IV. ENVIRONMENTAL IMPACTS

A. Impacts Of The Proposed Action

The proposed action, Alternative 1 is to issue the lease as applied for, that is, as a maintenance tract under the lease-by-application regulations. Possible modifications to the proposed action include altering the tract boundary to include a small wedge of land in Section 7, south of Highway 450 (Option A), and dividing the tract into two smaller tracts if it is determined that this action would make the coal more attractive to potential bidders and thus increase lease sale revenues to the federal government (Option B). Alternative 1, the proposed action, with Option A included is the preferred alternative of the BLM.

This section describes the environmental impacts that would result if the WBT tract were leased to TBCC as a maintenance tract for the adjacent BTM (Alternative 1). Discussions of changes in the environmental impacts of the proposed action as a result of adopting Option A or Option B are included in this discussion. Impacts are quantified for each discipline addressed in Section III of this report. The following section (IV. B.) addresses impacts of alternatives, primarily by comparison to the impacts of the proposed action. 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 geology of the affected land. Overburden is drilled, blasted, and removed from atop the coal, either by trucks and shovels or by draglines. Both mining methods are employed at the BTM. The overburden is either stockpiled or replaced directly into a mined-out area. Coal is blasted and removed by trucks and shovels. A coal recovery efficiency of about 90 to 95 percent is typical for Powder River Basin mines, based on information provided in numerous mine permit documents on file with WDEQ/LQD. The small percentage of coal not taken may be left intentionally, such as ashy or otherwise poor-quality coal or coal which is left as a safety measure, or it may be lost by spillage from equipment or not loaded during the normal mining process.

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 BTM, truck-shovel spoils have a design swell factor of 13.5 percent and

dragline spoils have a design swell factor of 20 percent (TBCC, 1990, Book No. 17). The dragline generally removes the 100 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 versus truck/shovel spoils.

Within the existing mine area, approximately 6,390 acres will be affected by actual mining and coal removal. The remainder of the 8,344 acres to be affected over the mine life are subject to surface disturbance such as construction of roads and diversions and mining of scoria for road surfacing material. Because of contemporaneous reclamation efforts, not all of this area would be disturbed at one time. Mining of the WBT tract as proposed as a maintenance tract would add about 3,225 acres to the total area actually mined and another 500 or so acres around the lease boundary disturbed by overburden benching, topsoil removal, and possibly highwall slope reduction during reclamation. Option A would add approximately 280 acres in Section 7 south of Highway 450 to the mine area, with possibly 120 acres of additional surface disturbance along the west and north boundaries. Option B, leasing the WBT tract in two parcels, would not in itself change the area affected by mining. Thus the area subject to coal removal ranges from about 6,390 acres in the current mine area to about 9,615 acres if the WBT tract is leased and mined as applied for to 9,895 acres with Option A. Total surface disturbance would range from 8,344 acres proposed in the current plan to 12,070 acres under the proposed action to 12,470 with Option A.

The topography of the lease area is subject to considerable change during the mining process. Due to the thickness of the coal seam, the average elevation of the mined area would be lowered, even after allowing for overburden swelling. A typical average overburden thickness for mines in the Powder River Basin is about 150 feet. Coal thicknesses vary, but an average mineable thickness is approximately 60 feet. Thus removal of the coal and swelling of the overburden by 15 percent results in a change in average elevation of :

$$150(0.15) - 60 = -37.5 \text{ feet.}$$

Overburden thickness generally increases as the coal dips westward, away from the outcrop, and the ratio of overburden to coal may be thicker in the WBT tract than in the illustration above, meaning that the average drop in elevation may be less than 37.5 feet.

Certain habitat features of the premining landscape are directly related to topography (see Section III.B.3 and B.6 of this report). These include closed depressions which contain intermittent lakes, or playas, in their bottoms and dissected stream channels which are often lined with cut banks and rock outcrops. As described in the mitigation section, these features would be simulated in the postmining landscape.

2. Water Resources

Surface coal mining has several impacts on local hydrology, including both the surface and ground-water systems. These impacts are acknowledged by both mine operators and regulatory agencies, and 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:

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

2. 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.

3. 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 (wash-down, etc.) uses. Most mines in the Powder River Basin, including BTM, have water-supply wells completed in the sub-coal Fort Union Formation.

Other ground-water impacts, which may or may not occur or which may occur only at specific locations, include off-site changes in water quality and changes in recharge-discharge conditions and ground-water flow patterns.

Surface-water impacts generally include the following:

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

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

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

4. Possible changes in surface-water quality.

a. Ground Water

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 would be large enough to consider the material an aquifer (Groenewold, 1979). The final hydraulic conductivity of the spoil aquifer would probably approximate the geometric mean

values of hydraulic conductivity for the undisturbed Wasatch aquifer (0.2 ft/day) and the Wyodak coal aquifer (0.8 ft/day) (Martin, et al., 1988, p. 23). Given the expected final saturated thickness, the spoil aquifer could supply water of adequate quantity for supply of the small yields needed for stock and domestic wells. This hydraulic conductivity could 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) would replace two aquifer systems (coal and overburden) within the mine areas.

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 would 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.
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> 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.
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> 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.
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> 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, including one drilled in late 1991, have been completed in replaced spoils at the BTM. The most recent water-level data available for five of these wells are presented in Appendix 7.1 and 7.2 of the 1990 BTM Annual Report. Four of these wells

have encountered water, and one has remained dry since its construction in 1987. Water levels in the wells which encountered water range from about 50 to 180 feet below the reclaimed surface. Saturated thickness of the spoil aquifer at these wells currently ranges from 0 to over 30 feet.

In a regional study of the cumulative impacts of coal mining, the median concentrations of dissolved solids and sulfates were found to be larger in water from spoil aquifers than in water from either the Wasatch overburden or the coal aquifer. This is expected because blasting and movement of the overburden materials exposes more surface area to water, increasing dissolution of soluble materials, particularly when the 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.

Dissolved-solids concentrations in the backfill wells at BTM range from about 1,400 mg/L to over 4,500 mg/L, which is within the range of premining ground-water quality samples (TBCC, 1990 Annual Report to WDEQ/LQD, Appendix 7.3).

Water-supply wells within the mine area would experience water-level declines as they are approached by the pit, and ultimately would be removed by mining. Water-supply wells completed in the coal and possibly wells in the overburden outside but in close proximity to the mine area would experience reductions in water levels. To monitor the effects of mining on water levels, TBCC maintains 18 coal, 13 overburden, and 11 alluvial monitoring wells.

TBCC has conducted ground-water modeling, and the results are reported in Appendix II.F. 2.6, Part 1 of the 1990 permit update on file with WDEQ/LQD. Drawdowns in the coal aquifer, as modeled, extend much further beyond the mine boundaries than do those in the overburden. WDEQ/LQD policy is to have the mining companies determine the extent of the five foot drawdown contour. This contour extends about six miles north, about five miles west, and about two miles south of the current permit boundary. Drawdowns do not extend to the east because the mine is located on the coal outcrop line. The WBT tract is within an area where drawdowns will generally exceed 40 feet. There is some cumulative effect to the north, where drawdowns from the Black Thunder and Jacobs Ranch mines intersect, and to the south where drawdowns from the Black Thunder and North Rochelle mines intersect.

A review of water-level data from BTM coal monitoring wells BTR-7, BTR-28 and BTR-31, which are on the WBT tract (see Figure 3), for the years 1984-1989 shows only short-term declines and a net increase in water levels for two of these wells. Well BTR-7 showed an increase in water level of 11 feet, and well BTR-28 showed an increase of 18 feet over this period. A net decline of 6 feet was measured at BTR-31.

During the permitting process which would be required to include the WBT tract in the BTM permit area, the drawdown study would be reassessed using data from the WBT tract and incorporating a new mine plan. At this time it can be assumed that the extent and magnitude of the drawdowns would be shifted westward by about one mile as mining extends one mile west through the WBT tract. For the proposed action and Option B, northward and southward extents of coal removal would not be materially changed by the mining of the WBT tract, and therefore the maximum northward and southward extents of drawdown should not change. There could be a small northward shift with Option A, as it includes coal north of the current lease line.

A total of thirteen water-supply wells have been identified as being impacted by BTM. Impacts to these wells will range from removal by mining to minor drawdowns. Two of these wells are located on the WBT tract.

A more regional study of drawdown impacts was conducted by the USGS in their CHIA of the Powder River Basin (Martin, et al., 1988). This study showed 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 coal aquifer, and about 280 in strata below the coal. The remainder have unknown completion data.

Wells in the Wasatch were considered to be impacted by drawdowns only if they were within 2,000 feet of a mine pit (Martin, et al., 1988, p. 29). However, water-supply wells completed 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.

Water-level declines in the sub-coal Fort Union Formation have been documented in the Gillette area. According to Crist (1991), pumpage for municipal use by Gillette and for public supply by the subdivisions around Gillette is the principal cause of water-level declines in the upper Fort Union measured in wells in the immediate vicinity of Gillette. 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, p. 30). Since the mine facilities are always separated by distances of a mile or more, there is little interference between mine supply wells.

In response to concerns voiced by regulatory personnel, several mines have conducted impact studies of the sub-coal Fort Union Formation. The 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 (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 the Gillette area, water levels in this aquifer are probably declining because the city of Gillette and several subdivisions are utilizing water from this formation (Crist, 1991). (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 100 to 200 feet in the vicinity of a pumped well would not dewater the aquifer.

There would be no direct impact to the Fort Union aquifers near Gillette as a result of leasing the proposed WBT tract, due to the distance from the Black Thunder Mine to the city of Gillette (approximately 40 miles) and the discontinuous nature of the sand lenses in the Tullock.

