Text to Accompany:

Open-File Report 79-128

1979

COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE SOUTHWEST QUARTER OF THE SUPERIOR 15-MINUTE QUADRANGLE, SWEETWATER COUNTY, WYOMING

[Report includes 26 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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INTRODUCTION

Purpose

This text is to be used in conjunction with Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) Maps of the southwest quarter of the Superior 15-minute quadrangle, Sweetwater County, Wyoming. This report was compiled to support the land planning work of the Bureau of Land Management (BLM) to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) in the western United States. This investigation was undertaken by Dames & Moore, Denver, Colorado, at the request of the U.S. Geological Survey under contract number 14-08-0001-17104. The resource information gathered for this report is in response to the Federal Coal Leasing Amendments Act of 1976 (P.L. 94-377). Published and unpublished public information available through April, 1978, was used as the data base for this study. No new drilling or field mapping was performed, nor was any confidential data used.

Location

In this report, the term "quadrangle" refers only to the southwest quarter of the Superior 15-minute quadrangle which is located in central Sweetwater County, approximately 17 miles (27 km) northeast of the city of Rock Springs and 7 miles (11 km) northwest of the town of Point of Rocks, Wyoming. With the exception of the towns of Superior and South Superior located in the southwestern corner of the quadrangle, the area is unpopulated.

Accessibility

Wyoming Highway 371 cuts across the southwestern corner of the quadrangle connecting the towns of Superior and South Superior with Interstate Highway 80, approximately 5 miles (8 km) south of the quadrangle. An improved light-duty road crosses east-west through the southern third of the quadrangle. Several unimproved dirt roads and trails provide access through the remainder of the quadrangle.

The main east-west line of the Union Pacific Railroad passes approximately 5 miles (8 km) south of the quadrangle. This line provides railway service across southern Wyoming connecting Ogden, Utah to the west with Omaha, Nebraska to the east. An abandoned spur of the railroad extends north from the main line at Thayer Junction and parallels Wyoming Highway 371 across the southwestern corner of the quadrangle.

Physiography

The southwest quarter of the Superior 15-minute quadrangle lies on the northeastern flank of the Rock Springs uplift and on the southwestern edge of the Great Divide Basin. The landscape is characterized by low rolling terrain, buttes and badland topography. The Continental Divide bisects the quadrangle, crossing the top of Emmons Mesa. Hatcher Mesa, Cabin Butte, Emmons Cone, Emmons Mesa and Zirkel Mesa are part of the Leucite Hills. Altitudes in the quadrangle range from 6,800 feet (2,073 m) in Horsethief Canyon in the southwestern corner of the quadrangle, to 7,958 feet (2,426 m) on Zirkel Mesa in the central part of the quadrangle.

Horsethief Canyon, Deadman Wash, and Potash Wash, tributaries of Bitter Creek, drain the area south of the Continental Divide into the Green River Basin. In the northern half of the quadrangle Table Wash, Black Rock Creek, and their tributaries flow northeasterly and drain into the Great Divide Basin. All of the streams in the quadrangle are intermittent and flow mainly in response to snowmelt in the spring.

Climate and Vegetation

The climate of southwestern Wyoming is semiarid and is characterized by low precipitation, rapid evaporation, and large daily temperature changes. Summers are usually dry and mild, and winters are cold. The annual precipitation averages 9 inches (23 cm), with approximately two thirds falling during the spring and early summer months.

The average annual temperature is 42°F (6°C). Temperatures during January average 18°F (-8°C), and range from 8°F (-13°C) to 28°F (-2°C).

During July temperatures range from 54°F (12°C) to 84°F (29°C), with an average of 69°F (21°C) (U.S. Bureau of Land Management, 1978, and Wyoming Natural Resources Board, 1966).

Winds are usually from the west-southwest and southwest with an average velocity of 11 miles per hour (18 km per hr) (U.S. Bureau of Land Management, 1978).

Principal types of vegetation in the area include sagebrush, saltbush, rabbitbrush, greasewood, and grasses (U.S. Bureau of Land Management, 1978).

