UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

ROCKY BUTTE SOUTHWEST QUADRANGLE

CAMPBELL COUNTY, WYOMING

BY

INTRASEARCH INC.

DENVER, COLORADO

OPEN FILE REPORT 79-022
1979

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CONVERSION TABLE

To Convert	Multiply By	To Obtain
inches	2.54	centimeters (cm)
feet	0.3048	meters (m)
miles	1.609	kilometers (km)
acres	0.40469	hectares (ha)
tons (short)	0.9072	metric tons (t)
cubic yards/ton	0.8428	cubic meters per metric ton
acre feet	0.12335	hectare-meters
Btu/lb	2.326	kilojoules/kilogram (kJ/kg)
Btu/lb	0.55556	kilocalories/kilogram (kcal/kg)
Fahrenheit	5/9(F-32)	Celsius

I. Introduction

The report and accompanying maps set forth the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) of coal beds within the Rocky Butte Southwest Quadrangle, Campbell County, Wyoming. This CRO and CDP map series includes 24 plates (U.S. Geological Survey Open-File Report 79-022). The project is compiled by IntraSearch Inc., 1600 Ogden Street, Denver, Colorado under KRCRA Northeastern Powder River Basin, Wyoming Contract Number 14-08-0001-17180. This contract is a part of a program to provide an inventory of federal coal in Known Recoverable Coal Resource Areas (KRCRA) in the western United States.

The Rocky Butte Southwest Quadrangle is located in Campbell County in northeastern Wyoming. It encompasses all or parts of Townships 55 and 56 North, Ranges 71 and 72 West, and covers the area: 44°45' to 44°52'30" north latitude; 105°22'30" to 105°30' west longitude.

Wyoming State Highway 59 provides the main access to the Rocky Butte Southwest Quadrangle. This hard surface, secondary highway approximately parallels the Little Powder River drainage in the southeastern part of the quadrangle. Numerous unimproved and light-duty roads which branch from Wyoming State Highway 59 form a network of accessibility for much of the area. The nearest railroad is the Burlington-Northern trackage, approximately 24 miles (39 km) south of the quadrangle near Gillette, Wyoming.

The Little Powder River flows northeastward through the southeastern part of the quadrangle. The elevation of the valley floor is approximately 3530 feet (1076 m) above sea level. Elk Creek and White Tail Creek are tributary to the Little Powder River from the west, and drain fairly rugged terrain that attains elevations of 4400 feet (1341 m) above sea level. The somber grays, yellows, and browns of outcropping shales and siltstones contrast strikingly with the brilliant reds, oranges, and purples of "clinker", and deep greens of the juniper and pine tree growth.

The thirteen to fourteen inches (33 to 36 cm) of annual precipitation that falls in this semi-arid region accrues principally in the springtime. Summer and fall precipitation usually originates from thunderstorms, and infrequent snowfalls of six inches (15 cm) or less generally characterize winter precipitation. Although temperatures ranging from less than -25°F (-32°C) to more than 100°F (38°C) have been recorded near Arvada, Wyoming, average wintertime minimums and summertime maximums approach +5° to +15°F (-15° and -9°C) and 75° to 90°F (24° to 32°C), respectively.

Surface ownership is divided among fee, state, and federal categories with the state and federal surface generally leased to ranchers for grazing purposes. Details of surface ownership are available at the County Courthouse in Gillette, Wyoming.

Details of mineral ownership on federal lands are available from the U.S. Bureau of Land Management in Cheyenne, Wyoming. Federal coal ownership is shown on Plate 2 of the Coal Resource Occurrence maps. The non-federal coal ownership comprises both fee and state coal resources.

The Coal Resource Occurrence and Coal Development Potential program focuses upon: 1) the delineation of lignite, subbituminous, bituminous and anthracite coal at the surface and in the subsurface on federal land; 2) the identification of total tons in place as well as recoverable tons; 3) categorization of these tonnages into measured, indicated and inferred reserves and resources, and hypothetical resources; and 4) recommendations regarding the potential for surface mining, subsurface mining and in-situ gasification of the coal beds. This report evaluates the coal resources of all coal beds in the quadrangle which are five feet (1.5 m) or greater in thickness and occur at depths down to 3000 feet (914 m).