There would not be significant impact to the water supply of the city of Wright as a result of leasing the WBT tract. According to the State Engineer's Office, the only permitted wells drilled below 1000 feet in a 100 square mile area surrounding Wright are four wells permitted to the city of Wright (Stockdale, State Engineer's Office, 1992). As discussed above, Crist (in Martin, et al., 1988) indicated most of the water level declines in the sub-coal Fort Union wells occur within one mile of the pumped wells.

In the vicinity of the BTM, the recharge zone (outcrop area) for the subcoal Fort Union extends eastward approximately 20 miles from the east edge of the lease boundary (BXG, 1983). About half of this distance is the Tongue River/Lebo outcrop, and half is the outcrop of the Tullock member. Recharge from this outcrop tends to flow downdip, or to the west and north, under the area being mined. The BTM lease boundary is about five miles long in the north-south direction, so the Tullock member recharge area in the vicinity of the BTM would be approximately 50 square miles in size (5 miles north-south by 10 miles east-west). Using a value of .1 inch per year of recharge over this outcrop (McIntosh, 1984), the recharge area would contribute around 90 million gallons annually to the Tullock beneath the mine. The current annual BTM usage of water from the Tullock member is about 55 million gallons, which is less than the expected annual recharge to the Tullock in the vicinity of the mine.

If the WBT tract is mined as proposed under the proposed action or Option A, there would probably be no need for additional sub-coal Fort Union wells since no new facilities would be required. In the event that the proposed acreage was sold to two separate operators

under Option B, additional facilities could be required, which could result in a need for additional deep water wells.

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.

After mining, under all three options, water levels would begin to recover, and eventually an equilibrium flow pattern would develop. Water from the spoil aquifer would enter the adjacent, unmined coal. This would result in increased dissolved-solids concentrations in the coal aquifer water initially, but since there is a finite quantity of soluble salt in the spoil material this increase would be temporary. Martin, et al.(1988) point out that, in general, current and future water from the spoil aquifers will meet state standards for livestock, which is the current major use of water from the coal and overlying Wasatch aquifers. This conclusion was based on 336 chemical analyses of samples collected from 45 wells completed in spoil aquifers at ten existing mines. The BTM was one of the mines included in that analysis. As noted previously, dissolved-solids concentrations in the backfill wells at BTM range from about 1,400 mg/L to over 4,500 mg/L, which is within the range of premining ground-water quality samples (TBCC, 1990 Annual Report to WDEQ/LQD, Appendix 7.3). Since the water in the spoil aquifer is currently within the range of the premining ground water quality in this area, there should not be a significant impact to the water quality in the adjacent unmined coal when the water from the spoil pile enters it.

Martin, et al., 1988, also point out that column leach tests indicate that the elevated levels of dissolved solids caused by coal mining will decrease over time. 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).

Clinker would 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.

b. Surface Water

The incremental impacts to the surface drainage system caused by mining the WBT tract would be minimal. The two main streams on the property, Little Thunder Creek and North Prong Little Thunder Creek, have already been mined through. Both streams are now conveyed around active mining areas in diversion channels. Plans for the restoration of these streams have been submitted to and approved by WDEQ/LQD, and portions of both streams have already been partially restored. These restoration plans are designed to provide channel and drainage-basin erosional stability comparable to premining stability.

Impacts to downstream water rights would be minimal, primarily because there are few downstream rights and these are located well downstream from the mine. Considerable intervening drainage area provides most of the flows to satisfy these rights.

A check of the records in the State Engineer's Office shows eleven downstream water rights, three on Little Thunder Creek and eight on Black Thunder Creek. About 78 percent of the drainage area of Little Thunder Creek is below the mine boundary and above the diversion locations for the water rights on Little Thunder Creek. Because runoff is proportional to drainage area, only about 22 percent of the flow of Little Thunder Creek is subject to alteration by the BTM. Only 10 percent of the drainage area above the water rights on Black Thunder Creek is above the BTM. Normal seasonal and annual fluctuation in streamflow would mask any effects the mine has on these downstream water rights.

Some studies indicate that infiltration rates are initially 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 this 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. Little Thunder Creek would see a 2.9 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 would probably not be delivered to area streams due to sediment deposition as a result of flatter slopes on reclaimed lands and sediment trapping by mandated sedimentation ponds.

c. Alluvial Valley Floors

Impacts to designated alluvial valley floors (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 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. The portion of Little Thunder Creek that crosses the WBT tract is already in the BTM permit area and is not part of the designated AVF.

d. Wetlands

Western Water Consultants found a total of 107.9 acres within the BTM study area, including the WBT tract, which met the definition of jurisdictional wetlands. Of this 107.9 acre total, 6.15 acres (4 sites) were comprised of playas, 21.38 acres (3 sites) were associated with man-made reservoirs, and 80.37 acres (9 sites) were within or immediately adjacent to stream channels. Mitigation in accordance with the prevailing USCE regulations will be addressed as part of future mining permits.

3. 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 homogenous mixture than the premining soils and are replaced at a more uniform depth. On average, the postmining soils would be superior in quality to premining soils since soil material determined to be unsuitable, because of physical or chemical limitations, is not salvaged and replaced. The average topsoil replacement depth at the current BTM is about two feet. Since soils in the WBT tract are similar to those in the current mine area, the average replacement depth for the entire mine area including the WBT tract, with or without Option A, 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 would probably be smaller soon after reclamation is completed, but over time, as the postmining vegetation root system develops and natural weathering action affects the soil structure, infiltration rates should trend toward premining levels (Martin, et al., 1988).

It is estimated that about 3,725 acres of soil resources would be disturbed in the proposed WBT lease area and adjacent disturbance areas under the proposed action, including about 144 acres of hydric soils in playas. An additional 400 acres would be disturbed under Option A.

Improper disturbance to soils could cause numerous types of impacts associated with alteration of existing soil characteristics and properties. Potential impacts to soil resources as a result of mining could include changes in soil structure, texture, organic matter content, infiltration rate, permeability, water-holding capacity, nutrient level, soil microorganism composition, and soil productivity. Mining could expose lower soils or overburden material

which may contain chemical constituents, such as selenium, at levels which could be harmful to plants and animals.

Stockpiling soil material could degrade biological, chemical, and physical properties. Stockpiling could 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 (USFS, 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. Soil loss can be modeled for a range of conditions through use of the Revised Universal Soil Loss Equation (USDA-ARS, 1991). 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 reclamation efforts on reclaimed areas of the adjacent BTM for similar soils. No significant site-specific or cumulative impacts have been encountered on the currently active BTM to date and none are foreseen on the WBT tract. No prime farmland or alluvial valley floors exist within the proposed WBT lease area, and therefore none would be disturbed. Ponds, impoundments, and other drainage features have been reconstructed during BTM reclamation, and similar reclamation techniques would be used on the WBT tract. No detrimental long-term impacts to wetland resources are foreseen based on the experience on the currently active BTM.

There has recently been some general concern expressed about levels of selenium in coal mine overburden and backfill. During fifteen years of actual mining experience at the BTM, there have been no problems concerning selenium.

Several years ago, the WDEQ/LQD revised their guidelines for handling seleniferous materials based on the results of a laboratory study. At this time, the chemistry of selenium in Powder River Basin soils is being studied to see if the current guidelines can reasonably be applied for this area. The Wyoming Mining Association and the WDEQ/LQD have embarked on a comprehensive research program, in which the TBCC is involved, to address issues such as:

- appropriate analytical techniques for obtaining reproducible selenium measurements in soils;
- 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 groundwater or surface water resources from backfill areas.

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

4. Vegetation

Vegetation on the WBT tract is similar to that which occurred prior to mining on the current mine permit area. These vegetation types are common throughout the region. Through the 1990 annual reporting period, a total of 4,410 acres had been disturbed on the BTM (TBCC, October 1990, p. 3.9). Of this, about 1,350 acres had been permanently reclaimed as of spring, 1991 (Bob Moore, personal communication, June 24, 1991). Since 1981, revegetation of mined lands at the BTM has been a continuous process. Revegetation success at the BTM has been monitored on an on-going basis since 1985. Data from this monitoring suggests that the reclaimed lands have cover and productivity equal to or greater than the native mixed grass prairie, and reclaimed areas also show the capability to withstand and recover from years with below-average rainfall amounts. Cover and productivity on reclaimed areas were limited during the drought years of 1985 and 1988. In more favorable years, like 1989, 1990, and 1991, cover and production rebounded on the reclaimed areas.

Vegetation monitoring has also documented increased species diversity and shrub density in recent years. Through the evolution of seeding methods, seeding rates, seed mixes and evaluation of interim vegetation monitoring data, significant progress has been made in enhancing species diversity and establishing shrublands.

The success of revegetation has also been evaluated in conjunction with a grazing demonstration study conducted over the past three years on reclaimed areas. Data from this study has shown that excellent weight gains can be attained by cattle utilizing the reclaimed areas. Forage utilization levels in the pastures have been between 50 and 65 percent, and livestock weight gains have been approximately two pounds per day. Vegetation sampling from the two pastures utilized in the study suggests that grazing is having no adverse impact on the vegetation and that the reclaimed areas are stable enough to support a managed grazing program.

Vegetative impacts from mining the WBT tract would be temporary. It is anticipated that the WBT tract could be successfully revegetated using the same techniques currently being used at the BTM, based on the similarity to the WBT tract to the premine BTM tract.

5. Land Use

During mining, portions of the WBT tract and adjacent areas would be unavailable for livestock grazing. At a mining rate of 30 million tons per year, about 300 acres per year would

be disturbed. 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 500 acres or more. Under the proposed action, this disturbance would be divided between the existing lease and the WBT tract.

