UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TEXT TO ACCOMPANY:

COAL RESOURCE OCCURRENCE

AND

COAL DEVELOPMENT POTENTIAL

MAPS

OF THE

EAGLE ROCK QUADRANGLE,

CAMPBELL COUNTY, WYOMING

BY

INTRASEARCH INC.

DENVER, COLORADO

OPEN FILE REPORT 79-061
1979

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

This report and accompanying maps set forth the Coal Resources Occurrence (CRO) and Coal Development Potential (CDP) of coal beds within the Eagle Rock Quadrangle, Campbell County, Wyoming. This CRO and CDP map series includes 25 plates (U. S. Geological Survey Open-File Report 79-061). 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 unleased federal coal in Known Recoverable Coal Resource Areas (KRCRA) in the western United States.

The Eagle Rock Quadrangle is located in southern Campbell County, Wyoming. It encompasses all or parts of Townships 45, 46 and 47 North, Ranges 71 and 72 West, in Wyoming, and covers the area: 43° 52' 30" to 44° 00' north latitude; 105° 22' 30" to 105° 30' west longitude.

Wyoming State Highway 59 traverses north-south through the quadrangle, nearly paralleling the boundary between Ranges 71 and 72 West. Three maintained gravel roads branch from Highway 59 and extend east-west across the study area. Another maintained gravel road angles north-south through the northeastern corner of the Eagle Rock Quadrangle. Minor roads and jeep trails that branch from the aforementioned roads provide additional access to the study area. The closest railroad is the Burlington Northern trackage extending south from Gillette, approximately 4 miles (6 km) east of Highway 59.

The Belle Fourche River flows northeastward through the central part of the quadrangle. Hay Creek drains the southern half of the study area, flowing northward into the Belle Fourche River. The maximum elevation, 5020 feet (1530 m) above sea level, occurs in the southeastern corner of the quadrangle. A minimum elevation of approximately 4535 feet (1382 m) above sea level is located in the valley floor of the Belle Fourche River in the northeastern corner of the study area. The somber grays, yellows, and browns of outcropping sandstones, 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 $-25^{\circ}F$ ($-32^{\circ}C$) to more than $100^{\circ}F$ ($38^{\circ}C$) have been recorded near Gillette, Wyoming, average wintertime minimums and summertime maximums approach $+5^{\circ}$ to $+15^{\circ}F$ (-15° and $-9^{\circ}C$) and 75° to $90^{\circ}F$ (24° to $32^{\circ}C$), 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 Campbell 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 nonfederal coal ownership comprises both fee and state coal resources.

The Coal Resource Occurrence and Coal Development Potential program pertains to unleased federal coal and focuses upon: 1) the delineation of lignite, subbituminous coal, bituminous coal and anthracite 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, underground mining and in-situ gasification of the coal beds. This report evaluates the coal resources of all unleased federal 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). No resources or reserves are computed for leased federal coal, state coal, fee coal, or lands encompassed by coal prospecting permits and preferential right lease areas.

Surface and subsurface geological and engineering extrapolations drawn from the current data base suggest the occurrence of approximately 5.9 billion tons (5.4 billion metric tons) of total coal resources in the Eagle Rock 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 supplements the cartographically displayed information with minimum verbal duplication of the CRO-CDP map 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 of the drillsite 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 unusal 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, the contact is positioned near the top of the Roland coal bed as mapped by Olive (1957) in northwestern Campbell County, Wyoming, 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 in central and southern Campbell County. 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 For Union clastics.

The Eagle Rock Quadrangle is located in an area where surface rocks are classified into the Wasatch Formation. Approximately 450 to 500 feet (137 to 152 m) of these sediments 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.

IntraSearch's correlation of thick coal beds from the Spotted Horse coal field to Gillette points out that the Wyodak coal bed, named the D coal bed by Dobbin and Barnett (1927), is equivalent to the Anderson, Canyon and all or part of the Cook coal beds to the north and west of Gillette, Wyoming. Correlation of this suite of coal beds with the Wyodak coal bed south and southwest of Gillette suggests that the Anderson and Canyon coal beds equate with the upper ten to twenty-five precent of the thick Wyodak coal bed, and the Cook and Wall or Upper Wall coal beds are equivalent to the major part of the Wyodak coal bed. Due to problematic correlations outside of the Gillette area, the name Wyodak has been informally used by many previous authors to represent the coal beds in the area surrounding the Wyodak coal mine. The Wildcat, Moyer, and Oedekoven coal beds were informally named by IntraSearch (1978b, 1979, and 1978a).