Surface and subsurface geological and engineering extrapolations drawn from the current data base suggest the occurrence of approximately 824 million tons (747 million metric tons) of total coal-in-place in the Rocky Butte Southwest Quadrangle.

The suite of maps that accompany this report set forth and portray the coal resource and reserve occurrence in considerable detail. For the most part, this report intends to augment the cartographically displayed information with minimum word duplication of said data.

II. Geology

Regional. The thick, economic coal deposits of the Powder River Basin in northeastern Wyoming occur mostly in the Tongue River Member of the Fort Union Formation and in the lower part of the Wasatch Formation. Approximately 3000 feet (914 m) of the Fort Union Formation that includes the Tongue River, Lebo, and Tullock Members of Paleocene age, are unconformably overlain by approximately 700 feet (213 m) of the Wasatch Formation of Eocene age. These Tertiary formations lie in a structural basin flanked on the east by the Black Hills uplift, on the south by the Hartville and Casper Mountain uplifts, and on the west by the Casper Arch and the Big Horn Mountain uplift. The structural configuration of the Powder River Basin originated in Late Cretaceous time, with episodic uplift thereafter. The Cretaceous Cordillera was the dominant positive land form throughout the Rocky Mountain area at the close of Mesozoic time.

Outcrops of the Wasatch Formation and the Tongue River Member of the Fort Union Formation cover most of the areas of major coal resource occurrence in the Powder River Basin. The Lebo Member of the Fort Union Formation is mapped at the surface northeast of Recluse, Wyoming, east of the principal coal outcrops and associated clinkers (McKay, 1974), and presumably projects into the subsurface beneath much of the basin. One of the principal characteristics for separating the Lebo and Tullock Members (collectively referred to as the Ludlow Member east of

Miles City, Montana) from the overlying Tongue River Member is the color differential between the lighter-colored upper portion and the somewhat darker lower portion (Brown, 1958). Although geologists working with subsurface data, principally geophysical logs, in the basin are trying to develop criteria for subsurface recognition of the Lebo-Tullock and Tongue River-Lebo contacts, no definitive guidelines are known to have been published. Hence, for subsurface mapping purposes the Fort Union Formation is not divided into its member subdivisions for this study.

During the Paleocene epoch, the Powder River Basin tropic to subtropic depositional environment included broad, inland flood basins with extensive swamps, marshes, freshwater lakes, and a sluggish but active northeastward discharging drainage system, superimposed on a near base level, emerging sea floor. Much of the vast areas where organic debris collected was within a reducing depositional environment. Localized uplifts began to disturb the near sea level terrain of northeastern Wyoming, following retreat of the Cretaceous seas. However, the extremely fine-grained characteristics of the Tongue River Member clastics suggest that areas of recurring uplift peripheral to the Powder River Basin were subdued during major coal deposit formation.

The uplift of areas surrounding the Powder River Basin created a structural basin of asymmetric characteristic, with the steep west flank located on the eastern edge of the Big Horn Mountains. The axis of the Powder River Basin is difficult to specifically define, but is thought to be located in the western part of the basin, and to display a north-south configuration some 15 to 20 miles (24 to 32 km) east of Sheridan, Wyoming. Thus, the sedimentary section described in this report lies on the east flank of the Powder River Basin, with gentle dips of two degrees or less disrupted by surface structure thought to relate to tectonic adjustment and differential compaction.

Some coal beds in the Powder River Basin exceed 200 feet (61 m) in thickness. Deposition of these thick, in-situ coal beds requires a discrete balance between subsidence of the earth's crust and in-filling by tremendous volumes of organic debris. These conditions in concert with a favorable ground water table, non-oxidizing clear water and a climate amenable to the luxuriant growth of vegetation produce a stabilized swamp critical to the deposition of coal beds. Deposition of the unusually thick coal beds of the Powder River Basin may be partially attributable to short distance water transportation of organic detritus into areas of crustal subsidence. Variations in coal bed thickness throughout the basin relate to changes in the depositional environment. Drill hole data that indicate either the complete absence or extreme attenuation of a thick coal bed probably relate to location

within the ancient stream channel system servicing this low land area in Early Cenozoic time. Where thick coal beds thin rapidly from the depocenter of a favorable depositional environment, it is not unusual to encounter synclinal structure over the maximum coal thickness due to the differential compaction between organic debris in the coal depocenter, and fine-grained clastics in the adjacent areas.