The three plugged and abandoned oil wells would be mined through and the plugs replaced. TBCC has had experience with this procedure in the current lease area. Mitigation of impacts to the two producing wells is discussed in Section IV.C. of this report.

6. Wildlife

During mining, pronghorn would be displaced to adjacent sagebrush-grassland habitat. Due to the quality and quantity of the adjacent habitat, minimal or no impact to pronghorn is anticipated as a result of leasing this tract. 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 and elk habitat on the WBT tract area is limited, and there would be little impact on these species.

Although existing raptor nest sites would be destroyed by mining on the proposed lease area, it is unlikely that nesting raptors would be deleteriously impacted because of the availability of alternate nest sites. Only one of the four ferruginous hawk territories in the proposed lease area has been regularly active since 1983. Nests from that territory could be relocated prior to mining to suitable sites proximate to their present locations. This would help maintain the productivity of the existing pair. The eagles that may nest in the proposed lease area have demonstrated acceptance of past mitigation measures, and probably could be relocated away from the area in the future. There is a raptor mitigation plan for all nests on the Black Thunder permit area which 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 would be submitted to the USFWS for review and approval.

Sage grouse are not limited by lack of habitat in this area, and therefore would not be impacted by temporary loss of this habitat on the WBT tract. Because non-raptor migratory birds of high federal interest do not regularly use the area, mining would have a negligible impact on these species. No unique source of prey for bald eagles exists on the WBT tract; therefore the impact of mining on this species would be negligible. Because no prairie dog towns exist within one mile of the WBT tract and therefore no prey for black footed ferrets, mining would not impact black-footed ferrets.

7. Cultural Resources

Cultural resources located on the WBT tract will be irreversibly impacted by mining. For those sites eligible for the National Register of Historic Places, a treatment plan will be developed and implemented prior to disturbance to mitigate the impact. As discussed previously, treatment plans will be developed jointly with all appropriate regulatory agencies. Therefore,

before a site is mined away, all important information and site detail will have been collected for the permanent record.

8. Paleontological Resources

No unique or significant paleontological resources were found in the paleontological survey conducted by Dr. Dale Hoffman in 1975. In the event that significant paleontological resources are discovered in the course of mining, those resources will be handled as specified in the special stipulations concerning paleontological resources which is cited in section IIA of this EA.

9. Visual Resources

No unique visual resources are found on the WBT tract, and therefore impacts to visual resources would 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 activities 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. Option A would result in an additional visual impact as a result of the proximity of the mine to Highway 450.

The duration of the visual impact varies from one to several years. However, stringent reclamation guidelines require that these lands be restored to their premine character to the extent practicable.

10. Noise

There have been no notable off-site noise impacts from the existing operations at the BTM. The proposed WBT lease is approximately the same distance from public access (Highway 450) as the existing operations. The nearest residence is about 2.5 miles from the proposed lease area and is owned by the Jacobs Ranch, a Kerr-McGee subsidiary which operates the agricultural portion of the Kerr-McGee coal mining business on the undeveloped and reclaimed mine land. The WBT tract is no closer to this residence than is the current pit, and is much farther from this residence than the initial pit at the BTM. Since no noise problems occurred when the pit was closer to the residence, it is reasonable to expect that mining the WBT tract will not cause noise problems. The next nearest residence is about five miles northwest of the proposed lease area. 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 would be housed at the mine site, compliance with the work-related hearing conservation programs of MSHA is sufficient to insure impacts to workers on the proposed lease area would be minimized.

Section III.B.11 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 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 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 (db), 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 db higher. Thus a sound of 100 db has an intensity level one million times higher than a sound of 40 db (10^6). A 100-db sound would be reduced to a 40 db level at a distance of about 10,000 feet from the source, assuming no attenuation of the sound. In other words, the sound of a 100 db source would be reduced to near ambient levels within 10,000 feet (less than two miles) from the source. Since the nearest dwelling is over 2.5 miles from the mine, it is unlikely that most sounds from the mine can be detected at this location.

11. Air Quality

As discussed in Section III.B.12 of this report, air quality monitoring indicates that coal production in Wyoming's Powder River Basin increased nearly 2.5 times between 1980 and 1989 without adversely impacting air quality. This is a measure of the effectiveness of controls. These controls, which include bag houses, covered transfer points, sprinkling of water and addition of EPA-approved 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. 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 the proposed action, the air quality impacts would not be significantly different from the present because the WBT tract would be used to extend the life of the operating BTM 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, would change but the numbers and types of sources would not.

Before the WBT tract can be mined, even as an extension of an operating mine, an air

quality permit application must be submitted to and approved by WDEQ/AQD. The analysis of emissions for the WDEQ/AQD permit modification would be similar to previous analyses since no changes in mining methods or rates are proposed. The haul distance from the WBT tract to the coal preparation plant would be less than from the southern portions of the current permit area to the plant. Thus one source of emissions, dust from the coal haul road, could be reduced from current levels when the WBT tract is mined. When mining is concluded on the southern end of the current permit area, the near-pit crusher and conveyor will be extended to the northwest, further reducing the average haulage in trucks. The average volume of overburden removed per ton of coal mined will be somewhat larger in the WBT tract than in the current mine area. Thus, even though coal production rates will not change, the sizes of the pits and the annual volumes of overburden removed will increase. Offsetting this change, a new dragline is currently being erected, which will reduce the amount of overburden hauled in trucks. Other than this, no changes in size and numbers of machinery are being proposed at this time.

Mining is currently done at up to six active coal faces. Mining plans now on file with WDEQ/LQD show that the number of active pits will be reduced, and reclamation will begin to proceed at a faster rate than new disturbance for the next several years. This should help reduce dust emissions compared with current emission rates.

Blasting, another source of emissions, will increase due to gradually increasing overburden thickness and to company plans to utilize more cast blasting. Cast blasting may increase short-term blasting emissions, but will decrease the amount of overburden moved with draglines, shovels and haul trucks. Cast blasting is a permitted procedure whereby backfill is cast into place using explosives which reduces the amount of material to be rehandled. The net effect to air quality will be determined ultimately through monitoring.

Option A of the proposed action would not directly affect air quality except to extend the life of the mine incrementally. However, under Option A blasting and mining operations would be closer to Highway 450, making the dust from operations more visible to the public. There is a potential for impacts to highway travelers in the form of blowing dust along the highway, as a result of the proximity of the pit to the road. However, the predominate wind direction at the site is out of the northwest, or away from the highway, and BTCC's previous experience with operations on both sides of the highway indicates that these types of impacts can be mitigated. Specific mitigation will be addressed in the mine's blasting plan.

Option B, leasing the WBT tract in two parcels, could impact air quality if the two parcels are leased to two different operators and if the operators mine concurrently. Having two pits in close proximity to each other could essentially double the emissions, requiring both operators to implement additional controls in order to maintain compliance with air quality standards. Both operators would be required to submit air quality permit applications and conduct computer air quality modeling.

12. Transportation Facilities

Mining of the WBT tract by TBCC would not increase the current level of impacts on transportation facilities, other than the potential for increased dust under Option A, as discussed above under air quality. By extending the mine life, the current levels of use of Highway 450 and the railroad spur would also be extended.

The nearby Jacobs Ranch Mine is scheduled to end operations in year 2012 assuming their maintenance tract lease (No. WYW117924) is approved (BLM, 1991). During the final years of operation at BTM the use of both the railroad and highway will be reduced from current levels if Black Thunder is the only mine still using these facilities. Thus extending the life of Black Thunder would not cause additional use of existing transportation facilities over and above what is now occurring.

13. Socioeconomics

If the WBT tract is leased to TBCC to extend the life of the BTM, a new mine and reclamation plan would be developed to show a logical mining sequence from the current northwest pit into the WBT tract. Coal production would occur from both the WBT tract and the existing lease simultaneously. Although the new mine plan has not been finally designed, pending the outcome of the lease sale, TBCC has made preliminary plans for mining this tract. These plans show coal production from the mine, including the current lease and the WBT tract, averaging about 30 mmtpy. Since the application is for approximately 400 million tons of recoverable coal (433 million tons with option A), mining of this additional coal would add approximately 13 years to the life of the mine (14 years for Option A). Production is weighted toward WBT in the early years due to its proximity to the facilities area compared with the southern reaches of the current lease area, although annual production from the WBT tract has not been estimated.

The current spot-market price of coal for the BTM is estimated at $4.00 to $5.00 per ton. Assuming a future price of $5.00 per ton, the market value of the additional coal would be about $2 billion ($2.17 billion under Option A) in addition to expected market value of the coal from the current lease. Applying an economic multiplier of 1.796 to the revenues, the total economic impact to the local area from the additional coal would be approximately $3.6 billion ($3.9 billion for Option A), based on spot coal prices. Since long-term contract prices are generally higher than spot coal prices, the economic impacts would be larger if long-term contract are considered.

Employment at the BTM would be able to be maintained at current levels under the proposed action, continuing to average about 500 employees. This results in annual wages to mine employees of about $23.5 million. These wages would continue for approximately 13 additional years under the proposed action and 14 additional years under Option A. Without the WBT tract, coal production and therefore employment would begin to decline after 1996.

The level of mine operations under the proposed action or Option A would not create any boomtown effects because annual output, as well as labor and wage levels, would not increase significantly from current levels. However, mining the WBT tract as a maintenance tract to extend the life of the BTM would enable current staffing levels to be maintained for a longer time period.

Ad valorem and severance taxes are paid by the mine 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).

Option B would not change the amount of coal recovered, hence, the total economic impact from coal recovery, but leasing the tract in two parcels may change the production rate and therefore the rate at which the economic benefits accrue to the state and federal governments, and to the local communities.