Local. The Eagle Rock Quadrangle lies on the eastern flank of the Powder River Basin, where the strata dip gently westward. The Wasatch Formation that crops out over the entire quadrangle is composed of friable, coarse-grained to gritty arkosic sandstones, very fine-grained sandstone, siltstone, claystone, shale, carbonaceous shale, and numerous coal beds.

III. Data Sources

No published information regarding coal bed outcrops and associated clinker is available for the Eagle Rock Quadrangle. Lingley (1977) compiled the Preliminary Coal Resource Occurrence Map of the Eagle Rock Quadrangle, Campbell County, Wyoming. This information is utilized in this report.

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-CDP 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 drill holes have no identifier headings, they are not set forth on the Coal Data Sheet (Plate 3). The geophysical logs of these drill holes were unavailable to IntraSearch to ascertain the accuracy of horizontal location, topographic elevation, and downhole 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 the workers in the area.

IntraSearch nomenclature focuses upon the suggestion of regional coal bed names 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 broaded 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 Eagle Rock Quadrangle is published by the U. S. Geological Survey, compilation date, 1971. Land network and mineral ownership data are 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

The Wasatch Formation coal beds that occur in this quadrangle are the Felix and Smith coal beds. Fort Union Formation coal beds that are present in all or part of the Eagle Rock Quadrangle include, in descending stratigraphic order, the Upper Wyodak, Middle Wyodak, Lower Wyodak, Wildcat, 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 Smith coal bed, Upper Wyodak coal bed, Middle and Lower Wyodak coal beds, and the Wildcat-Moyer-Oedekoven coal zone. The Felix coal bed is present in a small area on this quadrangle; therefore, the coal resource occurrence maps are included as Figures 1, 2, and 3.

No physical and chemical analyses are known to have been published regarding the coal beds in the Eagle Rock Quadrangle. However, the general "as received" basis proximate analysis for these coal beds in adjacent quadrangles as follows:

COAL BED NAME		ASH	FIXED CARBON	MOISTURE	VOLATILES	SULFUR	BTU/LB
Felix (U)	Hole 7315	6.757	32.934	28.714	31.595	0.548	8093
Smith (U)	Hole 7312C	6.167	33.340	29.160	30.883	1.068	8215
Wyodak(U)	Hole 755	4.438	35.522	27.405	32.719	0.207	8568

(U) - U. S. Geological Survey & Montana Bureau of Mines & Geology - 1975

All analyses except for BTU/LB are expressed as a percentage.

The Coal Data Sheet, Plate 3, shows the downhole identification of coal beds within the quadrangle as interpreted from U. S. Geological Survey and Montana Bureau of Mines and Geology drill holes and geophysical logs from oil and gas test bores and producing sites. A datum coal bed is utilized to position columnar sections on Plate 3. This portrayal is schematic by design; hence, no structural or coal thickness implications are suggested by the dashed correlation lines projected through no record (NR) areas. Inasmuch as the Oedekoven coal bed underlies the entire quadrangle, it is designated as datum for the correlation diagram. The Middle and Lower coal beds show the thickest single bed occurrences throughout the quadrangle.

