ENVIRONMENTAL ASSESSMENT
of the
NORTH ANTELOPE AND ROCHELLE COAL LEASE APPLICATIONS
FOR POWDER RIVER COAL COMPANY
(Federal Coal Lease Applications WYW119554 & WYW119555)

I. INTRODUCTION

A. Purpose and Need

The Powder River Regional Coal Team (RCT) recommended decertifying the Powder River Federal Coal Production Region as a Federal coal production region in October, 1989. The RCT also recommended that it remain in place to periodically review coal leasing in the region. These recommendations were accepted by the Bureau of Land Management (BLM) Director in January, 1990.

The RCT recommendations were based on decreasing industry interest in new competitive Federal coal leasing and the condition of the coal market. Industry interest in leasing federal coal in the Powder River Region dropped from 46 expressions of interest in 22 tracts in 1982 to six expressions of interest in six tracts in 1988, before the region was decertified. Expressions of interest are nominations of coal tracts for leasing which are made by companies interested in leasing the coal. The RCT periodically sends out requests for expressions of interest in coal tracts in order to assess the level of interest in coal leasing and evaluate the need for leasing coal on a regional basis.

Decertification allows leasing to take place on a lease-by-application (LBA) basis. According to the Powder River Regional Coal Team Operational Guidelines for Coal Lease-By-Applications, which were approved by the BLM Director in August, 1991, if an application is either for (1) a tract that would increase permitted production levels or (2) increase production beyond existing production facilities or (3) is a tract that would be mined by a new mining operation, the RCT members will decide whether to hold a meeting to consider the application and to determine if the RCT should recommend recertifying the Powder River Coal Production Region.

It has been projected that the passage of the 1990 Clean Air Act, with its incentives for use of low-sulfur coal, will lead to renewed interest in low-sulfur Powder River Basin coal. Since the region was decertified, six LBAs have been received for leases in the Wyoming portion of the Powder River Region. Prior to decertification, six expressions of interest for leasing in the region were received. At this time, interest in leasing appears to be at about the same level as it was at the time of decertification.

The BLM must complete three actions for an LBA to be processed. They are a planning and environmental review, geologic review and economic review of the proposed lease area. Leasing by application is a competitive leasing process and a public hearing is required for each LBA.

On March 2, 1990, Powder River Coal Company (PRCC) filed two applications with the BLM for coal leases on federal coal reserves located adjacent to the existing North Antelope and Rochelle surface coal mines. One tract is adjacent to and west of the North Antelope Mine, and the other is adjacent to and north of the Rochelle Mine. Figure 1 is a map showing the general location of the area, which is in southern Campbell County about twenty-five miles southeast of Wright, Wyoming. After BLM review, the applications were determined to meet the lease-by-application qualifications and they are therefore being processed as production maintenance tracts. If leased as maintenance tracts, under either Alternative 1 or 2, the coal reserves would allow the level of production at the Rochelle and North Antelope mines to be maintained for a longer period of time providing additional royalty, rent, and tax revenues to the federal and state governments. If not leased as production maintenance tracts, the coal will have to be mined as a stand-alone project or may never be mined. This Environmental Assessment (EA) has been prepared to assist the BLM in making a decision on the proposed lease applications, to provide a basis for public review, and to comply with the requirements of the National Environmental Policy Act.

The North Antelope Mine lease application includes approximately 954 acres containing 120 million (mm) tons of coal, and the Rochelle Mine lease application includes approximately 1,196 acres containing about 150 mm tons. Figure 2 is a map showing the location of the proposed leases relative to the current permit areas for the adjacent North Antelope and Rochelle Mines. The surface of the proposed lease areas is owned by private interests, PRCC, North Antelope Coal Company, and by the federal government under the management of the U.S. Forest Service. As proposed in the lease applications, the lease tracts would be incorporated into the existing mining operations at the North Antelope and Rochelle Mines. After mining, the land would be reclaimed for livestock grazing and wildlife habitat which are the predominant land uses at the present time.

B. Conformance With Land Use Plan

One land use plan governs the federal lands involved with the North Antelope and Rochelle lease applications. This plan is the Medicine Bow National Forest and Thunder Basin National Grassland Land and Resource Management Plan (LRMP) (USDA, Forest Service, November 20, 1985). This land use plan directly pertains to the North Antelope and Rochelle lease applications because portions of these lands (approximately 360 acres) are on the Thunder Basin National Grassland (TBNG), for which the U.S. Forest Service is the surface management agency.

Following a multiple use conflict evaluation, it was determined that there were no serious surface resource use conflicts on TBNG and that any conflicts which do arise can be mitigated on a case by case basis. The unsuitability criteria assessment for high to moderate coal potential lands in the TBNG is contained in Appendix F of the Medicine Bow LRMP. The coal leasing

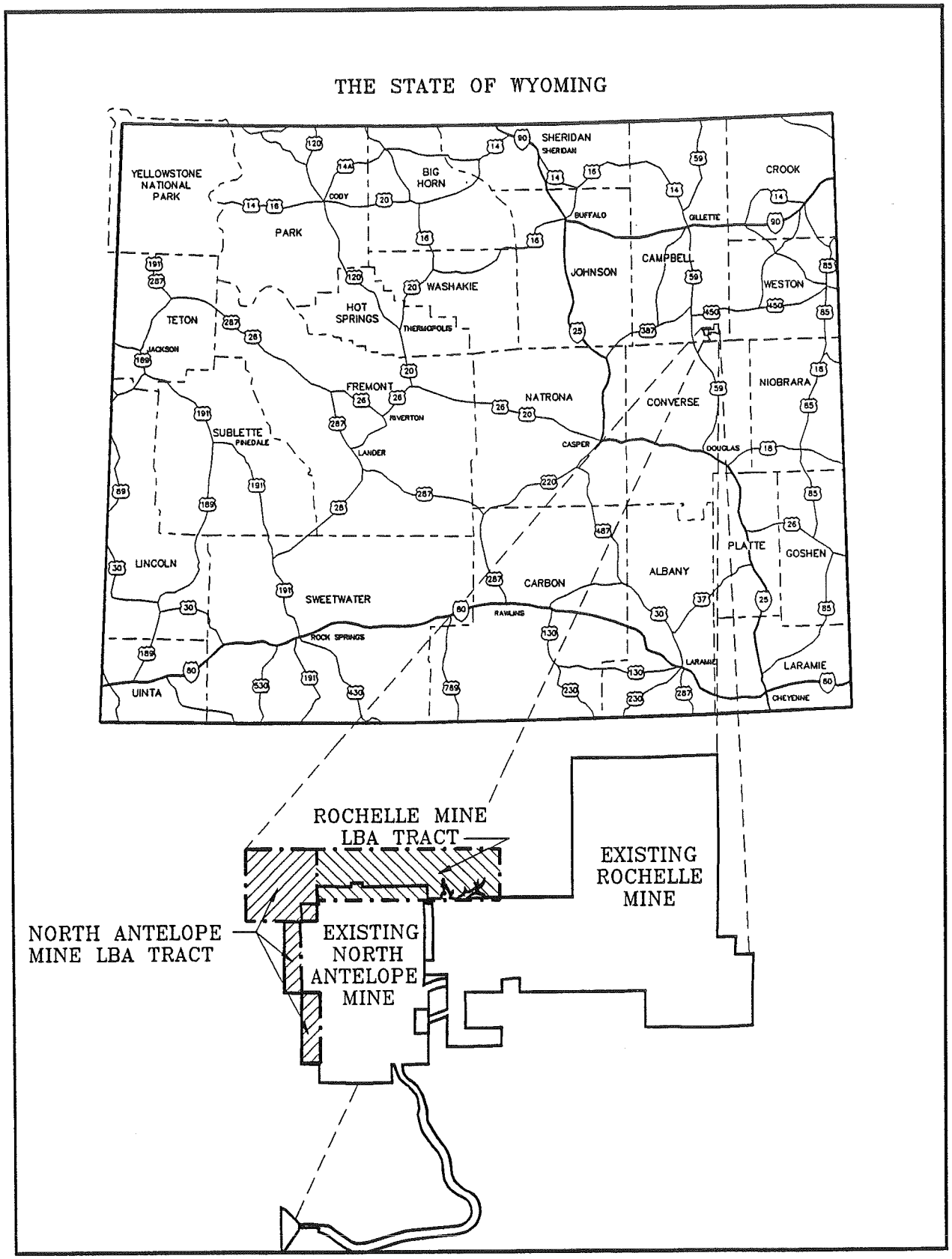

Figure 1. General Location Map of North Antelope and Rochelle Lease Tracts

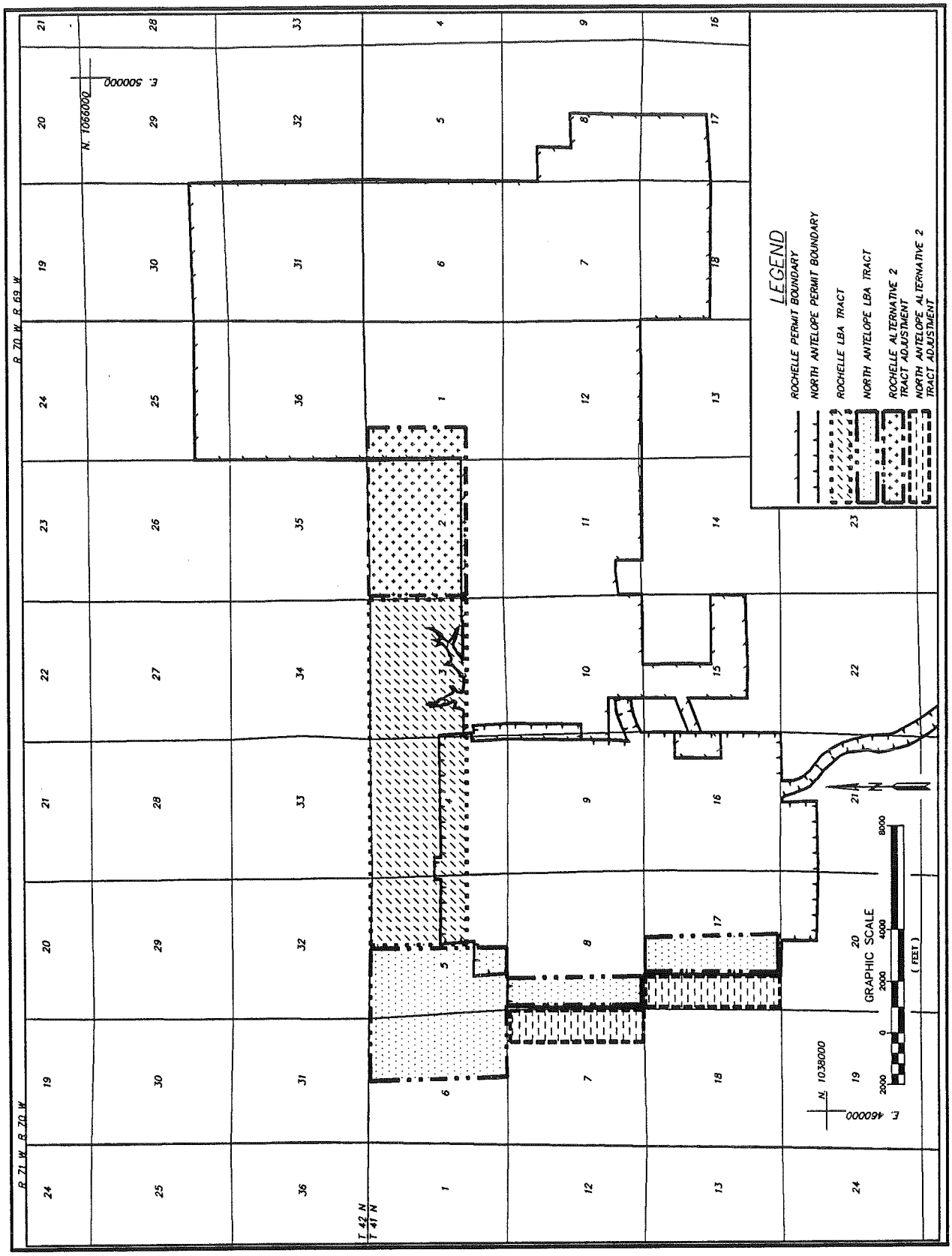

Figure 2. Location Base Map of North Antelope and Rochelle LBA Tracts

unsuitability criteria listed in the Federal Coal Management Regulations (43 CFR 3461) were applied to the entire TBNG study area. Table 1 summarizes the unsuitability criteria (column 1), describes the findings for the entire study area (column 2), and presents a validation of these findings for the PRCC proposed lease tracts. The table shows that none of the lands found unsuitable for leasing in the TBNG study area are located on the PRCC tracts, and therefore these tracts are available for further consideration.

C. Relationship To Statutes, Regulations, Or Other Plans

The coal lease applications were submitted and will be processed and evaluated under the following authorities: Mineral Leasing Act of 1920 as amended; Multiple-Use Sustained Yield Act of 1960; the National Environmental Policy Act of 1969 (NEPA); Federal Coal Leasing Amendments Act of 1976 (FCLAA); the Federal Land Policy and Management Act of 1976 (FLPMA); and the Surface Mining Control and Reclamation Act of 1977 (SMCRA).

SMCRA gives the Office of Surface Mining Reclamation and Enforcement (OSM) primary responsibility to administer programs that regulate surface coal mining operations and the surface effects of underground coal mining operations. Pursuant to Section 503 of SMCRA, the Wyoming Department of Environmental Quality (WDEQ) developed, and in November 1980 the Secretary of Interior approved, a permanent program authorizing WDEQ to regulate surface coal mining operations and surface effects of underground mining on non-federal lands within the State of Wyoming. In January 1987, pursuant to Section 523(c) of SMCRA, WDEQ entered into a cooperative agreement with the Secretary of the Interior authorizing WDEQ to regulate surface coal mining operations and surface effects of underground mining on federal lands within the state.

Pursuant to the cooperative agreement, federal coal lease holders in Wyoming must submit permit application packages (PAP) to OSM and WDEQ for proposed mining and reclamation operations on federal lands in the state. WDEQ reviews the PAP to ensure that the permit application complies with the permitting requirements and that the coal mining operation will meet the performance standards of the approved Wyoming state permanent program. If it does comply, WDEQ issues the applicant a permit to conduct coal mining and reclamation operations. OSM, BLM, the Forest Service (FS), and other federal agencies review the PAP to ensure that it complies with the terms of the coal lease, the Mineral Leasing Act of 1920, the National Environmental Policy Act of 1969, and other federal laws and their attendant regulations. OSM recommends approval, approval with conditions, or disapproval of the mining plan to the Assistant Secretary, Land and Minerals Management. Before the mining plan can be approved, the BLM and the surface managing agencies must concur with this recommendation.

WDEQ enforces the performance standards and permit requirements for reclamation during the mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility for this enforcement. BLM and FS have authority in those emergency situations where WDEQ or OSM inspectors cannot act before significant environmental harm or damage occurs.

Table 1. Validation of Leasing Criteria for North Antelope and Rochelle LBA Tracts

UNSUITABILITY CRITERIA	FINDINGS FOR TBNG STUDY AREA (USFS, 1985)	VALIDATION FOR PRCC LBA TRACTS
1. Federal Land Systems. With certain exceptions that do not apply to these tracts, all federal lands included in the following systems are unsuitable for leasing: National Parks, National Wildlife Refuges, National System of Trails, National Wilderness Preservation System, National Forests and federal lands in incorporated cities, towns and villages.	TBNG is not part of a national forest and none of the other listed federal lands categories is present within the study area.	None of the listed federal lands are present on the PRCC tracts and the tracts are available for further consideration.
2. Rights of Way and Easements. Federal lands that are within rights of way or easements or within surface leases for residential, commercial, industrial or other public purposes, or for agricultural crop production on federally owned surface are unsuitable for leasing.	TBNG contains two rights of way that meet the intent of this criterion: BN railroad and the Tri-County 230 KV transmission line.	Neither of these rights of way is on the PRCC tracts, and the areas are available for further consideration.
3. Buffer Zones for Rights of Way, Communities, and Buildings. Federal lands within 100 feet of a right of way of a public building, school, church, community or institutional building or public park or within 300 feet of an occupied dwelling.	Within TBNG, a school at Wilkinson Ranch headquarters, Wyoming State Highway 59, and 5 ranch headquarters were found to meet the intent of this criterion	None of the listed rights of way or buildings are on the PRCC tracts, and the tracts are therefore available for further consideration.
4. Wilderness Study Areas. Federal lands designated as wilderness study areas are unsuitable while under review for possible wilderness designation.	No lands within TBNG review area are within a wilderness study area.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
5. Scenic Areas. Scenic federal lands designated by visual resource management analysis as Class I (outstanding visual quality or high visual sensitivity) but not currently on National Register of Natural Landmarks are unsuitable.	No lands on TBNG meet the scenic criteria as outlined.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
6. Land Used for Scientific Study. Federal lands under permit by the surface management agency and being used for scientific studies involving food or fiber production, natural resources, or technology demonstrations and experiments are unsuitable for the duration of the study except where mining would not jeopardize the purpose of the study.	No lands in the TBNG review area are under permit except small enclosures being used to gage reclamation success on existing mines.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
7. Historic Lands and Sites. All districts, sites, buildings, structures, and objects of historic, architectural, archeological, or cultural significance on federal lands included in or eligible for inclusion in the National Register of Historic Places and an appropriate buffer zone are unsuitable.	On the basis of the consultation with the State Historic Preservation Office, there were no unsuitable findings under this criterion in the TBNG review area.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
8. Natural Areas. Federal lands designated as natural areas or National Natural Landmarks are unsuitable.	No lands in the TBNG are designated as natural areas or as National Natural Landmarks.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
9. Critical Habitat for Threatened or Endangered Plant and Animal Species. Federally designated critical habitat for T or E plant and animal species, and essential habitat for T or E species are unsuitable.	There is no federally designated criterion habitat for T or E plant or animal species within the TBNG review area.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
10. State Listed Species. Federal lands containing habitat determined to be critical or essential for plant or animal species listed by a state pursuant to state law as T or E shall be considered unsuitable.	Wyoming does not maintain a state list of T or E species of plants or animals. Therefore, this criterion does not apply.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
11. Bald or Golden Eagle Nests. An active bald or golden eagle nest and appropriate buffer zone are unsuitable unless the lease can be conditioned so eagles will not be disturbed during breeding season or unless golden eagle nests will be moved.	The USFS found numerous eagle nests, and buffer zones were established, and determined that coal leasing can occur within the buffer zone if the nests are protected with stipulations and site mitigation plans. There were no unsuitable findings under this criterion, but lands involved in buffer zones are subject to special lease stipulations.	Active eagle nests were found near the both tracts and special lease stipulations maybe required to assure protection and mitigation. However, there are no unsuitable findings, and the PRCC tracts are available for further consideration.
12. Bald and Golden Eagle Roost and Concentration Areas. Bald and golden eagle roost and concentration areas on federal lands during migration and wintering are unsuitable unless mining can be conducted in such a way as to ensure that eagles shall not be disturbed.	No golden eagle roost or concentration areas occur on the TBNG review area. Mining planned in the review area is not likely to jeopardize the continued existence of the bald eagle. Coal leasing can occur and adequate protection can be provided. There were no unsuitable findings in the TBNG review area.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
13. Federal lands containing an active falcon (excluding kestrel) cliff nesting sites and a suitable buffer zone shall be considered unsuitable.	After consultation with the USFWS, it was determined that this criterion does not apply in TBNG.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
14. Habitat for Migratory Bird Species. Federal lands which are high priority habitat for migratory bird species of high federal interest shall be considered unsuitable.	After consultation with the USFWS, it was determined that this criterion does not apply in TBNG.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
15. Fish and Wildlife Habitat for Resident Species. Federal lands which the surface management agency and state jointly agree are fish and wildlife habitat of resident species of high interest to the state, and which are essential for maintaining these priority wildlife species, shall be considered unsuitable.	Sage grouse leks were found on and near the TBNG review area. However, methods of mining can be developed which will not have a significant long-term impact on the grouse or their habitat. Therefore, the areas involved in leks and buffer zones are not unsuitable.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
16. Floodplains. Federal lands in riverine, coastal, and special floodplains shall be considered unsuitable unless stipulated methods of mining can be undertaken without substantial threat of loss of life or property.	After consultation with the USGS , it was determined that floodplains can be mined with site specific stipulations and resource protection safeguards to be developed during mining and reclamation planning. Therefore, all lands within the TBNG review area are available for further consideration.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
17. Municipal Watersheds. Federal lands which have been committed by the surface management agency to use as municipal watersheds shall be considered unsuitable.	There are no municipal watersheds in the TBNG review area.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
18. National Resource Waters. Federal lands with national resource waters, as identified by states in their Water Quality Management Plans, and 1/4-mile buffer zones shall be unsuitable.	There are no natural resource waters within the TBNG review area.	There are no unsuitable findings, and the PRCC tracts are available for further consideration.
19. Alluvial Valley Floors. All lands identified by the surface management agency, in consultation with the state, as AVFs where mining would interrupt, discontinue or prelude farming, are unsuitable. Additionally, when mining federal lands outside an AVF would materially damage the quality or quantity of water in surface or underground water systems that would supply AVFs, the land shall be considered unsuitable.	Lands along prominent drainages were considered potential AVFs pending a final determination by the state. These lands are placed in an "available pending further study" category and are not considered unsuitable.	The state has made a final determination on Porcupine Creek in the North Antelope Permit area, which includes Porcupine Creek on the NACC tract. The AVF is not significant to farming, and has been partially mined and restored. Thus the area is available for further consideration.
20. State or Indian Tribe Criteria. Federal lands to which is applicable a criterion proposed by the state or Indian tribe located in the planning area and adopted by rulemaking by the Secretary are unsuitable.	The state has no applicable criteria and there is no Indian tribe located in or near the planning area. Therefore there is no unsuitability finding.	Various tribal entities were notified by the FS archeologist during scoping process. None expressed concerns. Thus the PRCC tracts are available for further consideration.

D. Public Participation

Preliminary scoping for developing the initial draft EA was based upon the issues considered in the numerous environmental analyses and detailed mine permits issued for the region. An additional opportunity for public participation was provided during a scoping meeting held in Gillette on September 16, 1991. An internal scoping meeting was conducted by FS personnel during a site tour on August 1 and 2, 1991. FS concerns developed during this tour are addressed in this EA. Additional review and coordination with state and federal agencies was also done. Specifically, a letter was written to appropriate agencies and known interested parties on August 29, 1991 advising of the pending lease application and requesting their input regarding issues and concerns. Results are discussed below in the sections dealing with the respective environmental disciplines.

II. ALTERNATIVES INCLUDING PROPOSED ACTION

A. Alternative No. 1. Lease Sale With Coal To Be Mined With Existing Mining Operations

Under this alternative, the two tracts would be offered for competitive leasing subject to standard and special lease stipulations. The boundaries of the tracts would be consistent with the tract configuration designated in the PRCC lease application dated February 23, 1990. Figure 2 shows the locations of the lease application areas with respect to existing mine permit areas. The legal descriptions of the lease application areas are as follows:

North Antelope Lease Application Area:

T. 41 N., R. 70 W., 6th P.M. Campbell County, Wyoming
Sec. 5: Lots 7 through 10 and 15 through 18
Sec. 6: Lots 8, 9, 14 through 17, 22, and 23
Sec. 8: Lots 4, 10, 11, and SW1/4NW1/4
Sec. 17: Lots 3, 6, 11, and 14

Total area: 953.79 acres, more or less

Rochelle Lease Application Area:

T. 41 N., R. 70 W., 6th P.M. Campbell County, Wyoming
Sec. 3: Lots 5 through 16
Sec. 4: Lots 5 through 15 and SW1/4NE1/4
Sec. 5: Lots 5, 6, and 11 through 14

Total area: 1196.41 acres, more or less

These legal descriptions and acreages are based on approved U.S. Department of Interior BLM plats filed in Cheyenne, Wyoming. The North Antelope lease application area contains approximately 120 million tons of recoverable coal; the Rochelle lease application area contains about 150 million tons of recoverable coal.

The special lease stipulations required would be as follows:

In addition to observing the general obligations and standards of performance set out in the current regulations, the lessee shall comply with and be bound by the following stipulations. These stipulations are also imposed upon the lessee's agents and employees. The failure or refusal of any of these persons to comply with these stipulations shall be deemed a failure of the lessee to comply with the terms of the lease. The lessee shall require his agents, contractors and subcontractors involved in activities concerning this lease to include these stipulations in the contracts between and among them. These stipulations may be revised or amended, in writing, by the mutual consent of the lessor and the lessee at any time to adjust to changed conditions or to correct an oversight.

(a) CULTURAL RESOURCES

(1) Before undertaking any activities that may disturb the surface of the leased lands, the lessee shall conduct a cultural resource intensive field inventory in a manner specified by the authorized office of the BLM or of the surface managing agency, if different, on portions of the mine plan area and adjacent areas, or exploration plan area, that may be adversely affected by lease-related activities and which were not previously inventoried at such a level of intensity. The inventory shall be conducted by a qualified professional cultural resource specialist (i.e., archeologist, historian, historical architect, as appropriate), approved by the authorized officer of the surface managing agency (BLM, if the surface is privately owned), and a report of the inventory and recommendations for protecting any cultural resources identified shall be submitted to the Assistant Director of the Western Support Center of the Office of Surface Mining, the authorized officer of the BLM, if activities are associated with the coal exploration outside an approved mining permit area (hereinafter called Authorized Officer), and the Authorized Officer of the surface managing agency, if different. The lessee shall undertake measures, in accordance with instructions from the Assistant Director or Authorized Officer to protect cultural resources on the lease lands. The lessee shall not commence the surface disturbing activities until permission to proceed is given by the Assistant Director or Authorized Officer.

(2) The lessee shall protect all cultural resource properties within the lease area from lease-related activities until the cultural resource mitigation measures can be implemented as part of an approved mining and reclamation plan or exploration plan.

(3) The cost of conducting the inventory, preparing reports, and carrying out mitigation measures shall be borne by the lessee.

(4) If cultural resources are discovered during operations under this lease, the lessee shall immediately bring them to the attention of the Assistant Director or Authorized

Officer, or the Authorized Officer of the surface managing agency. The lessee shall not disturb such resources except as may be subsequently authorized by the Assistant Director or Authorized Officer. Within two (2) working days of notification, the Assistant Director or Authorized Officer will evaluate or have evaluated any cultural resources discovered and will determine if any action may be required to protect or preserve such discoveries. The cost of data recovery for cultural resources discovered during lease operations shall be borne by the surface managing agency unless otherwise specified by the authorized officer of the BLM or of the surface managing agency, if different.

(5) All cultural resources shall remain under the jurisdiction of the United States until ownership is determined under applicable law.

(b) PALEONTOLOGICAL RESOURCES

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

(c) OIL AND GAS RESOURCES

The BLM realizes that coal mining operations conducted on leases issued within producing oil and gas fields may interfere with the economic recovery of oil and gas; just as oil and gas leases issued in a coal lease may inhibit coal production. BLM retains complete authority to alter and/or modify coal operations or oil and gas operations on lands covered by Federal leases so as to obtain maximum resource recovery of either or both resources with due regard to valid existing rights.

(d) RESOURCE RECOVERY AND PROTECTION

Any proposed bypass of Federal coal determined to be economically recoverable must have the written approval of the authorized officer of the BLM in the form of an approved modification to the Resource Recovery and Protection Plan (R2P2) prior to the Federal coal being bypassed. (43 CFR 3482.2(c)(2)) Failure to comply with this requirement shall result in the issuance of a Notice of Noncompliance by the authorized officer. The Notice of Noncompliance will include the amount of damages to be assessed for the unauthorized bypass of Federal coal as determined by the authorized officer. The amount of damages, at a minimum, will be the amount of royalty to be assessed as determined by the authorized officer to compensate the Federal government for the unauthorized bypassed Federal coal.

(e) PUBLIC LAND SURVEY PROTECTION

The lessee will protect all survey monuments, witness corners, reference monuments, and bearing trees against destruction, obliteration, or damage during operations on the lease areas. If any monuments, corners or accessories are destroyed, obliterated, or damaged by this operation, the lessee will hire an appropriate county surveyor or registered land surveyor to reestablish or restore the monuments, corners, or accessories at the same location, using surveying procedures in accordance with the "Manual of Surveying Instructions for the Survey of Public Lands of the United States". The survey will be recorded in the appropriate county records, with a copy sent to the authorized officer.

The majority of the coal reserves at the North Antelope Mine are dedicated to a single customer. The mine is operated by North Antelope Coal Company (NACC), a subsidiary of Powder River Coal Company (PRCC) which in turn is a subsidiary of Peabody Holding Company. PRCC has been attempting to lease additional coal at this site for several years to assure the customer it can supply its additional long-term coal requirements. However, until the lease-by-application regulations were promulgated in 1990 there had been no coal leasing activity in the Powder River Basin, other than emergency bypass leases, since 1982. The North Antelope Mine has an Air Quality Division air quality permit for a maximum production rate of 14 million tons per year. Under the current mine plan a total of 196,400,000 tons of coal will be removed over the life of the mine, with the last coal removal occurring in the year 2004. The customer at NACC has a need for additional coal to the year 2012.

In contrast to the North Antelope Mine, the Rochelle Coal Company (RCC) sells coal from the Rochelle Mine on the open market. Recent changes to the Clean Air Act and other developments are causing customers to reevaluate their coal supply contracts, and to meet these changing requirements it will be necessary to develop two pits at the Rochelle Mine. Operation of two pits will enable blending of coal to meet the quality requirements of the customers and enable full utilization of the coal reserves at the mine. The Rochelle Mine has an Air Quality Division permit for a maximum production rate of 22 million tons per year. Under the current Land Quality Division mine plan a total of 419,600,000 tons of coal will be removed over the life of the mine, with the last year of coal removal occurring in the year 2011.

If PRCC acquires the leases, the leases will be mined as part of the existing North Antelope and Rochelle mining operations. New mine and reclamation plans would be developed to show a logical mining sequence into the acquired leases. It is estimated that coal removal within the acquired lease areas would begin sometime in 1995. Topsoil removal would begin a few months prior to actual mining operations. These dates assume the appropriate mining permits are obtained in a timely fashion.

At the currently planned production rate of 12 million tons per year (as stated in the approved Land Quality Division permit), the 120 million tons of coal in the North Antelope lease application area could extend the North Antelope mine life by 10 years. At the currently planned production rate of 18 million tons per year, the 150 million tons of coal in the Rochelle lease application area could extend the Rochelle Mine life by about 8 years.

The North Antelope Mine is primarily a dragline operation, with assistance provided by trucks and shovels. Operations began along the coal crop line in Section 16 and are progressing westward, toward the North Antelope lease application area. As the pit advances toward the west, the length of the highwall will be extended and eventually the highwall will extend from the southern to the northern boundary of the permit area. The portion of the lease application area in Section 17 will be the first lease application area reached by the pit advance.

The Rochelle Mine is a truck-shovel operation. Operations began near the facilities area in Section 10, and the pit is currently progressing westward toward the North Antelope Mine. If the new lease is acquired, the current pit will turn north into the new lease area as the second pit progresses toward the east through Sections 11 and 12.

