CHAPTER II

POTENTIAL DEVELOPMENT

Coal Development

In order to appraise the environmental impact of proposed coal mining in the Eastern Powder River Basin in Campbell and Converse Counties, Wyoming, it is necessary to summarize the importance of the coal resources, indicate likely development patterns, and arrive at a coal production projection for the future. The number and total acreage of coal leases, lease applications, and permits for federal coal are given below.

Action Status	Number	Acres	Percent of County Area	Percent of Study Area
Issued Federal Coal Leases	42	93,075	1.6	1.9
Preference Right Coal Lease Applications	44	96,517	1.7	1.9
Outstanding Coal Prospecting Permits	28	64,252	1.1	1.3
Subtotal	114	253,844	4.4	5.1
Competitive Coal Lease Applications	20	157,861	2.7	3.2
Total	134	411,705	7.1	8.3

Table 1 lists holders of these coal interests, and Map 5, Appendix A, shows locations of leases and applications.

Of this land, only that for which leases have been issued is immediately available for commitment and development of included coal reserves. The importance of the coal resources of the Eastern Powder River Basin in Wyoming is indicated by the estimate that 12.4 billion tons of economically strippable recoverable coal reserves are in Campbell and Converse Counties, that 13.3 billion tons are in the Northern Great Plains of Wyoming, and that 36.5 billion tons of

economically strippable recoverable coal and lignite reserves are in the Northern Great Plains of Montana, North Dakota, South Dakota, and Wyoming. The national strippable coal reserve was estimated by the U.S. Bureau of Mines in 1971 to be about 45 billion tons. The national reserve has been increased by new coal discovery since 1971. The Eastern Powder River Basin contains a significant portion of the Nation's economically recoverable strippable coal reserves.

The immense coal reserves and resources of the Eastern Powder River Basin can be mined effectively by both opencast and underground methods depending upon coalbed thickness and the thickness of overburden. Coal resources are sufficient to satisfy future mining and coal demand with due regard for economic and physical constraints.

The relatively thick coalbeds are overlain by thin overburden in many places. Thus, large tonnages of coal can be exposed and mined near the outcrop with little overburden handling. As the working faces of active mines are advanced basinward down the dip of the coalbeds, the overburden increases in thickness and becomes thicker than can be economically removed by surface-mining methods. At this point the coal must be mined underground if it is to be recovered. Portions of coalbeds in excess of about 12 feet in thickness cannot be recovered by underground methods. Thus, underground methods employed in thick coalbeds lead to poor recovery and resulting waste of coal resources. Ongoing underground mining research by industry and government is directed to the development of new mining techniques and methods to recover a much higher percentage of coal than is possible with present methods. Coal production from the Eastern Powder River Basin in the next few years will most likely be entirely from the development and expansion of strip mines at land surface where full economic advantage of thin overburden occurrences can be realized. Present plans of mining companies include only surface mining. Underground mining can be expected in the future but only as areas amenable to surface mining are no longer available.

Table 1

Coal Interests
Campbell and Converse Counties
North of Platte River

Issued Leases

Atlantic Richfield

Serial Number	Acres
W-2313	5,844
W-3446	5,800
W-36094	40
	11,684

Wayne Brannan

B-031719	40

The Carter Oil Company

W-3397	5,251
W-5035	4,782
W-5036	5,457
	15,490

Concho and J. C. Karcher

W-0256663	756
W-0220516	1,571
	2,327

Farmers Union Central Exchange, Inc.

W-0325878	599

(Continued)

Table 1 (Continued)

Humac Company

Serial Number	Acres
W-0136195	1,477
W-0136196	1,560
W-0136194	322
	3,359

Kerr-McGee Corporation

W-23928	4,192
W-24710	160
W-0311810	1,263
W-0312311	880
W-0313668	2,200
	8,695

Meadowlark Farms, Inc.

W-0313773	3,520
W-0317682	2,440
	5,960

Mobil Oil Corp.

W-23929	4,000

Pacific Power & Light

W-038597	1,400
W-038602	2,000
C-054769	120
W-041355	560
W-0244167	1,803
W-0312918	3,780
W-0322255	1,869
W-0321780	2,980
	14,440

(Continued)

Table 1 (Continued

Peabody Coal Co.

Serial Number	Acres
W-37829	40
W-0271199	640
W-0271200	760
W-0271201	2,180
W-0313667	2,560
W-0321779	11,101
	17,281

Summit Exploration & Development Co.

W-0310712	40
W-0324701	680
	720

Sun Oil Company

W-8385	6,560

Wyodak Resources Development Corp.

W-073289	240
W-0111833	80
W-0313666	1,560
B-037423	40
	1,920

Issued Leases	Total Acres
42	93,075

(Continued)

Table 1 (Continued)

Preference Right Lease Applications

Peabody

Serial Number	Acres
W-916	3,318
W-917	320
W-25717	200
W-25718	160
W-26198	2,508
W-26199	640
W-32061	80
W-32062	160
W-32063	520
W-32064	1,560
W-32065	280
W-25719	680
W-32506	835
W-32067	80
W-32068	240
	11,581

E. L. Lockhart

W-1595	5,120
W-1596	2,520
W-1597	3,592
W-1598	4,200
W-1599	5,110
W-2273	2,443
W-2274	4,274
W-2275	4,958
W-2276	3,815
W-4996	2,616
W-4997	2,668
W-4998	1,737
W-16313	2,205
	45,258

Coal Conversion Corp.

W-4995	2,557

Thomas Woodward

Serial Number	Acres
W-8307	4,756
W-8308	3,224
W-8309	2,229
W-8310	3,400
W-8311	3,966
W-8312	1,575
	19,150

J & P Corp. (Wold)

W-9033	240
W-9036	80
	320

Peter Wold

W-11128	1,359

Eugene Stevens

W-12767	1,281
W-14355	4,352
W-14390	3,928
W-14392	3,655
	13,216

Pioneer Nuclear Corp.