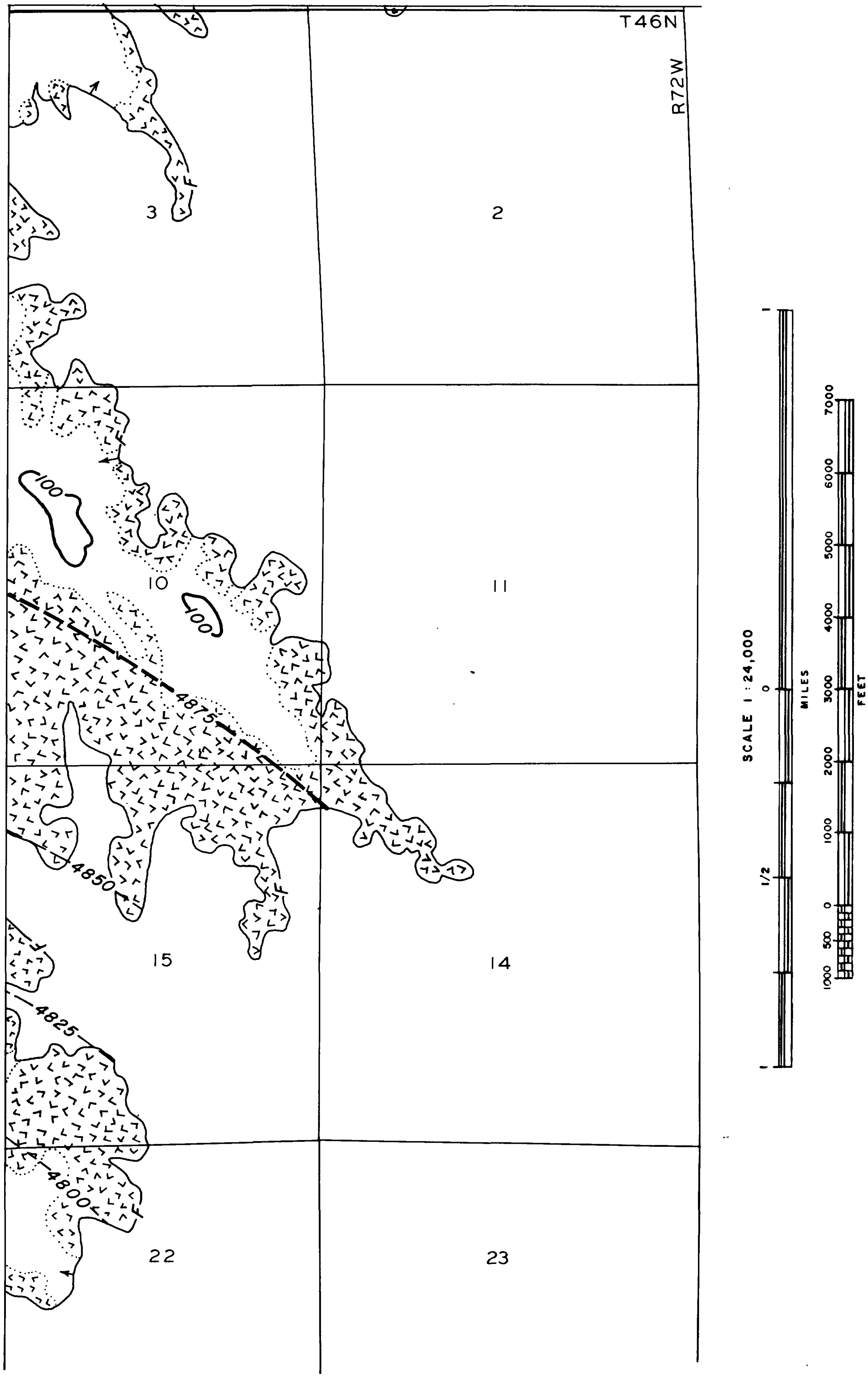
The Felix coal bed is preserved from erosion and oxidation along the western edge of the quadrangle in Sections 3, 10, 15, and 22, T. 46 N., R. 72 W. (Figure 1). Structure contour control is established utilizing outcrop elevations and coal bed thickness control is projected eastward from the quadrangle west of Eagle Rock. Inasmuch as the Felix coal bed reserves are inferred throughout this area, there are no boundary lines shown on Figure 3.

The Smith coal bed lies approximately 80 to 490 feet (24 to 149 m) beneath the surface throughout the Eagle Rock Quadrangle. Thicknesses for the Smith coal bed range from 4 to greater than 15 feet (1.2 to 4.6 m) and average approximately 9 feet (2.7 m). The Smith coal bed dips gently westward and a small synclinal feature occurs in the southwest quadrant of the study area. An insufficient data line is located in the center of the quadrangle, and delimits an area to the east where no outcrop information or subsurface data is available. The Smith coal bed may be present in this area of insufficient data. If so, the estimated tonnages for the Smith coal bed may be understated and the coal development potential for the Smith coal may be moderate to high in this area.

From 95 to 208 feet (29 to 63 m) of clastic sediments separate the Upper Wyodak coal bed from the overlying Smith coal bed. The Upper Wyodak coal bed occurs beneath most of the quadrangle except the northeast and southeast corners. Thicknesses for the Upper Wyodak coal bed range from 0 to 14 feet (0 to 4 m), and average approximately 8 feet (2.4 m). Maximum thicknesses of 10 to 14 feet (3 to 4 m) occur in the western portion of the quadrangle. The Upper Wyodak coal bed decreases in thickness to 0 to 6 feet (0 to 1.8 m) along the eastern portion of the study area. A northwest-plunging syncline warps the coal bed in the east-central part of the quadrangle. The Upper Wyodak coal bed lies approximately 100 to 660 feet (30 to 201 m) beneath the surface throughout the Eagle Rock Quadrangle.