The Wasatch Formation of Eocene age crops out over most of the central part of the Powder River Basin and exhibits a disconformable contact with the underlying Fort Union Formation. The contact has been placed at various horizons by different workers; however, for the purpose of this report, in northwestern Campbell County, Wyoming, the contact is positioned near the top of the Roland coal bed as mapped by Olive (1957) and is considered to disconformably descend in the stratigraphic column to the top of the Wyodak-Anderson coal bed (Roland coal bed of Taff, 1909) along the eastern boundary of the coal measures. No attempt is made to differentiate the Wasatch and Fort Union Formations on geophysical logs or in the subsurface mapping program that is a part of this CRO-CDP project.

Although Wasatch and Fort Union lithologies are too similar to allow differentiation in some areas, most of the thicker coal beds occur in the Fort Union section on the east flank of the Powder River Basin. Furthermore, orogenic movements peripheral to the basin apparently increased in magnitude during Wasatch time causing the deposition of friable, coarse-grained to gritty arkosic sandstones, fine to very

fine-grained sandstones, siltstones, mudstones, claystones, and brown to black carbonaceous shales. These sediments are noticeably to imperceptibly coarser than the underlying Fort Union clastics.

The Rocky Butte Southwest Quadrangle is located in an area where surface rocks are classified into the Tongue River and Lebo Members of the Fort Union Formation. Although the Tongue River Member is reportedly 1200 to 1300 feet (366 to 396 m) thick (Olive, 1957), only 800 to 900 feet (244 to 274 m) are exposed in this area. Olive (1957) correlated coal beds in the Spotted Horse coal field with coal beds in the Sheridan coal field (Baker, 1929) and Gillette coal field (Dobbin and Barnett, 1927), Wyoming, and with coal beds in the Ashland coal field (Bass, 1932) in southeastern Montana. This report utilizes, where possible, the coal bed nomenclature used in previous reports. Baker (1929) named the Canyon and Wall coal beds, the Cook coal bed was named by Bass (1932), and the Pawnee and Cache coal beds were named by Warren (1959). The Oedekoven and Moyer coal beds were informally named by IntraSearch (1978a and 1979).

Local. The Rocky Butte Southwest Quadrangle lies on the eastern flank of the Powder River Basin, where the strata dip gently westward. The Tongue River Member of the Fort Union Formation crops out within the quadrangle. The Fort Union Formation is composed of very fine-grained sandstone, siltstone, claystone, shale, carbonaceous shale, and numerous coal beds.

Three northwest-trending faults occur in the northwest part of the quadrangle. These faults are identified by photogeologic interpretation utilizing IntraSearch, 1:24,000 scale, color aerial photography. Two of these faults are downthrown to the south with vertical displacements between 5 and 20 feet (1.5 to 6 m). A third fault trends south-southeast to a juncture with the southernmost fault mentioned above. The third fault is downthrown to the north with a vertical displacement of approximately 40 feet (12 m). A structural high is located in the southwest portion of the Rocky Butte Southwest Quadrangle.

III. Data Sources

Areal geology of the coal bed outcrops and associated clinker is derived from data interpreted from aerial photography. IntraSearch requested and received permission to study color aerial photography for the purpose of establishing the Pawnee and Cache coal bed outcrop delineations. Subsequent to completion of this mapping, CRO maps by Lingley (1977) were supplied to IntraSearch by the U.S. Geological Survey. Outcrop configurations of Lingley and IntraSearch are in general agreement on the Pawnee coal bed. However, Cache coal bed outcrops and clinkers are difficult to identify with any lateral significance; this contributes to the minor differences in location of the Cache outcrop configuration.

The major source of subsurface control, particularly on deep coal beds, is the geophysical logs from oil and gas test bores and producing wells. Some geophysical logs are not applicable to this

study, for the logs relate only to the deep potentially productive oil and gas zones. More than eighty percent of the logs include resistivity, conductivity, and self-potential curves. Occasionally the logs include gamma, density, and sonic curves. These logs are available from several commercial sources.