W-21515	800
W-21516	2,276
	3,076

Preference Right Lease Applications	Total Acres
44	96,517

A 15-year time interval, ending about 1990, is used for projection purposes. This time interval is sufficiently great to include the total effect of known industry projections, although the operations of some individual companies have been projected beyond 1990. Also, this 15-year period allows for convenient discussion by multiples of 5-year time intervals and at the same time extends into the future sufficiently to encompass most events which might occur. Figure 3 shows the total projected coal production by year from 1970 to 1990 for the three active and seven proposed coal mines for which information is now available from industry sources. The curve in Figure 3 shows only a slight increase in coal production after 1983. The flattening of the curve illustrates that the ten mines are scheduled for full production not later than 1982 and that industry has not projected further mine development beyond 1983. Therefore, to estimate coal production and associated industrial activities to 1990, it is necessary to add to the model new mining operations, power plants, and gasification plants from 1983 to 1990.

Although these projections are considered the most likely level of development, expansion could extend beyond these levels by 1990. Approximately 75 percent of the coal resources of the Northern Great Plains are found in the Eastern Powder River Coal Basin. If a growth economy persists through 1995, production levels will almost certainly exceed those projected for 1990.

Projected annual coal production and number of operations at 5-year intervals from the present to 1990 are shown in the Assumptions and Analysis Guidelines at the end of this chapter. Items listed for the present and 1980 are based solely upon known plans and projections of industry. Items listed for 1985 and 1990 are based upon modest industrial and mine expansion after 1983. Changes in the annual rate of coal production beyond 1983 are based on

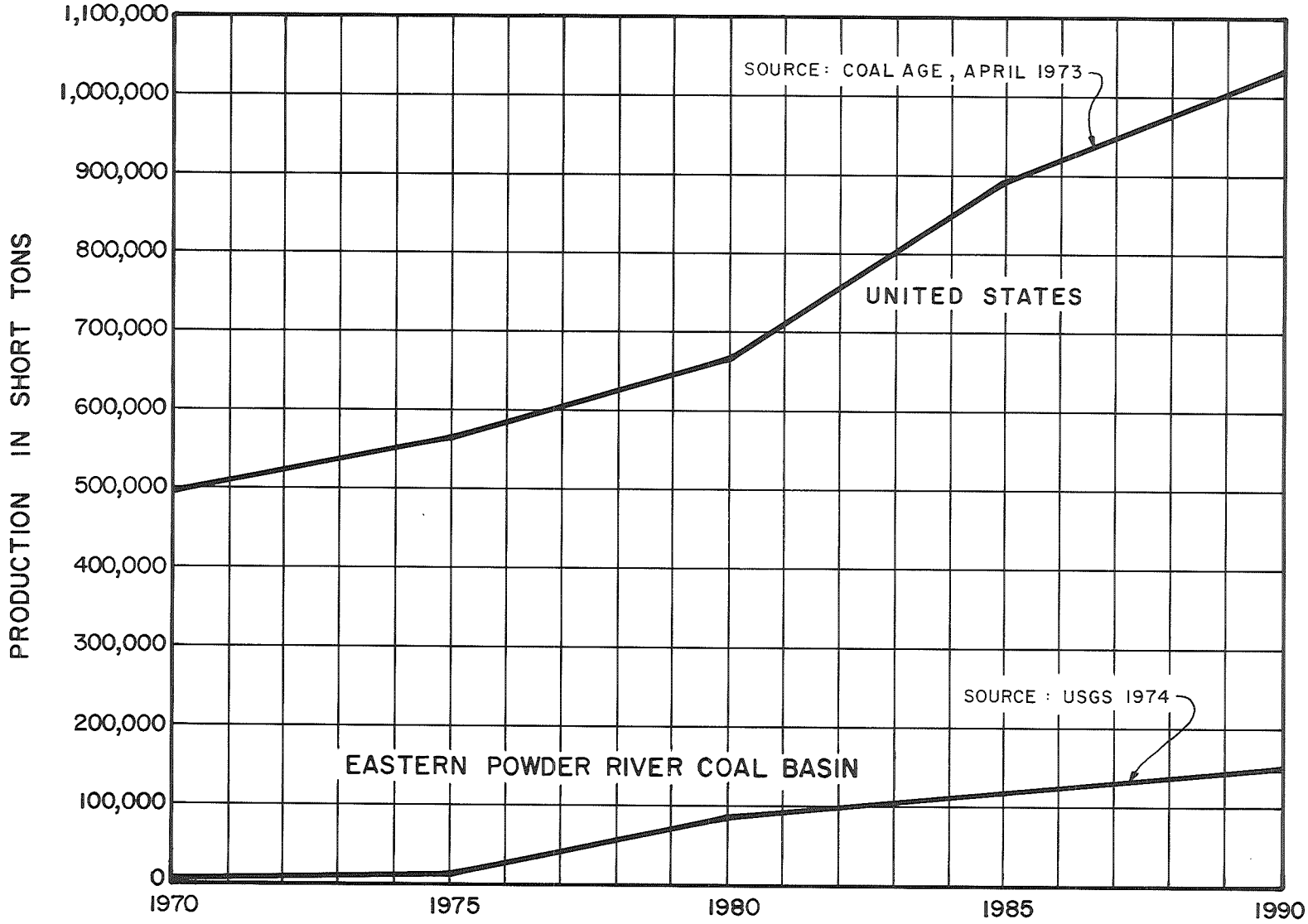


Figure 3

Projected coal production in the United States and the Eastern Powder River Coal Basin, Wyoming 1970 to 1990.

a modest rate of increase between three and four percent per year after about 1983. This rate is designed to recognize the national trend of ever increasing energy demand and at the same time stay within the most recent projections of Northern Great Plains studies. Further, the probable increase in the number of coal-consuming power plants and gasification plants is included in the "Assumptions" at the end of this chapter. Development forecasts for the Northern Great Plains Region (Great Plains of Montana, North Dakota, South Dakota, and Wyoming) indicate that coal production from Wyoming Great Plains might be as much as 153 million tons per year in 1985 and 387 million tons per year in 2000 (Northern Great Plains Resource Program unpublished draft, Table E-1, p. II-110). The most probable energy forecast indicates 75 million tons per year of coal by 1985 and 110 million tons per year by 2000 (Northern Great Plains Resource Program unpublished draft, Table 6.1 p. II-87). Forecasts of annual coal production in millions of tons for Campbell and Converse Counties, Wyoming, made by the Northern Great Plains Resource Program are shown in Table 2. Coal production projected in this statement exceeds the most probable forecast but is within the most extensive forecast thus far derived for the Wyoming Great Plains. The projection exceeds the forecast by counties (Table 2) until sometime after 1985 but is within the extensive forecast well before the year 2000. Northern Great Plains figures are included here for comparison purposes only. They are not used in developing the analyses in this statement.