The Middle and Lower Wyodak coal zone underlies the entire quadrangle approximately 115 to 260 feet (35 to 79 m) beneath the overlying Upper Wyodak coal bed. Thicknesses for the Middle and Lower Wyodak coal zone range from 44 to more than 90 feet (13 to more than 27 m), and average approximately, 65 feet (20 m). A split line of Middle and Lower Wyodak coal beds extends east-west across the central portion of the quadrangle. This split line delimits an area to the south where non-coal intervals up to 124 feet thick (38 m) separate the Middle and Lower Wyodak coal beds. North of the split line, the thickness of the Wyodak coal zone exceeds 90 feet (27 m) near the western quadrangle boundary, and thins eastward to 44 feet (13 m) at the eastern edge of the study area. The structural contours on top of the Middle Wyodak coal bed define a closed anticlinal high in Section 33, T. 46 N., R. 71 W., and a southwest-trending anticlinal feature extending from the northeast corner of the quadrangle. A minor southwest-trending anticlinal feature in the southeast corner of the study area is shown by the structural contours on top of the Lower Wyodak coal bed. The Middle and Lower Wyodak coal zone is less than 500 feet (152 m) beneath the surface throughout approximately 75 percent of the Eagle Rock Quadrangle.

The Wildcat-Moyer-Oedekoven coal zone lies approximately 650 to 800 feet (198 to 244 m) beneath the Lower Wyodak coal bed. The Wildcat coal bed is projected into the northern portion of the Eagle Rock Quadrangle based on the subsurface data in the adjoining Gap South Quadrangle to the north. The Wildcat coal bed is not identified in the geophysical logs of the Eagle Rock Quadrangle, although it occurs in the adjacent quadrangles to the north, west, and east. The pinchout line of the Wildcat coal bed (Plates 20, 21) is derived from subsurface data in quadrangles surrounding the study area. Thicknesses for the Wildcat-Moyer-Oedekoven coal zone range from 10 to 50 feet (3 to 15 m) and average approximately 19 feet (6 m). The minimum thickness of 10 feet (3 m) is mapped in the extreme southern portion of the quadrangle and the maximum thickness of 50 feet (15 m) occupies the northwest corner of the study area. Where the Wildcat coal bed is not present, structural contours are drawn on top of the Moyer coal bed. The Moyer coal bed occurs throughout approximately ninety percent of the study area and where it is absent along the east-central boundary, structural contours are drawn on top of the Oedekoven coal bed. The Wildcat-Moyer-Oedekoven coal zone dips one to two degrees to the west, and lies more than 1000 feet (305 m) beneath the surface throughout approximately ninety percent of the Eagle Rock Quadrangle.

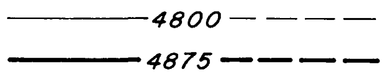


Base from U.S. Geological Survey, 1971

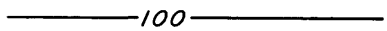
Compiled in 1979

FIGURE 1
STRUCTURE CONTOUR AND ISOPACH OF OVERBURDEN MAP
OF FELIX COAL BED IN
EAGLE ROCK QUADRANGLE
CAMPBELL COUNTY, WYOMING
(See following page for Explanation)

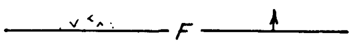
EXPLANATION FOR FIGURE 1



STRUCTURE CONTOURS-Drawn on top of coal bed. Contour interval 25 feet. Datum is mean sea level. Dashed where coal is burned or eroded.



OVERBURDEN ISOPACH-Showing thickness of overburden, in feet, from the surface to the top of the coal bed. Isopach interval 100 feet.



TRACE OF COAL BED OUTCROP-Arrow points toward the coal-bearing area. "V" symbol indicates burned rock with dotted line showing limit of burning.

To convert feet to meters multiply feet by 0.3048.

