wyoming (Wyoming Water Resources Center 1997). This study was prepared as part of a cooperative agreement involving WDEQ/LQD, the Wyoming State Engineer's Office, the WSGS, BLM, OSM and the University of Wyoming. The Wyodak CBM Project Draft EIS (BLM 1999a) presented the results of a modeling analysis of the potential cumulative impacts of coal mining and CBM development on groundwater in the coal and overlying aquifers as a result of coal mining and CBM development. As a result of comments received on this modeling analysis, it was revised and the revised results were included in the Wyodak CBM Project Final EIS (BLM 1999c), which was distributed to the public on October 1, 1999. The technical report for both these modeling analyses is available for public review at the BLM office in Buffalo, Wyoming (Applied Hydrology Associates, Inc. 1999). The results of these previously prepared analyses are incorporated by reference into this EIS.

The PRB Oil and Gas EIS, which is currently in preparation, will include an updated modeling analysis of the groundwater impacts if 50,000 CBM wells are drilled in the PRB in the next ten years. The project area for this EIS covers all of Campbell, Sheridan, and Johnson counties, as well as the northern portion of Converse County.

Another source of data on the impacts of surface coal mining on groundwater is the monitoring that is required by WDEQ/LQD and administered by the mining operators. Each mine is required to monitor groundwater levels and quality in the coal and in the shallower aquifers in the area surrounding their operations. Monitoring wells are also required to record water levels and water quality in reclaimed areas.

The coal mine groundwater monitoring data is published each year by GAGMO, a voluntary group formed in 1980. Members of GAGMO include most of the companies with operating or proposed mines in the Wyoming PRB, WDEQ, the Wyoming SEO, BLM, USGS, and OSM. GAGMO contracts with an independent firm each year to publish the annual monitoring results. In 1991, GAGMO published a report summarizing the water monitoring data collected from 1980 to 1990 in the Wyoming PRB (Hydro-Engineering 1991b). In 1996, they published a report summarizing the data collected from 1980 to 1995 (Hydro-Engineering 1996a).

The southern group of mines uses about 1,736 ac-ft of water per year for drinking, sanitation, washing equipment, and dust control. Sources of this water include seepage

into the mine pits, sediment- and flood-control impoundments as well as production from the aquifers below the coal. The five southern mines pump an estimated 1,400 ac-ft per year from the pits and dewatering wells.

Assessment of cumulative groundwater impacts in this EIS is based on impact predictions made by JRCC for mine-related drawdown at the Jacobs Ranch Mine and extrapolating those drawdowns to consider mining of the North Jacobs Ranch LBA Tract, along with previous drawdown predictions made within the southern mine group that includes the Jacobs Ranch Mine. Figure 4-7 depicts the predicted extent of the 5-ft drawdown contour within the coal aquifer from the various mining scenarios. The extent of the 5-ft drawdown contour is used by WDEQ/LQD to assess the cumulative extent of impact to the groundwater system caused by mining operations. In Figure 4-7, these predictions are compared to the predictions in the CHIA and monitoring information gathered since publication of the CHIA. Figure 4-7 shows only the predicted drawdowns in the coal aquifer due to mining because of the limited extent of the saturated sand aquifers in the Wasatch Formation overburden in the southern group of mines.

The major groundwater issues related to surface coal mining that have been identified by scoping are:

- the effect of the removal of the coal aquifer and any overburden aquifers within the mine area and replacement of these aquifers with spoil material;
- the extent of the temporary lowering of static water levels in the aquifers around the mine due to dewatering associated with removal of these aquifers within the mine boundaries;
- the effects of the use of water from the subcoal Fort Union Formation by the mines;
- changes in water quality as a result of mining; and
- potential overlapping drawdown in the coal due to proximity of coal mining and CBM development.

The impacts of large scale surface coal mining on a cumulative basis for each of these issues are discussed in the following paragraphs.

The effects of replacing the coal aquifer and overburden with a spoils aquifer is the first major groundwater concern. The following discussion of recharge, movement, and discharge of water in the spoil aquifer is excerpted from the CHIA (Martin et al. 1988:24):

> Postmining recharge, movement and discharge of groundwater in the Wasatch aquifer and Wyodak coal aquifer will probably not be substantially different

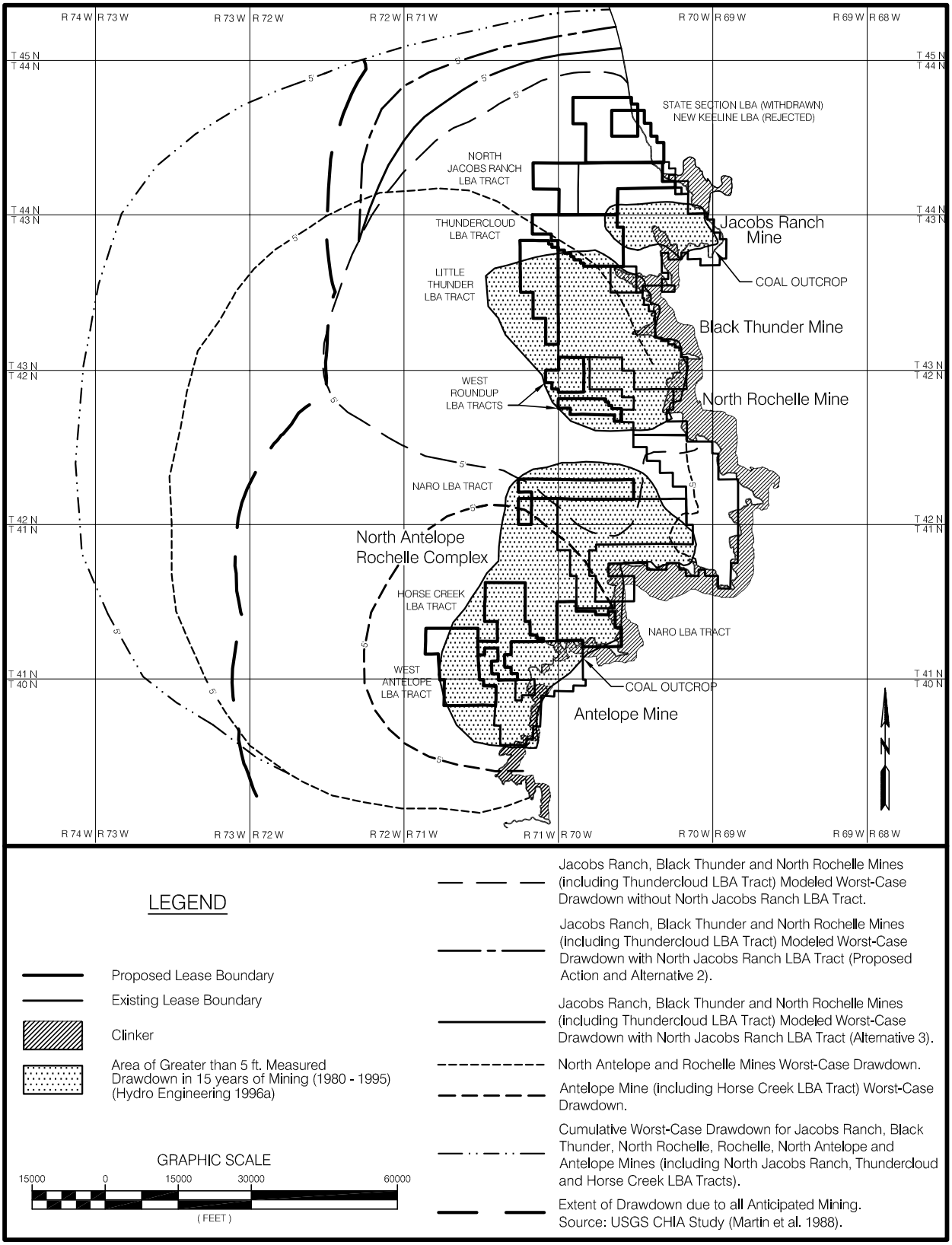


Figure 4-7. Modeled and Extrapolated Worst-Case Coal Aquifer Drawdown Scenarios Showing Extent of Actual 15-Year Drawdowns and USGS Predicted Cumulative Drawdowns.

from premining conditions. Recharge rates and mechanisms will not change substantially. Hydraulic conductivity of the spoil aquifer will be approximately the same as in the Wyodak coal aquifer allowing groundwater to move from recharge areas where clinker is present east of mine areas through the spoil aquifer to the undisturbed Wasatch aquifer and Wyodak coal aquifer to the west.