Table 2

Forecasts of Annual Coal Production for Campbell and Converse Counties, Wyoming (millions of tons)

Most Probable

Year	Annual Production
1980	34
1985	58.5
2000	72.2

Extensive

Year	Annual Production
1980	34
1985	122.7
2000	285.7

Source: Modified from Northern Great Plains Resource Program unpublished draft.

Projections presented are subject to serious distortion by possible technological trends and administrative actions. Planned expansion of coal production from 1974 to 1983 reflects mostly the present demand for low-sulfur coal to fuel existing and projected coal-fired power plants. The successful desulfurization of coal or successful removal of sulfur compounds from the stack gas of power plants could greatly reduce the demand for low-sulfur western coal which might then be displaced by use of midwestern coals. Further, the immense

fuel consumption of large power plants might yield from stacks sufficient quantities of sulfur compounds that even low-sulfur coal would be administratively determined to be an undesirable fuel. The extent to which nuclear power is used and the rate at which nuclear power is phased into the nation's energy supply is of direct consequence to the coal industry and bears directly upon the future coal production from the Eastern Powder River Basin. Extensive and rapid development and use of nuclear power plants would decrease the rate of development of the coal resources of the basin. Conversely, western coal before transport is available more cheaply than coal from the midwest and might be used in large quantities for conversion to gas and liquid, especially as domestic and foreign oil and gas is depleted in the future.

Exportation of Coal

Most coal produced will be exported from the basin largely to satisfy electric utility demand in the midwest and south-central United States.

In 1965, Amax Coal Company acquired its first lease, and when market conditions improved in 1971, development of the Belle Ayr mine 14 miles southeast of Gillette was started. Reserves of 350 million tons are located on 2,440 acres of federal land and 640 acres of private land. Initial production of the Belle Ayr mine in 1973 was 1.3 million tons, but plans are to mine three to four million tons in 1974 and ten million tons in 1976. The quarry type mining method is used. Of the initial production, one million tons were shipped in 1973 to the Public Service Company in Pueblo, Colorado.

Present plans are to export coal out of the basin to power plants as far south and east as the Gulf Coast and central Mississippi Valley. The production schedule through 1985 for four operations indicated in Chapter I is shown in Table 3. Also shown in this table are the quantity and destination by state of the scheduled production. Some production is presently scheduled for future contracts or for destinations not yet firm. Where destination is not known, the receiving organization is given. Additional companies are expected to be mining Powder River coal in this time period.

Table 4 presents the cumulative amounts of coal mined and approximate tonnage shipped out of the region.

Table 3

Production Schedules of Four Companies and the Destinations by State of the Coal Produced
(millions of short tons)

Company and Destination	Years 1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
ARCO			1.2	3.8	6.6	10.0	10.0	(10.0)*	(10.0)*	(10.0)*	(10.0)*	(10.0)*
Nebraska												
Oklahoma												
Texas												
Carter Oil Co.			.5	3.6	5.0	5.0	5.0	5.0	5.0	12.0	12.0	12.0
Indiana and Michigan Electric Co.			.5	3.6	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Kerr-McGee Corp.				1.227#	5.035	9.2	9.665		12.62	15.9	15.9	15.9
Arkansas				.465	2.965	5.0	5.0	5.46	7.5	7.5	7.5	7.5
Louisiana				.762	2.070	4.2	4.2	4.66	5.9	5.9	5.9	5.9
Wyodak Res. Dev. Corp.	.7	.7	.7	2.5	2.5	2.5	2.5	2.5	5.0	5.0	5.0	5.0
Wyoming	.7	.7	.7	2.5	2.5	2.5	2.5	2.5	5.0	5.0	5.0	5.0
Total Scheduled Production	.7	.7	2.4	11.127	19.135	26.7	27.165		30.12	35.9	42.9	42.9

*Production schedule ends in 1980, mine capable of an ultimate production of 15 to 20 million tons per year.
**Receiving organization, destination not firm.
#Numbers are not rounded because they reflect firm scheduling by the company. Thus, payment will be received for all amounts of coal delivered, here scheduled to the nearest 1,000 short tons.

Table 4

Cumulative Coal Mined and Exported (Million Ton)*

	1980	1985	1990
Total Mined	296	858	1,543
Exported	237	666	1,170
Percent Exported	80	78	76

*Based on total projected coal development in the study area

Mine Mouth Power Generation

Large scale mining for power generation did not begin in the Powder River Basin until 1956. Wyodak Resources Development Corp., a subsidiary of Black Hills Power and Light Company, acquired leases six miles east of Gillette. Coal from the Wyodak mine in Donkey Creek Valley is burned at the Black Hills Power and Light Company's plants at Wyodak and Osage, Wyoming, and Kirk and Rapid City, South Dakota. In 1969, Unit No. 5 was added to the Neil Simpson Station adjacent to the Wyodak mine. This unit features the first air cooled condenser on a steam turbine generating plant in the Western Hemisphere. It has a capacity of 21 megawatts. A major new air cooled power plant of 330-megawatt capacity is planned to be on line in 1977 in conjunction with expansion of the Wyodak mine.

In 1955 Pacific Power and Light Company(PP&L) was issued a coal prospecting permit which proved successful and resulted in the filing of a preference right lease in April 1956. Six miles east of the Town of Glenrock, ground breaking for the 100-megawatt Dave Johnston steam-electric plant began June 30, 1956, with an additional 200 megawatts being added during construction in 1958. The center of the Dave Johnston coal field is about 20 miles northeast of Glenrock. The 18-foot thick Badger Seam is separated from the underlying 35-foot thick School Seam by an interval of 100 feet in the northern part of the field and 180 feet in the southern portion.

