CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter presents the scientific and analytic basis used in the comparison of alternatives described in Chapter 2. Site-specific effects of the individual tracts are contained in the Tract Profiles (BLM, 1981), which are available from the Casper District Office upon request. Description of the affected environment was used in assessing the No-Action Alternative (Alternative 1) which was, in turn, then used as the new baseline to assess Alternatives 2, 3, and 4. Analyses are focused on 1990; however, the time frame expands to 1995 when necessary for the worst-case analysis. Analyses presented in this chapter were made based on the professional judgments of the resource specialists when other sources or references were unavailable. Discussions are presented on a resource by resource basis; however, some resource discussions have been broken down further by alternative as necessary for clarity.

Also included in this chapter are adverse impacts which cannot be avoided should coal leasing occur, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and irreversible or irretrievable commitments of resources.

GEOLOGY AND OTHER MINERALS

The only major impact to geology would be the mining of the coal. The direct impact to topography is insignificant in itself, but would impact wildlife and is assessed in the Wildlife section of this chapter. Table 4-1a gives annual coal production projected for 1990 under each alternative. Table 4-1b shows production amounts for federal reserves only.

UNAVOIDABLE ADVERSE IMPACTS

Removal of the coal beds and destruction of overlying strata.

SHORT TERM VS. LONG TERM

There are no short-term impacts associated with geology. The long-term impact would be the loss of the mined coal reserves for future use.

IRREVERSIBLE/IRRETRIEVABLE

Coal once mined and consumed would be irreversible. Coal not mined and left due to lack of technology would be economically irretrievable once the mining has passed it by. Coal lost would equal 10-15 percent of the reserve base available for each alternative (Table 1-1).

WATER RESOURCES

Ground Water

Impacts to the ground water resources would occur primarily in the vicinity of the mined area and would have little effect on the regional ground water systems. Impacts include removal or modification of aquifers, interruption of ground water flow during mining, modification of flow after reclamation, and changes in water quality.

The impacts of uranium mines on the water resources of the region are discussed in detail in environmental statements dealing specifically with individual uranium mine plans; therefore, no further discussion of the subject is included in this regional analysis.

Mining of new federal coal would result in the removal of the lowest coal aquifer mined and all aquifers above it. Coal beds are usually the most extensive shallow aquifers in the region; whereas sandstone aquifers in the overburden and interburden are usually lenticular beds of relatively small areal extent.

Reclamation regulations require that the overburden and interburden (spoil) be replaced in the mine to restore the area to as nearly its original condition as practical. The replaced spoil is usually moderately permeable unless it is unduly compacted during emplacement. Studies by Rahn (1975) indicate that dragline-laid spoil which undergoes gravity sorting and minimal compaction by machinery may be as much as a hundred times more permeable than scraper-laid spoil which is compacted by scraper wheels. Aquifers created by dragline-laid spoil can have a higher recharge rate and yield than the combined total of the original aquifers, while scraper-laid spoil aquifers may have lower recharge rates and yield than the original aquifers. Truck-shovel-laid spoil is in between in water-bearing characteristics. Thus the impact of removing aquifers in the mined areas can be mitigated by replacing spoil in a manner to create aquifers with water-bearing characteristics equal or superior to those of the original aquifers.

Coal mining would create a hole in the ground that will act as a large well if the mine extends below the water table. Water entering this "well" would be lost through evaporation, either naturally or as it is used for dust suppression or other mine purposes, or will be discharged to streams in dewatering operations. This discharge would create a lowering of water levels (cone of depression) in the vicinity of the mine. Pumping of standard-type wells to supply additional water for mine operations would increase the cone of depression.

The change in the water level surrounding the mine would depend on aquifer characteristics, recharge rates, and pumping rates. The greatest declines would be in the mine itself and would decrease with distance from the mine edges to negligible amounts within a few miles.

If the cone of depression caused by mining intersects a nearby stream, the hydraulic gradient of the water table can be reversed so that water moves from the stream toward the mine. A reduction in streamflow would result, but because of restrictions on mining alluvial valley floors and the generally low permeability of earth materials in the region other than alluvium, the reduction would be less than 1 percent.

Modification of ground water flow after reclamation results from breakup of the layering that generally occurs in native formations of the region and from modification of the slope of the land surface. In many parts of the region relatively impermeable shale layers interbedded with sandstone and coal cause perched zones of saturation to form. Where perching layers outcrop, springs or seeps occur. The replaced spoil is relatively uniform in composition so that vertical and horizontal permeability are similar, thereby eliminating perched zones and their springs and seeps and increasing recharge to the water table. The removal of springs and seeps from their former locations would affect the plants and animals that depended on the additional water at those locations. Springs and seeps might reappear at different locations after reclamation is completed or the extra recharge to the water table might discharge into streams. The overall impacts of mining would be to permanently change the pattern of ground water flow but mining would not permanently diminish the quantity of water available in the area of the mine.

The water in the spoil aquifer would be of poorer quality than the water in the original aquifers. This is because the disturbed spoil presents many fresh surfaces to percolating water and this causes solution of soluable minerals to occur at a higher rate. The solution rate would eventually return to normal levels; however, with the low levels of precipitation and recharge prevalent in the Powder River Region, this process may take many years, perhaps centuries. Contamination of ground water in spoil aquifers can be mitigated by requiring selective placement of saline spoil above the zone of saturation. The ground water occurring naturally in the region varies greatly in mineral content both areally and with depth at a given location. Spoil aquifer water varies also, but generally is two to three times as mineralized as water from undisturbed coal aquifers but typically is no higher in mineral content than the most highly mineralized ground water in the area (personal communication, N.J. King, USGS, 1981).

Water in spoil material typically contains calcium-magnesium-sulfate with lesser amounts of sodium and bicarbonate; whereas, water in the coal aquifers typically contains sodium-bicarbonate. Calcium-magnesium-sulfate water containing as much as 3,000 mg/L of dissolved solids generally is unsuitable for domestic use but should have no deleterious effects on livestock and wildlife. Water containing as much as 7,000 mg/L would be highly cathartic and would be marginal for use by livestock and wildlife. Ground water that is of the sodium-bicarbonate type and lower in dissolved solids usually can be obtained by developing wells in aquifers below the spoil aquifer. However, pumping lifts and costs would be greater if the mine is in a recharge area.

Because of the low sulfur content of coal in the region, no acid mine-water drainage problems are expected (BLM, 1979a). Also, trace elements and heavy metals normally are filtered out of the ground water in mined areas by coal wastes and other carbonaceous materials in the spoil.

Where spoil aquifers discharge into a nearby stream, the increased salt load from leaching of the spoil can be significant and contribute to the salinity of the stream. However, where discharge is indirect to the upper reaches of an ephemeral stream far from its confluence with a perennial stream, it may take decades or even centuries before any effects are noticed downstream. This is especially true where the natural DS concentrations of water in the alluvium underlying the stream is similar to that of the leachate from the spoil aquifer. The long-term effects of the movement of more highly mineralized water from the spoil aquifer into adjacent, undisturbed less mineralized aquifers is not clearly understood. However, a significant reduction in DS concentrations can be expected with increasing distance from the mined area as a result of the selective retention of ions on particle surfaces (Riffenburg, 1925; Qayyum and Kemper, 1962). Thus, degradation of water quality in areas adjacent to reclaimed spoil is expected to be a slow process, and it would be centuries, if ever, before deleterious effects become significant more than a few hundered feet from reclaimed areas.

Different aquifers that had poor hydraulic connection before mining would be connected through the spoil, allowing circulation if there were head differences (water pressure differences at higher and lower points) between the aquifers; however, this effect would also tend to decrease with increasing distance from the mine. Changes in hydraulic gradients in the vicinity of the mine would be insignificant when considering the total aquifer system.

Municipal water requirements due to additional population would increase up to 2,700 acre-feet per year for the region in 1990 (see Table 2-1). This increase would not have significant impact on the entire region but could have considerable impact on Ashland, Broadus, and Gillette, since it is anticipated that these towns would have the largest population increases. The following measures are being taken to mitigate these impacts. Ashland has a relatively new water system (4 years old) that has a capacity to supply more than twice the present population. The water system of Broadus is adequate to supply the present population and some increase; however, plans are being made to develop a new well field to supply the projected increased population expected by 1990. Gillette is developing a new well field (operational June 1, 1981) with the potential to supply 10 times the current municipal use. The quality of the water from this new well field is superior to that of the existing well field and would be blended to improve the quality of the present supply.

Surface Water

The surface outflow from the region would be reduced by 350 to 700 acre-feet per year (0.05 to 0.1 percent) but the impact would be negligible. Estimates of the reduction of surface outflow from the prospective lease tracts are based on field observations and are less than the projected increases in water use because much of the water intercepted and consumed by mining would otherwise be dissipated by evapotranspiration losses on site or en route downstream. Thus, use of this water for mining would, in part, merely exchange one form of consumptive use for another. The potential depletion of surface water that might result from large-scale ground water withdrawals cannot be quantified due to lack of data. Between 20 and 33 point-watering sources would be destroyed. Although the quantity of water lost would be insignificant, the loss of point-watering sources would be a deterrent to area use by wildlife and livestock until water sources would be restored.

Surface runoff from reclaimed areas may be altered slightly owing to temporary changes in infiltration rates. The effect would be relatively minor and would be short lived because infiltration on spoils would become similar to infiltration on native rangeland as root systems develop.