GAGMO data from 1990 to 1999 verify that recharge has occurred and is continuing in the backfill (Hydro-Engineering 1991a, 1992, 1993, 1994, 1995, 1996b, 1997, 1998, 1999). The water monitoring summary reports prepared each year by GAGMO list current water levels in the monitoring wells completed in the backfill and compare them with the 1980 water levels, as estimated from the 1980 coal water-level contour maps. In the 1991 GAGMO 10-year report, some recharge had occurred in 88 percent of the 51 backfill wells reported for that year. In the 1999 GAGMO report, 89 percent of the 64 backfill wells measured contained water.

Coal companies are required by state and federal law to mitigate any water rights that are interrupted, discontinued, or diminished by mining.

The cumulative size of the backfill area in the PRB and the duration of mining activity would be increased by mining of the recently issued leases and the currently proposed LBA tracts including the North Jacobs Ranch LBA Tract. However, since reclamation is occurring in mined-out areas and the monitoring data demonstrate that recharge of the backfill is occurring, it is not anticipated that additional significant impacts would occur as a result of any of the pending leasing actions. As previously discussed, through February 19, 2000 more than 60 percent of the area disturbed at the Jacobs Ranch Mine had been reclaimed, and backfill monitoring wells indicate that recharge is occurring in the backfill at the Jacobs Ranch Mine.

Clinker, also called scoria, the baked and fused rock formed by prehistoric burning of the Wyodak-Anderson coal seam, occurs all along the coal outcrop area (Figure 4-7) and is believed to be the major recharge source for the spoil aquifer, just as it is for the coal. However, not all clinker is saturated. Some clinker is mined for road-surfacing material, but saturated clinker is not generally mined since abundant clinker exists above the water table and does not present the mining problems that would result from mining saturated clinker. Therefore, the major recharge source for the spoil aquifer is not being disturbed by current mining. Clinker does not occur in significant amounts on the LBA tract being considered in this EIS.

The second major groundwater issue is the extent of water level drawdown in the coal and shallower aquifers in the area surrounding the mines.

Most of the monitoring wells included in the GAGMO 15-year report (542 wells out of 600 total) are completed in the coal beds, in the overlying sediments, or in sand channels or interburden between the coal beds. The changes in water levels in the coal seams after 15 years of monitoring are shown on Figure 4-7, which was adapted from the 1996 GAGMO 15-year report (Hydro Engineering 1996a). This map shows the area where actual drawdown in the coal seam has been greater than 5 ft in 15 years, in comparison with the predicted worst-case 5-ft drawdown derived from groundwater modeling done by the mines. WDEQ/LQD policy is to have the mining companies determine the extent of the 5-ft drawdown contour as a method of determining off-site impacts from the various mining operations.

Figure 4-7 indicates that the drawdowns observed in 15 years of mining are still well within the total cumulative drawdown predicted in the CHIA. The addition of the pending LBA tracts, including the North Jacobs Ranch tract, will extend the predicted cumulative extent of the 5-ft drawdown caused by coal mining beyond the cumulative drawdown prediction in the 1988 CHIA.

The CHIA predicted the approximate area of 5 ft or more water level decline in the Wyodak coal aquifer which would result from "all anticipated coal mining". "All anticipated coal mining" at that time included 16 surface coal mines operating at the time the report was prepared and six additional mines proposed at that time. All of the currently producing mines, including the Jacobs Ranch Mine, were considered in the CHIA analysis (Martin et al. 1988). The study predicted that water supply wells completed in the coal may be affected as far away as eight miles from mine pits, although the effects at that distance were predicted to be minimal.

As drawdowns propagate to the west, available drawdown in the coal aquifer increases. Available drawdown is defined as the elevation difference between the potentiometric surface (elevation to which water will rise in a well bore) and the bottom of the aquifer. Proceeding west, the coal depth increases faster than the potentiometric surface declines, so available drawdown in the coal increases. Since the depth to coal increases, most stock and domestic wells are completed in units above the coal. Consequently, with the exception of methane wells, few wells are completed in the coal in the areas west of the mines. Those wells completed in the coal have considerable available drawdown, so adverse impacts to wells outside the immediate mine area are unlikely.

Wells in the Wasatch Formation were predicted to be impacted by drawdown only if they were within 2,000 ft of a mine pit (Martin et al. 1988). Drawdowns occur farther from the mine pits in the coal than in the shallower aquifers because the coal is a confined aquifer that is areally extensive. The area in which the shallower aquifers (Wasatch

Formation, alluvium, and clinker) experience a 5-ft drawdown would be much smaller than the area of drawdown in the coal because the shallower aquifers are generally discontinuous, of limited areal extent, and may be confined or unconfined.

Since the actual 1995 drawdown lies within the cumulative drawdown predicted by the CHIA study, the cumulative impacts to water wells have not reached the maximum levels predicted in that report. Of the 1,200 water supply wells within the maximum impact area defined in the CHIA study, about 580 are completed in Wasatch aquifers, about 100 in the Wyodak coal aquifer, and about 280 in strata below the coal. There are no completion data available for the remainder of these wells (about 240).

The additional groundwater impacts that would be expected as a result of extending mining into the LBAs issued or proposed to date would be to extend the drawdown into areas surrounding the proposed new leases. The predicted cumulative effects of mining the LBA tract are depicted on Figure 4-7. Drawdowns have coalesced in the vicinity of the Black Thunder and North Rochelle mines, and the North Antelope/Rochelle and Antelope mines. Currently, the actual drawdown in the coal aquifer in the vicinity of Black Thunder and Jacobs Ranch mines is expressed in two separate cones of depression, but would coalesce in the future with the addition of mining activity on the Thundercloud lease and the North Jacobs Ranch LBA Tract, if it is leased.

If a maintenance lease is issued for the North Jacobs Ranch LBA Tract, prior to amending the tract into an existing WDEQ mine permit, the lessee would be required to conduct more detailed groundwater modeling to predict the extent of drawdown in the coal and overburden aquifers caused by mining the LBA tract. WDEQ/LQD will then use the drawdown predictions to update the CHIA for this portion of the PRB. The applicant has installed monitoring wells which would be used to confirm or refute drawdowns predicted by modeling. This modeling would be required as part of the WDEQ mine permitting procedure discussed in Section 1.2.

Withdrawal of water for the ENCOAL facility, which is currently indefinitely delayed, would lower water levels in the scoria aquifer to the east of the North Rochelle Mine if the rate of withdrawal exceeds recharge (currently unknown). As discussed above, the scoria provides the primary source of recharge to the Wyodak coal aquifer. As mining at the North Rochelle Mine continues, the coal will be removed and replaced with spoil, which would be expected to have the same conductivity as the Wyodak coal aquifer according to Martin, et al. (1988 p. 24). The primary impact due to lowering water levels in the scoria would be a potential delay in the recovery of water levels in the North Rochelle Mine backfill, as the rate at which the backfill would receive recharge from the scoria would be related to the scoria water levels. Based on the size of the scoria aquifer supplying

ENCOAL and the amount of water to be withdrawn from it, complete recovery of the scoria water levels could take up to 100 years, slowing recovery of North Rochelle Mine spoil water levels for an equal duration. Since predictions for recovery of water levels in the spoils range from tens to thousands of years, the additional delay in recovery caused by the ENCOAL water supply wells is within the range of predictions.