In 1964 a railroad was built to haul coal from the mine to the power plant and construction began on an additional 200-megawatt generating capacity. By 1965 mine production had reached 1,140,000 tons per year, and the mine force

consisted of about 35 men. Originally, all coal mined in Converse County, with the exception of the Best Coal Mine, was destined for the Dave Johnston power plant, but in 1968, Food Machinery and Chemical Company began to purchase from PP&L about 1,000 tons per year of outcrop coal to be used in the manufacturing of fertilizer material. This continued through 1972 but has never become a major alternate market. An additional 330 megawatts were installed at the Dave Johnston facility in 1969, and a major change in mining methods was planned to increase production for the additional power units. Coal production increased from 1.8 million tons to over 3 million tons per year, and the work force increased to 92 men. Electric generating capacity is now rated at 750 megawatts. A total of 864 acres was disturbed from 1958 to 1973; about 104 acres were disturbed last year.

Although no plans have been announced for new power plants in addition to the Wyodak expansion, it is projected that one plant will be built by 1985 and another by 1990. A 500-megawatt water-cooled plant requires about 2.25 million tons of coal and 5,500 acre-feet of water annually. Each plant would occupy about 1,000 acres and require mining which would disturb about 20 acres each year. Transmission lines require about 23 acres per mile.

Gasification

Plans for one coal gasification plant have been announced. This project is a joint venture of Panhandle Eastern Pipeline Company and Peabody Coal Company. The mine, to be operated by a subsidiary known as Rochelle Coal Company, is located about 48 miles north of Douglas. A plant site has not been selected; two principal sites are being considered. The first is near Douglas, about 30 miles south of the mine, and the other is near the mine. The gasification plant would be operated by a subsidiary company known as Wyoming Coal Gas Company.

Mine

The coal reserve dedicated to the gasification plant is 550,000,000 tons underlying 6,800 acres. The firm has 694,951,400 tons of coal reserves under lease or option underlying 8,588 acres.

Twelve miles of access road are planned by the company, and a railroad spur will be constructed to the proposed mainline of the Burlington Northern/Chicago North Western railroad. Deep water wells are expected to supply 1,200 acre-feet per year to meet water requirements at the mine. An electric power transmission line will be constructed to supply power for construction and for mining machines and other operating needs.

Plant

The gasification plant will require 1,000 acres for facilities, plus additional acreage for access roads, railroad spur line, and pipelines. It will process 11,000,000 tons of coal annually and will require 5,000 to 10,000

acre-feet of water. From this, 250 million cubic feet per day of 960-970 Btu/cu. ft. gas will be produced. By-products would be 8,000 barrels of liquid petroleum products and 100 tons of sulfur per day.

The company has proposed constructing a power plant of 60-megawatt capacity to supply electrical needs of the plant.

Unconfirmed plants

One other firm, Carter Oil Company, has proposed a gasification plant but no location has been announced. It is assumed that the plant will be of a size comparable to the Panhandle Eastern-Peabody plant, and it is very likely that the Carter plant will be in the vicinity of the Carter mine six miles north of Gillette. Other gasification plants have been rumored but not confirmed.

Detailed analyses of the gasification projects are not included in this study; an environmental analysis will be prepared at the time specific gasification projects are proposed to determine if approval of applications by federal agencies would constitute major federal action significantly affecting the quality of the human environment.

Other Industrialization

Other industries in the study area will be influenced in a variety of ways by coal development activities. Construction industry impacts will relate directly to basin growth while agriculture will be indirectly affected. Development of other energy commodities such as uranium, oil, and gas will be affected in the sense of competing for high demand goods, services, and resources.

The construction industry will experience enormous growth during the short term (ten years) with a subsequent leveling off in rate of expansion. Construction of coal gasification and electric power generating plants requires large labor forces and heavy capital investment. Other construction necessary for housing and related services needed to accommodate growth in the basin will be sustained for a much longer period and thus provide long-term growth in the industry after the peak energy related facilities are completed. Many million cubic yards of sand and gravel will be required for concrete structures. Because these materials are limited in the area, large quantities will have to be imported from the nearest economic source.

The same situation prevails for wood products. While some timber is harvested in the northeastern part of the area, yields will not approach the high demands required for community and industry development. Timber will be imported from the nearest economic source. With respect to employment, the present base of 3,200 is projected to reach an estimated 6,800 by 1990.

The outlook for the agricultural industry, particularly in view of a ten-year historical perspective, is one of continuing decline in percent of the total economy of the impacted area. Energy development in the basin will compete with agriculture for both water and employment. Doubtless, these resources will be attracted away from agriculture

by higher prices. Projected agricultural employment will drop from the present level of 3,800 to 3,300 by 1990.

Oil and natural gas reserves in the basin will become increasingly depleted by present extraction, and this industry will be faced with the ever present problem of resource availability. However, a highly active oil and gas exploration program is continuing to add new fields and zones to the discovery list each year. In fact, exploration activity for new fields in 1974 is again at an all time peak owing to the energy crisis and the unprecedented prices being paid for new oil and gas. Future prospecting can be expected to result in discovery of many more oil and gas fields and producing zones. Also, new recovery methods will improve ultimate production, resulting in extension and continuation of oil and gas operations in the basin for at least another 50 years. Despite increased exploration activity, the current employment level of 5,000 will probably reach only an estimated 5,150 by 1990.

Uranium mining and milling are presently conducted in the basin at the Exxon Corporation, Teton Exploration Drilling Company, and Kerr-McGee mines. Industry surveys conducted by the State of Wyoming Department of Economic Planning and Development and the Bureau of Land Management have identified four more prospective uranium operations that may be developed in the basin.

The Northern Great Plains Resource Program report states that:

> "Assuming that these plant developments are operative by 1980, employment in uranium mining and milling in 1980 should be approximately 1,472. The assumption is made that uranium activity will continue to increase to 1985 and then decline as breeder reactors become a source of fuel. On this basis, uranium mining and milling employment is projected to reach 1,772 by 1985 and then decline to the 1980 level by 2000."

No projection has been made for light industry, sales, and service growth that will occur in conjunction with area development. Since major industrial outlets and manufacturing centers are located long distances from the basin, the transportation and distribution of a wide variety of material will constitute a significant enterprise.