Discharge from coal-spoils aquifers may contain DS concentrations that are two to three times greater than those in the adjacent undisturbed aquifers (Van Voast and Hedges, 1975). This water could be cathartic and marginal for use by livestock and wildlife. Most of the discharge from spoils aquifers would occur as small springs and seeps in ephemeral stream channels, which would delay and reduce the effect of that discharge on the quality of water in perennial streams. The possible exception would be the Tongue River which may receive spoils discharge through the clinker. The upper limit of the potential increased dissolved load of the Tongue River that would result form the leaching of mine spoils (without additional leasing of federal coal, and assuming DS concentrations of spoils discharge is twice that from undisturbed aquifers) is estimated to be about 0.5 percent. The proposed leasing and development of additional federal coal could cause the DS concentrations of the Tongue River to increase 0.4 to 0.5 percent (a cumulative increase of 0.9 to 1.0 percent) depending on the alternative selected. Because Armells Creek would have the greatest area of spoils in relation to the size of the drainage, the dissolved load of Armells Creek near Forsyth, Montana, may be increased by as much as 4 percent owing to leaching of mine spoils. However, the increase in DS concentrations in Armells Creek, the Tongue River, and other tributaries to the Yellowstone River would cause the DS concentrations of the Yellowstone River to increase by less than 0.1 percent under Alternative 1, 0.03 percent under Alternatives 2 and 3, and 0.04 percent under Alternative 4. Increases in DS concentrations would have no significant impact on current uses of water or on aquatic biology downstream. In addition to increased concentrations of dissolved solids, sewage effluents typically contain fecal coliforms, suspended solids, nitrates, nitrites, chlorine, ammonia, and orthophosphates. The sewage effluent discharged to the North Platte River would increase about 20 percent at maximum cumulative development in 1990; however, dilution would be at least 60 to 1, which is more than adequate to prevent any significant impact to the aquatic biology downstream. The sewage effluent discharged to Goose Creek would increase nearly 40 percent by 1990, and dilution would be very low during low-flow periods in Goose Creek and the Tongue River; hence, sewage effluent could have a deterious effect on aquatic life in those streams. However, dilution would prevent any impact to the aquatic biology of the Yellowstone River.

National Pollutant Discharge Elimination System (NPDES) permits for all unnatural polluting sources must be issued by the appropriate State agencies (Wyoming Department of Environmental Quality or the Montana Department of State Lands).

Data show that concentrations of heavy metals in some of the spoils leachate are greater than in most of the natural surface water and exceed recommended maximum concentration for irrigation on a continuous basis, livestock use, public supply, and aquatic biota (BLM, 1979a). However, the data are not adequate to allow evaluation of potential hazards related to possible heavy metal contamination of streamflow by discharge from spoils aquifers.

Sewage effluent would increase in proportion to the quantity of municipal water used. As a result, increased salinity and harmful bacterial contamination would occur in the Tongue and North Platte rivers. The increase in DS concentrations resulting from increased sewage effluent would be about 0.5 percent in the Tongue River and 0.07 percent in the North Platte River. This would cause no significant impact to the aquatic biology downstream.

Restrictions on sediment transport from areas disturbed by mining activities (30 CFR 816.42 and 817.42) would result in reduced sediment yields from those areas. However, existing regulations do not apply to disturbances resulting indirectly from coal mining such as housing construction and related urbanization. Such off-site disturbances would cause sediment yields to double for 1 to 2 years and thereafter gradually decrease, returning to the predisturbance rate in 3 to 4 years. The decreased sediment yield from mined areas would offset increases resulting from urbanization; thus, impacts from increased erosion and sedimentation would be very local and short term.

UNAVOIDABLE ADVERSE IMPACTS

1) Removal of parts of certain aquifers would change the character of the aquifers in the mined area. Cumulative disturbance under Alternatives 2, 3, and 4 would affect a small (35,000 to 60,000 acres) part of the total area (25 million acres) and the effects would be only in the mined areas. At least 47 wells and eight small springs and possibly 100 wells and 10 springs (over Alternative 1) would be destroyed by mining; however, the wells could be replaced by deeper wells and new springs probably would eventually appear. There would be negligible effect on the regional ground water system.
2) Interruption of premining ground water flow would lower water levels in 58 to 81 wells (over Alternative 1) within a few miles of the mine, but the effect would be limited to the period of mining and would diminish with distance from the mine.
3) Modification of ground water flow by replaced spoil aquifer would eliminate perching conditions which created springs and seeps in cer-

tain areas. The effects would be limited to the area of the mine and would have negligible impact on the regional ground water system. Increased water use by the increased population resulting from mining new federal coal would cause a small lowering of ground water levels in the vicinity of municipal well fields.

4) Changes in ground water quality caused by leaching of spoil materials would increase DS concentrations in reclaimed areas possibly to two to three times the mining levels. The effects would be long term but would be largely local and the water would still be suitable for livestock.

5) Municipal use of water would increase up to 2,700 acre-feet (Alternative 4) per year. Increased consumptive use would decrease surface outflow by about 0.05 to 0.1 percent. The DS concentrations of streamflow in the region could increase by a maximum of about 4 percent, but the increase would be undetectable in the major rivers that carry water beyond the region.

SHORT TERM VS. LONG TERM

Ground water levels in the vicinity of the mines would be lowered during mining; however, they would return to near premining levels within a few years after reclamation. Reclaimed spoil aquifers contain two or three times the mineralization of the original aquifer and this would create a short-term impact on water quality from spoil aquifers. In the long term, the water would gradually return to approximately the same quality as the average quality in the removed aquifers.

Consumptive use of water by the increased population, which is assumed to be permanent, would reduce water yield from the region by less than 0.025 or up to 0.05 percent.

IRREVERSIBLE/IRRETRIEVABLE

Removal of aquifers and other strata in the mined areas would permanently destroy 35,000 to 60,000 acres of aquifers (.002 percent of total aquifers within the region) and alter conditions of ground water occurrence. Removal of perching layers would destroy eight to ten springs and several seeps. Forty-seven to 100 shallow wells would be permanently destroyed (Van Voast and Hedges, 1975).

Water consumed by the increased population would be irretrievable. Increased consumptive use at maximum development would be 2,700 acre-feet per year. Increased DS concentrations that result from increased sewage effluent would irreversibly increase the DS concentrations of receiving streams by as much as 0.07 percent, but water would still be suitable for all current uses.

AIR QUALITY

The direct effects from mining activities and the indirect effects of mining-related development (associated population and transportation growth) were assessed for the areas in which significant increases in concentrations above background levels are expected. These areas are the Decker area, the Colstrip area, and the Custer National Forest area and Gillette (Radian, 1981).

The significant pollutant emissions associated with the development of the proposed lease tracts and the accompanying secondary growth are TSP, NO_2, and SO_2. Impacts of emissions of the other criteria pollutants would be insignificant, and virtually unmeasurable on a regional scale (Radian, 1981). Mining activities generate significant quantities of TSP, and relatively small quantities of NO_2, SO_2, CO, NMHC, O_3, and Pb. Power plants in the affected region are significant sources of TSP, NO_2, and SO_2, while emitting smaller amounts of the other pollutants. The principal emissions from cities and towns are TSP, NO_2, and SO_2. Vehicular traffic may produce localized elevations of CO levels, but these emissions are not significant on a regional basis. Thus, the analysis of air quality will focus on the impacts on ambient levels of TSP, NO_2, and SO_2.

The models, meteorological data, receptor array, and vistas used in the air quality analyses are discussed in the Technical Report (Radian, 1981).

Characterization of the source emission is also discussed in the Technical Report (Radian, 1981). Included are the emission factors, control devices, and efficiencies. Also discussed are the major point and area sources which would be impacted by the proposed mines.

All pollutant sources must be evaluated to determine PSD applicability. Coal mines are subject to new source review for PSD only if nonfugitive emissions of any regulated pollutant exceed 250 tons per year after application of controls. Surface coal mines will seldom have the potential to exceed that level. This essentially eliminates the proposed lease tracts from the detailed PSD review process.

Therefore, PSD applicability is not discussed further.

Alternative 1

Annual TSP concentrations near existing mines in Montana and near Sheridan, Wyoming, would not exceed 25 $\mu g/m^3$ (33 percent of the Montana and federal standard and 40 percent of the Wyoming standard). In the vicinity of Gillette, Wyoming predicted concentrations would not exceed 40 $\mu g/m^3$ (53 and 67 percent of the federal and Wyoming standards, respectively). Near the Caballos Rojo and Cordero Mines, the TSP levels could be as high as 50 $\mu g/m^3$ (67 and 83 percent of the federal and Wyoming standards, respectively). Total TSP levels would be about 69,300 tons per year.

Emissions from Gillette are predicted to add less than 1 $\mu g/m^3$ to the background TSP levels in 1995. The interaction of the town, the surrounding mines, and the major roads entering Gillette would contribute less than 5 $\mu g/m^3$ to the background levels of 16 $\mu g/m^3$ outside of Gillette.

Other major source contributions include major roadways such as I-90 between Gillette and Moorcroft which adds 1 $\mu g/m^3$ or less to background levels, and the Wyodak and Neil Simpson power plants which would add less than 8 $\mu g/m^3$ to the background TSP concentration.

Predicted concentrations of NO_2 throughout the region would not exceed the state or federal ambient air quality standards in 1990 or 1995. Ambient concentrations in the vicinity of Gillette are predicted to be less than 48 $\mu g/m^3$ and regional impacts of emissions from the Wyodak and Neil Simpson power plants would be less than 35 $\mu g/m^3$. Roadways would contribute less than 3 $\mu g/m^3$ to the 16 $\mu g/m^3$ background level.