Potential water-level decline in the subcoal Fort Union Formation is the third major groundwater issue. According to the Wyoming State Engineer's records as of July 1999, 14 mines hold permits for 42 wells between 400 ft and 10,000 ft deep. The zone of completion of these wells was not specified, and not all of the wells were producing (for example, three of the permits were held by an inactive mine, and one of the wells permitted by the Black Thunder Mine has not been used since 1984).

Water level declines in the Tullock Aquifer have been documented in the Gillette area. According to Crist (1991), these declines are most likely attributable to pumpage for municipal use by Gillette and for use at subdivisions and trailer parks in and near the city of Gillette. Most of the water-level declines in the subcoal Fort Union wells occur within one mile of the pumped wells (Crist 1991; Martin et al. 1988). The mine facilities in the PRB are separated by a distance of one mile or more, so little interference between mine supply wells would be expected.

In response to concerns voiced by regulatory personnel, several mines have conducted impact studies of the subcoal Fort Union Formation. The OSM commissioned a cumulative impact study of the subcoal Fort Union Formation to study the effects of mine facility wells on this aquifer unit (OSM 1984). Conclusions from all these studies are similar and may be summarized as follows:

- Because of the discontinuous nature of the sands in this formation and because most large-yield wells are completed in several different sands, it is difficult to correlate completion intervals between wells.

- In the Gillette area, water levels in this aquifer are probably declining because the city of Gillette and several subdivisions are utilizing water from the formation (Crist 1991). (Note: Gillette is mixing this water with water from wells completed in the Madison Formation at this time.)

- Because large saturated thicknesses are available in this aquifer unit, generally 500 ft or more, a drawdown of 100 to 200 ft in the vicinity of a pumped well would not dewater the aquifer.

The Jacobs Ranch Mine adjacent to the North Jacobs Ranch LBA Tract has a permit from the State Engineer for five deeper Ft. Union Formation water supply wells. Extending the life of the mine with the LBA tract would

result in additional water being withdrawn from the Tullock Aquifer. The additional water withdrawal would not be expected to extend the area of water level drawdown over a significantly larger area due to the discontinuous nature of the sands in the Tullock Aquifer and the fact that drawdown and yield reach equilibrium in a well due to recharge effects.

The nearest sub-coal Fort Union well to the Jacobs Ranch Mine facilities is over 5 miles away, at the Black Thunder Mine. Due to the distance involved, these wells have not experienced interference and are not likely to in the future. The Jacobs Ranch Mine wells will be in use for roughly 14 to 23 more years if the North Jacobs Ranch LBA Tract is leased depending on which alternative is selected. Their annual water production would increase, though not directly in proportion to coal production, which could increase by about 30 percent if the North Jacobs Ranch Tract is leased.

According to the Wyoming SEO, the only permitted, non-mine wells drilled below 1,000 ft in a 100 mi^2 area surrounding Wright are four wells permitted by the City of Wright. As discussed above, most of the water-level declines in the subcoal Fort Union wells occur within one mile of pumped wells. The North Jacobs Ranch LBA Tract, about 7 miles east of Wright, would not contribute significantly to any cumulative impact on the water supply for that town under the action alternatives because no new wells would be required to maintain existing production.

Water requirements and sources for the proposed Two Elk project are not currently known. The State Engineer is discouraging further development of the lower Fort Union aquifers, so the most likely groundwater source for Two Elk is the Lance-Fox Hills. This will reduce the chances that Two Elk will add to cumulative hydrologic impacts of mining.

The fourth issue of concern with groundwater is the effect of mining on water quality. Specifically, what effect does mining have on the water quality in the surrounding area, and what are the potential water quality problems in the spoil aquifer following mining?

In a regional study of the cumulative impacts of coal mining, the median concentrations of dissolved solids and sulfates were found to be larger in water from spoil aquifers than in water from either the Wasatch overburden or the coal aquifer (Martin et al. 1988). This is expected because blasting and movement of the overburden materials exposes more surface area to water, increasing dissolution of soluble materials, particularly when the overburden materials were situated above the saturated zone in the premining environment. Using data compiled from ten surface coal mines in the eastern PRB, Martin et al. (1988) also concluded that backfill groundwater quality improves markedly after the backfill is leached with one pore volume of water. The same

conclusions were reached by Van Voast and Reiten (1988) after analyzing data from the Decker and Colstrip Mine areas in the northern PRB. In general, the mine backfill groundwater TDS can be expected to range from 3,000 - 6,000 mg/L, similar to the premining Wasatch Formation aquifer, and meet Wyoming Class III standards for use as stock water.

One pore volume of water is the volume of water which would be required to saturate the spoils following reclamation. The time required for one pore volume of water to pass through the spoils aquifer is greater than the time required for the postmining groundwater system to reestablish equilibrium. According to the CHIA, estimates of the time required to reestablish equilibrium range from tens to hundreds of years (Martin et al. 1988).

Chemical analyses of 336 samples collected between 1981 and 1986 from 45 wells completed in spoil aquifers at ten mines indicated that the quality of water in the spoils will, in general, meet state standards for livestock use when recharge occurs (Martin et al. 1988). The major current use of water from the aquifers being replaced by the spoils (the Wasatch and Wyodak Coal aquifers) is for livestock because these aquifers are typically high in dissolved solids in their premining state (Martin et al. 1988).

According to monitoring data published by GAGMO (Hydro-Engineering 1991a, 1991b, 1992, 1993, 1994, 1995, 1996b, 1997, 1998 and 1999), TDS values in backfill wells have ranged from 400 to 25,000 mg/L. Of the 43 backfill wells measured in 1998 and reported in the 1999 annual GAGMO report (Hydro Engineering 1999), TDS in 70 percent were less than 5,000 mg/L, TDS in 28 percent were between 5,000 and 10,000 mg/L, and TDS in one well was above 10,000 mg/L. These data support the conclusion that water from the spoils will generally be acceptable for its current use, which is livestock watering, before and after equilibrium is established. The incremental effect on groundwater quality due to leasing and mining of the LBA tract would be to increase the total volume of spoil and, thus, the time for equilibrium to reestablish.

The fifth area of concern is the potential for cumulative impacts to groundwater resources in the coal due to the proximity of coal mining and CBM development. The Wyodak coal is being developed for both coal and CBM in the same general area. Dewatering activities associated with reasonably foreseeable CBM development would be expected to overlap with and expand the area of groundwater drawdown in the coal aquifer in the PRB over what would occur due to coal mining alone.

Numerical groundwater flow modeling was used to predict the drawdown impacts of the Wyodak CBM Project (BLM 1999c). The modeling considered coal mining and CBM development in order to assess cumulative impacts. Modeling was

done to simulate mining with and without CBM development in order to differentiate the impacts of the two types of activities.

As expected, modeling showed that the additional groundwater impacts that would result from CBM development would be additive in nature and would extend the area experiencing a loss in hydraulic head to the west of the mining area. The area between the CBM fields and the mines would be subjected to cumulative impacts of the two activities. The 15-year GAGMO report points out that there are already areas of overlapping impacts between the Marquiss and Lighthouse CBM projects and the Caballo, Belle Ayr and Cordero Rojo mines (Hydro-Engineering 1996a).