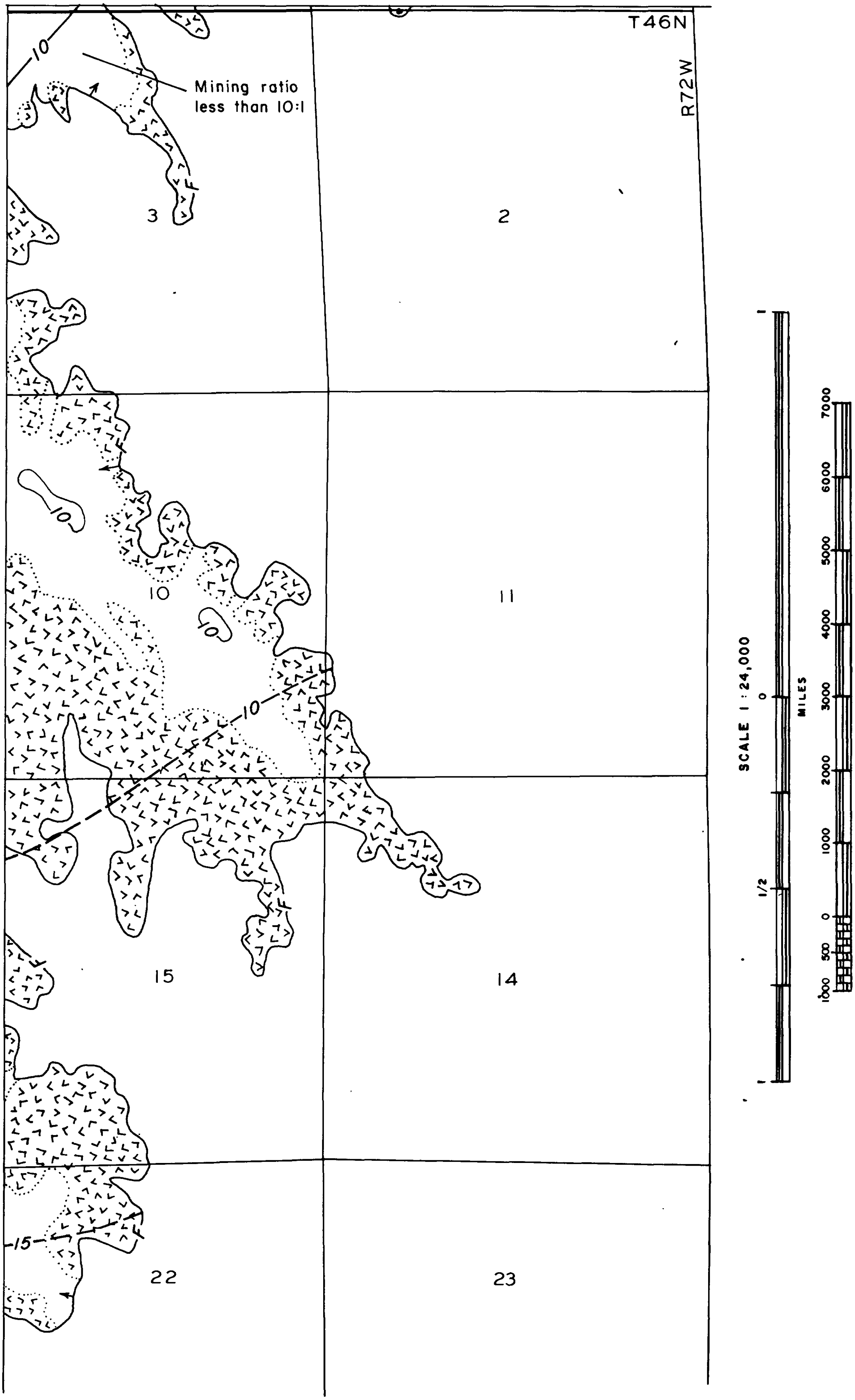
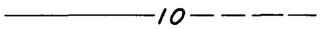


FIGURE 2
ISOPACH AND MINING RATIO MAP
OF FELIX COAL BED IN
EAGLE ROCK QUADRANGLE
CAMPBELL COUNTY, WYOMING
(See following page for Explanation)

