UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

OF THE

KLINE DRAW QUADRANGLE

CAMPBELL COUNTY, WYOMING

BY

INTRASEARCH INC.

DENVER, COLORADO

OPEN FILE REPORT 78-831
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This report is preliminary, and has not been edited or reviewed for conformity with United States Geological Survey standards or stratigraphic nomenclature.

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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 Kline Draw Quadrangle, Campbell County, Wyoming. The CRD and CDP map series includes 34 plates (U.S. Geological Survey Open-File Report 78-831). 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 Kline Draw Quadrangle is located in northern Campbell County, Wyoming. It encompasses all or parts of Townships 55,56, and 57 North, Ranges 75 and 76 West, in Wyoming, and covers the area: 44°45' to 44°52'30" north latitude; 105°52'30" to 106°00' west longitude.

A maintained gravel road provides access to the eastern half of the Kline Draw quadrangle. Minor roads and trails that branch from this gravel road constitute an avenue of access to much of the area. U.S. Highway 14-16 provides paved access to the Kline Draw quadrangle from the southern boundary. The closest railroad is the Burlington Northern trackage, approximately 6 miles (10 km) to the west at Arvada, Wyoming.

The Powder River flows northeastward and is located approximately 3 miles (4.8 km) west of the eastern border of Kline Draw quadrangle. Spotted Horse Creek, Ivy Creek, and LX Bar Creek are tributary to the Powder River from the east and drain fairly rugged terrain. Topographic relief varies up to 510 feet (155 m) in the area. 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 temperature ranges 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 a depth up to 3000 feet (914 m).

Surface and subsurface geological and engineering extrapolations drawn from the current data base suggest the occurrence of approximately 7.6 billion tons (6.9 billion metric tons) of total coal-in-place in the Kline Draw 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. 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 from 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 in the quadrangle just east of the Homestead Draw Quadrangle (McKay, 1974), and presumably projects into the subsurface beneath much of the area of this report. 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 suptropic depositional environment included broad, inland flood basins with extensive swamps, marshes, freshwater lakes, and a sluggish but active drainage system, superimposed on a near base level, emerging sea floor. 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

theorized 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.

The surface drainage system existent during Fort Union time in the Wyoming portion of the Powder River Basin displayed a near base level profile with discharge northeastward. During Tongue River time, the flat landmass was near sea level. A tropical to subtropical climate existed, and much of the vast areas where organic debris collected was within a reducing depositional environment.

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 infilling 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. Drillhole 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 western Campbell County, Wyoming, the contact is positioned at 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 (Roland 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 Kline Draw Quadrangle is located in an area where surface rocks are classified into the Tongue River Member of the Fort Union Formation and the Wasatch Formation. Although the Tongue River Member is reportedly 1200 to 1300 feet (366 to 396 m) thick, and the Wasatch Formation 700 feet (213 m) thick, only 500 to 550 feet (152 to 168 m) and 100 to 150 feet (30 to 46 m) respectively, 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. The Smith coal bed was named by Taff (1909). Baker (1929) assigned names to the Anderson, 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 coal bed was informally named by IntraSearch (1978).

Local. The Kline Draw Quadrangle lies on the eastern flank of the Powder River Basin, where the strata dip gently westward. Wasatch strata crop out in the high elevations; however, the Tongue River Member of the Fort Union Formation crops out over most of the quadrangle. The Fort Union Formation is composed of very fine-grained sandstone, siltstone, claystone, shale, carbonaceous shale, and numerous coal beds. The Wasatch Formation caps divides in the Kline Draw area, and lies disconformably on the Tongue River Member (Olive, 1957). The Wasatch consists of sandstone, siltstone, shale, and thin coal beds.

The configuration of structural contours on coal bed tops indicates minor folding in the eastern portion of the quadrangle. Two small faults, one east-west trending in Secs. 27 and 34, T.56 N., R. 76 W., and one north-east trending fault in the northeast corner of the quadrangle displace strata 5 to 10 feet (1.5 to 3 m).

III. Data Sources

Areal geology of the coal outcrops and associated clinker is derived from the Spotted Horse Coal Field Report (Olive, 1957). The coal bed outcrops are adjusted to the current topographic maps in the area.

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.

The topographic map of the Kline Draw Quadrangle is published by the U.S. Geological Survey, compilation date, 1971. Land ownership data is compiled from land plats obtained from the U.S. Bureau of Land Management in Cheyenne, Wyoming. This information is current to October 13, 1977.