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.

14. Hazardous Waste

Waste is generated during mining operations at the BTM as at all mines. Some of the waste is classified as hazardous by the EPA under the Resource Conservation and Recovery Act (RCRA), however the majority is not classified as hazardous. Non-hazardous waste, which is similar to domestic or municipal solid waste, is currently disposed of in onsite landfill(s) permitted by the WDEQ. Materials classified as hazardous waste at BTM include some greases, solvents, paints, and other materials which either contain listed wastes or may be hazardous by characteristic. These wastes are drummed and shipped to an EPA-permitted incinerator for disposal. In 1991, TBCC took steps to significantly reduce the quantities of hazardous waste generating materials used at the BTM by reducing purchases of hazardous solvents and leaded paints and by substituting non-hazardous lubricants.

B. Impacts of Alternatives

1. Alternative No. 2: No Action

Under the no action alternative, the WBT tract would not be leased. Disturbance of land on the WBT tract would be limited to current disturbance associated with the Little Thunder Creek Diversion and to overstripping necessary to recover coal within the current lease boundary. This disturbance would total about 65 to 70 percent of the land that would be disturbed by mining the WBT tract. The entire area, other than what has already been disturbed or would be disturbed by overstripping, would remain available for livestock and wildlife habitat.

Although much of the surface would be disturbed as a result of the Little Thunder Creek Diversion, even if the tract is not leased, the basic topography and the geology underlying the diversion area would not be affected. 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 WBT tract would be limited to what has already occurred by construction of the Little Thunder Creek Diversion.

The air quality would be altered primarily by the fact that the mining rate would begin to decline after 1996 and would cease several years sooner under this alternative.

The economic benefits described in the previous section attributable to the WBT tract, including employees' wages, taxes and royalties, would be forgone under this alternative.

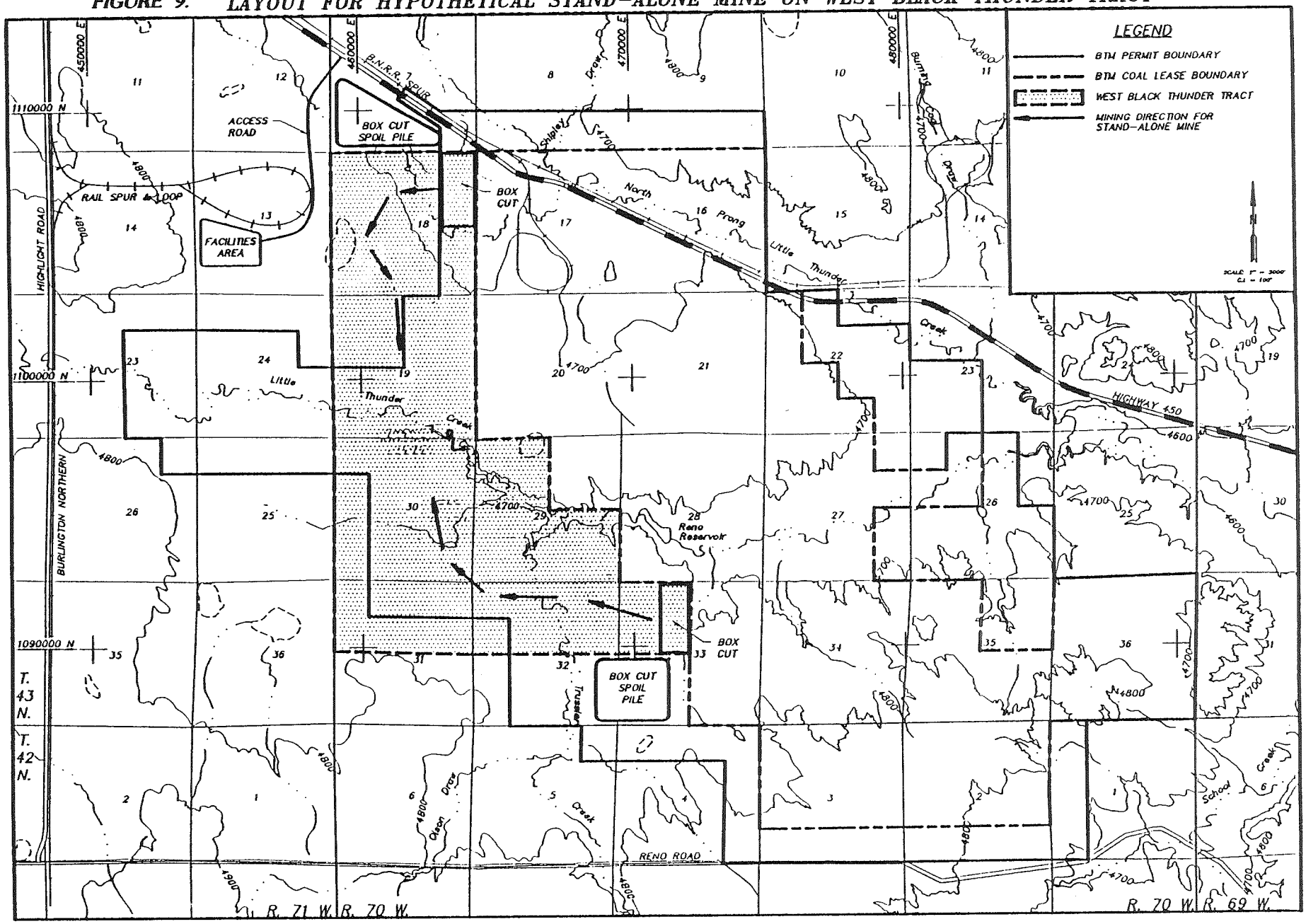
2. Alternative 3: New Stand-Alone Mine

The size of the WBT tract makes the stand-alone mine alternative logistically feasible. No analysis has been performed to determine the economic viability of such a project.

In order to predict environmental impacts of a new mine at the WBT tract, a hypothetical mine plan and layout are required. Figure 9 shows one possible stand-alone mine designed to recover coal from the WBT tract. This scenario was developed by the BLM to be used as an assumption for an analysis of potential impacts of this alternative. If the WBT tract were to be mined as a stand-alone tract rather than as a maintenance tract, the lessee would not necessarily develop the lease in this manner or at this rate.

It was assumed that this mine would recover about 400 million tons over its life. Reflecting recent trends, the mine would probably be a dragline operation with truck-shovel assisting for overburden and interburden removal. The hypothetical mine plan assumes 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 9. Both box cuts would require out-of-pit overburden stockpiles, and possible locations are shown on Figure 9. The south pit box cut spoil is located off the WBT tract and outside the existing BTM lease. The

FIGURE 9. LAYOUT FOR HYPOTHETICAL STAND-ALONE MINE ON WEST BLACK THUNDER TRACT



north pit box-cut spoil is located off the WBT tract as close as possible to the box-cut without placing it over coal within the tract. If the tract is amended to include the Option A area in Section 7, which is the preferred alternative of the BLM, this box-cut spoil would have to be placed elsewhere.

The hypothetical facilities area was located in Section 13, west of the WBT tract over coal that may be too deep to mine economically in the foreseeable future. A rail spur was linked to the main Gillette-Douglas spur line in Section 14. Regarding production from the stand-alone mine, the hypothetical schedule shown in Table 14 was assumed. Table 14 shows coal production averaging about 11.4 mmtpy over the 35 years of actual mining.

Table 14. Hypothetical Coal Production Schedule for Stand-Alone Mine on WBT Tract

YEAR	COAL PRODUCTION (mmtpy)
1-6	No production--used for baseline studies, permitting, and construction of facilities.
7	0.5
8	1.0
9	2.5
10	5.0
11	7.5
12	10.0
13-39	13.0
40	11.0
41	9.0
42-46	No production-reclamation only.

According to this scenario, if the lease sale were held in 1992 (year 1), the hypothetical mine would commence mining in 1998 (year 7), following baseline data collection, preparation of an environmental impact analyses, and satisfying the requirements for obtaining a mining permit. Peak production of 13 mmtpy would be reached in 2004 (year 13), and the last production would occur in 2032 (year 41). This is about 15 years after production is now scheduled to cease at the BTM. The assumption is made that it would be possible to obtain an air quality permit for this stand-alone mine for this production rate.

At an average production rate of 11.4 mmtpy, the hypothetical stand-alone mine would require disturbance of an average of about 110 acres per year, including overstripping along the lease boundaries. Additional disturbance would be required for the facilities area and loop (640 acres), rail spur (30 acres), access road (10 acres), box-cut spoil storage areas (400 acres), and diversion or storage facilities for Little Thunder Creek, North Prong, Trussler Creek and BK Draw outside the tract boundaries (200 acres).

It is assumed that employment at the stand-alone mine would be between about 230 and 300 people. Initially, this would represent up to a 300 person increase in employment in the area, not including employment during the construction of the mine. However, employment would begin to decline at the Black Thunder Mine after 1996, as projected by the current Black Thunder mine plan. Therefore, it is assumed that there would initially be an increase in area employment which would also decline after 1996.

To minimize air quality impacts and because of the distance from the south pit to the facility area, it is assumed that the new mine would have an overland conveyor from the south pit.

Environmental impacts of the stand-alone mine can best be examined by comparing features of this mine with the existing BTM extended into the WBT tract (Alternative No. 1, the proposed action). The total area disturbed by coal removal would not change as a function of mining as a stand-alone mine or a maintenance tract at the BTM. However, total disturbed area would be larger for the stand-alone mine. Additional disturbances would include a new loop track and coal preparation plant, a new railroad spur, a new access road, and two out-of-pit spoil stockpiles to accommodate the two box-cuts at the stand-alone mine. This additional disturbed area would total about 1,080 acres. Facilities required to store or divert the flows of the major streams around the pit areas would probably be the same whether this is a new mine or a maintenance lease.