Base from U.S. Geological Survey, 1971

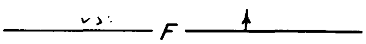
Compiled in 1979

EXPLANATION FOR FIGURE 2



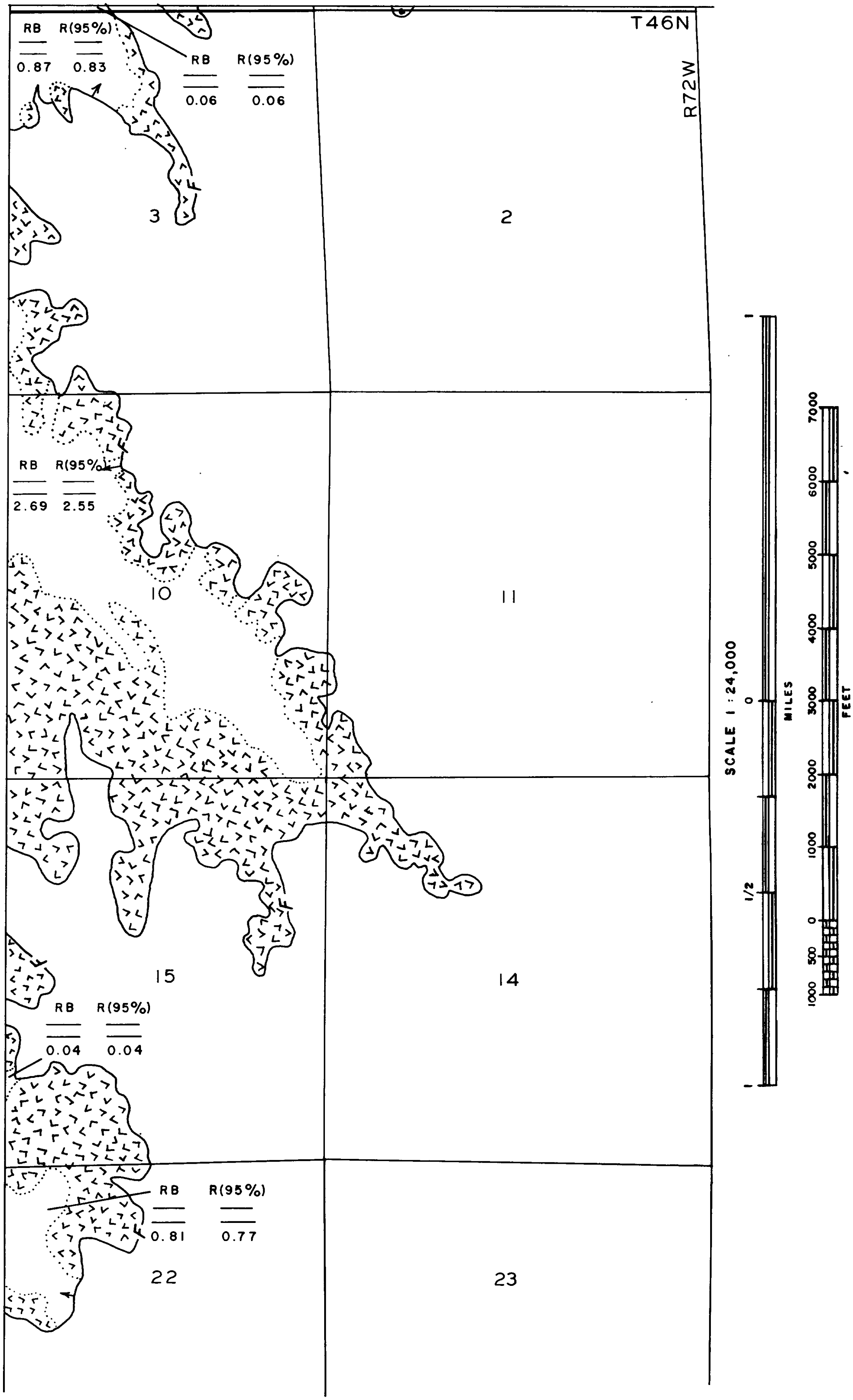
ISOPACHS OF COAL BED-Showing thickness in feet, interval 5 feet. Dashed where coal is burned or eroded.

MINING RATIO CONTOUR-Number indicates cubic yards of overburden per ton of recoverable coal by surface mining methods. Contours shown only in area suitable for surface mining within the stripping limit.



TRACE OF COAL BED OUTCROP-Arrow points towar the coal-bearing area. "V" symbol indicat burned rock with dotted line showing limit of burning.

To convert feet to meters multiply feet by 0.3048.