IV. Coal Bed Occurrence

Fort Union Formation coal beds that are potentially recoverable in all or part of the Kline Draw Quadrangle include, in descending stratigraphic order, the Smith, Anderson, Upper Canyon, Lower Canyon,

Upper Cook, Lower Cook, Wall, and Pawnee. A complete suite of maps (structure, isopach, mining ratio, overburden/interburden, identified resources and areal distribution of identified resources) is prepared for each of these coal beds.

No physical and chemical analyses are known to have been published regarding the coal beds in the Kline Draw Quadrangle. However, the general "as received" basis proximate analyses for northern Campbell County, Wyoming coal beds are as follows:

COAL BED NAME	ASH	FIXED CARBON	MOISTURE	VOLATILES	SULPHUR	BTU/LB
Smith (P)	6.440	31.390	35.370	26.800	.450	7125
Anderson (U) Hole 7406	6.317	31.113	32.583	29.986	.327	7498
Canyon (P)	4.290	32.852	35.100	27.758	.307	7298
Cook (P)	4.620	34.410	33.640	27.330	.250	7766
Wall (U) Hole 7426	9.542	29.322	32.150	28.985	.500	7279
Pawnee (U) Hole 7424	7.880	31.029	31.910	29.183	.386	7344
Cache (U) Hole 741	9.481	30.517	31.420	28.582	.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 Canyon coal bed underlies the entire quadrangle, it is designated

as datum for the correlation diagram. The Cook coal bed shows the thickest single bed occurrence throughout the quadrangle. The Wall and Pawnee coal beds maintain a fairly uniform thickness throughout the area, and structural configurations on the tops of both coal beds are similar. Coal beds of local extent exist in T. 56 N., R. 75 W., between the Smith and Anderson, between the Wall and Pawnee, and beneath the Pawnee coal beds. Neither the amount of data existent on these coal beds nor the coal thicknesses indicate full-scale mapping of the coal beds to be appropriate. This situation also applies to the Cache and Oedekoven coal beds reported on logs in T. 55 N., R. 75 W. and T. 56 N., R. 75 W., respectively.

The Smith coal bed is eroded from approximately 25 percent of the area. Where the coal is present, only a small amount of burning is apparent along the outcrop. Subsurface control indicates that the Smith coal bed reaches a maximum thickness of approximately 25 feet (8m) in the southeastern and southwestern corners of the quadrangle, and thins to less than 5 feet (1.5 m) to the north. The structural top of the coal varies from 3700 feet (1128 m) above sea level in the southwestern corner to 3940 feet (1201 m) in the northern portion of the map. A small, southwest plunging structural high is evident in the eastern portion of the area.

The Anderson coal bed occurs 102 to 225 (31 to 69 m) below the Smith coal bed and varies in thickness from 10 to slightly over 30 feet (3 to 9 m). The Anderson coal bed is eroded from approximately 15% of the area. Surface geologic mapping (Olive 1957) indicates burning of the coal is nominal to absent along the outcrop. Structural contours on the coal bed top establish a 1°-2° north to northwest dip, with minor folding in the southeastern sector of the quadrangle.

The Upper Canyon coal bed lies 109 to 284 feet (33 to 87 m) beneath the Anderson coal bed, and varies in thickness from 9 to 20 feet (2.7 to 6 m). From 0 to 97 feet (30 m) of clastic debris separates the Lower and Upper Canyon coal beds in the northern one-third of the Kline Draw Quadrangle. The Lower Canyon coal bed averages 9 feet (2.7 m) in thickness. In the southern two-thirds of the quadrangle, the Canyon coal bed consists of one thick coal bed, varying in thickness from 30 feet (9 m) in the north, to 45 feet (14 m) in the southeastern corner of the area. The structure on top of the Canyon coal bed depicts a small, low relief syncline, and an adjacent anticline in the western half of the area superimposed on a gentle, westward dip. Insufficient data precludes geological mapping of a small portion of the western part of the quadrangle.

The Upper Cook coal bed occurs 46 to 240 feet (14 to 73 m) beneath the Lower Canyon coal bed, and averages 0 to 15 feet (5 m) in thickness. The Lower Cook coal bed occurs 0 to 226 feet (69 m) beneath the Upper Cook coal bed. The Cook coal beds are split in the northern portion of the Kline Draw Quadrangle and combine to form one thick (40 to 50 feet, 12 to 15 m) coal bed in the southern half of the area. Approximately four square miles (10 sq. km) in the southwestern corner of the area is not mapped, due to insufficient data. The Cook coal beds do not crop out within this quadrangle, and the structure on top of both the Upper and Lower Cook coal beds depicts a gentle westward dip with a structural high in the northeastern corner. Portions of the Cook coal bed occur in excess of 500 feet (152 m) beneath the surface in the Kline Draw Quadrangle.