Initially, more area would be disturbed with two ongoing operations, however the duration of the disturbance as a result of mining at the BTM would be decreased. The hydrologic impacts would not be significantly different for a new stand-alone mine versus a maintenance tract. Two separate operations would require more sediment-control facilities. With two ongoing operations, the rate of water level lowering could potentially increase, although there should not be a change in the area affected, whether the WBT is mined as part of the BTM or as a separate operation. The duration of mining at the WBT would be decreased if the WBT lease were mined as a separate operation, so the initial increase in rate of water level decline would not persist throughout mining of the WBT tract. If the new mine constructed one or more water-supply wells in the sub-coal Fort Union Formation, there is some likelihood that there could be interference (i.e., intersecting cones of depression) between these wells and the existing BTM facility wells. However, with two miles separating the two preparation plants it is unlikely that the cumulative effects would be significant, much less dewater the aquifers. Moreover, the potential impacts would only affect the two mine operations.

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 both the Highlight Road and Highway 450.

The additional emissions from the new preparation plant and larger disturbed area, as well as the simultaneous operation of two adjacent mines, would probably cause more deterioration of ambient air quality for this alternative as compared to the proposed action, even if the aggregate production remained at 30 mmtpy. 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. Any additional employees would be expected to live in Gillette and Wright and would use Highways 59 and 450 to travel to work. The railroad might haul additional tonnage while the two 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 County (see Section III.B.14 of this report), 230 to 300 additional employees could be supplied from local labor. An added payroll of an estimated $10 million per year would accrue to the local economy, offset by whatever declines in employment occur at BTM.

The addition of up to 300 new jobs could potentially impact housing and public facilities in the nearest community, which is Wright. As discussed in section III.B.14, unemployment figures for this area indicate most of the needed employees could be supplied from labor already living in the area. Therefore, the impact to Wright is not expected to be significant. Also, as indicated in section III.B.14. of this document, housing data indicate that there is sufficient housing in the area (including Gillette, Wright, and Newcastle), to accommodate over 900 additional workers.

Cumulative severance tax and royalty revenues would not vary between Alternatives 1 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 two mines. In the short term, there would be an increase in tax and royalty revenue as a result of a new mine. In the long term, this would be offset by declining production and earlier closure of the BTM. Additional property taxes would be realized due to the additional plant and equipment associated with Alternative 3.

Option A would increase the impacts of a new mine start incrementally as described in

the proposed action. Option B could preclude a new mine start if neither tract was large enough to start a new mine, and if the company interested in establishing a new mine operation failed to acquire both tracts.

It may not be economically feasible for a new mine to start production on the WBT tract and effectively compete with existing Powder River Basin mines for new coal sales. Each ton of coal sold from a new mine would need to recover all of the costs associated with producing the coal and provide a sufficient return on capital investment. As a result, the minimum selling price of coal required for a new mining operation would be higher than for existing mining operations.

3. Alternative 4: Postponement of the Lease Sale

Under this alternative, the WBT lease sale would be postponed under the assumption that potentially rising coal prices in the future would increase the value of the coal and the federal government would receive a larger bonus bid up front from the lease sale.

Since the 12.5 percent royalty payments are the major source of revenue to the Federal and state governments, and they are collected when the coal is sold, the mechanism is already in place for government revenues to increase if coal prices rise. Postponement of a lease sale does not guarantee that a price rise may be fully taken advantage of, since the time lag between the escalation of prices and 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 could result in lower royalty revenues to the government if the operator must sell the coal on the cheaper spot market, because he cannot anticipate having the reserves to negotiate higher priced, long-term contracts.

The environmental impacts for this alternative could be the same as for any of the previous alternatives. If the lease sale is not postponed too long for TBCC to logically mine the tract, it could be mined as a maintenance tract. In this case the environmental impacts would be the same as for Alternative No. 1. If the lease sale is delayed beyond the time the WBT could be mined as a logical extension of the BTM, the value of the tract as a maintenance tract would decline. Once the boundary between the existing lease and the WBT tract has been mined and reclaimed, opening new box-cuts and reaffecting previously reclaimed land would result in additional costs to the BTM, and additional impacts to the area.

If WBT loses its value as a maintenance tract due to time delays, and if coal market conditions make it uneconomical as a stand-alone mine, the environmental and economic impacts of this alternative would be the same as for the No Action alternative.

If the lease sale were delayed so long that the tract could only be mined as a stand-alone mine, environmental and economic impacts would be similar to those for Alternative No. 3, except that there would be fewer cumulative impacts if the period of concurrent operations with other mines in the area is reduced.

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 would be reviewed by WDEQ/LQD during the permit application process. Design and approval of the postmining topography would be facilitated by following the USFS design guidelines for the Thunder Basin National Grassland (USFS, 1991). Specific recommendations pertinent to the WBT tract 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 postmining topography design would 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 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. Provision of ponds and reservoirs on the reclaimed surface, similar to what TBCC is doing on the BTM, helps conserve surface water resources and provides a recharge source for the spoils aquifer.

Impacts to ground-water supplies will be mitigated. SMCRA and state regulations 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 formation.

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 permit process.

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 TBCC and implemented on the adjacent BTM 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.

Continued emphasis on increasing vegetal species diversity on reclaimed lands, and particularly on establishing shrublands, would help restore wildlife habitat on reclaimed lands.

Playas, which rely on topography, soil types and vegetation, provide special habitats that would be restored in the postmining topography. Continued sampling and monitoring and grazing demonstration studies such as that practiced at the BTM would provide valuable data for continuing improvements in revegetation practices.

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, would 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.

The coal lessee must prepare a mine plan study to determine if the operating oil wells would have any impact on the mining operation. Alternatives to manage any conflicts with these wells include an economic evaluation to determine if they could be purchased or temporarily plugged and restored when mining has been completed. Under the FLPMA, multiple use and concomitant development of natural resources are governed by the Department of the Interior (USDI). USDI guidelines have been developed to address this type of situation. Moreover, the leased lands are managed according to the RMP 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.

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 the NRHP and cannot be avoided, then an appropriate treatment plan will be developed and implemented prior to mining, in accordance with 36 CFR 800 and other relevant regulations.

Three previously identified cultural resources that are eligible for the NRHP and will require treatment plans are located within the area of effect. Two are located within the proposed coal lease boundary and one on the adjacent buffer zone. New sites that have not yet been reviewed for their eligibility for the NRHP will require final evaluation for nomination to the NRHP. Those new sites that are not eligible for the NRHP will not be considered further, as all pertinent data has been gathered. New sites which are eligible for the NRHP and cannot be avoided will be handled by developing and implementing a treatment plan prior to mining as required by the National Historic Preservation Act.

All hazardous materials generated on the proposed lease area would be handled in accordance with current regulations.

D. Residual Impacts

Despite proper reclamation planning and implementation of mitigating measures, there are impacts of mining that remain after reclamation is completed. The coal aquifer and any overburden aquifers are replaced with spoil material. While indications are that this material would function as an aquifer and, in fact, is resaturating more quickly than generally predicted (Martin et al., 1988, p. 156), it would be some time before the spoils are fully saturated and a steady-state flow pattern is reestablished. In the meantime there would be no shallow ground-water source in the reclaimed areas. Just as during mining, alternative sources of water would 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 from the spoils aquifer to the undisturbed coal and overburden aquifers, water quality in those aquifers may be temporarily degraded.

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 several years.

E. Cumulative Impacts

Six LBAs are currently pending before BLM in the Powder River Basin of Wyoming, and there are eighteen operating mines in this area. NEPA requires that cumulative as well as site specific impacts of proposed federal actions be considered as part of the decision making process. The need to consider the cumulative impacts of the proposed LBAs is an issue which was raised during the scoping conducted for the Jacobs Ranch and the West Black Thunder LBAs and in the comments received on the Jacobs Ranch EA.

According to the Council of Environmental Quality, "cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative actions can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). This section should not, and does not, address impacts specific to the Black Thunder LBA, as those are addressed elsewhere in this EA.

Six LBAs have been received to date: Jacobs Ranch, West Black Thunder, North Antelope, Rochelle, West Rocky Butte, and Eagle Butte. Five of the LBAs were applied for as maintenance tracts, intended to extend the life of already existing mines: Jacobs Ranch, West Black Thunder, North Antelope, Rochelle, and Eagle Butte. West Rocky Butte is adjacent to an existing lease on which there are no mining operations. On September 6, 1991, the Powder River Regional Coal Team voted to proceed with this application, although it is not a mine maintenance tract.

Four of the LBAs are located in an area southeast of Wright, Wyoming, near the southern end of the eastern Powder River Basin coal producing trend: Jacobs Ranch, West Black Thunder, North Antelope, and Rochelle (Figure 10). The Rocky Butte lease is located approximately ten miles south of Gillette, in the central part of the Wyoming Powder River Basin coal producing area, and the Eagle Butte LBA is located approximately five miles north of Gillette, at the northern end of the coal producing trend (Figure 10).

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 LBAs 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 of leased federal coal and an increase in acreage of 8.2 percent. At the 1990 rate of coal production for the Wyoming portion of the Powder River Basin of 162.6 million tons mined, the coal underlying the proposed leases represents approximately 6.4 years of leased reserves for the basin as a whole.

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 for 1990 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 LBAs added to current mining.