Modes of Distribution

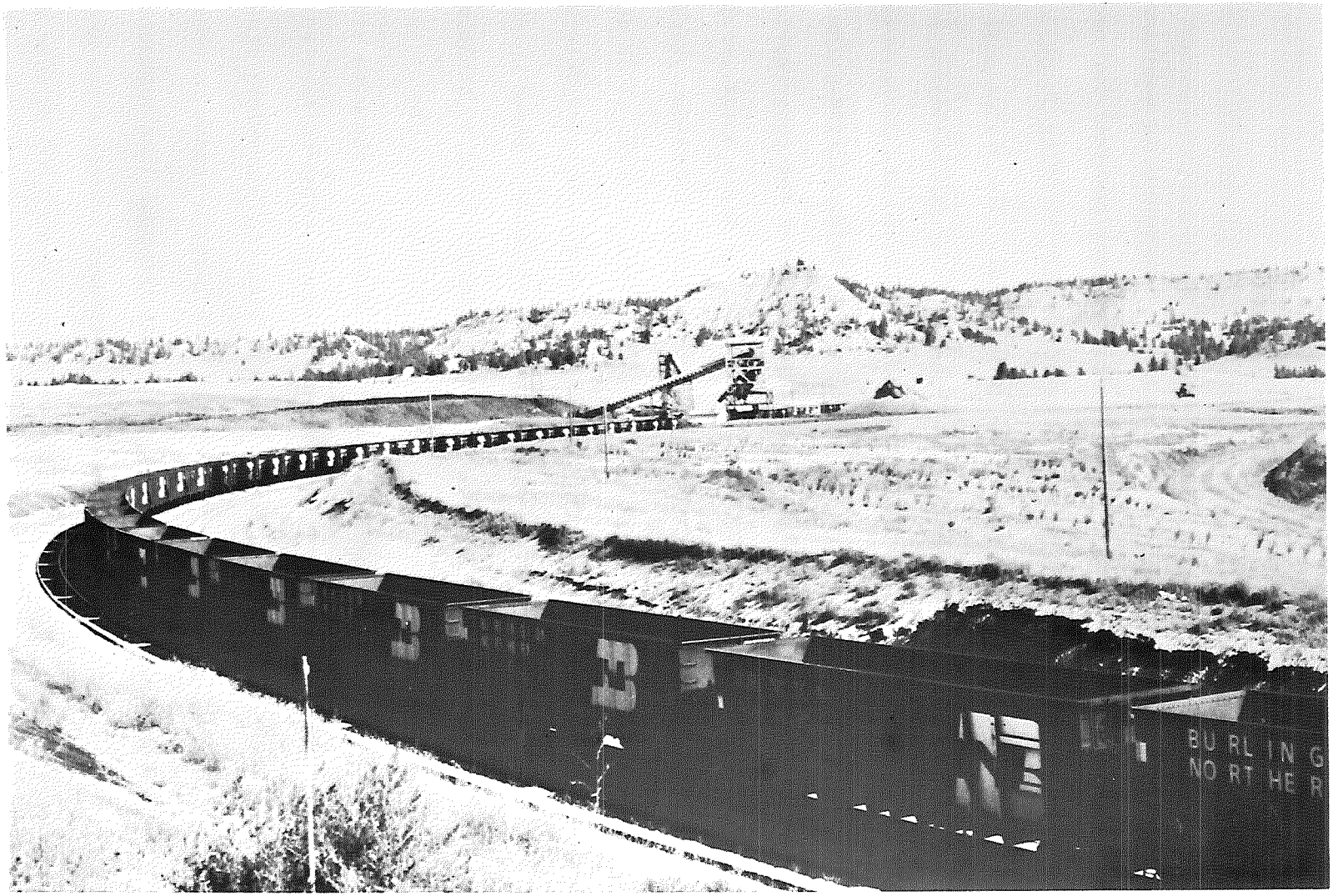
Railroads

Rapid continuous transport of coal is essential to efficient mining operations. Coal production of 5 to 15 million tons per year for each mine requires a transportation system capable of rapidly handling large volumes. A railroad is one system that meets this requirement. The mining companies propose to export coal from the region by unit trains of approximately 100 cars (Figure 4) using the Burlington Northern's and Chicago and North Western Transportation Company's proposed Gillette to Douglas railroad line. The theoretical capacity of the proposed line as presently considered for construction, with sidings at 12.5-mile intervals and a 25-mph average train speed, would be 48 unit trains per day including returning empties or a 365-day yearly transportation capacity of approximately 96 million tons of coal. This capacity would be reduced significantly by smaller train sizes, unequal return train times, transportation failure, and railroad maintenance. Based on the projected coal production, full theoretical rail line capacity would be achieved before 1983.

Each operation requires a spur line connecting the mine site to the mainline. The spur normally has a loop and storage silos to facilitate rapid, continuous loading. Proposed spur lines are built to heavy-duty standards to carry heavy, continuous traffic. A large loop permits trains to move through loading silos at a constant rate and return to the spur line without switching or stopping. Two to five 12,000-ton, drive-through storage silos are required on each loop. The loading capacities will range from 2,000 to over 4,000 tons per hour, or a continuous loading capacity of as much as 100,000 tons per day.

Figure 4

100 Car Unit-Train on Its Way to Loading Facility



With computerized weighing and optical accounting of cars, the coal tonnage of each train will be continuously and accurately monitored. In addition to a coal loading loop, another track may be necessary for handling ash and waste material from a gasification plant. A switch will give the ash train access to the loop, and it will use the same spur to the mine site that the coal train uses.

Carter Oil Company proposes to connect the North Rawhide mine site to the Burlington Northern mainline at Gillette by a nine-mile branch line. The same branch will also serve the proposed Belle Ayr North mine of Amax Coal Company. In order to carry the ultimate production of 15 to 20 million tons per year, double track may be required for the branch. Where the proposed Burlington Northern/Chicago and North Western mainline crosses the mine leases, the train loops will connect directly to the mainline. A seven-mile spur from this mainline will serve both the Altantic Richfield and Kerr-McGee mines. This spur may also require double track if the proposed ultimate production of 30 million tons of these mines is achieved. At the Peabody Coal Company site, a nine-mile spur will be required to connect the mine to the proposed Gillette-Douglas mainline. This spur will permit high-capacity coal and ash transportation seven days per week.