Figure 4-8 shows the Jacobs Ranch Mine life-of-mine drawdown map (same as Figure 4-2) with the maximum modeled drawdowns from the Wyodak CBM DEIS superimposed. These modeled drawdowns are for CBM only in the upper Wyodak Coal and are for the proposed action of 3,000 CBM wells (BLM 1999a, 1999c). The groundwater modeling study done for the Wyodak Project Area CBM EIS considered the impacts of coal mining and CBM development on groundwater in the coal and overlying aquifers in the area shown in Figure 1-1 if an additional 5,000 CBM wells were drilled. This analysis used the existing coal mines and predicted CBM well locations based on discussions with CBM operators. At the time the model was prepared, there were no CBM wells in the vicinity of the Jacobs Ranch Mine, but the model assumed that CBM drilling would occur west of the Jacobs Ranch Mine. CBM wells have been drilled adjacent to the Jacobs Ranch Mine predicted. Figure 4-8 shows that the projected drawdown in the coal caused by mining at the Jacobs Ranch Mine would be expected to overlap with projected drawdown due to CBM production. To the north, south and west of the Jacobs Ranch Mine, the projected drawdown in the coal aquifer due to CBM production would exceed drawdown due to mining. Even within close proximity to the mine, projected drawdown due to mining would be less than projected drawdown due to CBM production. Drawdowns from CBM development would be projected to exceed drawdowns from coal mining at a distance of less than one mile from the mine.

Drawdowns in the coal caused by CBM development would be expected to reduce the need for dewatering in advance of mining, which would be beneficial for mining. Wells completed in the coal may also experience increased methane emissions in areas of significant aquifer depressurization. There would be a potential for conflicts to occur over who (coal mining or CBM operators) is responsible for replacing or repairing private wells that are adversely affected by the drawdowns; however, the number of potentially affected wells completed in the coal is not large.

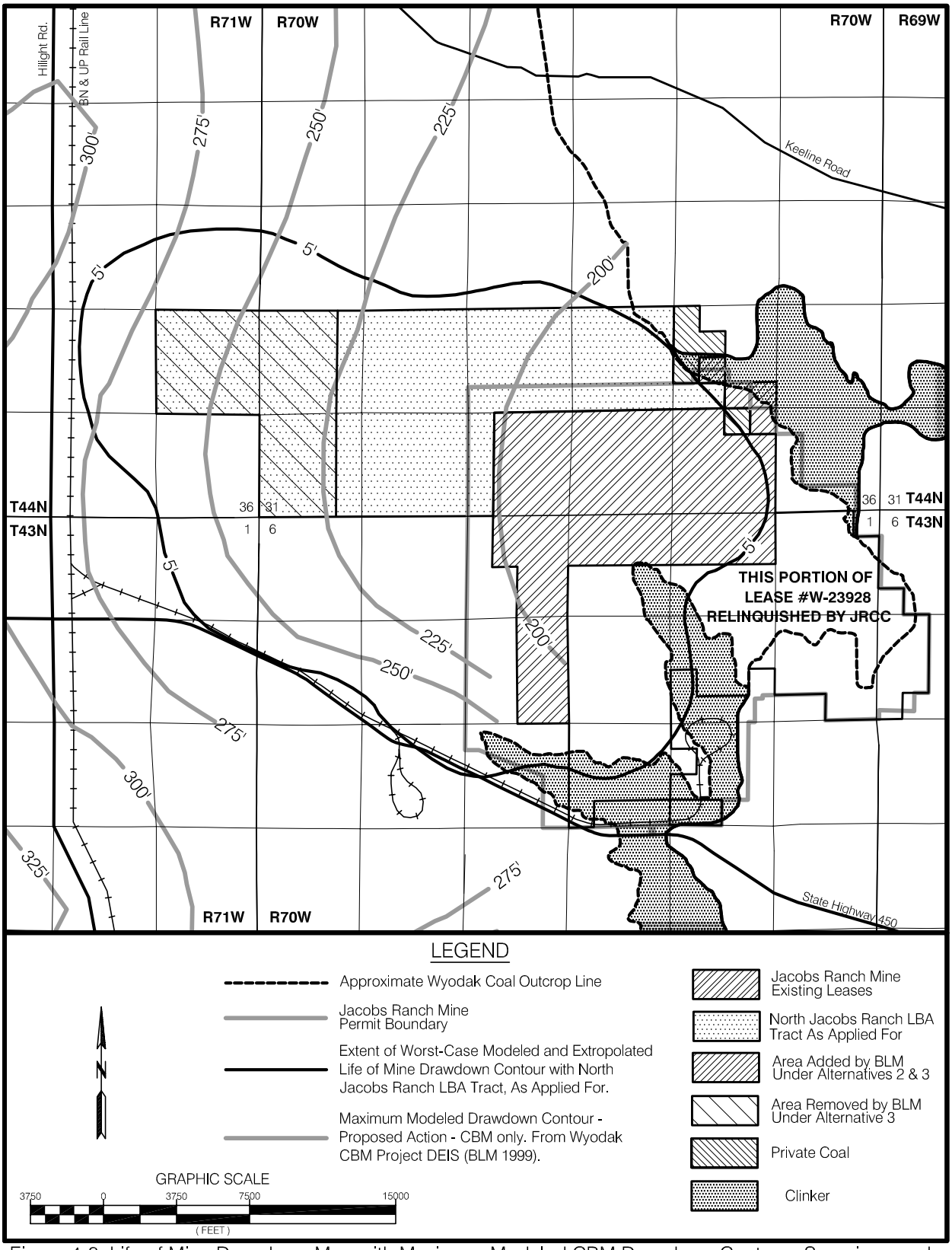


Figure 4-8. Life of Mine Drawdown Map with Maximum Modeled CBM Drawdown Contours Superimposed.

As discussed previously, coal companies are required by state and federal law to mitigate any water rights that are interrupted, discontinued, or diminished by coal mining. In response to concerns about the potential impacts of CBM development on water rights, a group of CBM operators and local landowners developed a standard water well monitoring and mitigation agreement that can be used on a case-by-case basis as development proceeds. The BLM decision record for the Gillette South CBM Project EIS (BLM 1997) requires that CBM operators offer landowners this agreement as part of the federal well approval process.

BLM and industry have cooperated to develop a system of monitoring wells designed to monitor groundwater levels in the coal and in shallower aquifers in areas of CBM production. In the future, the CBM operators will be responsible for drilling and maintaining additional monitoring wells as the area of CBM development expands.

The increased dewatering or depressuring of the coal seam caused by CBM development and mining together will also increase the time required for water-level recovery to occur after the CBM and mining projects are completed.

4.5.6 Alluvial Valley Floors

No cumulative impacts to alluvial valley floors are expected to occur as a result of leasing and subsequent mining of the North Jacobs Ranch LBA Tract. Impacts to designated AVF's are generally not permitted if the AVF is determined to be significant to agriculture. AVF's that are not significant to agriculture can be disturbed during mining but they must be restored as part of the reclamation process. Impacts during mining, before the AVF is restored, would be expected to be incremental, not additive.

4.5.7 Wetlands

Wetlands are discrete features that are delineated on the basis of specific soil, vegetation, and hydrologic characteristics. Wetlands within areas of coal mining disturbance are impacted; wetlands outside the area of disturbance are generally not affected unless their drainage areas (hence, water supplies) are changed by mining. Therefore, the impacts to wetlands as a result of surface coal mining are mostly incremental, not additive as are impacts to groundwater and air quality. Increasing the area to be mined would increase the number of wetlands that would be impacted.

Jacobs Ranch Mine has been authorized to impact 81.15 acres of jurisdictional wetlands. This number would increase if the LBA tract is leased (Section 3.8 and Section 4.1.7). COE requires replacement of all impacted jurisdictional wetlands in accordance with Section 404 of the Clean Water Act. As part of the mining and reclamation plans for each mine, COE approves the plan to restore the wetlands and the number of acres of wetlands to be restored.

Replacement of functional wetlands may occur in accordance with agreements with the surface managing agency (on public land) or by the private landowners. No federal surface lands are included in the North Jacobs Ranch LBA Tract. During mining and before replacement of wetlands, all wetland functions would be lost. The replaced wetlands may not function in the same way as the premine wetlands did.