All geophysical logs available in the quadrangle are scanned to select those with data applicable to Coal Resource Occurrence mapping. Paper copies of the logs are obtained, interpreted, and coal intervals annotated. Maximum accuracy of coal bed identification is accomplished where gamma, density, and resistivity curves are available. Coal bed tops and bottoms are picked on the logs at the midpoint between the minimum and maximum curve deflections. The correlation of coal beds within and between quadrangles is achieved utilizing a fence diagram to associate local correlations with regional coal occurrences.

In some parts of the Powder River Basin, additional subsurface control is available from U.S. Geological Survey open-file reports that include geophysical and lithologic logs of shallow holes drilled specifically for coal exploration. A sparse scattering of subsurface data points are shown on unpublished CRO-CTP maps compiled by the U.S. Geological Survey, and where these data are utilized, the rock-coal intervals are shown on the Coal Data Map (Plate 1). Inasmuch as these drillholes have no identifier headings, they are not set forth on the Coal Data Sheets (Plate 3). IntraSearch cannot obtain geophysical

logs of these drill holes to ascertain the accuracy of horizontal location, topographic elevation, and down-hole data interpretation.

The reliability of correlations, set forth by IntraSearch in this report, vary depending upon: the density and quality of lithologic and geophysical logs; the detail, thoroughness, and accuracy of published and unpublished surface geological maps; and interpretative proficiency. There is no intent on the part of IntraSearch to refute nomenclature established in the literature or used locally by workers in the area: The thrust of the IntraSearch intent focuses upon the suggestion of a regional nomenclature applicable throughout the eastern Powder River Basin. It is expected and entirely reasonable that some differences of opinion regarding correlations as suggested by IntraSearch exist. Additional drilling for coal, oil, gas, water, and uranium, coupled with expanded mapping of coal bed outcrops and associated clinkers will broaden the data base for coal bed correlations and allow continued improvement in the understanding of coal bed occurrences in the eastern Powder River Basin.

The topographic map of the Rocky Butte Southwest Quadrangle is published by the U.S. Geological Survey, compilation date, 1972. Land ownership data inside the KRCRA boundary arecompiled from land plats available from the U.S. Bureau of Land Management dated October 12-13, 1977. Supplemental land ownership data outside the KRCRA boundary are compiled

from land plats dated September 29, 1977, supplied to IntraSearch by the U.S. Geological Survey Conservation Division. The lease, Coal Prospecting Permit and P.R.L.A. areas on the September 29, 1977 land plats may not agree with the October 12-13,1977 land plats. It is possible that additional leases are included outside the KRCRA boundary utilizing the September 29, 1977 plats.

IV. Coal Bed Occurrence

Fort Union Formation coal beds that are present in all of part of the Rocky Butte Southwest Quadrangle include, in descending stratigraphic order, the Canyon, Cook, Wall, Pawnee, Cache, Moyer, and Oedekoven coal beds. A complete suite of maps (structure, isopach, mining ratio, overburden/interburden, identified resources and areal distribution of identified resources) is prepared for the Cook, Pawnee, Cache, and Oedekoven coal beds. Because of insufficient data, limited areal extent or thinness, the Canyon, Wall, and Moyer coal beds are not included in the CRO mapping series.

The general "as received" basis proximate analyses for northern Campbell County, Wyoming coal beds are set forth below. Coreholes 7424 and 7426 are located in Section 25, T. 56 N., R. 72 W., and Section 14, T. 55 N., R. 72 W., respectively. Hole 7426 penetrates the Wall coal bed and Hole 7424 provides an analysis for the Pawnee coal bed.

COAL BED NAME		ASH	FIXED CARBON	MOISTURE	VOLATILES	SULPHUR	BTU/LB
Canyon (P)		4.290	32.852	35.100	27.758	0.307	7298
Cook (P)		4.620	34.410	33.640	27.330	0.250	7766
Wall (U)	Hole 7426	9.542	29.322	32.150	28.985	0.500	7279
Pawnee (U)	Hole 7424	7.880	31.029	31.910	29.183	0.386	7344
Cache (U)	Hole 741	9.481	30.517	31.420	28.582	0.488	7271

(P) - Proprietary Data
(U) - U.S. Geological Survey & Montana Bureau of Mines & Geology - 1974

The Coal Data Sheet, Plate 3, shows the downhole identification of coal beds within the quadrangle as interpreted from geophysical logs from oil and gas test bores and producing sites. Inasmuch as the Pawnee coal bed underlies the entire quadrangle, it is designated as datum for the correlation diagram. The eastern half of the Rocky Butte Southwest Quadrangle has no drill hole information, and is considered to be an area of insufficient data.