Pacific Power and Light Company presently maintains its own 16-mile railroad between its mine and power plant. Amax ships its coal by unit train to Pueblo, Colorado. An 18-mile spur line was constructed by Burlington Northern Inc. to connect the mine to the main railroad. The Wyodak mine uses part of its production at the Neil Simpson Power Plant adjacent to the mine and ships the remaining portion by unit trains.

Upon completion of mining activities and abandonment of the mine leases, spur track, silos, etc., will be removed and the right-of-way revegetated.

Figure 5 illustrates a typical mine site layout including unit train loop and loading silos.

Roads

Prime all-weather access roads 5 to 20 miles long will connect the mine sites with major state routes. The roads will be designed for light truck and commuter traffic. Within the mine area, haul roads are proposed for use by heavy-duty trucks having a 100- to 200-ton capacity. These roads extend from the mine pits to storage and processing facilities near the unit train loops. Haul roads will be wide enough to accommodate large draglines, drill rigs, bulldozers, shovels, and other heavy mine equipment. An estimated 24 miles of new mainline, state or county roads will be constructed by 1990.

At the North Rawhide mine site, State Route 59 will be relocated southeastward from its present location over coal deposits. The new road will pass around the mine facilities at the southeast margin of the lease.

Pipelines

The Northern Great Plains Resource Program study estimated 999 miles of major pipelines presently within Campbell and Converse Counties. These pipelines are for transportation of crude oil and natural gas. Additional pipelines are proposed and assumed for development of coal resources. New pipelines would transport coal as a slurry, gas derived from coal, and water to support the above. Water would also be transported for use by new or expanded communities and possibly new power generating plants.

There is a proposal by Energy Transportation Systems Inc. to construct a 1,040-mile, 38-inch pipeline to export coal from the study area to Arkansas in the form of a coal-water slurry. A slurry pipeline rapidly handles large volumes of coal and is an alternative to rail transportation.

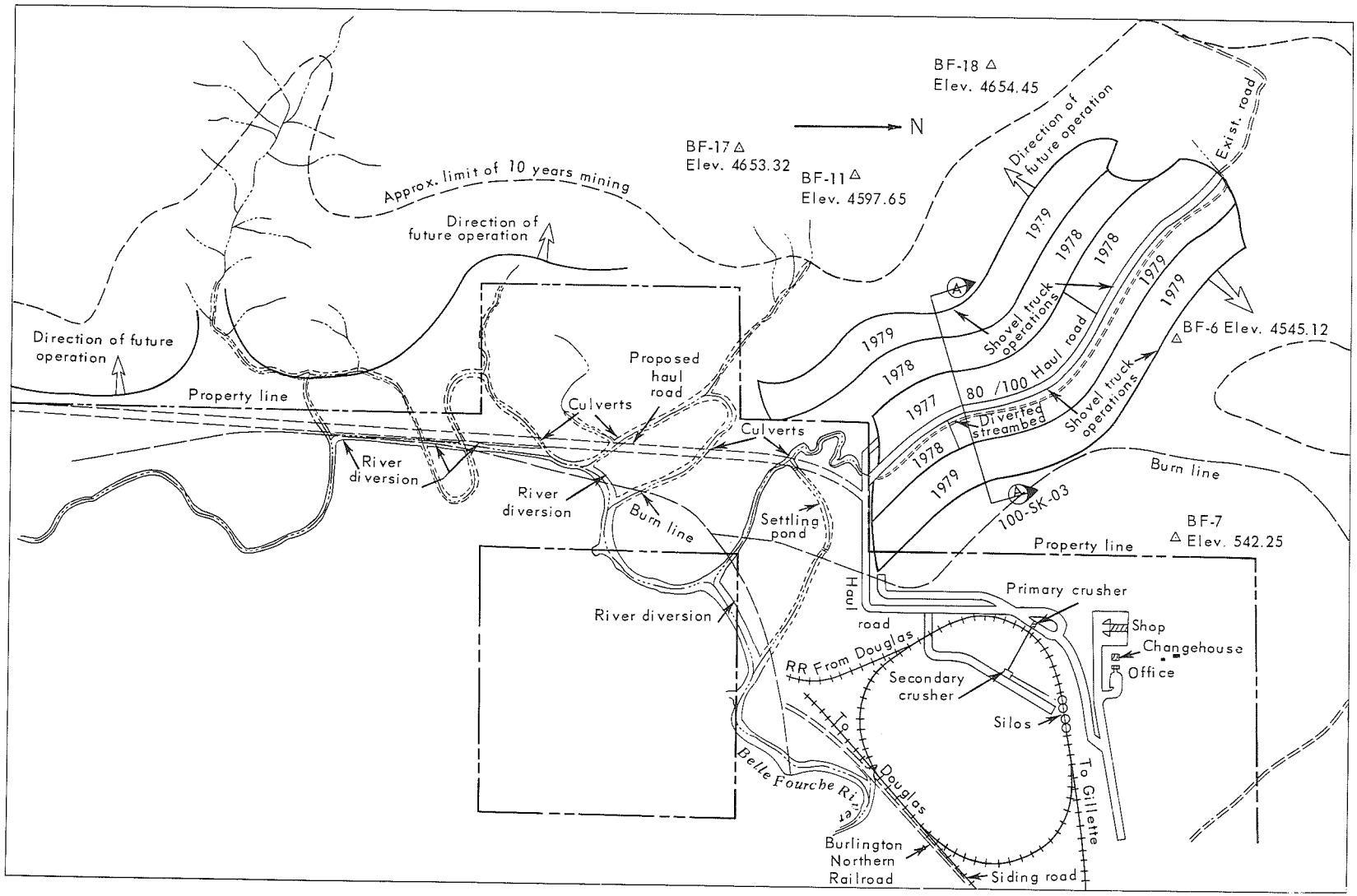


Figure 5

Typical Plan for Unit-Train Loop, Loading Silos, Haulage and Access Roads, Office and Shop Facilities, and Areas Disturbed (Mined) Annually (After Sun Oil Co.).