4.5.8 Vegetation

Most of the land that is being or would be disturbed is grassland, sagebrush shrubland or breaks grassland and is used for grazing and wildlife habitat. Rangeland is, by far, the predominant land use in the PRB, comprising 92 percent of the land use in Converse and Campbell Counties. A small amount of previously cultivated lands would be disrupted by mining. At the completion of mining, it is anticipated that all disturbed land would be reclaimed for grazing and wildlife habitat, mostly in the form of mixed native grass prairie, sagebrush shrubland and, where appropriate, bottomland grassland. Some of the minor community types, such as those occurring on breaks, would not be restored to premining conditions but may be replaced to a higher level due to use of better quality soils.

Based on annual reports prepared by mining companies and submitted to WDEQ, in any given year approximately 10,000 acres of land disturbed by mining activities at the five existing southern surface coal mines would not be reclaimed to the point of planting with permanent seed mixtures. Over the life of the five southern mines, a total of about 63,500 acres would be disturbed. This disturbed area includes all leases existing including federal, state and private coal. The currently proposed North Jacobs Ranch, NARO, Little Thunder, West Roundup, and West Antelope LBAs would add roughly another 20,000 acres. Almost all of this acreage is native rangeland and would be returned to a native rangeland state through planting of approved revegetation seed mixtures as required.

Several impacts to vegetation would occur as a result of operations at these five mines. Most of the surface disturbance would occur in two vegetation types: mixed grass prairie (25 percent) and Wyoming big sagebrush (40 percent). The big sagebrush vegetation type comprises 44 percent of the North Jacobs Ranch LBA Tract area, roughly the same percentage for the five-mine southern cluster. Upland grassland comprises 14 percent of the disturbance area of the tract. All five mines plan to restore these two types as required by law. It is estimated that it would take from 20 to 100 years for big sagebrush density to reach premining levels. The big sagebrush component provides important wildlife habitat (particularly for mule deer, pronghorn, and sage grouse). The reduction in acreage of big sagebrush vegetation type would, therefore, reduce the carrying capacity of the reclaimed lands for pronghorn and

sage grouse populations. Mule deer should not be affected since they are not as abundant in this area.

Although some of the less extensive native vegetation types (e.g., graminoid/forb ephemeral drainages) would be restored during reclamation, the treated grazing lands would not. Following reclamation and release of the reclamation bond, however, privately owned surface lands would be returned to agricultural management and the areas with reestablished native vegetation could again be subject to sagebrush management practices.

Community and species diversities would initially be lower on reclaimed lands. The shrub components would take the longest to be restored to premining conditions. Shrub cover and forage values would gradually increase in the years following reclamation. Over longer periods of time, species re-invasion and shrub establishment on reclaimed lands should largely restore the species and community diversity on these lands to premining levels.

Over the long term, the net effect of the cumulative mine reclamation plans may be the restoration, at least in part, of all vegetation types originally found in the area. However, the shrub component may be substantially reduced in areal extent. Shrubs are relatively unproductive for livestock but very important for wildlife. All of the vegetation types found in the cumulative analysis area, as on the LBA tract, are fairly typical for this region of eastern Wyoming.

4.5.9 Wildlife

The direct impacts of surface coal mining on wildlife occur during mining and are therefore short-term. They include road kills by mine-related traffic, restrictions on wildlife movement created by fences, spoil piles and pits, and displacement of wildlife from active mining areas. The indirect impacts are longer term and include loss of carrying capacity and microhabitats on reclaimed land due to flatter topography, less diverse vegetative cover, and reduction in sagebrush density.

After mining and reclamation, alterations in the topography and vegetative cover, particularly the reduction in sagebrush density, would cause a decrease in carrying capacity and diversity on the LBA tract. Sagebrush would gradually become reestablished on the reclaimed land, but the topographic changes would be permanent.

Cumulative impacts to most wildlife would increase as additional habitat is disturbed but would moderate as more land is reclaimed. Raptor and grouse breeding areas have been diminishing statewide for at least the last 30 years due, in part, to surface-disturbing activities. Coal mining and gas exploration and development have been identified as potential contributors to the decline in their breeding habitat. Therefore, surface occupancy and disturbance restrictions, as well as seasonal

restriction stipulations, have been applied to operations occurring on or near these crucial areas on public lands. These restrictions have helped protect important raptor and grouse habitat on public lands, but the success of yearlong restrictions on activities near areas critical to grouse has been limited because most of the surface in the PRB is privately owned. Erection of nesting structures and planting of trees on reclaimed land will gradually replace raptor nesting and perching sites. There is little crucial habitat for waterfowl or fish on the mine sites. Small- and medium-sized animals would move back into the areas once reclamation is completed.

Numerous grazing management projects (fencing, reservoir development, spring development, well construction, vegetative treatments) have also impacted wildlife habitat in the area. The consequences of these developments have proven beneficial to some species and detrimental to others. Fencing has aided in segregation and distribution of livestock grazing, but sheep-tight woven wire fence has restricted pronghorn movement. Water developments are used by wildlife; however, without proper livestock management, many of these areas can become overgrazed. The developed reservoirs provide waterfowl, fish, and amphibian habitat. Vegetation manipulations have included the removal or reduction of native grass-shrublands and replacement with cultivated crops (mainly alfalfa/grass hay), as well as a general reduction of shrubs (mainly sagebrush) in favor of grass. These changes have increased spring and summer habitat for grazing animals, but have also reduced the important shrub component that is critical for winter range, thus reducing overwinter survival for big game and sage grouse. The reduction in sagebrush has been directly blamed for the downward trend in the sage grouse populations.

The regional EIS's (BLM 1974, 1979, 1981, and 1984) predicted significant cumulative impacts to pronghorn from existing concentrated mining and related disturbance as a result of habitat disturbance and creation of barriers to seasonal and daily movements. Significant cumulative indirect impacts were also predicted because of increased human population and access resulting in more poaching, increased vehicle/pronghorn collisions, and increased disturbance in general. However, the WGFD recently reviewed monitoring data collected on mine sites for big game species and the monitoring requirements for big game species on those mine sites. Their findings concluded that the monitoring had demonstrated the lack of impacts to big game on existing mine sites. No severe mine-caused mortalities have occurred and no long-lasting impacts on big game have been noted on existing mine sites. The WGFD therefore recommended that big game monitoring be discontinued on all existing mine sites. New mines will be required to conduct big game monitoring if located in crucial winter

range or in significant migration corridors.

Leasing of the North Jacobs Ranch LBA Tract would increase the area of habitat disturbance in the southern group of mines by approximately 6 percent and would enlarge the area where daily movement is restricted.

The North Jacobs Ranch LBA Tract is within the Hilight Pronghorn Herd Unit, which includes about 546,000 acres. The mining operations within the Hilight Herd Unit are the Caballo, Belle Ayr, Caballo-Rojo, Coal Creek, and Jacobs Ranch. These mines will cumulatively disturb 44,754 acres based on existing leases. If the North Jacobs Ranch LBA Tract is leased, the estimated mining disturbance within the Hilight Herd Unit would increase by up to 5,364 acres to 50,118 acres. This would represent approximately 9.2 percent of the Hilight Herd Unit area.

The North Jacobs Ranch LBA Tract is located within the Thunder Basin Mule Deer Herd Unit. The herd unit contains approximately 2.33 million acres and includes 9 permitted coal mines along Highway 59. The northern-most is Caballo and the southern-most is Antelope. Currently permitted disturbance within this 9-mine group includes approximately 85,260 acres. Addition of the recently leased Horse Creek and proposed North Jacobs Ranch LBA Tracts would increase the disturbance area by up to 8,945 acres, an increase of 10.5 percent. Adding the North Jacobs Ranch Tract and the recently issued, Horse Creek lease to the area to be disturbed within the Thunder Basin and Lance Creek Mule Deer Herd Units (The Horse Creek lease is within the Lance Creek Herd Unit) would increase disturbance by as much as 8,850 acres, bringing the total disturbance up to about 94,000 acres or about 2.4 percent of the four million acres that encompass the two herd units.