Approximately 90 feet (27 m) of overburden overlies the Canyon coal bed where 23 and 26 feet (7 and 9 m) of coal is penetrated in two drill holes within the quadrangle. Because of burning, erosion, and insufficient data, the Canyon coal bed is not mapped on the Rocky Butte Southwest Quadrangle.

The Cook coal bed is separated from the overlying Canyon coal bed by 97 feet (30 m) of clastic debris. The Cook coal bed ranges from 8 to 21 feet (2.4 to 6 m) in thickness, and averages 14 feet (4 m) thick. The Cook structure map indicates a westward dip of approximately one degree.

The Wall coal bed lies approximately 107 feet (33 m) beneath the Cook coal bed. The thickness of the Wall coal bed averages less than five feet (1.5 m), therefore it is not mapped on this quadrangle.

The Pawnee coal bed occurs 5 to 16 feet (1.5 to 5 m) beneath the Wall coal bed, and averages 17 feet (5 m) thick. Thickness of the Pawnee coal bed ranges from 10 to 23 feet (3 to 7 m), and the Pawnee structure map indicates a westward dip of one to two degrees. A synclinal feature occurs on the western edge of the quadrangle where three faults are present.

The Cache coal bed is separated from the overlying Pawnee coal bed by 51 to 108 feet (15 to 33 m) of interburden. Thickness of the Cache coal bed averages five feet (1.5 m), and ranges from 0 to 14 feet (0 to 4 m). The Cache coal bed pinches out eastward and is absent from the eastern half of the quadrangle. Structure contours on the Cache coal bed top indicate a westward dip of one to two degrees interrupted by two synclinal features in the southwest corner of the Rocky Butte Southwest Quadrangle.

The Moyer coal bed is identified in two drillholes in this quadrangle. Therefore, due to insufficient data and limited areal extent, the Moyer coal bed is not mapped.

From 313 to 434 feet (95 to 132 m) of clastic sediment separates the Oedekoven coal bed from the Cache coal bed. Thickness of the Oedekoven coal bed ranges from 0 to 11 feet (0 to 3 m). The Oedekoven

coal bed is absent from most of the eastern half of the quadrangle, and occurs in excess of 500 feet (152 m) beneath the surface throughout the study area. The structure map of the Oedekoven coal bed portrays a westward dip of one to two degrees.

V. Geological and Engineering Mapping Parameters

Subsurface mapping is based on geologic data within and adjacent to the Rocky Butte Southwest area. Data from geophysical logs are used to correlate coal beds and control contour lines for the coal thickness, structure, and overburden maps. Isopach lines are also drawn to honor selected measured sections where there is sparse subsurface control. Where isopach contours do not honor surface measured sections, the surface thicknesses are thought to be attenuated by oxidation and/or erosion, hence not reflective of total coal thickness. Structure contour maps are constructed on the tops of the main coal beds. Where subsurface data is scarce, supplemental structural control points are selected from the topographic map along coal outcrops.

In preparing overburden isopach maps, no attempt is made to identify coal beds that occur in the overburden to a particular coal bed under study. Mining ratio maps for this quadrangle are constructed utilizing a 95% recovery factor. Contours on these maps identify the ratio of cubic yards of overburden to tons of recoverable coal. Where ratio control points are sparse, interpolated points are computed using coal structure, coal isopach, and topographic control. On the Areal

Distribution of Identified Resources Map (ADIR), coal bed reserves are not calculated where the coal is less than 5 feet (1.5 m) thick, where the coal occurs at a depth greater than 500 feet (152 m), or where non-federal coal exists.

Coal tonnage calculations involve the planimetering of areas of measured, indicated and inferred reserves and resources, and hypothetical resources to determine their areal extent in acres. Acres are multiplied by the average coal bed thickness and 1750 (the number of tons of lignite A per acre-foot; 12,874 metric tons per hectare-meter) to determine total tons in place. Recoverable tonnage is calculated at 95% of the total tons in place. North of the Rocky Butte Southwest Quadrangle, in the Montana portion of the Powder River Basin, a recovery factor of 85 percent is utilized because of the general northward thinning of economic coal beds. Where tonnages are computed for the CRO-CDP map series, resources and reserves are expressed in millions of tons. Frequently the planimetering of coal resources on a sectionized basis involves complexly curvilinear lines (coal bed outcrop and 500-foot stripping limit designations) in relationship with linear section boundaries and circular resource category boundaries. Where these relationships occur, generalizations of complex curvilinear lines are discretely utilized, and resources and/or reserves are calculated within an estimated two to three percent plus or minus accuracy.