The interaction among all NO_2 sources would produce NO_2 concentrations no greater than 40 $\mu g/m^3$. Combined with the background level of 16 $\mu g/m^3$ total ambient NO_2 concentrations would reach 56 $\mu g/m^3$ which is 56 percent of the state and federal standards.

Predicted 1990 and 1995 SO_2 concentrations throughout the region are less than 26 $\mu g/m^3$ (including the 1 $\mu g/m^3$ background level), which is 32 percent of the federal standard and 43 percent of state standard. The highest concentrations would be in the vicinity of Neil Simpson and Wyodak power plants.

Alternative 2

Alternative 2 would not significantly increase the emissions from any town, roadway or power plant in the region. The impact of emissions from these sources would not noticeably change from Alternative 1 impacts.

The Colstrip tracts would increase TSP concentrations 5 $\mu g/m^3$ above Alternative 1 levels to 26 $\mu g/m^3$ vicinity of these mines. The interaction of the Colstrip tracts with nearby existing mines (i.e., Big Sky) is negligible.

Ashland (Coalwood) and Northwest Otter Creek would add 5 $\mu g/m^3$ near the mine boundaries to the 16 $\mu g/m^3$ background level 1 $\mu g/m^3$ about 1 mile from the mines. The interaction of these mines with existing Coal Creek Mine is negligible.

Spring Creek, North and West Decker mines would add 5 $\mu g/m^3$ to the Alternative 1 TSP levels. This would result in ambient concentrations of 26 $\mu g/m^3$ around the East, North, and West Decker mines.

Spring Draw would increase TSP concentrations 1 $\mu g/m^3$ within 1 to 2 miles of the mine. This would act to increase the area of 5 and 20 $\mu g/m^3$ total TSP concentrations over what was predicted in Alternative 1. Concentrations near the mine boundaries at Timber Creek and Duck Nest Creek would increase by 5 $\mu g/m^3$. Increases of 1 $\mu g/m^3$ would occur within 2 to 3 miles of these mines. These mines will act to increase the size of the concentration isopleths. Duck Nest Creek would interact with Belle Ayr to increase concentrations by 10 $\mu g/m^3$. Total TSP level would be about 84,700 tons per year.

The increase in nitrogen dioxide concentrations is predicted to be less than 5 $\mu g/m^3$ within the region in 1990 and 1995, resulting in ambient levels of 21 $\mu g/m^3$.

Sulfur dioxide levels are not predicted to increase more than 1 $\mu g/m^3$ above the background level of 1 $\mu g/m^3$ throughout the region in 1990 and 1995.

Alternative 3

The impacts of Alternative 3 are the same as for Alternative 2 except in the area of Spring Draw, Kintz Creek, and Keeline. Spring Draw is not included in this alternative. Kintz Creek and Keeline are predicted to add less than 5 $\mu g/m^3$ of TSP in their vicinity in 1990 and 1995. These two tracts would interact with existing mines to produce ambient concentrations of less than 26 $\mu g/m^3$. Total TSP level would be about 86,100 tons per year.

The increase in nitrogen dioxide concentrations is predicted to be less than 5 $\mu g/m^3$ within the region in 1990 and 1995 resulting in ambient levels of 21 $\mu g/m^3$.

Sulfur dioxide levels are not predicted to increase more than 1 $\mu g/m^3$ above the background level of 1 $\mu g/m^3$ throughout the region in 1990 and 1995.

Alternative 4

The impacts of the maintenance tracts in Alternative 4 are identical to those of Alternatives 2 and 3. The impact of Duck Nest Creek is identical to its impact in Alternatives 2 and 3. The impacts of Spring Draw, Kintz Creek and Keeline are identical to those of Alternatives 2 and 3.

Ashland (Decker-Birney), Ashland (Coalwood), Northwest Otter Creek, and Southwest Otter Creek all produce impacts of less than 10 $\mu g/m^3$ near the mines and 1 $\mu g/m^3$1 mile from the mines. Their interaction results in ambient concentrations of 26 $\mu g/m^3$ between the two Ashland mines and an area of 17 $\mu g/m^3$ concentrations stretching 15 miles along the north-south axis of Ashland (Coalwood) and Southwest Otter Creek and 9 miles along the east-west axis of Ashland (Decker-Birney) and Northwest Otter Creek. In this alternative, Rocky Butte and Timber Creek interact with Caballo to produce maximum ambient concentrations of approximately 46 $\mu g/m^3$. This is 77 percent of the Wyoming standard and the federal secondary standard. Total TSP level would be about 94,900 tons per year.

The increase in nitrogen dioxide concentration is predicted to be less than 5 $\mu g/m^3$ within the region in 1990 and 1995 resulting in ambient levels of 21 $\mu g/m^3$.

SO_2 levels are not predicted to increase more than 1 $\mu g/m^3$ for an ambient concentration of 2 $\mu g/m^3$ throughout the region in 1990 and 1995.

Short-term (24-hour) modeling was performed for two groups of sources near the town of Gillette. One group consisted of the town of Gillette; the Neil Simpson and Wyodak power plants; and Wyodak, East Gillette, Dry Fork, South Rawhide, Buckskin, and Eagle Butte surface coal mines; and Spring Draw tract. The other group consisted of the Rocky Butte, Timber Creek, Duck Nest Creek tracts; and Caballo, Belle Ayr, Pronghorn, Caballos Rojo, and Cordero surface coal mines. Emissions from 1995 were modeled to determine maximum 24-hour TSP concentrations since emissions for 1990 would be less. Therefore, air quality impacts predicted for 1995 are a conservative estimate of maximum expected short-term concentrations.

Emissions from the mines and power plants north and east of Gillette produced several areas with ambient concentrations greater than 36 $\mu g/m^3$. The ambient concentrations exceed 116 $\mu g/m^3$ in several areas. Violations of the Wyoming 24-hour standard may occur north of Spring Draw, Buckskin, Rawhide, and Wyodak.

In the area southeast of Gillette, the mines interact to form several areas with concentrations exceeding 36 $\mu g/m^3$ the largest of which extends for about 11 miles north-south. Ambient concentrations greater than 116 $\mu g/m^3$ occur at several locations. Ambient concentrations in the following areas may exceed the 24-hour TSP standard in Wyoming: northeast of Rocky Butte, Belle Ayr and Duck Nest Creek, and southeast of Caballos Rojo.

The visibility impacts of the existing sources and the proposed mines would not be significant. Reduction of visual range in 1995 east of the Northern Cheyenne Indian Reservation would be about 3 percent and a decrease in apparent contrast 0.047. North of Gillette reduction of visual range would be about 7 percent for 1995 and decrease in apparent contrast 0.021. (The inherent contrast of the viewed object is assumed to equal -0.7, a typical value for a tree covered hill). Therefore, on a regional basis, the proposed alternatives would cause a minimal visibility impact. Visibility degradation may occur downwind of the largest proposed mines when meteorological conditions cause poor dispersion.

The Technical Report (Radian, 1981) contains a more detailed discussion of the above results.

UNAVOIDABLE ADVERSE IMPACTS

The coal cannot be produced by surface mining without generating fugitive dust. The impacts of individual mines decrease rapidly beyond the mine boundary. Annual ambient TSP levels would increase by 1 $\mu g/m^3$ over sizeable portions of the region. Localized violations of the short-term standards could occur if unfavorable meteorological conditions persist for several hours at a time.

SHORT TERM VS. LONG TERM

Anticipated air quality impacts would constitute a short-term use of the air resource. Insofar as the impacts may cause or contribute to violations of the federal and state ambient air quality standards (e.g., in the immediate vicinity of some existing and proposed mine clusters), or consume a portion of the PSD increment, there would be a potential restriction on the nearby development of other industrial activities that emit air pollutants. Near the mines, this impact would cease when mining activities are completed and the areas are reclaimed. Air pollutant emissions that result from the portion of the induced population that chooses to remain in the area after mining is completed may continue to consume a minor portion of the PSD increments, and thus may result in a small, localized long-term impediment to industrial siting opportunities.

IRREVERSIBLE/IRRETRIEVABLE

On a regional basis, the proposed leasing actions would irreversibly commit a relatively small portion of the air resource. Upon completion of the mining activities, reclamation of the leased properties and relocation of the population increments that result directly and indirectly from the mining activities, it would be possible to retrieve the air resource commitment and return air quality to the current conditions.

SOILS, VEGETATION, AND RECLAMATION

The difference in impacts to soils and vegetation between alternatives primarily is a function of the amount of soil disturbed. Table 4-3 shows the total acres disturbed through end of mine life. The impacts of these alternatives on the soils would be the alteration of existing soil characteristics and properties. These alterations would affect permeability, infiltration rates, soil/air and soil/water relationships, bulk density, nutrient level, micro-organism composition, and productivity, all of which have developed over a period of time.

All of the regional development activities would result in accelerated erosion by wind and water due to exposure and increased activity, until the soil is revegetated. The increased erosion would result from the disturbed soils not having any protective cover and inability of the soil to soak up water. Future population increase in the region would impact soils by a permanent loss of soil surface which results from the construction of housing and support facilities.

Reclaimed soils would not redevelop structural characteristics comparable to the original soil for decades (in the case of less developed soils) to many centuries (for the more developed soils) or not at all for Aridisols, which probably formed under a different climate. Though these lands would be reclaimed, in some cases they would require more intensive and costly management to be revegetated and stabilized. The success of reclamation and revegetation would depend on the nature of the mine site and the specifics of the mine and reclamation plan. Reclamation success for vegetation has been shown to be good so the impact of vegetation loss would not be long term (BLM, 1981; Packer, 1974).