Land Status

The southwest quarter of the Superior 15-minute quadrangle lies in the north-central part of the Rock Springs Known Recoverable Coal Resource Area (KRCRA). All of the quadrangle lies within the KRCRA boundary, with the Federal government owning the coal rights for approximately one third of this area. One active coal lease is present within the KRCRA boundary as shown on plate 2.

GENERAL GEOLOGY

Previous Work

Schultz described the geology and coal resources of the northern part of the Rock Springs coal field in 1909 and the geology and structure of the Baxter Basin and surrounding area in 1920. The Superior coal district within the quadrangle was mapped and described by Dobbin in 1944. Hale described the stratigraphy and depositional history of the formations cropping out on the flanks of the Rock Springs uplift in 1950 and 1955. Yourston (1955) described the structure and stratigraphy of the coal-bearing formations in the Rock Springs coal field and published analyses for Rock Springs area coals. Carey reviewed the geology of the Leucite Hills area including this quadrangle in 1955. Weimer (1960), Smith (1961), Weichman (1961), Lewis (1961), Burger (1965), and Keith (1965) described the stratigraphy and discussed the depositional environment of Upper Cretaceous formations in the Rock Springs area. The depositional history of the Upper Cretaceous formations exposed on the flanks of the Rock Springs uplift was also described by Weimer (1961) and Douglass and Blazzard (1961). Roehler (1961) described the Late Cretaceous-Tertiary unconformity present in the Rock Springs area. Lawson and Crowson (1961) described the stratigraphy of the Fort Union and Wasatch Formations of the Patrick Draw field on the eastern flank of the Rock Springs uplift. Bradley (1964) discussed the stratigraphy of the Wasatch and Green River Formations in the Rock Springs uplift. Gosar and Hopkins (1969) summarized the structure and stratigraphy of Upper Cretaceous and Tertiary rocks in the southwestern part of the Rock Springs uplift. Land mapped the Fox Hills Sandstone and associated formations on the eastern flank of the Rock Springs uplift in 1972 and described their stratigraphy and depositional history. Coal analyses and measured sections of coals in the Rocks Springs coal field were reported by Glass in 1975. Roehler, Swanson, and Sanchez described the geology and coal resources of the Rock Springs uplift in 1977. Roehler also prepared a geologic map of the Rock Springs uplift and adjacent areas in 1977. LaPoint (1977) mapped part of the Superior 15-minute quadrangle including this quadrangle. Unpublished data from Rocky Mountain Energy Company (RMEC) also provided coal thickness information.

Stratigraphy

The formations in the southwest quarter of the Superior 15-minute quadrangle range in age from Late Cretaceous to Tertiary and crop out across the quadrangle in northwest-trending bands. The Rock Springs, the Almond, and the Lance Formations, all of Late Cretaceous age, and the Fort Union Formation of Paleocene age are coal-bearing within the quadrangle.

The Mesaverde Group of Late Cretaceous age is subdivided into four formations which are, in ascending order, the Blair Formation, the Rock Springs Formation, the Ericson Formation, and the Almond Formation.

The Blair Formation, present in the subsurface, ranges from approximately 1,330 to 1,410 feet (405 to 430 m) thick where measured in the oil and gas wells drilled in the quadrangle. The lower part of the formation is composed of a thick series of light-brown, thin-bedded, fine- to medium-grained sandstones. This is overlain by light-brownish-gray arenaceous siltstones and brownish-gray silty to sandy shales. The upper part of the formation consists of light-brown sandy shales, occasional thin coal beds and thin brown sandstones which grade upward into the sandstones of the Rock Springs Formation (Hale, 1950, 1955, Douglass and Blazzard, 1961, Smith, 1961, and Keith, 1965). Only the upper 400 feet (122 m) of the Blair Formation is shown on plate 3.

The Rock Springs Formation, conformably overlying the Blair Formation, ranges in thickness from 1,440 to 1,470 feet (439 to 448 m) where measured in the oil and gas wells drilled in the quadrangle. Dobbin (1944) states that the Rock Springs Formation is approximately 1,350 feet (411 m) thick where measured in the Superior coal district. Cropping out in a northwest-trending band across the southwestern corner of the quadrangle, the Rock Springs Formation consists of a sequence of interbedded coal, carbonaceous shales, siltstones, claystones, and sandstones (Hale, 1950, 1955, Smith, 1961, Weichman, 1961, Keith, 1965, and Roehler, 1977).