VI. Coal Development Potential

Strippable Coal Development Potential. Areas where coal beds are 5 feet (1.5 m) or more in thickness and are overlain by 500 feet (152 m) or less of overburden are considered to have potential for surface mining and are assigned a high, moderate, or low development potential based on the mining ratio (cubic yards of overburden per ton of recoverable coal). The formula used to calculate mining ratios is as follows:

$$MR = \frac{t_o\ (0.922)}{t_c\ (rf)}$$

where MR = mining ratio
t_o = thickness of overburden
t_c = thickness of coal
rf = recovery factor
0.922 = conversion factor (cu.yds/ton)

A surface mining potential map is prepared utilizing the following mining ratio criteria:

1. Low development potential = 15:1 and greater ratio.
2. Moderate development potential = 10:1 to 15:1 ratio.
3. High development potential = 0 to 10:1 ratio.

The surface mining potential is low for most of the Rocky Butte Southwest Quadrangle. The Cook coal bed lies near the surface north and south of Elk Creek at the center of the quadrangle, creating a high development potential in this area. The depth of burial and thinness of the Wall, Pawnee, Cache and Oedekoven coal beds results in a low development potential for surface mining over most of the Rocky Butte Southwest Quadrangle. No coal is mapped in the eastern half of the quadrangle. Table 1 sets forth the estimated strippable reserve base tonnages per coal bed for the quadrangle.

Underground Mining Coal Development Potential. Subsurface coal mining potential throughout the Rocky Butte Southwest Quadrangle is considered low. Table 2 sets forth the estimated coal resources in tons per coal bed.

In-Situ Gasification Coal Development Potential. The evaluation of subsurface coal deposits for in-situ gasification potential relates to the occurrence of coal beds more than 5 feet (1.5 m) thick buried from 500 to 3000 feet (152 to 914 m) beneath the surface. This categorization is as follows:

1. Low development potential relates to a total coal section less than 100 feet (30 m) thick, or coal beds that lie 500 feet (152 m) to 1000 feet (305 m) beneath the surface.
2. Moderate development potential is assigned to a total coal section from 100 to 200 feet (30 to 61 m) thick, and from 1000 to 3000 feet (305 to 914 m) beneath the surface.
3. High development potential involves 200 feet (61 m) or more of total coal thickness buried from1000 to 3000 feet (305 to 914 m).

The coal development potential for in-situ gasification on the Rocky Butte Southwest Quadrangle is low, hence no CDP map is generated for this map series. The resource tonnage for in-situ gasification with low development potential totals approximately 160 million tons (145 million metric tons) (Table 3). None of the coal beds in the Rocky Butte Southwest Quadrangle qualify for a moderate or high development potential rating.

Table 1.--Strippable Coal Reserve Base Data (in short tons) for Federal Coal Lands in the Rocky Butte Southwest Quadrangle, Campbell County, Wyoming.

Development potentials are based on mining ratios (cubic yards of overburden/ton of recoverable coal).

Coal Bed	High Development Potential (0-10:1 Mining Ratio)	Moderate Development Potential (10:1-15:1 Mining Ratio)	Low Development Potential (>15:1 Mining Ratio)	Total
Cook	55,160,000	48,100,000	115,520,000	218,780,000
Pawnee	70,160,000	45,520,000	167,200,000	282,880,000
Cache	-	1,010,000	39,910,000	40,920,000
Oedekoven	-	-	13,110,000	13,110,000
TOTAL	125,320,000	94,630,000	335,740,000	555,690,000

Table 2.-- Coal Resource Base Data (in short tons) for Underground Mining Methods for Federal Coal Lands in the Rocky Butte Southwest Quadrangle, Campbell County, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Cook	-	-	-	-
Pawnee	-	-	45,990,000	45,990,000
Cache	-	-	8,730,000	8,730,000
Oedekoven	-	-	105,110,000	105,110,000
TOTAL	-	-	159,830,000	159,830,000

Table 3.--Coal Resource Base Data (in short tons) for In-Situ Gasification for Federal Coal Lands in the Rocky Butte Southwest Quadrangle, Campbell County, Wyoming.