UNAVOIDABLE ADVERSE IMPACTS

The residual impacts on soils would be the alteration of existing soil characteristics and properties. These alterations would affect permeability, infiltration rates, soil/air and soil/water relationships, bulk density, nutrient level, micro-organism composition, and productivity. Vegetation would be lost until reclamation and revegetation is completed.

SHORT TERM VS. LONG TERM

Return of a significant part of the disturbed land to a productive state during the life of the mine is anticipated. Several years after initial revegetation, vegetative productivity could vary from 50 to 100 percent of the premining level, which exhibits wide variation due to different soils and terrain.

IRREVERSIBLE/IRRETRIEVABLE

Soil loss resulting from disturbance would be considered irretrievable. The disturbance of natural soil profiles and the different associated vegetation types is irreversible.

WILDLIFE

Losses (death and relocation) to mule deer could be as high as 450 (net loss by end of mining equalling 4 percent of total hunt area population). Major causes for these losses would be habitat loss, and a combination of poaching, road kills, and urban development. Location of mines, access roads, and railroad spurs would disrupt local daily and seasonal movements in the Otter Creek area. Drastic topography changes in hunt areas 17 and 18 would occur due to the Thunderbird, Wildcat and Horse Creek developments. Extensive areas of ponderosa pine or juniper cover would be mined and removed for use as important thermal and escape cover.

Antelope losses (death and relocation) within the region could be as much as 2,460 animals (net loss by end of mining). These losses would occur due to habitat loss, location of railroad and access roads, and increased traffic. Up to 460 animals could be lost in the Decker and Otter Creek areas alone during a severe winter due to loss of critical habitat (USGS, 1979; Martin, 1980). The Spring Creek and North Decker Mines would remove several hundred acres of critical habitat used by about 375 antelope during the severe winters of 77-78 and 78-79. This, in turn, would cause overcrowding on nearby important winter ranges. The animals would be more vulnerable to death from disease and starvation during severely cold weather and heavy snow. Losses to antelope in hunt areas 24 and 101 would be about 560 animals (8 percent of hunt area population). Animal access to hunt areas 24 and 101 would be severely restricted because of the railroad between Gillette and Orin Junction. Seasonal or daily movements would be further restricted by active mining operations and county roads crossing the railroad which would reduce the hunt areas into smaller pastures. Duck Nest Creek tract would create the greatest restriction to movement. Range overuse, possible lack of water sources, increased road kills, and crop depredation would all result from the development of this tract. The mine pit, haul roads, and stream channel diversion would cause the north-south movement corridor between the Belle Ayr Mine and Highway 59 to be about 1 mile wide at the western edge of the pit. Additional restriction of movement in the northern portion of hunt area 24 would occur with the development of Timber Creek and Rocky Butte tracts together. Development of Kintz Creek and Keeline tracts would disrupt seasonal use in the southern portion of hunt area 24. Losses to antelope in hunt area 17 would be about 400 animals (4 percent of hunt area population). The railroad spur to Wildcat, Wildcat Creek, and Horse Creek developments would create a movement barrier to antelope in hunt area 17. Movement to favored wintering areas would further be hindered by increased traffic on Highway 14-16 and the presence of new subdivisions on the west side of the highway. Development of the Spring Draw tract in hunt area 17 would take place in an area used for staging (where animals congregate prior to movement) prior to fall migration. As mining would progress into the western third of the Spring Draw tract severe restriction of seasonal movement would occur. Contributing factors to the impact on this tract would be the presence of housing subdivisions to the west and northwest, and the Buckskin Mine access road to the south. Fall antelope movement north of Rocky Butte tract would be further hindered by new housing subdivisions.

About 13 sharp-tailed grouse leks could be affected. Four sharp-tailed grouse leks would be destroyed in the Colstrip area and nine in the Otter Creek area. Long-term population decline should not occur in the Colstrip area. As long as sufficient nesting habitat remains near the disturbed lek, the population would probably shift to undisturbed areas. If exceptions are granted on two leks overlying federal minerals in the Otter Creek area, 58 percent of the Otter Creek area population would be affected. One sage grouse lek would be destroyed in the Decker area. Within hunt area boundaries 24 and 101 two sage grouse leks would be destroyed and nesting territories for these game birds would be reduced by 20 to 50 percent.

Approximately 13 percent of the Campbell County population of golden eagles would move to new nesting locations because their nesting sites would be mined. Successful mitigation would involve establishing artificial nests or platforms within a territory being disturbed.

Table 4-4 shows wildlife habitat acreage that would be disturbed under each alternative.

No adverse impacts to threatened or endangered species are anticipated in Wyoming or Montana coal lease areas. Section seven consultation has been completed for the Montana tracts and should be completed on the Wyoming tracts by December, 1981.

UNAVOIDABLE ADVERSE IMPACTS

The short-term loss of wildlife habitat as depicted in Table 4-4 would be unavoidable. Wildlife population losses due to poaching and road kills would be unavoidable.

SHORT TERM VS. LONG TERM

On the short-term, antelope populations could be reduced by as much as 2,000 animals in Wyoming hunt areas 24 and 101 and 17; reduction in the Decker and Otter Creek areas of Montana could be up to 460 antelope. About 13 pairs of golden eagles would be manipulated into nesting away from active mining areas. Sufficient hunting habitat for these birds would exist after mining, which would allow them to reoccupy the nests they presently use. Sharp-tailed grouse population in the Colstrip and Otter Creek areas would be reduced from 15 to 48 percent during the short term due to the loss of 13 leks and adjacent nesting territories.

In the long term, antelope population would remain depressed 10 to 30 years after mining due to the long establishment time for sagebrush to invade reclaimed areas. Also, sharp-tailed grouse population would remain depressed from 10 to 20 years after mining until sufficient escape cover has regrown in reclaimed areas.

IRREVERSIBLE/IRRETRIEVABLE

Animals lost during the development of new coal mines in the region would be irretrievably lost. Loss of topographic diversity (rough topography reclaimed to gentle slopes) would support fewer deer population.

CULTURAL RESOURCES

All cultural sites will be identified on the lease tracts prior to mining. The Keeper of the National Register of Historic Places will determine significance. Any site identified as potentially eligible for listing on the National Register would be protected (National Historic Preservation Act, Section 106). The site density figures are based on the existing documented data base made up of numerous sources. However, the data base in some cases is incomplete.

Cultural resources would be committed to either destruction or data retrieval. Table 4-5 shows estimated cultural sites that could be affected by 1990. A systematic collection and analysis of information would add to the scientific knowledge of the area; however, some knowledge would be lost due to excavation of sites before improved technology is available. Also, unauthorized collection of artifacts due to population increases would result in the reduction of the integrity of the resource. Buried sites would be lost.

UNAVOIDABLE ADVERSE IMPACTS

All sites would be disturbed with mining. Some knowledge would be lost due to excavation of sites before improved technology.

SHORT TERM VS. LONG TERM

A cultural inventory for unstudied areas of the region would be performed at an earlier date with coal development taking place.

IRREVERSIBLE/IRRETRIEVABLE

Cultural resources would be disturbed. Data retrieval would not be available for future researchers. Buried cultural sites would be lost.

VISUAL RESOURCES

Coal mining would have the greatest impact on the scenic quality of the landscape than any of the other energy related activities within the region. The extraction of the coal by strip-mining changes form, line, color, and texture of the landscape. Silos, conveyors, and facility structures change line and color; access roads, railroad spurs, and power lines change line and texture.

These changes would result in a reduction of scenic quality and a change in management class. The area impacted is largely scenic quality C with some B, and VRM Class III or IV (see Appendix D). Within the region the most sensitive locations to this reduction in scenic quality would be along high-use roadways, recreation areas, and near population centers. Mines located in these areas could also provide a resource for interpretive and educational programs.

UNAVOIDABLE ADVERSE IMPACTS

Decreasing VRM Class III and IV areas to Class V through the end of mine life would be unavoidable.

SHORT TERM VS. LONG TERM

Visual contrast impacts created by access roads, railroad spurs, power lines, and facility structures would change VRM Class III and IVs to Class V on the short term.

IRREVERSIBLE/IRRETRIEVABLE

None identified.

LAND USE

Table 4-3 shows acres disturbed by mining for each alternative. Access roads, railroad spurs, and urban growth would remove an additional 11,400 acres under Alternative 1, 800 acres each for Alternatives 2 and 3, and 930 acres under Alternative 4. Underground utilities, pipelines, and overhead power lines would modify agricultural use but would not remove a significant amount of acreage from production.

Impacts to the 44 individual farm and ranch operations would be offset by compensation and royalties to the landowner (see Appendix G).

Loss in crop production would depend upon acres of each crop planted but the acreage itself represents county decreases of .2 percent in Big Horn, .5 percent in Powder River, 1 percent in Rosebud, and 2 percent in Campbell under Alternative 2. Decreases that would occur under Alternative 3 are identical except for Powder River County, which would be 1 percent. Under Alternative 4 decreases would be .2 percent in Big Horn, 1 percent Powder River, 2 percent in Rosebud, and 4 percent in Campbell.

The loss in agricultural land use would represent a loss of 7,063 AUMs of grazing under Alternative 2; 7,558 under Alternative 3; and 11,476 under Alternative 4.

Other impacts upon land use would occur by relocation of railroad lines and county roads.

UNAVOIDABLE ADVERSE IMPACTS

Conversion of existing rural land uses to mine-related and urban uses would be unavoidable. Loss of AUMs described above is also unavoidable.

SHORT TERM vs. LONG TERM

In the short term there would be a loss of agricultural productivity on tracts and in pipeline, powerline and utility rights-of-way until reclamation is completed. There would be a long-term loss of agricultural land use to urban growth.