B. Alternative No. 2. Same as Alternative 1 but with Adjusted Tract Boundaries (Proposed Action)

Alternative 2 is the same as Alternative 1 except that BLM would adjust the tract boundaries to include coal that might be bypassed if not taken by the current mining operations. It is proposed to include adjacent coal with a similar stripping ratio to that in the lease application areas while keeping the tracts reasonably responsive to the applications' size and scope. The areas which would be added to the tracts under Alternative 2 are illustrated on Figure 2. Although the tracts are shown separately on Figure 2, the two tracts following adjustment of the boundaries to include the additional coal would be combined into a single tract for the lease sale.

The North Antelope lease application tract would be modified by adding the following lands:
T. 41 N., R. 70 W., 6th P.M. Campbell County, Wyoming
Sec. 7: Lots 5, 12, 13 and 20
Sec. 17: Lots 4, 5, 12, and 13

Total area: 320.15 acres, more or less.

The Rochelle lease application tract would be modified by adding the following lands:
T. 41 N., R. 70 W., 6th P.M. Campbell County, Wyoming
Sec. 1: Lost 8, 9, and 16
Sec. 2: Lots 5 through 16

Total area: 593.69 acres, more or less.

These legal descriptions and areas are based on approved US Department of the Interior, Bureau of Land Management plats on file in Cheyenne, Wyoming.

The same special lease stipulations would be required for Alternative 2 as for Alternative 1. The lease tract boundary adjustments would add 40 million tons to the North Antelope lease area and 60 million tons to the Rochelle lease area. Alternative 2 is the BLM's preferred alternative, hereafter also referred to as the Proposed Action.

C. Alternative No. 3. Proposed Lease Sale For A New Stand-Alone Mine

Since the lease-by-application process is a competitive leasing process, a party other than PRCC could acquire the coal leases. The tracts as applied for are located such that they could not be practically mined as extensions of another party's active mining operations. Thus, if leased by another party, a new stand-alone mine would be required. Adjusting the lease boundaries as described for Alternative 2 and combining the two lease tracts into one would be the best way for BLM to provide for a sound, competitive lease for a stand-alone mine.

Figure 3 shows a possible stand-alone mine that would recover coal from the entire combined tract. No analysis has been performed to determine the economic viability of such a project. The hypothetical mine plan described below was developed in order to provide a basis for the impact assessment in Chapter IV. It was assumed that this mine would recover about 370 million tons over its 44-year life. Reflecting recent trends, the mine would probably be a dragline operation with trucks and shovels assisting for overburden and interburden removal. There would be two pits to enable coal mixing and optimize stripping operations. The starting locations (box cuts) and directions of mining are illustrated on Figure 3. Both box cuts will require out-of-pit overburden stockpiles, and possible locations are shown on Figure 3. The south pit (Pit 1 in the figure) box-cut spoil is located west of the lease tract. The north pit (Pit 2) box-cut spoil is located north of the lease tract. Both box-cut spoil piles are located as close as possible to the box cut without placing them over coal within the tract. It is likely that these box-cut spoil piles would ultimately be used to fill the final pits unless arrangements could be made with PRCC to coordinate the reclamation plans with the North Antelope and Rochelle mines and thereby make other arrangements for the reclamation of the final pits.

The facilities area was somewhat arbitrarily located in Sections 1 and 12, well to the west of the lease tract over coal that is probably too deep to mine economically in the foreseeable future. A 2 1/4-mile long rail spur would provide a link to the main Gillette-Douglas spur line. A rail loop for loading unit trains was located near the initial box cuts in Sections 1, 6, and 7. No design studies were conducted to determine whether a rail spur and loop at this location could meet railroad grade and alignment criteria.

Regarding production from the stand-alone mine, the hypothetical schedule shown in Table 2 was assumed. Table 2 shows coal production averaging about 11.2 mmtpy over the 33 years of actual mining.

If the lease sale were held in 1992 (year 1), mining would commence in 1998 (year 7), reach peak production of 13 mmtpy in 2004 (year 13), and the last production would occur in 2030 (year 39). This is about 26 years after production is now scheduled to cease at the North Antelope Mine and about 19 years after production is now planned to end at the Rochelle Mine. The assumption is made that an air quality permit for this stand-alone mine could be obtained for this production rate.

Employment at the stand-alone mine is assumed to average about 230. This is based on employment data for other Powder River Basin mines with similar production capacities (Wyoming Coal Information Committee, 1991). Again, Alternative 3 will require the same special lease stipulations as the previous alternatives.

Table 2. Hypothetical Coal Production Schedule for Stand-Alone Mine on Combined Lease Tracts

Year	Coal Production (mmtpy)	Cumulative Production (mmt)
1-6	No production-used for baseline studies, permitting, and construction of facilities.	0
7	1	1
8	1	2
9	2	4
10	4	8
11	7	15
12	10	25
13-37	13	350
38	11	361
39	9	370
40-44	No production-reclamation only.	370

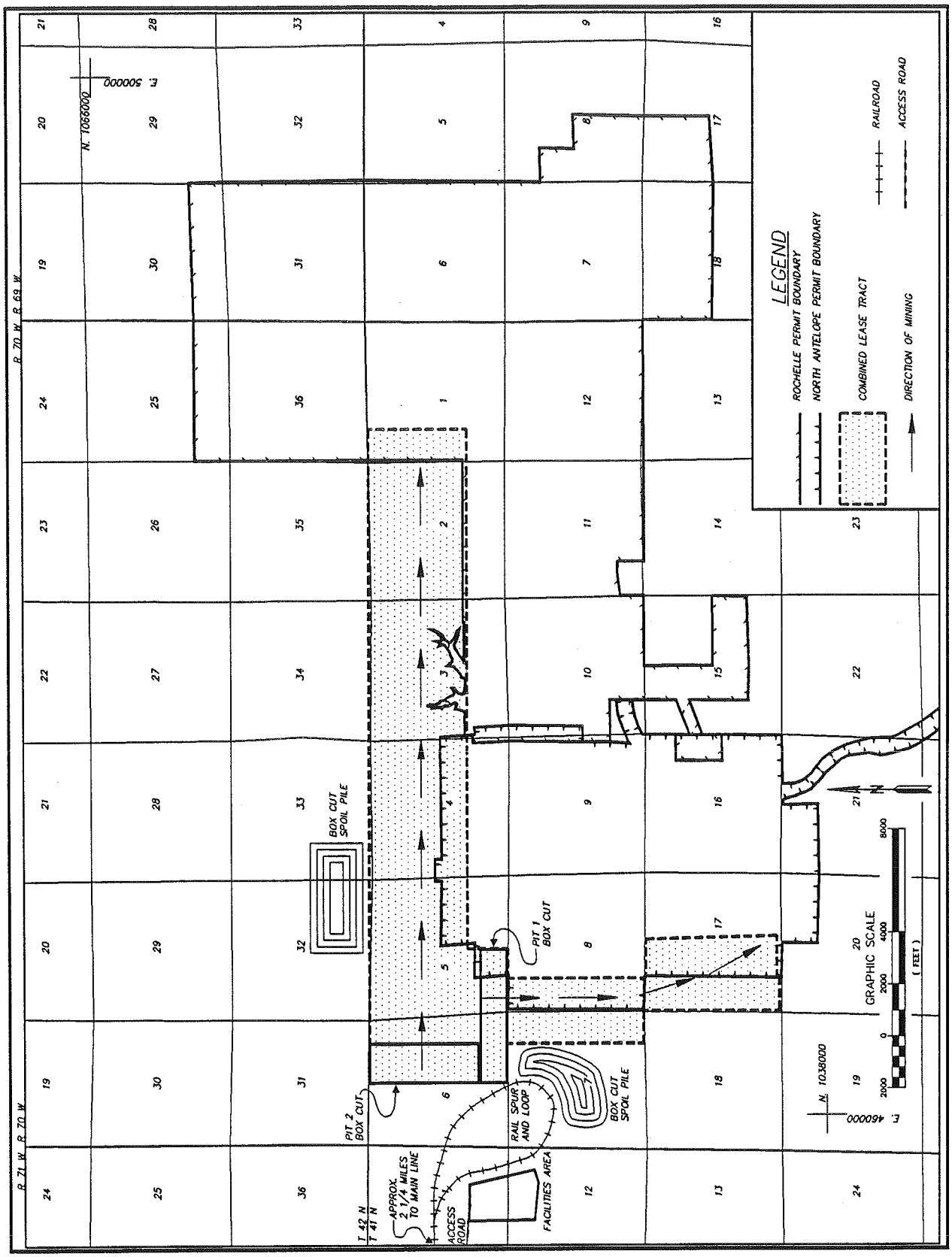

Figure 3. Layout for Hypothetical Stand-Alone Mine on Combined Lease Tract

D. Alternative No. 4. No Action

No Action means that the BLM would reject or defer the lease applications. The effect of rejecting the applications would be that the coal would not be mined at this time. A possible subset of this alternative would be to postpone the lease sale until a later date.

III. AFFECTED ENVIRONMENT

A. General Setting

The proposed lease area is within a region which has been evaluated by several federal environmental analyses which describe the existing and affected environment. The relevant publications which are on file at both the Casper and Cheyenne BLM offices are as follows:

- Draft Environmental Assessment, Rochelle Coal Mine, Washington, D.C., 1974
- Proposed Federal Coal Leasing Program Final Environmental Impact Statement, USDI, 1974
- Final Environmental Impact Statement, Eastern Powder River Coal Basin of Wyoming, Washington, D.C. 1979.
- Amendment to Wyoming Land Use Decisions: Eastern Powder River Basin Area Management Framework Plan: Gillette Review Area, Casper, Wyoming 1980.
- Powder River Region Coal Final Environmental Impact Statement, BLM, Casper District Office, 1981.
- WyCoal Gas Draft Environmental Impact Statement, Washington, D.C., February 1981.
- Powder River Coal Regional Tract Summaries, Cheyenne, Wyoming, 1983.
- Draft Environmental Impact Statement for Round II Coal Lease Sale in the Powder River Region, Casper, Wyoming, 1984.
- Federal Coal Management Program Draft Environmental Impact Statement, February 1985.
- Buffalo Resource Area, Resource Management Plan (RMP) and Final EIS, October 5, 1985.
- Medicine Bow National Forest and Thunder Basin National Grassland Land and Resource Management Plan (LRMP), November 20, 1985.

- Coal Bed Methane Environmental Assessment, Eastern Campbell County and Western Johnson County, Wyoming WY-061-0-EA064, Casper BLM, March 1990 (for part of the socioeconomic data).

- Final Environmental Impact Statement for the Medicine Bow National Forest and Thunder Basin National Grassland Land and Resource Management Plan, U.S. Forest Service, November 1985.

- Proposed Mining and Reclamation Plan, North Antelope Mine, Campbell County, Wyoming, Draft Environmental Impact Statement OSM-EIS-6, February 1982.

The area is substantially similar to the adjacent mines for which detailed site-specific environmental data have been collected and environmental assessments have been prepared to secure the necessary mining permits. The affected environment is described in detail in the North Antelope Mine and Reclamation Plan, Permit Number 532-T2, which was approved by the Wyoming Department of Environmental Quality, Land Quality Division on November 4, 1986 and the Rochelle Mine and Reclamation Plan, Permit Number 569-T2, which was approved December 6, 1990. Moreover, detailed environmental baseline information for the proposed lease area has been or is being gathered by PRCC and various consultants to comply with the Wyoming Department of Environmental Quality, Land Quality Division (WDEQ/LQD) requirements for a mine plan submittal. This information includes land use, climatology, geology, soils, vegetation, ground- water and surface- water hydrology, water rights, cultural resources, paleontology, air quality and wildlife.

These studies have revealed that the following elements of the human environment are either not present in the study area or will not be affected: Areas of Critical Environmental Concern (ACEC), prime lands, prime or unique farmlands, floodplains, riparian areas, wild or scenic rivers, wilderness areas, consumers, civil rights, or minority groups. In the event that any of the above items are identified during mining activities, lease stipulations and permit provisions require that appropriate protection and/or mitigation measures be implemented.

The proposed lease areas are located to the west and north of the existing North Antelope and Rochelle Mines. The lease areas are adjacent to the existing mines as shown on Figures 1 and 2. The lease application areas are about 60 miles southeast of Gillette, Wyoming and twenty-five miles southeast of Wright, Wyoming. Access to the areas is provided by Wyoming Highway 59 and county roads.

North Antelope is a surface coal mine operated by North Antelope Coal Company as a joint venture between Powder River Coal Company (PRCC) and Trinity Mining Company. Coal is mined by a combination truck/shovel and dragline operation. Annual coal production for 1990 was approximately 8,000,000 tons. The Rochelle Mine is a truck/shovel coal mine owned by Powder River Coal Company (PRCC) which is a wholly owned subsidiary of Peabody Holding Company. Coal is mined by truck and shovel and 1990 annual production was approximately 12,000,000 tons. Existing facilities at the mines include crushing, conveying, storage, loading, administrative, and equipment maintenance facilities. Railroad access to the existing mines is

provided by a double track spur operated by the Burlington Northern Railroad. Both rail and highway access are shared by the North Antelope and Rochelle Mines.

The initial state mine permit (Permit 532-T1) for the North Antelope Mine was issued on June 22, 1982. The U.S. Department of Interior Office of Surface Mining (OSM) issued a federal mining permit (WY-0041) to the North Antelope Mine on July 13, 1982. The Rochelle Mine permit (569-T1) was approved by the State of Wyoming on December 4, 1984 and by the OSM (WY-0042) on February 2, 1985. Both Federal permits were terminated by OSM on January 11, 1989 and January 13, 1989, respectively.

The proposed lease areas are situated in the rolling high plains of northeastern Wyoming. Elevations generally range from 4600 to 4950 ft mean sea level. The climate is semi-arid. Precipitation averages about 13 inches, with 75 percent of the average precipitation occurring during the growing season which is from April through September. Summer precipitation is often in the form of brief, intense thunderstorms. Annual evaporation exceeds annual precipitation. The prevailing winds are from the northwest and the mean annual wind speed is about 8 to 10 mph.

Both lease areas are within the drainage area of Porcupine Creek, a tributary of Antelope Creek which is within the Cheyenne River drainage basin. The Cheyenne River joins the Missouri River at Oahe Reservoir north of Pierre, South Dakota. Porcupine Creek crosses the proposed North Antelope lease area from the northwest to the southeast and joins Antelope Creek about 4 miles downstream from the lease area. Streamflow in Porcupine Creek is ephemeral (flowing only in direct response to precipitation or snowmelt). Portions of Porcupine Creek downstream from the North Antelope lease area are intermittent (in contact with the local ground-water table), although very little flow is attributable to ground-water discharge. The remaining streams on the proposed lease tracts are ephemeral tributaries of Porcupine Creek.

B. Affected Resources

1. Geology and Topography

The Powder River Coal Basin of northeastern Wyoming lies within the boundaries of the Powder River structural and topographic basin. The basin is a broad asymmetric syncline bounded on the west by the Big Horn Mountains, on the east by the Black Hills, and to the south by the Casper Arch, Laramie Mountains, and the Hartville Uplift. The axis of the syncline is west of the center of the basin. Dips are gentle on the eastern limb (2 to 4 degrees) where the North Antelope and Rochelle mines are located.

Stratigraphic units of interest in the proposed lease areas include, in descending order, recent (Quaternary age) alluvial deposits, the Eocene age Wasatch formation which comprises the overburden, and the Paleocene age Fort Union formation. The top of the Fort Union formation is designated as the top of the Wyodak-Anderson coal seam, the main coal seam being mined. Locally, the shallow strata generally dip less than three degrees to the west-southwest, although some local dips are to the east because of the undulating character of the coal beds.

The Wyodak-Anderson coal seam in the North Antelope permit area is about 73 feet thick, has an average heating value of about 8,600 Btu per pound and contains about 5.1 percent ash, 0.2 percent sulfur, 30.5 percent volatiles, 36.1 percent fixed carbon and 25.7 percent equilibrium moisture. In the Rochelle permit area the coal averages 63 feet in thickness, has a heating value of about 8,500 Btu per pound, and contains about 4.5 percent ash, 0.2 percent sulfur, 31.1 percent volatiles, 35.5 percent fixed carbon, and about 24.8 percent equilibrium moisture. The coal in the lease application areas is expected to be similar in quality, with possibly some improvement since it is farther from the oxidized zones near the outcrop.

Compaction structures in the coal-bearing formations, such as those which have allowed gas in the coal seam to vent at the surface near the Rawhide Village residential subdivision (Law, 1976), have not been identified in the vicinity of the PRCC LBA's. In the absence of such structures, and because there are no reported gas vents in the immediate vicinity, it is unlikely that the situation that occurred at Rawhide Village could occur near the North Antelope and Rochelle mines.

Various gases, including methane and hydrogen sulfide, occur naturally in the Wyodak-Anderson coal seam. In some areas, including the vicinity of the PRCC LBA areas, the presence of gas in the coal seam causes this unit to be avoided when completing water wells.

As a requirement of preparing an application for a permit to mine, the successful bidder for the PRCC LBA's would drill and sample the overburden to determine geochemistry and reclamation suitability. If some unsuitable overburden is found, as is typical of other mines in the region, the permit applicant will be required to design the mine and reclamation plan to minimize any adverse effects of the potentially problematic materials. Typically, a plan is prepared to assure that sufficient suitable overburden material is available for placement atop the graded spoils and beneath the replaced topsoil. This provides a vegetation root zone that meets WDEQ/LQD suitability limits. Special handling may also be required to avoid placement of certain unsuitable materials beneath reclaimed stream channels and impoundments and deep within the spoils away from an oxidizing environment. Identification and handling of unsuitable zones of overburden is a permit issue that can only be dealt with quantitatively after all permit-level baseline studies are completed.

The alluvial deposits along Porcupine Creek consist of primarily unconsolidated, discontinuous layers of clays, silts and sands. The Wasatch formation consists of interbedded, lenticular clays, silty clays, sandy clays, thin, discontinuous coals, and sandstones. Where sandstones in the Wasatch formation are of sufficient porosity and areal extent they serve as aquifers for stock and domestic uses. The Fort Union formation consists of non-carbonaceous to highly-carbonaceous clays, minor sands, sandstones, and coal. Due more to its continuity and thickness than to its permeability or water quality, the coal is used for stock and domestic water in areas where it is sufficiently close to the surface and where equal or better aquifers are not present at shallower depths in the Wasatch overburden. Due to the presence of gas in the coal seam, it is not used extensively as a water supply source in the immediate vicinity of the North Antelope and Rochelle mines. A fourth geologic unit, clinker (locally known as scoria or porcelanite), is baked or fused rock formed by prehistoric burning of the main Wyodak-Anderson coal seam. Clinker deposits are common along the coal crop zone, located in the

southern portions of both current permits but are not generally present in the lease application areas due to the depth of the coal and the distance from the crop line.

Porcupine Creek, the largest stream in either mine permit area, flows through the North Antelope lease application area in Sections 5 and 6. Porcupine Creek is a southeastward-flowing tributary of Antelope Creek, a tributary to the South Fork of the Cheyenne River. The drainage area of Porcupine Creek at its confluence with Antelope Creek is about 135 square miles. The topography of the lease application areas is best described in reference to the dominance of Porcupine Creek on the local landforms. The Porcupine Creek valley floor extends northwest to southeast through the North Antelope lease application area and the current North Antelope permit area. Surrounding this valley at elevations of 200 feet and more above the valley floor are level to rolling uplands typical of the Powder River Basin. A steep, deeply incised drainage network extends from these uplands to the valley floor in the vicinity of the mine area. All three landforms exist within the lease application areas. The southern end of the North Antelope lease application area, in Section 17, is primarily situated in level to rolling uplands. A closed topographic depression, containing an ephemeral pond, commonly called a playa, is located on these uplands in the lease application area. The northern portion of the North Antelope lease application area contains about a one-mile long reach of the valley floor of Porcupine Creek. The central part of the North Antelope lease application area and virtually all of the Rochelle lease application area are dominated by eroded gullies tributary to Porcupine Creek. The major Porcupine Creek tributary in the North Antelope lease application area is named Rogers Draw, while Payne Draw and Knapp Draw are the prominent tributaries in the Rochelle lease application area.

The terrain in the vicinity of the lease areas is typical of that found in the active mining areas and the Powder River Basin in general. Mine permit regulations require that the premining topography be subjected to quantitative analysis to help provide design guidelines for the postmining surface. Slope analyses have been done for both the North Antelope and Rochelle permit areas and will be done for the lease application areas after the tract boundaries are finalized and the necessary permit amendment boundaries can be defined. In the current North Antelope permit area, premining slopes ranged from flat to over 60 percent and averaged about 10 percent. In the current Rochelle permit area, premining slopes ranged from flat to over 15 percent and averaged 4 percent. On the flatter highlands in the northern reaches of the current Rochelle Mine permit area there are closed topographic depressions. These depressions do not contribute runoff to area streams; runoff which does occur in these depressions is captured in playas located in the bottoms of the depressions.

2. Soils

A Soil Conservation Service (SCS) Order 3 soil survey has been completed for the proposed lease area. Some of the map units, such as those on bottomlands or on slopes of less than 6 percent, were mapped at the more detailed Order 2 level. The SCS mapping is part of the ongoing Soil Survey of Campbell County, Southern Part, which is unpublished at this time (SCS, 1991a). In addition, PRCC has completed a detailed soil survey of those portions of the proposed lease tracts which are within the current permit areas. A detailed soil survey, with

profile descriptions and laboratory characterization of all major soil types, was conducted on the NACC and RCC lease application areas during 1990 by BKS Environmental Associates, Inc.

Nineteen soil types are contained within the lease application areas. Dominant soils and relative amounts are similar to those on the current mine permit areas. The soil baseline reports in the Department of Environmental Quality - Land Quality Division mine permit documents contain a complete physical description and laboratory data for these soils. The following is a list of the soil map units found in the proposed lease area.

- Absted - Openay (Arvada complex)
- Aeric haplaquepts - fine
- Bidman clay loam
- Bowbae
- Briggsdale - fine sandy
- Cushman - fine sandy loam
- Fort Collins
- Haverson - Kim
- Nelson
- Olney - fine sandy loam
- Pugsley - sandy loam
- Rauzi - sandy loam
- Shingle - loam and samsil complex
- Stoneham
- Taluce
- Terry
- Thedalund loam
- Turnercrest - variant
- Ulm

Hydric soils are of limited extent on the proposed lease area, and these will be evaluated, along with possible presence of hydrophytic vegetation and wetland hydrology, as part of the overall wetlands delineation and determination during preparation of the mine permit application document. Wetland determinations are performed under criteria and methods similar to those described in the "Federal Manual for Identifying and Delineating Vegetated Wetlands" (Federal Interagency Committee for Wetland Delineation, 1989, and as revised, 1991).

Playa inclusions in several soil mapping units are considered by SCS to meet hydric criteria. Only the playa portion of the map unit is considered to meet these criteria. The topography of the playas is flat to slightly concave. Runoff from the surrounding upland terrain is collected into the playa basins where the water is evaporated or percolates into the ground.

Recently, there has been general concern expressed about levels of selenium in coal mine overburden and backfill. The WDEQ/LQD has issued very conservative guidelines for handling seleniferous materials at coal mines throughout Wyoming. However, the chemistry of selenium in Powder River Basin soils is being further studied to see if these guidelines are in fact reasonable. The Wyoming Mining Association and the WDEQ/LQD have embarked on a

comprehensive research program, in which PRCC is planning to be an active participant, to address such issues as:

- appropriate analytical techniques for measuring selenium in soils and overburden,
- levels of selenium in vegetation on reclaimed areas and undisturbed ground,
- the interrelationship between selenium in soils and vegetation,
- the characteristics of selenium uptake by vegetation, and
- the potential for contribution of selenium to the ground water or surface water resources from backfill areas.

The intent of this research is the potential promulgation of rules for handling seleniferous soils and overburden to minimize or avoid long-term impacts to the environment. To date, impacts related to selenium have not been significant, and this research will help assure future selenium problems are not encountered.

3. Vegetation

Vegetation assessments of the North Antelope and Rochelle lease areas were performed during 1990 by BKS Environmental Associates, Inc. This section summarizes the results of the assessments. The vegetation in the proposed lease tracts is typical of that found in the southern part of the eastern Powder River Basin and is very similar to the premining vegetation found on the existing North Antelope and Rochelle Mine sites. Five general native vegetation types occur in the proposed lease areas. The better drained and gently rolling upland areas are characterized by Big Sagebrush and Upland Grassland. Areas in or adjacent to defined stream channels or minor drainages are composed of the Meadow vegetation type. The steep slopes surrounding drainages support the Breaks vegetation type. The poorly drained upland areas within the North Antelope lease application area support a Playa Grassland vegetation type. The majority of the North Antelope and Rochelle lease application areas is composed of the Breaks vegetation type with the Upland Grassland type comprising the second largest area. Past agricultural activities have resulted in relic crested wheatgrass fields in the Rochelle lease application area which are no longer farmed on a regular basis.

Native vegetation covers over 90 percent of North Antelope lease area and over 94 percent of the Rochelle lease area. The following is a description of the five native vegetation types found in the vicinity of the proposed lease area along with the relative abundance of each type by percent areal extent of coverage.

Upland Grassland: This vegetation type covers approximately **35** percent of the North Antelope lease application area and approximately **19** percent of the Rochelle lease application area. The dominant species comprising this type include blue grama, needle-and-thread and western wheatgrass.

Big Sagebrush: The Big Sagebrush vegetation type covers approximately **14** percent of the North Antelope lease application area and **8** percent of the Rochelle lease application area. The vegetation type is predominantly composed of big sagebrush with blue grama and western wheatgrass in the understory.

Breaks: This vegetation type occupies the rough broken topography within the proposed lease areas and constitutes the most prevalent vegetation type. The Breaks vegetation type covers approximately **35** and **60** percent of the North Antelope and Rochelle lease application areas, respectively. The major species included in type are big sagebrush, broom snakeweed, western wheatgrass, needle-and-thread, and thickspike wheatgrass.

Meadow: The Meadow vegetation type which thrives along minor drainages covers approximately **9** percent of the North Antelope lease application area and approximately **3** percent of the Rochelle lease application area. Major species composition includes big sagebrush along with the perennial grass species of western wheatgrass, slender wheatgrass, inland saltgrass and Kentucky bluegrass.

Playa: This vegetation type, which exists in poorly drained, seasonally inundated areas, is found in only about **1** percent of the proposed North Antelope lease application area and is not found in any significant portion of the Rochelle lease application area. This grassland type consists primarily of western wheatgrass and slender spikerush. A detailed wetlands inventory and, if indicated, a wetlands mitigation plan will be required before the successful bidder on the lease application tract can acquire a mining permit.

In addition to these native vegetation types approximately **30** acres of agricultural vegetation exists in Rochelle lease application area. The agricultural vegetation area consists of relic crested wheatgrass fields which are generally old and have not been reworked in recent years.

None of the plants identified during the vegetation assessments of the proposed lease areas are included on the U.S. Department of Interior's "Endangered and Threatened Species Plants" list. However, Oryzopsis contracta, a species of ricegrass designated as a 3C species on the USFWS Candidate Species List, is known to occur on the Thunder Basin National Grassland, and may potentially occur on this site.

4. Water Resources

a. Ground Water

The Wyodak-Anderson coal bed is the most continuous shallow hydrogeologic unit in the area. Recharge to the coal aquifer occurs primarily from clinker along the outcrop areas. The regional flow pattern is from the outcrop areas northwestward toward discharge areas in the northern reaches of the Powder River structural basin (Daddow, 1986). Because of its westward dip and relatively small yields, the Wyodak-Anderson coal seam is less widely used as an aquifer as distance increases from the outcrop. Where the coal is deeper than a few hundred feet, sandstones and coal seams in the overlying Wasatch formation can generally provide adequate

water supply for stock and domestic purposes, and the Wyodak-Anderson coal seam is subject to little exploitation. Exceptions are found in the center of the basin, where artesian pressure in the coal and associated sandstones cause some wells to flow at the surface, balancing higher drilling costs due to greater depths to the coal. In the vicinity of the North Antelope and Rochelle mines the coal is avoided as an aquifer due to the presence of gas. Near outcrop areas ground-water flow in the coal can be locally controlled by topographic features, and alluvial systems can be local discharge points for the coal aquifer.

Locally, flow in the coal seam is generally from the outcrop on the east side of the Rochelle Mine westward through the North Antelope Mine. Discharge to Porcupine Creek is limited to areas near the coal outcrop. The thick and hydraulically tight overburden units above the coal seam isolate Porcupine Creek from most of the coal (NACC, 1990b, Vol. B., Appendix D-6, p.30). The coal is not hydraulically connected to surface drainages in the lease application areas. A large portion of the coal seam in the central portion of the Rochelle Mine permit area is dry. This dry zone extends into the eastern part of the Rochelle Mine lease application area and includes the Rochelle lease area that would be added under Alternative 2. The coal progresses from unconfined, or water-table, conditions in the vicinity of the crop line to a confined (i.e., artesian) aquifer along the westward dip of the formation.

The Wasatch formation is basically a matrix of siltstones and shales with interbedded sandstones and coal seams. The sandstones and coal seams, where they are saturated, can provide water to stock and domestic wells, but they generally do not have the lateral extent of the Wyodak-Anderson coal seam. The strata immediately above the coal seams are especially fine-grained and are effective aquitards. This aquitard sequence above the coals causes the Wasatch aquifers to be perched and the coal aquifer to be confined where the coal potentiometric surface elevation is higher than the top of the coal. Recharge to the Wasatch aquifer is from infiltration of precipitation and lateral movement of water from adjacent clinker. Regionally, water is discharged by small springs and seeps along stream drainages, by evaporation and transpiration, and by pumping of wells. Antelope Creek and Porcupine Creek are local discharge zones for the Wasatch formation, but flow rates are so small that these discharges do not maintain streamflows -- the flow is instead lost to evapotranspiration along the valleys. As with the coal, there is a dry zone in the overburden. This dry zone extends from the east-central part of the North Antelope permit area to about the center of the Rochelle permit area.

The clinker is the most permeable geologic unit in the area. It has a high recharge capacity, and clinker deposits with large areal extent and saturated thickness can supply large volumes of water to wells. Saturated clinker is an important recharge source for the coal and is so permeable relative to coal it generally acts as a constant-head boundary (that is, drawdown in coal normally does not appreciably affect water levels in the clinker). There is clinker along the outcrop area in both the North Antelope and Rochelle mine permit areas, but clinker is absent in the lease application areas.

Ground-water quality data have been collected since 1978 at the two mine areas. The mine permit renewal application document, submitted to the WDEQ/LQD in April 1991, contains a summary of an analysis of the water quality data collected between 1978 and 1990. Approximately 126 monitor wells at the two mines were sampled for water quality analysis between 1980 and 1985. In 1988 the hydrology monitoring program was revised to delete some

of the baseline sampling, following a statistical showing that sample size adequacy to define baseline water quality had been met.

Water quality in the coal aquifer varies as a function of distance from the outcrop recharge areas or from the dry areas. Near such areas, ground water in the coal seam has a high total dissolved solids (TDS) concentration (mean is approximately 1,800 milligrams per liter, or mg/L). As the ground water travels in the coal aquifer, especially under confined conditions, the TDS concentration declines to about 800 mg/L. As the TDS concentration declines, calcium is replaced with sodium as the dominant cation and sulfate is reduced and replaced with bicarbonate as the dominant anion. The 800 mg/L in the confined zones is within the range suitable for drinking water (up to 1,000 mg/L), while the 1,800 mg/L average near the recharge areas approaches the recommended limit for irrigation (2,000 mg/L) (WDEQ/WQD, 1980).