The WGFD big game herd unit maps show the LBA tract is out of the normal white-tailed deer range. The WGFD does not consider the LBA tract to be an elk use area, but elk have been recorded on the tract over the past several years and observed wintering on adjacent grasslands southeast of the tract in recent years as well. None of the lease area or areas within two miles have been classified as crucial or critical elk habitat. The nearest crucial elk habitat is just over 2 miles to the southeast on Jacobs Ranch Mine reclaimed mine land. The WGFD (Oedekoven 1991) designated an area of approximately five square miles on Jacobs Ranch Mine reclaimed or adjacent lands as crucial winter habitat for the Rochelle Hills elk herd. There is potential for expansion of elk habitat on the lease area through quality reclamation.

The area of active mining in the southern group of mines contains significant numbers of raptor nests. The largest concentration of nesting activity in the area is associated with the rough breaks country and areas where trees have become established. Raptor mitigation plans are included in the approved mining and

reclamation plans of each mine. The raptor mitigation plan for each mine is subject to USFWS review and approval before the mining and reclamation plan is approved. Any nests that are impacted by mining operations must be relocated in accordance with these plans, after special use permits are secured from USFWS and WGFD. The creation of artificial raptor nest sites and raptor perches may ultimately enhance raptor populations in the mined area. On the other hand, where power poles border roads, perched raptors may continue to be illegally shot and continued road kills of scavenging eagles may occur. Any influx of people into previously undisturbed land may also result in increased disturbance of nesting and fledgling raptors.

Cumulative impacts to waterfowl from already-approved mining, as well as the proposed LBA tract, would be insignificant because most of these birds are transient and most of the ponds are ephemeral. In addition, the more permanent impoundments and reservoirs that are impacted by mining would be restored. Sedimentation ponds and wetland mitigation sites would provide areas for waterfowl during mining.

Direct habitat disturbance from already-approved mining, as well as the LBA tract, should not significantly affect regional sage grouse populations because few vital sage grouse wintering areas or leks have been, or are planned to be, disturbed. However, noise related to the mining activity could indirectly impact sage grouse reproductive success. Sage grouse leks close to active mining could be abandoned if mining-related noise elevates the existing ambient noise levels. Surface coal mining activity is known to contribute to a drop in male sage grouse attendance at leks close to active mining, and over time this can alter the distribution of breeding grouse (Remington and Braun 1991). Because sage grouse populations throughout Wyoming have been declining over the past several years, this impact could be significant to the local population when evaluated with the cumulative impacts of all energy-related development occurring in the area.

The existing and proposed mines in the southern PRB would cumulatively cause a reduction in habitat for other mammal and bird species. Many of these species are highly mobile, have access to adjacent habitats, and possess a high reproductive potential. Habitat adjacent to existing and proposed mines include sagebrush shrublands, upland grasslands, bottomland grasslands, improved pastures, haylands, wetlands, riparian areas, greasewood shrublands, and ponderosa pine woodlands. As a result, these species should respond quickly and invade suitable reclaimed lands as reclamation proceeds. A research project on habitat reclamation on mined lands within the PRB for small mammals and birds concluded that the diversity of song birds on reclaimed areas was slightly less than on adjacent undisturbed areas,

although their overall numbers were greater (Shelley 1992).

Cumulative impacts on fish habitat and populations would be minimal because local drainages generally have limited value due to intermittent or ephemeral flows. Some of the permanent pools along drainages support minnows and other nongame fish, and the larger impoundments and streams in the area which have fish populations would be restored following mining.

Additional discussions of cumulative impacts to wildlife from coal development and industrialization of the eastern PRB are discussed in BLM regional EIS's for the area (BLM 1974, 1979, 1981, 1984), and these documents are incorporated by reference into this EIS. The impacts predicted in these documents have generally not been exceeded. Recent findings by the WGFD have revealed that impacts of mining on big game have been minimal. No severe mine-caused mortalities have occurred and no long-lasting impacts on big game have been noted on existing mine sites. The WGFD therefore recommended that big game monitoring be discontinued on all existing mine sites. New mines will be required to conduct big game monitoring if located in crucial winter range or in significant migration corridors, neither of which apply to the LBA tract.

The cumulative impacts of mining the LBA tract will be assessed within the WGFD's and the WDEQ/LQD's review of the mine permit application and the WDEQ/LQD's permit approval process.

4.5.10 Threatened, Endangered, and Candidate Species

Refer to Appendix G.

4.5.11 Land Use and Recreation

Surface coal mining reduces livestock grazing and wildlife habitat, limits access to public lands that are included in the mining areas, and disrupts oil and gas development. In addition, when oil and gas development facilities are present on coal leases, all associated facilities and equipment must be removed prior to mining. Mining the coal prior to the recovery of all of the CBM resources releases CBM into the atmosphere. The potential impacts of conflicts between CBM and coal development are discussed in Section 4.1.2.

Cumulative impacts resulting from energy extraction in the PRB include a reduction of livestock grazing and subsequent revenues, a reduction in habitat for some species of wildlife (particularly pronghorn, sage grouse and mule deer), and loss of recreational access to public lands (particularly for hunters).

There are no recreation facilities, wilderness areas, etc., in the immediate vicinity of the existing southern group of mines, and the majority of the land is seldom used by the public except for dispersed recreation (e.g., hunting), off-road vehicles, and sightseeing. Hunting

and other public access is generally limited inside of the mine permit areas for safety reasons. However, approximately 80 percent of this land surface is private and access is controlled by the landowner. Leasing the North Jacobs Ranch LBA Tract would not affect access to public lands because no public lands are included on the tract.

The increased human presence associated with the cumulative energy development in the PRB has likely increased levels of legal and illegal hunting. Conversely, the mines in the area have become refuges for big game animals during hunting seasons since they are often closed to hunting. Reclaimed areas are attractive forage areas for big game. As an example, reclaimed lands at the Jacobs Ranch Mine have been declared crucial elk winter habitat by WGFD (Oedekoven 1994). Energy development-related indirect impacts to wildlife have and will continue to result from human population growth. Energy development has been the primary cause of human influx into the eastern PRB. Mining the LBA tract under the Proposed Action and Alternatives 2 and 3 will allow a continuation of employment and production at the Jacobs Ranch Mine for up to 23 years.

The demand for outdoor recreational activities, including hunting and fishing, has increased proportionately as population has increased. However, at the same time these demands are increasing, wildlife habitat and populations are being reduced. This conflict between decreased habitat availability and increased recreational demand has had (or may have) several impacts: demand for hunting licenses may increase to the point that a lower success in drawing particular licenses will occur; hunting and fishing, in general, may become less enjoyable due to more limited success and overcrowding; poaching may increase; the increase in people and traffic has and may continue to result in shooting of nongame species and road kills; and increased off-road activities have and will continue to result in disturbance of wildlife during sensitive wintering or reproductive periods.

Campbell County's public recreation facilities are some of the most extensively developed in the Rocky Mountain Region, and use by young, recreation-oriented residents is high. The relatively strong financial position of the county recreation program appears to assure future recreation opportunities for residents regardless of the development of the LBA tract or any other specific mine. Converse County's recreational facilities are not as advanced, and development of the LBA tract and the ensuing employment increase may increase demand for recreational opportunities in Converse County.