The Wall coal bed is separated from the overlying Cook coal bed by 11 to 107 feet (3 to 33 m) of clastic sediments. This coal bed varies from 20 feet (6 m) thick over 75 percent of the area, to slightly greater than 35 feet (11 m) near the central eastern edge of this quadrangle. A strip of land approximately one mile wide along the western edge of the quadrangle in T. 56 N. is not mapped due to insufficient data. The structure on top of the coal depicts gentle west dip with a series of northeast trending anticlines and synclines in the northeast corner. The Wall coal bed does not crop out within the Kline Draw Quadrangle and occurs in excess of 500 feet (152 m) beneath the surface throughout the area.

Twenty-five to 111 feet (8 to 34 m) of Tongue River Member sediments separate the overlying Wall coal bed from the Pawnee coal bed. Although the Pawnee coal bed is absent in the southeast corner of the quadrangle, it attains a thickness in excess of 30 feet (9 m) near the central eastern edge of the quadrangle. Two broad anticlines with adjacent synclines that trend east-west dominate structure configurations in the eastern half of the area. Gentle west dip is common to the western portion of the map. The Pawnee coal bed occurs in excess of 500 feet (152 m) beneath the surface throughout the Kline Draw Quadrangle.

V. Geological and Engineering Mapping Parameters

Subsurface mapping is based on geologic data within and adjacent to the Kline Draw 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 bank 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 Maps (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), and where non-federal coal exists.

Coal tonnage calculations involve the planimetering of areas of measured, indicated, 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. Directly north of the Kline Draw 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 (bank 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 (bank cu.yds/ton)

A surface mining potential map is prepared utilizing the following mining 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 high for approximately 55% of the Kline Draw Quadrangle. The valleys of the LX Bar Creek and Spotted Horse Creek cut into the Tongue River Member of the Fort Union Formation on the Kline Draw Quadrangle. The Canyon and Cook coal beds underlie these valleys at depths less than 500 feet (152 m). These thick coal beds account for much of the high development potential for surface mining. The inter-drainage, high, mesa-like terrain, capped by the Wasatch Formation, overlies the Smith and Anderson coal beds. Where these coal beds are less than 500 feet (152 m) beneath the surface, the mesa-like flats are considered a moderate development potential for surface mining. However, due to favorable mining ratios, the valley sides justify a high development potential for surface mining in this rugged terrain. Table 1 sets forth the strippable reserve tonnages per coal bed for the quadrangle.

Underground Mining Coal Development Potential

Subsurface coal mining potential throughout the Kline Draw Quadrangle is considered low. Table 2 sets forth the 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 from 1000 to 3000 feet (305 to 914 m).

The coal development potential for "in-situ" gasification on the Kline Draw 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 5.2 billion tons (4.7 billion metric tons) (Table 3). None of the coal beds in the Kline Draw 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 Kline Draw Quadrangle, Campbell County, Wyoming.

(Development potentitals are based on mining ratios (bank 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
Smith	276,160,000	177,770,000	68,870,000	522,800,000
Anderson	231,860,000	283,030,000	342,310,000	857,200,000
Canyon	247,500,000	456,700,000	86,200,000	790,400,000
Cook	15,160,000	66,470,000	44,870,000	126,500,000
Wall	-	-	-	-
Pawnee	-	-	-	-
TOTAL	770,680,000	983,970,000	542,250,000	2,296,900,000

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

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Smith	-	-	-	-
Anderson	-	-	35,800,000	35,800,000
Canyon	-	-	835,800,000	835,800,000
Cook	-	-	2,279,500,000	2,279,500,000
Wall	-	-	1,217,600,000	1,217,600,000
Pawnee	-	-	793,100,000	793,100,000
TOTAL	-	-	5,161,800,000	5,161,800,000

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

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Smith	-	-	-	-
Anderson	-	-	35,800,000	35,800,000
Canyon	-	-	835,800,000	835,800,000
Cook	-	-	2,279,500,000	2,279,500,000
Wall	-	-	1,217,600,000	1,217,600,000
Pawnee	-	-	793,100,000	793,100,000
TOTAL	-	-	5,161,800,000	5,161,800,000

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., 1978 , 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.

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.

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.

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.

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 Formation in the eastern Powder River Basin, Campbell and Converse Counties, Wyoming: U. S. Geol. Survey Open-File Report.

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, 1976, Preliminary Report of Coal Drill-Hole Data and Chemical Analyses of Coal Beds in Campbell and Sheridan Counties, Wyoming; Custer, Prairie, and Garfield Counties, Montana; and Mercer County, North Dakota: U. S. Geol. Survey Open-File Report 76-319, 377 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.