Water quality in the Wasatch formation is variable, with TDS concentrations ranging from near 600 mg/L to nearly 10,000 mg/L, or twice the limit of suitability for livestock consumption (ibid.). The mean TDS concentration for the overburden is approximately 2,900 mg/L.

As is typical for the Powder River Basin, the poorest water quality is found in the alluvium. This water is generally a calcium sulfate type, with TDS concentrations ranging from 1,000 to 6,000 mg/L and averaging about 3,700 mg/L. However, near the coal outcrop, the TDS concentration is lower, averaging about 1,500 mg/L, and while the water quality is still dominated by calcium and sulfate there is a higher percentage of sodium and bicarbonate. The zone of better alluvial water quality is due to the diluting effect of discharges from the coal. Downstream of the coal outcrop, the average TDS concentration rises, showing that the diluting effect of the coal aquifer discharge is local (NACC, 1991, Vol. B., App. D6, p. 33a).

All of the ground water in these aquifers tends to have a relatively high alkalinity and very low concentrations of dissolved metals. The majority of samples collected have trace metal concentrations which are at or below the normal lab detection limits. As a result, dissolved trace metals were removed from the monitoring program for most of the wells in 1985, with the approval of the regulatory authorities.

Water supply for the Rochelle Mine is primarily obtained from wells. An estimated 2,000 gallons per day (gpd) of potable water and 30,000 gpd of utility water are required in the facilities area for sanitary purposes and equipment cleaning. Utility water requirements are met by two deep water-supply wells, a 2,000-foot deep completed in the Tullock member of the Fort Union formation and the other completed at a depth of about 5,400 feet in the Fox Hills and overlying Lance formations. The latter well was completed in 1990 and is the primary water-supply well for the mine. The Fort Union formation well is capable of producing about 200 gallons per minute (gpm), or about 288,000 gpd. The deeper well can produce about 400 gpm (576,000 gpd). Utility water from the wells is stored in a 120,000-gallon holding tank. Water is conserved at the Rochelle Mine by catching wash-down water in a holding pond and recycling it. Drinking water is provided by a commercial bottled-water service. An estimated 300,000 gpd is needed on a seasonal basis for dust control on haul roads. This also comes from the fresh water storage supplied by the wells. Due to the lack of water in the coal and overburden at the Rochelle Mine, pit water inflow is minimal. In future years when pit inflows increase, the pit water will be a secondary source for dust control.

A 2,050-foot deep Fort Union formation well provides utility water for the North Antelope Mine. Water from the well is stored in a fresh-water reservoir which also collects some runoff water. Potable water is stored in holding tanks following treatment to meet applicable health standards. Potable water supplies are supplemented by purchasing water from a commercial bottled-water service. In 1990 the water usage from the deep well averaged about 125,000 gpd. The previous year the water usage was about 80,000 gpd. The difference in pumping for these two years is a function of the availability of water collected in the pit and in sediment ponds for use in dust suppression. During wet years when the pits collect more water, pumpage from the wells is less than in years of little or no storm runoff. The well is permitted for a production rate of about 180,000 gpd, well in excess of what is actually used.

Water from the deep Fort Union wells is a sodium bicarbonate type with TDS concentrations below 300 mg/L. This water is generally suitable for domestic, stock and agricultural purposes. Water from the Lance-Fox Hills well is also a sodium-bicarbonate type, with a TDS concentration of about 1,200 mg/L.

Flow patterns in the subcoal Fort Union formation are similar to those of the coal, with recharge occurring in outcrop areas to the east of the Wyodak-Anderson coal outcrop and regional flow trending to the west.

According to information provided in the Rochelle and North Antelope mine permit documents, there are valid water rights for 36 water-supply wells within the area that will be subjected to drawdowns by the mining activities at the two mines. For the North Antelope Mine, only one well, owned by the Dilts family, will be mined through and only four wells, owned by the U.S. Forest Service (two wells), PRCC and the Bridle Bit Ranch, are located in areas where the drawdown is predicted to be more than five feet. These wells are completed in the overburden, coal, and/or underburden. There are six non-monitoring wells in the area predicted to be affected by drawdowns at the Rochelle Mine. Three wells owned by the U.S. Forest Service and two wells owned by Phillips Petroleum Co. will be removed by mining. The sixth well, owned by the U.S. Forest Service and completed in the overburden, is in the area where drawdown is projected to be 5 feet.

b. Surface Water

The lease areas are within the drainage basin of Porcupine Creek, a tributary of Antelope Creek which in turn drains to the South Fork Cheyenne River. The major tributaries of Porcupine Creek which drain the proposed lease areas are shown on Figure 4. The main stem of Porcupine Creek and its tributary, Rogers Draw, are the most prominent streams which cross the proposed North Antelope lease area. The major Porcupine Creek tributaries which drain the Rochelle lease application area are Payne Draw and Knapp Draw.

Porcupine Creek flows from the northwest to the southeast through the proposed North Antelope lease application area to its confluence with Antelope Creek about four miles downstream from the proposed lease area. A large reservoir, Porcupine Reservoir, is located

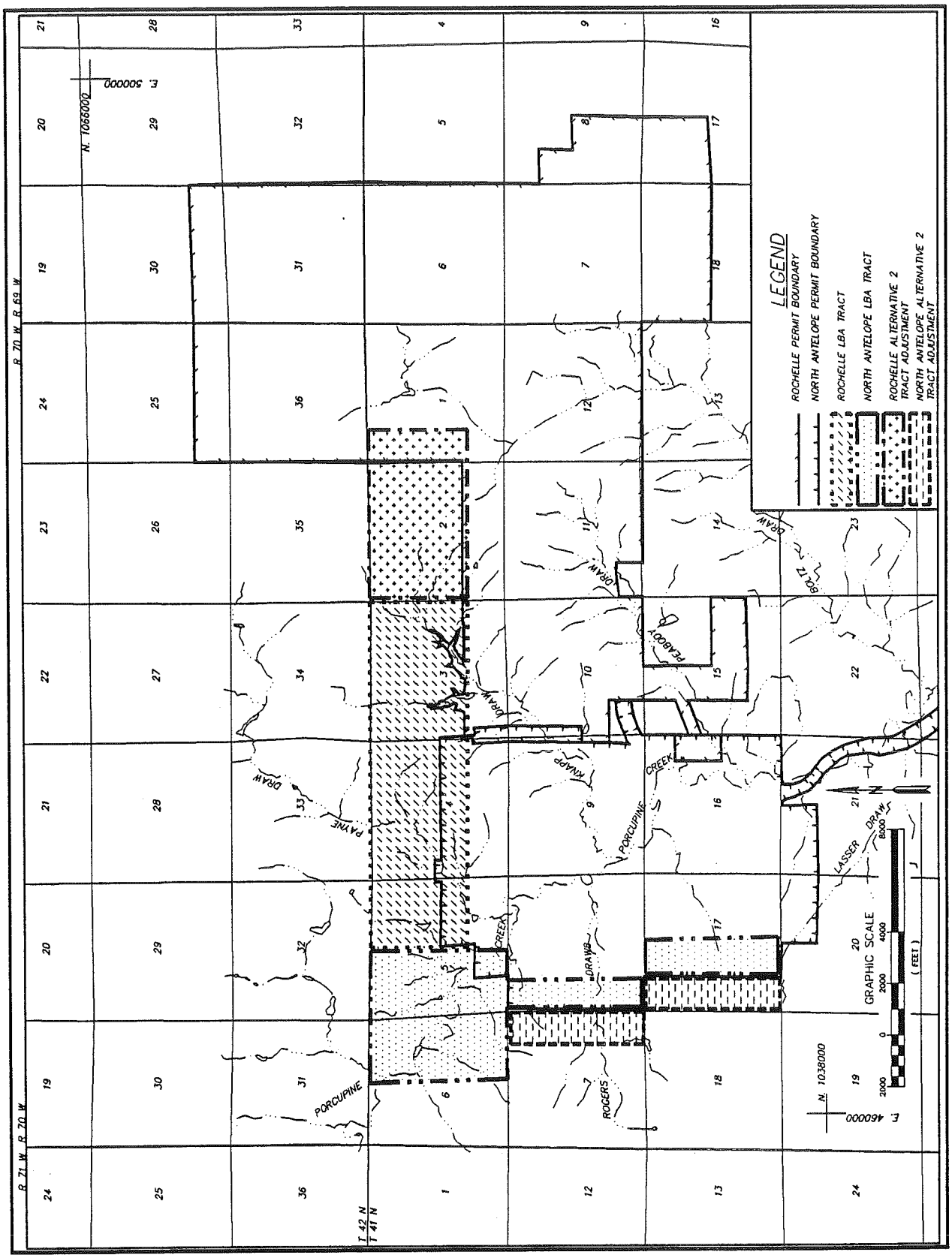

Figure 4. Stream Location Map of North Antelope and Rochelle LBA Tracts and Vicinity

about one mile upstream from the Antelope Creek confluence. The reservoir was constructed in 1938 to provide water for livestock and irrigation. The present capacity of the reservoir is estimated to be approximately 350 acre-feet. Porcupine Creek has a total drainage area of about 135 square miles above its confluence with Antelope Creek including an 18 square mile non-contributing area. Above and within the proposed North Antelope lease application area, Porcupine Creek is classified as an ephemeral stream, producing streamflow only in response to snowmelt or rainfall occurring within the contributing watershed. Downstream from the North Antelope lease application area in Section 16 Porcupine Creek is classified as an intermittent stream since the stream bed intersects the local water table in a few locations. These locations are evident where standing pools of water occupy the stream bottom during no-flow periods. In a general sense, these "potholes" produce little streamflow, and flow due to ground-water discharge in the southern portion of the North Antelope Mine permit area is estimated to be less than 0.01 cfs. Mean annual runoff from the Porcupine Creek drainage above its confluence with Antelope Creek is estimated to be between 1 and 10 cfs (Lowham, 1976 and Schumm and Hadley, 1961). Because of the presence of the Porcupine Reservoir, little if any of this runoff actually reaches Antelope Creek. Streamflow in Porcupine Creek is highly variable, and streamflow monitoring data from the North Antelope Mine permit application indicate a range of flow of from 0 to a high flow of 1,700 cfs which occurred in July of 1985 (NACC, 1990, Vol. B., App. D6, Table D6-18).

Surface water quality in Porcupine Creek is suitable for livestock watering and irrigation during most flow periods. Streamflows generally exhibit high TDS and low suspended solids (TSS) concentrations during low-flow periods and low TDS and high TSS during highflow. During low-flow periods, the ionic character of water in the creek is primarily sodium sulfate with an average TDS concentration of 4,300 mg/L. The chemical constituents of the low-flow water is similar to the water quality associated with alluvial ground-water. TSS concentrations range between 0 and 100 mg/L during low-flow periods and average about 2,000 mg/L during significant streamflow (NACC, 1991, Vol. B., App. D6, p. 121). Porcupine Creek is classified as Class IV (not suitable for trout) by the Wyoming Game and Fish Department.

The tributaries of Porcupine Creek which drain the remainder of the proposed lease area are ephemeral and are characterized by highly variable flows, ranging from years of no flow to three to five flow events per year. Flow in the Rogers Draw, Payne Draw and Knapp Draw is seasonal, occurring mostly in late winter and early spring due to snowmelt and rainfall.

Surface water within the region surrounding the proposed lease area is commonly used for wildlife, stock watering and limited irrigation. Water pumped from Porcupine Reservoir, located approximately 3 miles downstream from the North Antelope lease application area, is used for irrigating approximately 250 acres of alfalfa-grass hay meadows used by the Dilts family for supplemental winter feeding. Some flood irrigation was attempted at one time along Porcupine Creek in the northeast quarter of Section 21, T.41N., R.70W. The system failed in the first year of operation due to high summer flow and erosion and was never reconstructed.

The streams are typical for the region, and their flow events are closely reflective of precipitation patterns. Flow events of relatively small peak discharge can result from snowmelt during the late winter and early spring. Although peak discharges from such events are generally small, the duration and therefore percentage of annual runoff volume can be

considerable. During the spring, general storms (both rain and snow) increase soil moisture, hence decreasing infiltration rates, and can result in both large runoff volumes and high peak discharges. General regional storms between March and July 1978 resulted in the largest peak discharges in Antelope and Porcupine Creek. Brief, sometimes intense, summer thunderstorms can result in large peak flows, particularly on streams with small drainage areas. On the average, streams in this region experience from three to five separate runoff events in a typical year.

c. Alluvial Valley Floors

Quaternary alluvium occurs adjacent to Porcupine Creek and, to a minor extent, Knapp Draw. Alluvial deposits in the Porcupine Creek valley were subjected to a detailed alluvial valley floor (AVF) investigation in the original mine permit application submittal. The North Antelope Mine permit area, excluding the railroad spur, was determined to contain approximately 529 acres of unconsolidated stream laid deposits holding streams. Of these, 470 acres are located along Porcupine Creek and 59 acres are located along tributary streams. These areas, shown on Map D11-1 in the North Antelope Mine permit application document on file with the WDEQ/LQD extend onto the North Antelope lease application area in the SE1/4SE1/4 Section 5. The Wyoming DEQ determined that since there was no irrigated agriculture within the permit area, the AVF could be mined and reclaimed, and a plan to do so was presented and accepted in the original permit application document. Much of the AVF reclamation has been completed since the AVF was located where some of the first mining was done.

The AVF investigation was extended to areas adjacent to the permit area for a distance of one mile upstream on Porcupine Creek, which included most of the reach of Porcupine Creek within the North Antelope lease application area and outside the current mine permit area. The results, shown on Map D11-2 of the mine permit application document, indicate that this reach of Porcupine Creek probably meets the geomorphic criteria of an AVF. Since the area is not significant to farming, this finding is not expected to preclude mining but probably will require a reclamation plan that assures restoration of essential hydrologic functions. The essential hydrologic functions will be determined during the permitting of the lease application areas. The AVF investigations showed that the alluvial sediments are generally fine-grained and would yield very little water to wells.

5. Ownership And Use Of Land

The surface on the proposed lease areas has several separate owners, including Powder River Coal Company, North Antelope Coal Company, Jerry J. Dilts (Bridle Bit Ranch Company), and the U.S. Forest Service (Thunder Basin National Grassland). Surface ownership for the North Antelope and Rochelle lease application areas is illustrated on Figure 5. Adjacent surface owners that may be affected by overstripping or surface disturbance include the U.S. Forest Service, State of Wyoming, Powder River Coal Company, North Antelope Coal Company, and Jerry Dilts.

The land within the lease areas is composed of native rangeland which is utilized by wildlife and grazed by cattle and sheep. In addition to grazing and wildlife uses, land within the

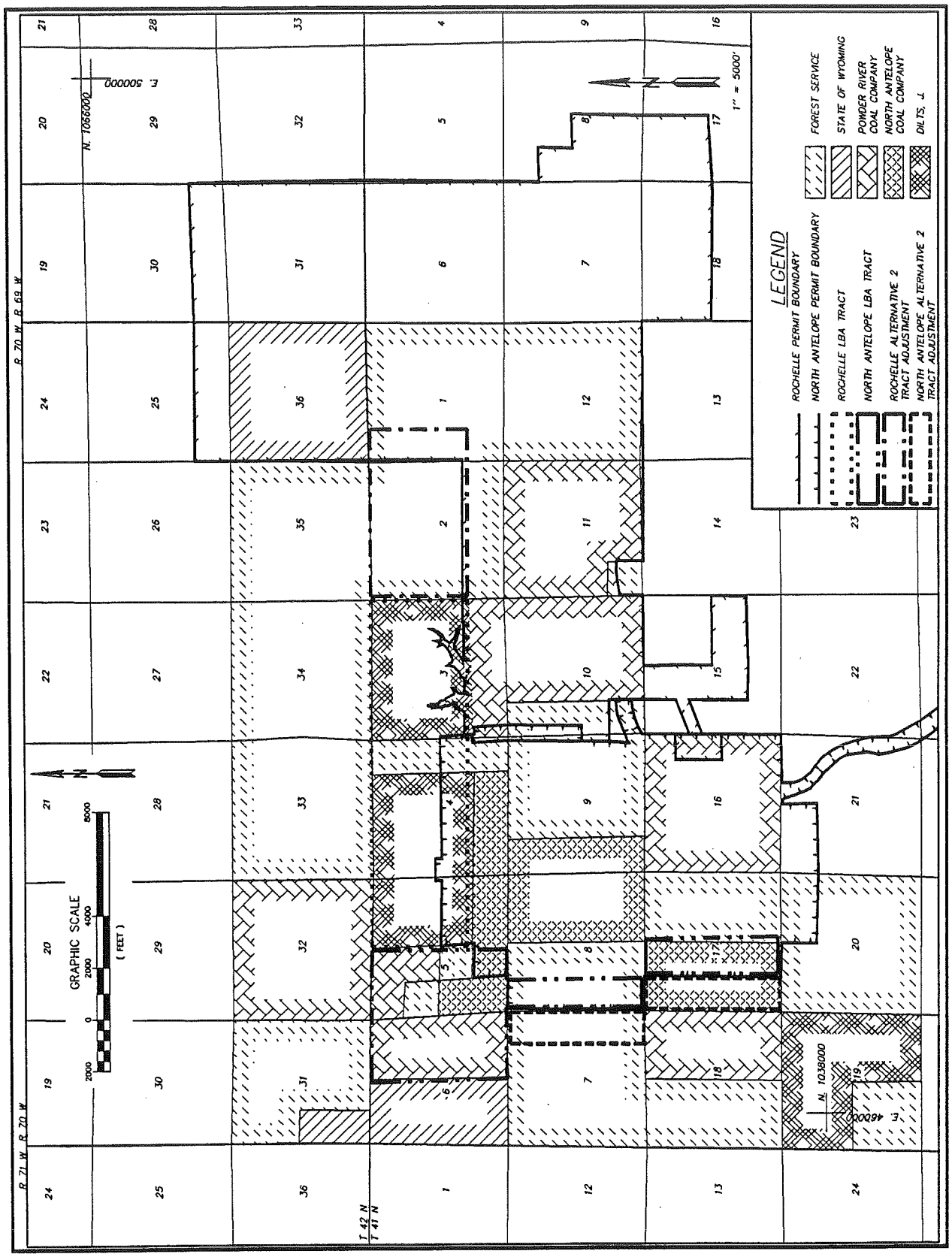

Figure 5. Surface Ownership Map of North Antelope and Rochelle LBA Tracts and Vicinity

proposed lease areas is used for oil and gas production, hay production and recreation. Approximately 360 acres of the North Antelope lease application area is currently within the North Antelope mine permit boundary. Approximately 240 acres of the North Antelope lease application area and 160 acres of the Rochelle lease application area are within the Thunder Basin National Grassland administered by the U.S. Forest Service. Moisture is the major limiting factor to agricultural use of land within the proposed lease areas. Dryland farming is marginal, and irrigation is limited to small areas of suitable topography near relatively dependable water sources, mostly along Porcupine Creek downstream from the North Antelope lease application area. Livestock grazing requires less water and is the only significant agricultural activity that occurs in the area.

The North Antelope lease application area is located within a 2,871-acre grazing permit currently operated by Steinle Ranches. The grazing permit is composed of both private and federal land and is grazed by cattle from May 15 to October 15. The grazing on these lands requires approximately 24 acres to support one animal unit per year. The Rochelle lease application area includes land managed by Jerry Dilts as part of the Bridle Bit Ranch Company. This ranch, which includes approximately 38 to 40 sections of land, including deeded land in addition to various state and federal grazing permits, is used for the grazing of cattle and sheep. The average area required per animal unit per year for the entire Dilts ranch is approximately 38 acres (NACC, 1990b and RCC, 1990b).

The varied topography and diversity of vegetation provide habitat for a broad range of wildlife. The wildlife environment is discussed in Section 6 below.

The general area is also used for oil and gas production and transportation. There is one producing well in the lease application area (see Figure 6). The well, in the NE1/4 SW1/4 Section 2, on a lease held by Inexco Oil Co. and operated by Berenergy Corporation since April 1, 1989, is on the area that would be added to the Rochelle lease under Alternative 2. There is a plugged and abandoned well in each lease application area and two others adjacent to the proposed lease areas. A six inch low-pressure natural gas pipeline owned by Phillips Petroleum crosses from the southeast to the northwest in Section 2 in the area that would be added to the Rochelle lease area under Alternative 2.

There are no occupied dwellings in either lease application area, and no lands are used for cultivated agriculture. Hunting, primarily for antelope and mule deer, is the main recreational use of the land.

6. Wildlife

Information on wildlife in this area is available from original baseline studies conducted in 1978 and 1979 (NACC, 1981 and RCC, 1983), from annual monitoring data for the two existing mines (most surveys cover areas inside a 2-mile perimeter around the current permit areas), and from site-specific survey work conducted in 1990 (Powder River Eagle Studies, 1991a and 1991b). The 1990 studies were done to provide information for this environmental assessment as well as to support a future mining permit application for these new leases. The 1990 study areas generally include the new lease areas as applied for (except those portions of the new lease

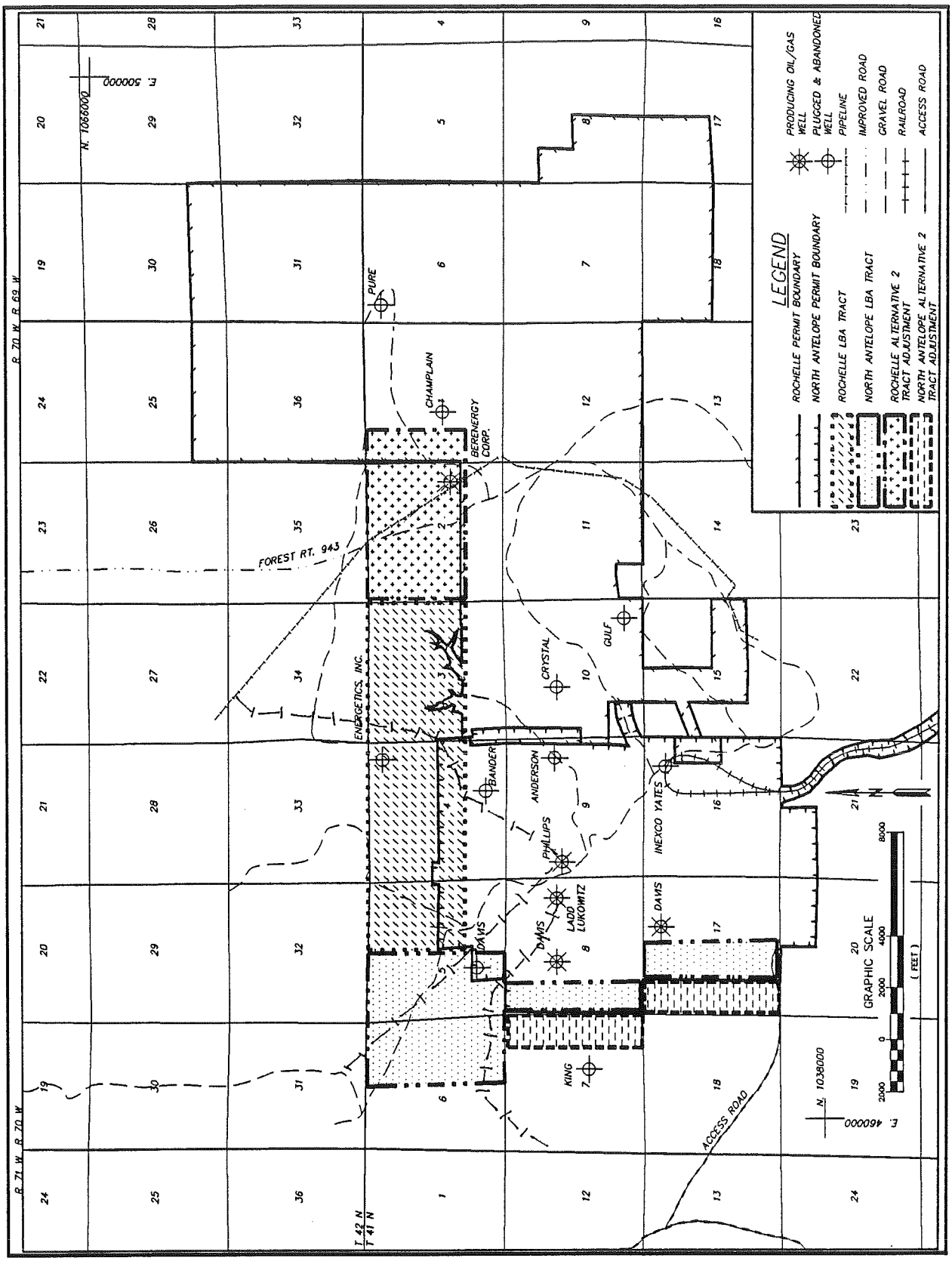

Figure 6. Transportation Facilities and Oil/Gas Wells on and near the North Antelope and Rochelle Tracts

areas that are already within the mine permit areas and thus covered in earlier baseline studies), plus a one-quarter mile wide strip of land outside the lease application areas. A search for migratory birds of high federal interest was conducted in this area plus an additional one-half mile perimeter area. The study area for big game, raptors, upland gamebirds, predators and furbearers included the extension area described above plus a 2-mile perimeter area. The following descriptions of habitats, faunal occurrence, and faunal abundance are drawn from all these sources.

There are seven habitat types on the two lease application areas, of which six are common to both areas. Each area has a small habitat type not found in the other area. The habitat types correspond to the vegetation communities described previously. The areas occupied by the respective habitat types described in this section do not precisely correspond to the areas occupied by the respective vegetation communities due to minor differences in the study areas covered by the respective inventories. Each habitat is described below in terms of extent and general location, characteristics, and land use.

Upland grassland: Upland grassland is the most abundant habitat type on the North Antelope lease application area (40 percent) and the second-most abundant habitat on the Rochelle lease application area (less than 30 percent). It occupies level to rolling uplands and is characterized by short grass species, primarily blue grama and junegrass. Taller grasses, such as western wheatgrass and needle-and-thread, are also present. Big sagebrush is absent or widely scattered. Pricklypear cactus is common. Upland grassland habitat is used for livestock grazing.

Breaks: The breaks habitat type is the most abundant type on the Rochelle lease application area (50 percent) and the second-most abundant type on the North Antelope application area. This habitat type is characterized by deeply dissected, erosional topography along creek banks and surrounding major and minor draws. Rock outcrops are common throughout this habitat. Although used for livestock grazing, the poor soils support only sparse vegetation. However, abrupt topography and larger rock outcrops serve to shelter both livestock and wildlife during weather extremes.

Sagebrush grassland: Sagebrush grassland is the third most abundant habitat type on both lease application areas, comprising about 15 percent of each. It is found on uplands and includes a shrub-grass continuum from grassland with moderate scattered sagebrush cover to shrublands so dense as to almost exclude any understory. Sagebrush grassland is used for livestock grazing.

Bottomland: Bottomland covers less than 10 percent of the two lease application areas and corresponds to the "meadow" vegetation type. It is found in the North Antelope lease application area on the terraces of Porcupine Creek and in both areas in thin bands lining the larger draws and around man-made stockponds. The influence of water on vegetation is readily apparent. Bottomland supports lush growth of grasses and forbs, including western wheatgrass, slender wheatgrass, inland saltgrass and Kentucky bluegrass. Big sagebrush is the major shrubby component, although isolated pockets of Wood's rose and western snowberry were found in the Rochelle lease application area. In a few places, isolated cottonwoods grow in bottomlands. Bottomland is used for grazing. Dammed stockponds serve as semi-permanent

water sources for livestock and wildlife. Channel pools on the Rochelle lease application area are small and widely scattered; they hold little water. Although Porcupine Creek is ephemeral, deep channel pools provide water for livestock and wildlife all year long in all but the driest years.

Playa: Playa habitat occupies a small area in the southern portion of the North Antelope lease application area and corresponds to the vegetation type of the same name. The single playa holds shallow water only briefly during the wettest seasons. Currently, the playa is grazed by livestock.

Seeded grassland: Seeded grassland habitat occurs on a small area in the Rochelle lease application area. It is found where an abandoned hayfield juts onto the study area from the north and on a revegetated oil drill site and its former access road. The principal species is crested wheatgrass, and the area is grazed by livestock.

Disturbed land: Disturbed land occupies about 2 percent of both lease application areas. In the Rochelle area it is found around two flood control reservoirs built to keep the flows of Knapp Draw out of the mine pit. In the North Antelope area it is found on an oil well pad, along graveled oilfield roads through the extension area, and where the paved mine access road crosses the area.

Three big game species occur in the vicinity of the current permit areas and the lease application areas: pronghorn, mule deer, and elk. No critical big game habitat is recognized by the Wyoming Game and Fish Department (WGFD) in this area and no critical wildlife issues that would affect leasing were identified (WGFD, September 27, 1991).

Pronghorn are, by far, the most common big game species in the area. The lands comprising the lease application areas are classified by the WGFD as winter/year-long habitat. Pronghorn are present on both lease application areas year-round in moderate numbers. There may be a slight influx of pronghorn into the area in the winter months. During the February, May, September, and November 1990 aerial surveys, the number of pronghorn observed within the 2-mile perimeter area ranged from 107 (3.2 per square mile) on the Rochelle area in February to a high of 362 (7.0 per square mile) on the North Antelope area in November. The majority of the pronghorn are seen in the sagebrush grassland habitat. Other habitats used extensively are upland grassland and breaks. All three habitats are common on the lease application areas and the 2-mile perimeter areas.

Mule deer are observed year-round in the area in small numbers. They are most commonly associated with breaks and bottomland, although a few small herds frequent the level to rolling big sagebrush habitat. Numbers of deer observed during the 1990 surveys ranged from 5 to 32 on the North Antelope lease application area and from 8 to 17 on the Rochelle lease application area.

Sightings of elk were reported in the original Rochelle and North Antelope mine baseline studies. A small herd resides in the Rochelle Hills east of the existing permit areas. These animals occasionally venture west of the timbered hills, but none were observed on the lease application areas during the 1990 surveys.

Lagomorphs (rabbits and hares) are an important prey item for raptors and other predators. Lagomorph abundance is cyclic and often has a great effect on predator numbers and reproductive success. Spotlight surveys in late September 1990 showed high lagomorph populations. Both white-tailed jackrabbits and cottontails were observed. Jackrabbits (at 8 to 14 per survey mile) were more common than cottontails (2 to 7 per survey mile). Cottontails were generally observed around rock outcrops in breaks habitat and in sagebrush grassland and upland grassland along the fringes of draws. Jackrabbits are more widespread, being observed in all habitats but preferring sagebrush grassland and upland grassland habitat types.

The area surrounding the North Antelope and Rochelle mines is used for sheep grazing. Because sheep are particularly vulnerable to predation, local ranchers continually attempt to reduce predator numbers in the area. Consequently, very few predators were observed during the 1990 field surveys. A red fox, a raccoon and a feral cat were observed on the North Antelope lease application area, and the same species plus striped skunk were observed in the 2-mile perimeter areas.