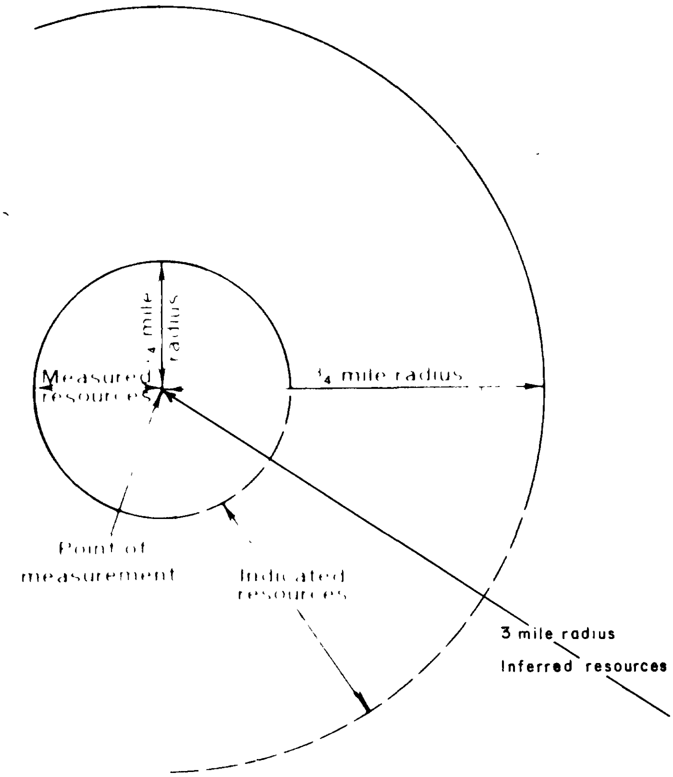


Base from U.S. Geological Survey, 1971

Compiled in 1979

FIGURE 3
AREAL DISTRIBUTION OF IDENTIFIED RESOURCES
AND IDENTIFIED RESOURCES MAP
OF FELIX COAL BED IN
EAGLE ROCK QUADRANGLE
CAMPBELL COUNTY, WYOMING
(See following page for Explanation)

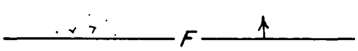
EXPLANATION FOR FIGURE 3



BOUNDARY LINES-Enclosing areas of measured, indicated and inferred coal resources of the coal bed. Dashed where projected from adjacent quadrangles.

RB	R(95%)	
—	—	(Measured)
—	—	(Indicated)
0.81	0.77	(Inferred)

IDENTIFIED RESOURCES OF COAL BED-In millions of short tons. Dash indicates no resources in that category. Reserve Base (RB) x the recovery factor (95%) = Reserves (R).



TRACE OF COAL BED OUTCROP-Arrow points toward the coal-bearing area. "V" symbol indicates burned rock with dotted line showing limit of burning.

To convert miles to kilometers multiply miles by 1.609.

To convert short tons to metric tons multiply short tons by 0.9072.

V. Geological and Engineering Mapping Parameters

The correct horizontal location and elevation of drill holes utilized in subsurface mapping are critical to map accuracy. IntraSearch plots the horizontal location of the drill hole as described on the geophysical log heading. Occasionally this location is superimposed or near to a drillsite shown on the topographic map, and the topographic map horizontal location is utilized. If the ground elevation on the geophysical log does not agree with the topographic elevation of the drillsite, the geophysical log ground elevation is adjusted to conformance. If there is no indication of a drillsite on the topographic map, the "quarter, quarter, quarter" heading location is shifted within a small area until the gound elevation on the heading agrees with the topographic map elevation. If no elevation agreement can be reached, the well heading or data sheet is rechecked for footage measurements and ground elevation correctness. Inquiries to the companies who provided the oil and gas geophysical logs frequently reveal that corrections have been made in the original survey. If all horizontal location data sources have been checked and the information accepted as the best available data, the drillsite elevation on the geophysical log is modified to agree with the topographic map elevation. IntraSearch considers this agreement mandatory for the proper construction of most subsurface maps, but in particular, the overburden isopach, the ratio, and Coal Development Potential maps.

Subsurface mapping is based on geologic data within and adjacent to the Eagle Rock Quadrangle 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. Isopach lines extend to the coal bed outcrops, the projections of coal bed outcrops, and the contact between porcellanite (clinker) and unoxidized coal in place. Attenuation of total coal bed thickness is known to take place near these lines of definition; however, the overestimation of coal bed tonnages that results from this projection of total coal thickness is insignificant to the Coal Development Potential maps. 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 ninety-five percent recovery factor. Contours of 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), where non-federal coal exists, or where federal coal leases, preference right lease applciations, and coal prospecting permits exist.