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Cook	-	-	-	-
Pawnee	-	-	45,990,000	45,990,000
Cache	-	-	8,730,000	8,730,000
Oedekoven	-	-	105,110,000	105,110,000
TOTAL	-	-	159,830,000	159,830,000

SELECTED REFERENCES

Baker, A.A., 1929, The northward extension of the Sheridan coal field, Big Horn and Rosebud Counties, Montana: U.S. Geol. Survey Bull. 806-B, p. 15-67.

Bass, N.W., 1932, The Ashland coal field, Rosebud, Powder River, and Custer Counties, Montana: U.S. Geol. Survey Bull. 831-B, p. 19-105.

Brown, R.W., 1958, Fort Union Formation in the Powder River Basin, Wyoming: Wyo. Geol. Soc. Guidebook, Thirteenth Annual Field Conf. p. 111-113.

Dobbin, C.E., and Barnett, V.H., 1927, The Gillette coal field, northeastern Wyoming, with a chapter on the Minturn district and northwestern part of the Gillette field by W.T. Thom, Jr.: U.S. Geol. Survey Bull. 796-a, p. 1-50.

Glass, G.B., 1975, Review of Wyoming coal fields, 1975: Wyoming Geol. Survey Public Information circ. 4, p. 10.

IntraSearch Inc., 1978a, Coal resource occurrence and coal development potential of the Cabin Creek Northeast Quadrangle, Sheridan and Campbell Counties, Wyoming, and Powder River County, Montana: U.S. Geol. Survey Open-File Report 78-064, 21 p.

_____, 1978b, Coal resource occurrence and coal development potential of the Rocky Butte Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 78-830, 22 p.

_____, 1979, Coal resource occurrence and coal development potential of the Larey Draw Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 79-023, 29 p.

Jacob, A.F., 1973, Depositional Environments of Paleocene Tongue River Formation: Am. Assoc. of Petroleum Geologists Bull. vol. 56, no. 6, p. 1038-1052.

Landis, E.R., and Hayes, P.T., 1973, Preliminary geologic map of the Croton 1 SE (White Tail Butte) Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open-File Report, scale 1:24,000.

Lingley, L., 1977, Preliminary coal resource occurrence map of the Rocky Butte Southwest Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey unpublished report, scale 1:24,000.

McKay, E.J., 1973, Preliminary geologic map of the Croton 1 NE (Homestead Draw) Quadrangle, Campbell, County, Wyoming: U.S. Geol. Survey Open-File Report, scale 1:24,000.

McKay, E.J., 1974, Preliminary geologic map of the Bertha 2 NW (Rocky Butte) Quadrangle, Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 74-173, scale 1:24,000.

Olive, W.W., 1957, The Spotted Horse coal field, Sheridan and Campbell Counties, Wyoming: U.S. Geol. Survey Bull. 1050, 83 p.

Schell, E.M., and Mowat, G.D., 1972, Reconnaissance map showing some coal and clinker beds in the Fort Union and Wasatch Formations in the eastern Powder River Basin, Campbell and Converse Counties, Wyoming: U.S. Geol. Survey Open-File Report, scale 1:63,360.

Taff, J.A., 1909, The Sheridan coal field, Wyoming in Coal Fields of Wyoming: U.S. Geol. Survey Bull. 341-B, p. 123-150.

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geol. Survey Bull. 1450-B 7 p.

U.S. Geological Survey and Montana Bureau of Mines and Geology, 1974, Preliminary report of coal drill hole data and chemical analyses of coal beds in Campbell County, Wyoming: U.S. Geol. Survey Open-File Report 74-97, 241 p.

Warren, W.C., 1959, Reconnaissance geology of the Birney-Broadus coal field, Rosebud and Powder River Counties, Montana: U.S. Geol. Survey Bull. 1072-J, p. 561-585.

Weimer, R.J., 1977, Stratigraphy and tectonics of western coals, in Geology of Rocky Mountain Coal, A Symposium, 1976: Colorado Geol. Survey Resource Series 1, p. 9-27.