IRREVERSIBLE/IRRETRIEVABLE

Lands used for urban expansion, access roads, and railroads would be irretrievable.

RECREATION

The present number of facilities would fall short by 1990. The regional population would increase from 180,000 to 239,000 (approximately 30 percent by 1990 for Alternative 1) and 434,000 (approximately 140 percent for Alternative 4). A corresponding increase in all recreational activities would occur. The greatest increases would be fishing in Montana and winter activities in Wyoming (Montana Game and Fish, 1978; Wyoming Recreation Commission, 1980). Hunting pressures would increase in Montana from 64,900 participation days to between 70,700 days for Alternative 1 (No-Action) and 77,000 days Alternative 4 (maximum leasing). In Wyoming the increase would be from 269,625 participation days to between 380,800 for Alternative 1 and 414,700 for Alternative 4.

While not quantifiable the impacts on recreation would be degradation of sites and areas from increased use and vandalism, and increases in operating and maintenance costs to federal, state, and local governments plus the private sector.

UNAVOIDABLE ADVERSE IMPACTS

Population increases from additional coal leasing would place high demand and use on existing facilities which have not increased in supply. Loss of public lands would decrease the areas available for recreation.

SHORT TERM VS. LONG TERM

The short-term effect would be increased use on a resource that is in short supply. The long-term effect would be a decrease in demand when the population levels off or decreases making recreation facility supply adequate.

IRREVERSIBLE/IRRETRIEVABLE

Access to public lands will be irreversibly lost. The aesthetic recreation experience would be irretrievably lost because of the increased number of users on existing recreation areas.

TRANSPORTATION

Railroads

Appendix F (Figure F-3) shows the estimated TPD for each alternative. These impacts are based on peak production and are shown on Table 4-6. The increased number of trains would have the most impact on communities along the main lines. In these communities, interruptions for at-grade crossings would increase the affect on traffic flow, emergency vehicles, yard operations, and noise levels within the communities (see Noise Section). The probability of car/train accidents would also increase as shown in Table 4-6.

Increased traffic along main lines would result in the need for upgrading switches and traffic control systems, additional sidings, and increased maintenance and repair. The capacity of these lines could be increased to keep up with mining production (personal communication, Peter Briggs, BN, 1981). New railroad spurs would be added to provide access to new mine facilities. These new railroad spurs would remove additional acres from agricultural production (see Land Use section).

Highways

Increased traffic is the major impact on road and highway systems. Both the number and type of vehicles impact roads directly. Increases in the traffic along primary and secondary roads would require the need for widening and safety improvements to expand road capacity. Increase in traffic, especially heavy trucks and equipment, would cause maintenance problems such as surface deterioration, ruts, potholes, snow and trash removal, bridge replacement, and signing. Additional increases in traffic would result from increased population. This growth is not estimated to exceed 2 percent annually (personal communication, Phil Colbert, Montana State Department of Highways, 1981). The roads connecting population centers and mines would be most affected. These would be Highway 59, Highway 387, Highway 14/16, Interstate 90 and Highway 87 in Wyoming; Highway 212, FAS 566, FAS 314, FAP 92, Interstate 90, and FAP 39 in Montana.

Increased traffic and road deterioration would cause increased accident rates. Because statistical projections are not available for specific routes, impacts are not quantified.

UNAVOIDABLE ADVERSE IMPACTS

Increases in railroad and auto traffic, delays for auto traffic at grade crossings, accident rates, and road maintenance would be unavoidable.

SHORT TERM VS. LONG TERM

None are identified.

IRREVERSIBLE/IRRETRIEVABLE

Any loss of life or property in car/train accidents.

NOISE

The noise-related impacts within the 55 dBA zone for railroads and highways would be interference of sleep and work tasks, disruption of concentration, general annoyance, and disruption of wildlife and domestic animal activities. These impacts would be most significant in areas along new railroad lines and in small communities which do not presently experience large amounts of highway traffic. These areas would include these along the proposed Tongue River Railroad and the Towns of Broadus, Ashland, and Birney, Montana. For railroads the distance included in this zone has been calculated based on traffic projections. These distances are given in Table 4-7 are number of feet from track center line to the 55 dBA contour. Because actual ADT projections have not been calculated for highway traffic, specific estimates of zones would not be made. The 55 dBA zones for most routes; however, would fall between 500 and 1,000 feet from the road center line.

SOCIOLOGY

Social Organization

Social organization in Ashland and Broadus would change considerably with new federal coal development. Newcomers would be different from long-time residents in terms of occupations, values, and interests (Massey, 1977). Influx of newcomers would be at a rapid rate (see Table 4-11). This rapid population growth would disturb the stability of these two communities by changing their structure and functioning. Because of these two factors, the current informal system would not be able to absorb these newcomers. Thus, newcomers would establish their own independent social networks. Interpersonal relationships would become more formal. Long-time residents may feel a loss of their "sense of community." Also, in Ashland there would be the potential for conflicts between the newcomers and the Native Americans. It is likely the Native Americans would feel their lifestyle and community (both in Ashland and on the reservation) as threatened by newcomers.

Rapid population growth in the Ashland area and the Broadus area would result in visible stresses such as personal property crime, family instability, (divorce, spouse abuse, child abuse and neglict), alcohol and drug abuse, interpersonal conflict, and similar behaviors.

While it is uncertain as to whether the rate would markedly change, the increased population levels would virtually insure that their actual incidents would increase. These stresses of adaptation, affecting both long-time residents and newcomers, would be most evident and intense during the initial construction phase of the mine development under Alternative 4. However, at least until construction is completed and stability is re-established, they would also exist in the Ashland and Broadus areas under Alternative 2 and 3 development.

The social organization in Gillette would continue apace toward formal interpersonal relationships. Population increases would add to the process of urbanization and suburbanization.

Community Services

The community services and facilities that would be required by 1990 are given in Table 4-8.

Housing

Table 4-9 gives the projected number of dwelling units that would be required in 1990 under each alternative.

There is planning underway for housing in the Ashland district. A subdivision has received approval for construction of 46 dwellings and an additional 96 lots (personal communication, Eldon Price, Rosebud County Planner, 1981). Also, planning for two subdivisions near Ashland, located in Powder River County, would provide for an addition of approximately 180 dwellings. The update of the Powder River County Comprehensive Plan of 1979 discusses plans for expansion within the town of Broadus including residential areas (Powder River County Director, 1981). Since Gillette has been growing at a rapid rate, housing construction is expanding concurrently.

ECONOMICS

Table 4-12 presents a comparison of potential fiscal impacts among the alternatives. The exact magnitude of projected deficits or surpluses should not be overemphasized. The importance of magnitudes derives only from their ability to provide a comparison of the relative impacts and to point out the localities where potential costs may exceed potential benefits, or vice versa, where potential benefits may exceed potential costs. Assumptions and methodology are implicit in the footnotes to the table.

Montana

Montana counties, schools or communities do not receive a percentage of the severance tax on mineral production from the state. However, in an effort to tie potential benefits to potential costs in the analysis of Alternatives 2, 3, and 4, additional revenues to local entities were estimated on the basis of coal production.

Big Horn County

Alternative 1 (No Action). Coal production will stimulate growth in Big Horn County even without additional federal competitive leasing. A production increase of 100 percent by 1986 would cause an equal increase in coal mining employment and a moderate increase in employment by other sectors by 1990 (Table 4-10). Population increases (Table 4-11) would result in increases in public expenditures through 1990 (Table 4-12) after which the changes would stabilize.

Alternatives 2, 3 and 4. Were it not for the slight increase in employment caused by the maintenance tract, North Decker, Big Horn County would not be affected economically by Alternatives 2, 3, or 4. Because North Decker is a component of each of Alternatives 2, 3, and 4, the economic impacts to Big Horn County would be the same under each. However, in the final analysis, a relatively insignificant increase in coal employment would not result in a notable increase in public expenditures until 1990, at which time public revenues derived from the tract would equal or slightly exceed the expenditures (Table 4-12).

Powder River County

Alternative 1 (No Action). Without additional federal competitive leasing the economy of Powder River County is expected to remain static (Table 4-12).

Alternatives 2, 3, and 4. All tracts that are expected to provide stimulus to employment, except North Decker, are located in Powder River County. However, due to the close proximity of Ashland, in adjacent Rosebud County, 60 percent of any resulting population increase is expected to reside in Rosebud County.

Even though Powder River County is expected to receive less than half of any population increase, the resulting economic impact would be significant due to the small number of residents in the county. Increases in expected public expenditures during the early phase of construction (1986) would outweigh any possible increase in revenues to the county, at that time, causing a negative fiscal impact under each of Alternatives 2, 3, and 4 (Table 4-12). By 1990, however, fiscal surpluses would occur for county schools and the community of Broadus. Powder River County would experience a fiscal surplus under Subalternatives 2B and 2C or 3B and 3C.

Rosebud County

Alternative 1 (No Action). Ongoing coal development, a new power plant, and an increase in oil and gas activity would put pressure on county, community, and school resources in Rosebud County without additional federal leasing. The heaviest impacts would be realized by 1986 as public expenditures increase by about 30 percent to provide necessary services to an increasing population.

Alternatives 2, 3, and 4. Because Rosebud County, Ashland in particular, would provide residence to 60 percent of the population increase associated with any of the action alternatives, but would not be the recipient of public revenues from the coal production, a negative net fiscal balance would result under Alternatives 2, 3, or 4 (Table 4-12). This would put added pressure on public finances as it would be occurring during a period when public expenditures are expanding due to other developments.