4.5.12 Cultural Resources

In most cases, treatment of eligible sites is confined to those that would be directly impacted, while those that may be indirectly impacted receive little or no consideration unless a direct mine-associated effect can be

established. The higher population levels associated with coal development coupled with increased access to remote areas can result in increased vandalism both on and off mine property. Development of lands in which coal is strip-mineable (shallow overburden) may contribute to the permanent unintentional destruction of segments of the archeological record.

A majority of the known cultural resource sites in the PRB are known because of studies at existing and proposed coal mines. An average density estimate of 8.5 sites per mi^2 (640 acres) can be made based on inventories at existing mines in the area, and approximately 25 percent of these sites are typically eligible for the NRHP. Based on the cultural inventory, the density of sites and occurrence of eligible sites appears to be lower on the North Jacobs Ranch LBA Tract (Section 3.12 and Table 3.9). Approximately 550 cultural resource sites will be impacted by already-approved mines, with an estimated 140 of these sites being eligible for nomination to the NRHP. Clearly, a number of significant sites, or sites eligible for nomination to the NRHP, have been or will be impacted by coal mining operations within the PRB. Ground disturbance, the major impact, can affect the integrity of or destroy a site. Changes in setting or context greatly impact historical properties. Mitigation measures such as stabilization, restoration, or moving of buildings may cause adverse impacts to context, in-place values, and overall integrity. Additionally, loss of sites through mitigation can constitute an adverse impact by eliminating the site from the regional database and/or affecting its future research potential.

Beneficial results or impacts can also occur from coal development. Valuable data are collected during cultural resource surveys. Data that would otherwise not be collected until some time in the future, or lost in the interim, are made available for study. Mitigation also results in the collection and preservation of data that would otherwise be lost. The data that has been and will be collected provided opportunities for regional and local archeological research projects.

4.5.13 Native American Concerns

No cumulative impacts to Native American traditional values or religious sites have been identified as a result of leasing and subsequent mining of the North Jacobs Ranch LBA Tract.

4.5.14 Paleontological Resources

Impacts to paleontological resources as a result of the already-approved cumulative energy development occurring in the PRB consist of losses of plant, invertebrate, and vertebrate fossil material for scientific research, public education (interpretive programs), and other values. Losses have and will result from the destruction, disturbance, or removal of fossil materials as a result of surface-disturbing activities, as well as unauthorized collection and vandalism. A beneficial impact of

surface mining can be the exposure of fossil materials for scientific examination and collection, which might never occur except as a result of overburden removal, exposure of rock strata, and mineral excavation.

4.5.15 Visual Resources

A principal visual impact in this area is the visibility of mine pits and facility areas. People most likely to see these facilities would either be passing through the area or visiting it on mine-related business. Except for the loading facilities and the draglines, the pits and facilities are not visible from more than a few miles away. No new facilities would be required to mine the LBA tract as an extension of the existing Jacobs Ranch Mine. Issuance of the LBA tract would not change this impact.

After mining, the reclaimed slopes might appear somewhat smoother than premining slopes and there would be fewer gullies than at present. Even so, the landscape of the reclaimed mine would look very much like undisturbed landscape in the area.

4.5.16 Noise

Existing land uses within the PRB (e.g., mining, livestock grazing, oil and gas production, transportation, and recreation) contribute to noise levels, but wind is generally the primary noise source. Mining on the LBA tract would not increase the number of noise-producing facilities within the PRB, but it would lengthen the time this particular noise source would exist, expand the area this noise source would affect, and may augment the level of impacts to other resources (e.g., increased exposure of wildlife to noise impact, increased noise impacts to recreational users). Mining-related noise is generally masked by the wind at short distances, so cumulative overlap of noise impacts between mines is not likely.

Recreational users and grazing lessees utilizing lands surrounding active mining areas do hear mining-related noise; but this has not been reported to cause a significant impact. As stated above, wildlife in the immediate vicinity of mining may be adversely affected by noise; however, observations at other surface coal mines in the area indicate that wildlife generally adapt to noise conditions associated with active coal mining.

Cumulative increases in noise from trains serving the PRB mines have caused substantial increases (more than five dBA) in noise levels along segments of the rail lines over which the coal is transported to markets. However, no significant adverse impacts have been reported as a result.

4.5.17 Transportation Facilities

New or enhanced transportation facilities (road, railroads, and pipelines) are expected to occur as a result of energy development in the Powder River Basin. However, no new cumulative impacts to transportation facilities are expected

to occur as a direct result of leasing and subsequent mining of the North Jacobs Ranch LBA Tract. The transportation facilities for the Jacobs Ranch Mine are already in place. Traffic levels from the mine will be maintained for a longer period under the action alternatives. Oil and gas pipelines on the tract will have to be relocated or removed prior to mining.

4.5.18 Socioeconomics

Because of all the energy-related development that has been occurring in and around Campbell and Converse Counties during the past 30 years, socioeconomic impacts are a major concern. Wyoming's economy has been structured around the basic industries of extractive minerals, agriculture, tourism, timber, and manufacturing. Each of these basic industries is important, and the extractive mineral industry has long been a vital part of Wyoming's economy. Many Wyoming communities depend on the mineral industry for much of their economic well being. The minerals industry is by far the largest single contributor to the economy of Wyoming. In 1999 valuation on minerals produced in 1998 was $3,435,709,958. This was 49 percent of the State's total valuation and placed Wyoming among the top ten mineral producing states in the nation (Wyoming Department of Revenue 2000). Because most minerals are taxed as a percentage of their assessed valuation, this makes the mineral industry a significant revenue base for both local and state government in Wyoming.

Since 1989, coal production in the Powder River Basin has increased by an average of 6.8 percent per year. WSGS projects coal production in Campbell County to increase by about 1 percent per year from 2000 through 2005, while Converse County coal production is projected to remain steady at 25 mmtpy through this period. In 1998, Wyoming coal supplied approximately 29 percent of the United States' steam coal needs when PRB coal was used to generate electricity for public consumption in 25 states as well as Canada and Spain (Lyman and Hallberg 1999). Electricity consumers in those states benefit from low prices for PRB coal, from cleaner air due to the low sulfur content of the coal, and from the royalties and bonus payments that the federal government receives from the coal.

Locally, continued sale of PRB coal helps stabilize municipal, county, and state economies. By 2005, annual coal production is projected to generate about $2.6 billion of total economic activity, including $351 million of personal income, and support the equivalent of nearly 15,885 full-time positions (BLM 1996a).

In addition to the North Jacobs Ranch LBA Tract a number of mineral and related developments have occurred, are in progress, or are anticipated in Campbell County and the surrounding area. The North Rochelle Mine located southeast of Wright, WY has completed an $83.6 million mine construction phase. Construction of the mine facilities

began in June 1997 and was completed in 1999.

The Two Elk plant is currently in the developmental stage, and North American Power Group is working on permitting and marketing. According to a recent article in the Gillette News Record, construction of the Two Elk plant could begin in 2001; the cost for constructing the proposed plant is estimated at $300 million; construction could last three years; and the construction-phase work force could peak at more than 600 persons. (Gillette News Record 2000a). The Black Hills Wygen#1 power plant is anticipated to be operational by January, 2003. The Black Hills Corporation estimates that the project will employ approximately 300 people during the construction period (Black Hills Corporation press release, 9/27/2000). North American Power Group very recently announced plans for a second unit at the Two Elk Site and another power plant to be constructed next to the Cordero Rojo Complex.

According to information provided by the Dakota, Minnesota & Eastern Railroad Corporation, construction of the DM&E railroad line was expected to start in 1999, take two years to complete and cost $1.5 billion. For Wyoming, the estimated direct construction-phase work force is 700 persons. DM&E received preliminary approval from the Surface Transportation Board in December 1998. The Surface Transportation Board released the draft EIS for public comment in September 2000. The public comment period on the DEIS ended on March 6, 2001.