Capacity of the line would be 25 million tons a year, and it would require 15,000 acre-feet of water. Deep aquifers are the proposed water sources. About 30 miles of the route are within the study area and will require about 360 acres; a slurry preparation plant will need about 60 acres more. The environmental problems will be addressed when applications are filed. Accounts of a second proposed slurry line have appeared but no further information is available.

The proposed Panhandle Eastern gasification plant will require a 24-inch, 475-mile gas line. About 20 to 30 miles of this line would be in the area of this study and would require 200 to 350 acres of land. It is expected that the line to supply water to the gasification plant would be 10 to 30 miles long and would require 100 to 200 acres. Another (Carter Oil) possible gasification plant of similar size is expected to require land for pipelines, but since the location has not been announced, the amount is uncertain.

Additional pipeline systems to transport water have been studied, such as those in the North Central Power study, but no firm plans have been announced. The City of Gillette has an option to purchase 1,000 acre-feet of water annually from the North Platte River drainage. This would require a pipeline 130 miles long and probably disrupt 1,000 acres.

Transmission lines

The Northern Great Plains Resource Program study reported 370 miles of major powerlines (69 kv and larger) within the Counties of Campbell and Converse.

Black Hills Power and Light and Pacific Power and Light Companies propose 44 miles of 230-kv transmission lines within the study area from the new plant to be constructed at Wyodak coal mine. The lines will total 153 miles for power transmission to Buffalo and Spearfish. These lines are scheduled to be in operation by 1980 and will occupy 900 to 1,000 acres.

Pacific Power and Light Company has proposed a 230-kv transmission line from the Dave Johnston plant near Glenrock to the area of Wyodak. This 120-mile-long line is to be constructed by 1985 and will occupy about 3,000 acres.

An additional 145 miles of transmission lines will be needed to serve the two power plants projected in this report and to serve expanded (or new) communities, mines, and processing plants. Other lines may cross the study area from generating plants to be constructed outside.

Water Requirements

Quantity

Development, exportation, and consumption of coal resources, together with associated industrial growth within the region, will require substantial supplies of water for consumptive purposes. Specific actions which would require large additional amounts of water include coal-fired power plants, coal gasification/liquefaction plants, coal slurry pipelines, and community growth (municipal). Minimal amounts of irrigation water would also be needed for reclamation during droughty years. Sources of water to meet these needs could be provided from available and unused ground and surface water or by transfer from present uses (irrigation, etc.). Table 5 gives estimates of present and projected water requirements for various types of uses in the study area for the years 1974, 1980, 1985, and 1990. In addition to the tabulated uses, other lesser but important annual water requirements include livestock water, domestic uses, wildlife needs, and recreation uses. Other short-term uses include construction activities associated with development.

Table 5

Estimated Water Requirements for Largest Users of Water in the Study Area

Type of Use	Annual Water Requirements (acre-feet) 1974	1980	1985	1990
Irrigation	10,000	10,000	10,000	10,000
Reservoir Evaporation	30,000	30,000	30,000	30,000
Municipal**	8,000	15,400	18,600	20,000
Oil Field (water-flood)	12,000	12,000	12,000	12,000
Power Plants	8,430*	8,650*	14,150*	19,650*
Gasification Plants	------	7,000	14,000	14,000
Slurry Pipelines	------	15,000	15,000	15,000
Totals	68,430	98,050	113,750	120,650

*Includes Neil Simpson air-cooled and Dave Johnston water-cooled plants.
**Includes use outside study area resulting from development in study area.

Sources

Some sources of water that will be required for industrial growth in the region have been identified by the companies proposing developments. These are described below for identified sources.

Additional water requirements in 1980 for power plants include a small amount (220 acre-feet per year) for the new air-cooled plant at Wyodak. This water will be furnished by existing wells at the Neil Simpson Station. Water required for the 500-megawatt, water-cooled plant by 1985 and another by 1990 will total 5,500 acre-feet in 1985 and 11,000 acre-feet in 1990. The sources for these plants have not been identified.

With construction of Panhandle Eastern's coal gasification plant by 1980, approximately 7,000 acre-feet per year are proposed to be pumped and piped to the plant site from a proposed reservoir to be constructed near the North Platte River just north of Douglas and from two well fields. Water for the reservoir could come from the North Platte River. Additional water is

proposed to be pumped from well fields north of the reservoir site and south of the North Platte River. The second gasification plant would require an additional 7,000 acre-feet per year by 1985. The source of water for this plant has not been identified.

By 1980 a coal slurry pipeline will be in operation which will require an annual water supply of 15,000 acre-feet. This water is proposed to be pumped from a well field in eastern Wyoming north of Lusk.

Increased population growth both within and outside the study area during the period 1974 to 1990 will require additional municipal water. These increased needs are estimated at 7,400 acre-feet per year by 1980, 10,600 acre-feet per year by 1985, and 12,000 acre-feet per year by 1990. The population growth at Gillette will require a substantial increase in annual water use. A large part of this increase is proposed to be piped in from new reservoirs proposed for construction in southern Converse County south of the North Platte River (including Deer Creek, La Bonte Creek, and Wagonhound Creek Reservoirs). Other municipal water will likely be pumped from existing and new water well fields.

Projected water requirements for irrigation (10,000 acre-feet per year) and oil field water flood (12,000 acre-feet per year) indicate no change over the period 1974 through 1990. However, during years of drought, minimal increases in irrigation use would be required for reclamation purposes. An exchange of use may occur during or subsequent to this period with some transfer of use from irrigation to other uses associated with regional coal development.

The potential for ground water development will exist for an infinitely long time based on annual recharge to the aquifers estimated at 150,000

acre-feet per year. This recharge volume is more than enough to satisfy the total increase in demand for water estimated at 50,000 acre-feet per year by 1990 within the study area. Much of the water is not suitable for some uses, such as municipal, domestic, and boiler feed supplies without desalting. Water quality requirements for other uses in the coal development industries have not been clearly specified.