Ashland: It is expected that all of the additional population to Rosebud County, due to Alternatives 2, 3, or 4, would reside in Ashland District (pop. 569 in 1980). This would severely impact the community (see Table 4-11). Alternative 2 or 3 would increase Ashland District population by about 1,700 in 1990, in the worst case.

Agricultural Economics: Appendix G (Tables G-1 and G-2) presents an analysis of the relative impacts to agriculture in the Montana section of the region.

Wyoming

Alternative 1 (No Action). Increased coal production, oil and gas development, new power plants, synthetic fuel plants, and uranium development would all be contributing factors to what is expected to be a period of rapid growth for several counties of the Wyoming region even without additional federal coal leasing. In Campbell County the major force behind an 80 percent increase in population by 1985 (Table 4-11) would be a fivefold increase in coal production, as well as a new power plant. In Converse County a tripling of coal production and the construction of a synfuels plant would contribute to an approximate 50 percent increase in population by 1985. Increased coal production in Sheridan County is expected to be accompanied by moderate growth. Other counties would undergo steady, but less spectacular, growth as they provide services or residences for commuters to the counties of high growth. Population increases in Natrona County and the city of Casper would continue apace as Casper continues to be a trade center providing wholesale and retail outlets and services to the region.

Alternatives 2, 3, and 4. In terms of the economic impacts which would result to Wyoming counties from Alternatives 2, 3, and 4 there are only two alternatives. This occurs because the effects of Alternatives 2 and 3 are the same, leaving a comparison between either of these alternatives and Alternative 4. Predictably, the impacts of Alternative 4 would be the heaviest.

Also predictable is the impact to Campbell County under any of the alternatives. Because all tracts under consideration in the Wyoming section of the region are located in Campbell County, the largest share of employment and population increases would occur in Campbell County (Tables 4-10, 4-11). Any employment or population increases to other counties, under the action alternatives, would be due to creation of secondary employment in the retail, wholesale, and services sectors or as a result of persons employed in Campbell County, but residing in another county.

Population impacts notwithstanding, Campbell County would realize a significant net fiscal surplus as the public revenues associated with Alternatives 2, 3, or 4 exceed the expected public expenditures (Table 4-12). This is true for the school district also. However, after the higher levels of sales and use tax associated with the construction period disappear, incremental expenditures by the city of Gillette resulting under these alternatives would exceed expected revenues by about 2.5 percent of the projected 1990 no-action expenditures under Alternative 2 or 3 or by about 5 percent under Alternative 4.

As the public revenues associated with the new coal production accrue to Campbell County and none to neighboring counties, the incremental net fiscal balance in other counties would be negative as public expenditures expand to serve increased populations. The largest, negative, incremental balances would occur in Natrona County and Casper at about .5 million dollars under Alternatives 2 or 3, or about 1 million dollars under Alternative 4 in 1990. The 1 million dollar level would equal about 3 percent of projected 1990 Natrona school district expenditures.

Agricultural Economics: See Section 3 "Socioeconomics" in the Tract Profiles (BLM, 1981) on the individual tracts for a discussion about the effects of coal production on Wyoming agriculture.

UNAVOIDABLE ADVERSE IMPACTS

The following unavoidable adverse impacts are presented by alternative for the purpose of comparison. Alternative 1 impacts have been added to each of the other alternatives.

ALTERNATIVE 1

1) Removal of the coal beds and destruction of overlying strata.
2) Removal of approximately 210,000 acres of aquifers.
3) Destruction of 252 wells and 25 springs.
4) DS concentrations would increase in reclaimed areas possibly two to three times the mining levels.
5) Total TSP levels would be about 69,300 tons per year.
6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 210,000 acres.
7) Wildlife population losses due to poaching and road kills.
8) Between 1,311 and 3,733 cultural sites would be disturbed. Some knowledge would be lost due to excavation of sites before improved technology.
9) Decrease of VRM Class III and IV areas to Class V.
10) Loss of 11,400 acres for conversion of existing rural land uses to mine-related and urban uses.
11) High demand would be placed on existing recreation facilities.
12) Increases in railroad and highway traffic.
13) Increased delays for auto traffic at grade crossings.
14) Increases in road maintenance.
15) Increases in accident rates.

ALTERNATIVE 2

1) Removal of the coal beds and destruction of overlying strata.

2) Removal of approximately 245,000 acres of aquifers.
3) Destruction of 299 wells and 33 springs.
4) DS concentrations would increase in reclaimed areas possibly two to three times the mining levels.
5) Total TSP levels would be about 84,700 tons per year.
6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 267,400 acres (Alternative 1 plus Alternative 2 acreage from Table 4-3).
7) Wildlife population losses due to poaching and road kills.
8) Between 1,882 and 4,304 cultural sites would be disturbed. Some knowledge would be lost due to excavation of sites before improved technology.
9) Decrease of VRM Class III and IV areas to Class V.
10) Loss of 1,200 acres for conversion of existing rural land uses to mine-related and urban uses.
11) High demand would be placed on existing recreation facilities.
12) Increases in railroad and highway traffic.
13) Increased delays for auto traffic at grade crossings.
14) Increases in road maintenance.
15) Increases in accident rates.

ALTERNATIVE 3

1) Removal of the coal beds and destruction of overlying strata.
2) Removal of approximately 247,000 acres of aquifers.
3) Destruction of 310 wells and 35 springs.
4) DS concentrations would increase in reclaimed areas possibly two to three times the mining levels.
5) Total TSP levels would be about 86,100 tons per year.
6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 274,000 acres (Alternative 1 plus Alternative 3 acreage from Table 4-3).
7) Wildlife population losses due to poaching and road kills.
8) Between 1,855 and 4,277 cultural sites would be disturbed. Some knowledge would be lost due to excavation of sites before improved technology.
9) Decrease of VRM Class III and IV areas to Class V.
10) Loss of 12,200 acres for conversion of existing rural land uses to mine-related and urban uses.
11) High demand would be placed on existing recreation facilities.
12) Increases in railroad and highway traffic.
13) Increased delays for auto traffic at grade crossings.
14) Increases in road maintenance.
15) Increases in accident rates.

ALTERNATIVE 4

1) Removal of the coal beds and destruction of overlying strata.
2) Removal of approximately 270,000 acres of aquifers.
3) Destruction of 352 wells and 35 springs.
4) DS concentration would increase in reclaimed areas possibly two to three times the mining levels.
5) Total TSP levels would be about 94,900 tons per year.
6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 293,500 acres (Alternative 1 plus Alternative 4 acreage from Table 4-3).
7) Wildlife population losses due to poaching and road kills.
8) Between 2,148 and 4,570 cultural sites would be distubed. Some knowledge would be lost due to excavation of sites before improved technology.
9) Decrease of VRM Class III and IV areas to Class V.
10) Loss of 12,330 acres for conversion of existing rural land uses to mine-related and urban uses.
11) High demand would be placed on existing recreation facilities.
12) Increases in railroad and highway traffic.
13) Increased delays for auto traffic at grade crossings.

14) Increases in road maintenance.
15) Increases in accident rates.

SHORT TERM VS. LONG TERM

The following lists of relationships between short-term uses of man's environment and the maintenance and enhancement of long-term productivity have also been presented by alternative.

ALTERNATIVE 1

1) Short-term impact of an increase in DS concentrations in reclaimed areas.
2) Ground water levels in the vicinity of the mines would be lower during the short term but would return to near premining levels after reclamation.
3) Anticipated air quality impacts would constitute a short-term use of the air resource near the mines which could place a potential restriction on the nearby development of other industrial activities that emit air pollutants.

ALTERNATIVES 2, 3, AND 4

1) Short-term impact of an increase of DS concentrations in reclaimed areas.
2) Ground water levels in the vicinity of the mines would be lower during the short term but would return to near premining levels after reclamation.
3) Anticipated air quality impacts would constitute a short-term use of the air resource near the mines which could place a potential restriction on the nearby development of other industrial activities that emit air pollutants.
4) Return of a significant part of the disturbed land to a productive state during the short term is anticipated.
5) Long-term productivity would be lowered for wildlife until sagebrush is re-established.
6) A cultural inventory of the unstudied areas of the region would be performed at an earlier date.
7) Short-term loss of agricultural productivity on the tracts until reclamation.

IRREVERSIBLE/IRRETRIEVABLE

The following types of irreversible or irretrievable commitments of resources would be the same under each alternative; differences between alternatives would be magnitude.

1) Coal once mined and consumed would be irreversible. Coal not mined due to lack of technology would be economically irretrievable.
2) Removal of aquifers and other strata in the mined areas would alter conditions of ground water occurrence.
2) Removal of perching layers would destroy springs and seeps.
3) Wells would be permanently destroyed.
4) Municipal water consumed by the additional population would be irretrievable.
6) Any soil loss resulting from disturbance would be irretrievable.
7) Disturbance of natural soil profiles and different associated vegetation types is irreversible.
8) Wildlife lost would be irretrievable.
9) Loss of topographic diversity would support fewer deer population.
10) Disturbance to cultural resources would be irreversible. Data retrieval would not be available to future researchers. Buried sites would be lost.
11) Land used for urban expansion and mine-related uses would be irretrievable.
12) The aesthetic recreation experience would be irretrievably lost.
13) Loss of life or property is irretrievable.