Currently, Gillette is experiencing a population increase as a result of CBM development in this area. In the past several years, Gillette's population has increased, unemployment has decreased, housing has becoming increasingly tight, and traffic and criminal activity have increased. School enrollment has not seen a similar increase, however.

If all of the new projects are undertaken, it is likely that the population in northeastern Wyoming would continue to grow, and there would be increasing demands on housing, schools, roads, law enforcement, etc. in the communities in this area. The population increase would be expected to be somewhat dispersed among all of the communities in the area, which would include Douglas, Wright, and Newcastle as well as Gillette. The extent of the impacts to the local communities would depend on the amount of overlap between the construction periods on the proposed projects. It was previously estimated that construction of the North Rochelle, ENCOAL and Two Elk projects could have added up to 2,900 people in northeastern Wyoming if they had been undertaken at the same time. As it has actually happened, development of these projects has not occurred concurrently. The North Rochelle construction project has been completed, CBM development is currently contributing to population

growth in the Gillette area, and construction at the Two Elk and Wygen #1 power plants could begin in 2001. Construction at the newly announced Two Elk Unit 2 plant and the proposed Middle Bear plant at the Cordero Rojo Complex would begin when permitting is complete. Construction of the proposed DM&E railroad is waiting on completion of the environmental analyses, and the ENCOAL project has been postponed indefinitely. Increases in mining employment would potentially occur gradually as new coal leases are permitted for mining. No new employment is currently anticipated if the North Jacobs Ranch LBA Tract is leased.

During the construction phase of the Two Elk, ENCOAL and DM&E projects, assistance money could total $7.5 million for Gillette, $4.43 million for Campbell County and $527,000 for Wright (Planning Information Corp. 1997). Assuming local sales and use tax permits are required, the developmental projects if approved would generate about $12.5 million for Gillette, Wright and Campbell County. The State of Wyoming would receive approximately $16.99 million from the developmental projects. Ad valorem tax is paid on production and property (Wyoming; Department of Commerce, Energy Section 1997). If all three developmental projects had proceeded as planned, ad valorem tax paid in 2001 was estimated to approach $10 million (Gillette News Record 1996).

4.6 The Relationship Between Local Short-term Uses of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

From 2001 on, the Jacobs Ranch Mine would be able to produce coal at an average production level of 24.5 million tons per year for 7 years and then 21 million tons per year for another 23 years under the Proposed Action, or for another 23.2 years under Alternative 2, or for another 14 years under Alternative 3 (Table 2-1). As the coal is mined, almost all components of the present ecological system, which have developed over a long period of time, would be modified. In partial consequence, the reclaimed land would be topographically lower, and although it would resemble original contours, it would lack some of the original diversity of geometric form.

The forage and associated grazing and wildlife habitat that the LBA tract provides would be temporarily lost during mining and reclamation. During mining of the LBA tract there would be a combined loss of native vegetation on 5,364 acres (Proposed Action) or 5,465 acres (Alternative 2), or 3,689 acres (Alternative 3) with an accompanying disturbance of wildlife habitat and grazing land. This disturbance would occur incrementally over a period of years. The mine site would be returned to equivalent or better forage production capacity for domestic livestock before the performance bond is released. Long-term productivity would depend

largely on postmining range-management practices, which to a large extent would be controlled by private landowners.

Mining would disturb pronghorn habitat, but the LBA tract would be suitable for pronghorn following successful reclamation. Despite loss and displacement of wildlife during mining, it is anticipated that reclaimed habitat would support a diversity of wildlife species similar to premining conditions. The diversity of species found in undisturbed rangeland would not be completely restored on the leased lands for an estimated 50 years after the initiation of disturbance. Re-establishment of mature sagebrush habitat--which is crucial for pronghorn and sage grouse--could take even longer.

CBM is currently being recovered from the tract and BLM's analysis suggests that a large portion of the CBM resources on the tract can be recovered prior to mining. CBM that is not recovered prior to mining would be vented to the atmosphere during the mining process. Methane is a greenhouse gas which contributes to global warming. According to the *Methane Emissions* section of Energy Information Administration/ Department of Energy (EIA/DOE) report 0573(99), *Emissions of Greenhouse Gases in the United States 1999*, U.S. anthropogenic methane emissions totaled 28.8 million metric tons in 1999. U.S. 1999 methane emissions from coal mining were estimated at 2.88 million metric tons (10.0 percent of the U.S. total anthropogenic methane emissions in 1999). According to Table 15 of this report, surface coal mining was estimated to be responsible for about 0.54 million metric tons of methane emissions in 1999. This represents about 1.88 percent of the estimated U.S. anthropogenic methane emissions in 1999, and about 18.75 percent of the estimated methane emissions attributed to coal mining of all types. Based on the 1999 coal production figure, the Wyoming Powder River Basin coal mines were responsible for approximately 0.9 percent of the estimated U.S. 1999 anthropogenic methane emission, and Jacobs Ranch Mine was responsible for approximately 0.08 percent of estimated U.S. 1999 anthropogenic methane emissions. Currently, the Jacobs Ranch Mine does not propose increasing coal production rates if the North Jacobs Ranch LBA Tract is leased.

Total U.S. methane emissions attributable to coal mining would not be likely to be reduced if the North Jacobs Ranch LBA Tract is not leased at this time because total U.S. coal production would not decrease if a lease for this tract is not issued. However, the methane on this LBA tract could be more completely recovered if leasing is delayed.

There would be a deterioration of the groundwater quality in the lease area because of mining; however, the water quality would still be adequate for livestock and wildlife. This deterioration would probably occur over a long period of time. During mining, depth to groundwater would increase only within one mile away

from the pits in the coal aquifer. The water levels in the coal aquifer should return to premining levels at some time (probably less than 100 years) after mining has ceased.

Mining operations and associated activities would degrade the air quality and visual resources of the area on a short-term basis. Following coal removal, removal of surface facilities, and completion of reclamation, there would be no long-term impact on air quality. The long-term impact on visual resources would be negligible.

Short-term impacts to recreation values may occur from reduction in big game populations due to habitat disturbance. These changes would primarily impact hunting in the lease area. However, because reclamation would result in a wildlife habitat similar to that which presently exists, there should be no long-term adverse impacts on recreation.

The Proposed Action, Alternative 2, and Alternative 3 would extend the life of Jacobs Ranch Mine by 23, 23.2, and 14 years, respectively, thereby enhancing the long-term economy of the region.

4.7 Irreversible and Irretrievable Commitments of Resources

The major commitment of resources would be the mining and consumption of 479.7 million tons (Proposed Action), or 483.3 million tons (Alternative 2), or 293.4 millions tons (Alternative 3) of coal to be used for electrical power generation. CBM that is not recovered prior to mining would also be irreversibly and irretrievably lost (see additional discussion of the impacts of venting CBM to the atmosphere in Section 4.6). It is estimated that 1-2 percent of the energy produced would be required to mine the coal, and this energy would also be irretrievably lost.

The quality of topsoil on approximately 5,364 acres (Proposed Action), or 5,465 acres (Alternative 2), or 3,689 acres (Alternative 3) would be irreversibly changed. Soil formation processes, although continuing, would be irreversibly altered during mining-related activities. Newly formed soil material would be unlike that in the natural landscape.

Loss of life may conceivably occur due to the mining operation and vehicular and train traffic. On the basis of surface coal mine accident rates in Wyoming as determined by the Mine Safety and Health Administration (1997) for the 10-year period 1987-1996, fatal accidents (excluding contractors) occur at the rate of 0.003 per 200,000 man-hours worked. Disabling (lost-time) injuries occur at the rate of 1.46 per 200,000 man-hours worked. Any injury or loss of life would be an irretrievable commitment of human resources.

Disturbance of all known historic and prehistoric sites on the mine area would be mitigated to the maximum extent possible. However, accidental destruction of presently unknown archeological or paleontological

values would be irreversible and irretrievable.