Surveys for nesting raptors have been conducted annually since 1985 on the current permit areas and 2-mile perimeters. The proposed lease areas are within the 2-mile perimeters and, consequently, have been thoroughly searched for raptor nests over the past seven breeding seasons (1985-1991). Results of previous surveys have been presented each year in the respective mines' annual reports to WDEQ/LQD. A mitigation plan for raptor nests in the North Antelope and Rochelle areas was developed in 1986. The mitigation plan was revised in the fall of 1990 and was approved by the U.S. Fish and Wildlife Service (USFWS) in December 1990.

The 1990 field studies included a search for nesting raptors within the 2-mile perimeter areas. A total of 33 nests were found, including 19 ferruginous hawk nests, 7 red-tailed hawk nests, 2 Swainson's hawk nests, 4 golden eagle nests and 1 great horned owl nest (see Figure 7). Not all nests were active in 1990; several are alternatives to nests active in 1990 and several others are listed as inactive. A total of 15 raptor nests were active in 1990, including 3 ferruginous hawk (8 young), 5 red-tailed hawk (11 young), 2 Swainson's hawk (3 young), 4 golden eagle (4 young), and the great horned owl nest (2 young).

None of the active nests is located on either of the lease application areas. However, four alternate ferruginous hawk nests are located on the Rochelle lease application area.

The only upland game bird occurring in the vicinity of the study area is the sage grouse. There are no historical records of sage grouse leks on either lease application area. No leks on these areas were located during early morning searches in the spring of 1990. During the spring of 1991 PRCC personnel conducted another search for sage grouse leks, and none was found.

Although no breeding grounds are present, sage grouse do occasionally pass through the lease application areas. During the 1990 field investigations, a single observation of sage grouse was made. Two hens with nine chicks were seen in June 1990 along Porcupine Creek in the North Antelope lease application area in the NE1/4SW1/4 Section 5. While no sage grouse sightings occurred on the Rochelle lease application area, isolated sign was present in some

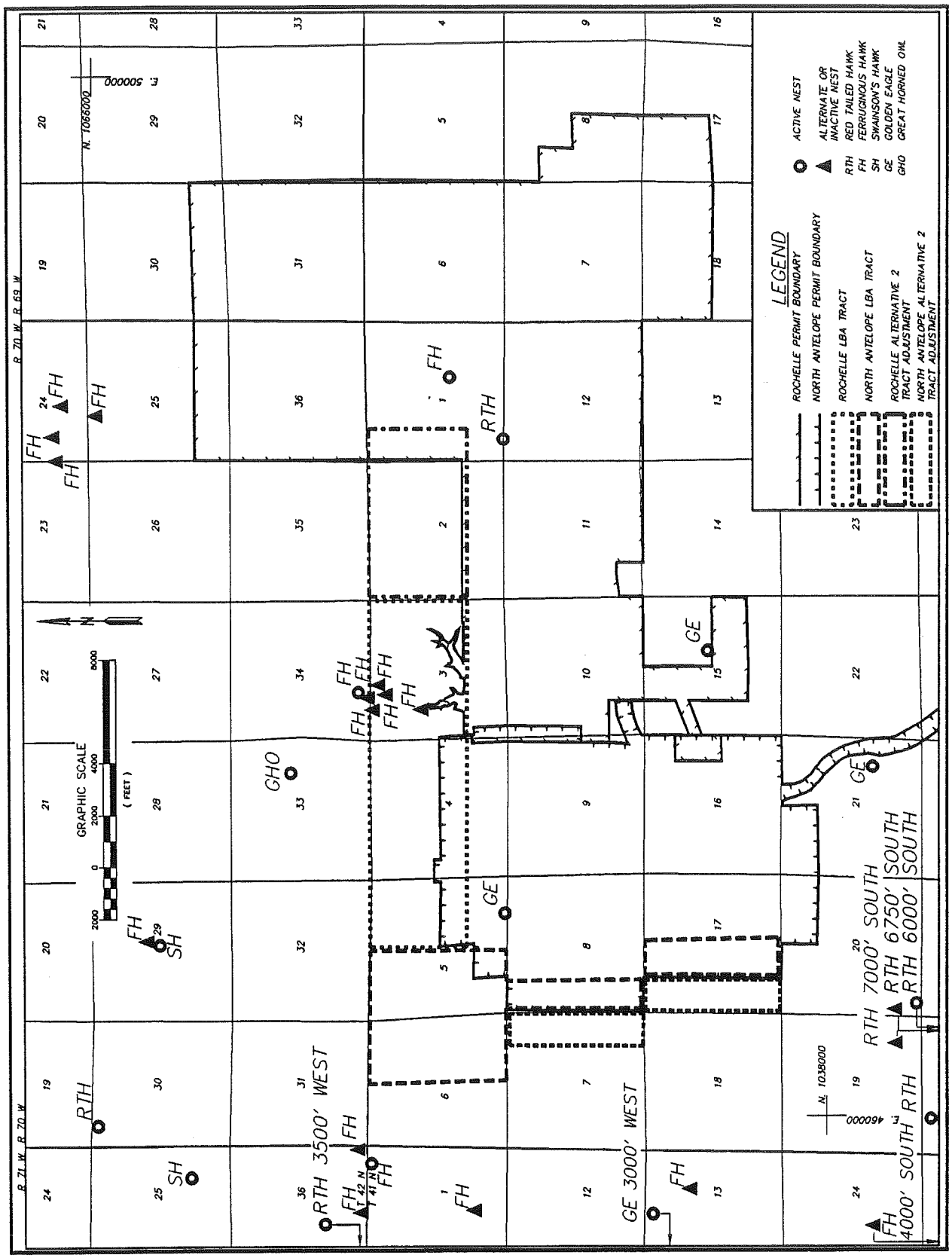

Figure 7. Raptor Nest Location Map of North Antelope and Rochelle LBA Tracts and Vicinity

areas. There are two leks within the Rochelle Mine permit area, one in Section 1, T.41N., R.70W. and one in Section 36, T.42N., R.70W.

The bottomland habitat type, particularly along Porcupine Creek, appears suitable as summering and brood-rearing habitat for sage grouse. Sagebrush grasslands on and near the lease application areas also seems to offer suitable grouse habitat. However, there is very little indication of use of the area by sage grouse. It is possible that expanses of sparsely vegetated breaks fragment and isolate otherwise suitable sage grouse habitat in the vicinity of the lease application areas.

The only migratory birds of high federal interest (MBHFI) seen in the lease application areas during the 1990 surveys were raptors. Both ferruginous hawks and golden eagles nest in the area. While most ferruginous hawks migrate out of the area in winter, golden eagles are year-round residents. Bald eagles are winter visitors in the Powder River Basin and were occasionally seen flying over the lease application areas. No bald eagle roosts or feeding sites occur in the immediate vicinity of the lease application areas. The only other MBHFI sighted during surveys were prairie falcons. A single prairie falcon was seen flying over bottomland habitat within one-half mile of the Rochelle lease application area in late summer 1990. Individual prairie falcons were seen flying over different locations on the North Antelope lease application area on three days in 1990; one bird was also seen feeding on prey in the lease application area in April 1990.

Few historical sightings of MBHFI have been recorded. In September 1986 an osprey was observed roosting in a tree along Porcupine Creek in the North Antelope lease application area. However, this bird was assumed to be migrating through the area, as no habitat suitable to support osprey occurs in the area. Habitat for burrowing owls is present in a black-tailed prairie dog town in Section 17, T.41N., R.70W. and scattered badger burrows. Burrowing owls nested in this prairie dog town, which is within the North Antelope lease application area and partly within the existing mine permit area, in 1985 but have not been observed since. Mountain plover habitat occurs in a few places on the North Antelope lease application area, but no plovers have been recorded in the area.

The USFWS and WDEQ have expressed concern about seventeen avian species or subspecies in the Powder River Basin coal region. In 1986, a records search and field surveys were performed to document the occurrence and status of migratory birds of high federal interest (MBHFI) at the North Antelope and Rochelle mines. Annual surveys for MBHFI have been conducted on and within one-half mile of the current permit areas since 1986. These survey areas encompass the proposed lease areas. In spring 1991, the proposed lease areas and their half-mile perimeters were added to the survey area.

Twelve of the seventeen species of MBHFI have been recorded through time on or near the North Antelope and Rochelle permit areas. Conclusions regarding MBHFI have not changed since the 1986 report. No non-raptor species of MBHFI regularly use the North Antelope or Rochelle areas. Suitable staging or breeding habitats for the non-raptor MBHFI species do not exist to any significant extent on or near the two permit areas or the proposed permit extensions which will encompass the two lease tracts. Ferruginous hawks and golden eagles are the only MBHFI that nest regularly on or within one-half mile of the proposed lease areas. These species

are discussed above. Nesting habitat for burrowing owls is present, but no nesting pairs have been found near the proposed lease areas. No suitable nesting habitat for other raptor MBHFI species exists on the area. Table 3 lists the MBHFI status in Northeast Wyoming and expected and recorded occurrences in the vicinity of the North Antelope and Rochelle mines.

No threatened or endangered (T or E) species, except wintering bald eagles, were seen in either lease application area during the 1990 baseline studies. There is one black-tailed prairie dog colony on the North Antelope lease application area and none on the Rochelle lease application area. The prairie dog town was searched for black-footed ferrets in February and March 1986. No evidence of ferret use of the prairie dog town was found during those surveys. Even though no ferrets were found, the U.S. Fish and Wildlife Service must be consulted with and give their approval before ferret habitat (i.e., the prairie dog town) can be disturbed by mining. No bald eagle roosting habitat (wooded canyons or large tree groves) exists on or near the proposed lease areas. Although bald eagles have been observed foraging on and near the permit areas, no unique source of prey occurs in the area.

Table 3. MBHFI Status in Northeast Wyoming and Expected Occurrence Near North Antelope and Rochelle Mines

Species	Seasonal Status/Breeding Records in NE Wyoming*	Sighting Records In North Antelope and Rochelle Area**	Expected Occurrence In North Antelope and Rochelle Area
White pelican	Summer/nonbreeder	PRES	Rare/migrant
Double-crested cormorant	Summer/breeder	NA, PRES	Rare/migrant
Canvasback	Summer/one record	None	Rare/migrant
Ferruginous hawk	Summer/breeder	NR, R, NR, A	Common/breeder
Golden eagle	Resident/breeder	NR, R, NR, A	Common/breeder
Bald eagle	Winter/nonbreeder	NA, R, NR, A	Common in winter
Osprey	Summer/has nested	PRES	Rare/migrant
Prairie falcon	Resident/breeder	NR, PRES	Uncommon/breeder
American peregrine falcon	Migrant/historical	None	Rare/migrant
Richardson's merlin	Resident/breeder	PRES	Rare/breeder
Whooping crane	Never recorded	None	Very rare/migrant
Sandhill crane	Migrant/nonbreeder	R, A, PRES	Uncommon/migrant
Mountain plover	Summer/breeder	PRES	Uncommon/breeder
Long-billed curlew	Summer/possible breeder	A	Rare/migrant
Burrowing owl	Summer/breeder	PRES	Uncommon/breeder
Lewis' woodpecker	Summer/breeder	None	Rare
Dickcissel	Summer/breeder	None	Rare

* Compiled from Oakleaf et al. (1982), includes Campbell and adjacent counties.

** Sighting Record References: NA = North Antelope Mine Permit; R = Rochelle Mine Permit; NR = North Rochelle Mine Permit; A = Antelope Mine Permit; PRES = Powder River Eagle Studies, unpubl. data

7. Cultural Resources and Native American Concerns

a. Cultural Resources

The LBA tracts, Alternative 2 adjustment areas, and buffer areas at least 1/4 to 1/2 mile wide have been inventoried for cultural resources at the Class III level. A Class III inventory is a professionally conducted, intensive examination of a target area, designed to locate all cultural properties which have surface and exposed profile indications. Cultural properties are recorded and sufficient information collected on them to allow evaluation for possible inclusion on the National Register of Historic Places (NRHP). That determination is made by the managing federal agency in consultation with the State Historic Preservation Officer (SHPO). Once the Class III inventory is completed, site-specific testing or limited excavation is utilized to gather additional data which will: 1) determine the final evaluation status of a site and/or 2) form the basis of additional work that will be conducted during implementation of a treatment plan if the site is eligible for the NRHP and within the area of effect. Treatment plans are implemented prior to mining and can include such mitigative measures as avoidance (if possible), large scale excavation, complete recording, Historic American Building Survey/Historic American Engineering Record documentation, archival research, and other acceptable scientific practices.

The existing North Antelope Mine permit area was inventoried at the Class III level by Western Cultural Resource Management, Inc (WCRM) in the spring of 1981 (Hall et al, 1981). About 360 acres of the North Antelope LBA tract and 240 acres of the Rochelle LBA tract were included in this 1981 inventory. Larson-Tibesar Associates conducted a Class III inventory of the Rochelle Mine permit area in 1981 (Tibesar et al, 1981). About 120 acres of the Rochelle Alternate 2 adjustment area were included in the Rochelle Mine inventory. In 1990 Mariah Associates, Inc. (Mariah) completed Class III inventories of a total of 3,000 acres adjacent to the North Antelope and Rochelle mines (Mariah 1990a, 1990b). These inventories covered the remaining portions of North Antelope and Rochelle LBA tracts, the North Antelope Alternative 2 adjustment area, a portion of the Rochelle Alternative 2 adjustment area, and some buffer areas. An additional 2,600 acres were inventoried for cultural resources at the Class III level by Mariah in 1991 (Mariah 1991). This inventory included the remaining portion of the Rochelle Alternative 2 adjustment area and additional buffer area.

A total of 67 cultural resource sites have been identified, including 30 within the LBA tracts, four within the Alternative 2 adjustment areas, and 33 within the buffer areas. Table 4 details the known sites by type, location, and NRHP status. Within the LBA tracts, ten sites are eligible for the NRHP, six sites have an unknown eligibility status, and 14 sites are not eligible for the NRHP. The Alternative 2 adjustment areas contain four sites that are not eligible for the NRHP. The buffer areas contain no sites that are eligible for the NRHP, 12 sites with an unknown eligibility status, and 21 sites that are not eligible for the NRHP. All sites that have been determined not eligible for the inclusion on the NRHP will require no further work prior to mining activities. All sites which are unknown with regard to their NRHP eligibility will have enough site-specific testing or archival research conducted to determine their eligibility, and if necessary, their final treatment. Prior to disturbance, a detailed treatment plan will be developed and implemented for all sites eligible for the NRHP. Some mitigation investigations have been conducted at NRHP eligible Sites 48CA113, 48CA1023, and 48CA 1069 in 1982 for

Table 4. Known Cultural Resources within LBA Areas, Adjusted LBA Areas, and Buffer Areas

Site No.	Type	Location	NRHP Status
48CA113	Prehistoric	LBA Area	Eligible
48CA131	Prehistoric	Buffer Area	Not Eligible
48CA132	Prehistoric	Buffer Area	Unknown
48CA182	Prehistoric	Buffer Area	Not Eligible
48CA183	Prehistoric	Buffer Area	Unknown
48CA190	Prehistoric	LBA Area	Not Eligible
48CA207	Prehistoric	Buffer Area	Not Eligible
48CA510	Prehistoric	LBA Area	Not Eligible
48CA511	Prehistoric	LBA Area	Not Eligible
48CA664	Prehistoric	LBA Area	Eligible
48CA665	Prehistoric	LBA Area	Eligible
48CA666	Prehistoric	LBA Area	Not Eligible
48CA667	Prehistoric/Historic	Buffer Area	Unknown
48CA668	Historic	Buffer Area	Unknown
48CA694	Historic	Buffer Area	Not Eligible
48CA770	Prehistoric	Adjusted	Not Eligible
48CA949	Historic	Buffer Area	Not Eligible
48CA960	Prehistoric/Historic	LBA Area	Not Eligible
48CA998	Prehistoric	LBA Area	Eligible
48CA1003	Historic	LBA Area	Not Eligible
48CA1009	Prehistoric	LBA Area	Eligible
48CA1020	Prehistoric	LBA Area	Eligible
48CA1022	Prehistoric	LBA Area	Not Eligible
48CA1023	Prehistoric	LBA Area	Eligible
48CA1027	Prehistoric	LBA Area	Not Eligible
48CA1032	Prehistoric	LBA Area	Not Eligible
48CA1069	Prehistoric	LBA Area	Eligible
48CA1070	Prehistoric	LBA Area	Eligible
48CA1071	Prehistoric	LBA Area	Eligible
48CA1126	Prehistoric	Buffer Area	Not Eligible
48CA1127	Historic	Buffer Area	Not Eligible
48CA1196	Prehistoric	Adjusted LBA Area	Not Eligible
48CA1263	Historic	Adjusted LBA Area	Not Eligible
48CA1271	Prehistoric	LBA Area	Not Eligible
48CA1622	Historic	Buffer Area	Not Eligible
48CA2487	Prehistoric	LBA Area	Not Eligible

Table 4. Known Cultural Resources within LBA Areas, Adjusted LBA Areas, and Buffer Areas (Cont'd)

Site No.	Type	Location	NRHP Status
48CA2610	Prehistoric	Buffer Area	Not Eligible
48CA2611	Prehistoric	Buffer Area	Unknown
48CA2612	Prehistoric/Historic	LBA &Buffer Area	Unknown
48CA2613	Prehistoric/Historic	LBA Area	Unknown
48CA2614	Historic	LBA Area	Not Eligible
48CA2615	Historic	LBA Area	Not Eligible
48CA2616	Historic	LBA Area	Not Eligible
48CA2617	Historic	Buffer Area	Not Eligible
48CA2630	Prehistoric	LBA Area	Unknown
48CA2631	Prehistoric	LBA Area	Unknown
48CA2632	Prehistoric	Buffer Area	Unknown
48CA2633	Prehistoric/Historic	Buffer Area	Not Eligible
48CA2634	Prehistoric	LBA Area	Unknown
48CA2635	Prehistoric	LBA Area	Unknown
48CA2668	Historic	Buffer Area	Not Eligible
48CA2669	Prehistoric	Buffer Area	Not Eligible
48CA2670	Historic	Buffer Area	Unknown
48CA2671	Historic	Adjusted LBA Area	Not Eligible
48CA2672	Prehistoric	Buffer Area	Not Eligible
48CA2673	Historic	Buffer Area	Unknown
48CA2674	Historic	Buffer Area	Unknown
48CA2675	Historic	Buffer Area	Unknown
48CA2676	Historic	Buffer Area	Not Eligible
48CA2677	Historic	Buffer Area	Not Eligible
48CA2678	Prehistoric	Buffer Area	Unknown
48CA2679	Prehistoric	Buffer Area	Unknown
48CA2680	Prehistoric	Buffer Area	Not Eligible
48CA2681	Prehistoric	Buffer Area	Not Eligible
48CA2682	Historic	Buffer Area	Not Eligible
48CA2683	Prehistoric	Buffer Area	Not Eligible
48CA2684	Historic	Buffer Area	Not Eligible

the North Antelope Mine permit area (Western Cultural Resource Management, 1983; Cultural Resource Division, 1983).

Of the 67 known sites, 41 are prehistoric, 21 are historic, and five are prehistoric/historic (Table 5). Within the LBA tracts, 13 prehistoric and two prehistoric/historic are eligible or have an unknown NRHP eligibility status. Many of these prehistoric sites generally consist of extensive remains located along the terraces of Porcupine Creek. Two such sites are Sites 48CA2613 and 48CA 2630. These sites have an unknown NRHP eligibility status, and additional testing will be required to completely determine the extent of buried remains. No NRHP eligible sites or sites with an unknown eligibility occur within the Alternative 2 adjustment areas. Within the buffer areas, six prehistoric, five historic, and one prehistoric/historic sites have an unknown NRHP eligibility status. The prehistoric sites with

Table 5. Known Cultural Resources by Site Type and NRHP Status.

	NRHP STATUS			
Site Type	Eligible	Unknown	Not Eligible	Total
LBA Area				
Prehistoric	10	4	9	23
Historic	0	0	4	4
Prehistoric/Historic	0	2	1	3
Total	**10**	**6**	**14**	**30**
Adjusted LBA Area				
Prehistoric	0	0	2	2
Historic	0	0	2	2
Prehistoric/Historic	0	0	0	0
Total	**0**	**0**	**4**	**4**
Buffer Area				
Prehistoric	0	6	10	16
Historic	0	5	10	15
Prehistoric/Historic	0	1	1	2
Total	**0**	**12**	**21**	**33**
TOTAL	**10**	**18**	**39**	**67**

an unknown NRHP eligibility status are extensive stone circle sites with intact, buried remains and additional large open sites along the terraces of Porcupine Creek. Site 48CA 132 is one of the more significant stone circle sites. During the 1990 Mariah inventory a trowel test within one of the stone circles recovered a secondary flake and four pieces of light tan, friable pottery that was probably Shoshonean. The historic sites consist of homesteads that will require archival research to fully determine their NRHP eligibility. One of the more significant homesteads is the Mackey Homestead (Site 48CA2675).

In addition to sites recorded during the intensive surface inventory, other buried cultural remains may occur along Porcupine Creek. This area has received extensive deposition in the past, and significant buried remains may have gone unnoticed during the surface inventory.

b. Native American Concerns

Native American consultation and coordination as required by the Archeological Resources Protection Act and the American Indian Religious Freedom Act was performed during the EA public review and final EA preparation periods. Comments from affected tribes were solicited through certified letters requesting their comments and concerns. No specific written comments were received from those parties.

8. Paleontological Resources

The study area contains exposures of the sedimentary Eocene Wasatch and Paleocene Fort Union formations. Most of the area contains outcrops of the Tongue River member of the Fort Union formation, a fine-grained drab to gray sandstone that is finely conglomeratic in places, and is interbedded with drab siltstone, claystone, and shale. The Wyodak-Anderson coal bed, deposited approximately 55 million years ago in a northwesterly flowing, warm-temperate, intermontane basin fluvial system, occurs in the eastern Powder River Basin as the uppermost unit in the Fort Union formation. The northeastern and southwestern edges of the area straddle the contact between the Fort Union formation and the overlying Wasatch formation. The Wasatch formation consists of buff arkosic sandstone, lenticular conglomerate, drab siltstone, carbonaceous shale, and coal.

Vertebrate, invertebrate, and paleobotanical fossils are known to occur within both the Wasatch and Fort Union formations over a large area. Fossilized plant remains, including leaves, wood, and pollen, are very abundant and well preserved in the Wasatch and Fort Union formations of the Powder River Basin and have been studied in detail. For these reasons, plant fossils are not usually considered significant unless they are exceptionally well preserved.

Vertebrate fossils are considered most important because of their rarity and for their scientific value to ongoing research in paleontology, evolutionary biology, and paleoecology. Fossil vertebrates have been known from the Wasatch formation of the Powder River Basin since the early 1900s, and include specimens of fish, turtle, champosaur, crocodile, alligator, and mammals. However, the number of vertebrate specimens recovered from the Wasatch formation in the Powder River Basin compared to Eocene strata elsewhere in Wyoming is low. For this reason, any identifiable fossil vertebrates found within the formation are considered significant. No fossil vertebrates have been recovered from the Paleocene-age Fort Union formation anywhere within the Powder River Basin. Therefore, any vertebrate fossils found in this formation would be considered significant. No significant paleontological localities have been recorded on federal lands within the Buffalo Resource Area, which encompasses the project area (BLM 1985).

Previous paleontological investigations in the general vicinity of the project area have failed to find significant paleontological resources; however, they have suggested the potential for significant finds. A 1981 survey of the Fort Union formation in the North Antelope Mine area revealed the presence of abundant fossil plant material but a paucity of vertebrate or invertebrate remains. A 1979 survey of the Antelope Mine area, about five miles south of the project area,

resulted in the discovery of fragmentary vertebrate (mammal and fish) remains within the Wasatch formation. These fossils were too fragmentary to be considered significant, but indicated the potential for the existence of additional vertebrate remains in the general area.

A literature search and paleontological field survey of areas adjacent to the Rochelle and North Antelope coal mines conducted in 1990 (Winterfeld, 1990) did not detect the presence of significant vertebrate, invertebrate, or paleobotanical resources within the mine permit area. This systematic survey included the examination of sedimentary outcrops, and other geomorphologic and natural features which favor the accumulation and visibility of fossils. These features include sandstone blowouts, well developed flats within and adjacent to outcrops, the bases of sandstone channels where coarse-grained material, including fossils, may accumulate, and ant hills produced by Western Harvester Ants. Poorly preserved fossil plant remains, consisting of leaf impressions as well as petrified logs, were found to occur in the permit area. These paleobotanical fossils are not considered to be significant because they are common, already well studied, and of poor quality as scientific specimens. Fossil invertebrates, including the shells of the snail *Viviparus meeki* and the bivalve *Pleisielliptio priscus*, were also found at the base of the Wasatch formation in a locality within the survey area. These two fossil invertebrates are well known from the Wasatch formation and equivalent aged rocks throughout Wyoming, and are not considered significant. However, despite the negligible findings of the surface examination, there remains the possibility that buried significant fossils, particularly those of vertebrate fauna, are contained in the sedimentary overburden beneath the visible ground surface.

9. Visual Resources

For management purposes, the BLM conducts an inventory that evaluates visual resources on all land under its jurisdiction. Once inventoried, these lands are classified into various visual resource management (VRM) classes. These classification ratings range from 1 to 5 as follows:

> Class 1 - Natural ecologic changes and very limited management activity is allowed. Any contrast (activity) within this class must not attract attention.
>
> Class 2 - Changes in any of the basic elements (form, line, color, texture) caused by an activity should not be evident in the landscape.
>
> Class 3 - Contrasts to the basic elements caused by an activity are evident but should remain subordinate to the existing landscape.
>
> Class 4 - Activity attracts attention and is a dominant feature of the landscape in terms of scale.
>
> Class 5 - This classification is applied to areas where the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to the level of one of the other four classifications.

When development is proposed, the degree of contrast between the proposed activity and the existing landscape is measured. This is called a contrast rating. In this process, various factors such as form, line, color, texture variety, contrast and lighting are evaluated.

The proposed lease area is remote and relatively inaccessible. It does not contain any unique or notable visual resources. The lands in the proposed lease areas are generally classified as VRM Class 4. Mining activity would not encounter any visual classification that would prohibit or restrict surface coal mining. Contrast would remain virtually unchanged.

10. Noise

An individual's judgement of the loudness of a noise correlates well with the A-weighted sound level (dBA) system of measurement. The A-weighted sound level, or A-scale, has been used extensively in the U.S. for the measurement of community and transportation noises. Table 6 relates A-scale decibel readings to some typical sounds commonly heard in daily life. The existing noise sources in the proposed lease area are wind, animal life, coal mining activities and limited agricultural activities. From these sources, the current noise level is estimated to be in the range of 30 to 45 decibels, depending on time of day and location, wind speed, and the presence of insects, birds, and other animals that contribute to background noise. Mining machinery will increase the noise level to a range of 85 to 95 decibels where actual operations are occurring.

Table 6. Typical Noise Levels of Common Occurrence

Noise Perception	Sound	Intensity Level dBA*
Permanent hearing damage	Saturn V moon rocket launch	180
Near permanent hearing damage	Jet aircraft engine (from 75 feet)	130-140
Threshold of pain	Loud rock music	120-130
Uncomfortably loud	Scraper-loader	110
Discomfort threshold	Jet airplane (from 1000 feet)	100
Very loud-interferes with conversation	Heavy city traffic	90
Hearing damage threshold for prolonged exposure	Air Compressor (from 20 feet)	85
Nuisance level	Small outboard motor	80
	Vacuum cleaner	70
Quiet	Conversational speech	60
	Window air conditioner	50
	Rustling leaves	20

* dBA = logarithmic measure of noise intensity (based on the A scale).

Sources: Zilly, R.G., ed., Handbook of Environmental Civil Engineering, 1975.

Shortley, G. and Williams, D., Elements of Physics, Vol. II, 3rd Ed., 1964.

Merritt, F.S., ed., Standard Handbook for Civil Engineers, 2nd Ed., 1976.

11. Air Quality

The background rural annual geometric mean total suspended particulate (TSP) concentration is about 15 micrograms per cubic meter ($\mu g/m^3$). In and near populated areas and active mining operations, particulate levels are significantly higher than background levels (BLM, 1985). Visibility of more than 60 miles is common. Significant reductions in visibility are generally weather-related, although major forest fires to the west and northwest have impaired visibility in the Powder River Basin. A detailed description of the air quality of the area has been produced for the BLM (PEDCO, 1983).

The basic regulatory framework which governs air quality in Wyoming is the Environmental Quality Act, the accompanying Air Quality Rules and Regulations, and the State Implementation Plan (SIP) approved by EPA under the Clean Air Act. This regulatory framework includes state air quality standards, which must be at least as stringent as National Ambient Air Quality Standards (NAAQS), and allowable increments for the prevention of significant deterioration (PSD) of air quality. The air quality standards which apply to coal mining are listed in Table 7. The large areas of disturbed land, crushing, loading and hauling of coal, and blasting associated with mining all produce dust which make the particulate standards the most important air quality issue for surface mining.

Table 7. Regulated Air Emissions for Wyoming

Emissions	Averaging Period	Wyoming Standard ($\mu g/m^3$)	National Standard ($\mu g/m^3$)
Total suspended particulates (TSP)	24-hour[1]	150	---
Particulate matter finer than 10 microns (PM_{10})	24-hour[1]	150	150
	annual[2]	50	50
Nitrogen oxides (NO_x)	annual[2]	100	100
Photochemical oxidants (O_3)	1-hour[1]	160	235
Sulfur dioxide (SO_2)	3-hour[1]	1,300	---
	24-hour[1]	260	365
	annual[2]	60	80
Carbon monoxide (CO)	1-hour[1]	40,000	40,000
	8-hour[1]	10,000	10,000

[1] Standards not to be exceeded more than once per year.

[2] Annual arithmetic mean not to be exceeded

The current particulate standards in Wyoming are for an annual average of 50 $\mu g/m^3$ and 24-hour average of 150 $\mu g/m^3$ both for particulate matter 10 micrometers and less in diameter (PM_{10}) and a 24-hour average of 150 $\mu g/m^3$ for TSP. The 24-hour standards are not to be

exceeded more than once per year. The various motor vehicles used in mining and transport of coal and people also produce carbon monoxide, nitrogen oxides, sulfur dioxide and by secondary processes, ozone, though these are seldom at levels to cause regulatory concerns at Wyoming's surface coal mines.

The PSD program is designed to protect air quality from significant deterioration in areas already meeting state standards. In other words, an increase or increment is allowed above baseline pollution levels so long as the state standard is not exceeded. The size of the increment allowable under PSD depends on the area's designation as a Class I, II, or III area, with Class I areas allowed the smallest increment and Class III the largest. The mine area, as is all of Wyoming outside the national parks and wilderness areas, is Class II. Wyoming's PSD standards, which are identical to federal standards, are summarized in Table 8.

Table 8. Maximum Allowable Increases for Prevention of Significant Deterioration of Air Quality in Wyoming

Emission	Averaging Time	Maximum Allowable Concentration Increase (micrograms per cubic meter)		
		Class I	Class II	Class III
Sulfur dioxide	Annual Mean	2	20	40
	24-hour[1]	5	91	182
	3-hour[1]	25	512	700
Total suspended particulates (TSP)	Annual Mean	5	19	37
	24-hour[1]	10	37	75

[1] Not to be exceeded more than once in any 12-month period.

In November 1990, the State of Wyoming submitted to the EPA a proposed revision to the SIP. One purpose of the revision was to modify Section 24 of the AQD regulations which deals with PSD. Prior to submission to the EPA, the WDEQ/AQD held a series of public hearings. During one of the hearings, the WDEQ/AQD presented testimony documenting that while coal production had increased dramatically, the air quality resource had not been diminished.