TABLE 4-1a
ANNUAL COAL PRODUCTION - 1990 (MILLION TONS)
(Federal, State and Private Coal)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Existing Mines	194.43	194.43	194.43	194.43
Proposed Mines	128.9	181.00	181.60	330.50
PRLAs	45.55	45.55	45.55	45.55
Total	368.88	420.98	421.58	470.48

TABLE 4-1b
ANNUAL COAL PRODUCTION - 1990 (MILLION TONS)
(Federal Recoverable Reserves Only)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Existing Mines	194.43	194.43	194.43	194.43
Proposed Mines	128.90	166.70	169.20	201.90
PRLAs	45.55	45.55	45.55	45.55
Total	368.88	406.68	409.18	441.88

TABLE 4-2
ESTIMATED MAXIMUM POTENTIAL EFFECTS ON DISCHARGE AND DISSOLVED-SOLIDS CONCENTRATIONS OF STREAMS

	Percent reduction in flow				Percent increase in dissolved-solids concentration			
	Alternative				Alternative			
	#1	#2	#3	#4	#1	#2	#3	#4
Armells Creek	1.8	a/	a/	a/	1.2	4.0	4.0	4.0
Rosebud Creek	1.0	a/	a/	a/	1.8	0.1	0.1	0.1
Tongue River	0.4	0.07	0.07	0.1	0.5	0.4	0.4	0.5
Otter Creek	0.01	1.3	1.3	2.7	0.02	1.2	1.2	2.5
Powder River	0.1	a/	a/	a/	0.3	a/	a/	a/
Little Powder River	2.8	0.2	a/	0.2	4.0	0.2	a/	0.2
Cheyenne River	0.7	a/	0.1	0.1	1.5	a/	0.1	0.1
Belle Fourche River	3.5	0.4	0.6	0.7	5.0	0.4	0.6	0.7
North Platte River	0.7	a/	a/	a/	0.07	a/	a/	a/
Yellowstone River	0.3	0.003	0.003	0.006	0.09	0.03	0.03	0.04

a/ No additional effect.

TABLE 4-3
TOTAL ACRES DISTURBED/VEGETATION TYPES AND LAND USE a/

		RANGELAND			AGRICULTURE			
ALTERNATIVE	TOTAL	SAGE/GRASS	GRASSLAND	PONDEROSA PINE	NON-IRRIGATED	IRRIGATED	RIPARIAN/ WETLAND	MISC. b/
1	210,000 c/							
2	57,400	23,800	16,900	8,100	5,300	900	142	2,258
3	64,200	29,800	17,200	8,100	5,800	900	142	2,258
4	83,500	39,800	21,100	10,100	8,800	1,300	142	2,258

a/ Acres derived from total acres of each tract based on habitat types generated by U.S. Fish and Wildlife Service, WELUT, 1980.
b/ One or more of the following types: closed sage, mixed shrub, ranch yards, roads.
c/ Data breakdown of the total acreage is not available.

TABLE 4-4
CUMULATIVE ACRES OF WILDLIFE HABITAT DISTURBED BY 1990

Location	Alternative 1	Alternative 2	Alternative 3	Alternative 4
MONTANA				
Colstrip Area	3,564	5,088	5,088	5,088
Decker Area	6,890	6,890	6,890	6,890
Otter Creek	0	2,057	2,902	3,862
WYOMING Hunt Areas:				
Antelope 24 & 101 (Deer 21)	61,420	62,894	63,831	64,834
Antelope 17, 18, & 19 (Deer 17 & 18)	95,631	97,066	96,243	97,199
Antelope 23 (Deer 19 & 20)	57,400	57,454	57,544	57,544

TABLE 4-5
ESTIMATED AFFECTED CULTURAL SITES
1990

Alternative 1	1,311 to 3,733
Alternative 2	1,882 to 4,304
Alternative 3	1,855 to 4,277
Alternative 4	2,148 to 4,570

a/ Using known and predicted site density figures.

TABLE 4-6
AVERAGE TRAINS PER DAY AND AT-GRADE CROSSING EFFECTS

Location	Trains Per day	At-Grade Crossings Daily Interruptions 5 mph	20 mph	Car/Train Accidents a/ Per 100 Years
Alternative 1				
Miles City, MT	29	5 hrs 48 min	1 hr 27 min	3
Gillette, WY	20	4 hrs	1 hr	2
Newcastle, WY	79	15 hrs 48 min	3 hrs 57 min	10
Torrington, WY	75	15 hrs	3 hrs 45 min	9
Alternative 2				
Miles City, MT	49	9 hrs 48 min	2 hrs 27 min	6
Gillette, WY	21	4 hrs 12 min	1 hr 3 min	2
Newcastle, WY	99	19 hrs 48 min	4 hrs 57 min	12
Torrington, WY	86	17 hrs 12 min	4 hrs 13 min	11
Alternative 3				
Miles City, MT	49	9 hrs 48 min	2 hrs 27 min	6
Gillette, WY	21	4 hrs 12 min	1 hr 3 min	2
Newcastle, WY	99	19 hrs 48 min	4 hrs 57 min	12
Torrington, WY	94	18 hrs 48 min	4 hrs 42 min	12
Alternative 4				
Miles City, MT	60	12 hrs	3 hrs	7
Gillette, WY	22	4 hrs 24 min	1 hr 6 min	3
Newcastle, WY	100	20 hrs	5 hrs	12
Torrington, WY	102	20 hrs 24 min	5 hrs 6 min	13

a/ Based on 1,000 vehicles daily.

TABLE 4-7
RAILROAD NOISE CONTOUR ZONES
(NUMBER OF FEET FROM TRACT CENTER LINE)

Location	Alternative 1	Alternatives 1 & 2	Alternative 4
Miles City, Montana (Northern Route)	4,640	6,130	7,536
Gillette, Wyoming (Central Route)	3,981	3,981	3,981
Newcastle, Wyoming (Central Route)	8,580	10,000	11,659
Torrington, Wyoming (Southern Route)	8,580	10,000	11,659

TABLE 4-8
COMMUNITY SERVICE AND FACILITY REQUIREMENTS (1990) a/

	Montana								Wyoming							
	Rosebud				Powder River				Campbell				Natrona			
Service/Facility	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4
Law Enforcement (sworn officers)	21	23	23	26	4	6	6	7	109	115	115	120	150	152	152	153
Teachers	210	235	235	260	48	69	69	90	811	850	850	892	1,174	1,189	1,189	1,203
Physicians	4	5	5	5	1	2	2	2	39	41	41	43	116	117	117	119
Dentists	6	7	7	7	1	2	2	2	10	11	11	11	46	46	46	47
Hospital Beds	39	43	43	48	10 b/	15	15	19	60	63	63	66	340	345	345	349

a/ Estimates of Montana requirements are based on existing levels per 1,000 population in 1980. Estimates of Wyoming requirements are based on existing levels per 1,000 population in 1979. Exceptions are noted.

b/ There is no hospital in Powder River County. This need is based on the standard of 4 beds per 1,000 population.

TABLE 4-9
PROJECTED NUMBER OF DWELLING UNITS REQUIRED IN THE
POWDER RIVER REGION IN 1990

Montana a/	Alternative 1 Baseline	Alternatives 2 or 3 Increment	Alternatives 2 or 3 Total	Alternative 4 Increment	Alternative 4 Total
Big Horn County	5,200	100	5,300	100	5,300
Hardin	1,800	0	1,800	0	1,800
Powder River County	1,150	500	1,650	1,000	2,150
Broadus	350	280	630	800	1,150
Rosebud County	5,600	750	6,350	1,500	7,100
Ashland District	350	750	1,100	1,500	1,850
Wyoming b/					
Campbell County	17,600	900	18,500	1,800	19,400
Gillette	9,000	460	9,460	900	9,900
Converse County	8,200	75	8,275	150	8,350
Douglas	3,600	35	3,635	70	3,670
Crook County	2,900	30	2,930	60	2,960
Moorcroft	510	10	520	15	525
Johnson County	3,700	40	3,740	80	3,780
Buffalo	2,050	20	2,070	40	2,090
Natrona Country	33,200	420	33,620	810	34,010
Casper	23,500	290	23,790	570	24,070
Sheridan County	14,600	170	14,770	340	14,940
Sheridan	8,800	100	8,900	200	9,000
Weston County	3,500	30	3,530	70	3,570
Newcastle	1,750	15	1,765	30	1,780

a/ Estimates based on 1980 population to housing ratio derived from 1980 final census and housing count.

b/ Estimates based on the 1980 population to housing ratio derived from 1980 preliminary census and housing count.

TABLE 4-10
PROJECTED EMPLOYMENT FOR THE POWDER RIVER REGION IN 1990

Montana a/	Alternative 1 Baseline	Alternatives 2 or 3 Increment	Alternatives 2 or 3 Total	Alternative 4 Increment	Alternative 4 Total
Big Horn County					
Coal Employment	1,900	80	1,980	80	1,980
All Other Employment	5,600	80	5,680	80	5,680
Total	7,500	160	7,660	160	7,660
Powder River County					
Coal Employment	15	690	705	1,380	1,395
All Other Employment	1,230	690	1,920	1,380	2,610
Total	1,245	1,380	2,625	2,760	4,005
Rosebud County					
Coal Employment	1,300	0	1,300	0	1,300
All Other Employment	6,100	0	6,100	0	6,100
Total	7,400	0	7,400	0	7,400
Wyoming b/					
Campbell County					
Coal Employment	9,200	1,010	10,200	2,000	11,200
All Other Employment	14,300	180	14,480	300	14,600
Total	23,500	1,190	24,680	2,300	25,800
Converse County					
Coal Employment	1,700	0	1,700	0	1,700
All Other Employment	7,200	80	7,280	170	7,370
Total	8,900	80	8,980	170	9,070
Crook County					
Coal Employment	0	0	0	0	0
All Other Employment	1,750	20	1,770	30	1,780
Total	1,750	20	1,770	30	1,780
Johnson County					
Coal Employment	0	0	0	0	0
All Other Employment	2,600	30	2,630	60	2,660
Total	2,600	30	2,630	60	2,660
Natrona Country					
Coal Employment	0	0	0	0	0
All Other Employment	43,300	540	43,840	1,100	44,400
Total	43,300	540	43,840	1,100	44,400
Sheridan County					
Coal Employment	1,400	0	1,400	0	1,400
All Other Employment	9,500	130	9,630	250	9,750
Total	10,900	130	11,030	250	11,150
Weston County					
Coal Employment	0	0	0	0	0
All Other Employment	2,900	30	2,930	50	50
Total	2,900	30	2,930	50	2,950

a/ Baseline coal employment estimates for the Montana counties were extrapolated from the Wyoming Powder River Input-Output model based on projected additional coal production. Estimates of additional coal employment under Alternatives 2, 3, and 4 were made by Keith Bennett in Tract Profiles, Miles City District Office (BLM, 1981). All secondary employment for Montana was estimated on the basis of one additional job for each permanent primary job and .5 additional jobs for each temporary primary job.

b/ All Wyoming employment estimates were generated by the Wyoming Powder River Input-Output model developed by John McKean at Colorado State University.