Assumption and Analysis Guidelines

Assumptions

The following tables were developed, based on projected coal and ancillary developments for the study area, to establish parameters and guidelines for the analysis of cumulative regional impacts. They are set forth here in order that the reader may follow how the causes were related to effects and magnitude of impact established. These tables also make it possible for the impacts to be revised in the future, based on amount of actual development which takes place. As new development information becomes available, these tables can be utilized to determine cumulative magnitude of additional impact due to additional development.

Projected Cumulative Development Data for the Study Area (1974 Base)

	Base	1980	1985	1990
Number of Mines	3	10	12	14
Number of Power Plants[1]	2[2]	3[3]	5[4]	6[5]
Number of Gasification Plants	-	1	2	2
Cumulative Tons of Coal Mined (millions)	-	297	858	1,543
Population Increase (1,000's)[6]	-	37	53	60
Miles of New Road	-	16	20	24
Miles of New Powerline	-	44	164	225
Miles of Slurry Pipeline[7]	-	1040	1040	1040
Miles of New Railroad[8]	-	140	145	150

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[1] It is assumed that the 500-MW power plants will be water cooled.

[2] Dave Johnston and Neil Simpson

[3] Plus Wyodak 330 MW

[4] Plus Wyodak 450 MW and new 500 MW

[5] Plus new 500 MW

[6] Population base is 1970. Increase is for eight-county area. Socio-economic impacts are analyzed on an eight-county basis. Projected cumulative population increases for the Campbell and Converse counties are 27,000 - 1980; 42,000 - 1985; and 47,000 - 1990.

[7] Miles of slurry pipeline include only the miles of the one firm proposal which has been made to private industry by Energy Transportation Systems. The pipeline will be an estimated 30 miles long in the study area.

[8] Miles of railroad includes the proposed single track as analyzed in Part II and estimated cumulative miles of spur line to be constructed by 1990.

Projected Coal Production for the Study Area
(million tons/year)

Year	Production	Year	Production
1974	8	1982	109
1975	11	1983	118
1976	16	1984	120
1977	32	1985	122
1978	62	1986	124
1979	79	1987	131
1980	88	1988	137
1981	99	1989	143
		1990	150

Acreage Requirement Used to Analyze Impacts

Facility	Acreage Required (Acres)
Gasification Plant	1,000 per plant
Power Plant (water cooled)	2 per megawatt
Mine[5]	100 per mine
Slurry Preparation Plant	60 per plant
Slurry Pipeline (100' R/W)	12 per mile
Powerlines (230 kv)	23 per mile
Roads (2 lane, 175' R/W)	21 per mile
Per 1,000 Population Increase[6]	50
Per Million Tons of Coal Mined	9 surface acres

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[5] Includes mine buildings, shops, etc.

[6] Calculated on the basis of six single-family units per acre and 3.4 persons per family unit.

Water Requirements Used to Analyze Impacts

Facility	Acre-feet/yr.
Gasification plant (250 million cubic feet per day)	7,000
Power Plants (water cooled)	11 per megawatt
Slurry Pipeline (25 million ton coal per year)	15,000
Per 1,000 Population Increase	200

Projected Increased Water Needs for the Study Area

Type of Use	Annual Water Requirements (acre-feet) 1974	1980	Inc.[1]	1985	Inc.[1]	1990	Inc.[1]
Irrigation	10,000	10,000	0	10,000	0	10,000	0
Municipal[2]	8,000	15,400	7,400	18,600	10,600	20,000	12,000
Oil Field (Water-flood)	12,000	12,000	0	12,000	0	12,000	0
Power Plants[3]	8,430	8,650	220	14,150	5,720	19,650	11,220
Gasification Plants	------	7,000	7,000	14,000	14,000	14,000	14,000
Slurry Pipelines	------	15,000	15,000	15,000	15,000	15,000	15,000
Totals	38,430	68,050	29,620	83,750	45,320	90,650	52,220

[1]Increase over base year (1974).
[2]Includes need for the projected population for eight county socio-economic analysis area.
[3]Includes Neil Simpson air-cooled and Dave Johnston water-cooled plants.

Cumulative Disturbed and Reclaimed Acreages in the Study Area Based On Projected Development and Acreage Requirement Units

Type	Year 1980	1985	1990
Coal Disturbed	2,664	7,722	13,887
Coal Reclaimed[1]	0	1,372	4,132
R/W Disturbed	3,108	6,002	7,539
R/W Reclaimed	0	1,372	4,132
Total Disturbed	8,882	19,784	28,936
Total Reclaimed	171	4,036	11,854
Permanently Removed			
R/W's[2]	1,736	1,870	2,004
Facilities[3]	1,760	3,960	5,160
Population (in study area)	1,350	2,100	2,350
Total Permanently Removed	4,846	7,930	9,514

[1]Five year time lag assumed (see item 4 below).
[2]For railroad this will consist of an 80' wide average strip, and for roads a 100' wide average strip.
[3]Facilities include mine facilities, power plants, gasification plants.

Analysis Guidelines

1. Cumulative impacts will be analyzed for three time points (1980 - 1985 - 1990).

2. Level of mining technology will not change significantly through 1990.

3. Mined areas will be reclaimed for livestock grazing (grass species).

4. There will be a 5-year time lag in reclamation efforts for mined areas. After first 5 years, the same amount of area mined will be reclaimed each year.

5. For rights-of-way, railroad, powerlines, roads, there will be a 2-year time lag for vegetation restoration.

6. The following reclamation schedule will be used for proper restoration to a livestock grazing land use:

   1st year - reshaping and topsoiling

   2nd year - fallowing and mulching to allow moisture accumulation

   3rd year - seeding and rest for plant establishment

   4th year - rest for plant establishment

   5th year - allow grazing

7. There will be a 50 percent loss in productivity for grazing purposes. This will occur even if the entire area is revegetated.

8. Mining plan site analyses will cover, beside the mine and mine facilities, all associated facilities (i.e., powerlines, roads, spur railroad track, acres involved in population increase, living facilities bought or planned by the company).

9. The railroad site analysis will cover construction of the railroad, access roads, powerlines, operation and maintenance and population increase associated with railroad employment.

10. Any impacts lasting over 30 years will be considered permanent.

Figure 6
Cumulative Disturbed and Rehabilitated Acreage