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 EISs prepared during the 1970's and early 1980's. The four analyses are:

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

- Final Environmental 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 current coal production and presently anticipated levels of regional development activity. The analysis reviews cumulative impacts identified in the above referenced EISs as compared to the actual development activity which has occurred. This cumulative analysis also incorporates data, monitoring results and research done since the EISs were done, or in response

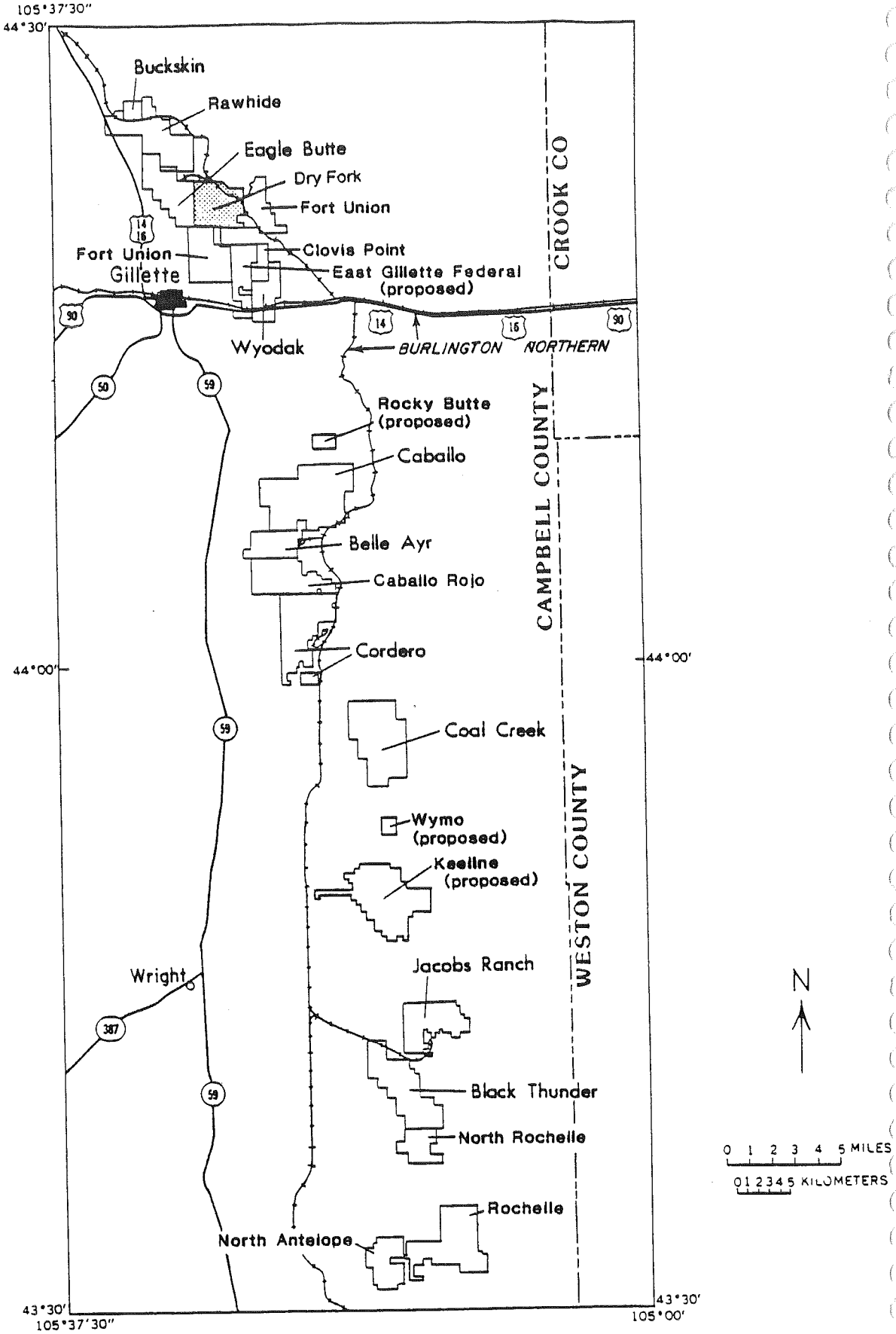


Figure 10-- Location of existing and proposed coal mines in Campbell County, Wyoming.

to impacts identified in these EISs, 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 1970's and early 1980's 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 EISs were prepared. 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 that time. All of the mines currently operating, including those requesting LBAs, in the Eastern Powder River region were specifically addressed in one or more of the referenced EISs, as shown in Table 15.

Each regional EIS predicted coal mining activity into the future, looking at number of mines, production levels, and acreage 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 LBAs 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 EISs is based.

Table 16 shows that the actual level of development which occurred by 1990 is within the range of predictions made in the referenced EISs. In retrospect, the 1979 EIS was the closest prediction. This is explained by the fact that the 1981 and 1984 EIS assumed higher 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 EISs. Cumulative disturbance to date added to all the pending LBAs represents less than one tenth of one percent of Campbell and Converse counties. The acreage disturbed has been specifically analyzed in the referenced EISs 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 already contoured, topsoiled and reseeded.

TABLE 15: MINE SITES ADDRESSED IN PREVIOUS REGIONAL EIS ANALYSES

MINE	OPERATOR	STATUS	1974 EIS	1979 EIS	1981 EIS	1984 EIS
Antelope	Antelope Coal Co.		XX		XX	XX
Belle Ayr	Amax Coal Co.		XX	XX	XX	XX
Black Thunder	Thunder Basin Coal Co.	*	XX	XX	XX	XX
Buckskin	Triton Coal Co.			XX	XX	XX
Caballo	Carter Mining Co.			XX	XX	XX
Caballo Rojo	Mobil			XX	XX	XX
Clovis Point/ East Gillette	Kerr–McGee	**		XX	XX	XX
Coal Creek	Thunder Basin Coal Co.			XX	XX	XX
Cordero	Cordero Mining		XX	XX	XX	XX
Dave Johnston	Pacificorp		XX	XX	XX	XX
Dry Fork	Dry Fork Coal				XX	XX
Eagle Butte	Amax Coal Co.	*	XX	XX	XX	XX
Fort Union	Fort Union Ltd.				XX	XX
Jacobs Ranch	Kerr–Mcgee	*	XX	XX	XX	XX
Keeline	Neil Butte Co.	++			XX	XX
North Antelope	Powder River Coal Co.	*	XX	XX	XX	XX
North Rochelle	Shell				XX	XX
Rawhide	Carter Mining Co.		XX	XX	XX	XX
Rochelle	Powder River Coal Co.	*	XX	XX	XX	XX
Wyodak	Wyodak Resources Dev.		XX	XX	XX	XX
Rocky Butte	Northwest Resources	*++			XX	XX
TOTALS: 21 (19 Mines + 2 Undeveloped Leases)			11	15	20	20

* = LBA application on file
** = Currently Inactive Mine
++ = Undeveloped Existing Lease

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*	37*,**
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)	162.6	178.6	150	174.3	332.9*	292.1*,**

* = Calculated from Wyoming and Montana totals in EIS. This EIS covered the entire Powder River Basin.
** = Baseline or "No Action" alternative used from this EIS. The 1984 EIS was not finalized and, therefore, the actions proposed were never taken.
*** = This column represents the actual 1990 activity added to the activity which would have been expected if the LBAs had been approved in 1990.

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*	40,900*,**
ACRES RECLAIMED	9,199	4,132	12,666	24,200*	22,800*,**
COAL EMPLOYMENT	2,862	5,200	3,899	11,900	11,500**
TOTAL POPULATION	40,498	65,600	59,400	69,000	62,300**

*Wyoming portion calculated from Montana plus Wyoming total in EIS. This EIS covered the entire Powder River Basin.

**Baseline or "No Action" alternative was used from this EIS. The 1984 EIS was not finalized and, therefore, although analyses were done, the actions proposed were never taken.

Sources of 1990 data: 1990 Annual Mine Reports for Eastern Powder River Basin Mines, BLM Casper District Records, 1990 Census Results for Wyoming Counties/Municipalities, "Annual Report of Mines of Wyoming" through 12–31–90.

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 depends on the total investment in reclamation rather than on physical factors.

Cumulative transportation impacts are related to coal production levels and are within the level of impacts identified in the referenced EISs.

Cultural sites are a non-renewable resource subject to destruction through disturbance. Specific impacts related to the decision to affect or avoid a site are addressed on a site-by-site basis. Unavoidable impacts to significant cultural properties are mitigated through approved recordation, research or data recovery plans. Although sites have been and will be affected and lost during the mining process, the information in them has been and will be preserved.

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 where rough, steep-sided hills, gullies or scoria knobs are replaced by more gently rounded approximate original contours.

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, poaching loss, and habitat loss. With all the pending LBAs added to acreage already permitted to mine, about 1% of the wildlife habitat in Campbell and Converse Counties would be disturbed.

Because disturbance would not occur to a large part of the leased area at any one time and reclamation is continually taking place, habitat loss caused by the projects included in the cumulative analysis would be less than one percent at any one time.

One of the LBAs, 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 EISs. As this potential new mine would result in an additional impact to the water resources, a new source of suspended particulate matter in the air and also new employment, an additional discussion of cumulative water, air quality, and socioeconomic impacts is presented. 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. Water Resources

Surface coal mining does impact local hydrology, including both the surface and groundwater 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. This new data is identified and assessed in this cumulative analysis.

a. Ground Water

The cumulative impact of surface coal mining on groundwater is an issue which was raised during scoping conducted for the currently proposed coal leasing.