A summary of the historical monitoring data for the years 1980 through 1988 is provided as Table 9. During this period the number of mines producing coal increased from 10 to 16 while coal production escalated from 58.8 million tons to 139.1 million tons. The number of mines monitoring air quality increased from 12 to 16 (Table 9). The number of actual monitoring sites varied from a low in 1980 of 29 to a high of 46 in 1986. In 1988 there were 45 operating sites. Some of these sites include more than one sampler, so the number of actual high volume air samplers is greater than the number of monitoring sites.

In an effort to summarize the monitoring data in comparative form, averages of the geometric means from all sites were calculated for each calendar year. The averages ranged from a high of 30.8 $\mu g/m^3$ in 1980 to a low of 20.5 $\mu g/m^3$ in 1986. Over 23,000 samples were collected during this period.

Table 9 shows that the average of the geometric means went up during 1987 and 1988. It is not clear exactly what caused this increase. Speculation is that it was due to mining activity approaching monitoring sites and to dry conditions due to the regional drought. The third quarter of 1988 may have been impacted by emissions from the forest fires in Yellowstone Park, the Big Horn Mountains and the Rochelle Hills.

Due to possible cumulative impacts identified by the WDEQ/AQD, ambient particulate concentrations for the Rochelle and North Antelope mines are measured by a single monitoring network. The rightmost column in Table 9 shows the annual geometric mean TSP concentrations for the monitoring station located between the two mines. This is the only sampler that has continuous data covering the years 1980 through 1988 at the two mines. Before the TSP annual standard was replaced by the PM_{10} standard, the TSP annual standard was 60 $\mu g/m^3$. As the table shows, the annual averages measured at the North Antelope/Rochelle mines are well below this former standard. Assuming that PM_{10}, which was not monitored during the years shown in Table 9, was about 30 percent of the TSP values, and further assuming that the geometric and arithmetic means are similar, it can be inferred from Table 9 that the North Antelope and Rochelle mines would have historically been well within the current annual PM_{10} standard of 50 $\mu g/m^3$.

Table 9. Summary of Air Quality Monitoring in Wyoming's Powder River Basin, 1980-1988

Year	Number of Mines (Producing/ Monitoring)	Number of Monitoring Sites	Coal (MMT)	Overburden (MMBCY)	TSP Average of All Geometric Means ($\mu g/m^3$)	NACC/RCC Geometric Mean TSP ($\mu g/m^3$)
1980	10/12	29	58.8	93.2	30.8	14
1981	11/13	34	68.9	108.0	30.4	14
1982	11/15	43	81.4	120.7	23.1	13
1983	13/15	41	88.0	157.2	24.3	10
1984	14/15	44	106.8	166.6	24.3	10
1985	16/15	45	113.8	196.3	24.3	11
1986	16/16	46	114.6	169.6	20.5	16
1987	16/16	45	124.6	180.9	25.6	19
1988	16/16	45	139.1	209.8	29.3	26

Note: Mines include Buckskin, Rawhide, Eagle Butte, Fort Union, Clovis Point, Wyodak, Caballo, Belle Ayr, Caballo Rojo, Cordero, Coal Creek, Jacobs Ranch, Black Thunder, North Antelope/Rochelle, Antelope, and North Rochelle.

The conclusion that can be drawn from the information presented by the WDEQ/AQD is that while coal production increased nearly 2.5 times in the 1980-1989 period, the air quality in the Powder River Basin was not adversely impacted. This is due in part to the conditions attached to air quality permits, which stipulate control measures that must be implemented by the mine operators. These measures can include increased sprinkling, use of chemicals to

control dust, limiting the amount of disturbed area, temporary vegetation of disturbed areas, and contemporaneous reclamation. Table 9 does show an increasing trend in TSP concentrations at the North Antelope/Rochelle monitoring station. This increase is no doubt due in part to increasing production, but the large increase in 1988 could also have been due to the regional drought and forest and range fires that occurred that year.

Currently, the North Antelope Mine has an Air Quality Permit that allows a coal production rate of 14 mmtpy and the Rochelle Mine has an Air Quality Permit that allows a coal production rate of 18 mmtpy for 1992 and 22 mmtpy thereafter. PRCC has historically modified Air Quality permits to keep pace with the actual production levels. The current permits reflect Wyoming DEQ/AQD policy that mines permit coal production at higher levels than what are expected to be achieved in order to eliminate the need to repermit on a yearly basis.

12. Transportation Facilities

Access from Gillette to the North Antelope and Rochelle mines is accomplished by traveling south on State Highway 59 to mile marker number 67, then east on county roads (Edwards and Mackey roads) to the North Antelope Mine access road. Access from Douglas is accomplished by traveling on State Highway 59 to mile marker number 50 then east on Antelope Road (County Road No. 37) to the North Antelope Mine access road. Piney Canyon Road (county) is located approximately one mile north of the lease application areas. A spur of the Burlington Northern Railroad provides rail access to the North Antelope and Rochelle Mines.

Three natural gas pipelines owned by Phillips Petroleum cross the proposed lease areas in Sections 5, 4, 3 and 2. A fourth pipeline, owned by Western Gas Processors, crosses the proposed lease area in Sections 5 and 6. An oil field access road enters Section 2 from the north. Forest Route 943, which joins Piney Canyon Road on the north with Irwin Road on the south, runs approximately parallel to the easternmost Phillips pipeline. These transportation facilities are shown on Figure 6.

13. Socioeconomics

The lease application areas lie in extreme southern Campbell County just north of the Campbell County/Converse County line within the Powder River Basin in northeastern Wyoming. Major Campbell County communities include Wright, located approximately twenty-five miles northwest of the lease area, adjacent to Highway 59, and Gillette, located approximately 62 miles to the north via Highway 59. Nearby Converse County communities include Bill, which is an unincorporated community located 33 miles south on Highway 59; Douglas, which is located approximately 63 miles south on Highway 59; and Glenrock, which is 29 miles west of Douglas on I-25. The majority of employees at the two existing PRCC mines reside in Douglas (46 percent) and Gillette (33 percent); the remainder come from Glenrock (13 percent) and Wright (8 percent).

Gillette is the county seat for Campbell County. It is the major trade center and the largest community within the affected area of the proposed coal lease property. Douglas, which is the

county seat for Converse County, and Gillette are the communities within the region that are most likely to attract new area residents due to their current population levels and availability of services and shopping amenities which exceed those of smaller communities within commuting distance of the proposed lease areas. According to the 1990 Census, Gillette had a population of 17,635 in 1990, relative to a 1990 population for Campbell County of 29,370. Based on the same census, Douglas had a population of 5,076 in 1990, while Converse County had a population of 11,128. Wright had a 1990 population of about 1,200 people.

Campbell County ranked sixth in population among the counties within the state in 1990. Local planners are projecting Campbell County population to rise to almost 31,000 by 1995. With a total area of 4,756 square miles, Campbell County's population density was almost 6.2 persons per square mile in 1990, compared to an average of about 4.7 persons per square mile for the state. The 1990 Census placed the state's population at 453,588.
According to the 1990 Census, Campbell County contained 11,538 housing units that year, of which 7,078 were in the town of Gillette. Vacant housing in Gillette is estimated to total about 549 units, excluding boarding and bunk house vacancies (see Table 10). The overall vacancy rate is about 8 percent.

Table 10. Housing Availability in Gillette, Wyoming, 1990

Unit	Occupancy No.	Vacancy No.	% Vacancy No.
Single family (Single homes)	3,272	188	6
Single family attached (townhouse/duplex)	914	78	9
Multiple family (rentals)	1,487	201	14
Mobile homes	882	82	9
Total	**6,555**	**549**	**8**

Source: Gillette Housing Development-Planning, May 17, 1991
Note: Boarding and bunk house vacancies are unknown.

Based on recent information, Converse County contains 5,276 housing units with 2,264 units located in Douglas (see Table 11). The overall vacancy rate in Douglas is about 3 percent. New workers entering the area in response to any growth in the local mining sector would probably find more vacant housing in Gillette than in other surrounding communities. Although the PRCC lease applications will not directly create additional jobs if mined as maintenance tracts, current available housing in the affected area, should be sufficient to accommodate over 900 additional workers.

Table 11. Housing Availability in Converse County, Wyoming

Unit	Occupancy No.	Vacancy No.	% Vacancy Rate
Single family (single homes)	3,341	*	*
Single family attached (townhouse/duplex)	152	*	*
Multiple family (rentals)	701	*	*
Mobile homes	1,082	*	*
Total	**5,276**	**1,129**	**21%**

Source: Converse County Planning Office, September 1991
Note: * Individual unit vacancy breakdown not available.

Campbell County's economy is based largely upon coal mining, petroleum development and extraction, energy production (specifically power generation), and agriculture. Campbell County's 1989 mineral assessment equalled $1.1 billion. The 1989 state total was $3.44 billion. Coal valuation in 1989 totaled $1.17 billion for the state and $744.29 million for Campbell County. Thus, Campbell County represented about 32 percent of the state's total mineral valuation, and almost 64 percent of the state's total coal valuation. The 1989 oil production in the county was valued at over $428.84 million, or about 26 percent of the state's output of almost $1.66 billion. The 1989 gas output in Campbell County was valued at almost $26.11 million, which is about 3.4 percent of the $771.21 million valuation for the entire state's 1989 production.

Campbell County produced about 136 million tons of coal in 1988, 144 million tons in 1989, and 155 million tons in 1990. This output equaled about 83 percent to 84 percent of the state's total coal output in those years. State output rose from 164 million tons in 1988 to 184 million tons in 1990, making Wyoming the largest coal producer among the states. Most of the state's increase occurred in the Powder River Basin. The North Antelope Mine produced over 7 million tons of coal in 1989 and over 8 million tons of coal in 1990 and is expected to produce nearly 10 million tons in 1991. The Rochelle Mine produced 11 million tons in 1989 and 12 million tons in 1990 and is scheduled to produce 13 million tons in 1991. Coal production and forecasts for selected years are shown on Table 12. For the foreseeable future Wyoming coal production is expected to increase at about 4.4 percent annually, while coal production in Wyoming's Powder River Basin is expected to increase at closer to 5 percent per year.

There were 2,100 producing oil/gas wells in Campbell County in 1989. Oil production in Campbell County totaled between 25 million and 25.5 million barrels (Bbls) in 1988 and 1989. Gas production in the county totaled over 22.4 million cubic feet (mmcf) in 1988 and over 19.8 mmcf in 1989. Estimates place the County's gas production at 28 mmcf in 1990. By comparison, the state produced a total of about 111.21 million Bbls of oil in 1988 and 100.35 million Bbls in 1989. It produced over 471.36 mmcf of gas in 1988 and 621.50 mmcf in 1989.

Table 12. Historic and Projected Coal Production for Wyoming, Campbell, and Converse Counties

Year	Wyoming million tons	Percent increase	Campbell Co. million tons	Percent Increase	Converse Co. million tons	Percent Increase
1988	163.6	---	135.7	---	5.7	---
1989	171.1	4.6	143.8	6.0	6.1	7.0
1990	184.0	7.5	154.7	7.6	7.5	23.0
1991	187.6	2.0	157.4	1.8	8.0	6.7
1992	196.4	4.7	164.8	4.7	9.0	12.5
1993	205.0	4.4	172.4	4.6	10.0	11.1
1994	214.0	4.4	181.1	5.1	10.5	5.0
1995	223.4	4.4	190.1	5.0	11.0	4.8

Source: Wyoming Geo-Notes No. 28, Issue of Nov. 1990, Table 8, p. 20.

Employment in Wyoming's coal mining industry totaled 4,809 in 1988, 4,897 in 1989 and is currently about 4,700 (Wyoming Department of Employment, June 1991). The Office of the State Inspector of Mines indicates that Wyoming's coal mining sector employed 4,623 persons in 1990 of which Campbell County employed 2,590. State employment in the oil/gas sector was 9,900 in 1989 and had declined to 8,400 by April 1991 (ibid.). The North Antelope and Rochelle Mines employed 114 and 113 persons respectively in 1988, and 122 and 155 respectively in 1989 (Wyoming Geo-Notes No. 26). The present work force includes 134 employees at North Antelope and 162 employees at Rochelle, with an additional 40 employees being employed by the Powder River Coal Company (personal communication with Ms. Betty Kahila, Employee Relations for PRCC, Sept. 11, 1991).

The average price of coal sold in Campbell County, Wyoming declined from a peak of $9.88 per ton FOB mine site in 1982 to only $6.92 per ton in 1989 (U.S. Department of Energy, Energy Information Administration, 1990). The average coal price reflects a composite of historic contract prices that have escalated over time, new contract sales and open market (spot) coal sales. In the mid-1980s spot coal prices dropped to levels as low as $3.00 per ton. More recently, spot coal prices have ranged from $3.70 to $4.60 per ton for 8,400 to 8,800 Btu per pound coal at the mine mouth (McGraw-Hill, 1991).

The Wyoming Income and Employment Report for November 1990 shows that Campbell County's agricultural sector employed between 600 and 750 persons in 1988. Total employment in the County in 1988 was 17,242. Labor force data for selected years are presented in Table 13.

Table 13. Labor Force Data for Selected Years for Wyoming, Converse and Campbell Counties

Year	Wyoming No.	Converse No.	Campbell No.
1980	235,000 1/	7,792 1/	14,430 1/
1985	250,000 1/	6,502 1/	18,592 1/
1990	246,000 1/	5,206 1/	16,504 2/
1991	249,803 1/	5,156 2/	16,394 2/

Sources:

[1] Employment Security Commission of Wyo., "Wyoming Labor Force", Research & Analysis, March 1989, Casper

[2] Wyoming Department of Employment, Wyoming Labor Force Trends, Vol. 28, No. 8, August 1991

Personal income in Campbell County totaled almost $473.36 million in 1987 and $489.57 million in 1988. This represented a 6.06 percent decrease from 1986 to 1987 and a 3.42 percent increase from 1987 to 1988. State personal income for those years totaled about $6.28 billion and $6.58 billion, respectively, which is a 2.70 percent decrease and a 4.78 percent increase from the previous years. In 1989, state personal income rose to over $6.88 billion, a 4.64 percent increase over 1988. (The percentages are calculated on the non-rounded database by the State of Wyoming). In Campbell County, income earned from all mining (including oil extraction) totaled over $193.70 million in 1987 and almost $204.75 million in 1988. Earnings in the County's agricultural sector were between $5 million and $6 million in both 1987 and 1988.

By comparison, earnings by place of work for the state totaled almost $4.59 billion in 1987, $4.76 billion in 1988, and $4.87 billion in 1989. Earnings from coal mining amounted to about $238.57 million in 1987, $251.02 million in 1988, and $257.15 million in 1989. Earned income from oil and gas extraction state-wide was about $319.17 million in 1987, $333.72 million in 1988, and $318.52 million in 1989. The state's agricultural sector produced earnings of over $100 million in 1987, over $124 million in 1988, and less than $67 million in 1989.

The state's per capita income averaged $12,868 in 1987 and $13,641 in 1988. In these same years, Campbell County per capita income averaged $14,123 and $14,927, respectively. Unemployment in Campbell County in April 1991 was 6.4 percent, down from 7.4 percent in April 1990. This compares to statewide figures of 5.2 and 5.4 percent for Aprils of 1991 and 1990, respectively. In April of 1991 there were 1,055 persons on the unemployment rolls in Campbell County (Wyoming Department of Employment, June 1991).

Table 14 shows a summary of total disbursements by Campbell County, the City of Gillette, and the Campbell County school districts for selected years. In 1990, School District No.1 in Gillette employed about 439 full-time classroom teachers and had a fall enrollment of 7,659 pupils, which resulted in a pupil/teacher ratio of 17.45. According to the Wyoming Department

of Education, this pupil/teacher ratio is good. The state is striving to have average pupil/teacher ratios at about 15:1 to 16:1. The Education Department also indicated that Gillette has the finances to accommodate additional students that might result from mine expansion in the area. This district had fifteen elementary, five junior high and middle schools, and three high schools in 1990.

Table 14. Local Disbursements for Campbell County and Gillette for Selected Years[1]

Years	Campbell County 1000 $	Gillette 1000 $	School Dist. 1000 $
1980	---	15,721.0	35,885.2
1985	---	30,415.0	62,261.0
1990	158,639.9	29,717.0	59,715.9
1991	133,973.4	33,000.0	62,700.0

[1] Figures for 1980, 1985, and 1990 are actual expenditures as reported by local entities. Figures include debt servicing.

Source: BLM, June 1991, Jacobs Ranch Federal Coal Lease Application Environmental Assessment.

Converse County's population ranks 14th in the state. Major industries which support the county economy include coal mining, power production, agriculture and oil. The largest employer in the county is the county school district and the second largest is the Dave Johnston Power Plant in Glenrock. Employment in the mining industry in the county has risen since 1960 despite the decline in energy demand experienced in the 1980s. In 1960 less than 2 percent of the labor force was involved in mining; by 1970 the number was 10 percent. Currently 16 percent of the county's work force is employed by the mining industry.

Employment in Converse County during June 1990 averaged 5,254 with an unemployment rate of 4.8 percent. By June 1991, employment was slightly lower at 5,156 with an unemployment rate of 5.8, up from the previous year. There were 298 persons on the Converse County unemployment list in June of 1991 (Wyoming Department of Employment, June 1991). Total earned income within the county was $84.5 million in 1988, with mining as the leading industry followed by agriculture, transportation and utilities. Converse County per capita income in 1987 was $11,905 compared to a state-wide per capita income of $12,868 for that same year. In 1988 the county's per capita income rose to $12,590, still below the 1988 state per capita income of $13,641 for that same year.

In 1989, oil production in Converse County totaled 5.56 million Bbls representing about 5 percent of the state's total oil production. Oil production in 1990 decreased to 4.2 million Bbls which amounted to about 4 percent of total state production. Gas production in 1989 totaled 39.3 mmcf which amounted to about 4.5 percent of the state's production. Gas production decreased to 27.1 mmcf in 1990 and represented about 3 percent of total state gas production.

Converse County has two school districts with 14 schools and an enrollment of 2,709 students. There are 213 teachers employed by the county resulting in a county-wide pupil/teacher ratio of about 13. There are eight schools attached to the Glenrock district and 6 in the Douglas district. Douglas has two grade schools, one middle school and one high school. With a teaching staff of 135 and a 1991 enrollment of 1,770 pupils, the pupil/teacher ratio in Douglas is also 13. A branch campus of Eastern Wyoming College was established in Douglas in 1980 and has a present enrollment of 450 students.

The area being considered in this Environmental Assessment, like many other areas of the state, suffered from the decline in energy demand during the 1980s; therefore, it is not expanding as rapidly as had been projected earlier by various state planners. However, the preceding information would indicate that Campbell County experienced an upward movement in mining activity and related earnings in the late 1980s and that Campbell County was above the state average in per capita income while Converse County remains slightly below the state average. Any increase in the demand for the area's energy-related resources will further the area's economic growth, with most of this growth likely to accrue to Gillette and Douglas due to their larger sizes and variety of available services.

IV. ENVIRONMENTAL IMPACTS

A. Impacts Of Alternative 1

Alternative 1 is to issue the leases as applied for as two separate maintenance tracts under the lease-by-application regulations. This section describes the environmental impacts that would most likely result if the two tracts were acquired by PRCC as production maintenance tracts for the adjacent North Antelope and Rochelle mines. Impacts are quantified for each discipline addressed in Section III of this report. The following section addresses impacts of other alternatives, primarily by comparison to the impacts of Alternative 1. Subsequent sections describe mitigation measures that would reduce or eliminate adverse impacts, residual impacts that might remain in spite of mitigation measures, and cumulative impacts of the proposed action and alternatives.

1. Geology and Topography

Surface coal mining radically alters the surface and subsurface characteristics of the affected land. Overburden is drilled, blasted, and removed from atop the coal, either by trucks and shovels or by a dragline. Both mining methods are employed at the North Antelope Mine while the Rochelle Mine is a truck-shovel mine. Irrespective of the type of equipment used, the overall mining process is similar for large surface coal mines. The mining process may be considered a continuously moving pit during which, after initial pit development, the overburden removed from the advancing face is placed directly into the previously mined-out area. Overburden from the development of the initial pit, or box cut, is stockpiled. Thereafter, stockpiling is minimized since rehandling of stockpiled material adds to mining costs. After overburden removal, coal is blasted and loaded by shovels into trucks which transport the coal to the crushing, storage and train loading facilities.

The replaced overburden, or spoil, is physically different from the in-place overburden. As described previously, the Wasatch formation which comprises the overburden consists primarily of discontinuous lenticular sandstone beds and sand channels surrounded by siltstone and shale. The replaced spoil is a mixture of these materials, with the physical characteristics (bulk density, porosity, hydraulic conductivity, etc.) of the spoil being a function of mining methods and relative percentages of sand and finer-grained sediments in the overburden.

Overburden volumes in place are generally expressed in bank cubic yards (bcy), while spoil volumes are expressed in loose cubic yards (lcy). The ratio between lcy and bcy is termed the swell factor. At the Rochelle mine, the postmining land surface was designed under the assumption that the truck-shovel spoils will have a swell factor of 12 percent (PRCC, 1990b, Vol. 11, p. 240). At the North Antelope Mine, where spoils will be placed using a combination of dragline, cast blasting and trucks, the postmining surface was designed using a swell factor of 18 percent (NACC, 1990b, Vol E, p. 6-46). The dragline, with the assistance of cast blasting, removes up to approximately 150 feet of overburden directly above the coal, while the rest of the overburden is mined with trucks and shovels. The overall swell factor depends not only on overburden lithology but on relative amounts of dragline vs truck/shovel spoils.

Pursuant to WDEQ/LQD regulations, both mines have designed and implemented sampling and analysis programs to identify unsuitable overburden (i.e., overburden which has chemical or physical characteristics that might, if placed in improper zones during reclamation, inhibit the growth of vegetation or impair water quality). Special handling plans for unsuitable overburden, including covering unsuitable overburden with suitable materials, have been incorporated into the respective mining and reclamation plans and approved by the state. It is assumed that such plans will be incorporated into the mine and reclamation plan revisions that will be necessary to amend the permit areas to include the proposed lease tracts.

The two existing mine permit areas total about 10,400 acres, of which 3,540 are within the North Antelope permit area and about 6,860 acres are within the Rochelle permit area. Over the life of the mine, about 2,300 acres in the North Antelope permit area and 5,040 acres in the Rochelle permit area will be disturbed under the current mine plans. Most of the disturbance is directly related to coal removal, but some results from associated activities such as road and railroad construction, office, shop and warehouse facilities, coal preparation and loadout facilities, overburden stockpile areas, and highwall reduction areas. Mining of the two lease tracts under Alternative 1 as maintenance tracts would add about 954 acres to the area actually mined at North Antelope and 1,196 acres at Rochelle. Disturbance around the lease boundaries due to overburden benching, topsoil removal, and possibly highwall slope reduction during reclamation would add 350 acres and 250 acres to the area disturbed at the North Antelope and Rochelle mines, respectively. Additional minor disturbance may be required to construct impoundments or diversions to keep the flows of Porcupine Creek, Rogers Draw and Payne Draw out of the mine pits. Thus, leasing the two tracts as applied for under Alternative 1 would increase the total area to be disturbed over the lives of the mines by about 1250 acres, or 55 percent, at the North Antelope Mine and by about 1450 acres, or 29 percent, at the Rochelle Mine.

The topography of the proposed lease areas is subject to considerable change during the mining process. Due to the thickness of the coal seam, the average elevation of the mined area

will be lowered by several feet, even after allowing for overburden swelling. Assuming an average overburden thickness of 200 feet and an average minable coal thickness of 65 feet, the removal of the coal and swelling of the overburden by 18 percent in the North Antelope lease application area results in a change in average elevation of :

$$200(0.18) - 65 = -29 \text{ feet.}$$

For the Rochelle Mine, where the swell factor is assumed to be 12 percent, the computed drop in average elevation would be 41 feet under the same assumptions of overburden and coal thickness.

Overburden thickness generally increases as the coal dips westward, away from the outcrop, and the ratio of overburden to coal may be larger in the two proposed lease tracts than in the example calculation above, meaning that the average drop in elevation may be less than the 29 or 41 feet. However, some drop in average elevation is expected.

Certain habitat features of the premining landscape are directly related to topography (see Sections III.B.3 and III.B.6 of this report). These include closed depressions which contain playas, dissected stream channels which are often lined with cut banks and rock outcrops, and level to rolling uplands with sagebrush and grassland habitat. As described in the mitigation section, these features should be simulated in the postmining landscape where possible.

Premining slopes in the vicinity of the existing mines and the proposed lease areas range from flat to over 60 percent. The steeper slopes are associated with the incised stream channels and eroded gullies and will not be replaced during reclamation. WDEQ/LQD policy is to limit postmining slopes to about 20 percent (5H:1V), and therefore there is a net reduction in average slope after mining and reclamation are completed. The flatter slopes in the postmining landscape are intended to provide stable drainage channels and promote vegetative productivity by limiting precipitation runoff, but slopes too flat may be monotonous in appearance and lack topographic diversity important to wildlife.

2. Soils

The topsoil, like the overburden, is removed and replaced during the mining and reclamation process. The postmining topsoil is therefore a composite of premining soils. However, there are important differences. Premining soils occur in mappable units, or soil series, which are distinguishable by their physical and chemical characteristics, depths, locations in the landscape, and other factors. Prior to mining, the operator is required to map the soils, test them for physical and chemical suitability to support plant growth, and provide a plan for their salvage and replacement.

The postmining soils are a more homogeneous mixture than the premining soils and are replaced at a more uniform depth. On average, the postmining soils should be superior in quality to premining soils because only soils that are physically and chemically suitable are salvaged and replaced. The current average topsoil replacement depth at the North Antelope Mine is about 1.25 feet, while that for the Rochelle Mine is about 1.8 feet. Since soils in the lease tracts are similar to those in the current mine areas, the average replacement depths for the two mine areas including the new lease tracts should not change significantly.

Infiltration rates of soils may be altered by the salvage and replacement activities. However, differences between infiltration rates for natural and replaced soils may be masked by the variability of infiltration rates among soils and by inherent inaccuracies in measuring infiltration rates. Average infiltration rates will probably be lower soon after reclamation is completed, but over time, as the postmining vegetation root system develops and the natural weathering action affects the soil structure, infiltration rates are expected to trend toward premining levels (Martin, et al., 1988).

It is estimated that about 1,300 and 1,450 acres of soil resources would be disturbed in the North Antelope and Rochelle lease application areas and adjacent disturbance areas, respectively, under Alternative 1, including about 30 acres of hydric soils in a playa located in and adjacent to the North Antelope lease application area. Improper disturbance to soils can cause numerous types of impacts associated with alteration of existing soil characteristics and properties. Potential impacts to soil resources as a result of mining can include changes in soil structure, texture, organic matter content, infiltration rate, permeability, water-holding capacity, nutrient level, soil microorganism composition, and soil productivity. Stockpiling soil material can degrade biological, chemical, and physical properties. Stockpiling can decrease organic matter content, disrupt nutrient cycles, increase bulk density, upset the carbon-nitrogen ratio and negatively affect the mycorrhizal response of stored soil material (USDA-FS 1984).

The exposure, compaction, and stockpiling of salvaged soil material can increase potential for soil loss from wind and water erosion until the soil is revegetated. Increases in surface runoff can cause increased soil erosion and subsequent sedimentation into drainage channels or impoundments. Erosion hazard is greatly reduced through successful establishment of reclamation measures.

Potential impacts to topsoil resources are short-term and not significant as evidenced by ongoing reclamation present on reclaimed areas of the adjacent North Antelope and Rochelle mines where similar soils have been successfully salvaged and replaced. No significant site-specific or cumulative impacts are foreseen. No prime lands, prime farmland or alluvial valley floors significant to farming exist within the proposed lease areas, and therefore none will be disturbed. No detrimental long-term impacts to wetland resources are foreseen based on PRCC's experience in reclamation of surficial hydrologic features and commitment to wetlands preservation and/or reconstruction. The small playa in the North Antelope LBA area, in Section 17, will be affected and will require a future restoration plan. As part of that plan, hydric soils from the floor of the playa will be salvaged and stockpiled separately for use in wetland restoration.

3. Vegetation

Vegetation on the two lease tracts is similar to that which occurred prior to mining on the current mine permit areas. These vegetation types are common throughout the region. Vegetation impacts from mining the two lease tracts will be temporary. It is anticipated that the tracts can be successfully revegetated using the same techniques currently being used at the North Antelope Mine, which are similar to practices of other Powder River Basin mines. The primary impact is a temporary reduction of species diversity. Seed mixes are constantly being reviewed by regulatory agencies and improved by the operators, and more emphasis is being

placed on the addition of shrubs and other species to increase species diversity and enhance wildlife habitat values on the reclaimed lands.

4. Water Resources

Surface coal mining has several impacts on local hydrology, including both the surface and ground-water systems. The analysis and mitigation of hydrologic impacts receives considerable attention in the preparation and review of mining permit application documents.

Ground-water impacts generally include the following:

a. Removal of the coal aquifer and any overburden aquifers within the mine area, and replacement of these aquifers with spoil material.

b. A 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.

c. A temporary lowering of static water levels in the sub-coal Fort Union formation if the mines pump from this formation to provide water for sanitary and industrial (equipment washing, etc.) uses. Mines in the Powder River Basin, including both the North Antelope and Rochelle mines, have water-supply wells completed in the sub-coal Fort Union formation. The Rochelle Mine also has a water-supply well completed in the deeper Lance and Fox Hills formations.

Surface-water impacts generally include the following:

a. Disruption of the surface drainage system (channels and tributaries) during mining, requiring replacement of these systems during reclamation.

b. Changes in streamflow patterns during mining caused by the regulatory requirement to store runoff and settle out solids; by the need to prevent unacceptable levels of runoff from entering the pit, either by constructing flood control reservoirs or diversion systems; and by discharges to streams of pit inflows or other sources of water in excess of the mines' water requirements.

c. Possible changes in runoff rates due to changes in infiltration rates.

d. Possible changes in surface-water quality.

Impacts to designated AVFs are generally not permitted unless the AVF is insignificant to farming or unless the permit to affect the AVF was issued prior to the effective date of SMCRA. In general, AVF impacts can include several of the ground-water and surface-water impacts listed above. Alluvial aquifers can be subject to water-table drawdowns, channels subject to changes in flow patterns, and the interaction between surface water and ground water can be altered. A portion of Porcupine Creek that crosses the North Antelope lease application tract is already in the North Antelope permit area and is part of the designated AVF. However, this

AVF is not significant to farming, and its mining and restoration have already been approved by the regulatory authorities. The designated AVF extends upstream onto the area that will be amended into the permit area if this lease is acquired by PRCC. There is no irrigated agriculture on this area, and it is probable that a mine and reclamation plan similar to that developed for the downstream AVF will be appropriate for this area.

The following sections describe the type of hydrologic impacts that would be expected to occur under Alternative 1.