TABLE 4-11
PROJECTED POPULATION IN THE POWDER RIVER REGION IN 1990

Montana a/	Alternative 1 Baseline	Alternatives 2 or 3 Increment	Alternatives 2 or 3 Total	Alternative 4 Increment	Alternative 4 Total
Big Horn County	14,800	320	15,120	320	15,120
Hardin	4,400	0	4,400	0	4,400
Powder River County	2,523	1,120	3,643	2,200	4,723
Broadus	715	580	1,295	1,660	2,375
Rosebud County	14,700	1,680	16,380	3,400	18,100
Forsyth	3,800	0	3,800	0	3,800
Ashland District	800	1,680	2,480	3,400	4,200
Wyoming b/					
Campbell County	45,100	2,300	47,400	4,500	49,600
Gillette	22,500	1,150	23,650	2,250	24,750
Converse County	21,400	200	21,600	400	21,800
Douglas	9,200	90	9,290	170	9,370
Crook County	6,400	70	6,470	130	6,530
Moorcroft	1,220	15	1,235	30	1,250
Johnson County	8,300	90	8,390	180	8,480
Buffalo	4,700	50	4,750	100	4,800
Natrona Country	84,000	1,050	85,050	2,050	86,050
Casper	59,500	740	60,240	1,450	60,950
Sheridan County	33,600	400	34,000	770	34,370
Sheridan	20,300	240	20,540	470	20,770
Weston County	8,600	80	8,680	160	8,760
Newcastle	4,300	40	4,340	80	4,380

a/ Montana county estimates are based on the 1980 ratio of population to employment for permanent employment and 1.3 population to transient employment. Projections of community populations are based on the 1980 ratio of community to county.

b/ Wyoming county estimates are based on the 1980 ratio of population to employment for permanent employment and the ratio of 1970-1980 population change to the 1970-1980 employment change for transient employment. Projections of community populations are based on the 1980 ratio of community to county.

TABLE 4-12
COUNTY, SCHOOL, AND COMMUNITY BUDGET
LEVELS PROJECTED FOR 1990
(Rounded to the Nearest $100,000, Includes Debt Servicing)

Montana	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
Big Horn County					
Revenues	8,200	200	8,400	200	8,400
Expenditures	8,200	200	8,400	200	8,400
Balance	0	0	0	0	0
Big Horn County Schools					
Revenues	13,300	400	13,700	400	13,700
Expenditures	13,300	300	13,600	300	13,600
Balance	0	100	100	100	100
Hardin					
Revenues	1,000	0	1,000	0	1,000
Expenditures	1,000	0	1,000	0	1,000
Balance	0	0	0	0	0
Powder River County					
Revenues	3,800	1,400	5,200	2,500	6,300
Expenditures	3,800	1,700	5,500	3,400	7,200
Balance	0	-300	-300	-900	-900
Powder River Co. Schools					
Revenues	2,000	4,100	6,100	5,600	7,600
Expenditures	2,000	900	2,900	1,700	3,700
Balance	0	3,200	3,200	3,900	3,900
Broadus					
Revenues	200	200	400	300	500
Expenditures	200	100	300	400	600
Balance	0	100	100	-100	-100
Rosebud County					
Revenues	9,800	0	9,800	0	9,800
Expenditures	9,800	1,100	10,900	2,300	12,100
Balance	0	-1,100	-1,100	-2,300	-2,300
Rosebud County Schools					
Revenues	9,100	0	9,100	0	9,100
Expenditures	9,100	1,000	10,100	2,100	11,200
Balance	0	-1,000	-1,000	-2,100	-2,100
Forsyth					
Revenues	2,000	0	2,000	0	2,000
Expenditures	2,000	0	2,000	0	2,000
Balance	0	0	0	0	0

TABLE 4-12 continued

Montana	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
Ashland c/					
Revenues	---	---	---	---	---
Expenditures	---	---	---	---	---
Balance	---	---	---	---	---
Wyoming					
Campbell County					
Revenues	26,600	5,700	32,300	11,300	37,900
Expenditures	26,000	1,400	28,000	2,700	29,300
Balance	0	4,300	4,300	8,600	8,600
School District #1					
Revenues	69,800	10,300	80,100	20,400	90,200
Expenditures	69,800	3,600	73,400	7,000	76,800
Balance	0	6,700	6,700	13,400	13,400
Gillette					
Revenues	19,800	500	20,300	1,000	20,800
Expenditures	19,800	1,000	20,800	2,000	21,800
Balance	0	-500	-500	-1,000	-1,000
Converse County					
Revenues	13,500	0	13,500	0	13,500
Expenditures	13,500	100	13,600	300	13,800
Balance	0	-100	-100	-300	-300
School District #1					
Revenues	24,800	0	24,800	0	24,800
Expenditures	24,800	200	25,000	500	25,300
Balance	0	-200	-200	-500	-500
Douglas					
Revenues	10,800	0	10,800	0	10,800
Expenditures	10,800	100	10,900	200	11,000
Balance	0	-100	-100	-200	-200
Crook County					
Revenues	4,300	0	4,300	0	4,300
Expenditures	4,300	0	4,300	100	4,400
Balance	0	0	0	-100	-100

TABLE 4-12 continued

Wyoming	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
School District #1					
Revenues	5,600	0	5,600	0	5,600
Expenditures	5,600	100	5,700	100	5,700
Balance	0	-100	-100	-100	-100
Moorcroft					
Revenues	500	0	500	0	500
Expenditures	500	0	500	0	500
Balance	0	0	0	0	0
Johnson County					
Revenues	2,600	0	2,600	0	2,600
Expenditures	2,600	0	2,600	100	2,700
Balance	0	0	0	-100	-100
School District #1					
Revenues	7,100	0	7,100	0	7,100
Expenditures	7,100	100	7,200	200	7,300
Balance	0	-100	-100	-200	-200
Buffalo					
Revenues	2,400	0	2,400	0	2,400
Expenditures	2,400	0	2,400	100	2,500
Balance	0	0	0	-100	-100
Natrona County					
Revenues	43,000	0	43,000	0	43,000
Expenditures	43,000	500	43,500	1,100	44,100
Balance	0	-500	-500	-1,100	-1,100
School District #1					
Revenues	37,300	0	37,300	0	37,300
Expenditures	37,300	500	37,800	900	38,200
Balance	0	-500	-500	-900	-900
Casper					
Revenues	50,400	0	50,400	0	50,400
Expenditures	50,400	600	51,000	1,200	51,600
Balance	0	-600	-600	-1,200	-1,200
Sheridan County					
Revenues	20,400	0	20,400	0	20,400
Expenditures	20,400	200	20,600	500	20,900
Balance	0	-200	-200	-500	-500

TABLE 4-12 concluded

Wyoming	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
School District #2					
Revenues	13,700	0	13,700	0	13,700
Expenditures	13,700	200	13,900	300	14,000
Balance	0	-200	-200	-300	-300
Sheridan					
Revenues	9,900	0	9,900	0	9,900
Expenditures	9,900	100	10,000	200	10,100
Balance	0	-100	-100	-200	-200
Weston County					
Revenues	4,700	0	4,700	0	4,700
Expenditures	4,700	0	4,700	100	4,800
Balance	0	0	0	-100	-100
School District #1					
Revenues	4,500	0	4,500	0	4,500
Expenditures	4,500	0	4,500	100	4,600
Balance	0	0	0	-100	-100
Newcastle					
Revenues	2,000	0	2,000	0	2,000
Expenditures	2,000	0	2,000	0	2,000
Balance	0	0	0	0	0

a/ These are the budget levels that are expected to exist without additional Federal Competitive Leasing. Expenditures were projected from actual FY 1979/1980 budgets (including debt servicing) on a per capita basis in order to maintain the per capita spending levels of FY 1979/1980. It is assumed that revenues will equal expenditures through additional taxes user fees, grants, royalties, or debt.

b/ The additional expenditures above baseline expenditures, which are required to maintain FY 1979/1980 per capita spending levels for additional populations, were projected from actual FY 1979/1980 budgets (including debt servicing) on a per capita basis. Additional revenues above baseline revenues for Montana Counties are based on revenue to coal production ratios derived from a baseline run of the coal town model, which was generated by Keith Bennett. Additional revenues for Wyoming Counties were generated by a coal revenue model developed by Thomas F. Stinson at the University of Minnesota.

c/ Because Ashland is an unincorporated community without a formal budget it is difficult to make reliable budget projections.