Concern over the effects of large-scale surface coal mining on groundwater 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 groundwater 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) is a voluntary group which was formed in 1980. The purpose of GAGMO is to assemble and report the hydrogeologic monitoring data being 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 WDEQ, the Wyoming State Engineer's Office, the BLM, the USGS, and the OSM, which joined in 1991. Each year, GAGMO contracts with an independent firm to publish the results of the monitoring for that year. This year, 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 10 year report (Hydro-Engineering, 1991), 646 monitoring wells were operated at 21 coal mines sites 1990. (The 21 sites included active and inactive mines, and unmined leases. The Dave Johnston Mine, located near Glenrock and the Rocky Butte unmined lease are not members of GAGMO.)

The major groundwater issues are:

1. The effect of the removal of the coal aquifer and any overburden aquifers within the mine area, and replacement of these aquifers with spoil material.

2. The extent of the temporary lowering of static water levels in the aquifers around the mine due to dewatering associated with removal of these aquifers within the mine boundaries.

3. The effect of the use of water from the sub-coal Fort Union Formation by the mines. Most mines in the Powder River Basin, have water-supply wells

completed in the sub-coal Fort Union Formation.

4. Changes in water quality as a result of mining.

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

1. The effects of replacing the coal aquifer and overburden with a spoil aquifer is the first major groundwater concern. The following discussion of recharge, movement, and discharge of water in the spoil aquifer is excerpted from the Powder River Basin Cumulative Hydrologic Impact Assessment (CHIA), a regional study of surface coal mining impacts in the Powder River Basin prepared by the USGS (Martin, et al., 1988):

> The potential for recharge to the backfilled spoil would 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).

According to the 1991 GAGMO ten year report, 56 backfill monitor wells had been drilled as of 1990. The report listed the current water levels in these wells, and compared 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 less than 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) 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 start 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 LBAs received to date.

Clinker, the baked and fused rock formed by prehistoric burning of the Wyodak-Anderson coal seam, 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. Therefore, the major recharge source for the spoil aquifer is not being disturbed by mining.

2. The second major groundwater issue is the extent of water level drawdown in the coal and shallower aquifers in the area surrounding the mines. Most of the monitoring wells included in the GAGMO 10-year report (578 wells out of 646 total) 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 11, 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 groundwater modeling done by the mines. WDEQ/LQD policy is to have the mining companies determine the extent of the five-foot drawdown contour. In general, drawdowns do not extend 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 most cases, the drawdown contours 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 discontinuous and of limited extent. 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-foot or more water decline in the Wyodak coal aquifer

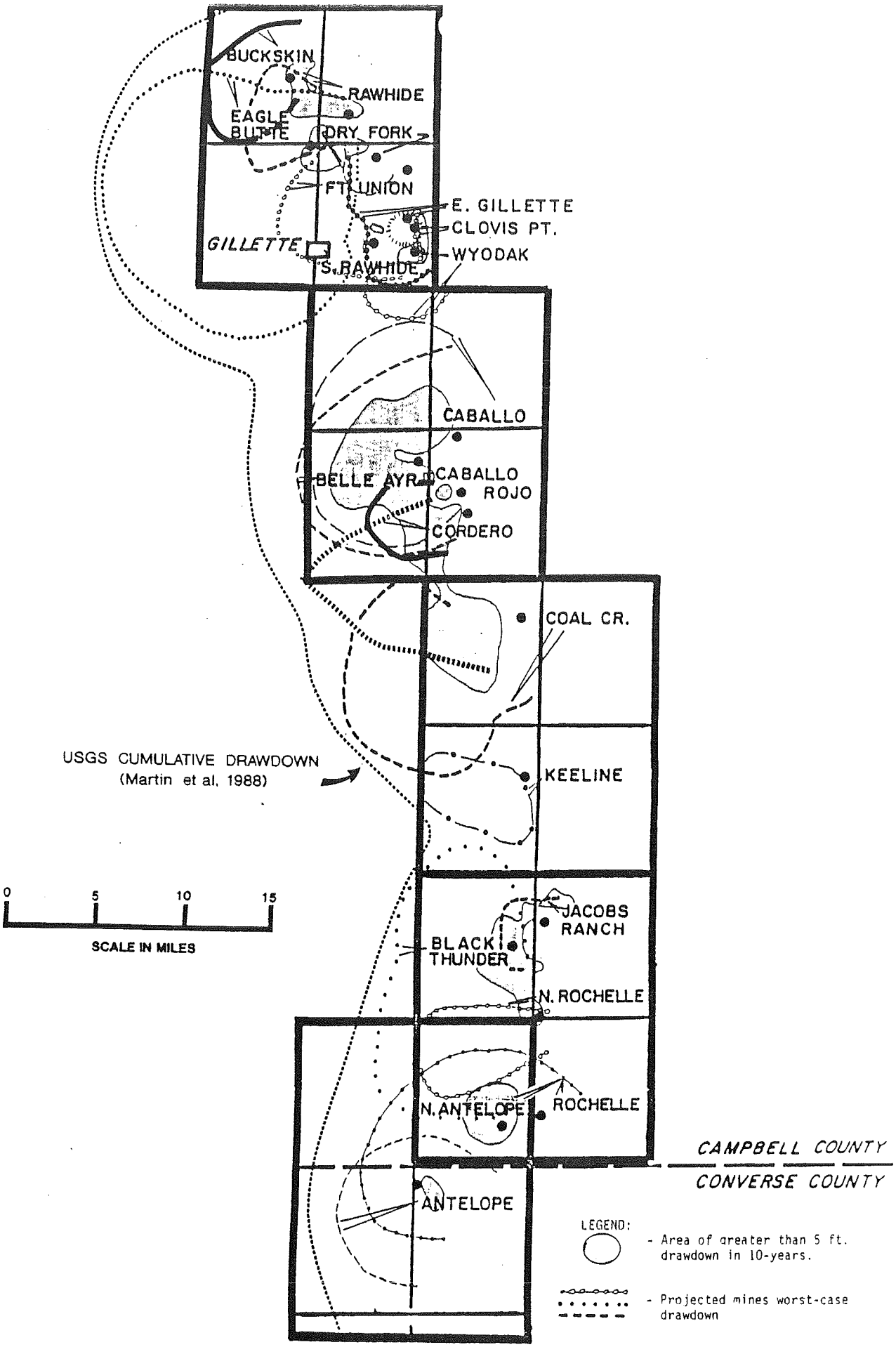


FIGURE 11. COMPARISON BETWEEN THE 1990 CUMULATIVE DRAWDOWNS AND THE MINES WORST-CASE AND THE USGS PREDICTED DRAWDOWNS. (Modified from Hydro-Engineering, 1991)

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 completed 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 were within 2,000 feet of a mine pit (Martin, et al., 1988, p. 29).

Based on the above assumptions, Martin, et al. 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 coal aquifer, and about 280 in strata below the coal. There is no completion data available for the remainder of these wells (about 240). They could be completed in any of the above aquifers.

Since the actual 10 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 groundwater impacts which would be expected as a result of extending mining as proposed in the LBAs received to date would be to extend the drawdown areas in the area surrounding the proposed new leases. The actual drawdown contours for the mines which have proposed LBAs to maintain their current operations to date are well within the cumulative drawdown anticipated in the report by Martin, et al., 1988, and some recharge was already 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 is not anticipated. The anticipated groundwater 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 groundwater modeling is currently being prepared to evaluate the impacts of leasing the West Rocky Butte tract.

3. Potential water-level decline in the sub-coal Fort Union is the third major groundwater 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, 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 wells Black Thunder

has permitted has not been used since 1984). The State Engineer's Office is currently conducting a study of sub-coal Fort Union water use (personal communication, Dave McElhaney, 10/4/91).

Water-level declines in the Tullock have been documented in the Gillette area. According to Crist (1991), these declines are most likely attributable to pumpage for municipal use by Gillette and for use at subdivisions and trailer parks in and near the city of Gillette. Most of the water-level declines in the sub-coal Fort Union wells occur within one mile of the pumped wells (M.A. Crist, in Martin, et al., 1988, p. 30). The mine facilities in the Powder River Basin are separated by distances of a mile or more, so little interference between mine supply wells would be expected..

In response to concerns voiced by regulatory personnel, several mines have conducted impact studies of the sub-coal Fort Union Formation. The 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 (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 the Gillette area, water levels in this aquifer are probably declining because the city of Gillette and several subdivisions are utilizing water from this formation (Crist, 1991). (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 100 to 200 feet in the vicinity of a pumped well would not dewater the aquifer.

The mines adjacent to the five currently proposed LBAs all have permits from the State Engineer for deeper wells. Extending the life of these mines would result in additional water being withdrawn from the Tullock. The additional water withdrawals would not be expected to extend the area of water level drawdowns over a significantly larger area due to the discontinuous nature of the sands in the Tullock aquifer.

The only potential impact to Gillette's water supply as a result of leasing the five LBAs adjacent to current mines would be an indirect one related to the fact that issuing these leases would extend the duration of mining operations at the five mines. Many of the mine employee in the eastern Powder River Basin live in or near Gillette, and are city or county water users. Contact with the city (Fritzler, Gillette City Utilities, 1991) and Campbell County (McDill, Campbell County Engineer, 1992) indicate that the position of the city and county is that there

is an adequate water supply for the city and county if these five LBAs are leased as proposed.

There would not be significant impact to the water supply of the city of Wright as a result of leasing the proposed LBAs. According to the State Engineer's Office, the only permitted wells drilled below 1000 feet in a 100 square mile area surrounding Wright are four wells permitted to the city of Wright (Stockdale, State Engineer's Office, 1992). As discussed above, Crist (in Martin, et al.) indicated most of the water level declines in the sub-coal Fort Union wells occur within one mile of the pumped wells.

The 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.