Ground-water impacts. As described in Section IV. A.1, the physical and chemical characteristics of the spoil material are dependent upon mining methods and overburden lithology. Research in other coal-mining areas in the northern Great Plains indicates that hydraulic conductivity in the reclaimed spoil will be large enough to consider the material an aquifer (Groenewold, 1979). The final hydraulic conductivity of the spoil aquifer will probably approximate the geometric mean values of hydraulic conductivity for the undisturbed Wasatch aquifer (0.2 ft/day) and the Wyodak-Anderson coal aquifer (0.8 ft/day) (Martin, et al., 1988, p. 23).

Given the expected final saturated thickness, the spoil aquifer in the North Antelope mine area will probably be capable of supplying water of adequate quantity for supply of the small yields needed for stock and domestic wells. This hydraulic conductivity will probably also be sufficient for the spoil aquifer to support flow patterns that are similar to premining patterns, allowing for the fact that one aquifer (spoil) will replace two aquifer systems (coal and overburden) within the mine areas. The large area in the Rochelle Mine where the premining overburden and coal are dry is not expected to contain a spoil aquifer after mining. In this area the base of coal is higher in elevation than the local potentiometric surface, and the spoils will probably remain unsaturated.

The following discussion of recharge, movement, and discharge of water in the spoil aquifer is excerpted from the Powder River Basin Cumulative Hydrologic Impact Assessment (CHIA) prepared by the USGS (Martin, et al., 1988):

> The potential for recharge to the backfilled spoil will be greater than in areas not disturbed by mining. The natural bedding will be destroyed, creating a more isotropic condition in the spoil, resulting in generally greater vertical permeability than exists in undisturbed areas. The infiltration capacity of the backfilled and reclaimed spoil will be greater than that of the undisturbed Wasatch aquifer and Wyodak coal aquifer. However, the infiltration rate for reclaimed soils is less than that for natural soils due to the lack of root structure and other paths for vertical movement of water. After several years, infiltration rates for reclaimed soils will increase to approximately the same rates as for undisturbed soils. As infiltration rates increase to approximate premining conditions, ground-water recharge rates also will increase to approximate premining conditions.
>
> Although the recharge potential of the reclaimed mine areas will increase, the actual recharge rate after reclamation probably will approximate or be somewhat greater than premining recharge. Actual recharge will depend on how well the surface contours are restored. A flatter average slope of the reclaimed land would increase the potential recharge by decreasing the rate of runoff from reclaimed areas. Recharge will increase locally where water is allowed to pond in surface impoundments. Also, some increase in recharge along re-constructed channels probably will occur during the infrequent periods of surface runoff.

Postmining recharge rates and mechanisms will not change in areas where lateral movement of ground water from adjacent clinker is a major source of recharge. This is because, in general, the clinker will not be disturbed by mining operations. After mining and reclamation have been completed, water will move laterally from clinker to the spoil aquifer.

Recharge to the spoil aquifer will be from infiltration of precipitation, lateral flow from the undisturbed clinker and the Wasatch aquifer and Wyodak coal aquifer, and leakage from surface-water impoundments and stream channels. Estimates of the time required for the ground-water system to re-establish equilibrium varies from a few tens of years to hundreds of years. The anticipated potentiometric surface of the spoil aquifer will resemble a composite of the premining potentiometric surfaces in the Wasatch aquifer and Wyodak coal aquifer. After equilibrium is re-established, ground-water flow patterns will approximate premining conditions. Discharge from the spoil aquifer will flow into the undisturbed Wasatch aquifer and Wyodak coal aquifer to the west (regional flow) or to reclaimed stream channels (local flow).

To date, six monitor wells have been completed in replaced spoils at the North Antelope Mine and two have been completed in spoils at the Rochelle Mine. The spoil wells at the Rochelle Mine are completed in an area where both the overburden and coal were dry. These spoil wells do not contain sufficient water to sample, nor are they expected to do so in the future. Therefore, the following discussion is based on information collected from the spoil wells at the North Antelope Mine. The wells were completed in the area where the earliest mining and reclamation took place. The most recent water-level data available for these wells is presented in the 1991 North Antelope Mine Annual Report (NACC, 1990a). Each of these wells has encountered water and has been sampled on a regular basis since its completion. The number of samples for each well had ranged from 5 to 22 as of the 1991 annual report. Water levels in the wells range from about 11 to more than 70 feet below the reclaimed surface. The saturated thickness of the spoil aquifer at these wells currently ranges from a few feet to nearly 40 feet. Based on these wells, EarthFax Engineering, Inc. (1991) concluded that, "...the water levels in the spoils recover to approximately one-third of the initial coal potentiometric surface within three years after spoil placement and to about two-thirds of the initial coal potentiometric surface within eight years following spoils placement."

Dissolved-solids concentrations in the backfill wells at North Antelope range from about 1,200 mg/L to over 25,000 mg/L. The largest values have been measured in samples from one anomalous well, and the reasons for the high readings from this well are unknown (personal communication with John Nadolski, PRCC Hydrology Supervisor, September 24, 1991). The mean TDS value for the four spoil wells completed through the entire thickness of the backfill is about 3,200 mg/L (NACC, 1990a).

Water-supply wells within the mine areas will experience water-level declines as they are approached by the respective pits and ultimately will be removed by mining. Water-supply wells completed in affected aquifers outside but in close proximity to the mine area will experience reductions in water levels.

The results of ground-water modeling studies performed by PRCC are reported in the 1990 permit renewal document on file with WDEQ/LQD (NACC, 1990b, Vol. C). WDEQ/LQD policy is to have the mining companies determine the extent of the five-foot drawdown contour. The modeling done for PRCC predicts that drawdown in the coal will extend approximately radially to the west from the mine areas. Distortions to the radial pattern occur on the east and

south sides of the mines due to the coal outcrop and the presence of naturally dry zones. The maximum extent of the 5-foot drawdown in the coal is simulated to be approximately 54,900 feet (10.4 miles) from the west-northwest corner of the North Antelope Mine permit boundary. As noted in Section III. B. 4a of this report, there are 18 water supply wells within this potentially impacted area. This compares with a distance of 7 miles predicted in earlier studies by the North Antelope and Rochelle mines and reported by the USGS (Martin, et al., 1988). The reason that the most recent PRCC model predicts a larger zone of mining impact than earlier studies is believed to be a result of conservative assumptions of hydraulic conductivity and the fact that the model was calibrated and verified to over-predict drawdowns actually measured at monitor wells. Despite this over-prediction of drawdowns, the maximum extent of the 5-foot drawdown is within the limit predicted by the USGS for "all anticipated mining" (Martin, et al., 1988).

Two other aquifers were assessed in the PRCC ground-water modeling studies, the overburden and a portion of the Fort Union formation immediately beneath the coal. Both zones are used for stock and domestic water supplies in the vicinity of the mines. Water levels are lowered in the overburden as a direct result of mining. During mining at the North Antelope Mine, trenches are dug into the top of the underburden to relieve the hydrostatic pressure below the floor of the mine. These trenches lower the potentiometric head on the underburden aquifer, and since the aquifer is confined, the lowering of head extends for some distance out into the aquifer. Model-predicted drawdowns in these two units are less than those predicted for the coal. For the overburden, the maximum extent of the 5-foot drawdown contour was predicted to be 9,100 feet (1.7 miles) from the south side of the North Antelope permit boundary. For the underburden, the maximum limit of the 5-foot drawdown is predicted to be about 37,600 feet (7.1 miles) from the west-northwest corner of the North Antelope permit area.

During permitting to amend the two lease tracts into the respective mine permit areas, the drawdown study will be reassessed using pump-test data from the new lease areas and based on the new mine plans. At this time it can be presumed likely that with mining extending through the lease tracts, and considering that the lease tracts are on the north and west sides of the current permit areas, the extent and magnitude of the drawdowns will be extended westward and northward by about the width of the lease application areas, or about one-fourth mile to one mile. Eastward and southward extents of coal removal will not be changed by the mining of the lease tracts, and therefore the maximum eastward and southward extents of drawdown should not change.

Wells in the Wasatch formation were considered to be impacted by drawdown only if they were within 2,000 feet of a mine pit (Martin, et al., 1988, p. 29). However, water-supply wells in the coal may be affected as far away as eight miles from mine pits, although at this distance the effects will be minimal. Drawdowns extend farther in the coal because the coal is a confined aquifer and because it is areally extensive, whereas the Wasatch aquifers are generally unconfined and discontinuous.

Figure 8 shows the limit of the 5-foot drawdown contour for the overburden, Wyodak-Anderson coal, and underburden (Fort Union formation immediately below the coal) as predicted by PRCC for the existing mines. The limit of the 5-foot drawdown contour in the coal seam as predicted by the USGS for "all anticipated mining" is also shown on Figure 8 along with the

location of the North Antelope and Rochelle lease application areas. As the figure indicates, the drawdowns predicted by PRCC for all three aquifer systems are within the area of drawdown predicted by the USGS for all anticipated mining. While detailed modeling studies may be required to obtain mining permits for the lease application areas, one can surmise from Figure 8 that extending the drawdown zones by the respective widths of the lease application tracts will still keep the drawdown zones within the USGS limit predicted for all anticipated mining. Figure 8 also shows the limit of the 5-foot drawdown in the coal seam as measured in 1990 by the Gillette Area Groundwater Monitoring Organization or GAGMO (Hydro-Engineering, 1991b). This limit is well within the projected maximum extent of the 5-foot drawdown, and probably is indicative of the conservatism used in all the modeling studies.

Concern has been expressed regarding the effects of the mines' facility wells on water levels and water-supply wells in the deeper aquifers of the Fort Union formation. **(Note: These wells, like two of the water supply wells at the North Antelope and Rochelle mines, are completed in the Tullock member of the Fort Union formation, generally at depths of 1,000 feet and more. This should not be confused with the "underburden" aquifers described above which are impacted by trenches on the pit floors and which provide water supplies to several local stock and domestic wells. The Tullock member of the Fort Union formation and the shallow "underburden" aquifers in the vicinity of the North Antelope and Rochelle mines are separated by more than 800 feet of relatively impermeable claystones and shales and are generally considered not to be in hydraulic communication.)**

Water-level declines in the Tullock member of the Fort Union formation may be subject to cumulative impacts (refer to Section IV. E of this report). One of several analyses of impacts on the Tullock member was commissioned by NERCO for the Antelope Mine, located a few miles southwest of the North Antelope Mine (Kaman Tempo, 1983). This investigation studied the cumulative impact of 10 Tullock wells, including existing facility wells at the Jacobs Ranch, Black Thunder (2 wells), Rochelle, North Antelope, and Antelope mines; probable wells at the North Rochelle Mine and at a hypothetical mine on the Peabody lease located between the Rochelle and North Rochelle mines; and the two water supply wells owned by the town of Wright, Wyoming. Drawdowns were computed for all these wells using the conservative assumptions that each well is pumped at its permitted rate (probable permitted rate in the case of the two hypothetical wells) continuously for a period of 30 years, that there is no recharge to the Tullock member, and that all of the wells are in hydrologic communication with each other. Under these assumptions it was calculated that drawdowns at the wells would range from about 600 to over 760 feet. Head losses of these magnitudes will increase pumping costs and possibly require deeper pump settings, but they will not dewater this aquifer. At the Rochelle Mine the premining head on this aquifer is over 2,000 feet (RCC, 1990b). Mining the LBA tracts under Alternative 1 will extend the lives of the mines, and therefore the time during which use is made of the Tullock wells, but will not increase the rate of use. No new Tullock well would be required under Alternative 1.

Ground-water quality in areas surrounding the mines is not impacted during mining. While the pits are opened, ground-water flow directions are toward the pit, and there is no mechanism for contaminants to migrate off-site. After mining, water levels will begin to recover, and eventually an equilibrium flow pattern will develop. The time required for complete recovery of water levels is not known. Estimates in various mine plans range from a few tens to

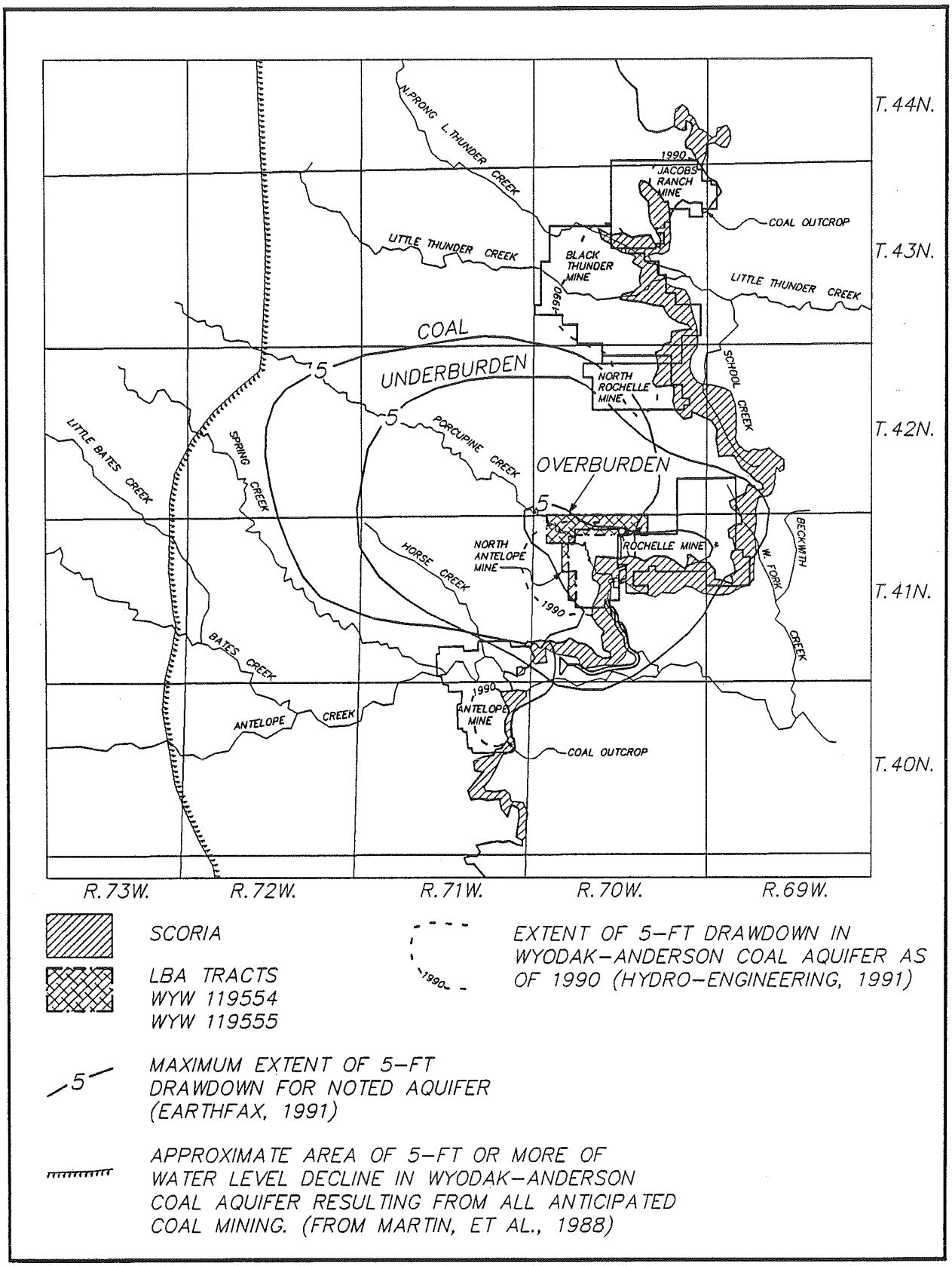

Figure 8. Maximum Extent of Drawdowns Predicted by PRCC for Existing PRCC Mines and by USGS for All Anticipated Mining

hundreds of years. The modeling study commissioned by PRCC estimates that water levels in the spoils, coal and underburden will recover to premining levels within about 170 years after completion of mining. The recovery follows an exponential curve, and most of the recovery occurs much sooner. According to PRCC, water levels in the overburden may not recover fully to premining levels since the confining layer that prior to mining perched the overburden water above the coal will be removed and not replaced.

After water levels recover in the spoils, water from the spoil aquifer will enter the adjacent, unmined coal. This will increase dissolved-solids concentrations in the coal aquifer water, but since there is a finite quantity of soluble salt in the spoil material this increase will be temporary. As soluble salts continue to leach from the spoil material, future postmining water entering the adjacent coal aquifer should decrease in dissolved-solids concentration until a postmining equilibrium condition is attained (Martin, et al., 1988 p. 92).

The addition of the two lease application tracts to the existing mines will add to the volume and areal extent of the spoils. The major recharge sources for the spoil aquifer are along the coal cropline and the pit boundaries. Since inflows to the spoils from these sources will not be appreciably changed by adding the new lease tracts, and since the volume of spoils will increase, it stands to reason that the time necessary to recharge the spoils will increase. The water quality in the spoils should be similar with or without the new lease tracts.

Surface-water Impacts. The incremental impacts to the surface drainage system caused by mining the North Antelope and Rochelle lease application tracts will be minimal. The primary streams on the lease tracts, Porcupine Creek, Rogers Draw, Payne Draw and Knapp Draw, have already been mined through or plans for their mining and replacement have been approved. A portion of Porcupine Creek is diverted around the North Antelope Mine facilities area in a diversion channel, and a reach of the stream just upstream from there was among the first areas mined and restored at the North Antelope Mine. Diversion plans have been designed for the lower reaches of both Payne and Rogers Draws. Flows of Knapp Draw are contained in a flood-control reservoir, and the lower reaches of the drainage are being mined through at the Rochelle Mine. Stream restoration plans have been designed to provide channel and drainage-basin erosional stability comparable to premining stability. Adding the lease application tracts to the existing mines will merely relocate upstream the point where the natural stream and the reclaimed stream will connect.

Downstream water rights will not be affected by the addition of these lease tracts to the existing operations. Flood control impoundments may be used to keep streamflows out of the pits. The impoundments will have to be dewatered following major runoff events to provide storage space for the subsequent event. The water thus released will be available to meet the needs of downstream water users. These issues have been addressed in the current mine plans and will not be substantially affected by the proposed incremental increases to the coal reserves from the two applications. There are no surface-water rights on the lease application tracts.

5. Land Use

During mining, portions of the two lease tracts and adjacent areas will be unavailable for livestock grazing. At a mining rate of 30 million tons per year (for the two mines combined), an average of about 270 acres per year will be disturbed by coal removal. Considering time required for topsoil and overburden removal in advance of mining and spoil grading and topsoil replacement following coal removal, the area disturbed at any given time would probably total 400 acres or more. Under Alternative 1, in which the lease application tracts are mined as production maintenance tracts for the existing mines, this disturbance will be divided between the existing leases and the proposed lease tracts. Approximately 200 acres disturbed at any given time on either lease application area represent less than 7 percent of either of the affected grazing leases (see Section III. B. 5 this report). No operating oil wells will be affected under Alternative 1.

6. Wildlife

During mining, abundant sagebrush-grassland habitat will be available outside the current and proposed mining area to assure that pronghorn are not adversely affected by mining the new lease tracts. Pronghorn are already using reclaimed areas seasonally, and as the shrub component on reclaimed land increases, more winter use of this land by pronghorn is expected. Deer make less use of the lease application areas than pronghorn and also have alternate habitat to use while the lease application areas are being mined. Elk habitat on the lease application areas is limited. During reclamation the replacement of sagebrush/grassland habitat with a grass/forb mix would benefit elk. This impact would remain until normal succession occurs and reinvasion by sagebrush occurs.

Existing raptor nest sites associated with one nesting pair will be displaced by mining on the proposed lease areas. A mitigation plan has been approved and implemented for the raptor nests that will be disturbed on the current mine areas. The raptor mitigation plan for all nests on the North Antelope and Rochelle permit areas must be updated each time new lands are added to the permit area, when the mine plan is significantly changed, or when the permit is renewed. Mitigation plans will be submitted to the U.S. Fish and Wildlife Service (USFWS) for review and approval.

Sage grouse, based on surveys, make little use of the habitat on the lease application areas. This is probably because there is little suitable brood rearing habitat in proper juxtaposition with sagebrush cover in the area. Therefore this species will not be impacted by temporary loss of this habitat on the two tracts. Because non-raptor migratory birds of high federal interest do not regularly use the area, mining will have a negligible impact on these species. No unique source of prey for bald eagles exists on the two tracts; therefore the impact of mining on this species will be negligible. The black-tailed prairie dog town on the North Antelope lease application area will be disrupted. However, searches have indicated that no black-footed ferrets use this town, and therefore this endangered species will not be affected.

A reduction in topographic diversity caused by inability, due to both physical and regulatory constraints, to restore breaks, badlands, and other rough topography, will limit habitat diversity in the reclaimed areas. This may limit the reclaimed area to summer range rather than winter

range for wildlife species that rely on sagebrush for winter food supplies. This condition will be relieved upon reinvasion of shrubs.

7. Cultural Resources and Native American Concerns

Impacts to cultural resources are addressed through the Section 106 process of the National Historic Preservation Act of 1966, as amended, and through other appropriate legislation and regulations. This specifies that the federal land managing agency, in consultation with the Wyoming SHPO, will make final eligibility and effect determinations for all sites located within the proposed lease area. If any sites are found to be eligible for NRHP and cannot be avoided, then an appropriate treatment plan will be developed and implemented prior to mining, in accordance with 36CFR800 and other relevant regulations.

Ten cultural resource sites that are eligible for the NRHP are located within the LBA tracts and will require treatment plans. Six sites within the LBA tracts and 12 sites within buffer areas have an unknown NRHP eligibility status. These sites will require final evaluation to determine their eligibility for inclusion in the NRHP. No further work will be required for sites not eligible for the NRHP, as all pertinent data has been gathered. Further work will include data recovery and recordation of important prehistoric and historic information at NRHP-eligible properties as identified in the mitigation plan.

As described in Section III.B.7.b of this report, comments concerning the PRCC LBA have been solicited from affected tribes. This solicitation will continue through the EA process. If concerns are expressed they will be addressed in the final EA.

8. Paleontological Resources

Impacts to paleontological resources consist of losses of vertebrate, invertebrate, and paleobotanical fossils of importance to scientific research. The losses would result from destruction, disturbance or removal of fossil materials as a result of coal mining activities, unauthorized collection, and vandalism. A positive impact of coal mining activities would be the exposure of fossils for scientific examination and collection which would otherwise not occur except as a result of overburden excavation and exposure of fossiliferous geologic strata.

No impact to known significant paleontological resources are expected as a result of coal mining activities. However, there is potential for buried paleontological resources in the Ecocene Wasatch and Paleocene Fort Union formations underlying the mine permit area.

9. Visual Resources

No unique visual resources are found on the North Antelope and Rochelle lease application tracts, and therefore impacts to visual resources will be minimal. The need to remove and stockpile overburden, extract coal and construct facilities requires a major modification of landforms in coal lease areas. These impacts are already occurring extensively as a result of several nearby surface mining operations. The additional cumulative increment, when compared to the general visual classification adjacent to the mines, is negligible. The duration of this impact varies from one to several years. However, stringent reclamation guidelines require that

these lands be restored to approximate original contours. Therefore, no permanent impacts to visual resources are expected.

10. Noise

There have been no complaints of off-site noise impacts from the existing operations at the North Antelope or Rochelle mines, due at least in part to the remoteness of the two mines. The nearest dwelling to either proposed lease area is at Teckla, approximately 1.8 miles west of the northwest corner of the North Antelope lease application tract. Mining of the North Antelope lease application tract will in effect move the pit boundary about one mile closer to this dwelling than would occur under the current mine plan. The WDEQ/LQD mine permit regulates blasting noise and vibration from a mine within one-half mile of the mine permit boundary. Thus, it is unlikely that noise impacts at the nearest public access or neighbor would be significant. Potential onsite noise impacts to workers are regulated by the Mine Safety and Health Administration (MSHA). Since no workers will be housed at the mine site, compliance with the work-related hearing conservation programs of MSHA is sufficient to insure that impacts to workers on the proposed lease area will be minimized.

Section III.B.10 of this report states that ambient noise levels are in the 30 to 45 decibel range, while the noise level in the immediate vicinity of mining operations is in the range of 85 to 95 decibels. The psychological property of a sound called **loudness** is intimately connected with the **intensity** of a sound wave. Intensity, generally measured in units of watts per square meter, of a sound wave is the power transferred through unit area normal to the direction of propagation. For a pure tone of given frequency, loudness increases with increasing intensity, but in general the relation between the loudness of a sound and its intensity is not simple. Loudness cannot be measured in physical terms, since it depends on the ear and judgement of the individual observer.

Using intensity as an indicator, it is possible to estimate approximately the distance one would have to be from a sound source of 100 decibels in the mine area to have the sound reduced to the ambient level of about 40 decibels. This estimate is based on the fact that sound energy is inversely related to the square of the distance and that the logarithm (base 10) of the ratio of two sound intensities is called the difference in intensity level, or **bels**. Ten times this logarithm is called the difference in intensity level in decibels, and this difference is ordinarily used to compare intensities of two sounds. A sound 10 times as intense as another has an intensity level 10 decibels (db) higher. A sound 100 times (10^2) as intense as another has an intensity level 20 db higher. Thus a sound of 100 db has an intensity level one million times higher (10^6) than a sound of 40 db. If the 100-db sound is measured, say, 10 feet from the source, the sound intensity would be reduced to 40 db at a distance of about 1,000 feet (0.2 miles) from the source, assuming no attenuation of the sound. In other words, the sound of the 100-db source would be reduced to near ambient levels within 1,000 feet from the source. Since the nearest dwelling is approximately ten times this distance from the nearest point of the proposed lease tract, it is unlikely that most sounds from the mine will be heard above ambient noises (wind, insects, etc.) at this location.

11. Air Quality

As discussed in Section III.B.11 of this report, the WDEQ/AQD determined that while coal production in Wyoming's Powder River Basin increased nearly 2.5 times between 1980 and 1989, air quality, in terms of TSP, was not adversely impacted. This is a measure of the effectiveness of controls which are designed with the use of air quality computer models. These controls, which include bag houses, covered transfer points and conveyors, sprinkling of water and addition of non-hazardous chemicals to haul roads, limiting disturbance areas, and contemporaneous reclamation, enable operators to plan and implement ways to increase coal production without adversely affecting air quality.

The amount of additional air quality resource that is available for future mining cannot be quantified without a rigorous technical evaluation employing computer models specified by the EPA and WDEQ/AQD. The amount of air increment utilized by a particular operation is highly dependent upon the type of operation, the types of equipment, and the mining sequence. Under Alternative 1, there would be little effect on air quality at the North Antelope Rochelle mines because these tracts would be used to extend the lives of the operating mines and would not have additional fugitive dust sources. The relative locations of emission sources, such as topsoil removal areas, haul roads, and active pit areas, will change but the numbers and types of sources will not. As the pits get further and further from the coal crushing and loading facilities, haul distances will increase, possibly increasing dust emissions. North Antelope and Rochelle are currently permitted by WDEQ/AQD for production levels of 14 and 22 mmtpy, respectively, somewhat more than currently planned production rates.

Before the two tracts can be mined, even as extensions of the operating mines, air quality permit modification applications must be submitted to and approved by WDEQ/AQD. The computer modeling that is done to prepare the permit application will predict air quality impacts and determine the level of controls necessary to remain in compliance with ambient air quality standards. The analysis of emissions for the AQD permit modification would be similar to previous analyses since no major changes in mining methods or rates are proposed. Thicker overburden in the LBA areas will require slightly more blasting than is needed in the current mine areas. However, blasting is not a significant factor in modeling of air quality impacts (the State of Wyoming does not recognize or require short-term modeling).

12. Transportation Facilities

Mining of the two lease application tracts as production maintenance tracts will have no direct impact on the transportation facilities. By extending the mine lives, the current use of Highway 59 and the railroad spur will also be extended in time.

13. Socioeconomics

Mining of the North Antelope and Rochelle lease application tracts as production maintenance tracts for the respective mines would have no direct impact on employment levels or local populations, other than what occurs due to maintaining production levels over a longer period of time. Alternative 1 would add about 120 million tons of coal to the North Antelope reserves. At a planned coal productive rate of 12 million tpy, the 120 million tons would extend

the life of the North Antelope Mine by 10 years. Current employment of the North Antelope Mine is about 130 persons. The annual payroll is roughly estimated at about $5.9 million per year. Over the 10-year additional mine life, the total payroll would amount to some $59 million, neglecting inflation.

Under Alternative 1 about 150 million tons of coal would be added to the Rochelle reserve base, which at the planned production rate of 18 million tpy would extend the mine life by about 8.3 years. The Rochelle Mine employs about 160 people and has a payroll of roughly $7.2 million per year. Maintaining this payroll level for an additional 8.3 years under Alternative 1 would provide total payroll benefits to the local economy of about $60 million.

Ad valorem and severance taxes are paid by the mines to the State of Wyoming, but these are not directly returned to the local area. Likewise, revenues from sales and use taxes related to coal production are realized by the State. Some of these revenues are redistributed to the local communities, with the amounts of these redistributions being dictated by state laws and policies.

Statewide, severance taxes and capital facilities taxes imposed on coal production in 1989 amounted to $97,582,590. This tax was assessed on a coal production with an average price of $8.21 per ton, and equated to a tax rate of 8.5 percent (Wyoming Coal Information Committee, 1991). Wyoming's general fund receives the largest share of the severance taxes (24 percent), followed by state highways (23 percent), the permanent mineral trust fund (18 percent), water development (17 percent), the budget reserve (12 percent), the school foundation (5 percent), and community colleges (2 percent) (Wyoming Coal Information Committee, 1991, p. 10).

Assuming a price of $5.00 per ton, NACC would realize gross revenues of about $600 million from the 120 million tons of coal on the North Antelope lease application area. At the same price the gross revenues from the 150 million tons of coal in the Rochelle lease application area would total $750 million. These revenues are in addition to expected revenues from the current leases. Applying an economic multiplier of 1.796 to these revenues, the total economic impact to the local area from the additional coal would be at least $1.1 billion from the North Antelope lease application area and $1.3 billion from the Rochelle lease application area based on a coal price of $5 per ton. Considering long-term contract prices, revenues and economic impacts would be larger.

Of the total gross revenues received by mines from sales of federal coal, 12.5 percent is returned to the federal government in royalties. Of this, the state receives 50 percent. Of this 50 percent, the cities and towns receive 7.5 percent. Based on the gross revenues shown above, the total federal royalties would amount to $75 million from the North Antelope lease application area and about $94 million from the Rochelle lease application area. The state's 50-percent share would total $37.5 and $47 million from the North Antelope and Rochelle LBA tracts, respectively. The cities and towns would receive $2.8 million and $3.5 million from their share of the federal royalties on the North Antelope and Rochelle LBA tracts, respectively.

B. Impacts of Other Alternatives

1. Alternative No. 2--Lease Sale after Adjusting Tract Boundaries (Proposed Action)

Alternative 2 is similar to Alternative 1 except that both tract boundaries would be adjusted to include additional coal that the BLM believes may be bypassed if not taken as a part of these tracts and the total area would be offered as one tract. The added lands would basically include the coal in contiguous tracts that has a similar stripping ratio (ratio of cubic yards of overburden to tons of coal). The adjusted boundaries, shown on Figure 2, include about 320 additional acres adjacent to the North Antelope LBA tract and about 590 additional acres adjacent to the Rochelle LBA tract. Legal descriptions for the added areas are provided in Section II.B of this EA. The tract modifications would add about 40 million tons of coal to the North Antelope LBA tract and about 60 million tons to the Rochelle LBA tract, bringing the total amount of coal leased under the proposed action to about 370 million tons.