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. An Insufficient Data Line is drawn to delineate areas where surface and subsurface data are too sparse

For CRO map construction. Various categories of resources are calculated in the unmapped areas by utilizing coal bed thicknesses mapped in the geologically controlled area adjacent to the insufficient data line. Acres are multiplied by the average coal bed thickness and 1770 (the number of tons of subbituminous C coal per acre-foot, 13,018 metric tons per hectare-meter), to determine total tons in place. Recoverable tonnage is calculated at ninety-five percent of the total tons in place.

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 discreetly utilized, and resources and/or reserves are calculated within an estimated two to three precent 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:

$$MR = \frac{t_o\ (0.911)^*}{t_c\ (rf)}$$

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

*Use (0.922) for lignite

A surface mining potential map is prepared utilizing the following mining ratio criteria for coal beds 5 to 40 feet (1.5 to 12 m) thick.

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 following mining ratio criteria is utilized for coal beds greater than 40 feet (12 m) thick:

1. Low development potential = 7:1 and greater ratio.
2. Moderate development potential - 5:1 to 7:1 ratio.
3. High development potential - 0 to 5:1 ratio.

The surface mining potential is moderate for most of the Eagle Rock Quadrangle. However, the thick, Middle and Lower Wyodak coal beds, present at shallow depths, result in a high development potential for surface mining in the northeastern and south-central portions of the quadrangle. Increasing overburden thicknesses above the Middle and Lower Wyodak coal beds create moderate development potentials over approximately 45 percent of the study area. The eastern and western portions of the Eagle Rock Quadrangle are classified as low development potential due to high overburden to coal bed thickness ratios that are related to greater overburden thicknesses. Some areas of moderate to high development potential may exist due to shallow burial of the Smith coal bed; however, surface and subsurface control are too sparse for mapping purposes. 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 Eagle Rock Quadrangle is considered low. Inasmuch as recovery factors have not been established for the underground development of coal beds in this quadrangle, reserves are not calculated for coal beds buried more than 500 feet (152 m) beneath the surface. 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: 1) a total coal section less than 100 feet (30 m) thick that lies 500 feet (152 m) to 3000 feet (914 m) beneath the surface, or 2) coal beds 5 feet (1.5 m) or more in thickness 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 buried 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 Eagle Rock Quadrangle is low, hence no CDP map is generated for this map series. The coal resource tonnage for in-situ gasification with low development potential totals approximately 2.9 billion tons (2.6 billion metric tons) (Table 3). None of the coal beds in the Eagle Rock 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 Eagle Rock 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
Felix	4,170,000	80,000	—	4,250,000
Smith	63,990,000	87,460,000	185,410,000	336,860,000
Upper Wyodak	2,450,000	55,040,000	101,660,000	159,150,000
Wildcat-Moyer-Oedekoven	—	—	—	—

	High Development Potential (0-5:1 Mining Ratio)	Moderate Development Potential (5:1-7:1 Mining Ratio)	Low Development Potential (>7:1 Mining Ratio)	Total
Middle & Lower Wyodak	1,050,520,000	1,180,450,000	123,260,000	2,355,130,000
TOTAL	1,121,130,000	1,323,030,000	411,230,000	2,855,390,000

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

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Identified Resources				
Upper Wyodak	—	—	60,320,000	60,320,000
Middle & Lower Wyodak	—	—	1,490,450,000	1,490,450,000
Wildcat-Moyer-Oedekoven	—	—	1,312,320,000	1,312,320,000
TOTAL	—	—	2,863,090,000	2,863,090,000
Hypothetical Resources				
Wildcat-Moyer-Oedekoven	—	—	1,280,000	1,280,000
TOTAL	—	—	1,280,000	1,280,000
GRAND TOTAL	—	—	2,864,370,000	2,864,370,000

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

Coal Bed Name	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Identified Resources				
Upper Wyodak	—	—	60,320,000	60,320,000
Middle and Lower Wyodak	—	—	1,490,450,000	1,490,450,000
Wildcat-Moyer-Oedekoven	—	—	1,312,320,000	1,312,320,000
TOTAL	—	—	2,863,090,000	2,863,090,000
Hypothetical Resources				
Wildcat-Moyer-Oedekoven	—	—	1,280,000	1,280,000
TOTAL	—	—	1,280,000	1,280,000
GRAND TOTAL	—	—	2,864,370,000	2,864,370,000

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