4. The fourth issue of concern with groundwater 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 a regional study of the cumulative impacts of coal mining, the median concentrations of dissolved solids and sulfates were found to be larger in water from spoil aquifers than in water from either the Wasatch overburden or the coal aquifer Martin, et al., 1988). This is expected because blasting and movement of the overburden materials exposes more surface area to water, increasing dissolution of soluble materials, particularly when the 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). One pore volume of water is the volume of volume of water which would be required to fill the pore space or open space in the spoil pile following reclamation. 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.

Chemical analyses of 336 samples collected between 1981 and 1986 from 45 wells completed in spoil aquifers at 10 mines indicated that the quality of water in the spoil piles will, in general, meet state standard for use for livestock when recharge occurs (Martin, et al., 1988). The major current use of water from the aquifers being replaced by the spoil piles (the Wasatch and Wyodak-Anderson coal aquifers) is for livestock because these aquifers are typically high

in dissolved solids in their primining state (see Table 4, Martin, et al.,1988). Therefore, the water from the spoil piles will generally be acceptable for it current use, which is for livestock, before equilibrium is re-established.

b. Surface Water.

Cumulative impacts to surface water have not been mentioned as a source of concern during scoping conducted for the currently proposed coal leasing. There are two main 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 infiltration rates are initially 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 this 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 (Martin, et al., 1988).

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 would probably not be delivered to area streams due to sediment deposition as a result of flatter slopes on reclaimed lands and sediment trapping by mandated sedimentation ponds.

Impacts to alluvial valley floors (AVF) can include several of the ground 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. 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.

3. Air Quality

Coal mining activities produce particles which can be released in 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 PM10 standard). The particulate standard change from TSP to PM10 is more lenient toward mining activities since mining produces mostly larger particles. Monitoring has indicated that at similar distances from the active pit, PM10 levels are one-third those of TSP. The Wyoming State Ambient Air Quality Standard has not changed from 150 ug/m^3 for a 24-hour average and only changed from 60 to 50 ug/m^3 for the annual average. Therefore, the WDEQ has kept the 24-hour TSP standard in addition to the PM10 standard.

Tables 18 and 19 use the TSP standard in order 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 size would be, the overall number and productivity of the mines in the Eastern Powder River Basin was projected with remarkable accuracy from 1979 to 1990.

Particulate emissions are controlled by the amount of regulation imposed as well as by 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 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 just used in special cases.

As can be seen from the tables, 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 ug/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 18. Particulate Concentration by Mine in the Eastern Powder River as projected for 1990 and as Measured[1] for 1990 for the Annual Ambient Air quality Standard

Mine Name	Projected 1990 Annual Avg TSP Concentration[2] ug/m^3	Measured 1990 Annual Avg TSP Concentration[3] UG/M^3
Antelope	20-40	29
Belle Ayr	20-40	40
Black Thunder	20-40	46
Buckskin	20-40	33
Caballo	20-40	33
Caballo Rojo	20-40	29
Clovis Point	20-40	Idle
Coal Creek	20-40	22
Cordero	20-40	43
Dave Johnston	20-40	28
Dry Fork	20-40	28
Eagle Butte	20-40	32
Fort Union	20-40	29
Jacobs Ranch	20-40	40
North Antelope/Rochelle	20-40	31
Rawhide	20-40	30
Wyodak	20-40	29
Average		33

[1] WDEQ.
[2] 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 be between 30 and 40 ug/m^3 and those north of Gillette would span a greater range of between 20 and 40 ug/m^3.
[3] Average of all sites making measurements in 1990 with 40 or more observations.

4. Socioeconomics

Five of the six proposed LBAs received to date 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 approximately 250 to 300 new jobs to the area. There are two other proposed projects which may be under construction at the same time as the

Rocky Butte Mine. These projects are: a proposed Black Hills Power and Light Company power plant and the second phase of construction scheduled at the Dry Fork Mine. These projects overlap as currently scheduled. The following discussion describes the current situation in the area of Gillette.

Table 19. 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)[1]	Actual 1990 Particulate Emission Rates (tons/year)[2]
Antelope		228
Belle Ayr	4520	2127
Black Thunder	3744	1912
Buckskin	1276	531
Caballo	3651	1126
Caballo Rojo		2701
Clovis Point	1492	Idle
Coal Creek	3432	1383
Cordero	9241	2477
Dave Johnston	961	
Dry Fork		750
Eagle Butte	3096	1101
Fort Union		278
Jacobs Ranch	3149	1869
North Antelope/Rochelle	2318	471
Rawhide	2218	1388
Wyodak	682	338
Total	39780	18680

[1] PEDCo, 1983.
[2] Tentative figures from various regional EISs, to be checked with the WDEQ.

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. It was at one time in the early

decades of this century, but this has changed and today relatively few people work in agriculture. Instead, it has a coal mining, petroleum and energy related based economy. In 1989, this helped Campbell County lead Wyoming in coal and oil production and make it 8th in gas production with assessed mineral valuations of over $1.2 billion or nearly 1/3 of total state mineral valuation (Wyoming Oil & Gas Conservation Commission, 1989; Hoffman, 1990).

Based on data supplied by the Wyoming Dept. of Employment, Campbell County's labor force stood at 16,705 workers in July 1991, with 15,859 people employed. The July 1991 unemployment rate for Campbell County was at 5.1 percent, virtually the same as it was in July 1990 (Wyoming Labor Force Trends, Sept. 1991). This represents a higher figure than the State's 3.8 percent rate in 1991, and 3.9 percent rate in 1990. Although labor force figures are reflected 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, a community of about 1,200 people, 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 timeframe.

In 1980 Campbell County's per capita personal income amounted to $13,918, in 1989, it was $15,663 representing a near 13 percent increase, lower however, than the State's 28 percent increase during the same period (Wyoming Income and Employment Report, 8/91).

Based on the most current information on housing availability in Gillette, there are about 549 housing units available, mostly single family and rental properties (Table 9).

In addition, Gillette can provide 851 rooms for workers, visitors tourists etc. through 12 motels and hotels located within the city (Gillette Economic Development Corp., 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(Gillette Economic Development Corp., 1991).

According to Campbell County School District 1991/92 first day attendance data, this school system is being used at nearly 68 percent of capacity based on fall 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.

In 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, with peaks of 7-9 million gallons during the summer months (Gillette City Utilities, Fritzler, 1991). This amounts to 730 million gallons (2240 acre-feet) per year. However, at this time deliverable water capacity stands at 11 million gallons of water per day (4015 million gallons or 12,322 acre-feet per year). The city serves 18,300 customers that

consume an average of 165.4 gallons of water per day (Gillette City Utilities, Fritzler, 1991).

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 per day, against a plant capacity of 3.85 million gallons a day (Gillette City Utilities, Schultz, 1991).

In 1990, electrical peak capacity in Gillette amounted to 38.76 megawatts of power (Gillette City Utilities, Lindgren, 1991). This is not locally produced energy but bought power 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. (Gillette City Utilities, Lindgren, 1991). 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, they could buy up to 60 megawatts of power without major 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 (Gillette City Utilities, Lindgren, 1991). If 400 new homes were to be built within the area, about 2.3 megawatts of additional power would be needed (Gillette City Utilities, Lindgren, 1991).

Crime rates, marriage and divorce rates, and birth and death rates are indicators of well being in communities. These topics are discussed in the following paragraphs.

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. Note the dramatic increase in law enforcement personnel over this timeframe in Table 20 below.

Table 20: Crime in Campbell County, 1980 and 1989

Type of Crime	1980	1989
Murder	1	2
Rape	9	7
Robbery	13	0
Aggravated Assault	49	105
Burglary	267	153
Larceny	979	850
Motor Vehicle Theft	91	53
Total	1409	1170
Crime Rate/10,000 Inhabitants	578.3	401.4

Law Enforcement Personnel		
Sheriff's Dept.	43	100
Gillette	44	50
Total	87	150

Source: Uniform Crime Reporting, Crime in Wyoming Jan through Dec. 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. Note comparisons with the U.S. and Wyoming rates in Table 21 below.

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. Again, note in Table 21 the comparisons with the U.S. and Wyoming averages.

Table 21: Marriage and Divorce Rates in Campbell County, 1980 and 1989

Category	Subject	1980	1989
Marriages	U.S. Average	10.6	9.7
	Wyoming	14.6	10.1
	Campbell County	13.7	8.0
Divorces	U.S. Average	5.2	4.7
	Wyoming	8.5	6.7
	Campbell	9.2	6.4

Source: Wyoming Vital Statistics, 1981 and 1989, Wyoming Divisions of Health and Medical Statistics (1983)/Wyoming Dept 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. Note comparisons with Wyoming figures in Table 22.

In 1980, Campbell County had a death rate of 3.6 persons per 1,000 population, in 1989 it had decrease slightly to 3.5 (Table 22).

There appears to be adequate medical facilities located in Gillette. For example: there is the Campbell County Memorial Hospital located in Gillette. It has a 119 bed capacity and in 1990/91 had 3,056 admissions. It has had a 22 percent occupancy rate (Wyoming Medical Facilities Directory, 1990/91, Wyoming Dept. 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).

Table 22: Birth and Death Rates in Campbell County, 1980 and 1989

Category	Place	1980[1]	1989[1]
Births	U.S. Average	15.8	-
	Wyoming	22.5	15.1
	Campbell County	29.3	16.7
Deaths	U.S. Average	8.9	8.7
	Wyoming	6.8	7.1
	Campbell County	3.6	3.5

[1] Numbers are reported in number per 1000 population.
Source: Wyoming Vital Statistics, 1981 and 1989.

This information indicates that the city of Gillette can handle a substantial influx of new people without experiencing the "problems" of growth. If all three proposed projects proceed on schedule, there could be some short-term effects on the city of Gillette. These potential impacts will be discussed in more detail in EIS for West Rocky Butte.