Adjusting the tract boundaries and mining the adjusted tracts as production maintenance tracts would add 100 acres of disturbance north of the adjusted Rochelle tract and about 150 acres of additional disturbance west of the adjusted North Antelope tract to allow for overburden benching and highwall reduction. Thus, the total disturbed area for this alternative would be about 3,710 acres, or about 960 acres more than would be disturbed under Alternative 1. When added to the total planned disturbance for the two existing mines (7,340 acres), Alternative 2 would bring the total disturbance to 11,050 acres, or a 51-percent increase in total affected acreage.

Considering the larger stripping ratio for the added areas than for the existing mines and the LBA tracts as applied for, there will be a smaller drop in average elevation after mining and reclamation are completed. The additional disturbed areas will include both uplands and dissected drainages, requiring similar planning and design to restore a stable and useful land surface.

The adjusted lease areas, particularly in Sections 17 and 2, contain larger percentages of uplands as compared to the Alternative 1 tracts. The upland areas generally have deeper topsoils than the breaks and gullies, and therefore the average topsoil depth available for reclamation should increase under this alternative. An additional wetland, located in Section 2 in the adjusted Rochelle lease area, will be affected under this alternative and will require restoration similar to that described for the playa in the North Antelope LBA area.

Hydrologic impacts of Alternative 2 would be similar to those predicted for Alternative 1. Drawdowns in the overburden, coal and shallow underburden were predicted to have their farthest extents in a direction northwest from the mine. For Alternative 1, it is assumed that these drawdowns would be shifted toward the west, northwest and north by about the respective widths of the LBA tracts. Alternative 2 would extend the North Antelope LBA tract by an additional one-quarter mile to the west in Sections 7 and 17 and the Rochelle LBA tract by an additional one mile to the east, merely filling in an otherwise unleased area between the LBA tract and the existing lease. There would be no extension of mining toward the northwest, the direction of greatest drawdown. Because of this configuration, no significant change to the shape or extent of the zones of drawdowns are expected under Alternative 2 as compared with

Alternative 1. There will be additional spoils created under Alternative 2, requiring more time to saturate and therefore delaying the time required for the postmining ground-water system to reach equilibrium. Based simply on spoil volume comparisons, it is reasoned that this time may be extended by about 13 percent compared with Alternative 1 and about 40 percent compared with Alternative 4 (no action). The water quality in the spoils will not change as a result of selection of Alternative 2 unless unexpected geochemical conditions are encountered in the overburden. PRCC will be required to sample the overburden prior to obtaining a permit to mine, and special handling measures will be required for any chemically unsuitable overburden. Because the volume of spoils will be increased under this alternative compared to Alternatives 1 or 4, the time necessary for one pore volume of water to flow through the spoils and begin a trend toward steady-state water-quality conditions will also increase.

No new streams would be impacted over and above those in Alternative 1, and no additional effects on Porcupine Creek would occur under Alternative 2. Larger portions of the drainages of Rogers Draw and Payne Draw would be disturbed and therefore require reclamation. Since the disturbance boundary on these drainages may occur in areas of steep slopes, substantial additional disturbance along the highwalls may be required to provide acceptable slopes during reclamation. Designs for the restoration of these streams will have to be presented to and approved by WDEQ/LQD, but these issues are addressed for similar areas in the current mine plans and there should be no technical obstacles to providing a suitable hydrologic restoration plan beyond what are now being faced by the mining company. There is no potential AVF in the areas added by Alternative 2.

Water uses will not increase under Alternative 2, with the possible minor exception of incremental increases in dust control water because of longer haul distances as the pit gets farther from the facilities area.

Land use impacts under Alternative 2 will be similar to those for Alternative 1. Total disturbed area will increase by about 960 acres, but the rate of disturbance will not be affected. At a constant production level, approximately the same number of acres will be reclaimed each year as disturbed. When this occurs, the total acreage available for grazing and wildlife habitat, considering both undisturbed and reclaimed lands, will remain approximately the same from year to year. One current land use that will be affected by Alternative 2 is the oil well in Section 2 on the adjusted Rochelle lease tract. Mitigation of impacts to this well is discussed in Section IV.C of this EA.

Wildlife impacts will be similar under Alternatives 1 and 2. No unique or irreplaceable habitat types were found on either tract. Neither LBA tract, as proposed by PRCC or as modified under Alternative 2, contains active raptor nests, although some alternate nest sites were found on the Rochelle LBA tract.

No known cultural resource sites eligible for NHRP registration or of unknown eligibility will be affected by adjusting the tract boundaries as proposed under Alternative 2. Four sites listed as ineligible (two prehistoric and two historic) will be affected by this alternative.

Air quality impacts will not be significantly different under Alternatives 1 and 2. The additional 40 million tons of reserves added to North Antelope Mine under Alternative 2 would

extend the current mine life by 13.3 years, or about 3.3 years more than Alternative 1. For the Rochelle Mine the additional 60 million tons would extend the current mine life by 11.6 years under Alternative 2, or 3.3 years more than Alternative 1. Extending the lives of the mines will extend the time during which air emissions from mining will occur and change the relative locations of such sources as disturbed areas, haul roads, and blasting, but the types, rates and numbers of emission sources will not change between Alternatives 1 and 2.

The lease tract adjustments proposed under Alternative 2 will not change the distance from the mine to the nearest occupied dwelling. Therefore, noise impacts will not be different for the two alternatives. Extending the North Antelope mine westward one-quarter mile in Section 7 will place the mine closer to the nearest public road. However, at this point the pit is down in the drainage of Rogers Draw, and it is doubtful that it will be visible from the road.

Transportation facilities will be impacted under Alternative 2 only to the extent that the use of highways by mine employees going to and from work and the use of the railroad to haul coal will be extended for an additional 3 years (as compared with Alternative 1).

At the assumed price of $5.00 per ton, the gross revenues from the additional 100 million tons mined under this alternative would total $500 million. Applying an economic multiplier of 1.796 to these revenues, as before, yields a total economic impact to the local area from this additional coal of $898 million. Employment levels would be maintained at present levels for an additional 3 years, resulting in annual wages of $13.5 million for a 3-year total of over $40 million. The 12.5-percent federal royalty on the additional 100 million tons, at a price of $5 per ton, would amount to $62.5 million. Of this, the state would receive 50 percent, or $31.25 million, and the cities and towns would receive 7.5 percent of the 50 percent, or about $2.3 million.

2. Alternative 3--Lease Sale for New Stand-Alone Mine

Under this alternative the LBA tracts, as adjusted in Alternative 2, would be combined into a single tract containing 370 million tons of coal and offered for sale with the assumption that the successful bidder would open a new stand-alone mine. Environmental impacts of a new mine at the combined lease tract are based on the hypothetical mine plan and layout described in Section II.C of this EA.

Probable environmental impacts of the stand-alone mine can best be examined by comparing features of this mine with the impacts predicted to result from extending the existing North Antelope and Rochelle mines into the adjusted tracts (Alternative No. 2, the Proposed Action). The total area disturbed by coal removal would be the same whether the tract is mined as a stand-alone mine or as a maintenance tract at the two existing mines. However, total disturbed area will be considerably larger for the stand-alone mine. Additional disturbances will include a new loop track and coal preparation plant, a new railroad spur, a new access road, two out-of-pit spoil stockpiles to accommodate the two box cuts at the stand-alone mine, and redisturbance of lands mined and reclaimed by PRCC along common lease boundaries. This additional disturbed area will total about 1,445 acres over and above the 3,710 acres disturbed under Alternative 2. Facilities required to store or divert the flows of the major streams around the

pit areas would probably be the same whether the area is mined as a new mine or as a production maintenance tract.

Other than the fact that more area would be disturbed, requiring additional sediment-control facilities, the hydrologic impacts would not be significantly different for Alternatives 2 and 3. It is probable that the new mine will construct one or more water-supply wells in the Tullock member of the Fort Union formation. There could be interference (i.e., intersecting cones of depression) between the new well(s) and the existing North Antelope and Rochelle facility wells. However, with more than three miles separating the new well(s) from the existing wells it is unlikely that there would be cumulative effects.

Because of the larger disturbed area and the longer life of the new mine, more livestock and wildlife habitat would be unavailable for historic uses under this alternative. Visual impact would be increased for the stand-alone mine, primarily because of the requirement for new coal-handling facilities with high-profile structures such as coal-storage silos and load-out facilities. These facilities would probably be visible from the Mackey county road.

Twelve cultural resource sites of unknown NHRP eligibility are within the buffer area and may be affected by this alternative. An additional 21 sites considered not eligible are within this buffer area.

The additional emissions from the new coal crushing and loading facilities and larger disturbed area, as well as the simultaneous operation of three adjacent mines, would probably cause more deterioration of ambient air quality for Alternative 3 as compared to Alternatives 1 and 2, particularly during years when all three mines are operating at maximum production rates. The air quality permit for the new mine would require a level of controls such that air quality standards are not violated.

Transportation facilities would be impacted somewhat by Alternative 3. The additional employees would probably live in Gillette, Douglas, and Wright and would use Highway 59 to travel to work. The railroad might haul additional tonnage while the three mines are in simultaneous operation.

The railroads have expressed intentions to increase rail capacity to keep pace with coal production. In January 1991, the Union Pacific Railroad (UP) announced a 5-year, $250 million program to upgrade their major coal-hauling trackage in six states, including Wyoming. This is part of a $620 million improvement plan. The UP, in a joint venture with the Chicago and Northwestern (CNW)-Western Railroad Properties, Inc., hauls coal out of the Powder River Coal Field to eastern Nebraska, from which point UP operates a major coal transportation route to midwestern U.S. markets. CNW also announced that they would do whatever was necessary to keep pace with increasing coal production (Wyoming Geological Survey, May 1991, p. 30). Burlington Northern (BN) announced that they would spend upwards of $190 million per year over the next several years on their major coal unit-train routes. In their announcement BN claimed they would be able to handle an additional 50-60 million tons of coal per year by 2001.

According to the unemployment figures for Campbell and Converse Counties (see Section III.B.13 of this report), 230 additional employees can easily be supplied from local labor, and

impacts on housing and public facilities would be slight. An added payroll of an estimated $10 million per year would accrue to the local economy, offset in the latter years by declines in employment that will occur at the PRCC mines as reserves are depleted.

Over the mine life, severance tax and royalty revenues would not vary between Alternatives 2 and 3 except as sale prices might vary, but the yearly distribution of these revenues would vary as a function of combined production between the three mines. Additional property taxes would be realized due to the additional plant and equipment associated with Alternative 3.

3. Alternative 4--No Action

Under this alternative, the lease sale for these tracts would not be held or would be postponed. Most revenues to the federal government from coal leasing accrue from royalty payments. Royalty payments are keyed to the price of coal (12.5 percent), but while revenues from royalties will increase as coal prices increase, there is little incentive to delay leasing if a willing buyer is available now. It must also be recognized that waiting for prices to rise before leasing the coal may be a disadvantage because of the significant time lag that exists (typically several years) between deciding to lease and bringing the coal to market. Also, having demonstrable reserves assists an operator in obtaining or maintaining higher priced, long-term contracts. Therefore, leasing the coal now as production maintenance tracts will likely increase revenues to the federal government in comparison to delaying the lease sale, although a truly quantitative comparison would have to be made on a present value basis.

The environmental impacts for this alternative could be the same as for any of the previous alternatives. If the lease sale is not postponed for too long and if PRCC remains interested in the tracts, the coal could still be mined as production maintenance tracts for the two operating mines. In this case the environmental impacts would be the same as for Alternative 1 if the lease tract boundaries remain unchanged from the original lease applications or for Alternative 2 if the tract boundaries are adjusted to avoid bypassing coal. If the lease sale is delayed too long, and if the area is not mined as a logical extension of the two adjacent mines, the value of the tract as a maintenance tract would decline. If the boundaries between the existing leases have been mined and reclaimed, PRCC or others would have to incur the additional costs of opening new box-cuts and reaffecting previously reclaimed land in order to mine these tracts.

Postponement of the lease sale could result in the tracts' being mined at higher cost if they cannot be mined as a logical extension of existing pits. If the tracts lose value as maintenance tracts due to time delays and if coal market conditions make it uneconomical to mine the combined tracts as a stand-alone mine, the environmental and economic impacts predicted for other alternatives would not occur.

Postponement of the lease sale to wait for higher coal prices does not guarantee that a price rise may be fully taken advantage of, since the time lag between the escalation of prices and actually bringing the coal to market may be several years. This lag is due to the time necessary for leasing, baseline data collection, permitting, and initiating a logical mining plan. Also, postponement tends to force the operator to sell this coal on the cheaper spot market, because it cannot be used to bolster reserves and encourage higher-priced, long-term contracts.

If the lease sale were delayed so long that the tracts could not be mined as maintenance tracts by NACC and RCC, they could then only be mined as a combined tract for a stand-alone mine. Environmental and economic impacts would be similar to those for Alternative 3, except that there would be fewer cumulative impacts if the period of concurrent operations with the other mines in the area is reduced.

Selection of Alternative 4 could conceivably mean that the coal beneath the two tracts is never mined. In this case, disturbance of the land on the two tracts would be limited to currently planned disturbance associated with overstripping necessary to recover coal within the current lease boundaries and whatever disturbance on the tracts is required to construct diversion or storage facilities to protect employees and equipment in the pit from hazards associated with flood flows from Porcupine Creek, Rogers Draw, Payne Draw and Knapp Draw. This disturbance would probably total about 600 acres, or about 16 percent of the disturbance that would occur under Alternative 2, the Proposed Action. The entire area, other than what has already been disturbed or will be disturbed by overstripping or the construction of flood control facilities, would remain available for livestock and wildlife habitat.

Although some of the surface will be disturbed even if the tracts are not leased, the basic topography and the geology would not be affected. Any aquifers in the overburden would remain unaffected, and drawdowns in the coal aquifer would only be those associated with the current operation. Changes to the drainage system on the two tracts would be limited to what has already occurred or has been approved for disturbance in the current mining and reclamation plans.

The air quality would be altered primarily by the fact that the mining rate will begin to decline after year 2004 and will cease several years sooner if the additional leases are not acquired. The economic benefits described in previous sections attributable to any of the first three alternatives, including employees' wages, taxes and royalties, would be dealyed and possibly even foregone under this alternative.

C. Mitigation Measures

Impacts to topography caused by mining can be mitigated by proper design of the postmining surface. The design of the postmining topography (PMT) will be reviewed by WDEQ/LQD during the permit application process. Design and approval of the PMT will be facilitated by following the USFS design guidelines for the Thunder Basin National Grassland (USFS, 1991). Specific recommendations pertinent to the North Antelope and Rochelle LBA tracts include providing topographic diversity in landforms and hillslopes, stable channels that have natural-appearing meanders and pools, and rockpiles and shrub mosaics designed and located so as to give a natural appearance and provide wildlife habitat and cover. The PMT design will be required to approximate original contours which, as generally agreed, means that the shape of the land after mining should be about the same as before, though not necessarily at the same elevation (Martin, et al., 1988, p. 118).

Impacts to soils can be mitigated by proper identification and handling of topsoils, protection of stockpiled and replaced soils from erosion hazards, and revegetating replaced soils as rapidly as possible. Nutrients lost during handling or stockpiling can be replaced. The erosion control,

reclamation and revegetation program outlined by NACC and RCC and implemented on the respective mines has provided an effective program that ensures successful erosion control and restoration of all land disturbance. Salvage of soils otherwise unsuitable for reclamation due to heavy texture or high salinity may be acceptable for use in special reclamation practices such as restoration of wetlands or playas. Care must be taken to handle such soils when moisture conditions are appropriate to avoid excess compaction or other physical damage to the soil structure.

Continued emphasis on increasing vegetal species diversity on reclaimed lands, and particularly on establishing shrublands, will help restore wildlife habitat on reclaimed lands. Playas, which rely on a combination of topography and soil types as well as vegetation for their beneficial characteristics, provide special habitats that should be restored in the PMT. Continued sampling, monitoring and grazing demonstration studies such as those proposed at the adjacent mines will provide valuable data for continuing improvements in revegetation practices.

Impacts to ground-water quality can be mitigated by special handling of chemically undesirable overburden materials to assure that these materials are not placed so as to adversely affect water quality. All mine permit applications submitted to WDEQ/LQD must include baseline data on overburden geochemistry and special handling plans for unsuitable materials to comply with state and federal surface mining regulations. Provision of ponds and reservoirs on the reclaimed surface helps conserve surface water resources and provides a recharge source for the spoils aquifer. All mine permits require that water uses which are interrupted by mining be mitigated by replacement with water from an alternate source of equivalent quality and quantity. Typically, wells which go out of production due to mine-related drawdowns are replaced with deeper wells completed in the sub-coal Fort Union formation. PRCC has placed a commitment in the North Antelope Mine and Rochelle Mine permit documents to replace the wells that will be mined through and to adjust the pump setting or type of pump in the wells that are expected to be subject to drawdown. Both permit documents also contain the required commitment that PRCC will "...replace the water supply of an owner of interest in real property who obtains all or part of his supply of water for domestic, agricultural, industrial, or other legitimate use from an underground or surface source where the supply has been affected by contamination, diminution or interruption proximately resulting from the surface coal mine operation" (W.S.35-11-415(b)(xii)). This applies to both surface and ground water supplies.

Special care must be taken to provide stable channels in the reclaimed surface. The design of stable drainage basins is critical to the success of the overall reclamation plan, and this issue receives considerable attention during the permitting process.

Wildlife impacts can be mitigated by continuing to consider wildlife habitat in the reclamation planning. Topographic features such as rockpiles and playas, riparian features such as channel potholes and impoundments, and revegetation features designed for wildlife, such as shrublands and trees where conditions permit, will all help to restore and enhance wildlife habitat on reclaimed land. Continued monitoring will provide important feedback concerning the effectiveness of these measures and, hence, important data for future designs. Mitigation efforts should continue to include relocation of affected raptor nests and consideration of raptor nest sites in reclamation planning. Consideration should be given to allowing hunting on mine areas to prevent the mines' functioning as refuges and leading to unsustainable population levels.

NHRP-eligible prehistoric resources which cannot be avoided by the proposed action should be subjected to data recovery. Mitigation by data recovery of NRHP-eligible sites listed under Criterion D will result in no adverse effect to those cultural resources, as defined under the Section 106 process. NRHP-eligible historical resources which cannot be avoided by the proposed action should be subjected to mitigation. Mitigation of adverse effects may include historical research and documentation as well as photographic documentation of historic structural remains to the standards of the Historic American Buildings Survey.

Mine personnel are instructed to recognize vertebrate fossils and large, well-preserved petrified tree trunks which might be uncovered during mining excavations. If such finds are made, a qualified paleontologist is contacted immediately to evaluate the find(s). Excavation in the immediate vicinity of the fossil discovery will be halted until the paleontological evaluation can be made.

A mine plan study must be done by the lessee of the new lease tract to determine if the operating oil well will have any impact on the mining operation. Alternatives to manage any conflict with this well include an economic evaluation to determine if it could be purchased or temporarily plugged and restored when mining has been completed. Under the Federal Land Policy and Management Act of 1976, multiple use and concomitant development of natural resources are governed by the Department of the Interior (DOI). DOI guidelines have been developed to address this type of situation. Moreover, the leased lands are managed according to the Resource Management Plan land use plans. The coal lessee will coordinate the development of an agreement with the oil and gas lessees to facilitate maximum utilization of the mineral resources (see Special Stipulation C., Page 9).

Replacement of fences removed by mining will enable restoration of premining grazing practices. During mining, there will be a temporary loss of grazing land. Contemporaneous reclamation will minimize the amount of time between mining and reclamation for any given parcel of land, helping to mitigate this temporary loss of grazing land.

D. Residual Impacts

Despite proper reclamation planning and implementation of mitigating measures, there are impacts of mining that remain after reclamation is completed. Removal of the coal creates permanent elevational changes. Although the land will approximate the original surface contours after reclamation, there will also be permanent topographic changes. The coal aquifer and any overburden aquifers are replaced with spoil material. While indications are that this material will function as an aquifer and, in fact, is resaturating more quickly than generally predicted (Martin et al., 1988, p. 156), it will be some time before the spoils are fully saturated and a steady-state flow pattern is reestablished. In the meantime there will be no shallow ground-water source in the reclaimed areas. Just as during mining, alternative sources of water will be required for these areas until the spoils aquifer can sustain water uses.

Once the spoils aquifer resaturates and a steady-state flow pattern is established, water quality in the down-gradient coal aquifer may be temporarily degraded. Geochemical modeling by the USGS suggests that the coal aquifer may contain elements capable of improving the water

quality of the water flowing out of the spoils aquifer (Martin, et al., 1988, p. 93). Additional data, however, are needed to confirm this.

Although coal-aquifer drawdowns toward the west (down-gradient) of the mines become less important as the depth to coal increases (hence fewer wells are completed in the coal), these drawdowns could persist for many years after mining and reclamation activities are completed. However, mitigation plans for wells impacted by mining will be implemented prior to the end of mining and reclamation activity. Therefore, there will be no residual effect on underground water rights.

E. Cumulative Impacts

Cumulative impacts are those impacts that increase in size, severity or frequency from the successive development of other activities yielding similar impacts. In this case, concerns center about cumulative impacts of coal development in the geographical area and other known activities which cause impacts similar to those resulting from coal development. This section should not, and does not, address impacts specific to each LBA, as those are addressed elsewhere in this EA.

There are currently 7.797 billion tons of federal coal underlying 102,426 acres under lease in the Wyoming portion of the Powder River Basin. The six LBA's received to date propose to add approximately 1.035 billion tons of federal coal underlying 8,428 acres. This represents an increase of 13 percent leased federal coal and an increase in acreage of 8.2 percent. Since the 1990 coal production for the Wyoming portion of the Powder River Basin was 162.6 million tons, the coal underlying the proposed leases represents approximately 6.4 years of reserves for the basin as a whole.

There are few impacts associated with mining the proposed lease tracts that are exaggerated or made worse by virtue of the proximity to other mines. The tracts are adjacent to the existing North Antelope and Rochelle Mines. The Rochelle lease area is about three miles south of Shell Mining Company's North Rochelle Mine to the north and the North Antelope lease area is located about three miles northeast of the NERCO Antelope Mine.

Air quality could be impacted under Alternative 3, in which the proposed leases would be mined as a stand-alone mine. This is because annual coal production from the new mine and the two adjacent existing mines could exceed that from the North Antelope and Rochelle Mines and because the new mine would require its own coal handling and load-out facilities, out-of-pit stockpiles, and related disturbances. Cumulative impacts are addressed in air quality permit applications, and control technologies are applied as necessary to acquire the permit.

Hydrologic impacts would not change between Alternatives 2 and 3, but the timing of the impacts would be different. The maximum extent of coal-aquifer drawdowns would be extended about one mile further northwest by mining the proposed lease tracts. The coal aquifer has no known recharge or discharge source within the lease tracts. Prior to mining, recharge probably occurred along the outcrop, east of the North Antelope and Rochelle mines.

Replaced spoils in the lease tracts may resaturate by lateral inflow from unmined coal to the west and north, but the spoils in the lease areas probably will not fully saturate until the up-gradient spoils are resaturated and a steady-state flow pattern, with recharge along the clinker line and flow through the spoils toward unmined coal to the west, is established. Thus, the cumulative effect of the spoils from the adjacent mines may act to delay the resumption of steady-state ground-water flow patterns.

All NRHP-eligible cultural resource sites will be considered together during the preparation of the treatment plan which will direct data recovery and research for the proposed action. One positive cumulative impact is the opportunity to study a large area with several significant sites. Comparisons of information from each site will provide an excellent opportunity to learn more concerning the settlement and subsistence patterns of the prehistoric inhabitants of the area.

The two PRCC LBA's add incrementally to a cumulative impact concerning antelope habitat. Hunting in general is not allowed within the fenced active mining areas. As a result, the mine areas are becoming "refuges" for relatively large numbers of antelope. If continued, this could lead to an increase in herd numbers and abnormally large losses during a bad winter.

The following discussion of cumulative impacts includes a comparison of the actual coal activity occurring in the Wyoming portion of the Powder River Basin in 1990 with the activity predicted in four previously prepared environmental impact statements on coal mining in the basin. Following that is a discussion of the cumulative impacts of the proposed LBA's added to current mining for the issues of hydrology, air quality, and socioeconomics.

1. Actual and Predicted Coal Activity in the Eastern Powder River Region

This cumulative impact analysis updates the cumulative analysis which is contained in each of four regional EIS's prepared during the 1970s and early 1980s. The four analyses are:

-Final Environmental Impact Statement, Eastern Powder River Coal Basin of Wyoming, BLM, October 1974.

-Final Environmental Impact Statement, Eastern Powder River Coal, BLM, March 1979

-Final Environmental Impact Statement, Powder River Coal Region, BLM, December 1981

-Draft Environmental Impact Statement, Round II Coal Lease Sale, Powder River Region, BLM, January 1984

This update provides an assessment and analysis of cumulative environmental impacts based on the current coal production outlook and presently anticipated levels of regional development activity. The analysis reviews cumulative impacts identified in the above referenced EIS's as compared to actual development activity which occurred. This cumulative analysis also incorporates data, monitoring results and research done since the EIS's were done, or in response to impacts identified in these EIS's which will provide further assessment of cumulative impacts resulting if the lease-by-applications currently pending before BLM are approved.

The coal region in which the current lease-by-applications are located can be defined as the Eastern Powder River Coal Region and is generally considered to include Campbell and Converse Counties in Wyoming. In the 1970s and early 1980s there was a great deal of interest and activity in mining existing leases and acquiring new federal coal leases. As a result, the four referenced regional EIS's were prepared, and each identified and discussed the regional, cumulative impacts resulting from coal development, coal-related development, and other regional activities based on reasonably foreseeable development scenarios at the time. All the mines currently operating, including those requesting LBA's, in the Eastern Powder River region were specifically addressed in one or more of the referenced EIS's, as shown in Table 15.

Table 15. Mine Sites Addressed in EIS Analyses

Mine	Operator	1974 EIS	1978 EIS	1981 EIS	1984 EIS
Antelope	Antelope Coal Co.	x		x	x
Belle Ayr	Amax Coal Co.	x	x	x	x
*Black Thunder	Thunder Basin Coal Co.	x	x	x	x
Buckskin	Triton Coal Co.		x	x	x
Caballo	Carter Mining Co.		x	x	x
Caballo Rojo	Mobil		x	x	x
Clovis Point/East Gillette	Kerr-McGee		x	x	x
Coal Creek	Thunder Basin Coal Co.		x	x	x
Cordero	Cordero Mining	x	x	x	x
Dave Johnston	Pacificorp	x	x	x	x
Dry Fork	Dry Fork Coal			x	x
*Eagle Butte	Amax Coal Co.	x	x	x	x
Fort Union	Fort Union Ltd.			x	x
*Jacobs Ranch	Kerr-McGee	x	x	x	x
Keeline	Neil Butte Co.			x	x
*North Antelope	Powder River Coal Co.	x	x	x	x
North Rochelle	Shell			x	x
Rawhide	Carter Mining Co.	x	x	x	x
*Rochelle	Powder River Coal Co.	x	x	x	x
*Rocky Butte	Northwestern Resources			x	x
Wyodak	Wyodak Resources Dev.	x	x	x	x
TOTALS: 20-(19 Mines + 1 New Mine Site)		11	15	20	20

* - LBA application on file

Each regional EIS looked at predictions of mining activity into the future, looking at number of mines, production levels, and acreage of disturbance. Coal-related developments, such as power plants, coal gasification, and other coal conversion industries were predicted. Other regional activities such as oil and gas, uranium, and any other known major development activities were also predicted. Then an analysis was developed to identify and evaluate impacts of all of these activities taken together.

Table 16 shows what activity has actually taken place in the region, and also shows the cumulative total of the activity that has actually taken place added to the activity predicted based

on the LBA's which are currently pending before BLM. The table also illustrates the predictions of coal, coal-related and other regional development activity upon which the cumulative impact analysis for each of these regional EIS's is based.

Table 16. Cumulative Regional Activity, Eastern Powder River Coal Region (Campbell and Converse Counties, Wyoming)

	1990 Actual Activity	1990 Actual Activity + LBA's	1974 Predictions Of 1990 Activity	1979 Predictions Of 1990 Activity	1981 Predictions Of 1990 Activity	1984 Predictions Of 1990 Activity
Number of Producing Mines	18	19	14	15	40[1]	37[1,2]
Number of Power Plants	3	3	6	2	3	3
Number of Gasification Plants	0	0	2	1	0	0
Leased Federal Coal (Millions of Tons)	7,796.5	8,831.5	Not Available	Not Available	Not Available	Not Available
Acres of Leased Federal Coal	102,426	110,854	93,075	Not Available	Not Available	Not Available
Coal Production (Millions of Tons Per Year)	162.6	178.6	150	174.3	332.9[1]	292.1[1,2]

1. Calculated from Wyoming and Montana totals in EIS. This EIS covered the entire Powder River Basin.
2. Baseline or "No Action" alternative used from this EIS as the 1984 was not finalized and, therefore, the actions proposed were never taken.

Sources of 1990 data: 1990 Annual Mine Reports for Eastern Powder River region mines and BLM Casper District records.

Table 16 shows that the actual level of development which occurred by 1990 is within the range of predictions made in the referenced EIS's. The 1979 EIS was the closest prediction, which is explained by the fact that the 1981 and 1984 EIS's assumed high levels of new leasing and more development of new leases and pending preference right lease applications than has actually occurred. Market conditions have not favored the development of new mines.

Many of the impacts of the development activities are related to the amounts of surface disturbance and new employment from the activity. Table 17 shows the 1990 predictions for each regional EIS as to acres disturbed, employment, and population. This table also illustrates surface disturbance, employment and population that actually had occurred or existed in 1990.

Cumulative surface disturbance to date is about 32,000 acres. This is within the range of predictions of the referenced EIS's. Cumulative disturbance to date added to all the pending LBA's represents less than one percent of Campbell and Converse Counties. The acreage disturbed has been specifically analyzed in the referenced EIS's, and no unique soils or vegetation types were identified as being impacted. The disturbed acreage is being reclaimed, with about one third of the already disturbed areas having been contoured, topsoiled and reseeded.

Table 17. Cumulative Surface Disturbance, Employment and Population-Actual and Predictions Without the Lease-By-Applications, Eastern Powder River Coal Region (Campbell and Converse Counties)

	Actual 1990 Levels	1974 Predictions of 1990 Levels	1979 Predictions of 1990 Levels	1981 Predictions of 1990 Levels	1984 Predictions of 1990 Levels
Acres Disturbed	31,744	13,887	22,794	43,550[1]	40,900[1,2]
Acres Reclaimed	9,199	4,132	12,666	24,200[1]	22,800[1,2]
Coal Employment	2,862	5,200	3,899	11,900	11,500[2]
Total Population	40,498	65,600	59,400	69,000	62,300[2]

1. Calculated form Montana and Wyoming totals in EIS. This EIS covered the entire Powder River Basin.

2. Baseline or "No Action" alternative used from the EIS as the 1984 EIS was not finalized, and therefore the actions proposed were never taken.

Sources of 1990 data: 1990 Annual Mine Reports for Eastern Powder Basin Mines, BLM Casper District Records, 1990 Census Results for Wyoming Counties/Municipalities, "Annual Report of Mines of Wyoming" through December 31, 1990.

Cumulative transportation impacts are related to coal production levels and are within the level of impacts identified on the referenced EIS's.

The success of revegetation (reclamation) depends on the ability of the plant communities to perpetuate themselves under the indigenous environmental conditions of an area, such as moisture distribution during the growing season, wind, temperature extremes, and drought. It also depends on the ability of the reclaimed land to meet postmining land use objectives.

Successful establishment of vegetative cover, according to the requirements of OSM as administered by WDEQ, has been demonstrated at the Dave Johnston, Black Thunder, Belle Ayr, Eagle Butte, Big Horn, Jacobs Ranch, Decker, and Rosebud coal mines to name a few. As a rule, successful reclamation of land disturbed by coal mining requires application of appropriate technology with full consideration of physical factors such as climate and ultimate land use. Successful reclamation can be accomplished in Wyoming's Powder River Basin provided funding is adequate and appropriate technology is applied.

Cultural impacts are addressed specifically for each site identified and related to specific decisions to excavate, avoid, or research these sites. The most notable cumulative impact of surface coal mining on cultural resources is destruction of a non-renewable resource. However, a benefit of the leasing and permitting process is more extensive inventory, cataloguing and excavation of cultural resources as additional areas are disturbed. Cumulative visual impacts are related to surface disturbance and activity. In the short term, mining activity dominates the landscape where mining is occurring. After mining is done the landscape character changes, particularly where rough, steep-sided breaks, gullies or scoria knobs are replaced by gently rounded slopes.

The cumulative impacts on wildlife are caused primarily by new impediments to daily and seasonal movements such as road right-of-way fences and railroad spurs. There are also impacts from road kills and habitat loss. With all the pending LBA's added to acreage already permitted to mine, about 2 percent of the wildlife habitat in Campbell and Converse Counties will be disturbed. Because disturbance would not occur to a large part of the leased area at any one time and reclamation is continuously taking place, habitat loss caused by the projects included in the cumulative analysis would be less than one percent at any given point in time.

One of the LBA's, West Rocky Butte, will, if approved, result in a new mine. With a new mine added to the current situation, total activity is within the reasonably foreseeable cumulative activity scenarios analyzed in the referenced EIS's. Because this potential new mine would result in additional impacts to water resources, new employment and also a new source of suspended particulate matter in the air, additional discussion of cumulative socioeconomic, water resources, and air quality impacts is presented below. The additional impacts of a new mine start to other resources, such as wildlife, soils, and transportation are included in the discussion of these topics in the paragraphs above.

2. Socioeconomics

Five of the six proposed LBA's received to date, including the North Antelope and Rochelle applications, are maintenance-type lease applications. As a result, it is not anticipated that issuance of these leases will result in additional socioeconomic impacts in the area. They will extend the period of employment for workers at these mines and will therefore increase income and employment over time in the area. They will not result in an increase in numbers of people employed in the area. The Rocky Butte LBA will result in a new mine start if approved. This would add up to about 500 new mine-related jobs in the area. The following discussion analyzes the impacts of a new mine start in the Eastern Powder River Region.

With a colorful early history of cowtown/boomtown conditions, Gillette lies in the heart of the Powder River Basin. With a 1990 population of 17,635 people, it lies in the center of Campbell County and is the largest town in northern Wyoming. Folklore suggests that this is cowboy country with its surrounding high plains and ranches. This was true at one time in the early decades of this century, but all that has changed and today few people actually work in agriculture. While the cowboy image still dominates the area's cultural economy, coal mining, petroleum and energy-related businesses dominate the fiscal economy. In 1989, this helped Campbell County lead Wyoming in coal and oil production and make it 8th in gas production with an assessed mineral valuation of over $1.2 billion or nearly one third the total state mineral valuation (Wyoming Oil & Gas Conservation Commission, 1990).

Based on data supplied by the Wyoming Department of Employment, Campbell County's labor force stood at 16,705 workers in July 1991, with 15,859 people employed. At this time the unemployment rate was at 5.1 percent, virtually the same as it was in July 1990 (Wyoming Labor Force Trends, September 1991). These represent higher figures than the State's 3.8 percent rate in 1991 and 3.9 percent rate in 1990. Although labor force figures are provided for Campbell County, the figure largely represents Gillette, which makes up 60 percent of the County's population, with some employment being reflected for Wright and other very small communities.

Total personal income in Campbell County in 1989 amounted to $500.7 million, up nearly 43 percent from the 1980 level. This increase far exceeded the State's 28-percent gain in total personal income during the same time frame.

In 1980 Campbell County's per capita personal income amounted to $13,918, and 1989 it was $15,663, representing a near-13 percent increase. This increase is lower however, than the State's 28 percent increase during the same period (Wyoming Income and Employment Report, August 1991).

Based on the most current information on housing availability in Gillette, there are about 549 housing units available, mostly single family and rental properties (see Table 10).
In addition, Gillette can provide 851 rooms for workers, visitors and tourists through 12 motels and hotels located within the city (personal communication with Pat Ament, Gillette Economic Development Corp., October 3, 1991). Typically, these rooms range from $27 to $40 per night. It also has 39 restaurants, cafes and other eating establishments throughout the city for the worker and visitor (Ibid.).

According to Campbell County School District 1991-92 first-day attendance data, this school system is being used at nearly 68 percent of capacity. This is based on fall 1991 attendance of 7,157 pupils (less kindergarten) and an enrollment capacity of 10,566. With kindergarten included this enrollment figure climbs to 73.6 percent of capacity. Based on this information, the school system could handle another 2,788 to 3,409 students.

With regard to utilities, Gillette appears to have the ability to provide additional services to many hundreds of new customers. For example, the average water usage in Gillette amounts to about two million gallons a day (about 2,200 acre-feet per year), with peaks of 7 to 9 million gallons per day during the summer months (personal communication with Frank Fritzler, Gillette City Utilities, October 1, 1991). However, at this time deliverable water capacity stands at 11 millions gallons of water per day. The city serves 18,300 customers that consume an average of 165.4 gallons of water per person per day (Ibid.)

Gillette's wastewater treatment facility was upgraded in 1989. This constituted the final phase of their improvement program. The average daily throughput is 2.4 million gallons, compared with a plant capacity of 3.85 million gallons per day (personal communication with Tara Schultz, Gillette City Utilities, October 1, 1991).

In 1990, electrical peak capacity in Gillette amounted to 38.76 megawatts of power (personal communication with Wayne Lindgren, Gillette City Utilities, October 1, 1991). This is not locally produced energy but power bought from two or more sources. For example, 60 percent of their power is purchased from Black Hills Power & Light Company located in Rapid City, S.D. Another source of energy is from the Western Area Power Administration. Service is provided for 6,500 homes in the area including business establishments. If the need arises local power retailers could buy up to 60 megawatts of power without modifications to their system. Usage stands at about 15 million kilowatts of use that translates into about 29.5 megawatts of capacity, far below the 1990 peak (personal communication with Wayne Lindgren, Gillette City Utilities, October 1, 1991).

Crime rates, marriage and divorce rates, and birth and death rates are indicators of well being in communities. Between 1980 and 1989, the crime rate in Campbell County decreased 30.6 percent. Large decreases were witnessed in burglary, robbery and motor vehicle theft while a 114-percent increase was seen in aggravated assault (from 49 to 105 incidents). There was a dramatic increase in law enforcement personnel over this time frame (Table 18).

Table 18. Crime in Campbell County, 1980 and 1989

Type Of Crime	1980	1989
Murder	1	7
Rape	9	7
Robbery	13	0
Aggravated assault	49	105
Burglary	267	153
Larceny	979	850
Motor vehicle theft	91	53
TOTAL:	1,409	1,170
Crime rate per 10,000 inhabitants	578.3	401.4
Law Enforcement Personnel:		
Campbell County Sheriffs Department	43	100
Gillette Police Department	44	50
Total	87	150

Source: Uniform Crime Reporting, Crime in Wyoming, January through December 1980, and 1989. Office of the Attorney General.

In 1980 the marriage rate in Campbell County was 13.7 per 1,000 population; in 1989 it had declined to 8.0 per 1,000 population. Table 19 shows comparisons between the U.S. and Wyoming rates. In 1980, the divorce rate in Campbell County was 9.2 per 1,000 population; in 1989 it had declined to 6.4 per 1,000 population. Table 19 shows the comparisons between the U.S. and Wyoming averages.

Table 19. Marriage and Divorce Rates in Campbell County, 1980 and 1989

Subject	Geographic Areas	1980	1989
Marriages (no. per 1,000)	U.S. Average	10.6	9.7
	Wyoming	14.6	10.
	Campbell County	13.7	1
			8.0
Divorces (no. per 1,000)	U.S. Average	5.2	4.7
	Wyoming	8.5	6.7
	Campbell County	9.2	6.4

Source: Wyoming Vital Statistics 1981 and 1989, Wyoming Division of Health and Medical Services (1983), Wyoming Department of Health (1991).

In 1980 Campbell County had a birth rate of 29.3 live births per 1,000 population; in 1989 this had decreased to 16.7. Comparisons with Wyoming figures are shown in Table 20. In 1980, Campbell County had a death rate of 3.6 persons per 1,000 population; in 1989 it had decreased slightly to 3.5 (see Table 20).

Table 20. Birth and Death Rates in Campbell County, 1980 and 1989

Subject	Geographic Areas	1980	1989
Births (no. per 1,000)	U.S. Average	15.8	16.2
	Wyoming	22.5	15.1
	Campbell County	29.3	16.7
Deaths (no. per 1,000)	U.S. Average	8.9	8.7
	Wyoming	6.8	7.1
	Campbell County	3.6	3.5

Source: Wyoming Vital Statistics 1981 and 1989. See above references.

There appear to be adequate medical facilities located in the Gillette area. The Campbell County Memorial Hospital located in Gillette has a 119-bed capacity and in 1990-91 had 3,056 admissions. It has recently had a 22-percent occupancy rate (Wyoming Medical Facilities Directory, 1990-91, Wyoming Department of Health). Further, there is a boarding home in Gillette, the Pioneer Manor Board and Care Facility and the Pioneer Manor Nursing and Convalescent Home (Wyoming Medical Facilities Directory, 1990-91).

In conclusion, the impact on Gillette of up to 500 new miners that might result from a new mine start should not create a boomtown problem on a city famous for such conditions back in the 1970s. It will not result in El Dean Kohrs "Gillette Syndrome" that characterized alleged adverse social conditions in Gillette during that period. On the contrary, from every indication available, the city can handle a substantial influx of new people without experiencing the "problems" of growth.

3. Air Quality

Coal mining activities produce particles which can be released into the air. Most of these particles are created as the result of physical forces such as blasting, crushing, and friction between vehicles and road surfaces. These particles are not considered to be as much of a health hazard as the generally much smaller particles produced by chemical activities such as condensation, absorption and adsorption. Also, the larger (heavier) the particle, the closer to the source it will settle to the ground.

The initial Federal particulate standard was based on all particle sizes which could be trapped using a high volume air pump and a particular type of filter. This was the total suspended particulates (TSP) standard. Recently, the federal standard was amended to account for the greater health risk due to particles less than 10 micrometers in diameter (the PM_{10} standard). Monitoring has indicated that at similar distances from the active pit, PM_{10} levels are roughly one-third those of TSP. The Wyoming State Ambient Air Quality Standard has not changed from 150 $\mu g/m^3$ for a 24-hour average and only changed from 60 to 50 $\mu g/m^3$ for the annual average. Therefore, the WDEQ has kept the 24-hour TSP standard in addition to the PM_{10} standard.

Tables 21 and 22 use the TSP standard to assess how well the previous regional impact assessments fit the current actual impacts. While it was not possible to predict with exact certainty which specific mines would be developed and what their sizes would be, the overall number and productivity of the mines in the Eastern Powder Rives Basin was projected with reasonable accuracy from 1979 to 1990.

Particulate emissions are related to the amount of regulation imposed as much as the rate of coal production. It would be expected that the actual emission rates would be less than the projected emission rates since regulations have become more strict and control technologies more mature during this time period. In particular, treatment of haul roads and stock piles, covering of conveyors, and more rapid revegetation of disturbed areas have become the norm rather than being used only in special cases.

As can be seen from Tables 21 and 22, the ambient concentrations across the region are usually well under past and current standards. With the major current standard being for finer particles which settle out more slowly, the area of potential cumulative impacts (the area where monitoring would pick up concentrations of 1 $\mu g/m^3$ as a result of all contributing sources) may be greater.

Since most large particles from mining processes drop out of the air quickly, cumulative impacts tend to occur only when the mine operations are within about 10 miles of each other. The trend over the past 10 years and with the currently proposed maintenance tracts is for the mines to spread apart, increasing the distance between them. In the case of a mine being developed as a new mine start, this trend would be reversed. The West Rocky Butte lease application could lead to a new mine start. An EIS is being prepared on that application in which air quality impacts of a new mine start will be evaluated. Overall coal production would decline sooner in the area without these new leases, and consequently air quality would probably improve.

Table 21. Particulate Concentration by Mine in the Eastern Powder River Basin as Projected for 1990 and as Measured[2] in 1990 for the Annual Ambient Air Quality Standard

Mine Name	Projected 1990 Annual Avg TSP Concentration ($\mu g/m^3$)	Measured 1990 Annual Avg TSP Concentration[3] ($\mu g/m^3$)
Antelope	20-40	29
Belle Ayr	30-40	40
Black Thunder	30-40	46
Buckskin	20-40	33
Caballo	30-40	33
Caballo Rojo	30-40	29
Clovis Point	20-40	idle
Coal Creek	30-40	22
Cordero	30-40	43
Dave Johnston	30-40	28
Dry Fork	20-40	28
Eagle Butte	20-40	32
Fort Union	20-40	29
Jacobs Ranch	30-40	40
North Antelope/Rochelle	30-40	31
Rawhide	20-40	30
Wyodak	20-40	29
Average[3]	**20-40**	**33**

[1] The technical report for the 1979 EIS with values for individual mines was not available at the writing of this draft, but the technical report for the 1984 EIS projected that mines south of Gillette would have average TSP concentrations between 30 and 40 $\mu g/m^3$ and those north of Gillette would span a greater ranger of between 20 and 40 $\mu g/m^3$.

[2] Wyoming Department of Environmental Quality.

[3] Average of all sites making measurements in 1990 with 40 or more observations.

Table 22. Particulate Emissions by Mine in the Eastern Powder River Basin as Projected for 1990 and as Estimated from Actual Mining Activities in 1990

Mine Name	Projected 1990 Particulate Emission Rates (Tons/Year)	Actual 1990 Particulate Emission Rates (Tons/Year)
Antelope	not available	228
Belle Ayr	4,520	2,127
Black Thunder	3,744	1,912
Buckskin	1,276	531
Caballo	3,651	1,126
Caballo Rojo	not available	2,701
Clovis Point	1,492	idle
Coal Creek	3,432	1,383
Cordero	9,241	2,477
Dave Johnston	961	not available
Dry Fork	not available	750
Eagle Butte	3,096	1,101
Fort Union	not available	278
Jacobs Ranch	3,149	1,869
North Antelope/Rochelle	2,318	471
Rawhide	2,218	1,388
Wyodak	682	338
Totals	39,780	18,680

[1] PEDCo, 1983.
[2] Wyoming Department of Environmental Quality.

4. Water Resources

Surface coal mining does impact local hydrology, including both the surface and ground-water systems. These impacts have been monitored over the years of mining activity. The potential and actual extent of these impacts have also been the subject of several regional studies. These new data are identified and assessed in this cumulative analysis.

a. Ground Water

The cumulative impact of surface coal mining on ground water is an issue which was raised during scoping conducted for the currently proposed coal leasing. The major hydrologic issues are discussed in Section IV.A.4 of this report.

Concern over the effects of large-scale surface coal mining on ground water around the mines has resulted in the establishment of a monitoring program which is administered by the State of Wyoming. Each mine is required to monitor ground-water levels in the coal itself as well as in shallower aquifers in the area surrounding their operations. There are also requirements for drilling monitoring wells in the backfill areas of the mines in order to record the recharge in these areas. The Gillette Area Groundwater Monitoring Organization (GAGMO), which was formed in 1980, assembles the hydrogeologic monitoring data collected by the coal mining companies operating in the eastern Powder River Basin of Wyoming from the Buckskin Mine north of Gillette to the Antelope Mine in northern Converse County. GAGMO is composed of the companies with operating or proposed mines in that area, the Wyoming Department of Environmental Quality, the Wyoming State Engineer's Office , OSM (since 1991), the USGS, and the BLM. Each year, GAGMO contracts with an independent firm to publish the results of the monitoring for that year. In 1991 GAGMO published two reports, an annual report for 1990 and a ten-year report. The ten-year report, which was prepared by Hydro-Engineering of Casper, summarizes the data accumulated during the last ten years of monitoring in the Powder River Basin. According to the GAGMO ten-year report (Hydro-Engineering, 1991b), 646 monitoring wells were operated at 21 coal mine sites (seventeen active mine sites and four inactive sites) in 1990.

One cumulative ground-water issue is the creation of a spoils aquifer to replace the premining coal and any overburden aquifers within the mined areas. The 1991 GAGMO ten year report indicates that 56 backfill monitor wells had been drilled as of 1990. The report lists the current water levels in these wells and compares them to the 1980 water-level elevations, which were estimated from the 1980 coal water-level contours. Of these 56 backfill wells, six (10.7 percent) were dry (the water level in that location was below the total depth of the well), 29 (51.8 percent) reported water at levels below the water levels estimated for 1980, and 21 (37.5 percent) reported water at levels equal to or greater than those estimated for 1980. The presence of water in 89 percent (50 of the 56) of the backfill wells drilled as of 1990 indicates that recharge is occurring in the backfill.

The impacts of mining the proposed LBA's and the proposed new mine would be to increase the size of the backfill area. However, since reclamation is done concurrently with mining, and the monitoring data indicate that recharge of the backfill is occurring, it is not anticipated that additional significant impacts will occur as a result of the leasing proposed in the LBA's received to date.

Clinker is believed to be the major recharge source for the spoil aquifer, just as it is for the coal. Although some clinker is mined for road surfacing material, 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.

The second major cumulative ground-water 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 (578 wells) are completed in the coal beds, in the overlying sediments, or in sand channels or interburden between the coal beds. These holes range from 9 feet to 420 feet in depth. The changes in water levels in the coal seams after ten years of surface coal mining are shown in Figure 9 which was taken from the 1991 GAGMO report. This map shows the actual area

where drawdown in the coal seam has been greater than five feet in ten years in comparison with the predicted worst-case five foot drawdowns derived from ground-water modeling done by the mines. In general, drawdowns do not tend east of the mines because the mines are located on or near the coal outcrop line. The actual ten-year five-foot drawdown contours have not exceeded the predicted worst-case drawdowns in any of the mines, and in fact are well within the mines' predicted worst-case drawdowns.

Drawdowns extend farther in the coal than in the shallower aquifers because the coal is a confined aquifer and because it is areally extensive, whereas the shallower aquifers (Wasatch, alluvium, and clinker) are generally unconfined and discontinuous. Therefore, the area in which the shallower aquifers have experienced a five-foot drawdown would be smaller in each case.

The actual five-foot drawdown levels are also well within the cumulative drawdown predicted by the USGS in the Powder River Basin CHIA (Martin, et al., 1988). This study predicts the approximate area of five feet or more water-level decline in the Wyodak-Anderson coal aquifer which will result from "all anticipated coal mining". All anticipated coal mining as referred to in the CHIA includes 16 surface coal mines operating at the time the report was prepared and six additional mines proposed at that time. The proposed mines include two mines which are now producing, one mine which did produce for a short time but is currently inactive, and the proposed Rocky Butte mine. The study assumes that water-supply wells in the coal may be affected as far away as eight miles from mine pits, although at this distance the effects were assumed to be minimal. Wells in the Wasatch are considered to be impacted by drawdowns only if they are within 2,000 feet of a mine pit (Martin, et al., 1988, page 29).

Based on the above assumption Martin, et al. (1988) show that there are about 3,000 wells in the area subject to impact by current and anticipated mining in Wyoming's Powder River Basin. Of these, about 1,200 wells are outside the actual mine areas (i.e., will not be removed by mining). About 1,000 of these supply water for domestic or livestock uses, and about 200 supply water for other uses. The remaining 1,800 wells are used by coal-mining companies: about 1,700 wells are monitor wells only, and the other 100 are used for water supply and/or dewatering at mine sites.

Of the 1,200 water-supply wells subject to impact, about 580 are completed in the Wasatch aquifer, about 100 in the Wyodak-Anderson coal aquifer, and about 280 in strata below the coal. The remainder have unknown completion data.

Since the actual ten-year drawdowns lie well within the cumulative drawdown predicted by Martin, et al., (1988), the cumulative impacts to water wells have not reached the levels described in that report.

The additional ground-water impacts which would be expected as a result of extending mining as proposed in the LBA's received to date would be to extend the drawdowns in the areas surrounding the proposed new leases. The actual drawdown contours for the mines which have proposed LBA's to maintain their current operations are well within the cumulative drawdown anticipated in the report by Martin, et al., (1988) and some recharge is already

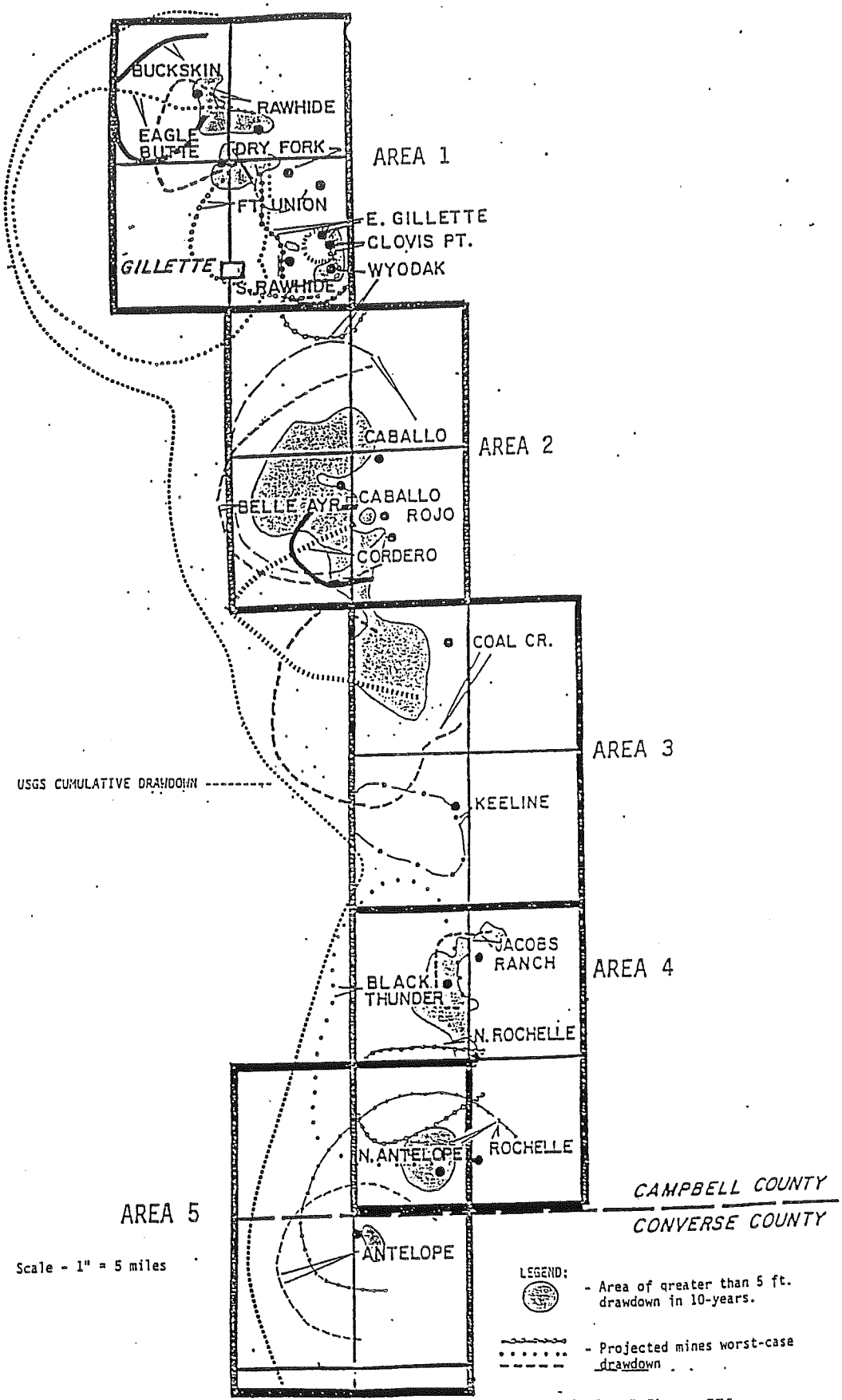

Figure 9. Comparison Between the 1990 Cumulative Drawdowns and the Mines Worst-Case and the USGS Predicted Cumulative Drawdowns.

occurring in 14 of the 15 backfill wells drilled by those mines in 1990. Therefore, additional significant impacts in water-level drawdown for the maintenance leases are not anticipated. The anticipated ground-water impacts for the proposed new start Rocky Butte mine are considered in the CHIA (Martin,et al., 1988). The addition of the West Rocky Butte tract could extend the drawdown area incrementally. An EIS which includes ground-water modeling is currently being prepared to evaluate the impacts of leasing the West Rocky Butte tract.

Potential water-level decline in the sub-coal Fort Union formation is the third major cumulative ground-water issue. According to the Wyoming State Engineer's records, fourteen mines hold permits for 42 wells which are between 400 feet and 10,000 feet deep. That number does not represent the actual number of wells potentially completed in the Tullock member, because the zone of completion of these wells is not specified and not all of the wells are currently producing (for example, three of the permits are held by an inactive mine, and one of the Black Thunder mine wells has not produced since 1984).

Water-level declines in the Tullock member have been documented in the Gillette area. These declines are most likely attributable to withdrawal at subdivisions and trailer parks in and near the City of Gillette (M.A. Crist, USGS, written communication, 1987, in Martin, et al., 1988, page 30). Most of the water-level declines in the sub-coal Fort Union wells occur within one mile of the pumped wells (M.A. Crist, in Martin, et al., 1988, page 30). The mine facilities in the Powder River Basin are separated by distances of a mile or more and the available drawdown at these wells is large (generally several hundred feet), so any interference (intersecting cones of drawdown) between mine supply wells is not likely to significantly reduce well yields.

In response to concerns voiced by regulatory personnel, several mines have conducted impact studies of the sub-coal Fort Union formation. OSM commissioned a cumulative impact study of the sub-coal Fort Union formation to study the effects of mine facility wells on this aquifer unit (Office of Surface Mining, McIntosh, et al., 1984). Conclusions from all these studies are similar and may be summarized as follows:

1. 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.

2. In some areas, most notably around the City of Gillette where the city and several subdivisions are utilizing water from this formation, regional water levels are probably declining. (Note: Gillette is using this water as a back-up source at this time.)

3. Because large saturated thicknesses are available in this aquifer unit, generally 500 feet or more, drawdowns of a few hundred feet in the vicinity of a pumped well would not dewater the aquifer.

The mines adjacent to the five currently proposed maintenance-tract LBA's all have permits from the State Engineer for deep wells. Extending the lives of these mines would result in additional water being withdrawn from the Tullock. The additional water withdrawals would

not be expected to significantly extend the area of water-level drawdowns due to the discontinuous nature of the sands in the Tullock aquifer. Any impacts of the new start mine at Rocky Butte on the Tullock aquifer will be considered in the EIS being prepared for the West Rocky Butte tract.

The Tullock member of the Fort Union formation is the lowermost unit in the formation, and it crops out at the surface east of the area being mined. Therefore, any recharge to the Tullock member from the outcrop area is not affected by mining.

The USGS, in cooperation with the Wyoming State Engineer's Office, has recently completed an evaluation of ground-water level changes in the vicinity of Gillette (Crist, 1991). The study area for that report included an area of about 220 square miles around Gillette, where energy-related developments have caused a dramatic population increase since about 1960. This report states that water levels in the Wasatch formation around Gillette declined by about 9 feet between 1965 and 1974 and now appear to be rising. This is probably because the City of Gillette stopped using its Wasatch wells after 1981, when the city started using its Madison pipeline. Data from 18 observation wells completed in aquifers below the Wasatch indicate declining water levels. Pumpage for municipal use by Gillette and for public supply by local subdivisions is the principal cause of water-level decline from 1972 to 1985 in the upper Fort Union (i.e., the Fort Union from the base of the Wyodak-Anderson Coal down to 750 feet below that level). A water-level measurement taken in 1985 indicates that the water levels in this zone have stabilized. Water-level changes in the lower part of the Fort Union formation (i.e., more than 750 feet below the Wyodak-Anderson Coal) are not well documented due to a lack of data.

The fourth cumulative impact issue of concern with ground water is the effect of mining on the 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?

Ground-water quality in areas surrounding the mines is not impacted during mining. While the pits are open, ground-water flow directions are toward the pit, and there is no mechanism for contaminants to migrate off-site even if contaminants were introduced into the ground-water.

In the regional study of the cumulative impacts of coal mining, (Martin, et al., 1988) 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. This is expected because blasting and movement of the overburden material exposes more surface area to water, increasing dissolution of soluble materials, particularly when the spoil materials were situated above the saturated zone in the premining environment. On the basis of studies done in North Dakota, it was estimated that at least one pore volume of water must leach the spoil before the dissolved-solids concentration in the water would be similar to the premining dissolved-solids concentration (Houghton, et al., 1987). The time required for one pore volume of water to pass through the spoil aquifer is greater than the time required for the postmining ground-water system to re-establish equilibrium.

b. Surface water

Inquiries as to the cumulative impacts to surface water have been mentioned during scoping conducted for the currently proposed coal leasing. There are two potential issues relating to cumulative surface-water impacts:

a. Possible changes in runoff rates due to changes in precipitation infiltration rates.

b. Possible changes in surface-water quality.

Some studies indicate that soil infiltration rates will be smaller on reclaimed lands than on premining lands. A reduction of up to 29 percent has been found, with this reduction declining over time until the postmining infiltration rates recover to premining levels (Martin et al., 1988, p.106). Since runoff and infiltration rates have an inverse relationship, a reduction in infiltration rates could cause an increase in runoff and, hence, streamflows. Assuming that the runoff from reclaimed areas is 29 percent greater than that from premining areas (based on the change in infiltration rates noted above), USGS determined that major streams in the Powder River Basin would see runoff increases ranging from 0.4 percent for the Cheyenne River to 4.3 percent for Coal Creek. Porcupine Creek would see a 2-percent increase in runoff (Martin, et al., 1988, p. 109).

Surface-water quality should not be significantly affected by mining, based on studies conducted by the USGS for the Belle Fourche River Basin (Bloyd, et al., 1986, pp.33-41). Sediment yield should not increase in area streams. Although reclaimed soils may be more erosive for the first few years after reclamation, the larger sediment production will not be delivered to area streams due to sediment deposition as a result of the flat slopes on reclaimed lands and sediment trapping by mandated sedimentation ponds. Recently, concern has been expressed over the presence of certain forms of selenium in overburden. The Wyoming DEQ and the mine operators are cooperating in a joint effort to study this issue and to determine safe levels of selenium in overburden placed near the reclaimed surface, near reclaimed streams and impoundments, or in saturated spoils.