In this quadrangle, the Ericson Sandstone is separated from the underlying Rock Springs Formation by a local unconformity (Roehler and others, 1977). The Ericson Sandstone is approximately 770 feet (235 m) thick where measured in the Prenalta Corporation No. 23-24-22-102-Government well located in sec. 24, T. 22 N., R. 102 W., and approximately 500 feet (152 m) thick where measured by Dobbin (1944) in the Superior coal district. The formation crops out in the southwestern half of the quadrangle and consists of light-gray, massive, cliff-forming, cross-bedded fine- to coarse-grained sandstone and conglomerate containing chert pebbles (Hale, 1950, 1955, Smith, 1961, and Roehler, 1977).

The Almond Formation, conformably overlying the Ericson Formation, crops out in a northwest-trending band across the center of the quadrangle. Where measured by Dobbin (1944) in the Superior coal district the Almond Formation is approximately 300 feet (91 m) thick. In the Prenalta Corporation No. 23-24-22-102-Government well located in sec. 24, T. 22 N., R. 102 W., the formation is approximately 655 feet (200 m) thick. The lower section of the formation consists of carbonaceous shale, siltstone, mudstone and sandstone alternating with coal beds of variable thickness and quality. The upper section is predominately a buff to light-gray, thick-bedded to massive, fossiliferous sandstone (Hale, 1950, 1955, and Roehler, 1977).

The Lewis Shale of Late Cretaceous age conformably overlies the Almond Formation and crops out in a northwest-trending band across the northeastern corner of the quadrangle. This formation consists of dark-bluish-gray gypsiferous silty shale with occasional thin interbeds of sandy limestone and siltstone. Zones of calcareous concretions are found near the middle of the section with thin ripple-marked sandstones common near the base and top. The Lewis Shale ranges from approximately 400 to 650 feet (122 to 198 m) thick in surrounding quadrangles and thins rapidly to the west (Hale, 1950, 1955, Land, 1972, and Roehler, 1977).

The Late Cretaceous-age Fox Hills Sandstone intertongues with the underlying Lewis Shale and crops out as a narrow northwest-trending band in the northeastern corner of the quadrangle. Post-Cretaceous erosion has removed much of the Fox Hills Sandstone on the northern end of the Rock Springs uplift. The formation ranges in thickness from approximately 60 to 165 feet (18 to 50 m) in surrounding quadrangles. The Fox Hills Sandstone is composed of a lower light-brown, very fine to fine-grained, thin-bedded, silty sandstone overlain by a light-tan to very light gray, fine- to medium-grained massive sandstone (Land, 1972, and Roehler, 1977).

The Lance Formation of Late Cretaceous age conformably overlies the Fox Hills Sandstone. It crops out in a northwest-trending band in the northeastern corner of the quadrangle and in a graben in the east-central part of the quadrangle. This formation ranges from approximately 400 to 880 feet (122 to 268 m) thick as measured in oil and gas test holes from surrounding quadrangles. The Lance Formation consists of thin, silty fine-grained sandstone interbedded with carbonaceous shale and coal (Hale, 1950, 1955, Land, 1972, Roehler, 1977, and Roehler and others, 1977).

The Fort Union Formation of Paleocene age unconformably overlies the Lance Formation and crops out in the northeastern corner of the quadrangle. Roehler and others (1977) indicate that the Fort Union Formation ranges in thickness from approximately 1,000 to 1,500 feet (305 to 457 m) in outcrops on the flanks of the Rock Springs uplift. The formation consists of light-gray shale, sandy shale and siltstone, thick beds of gray-white to white coarse-grained unconsolidated sandstone, gray and brown carbonaceous shale, and thick beds of coal. The occurrence of coal and carbonaceous material is more pronounced in the lower half of the formation (Lawson and Crowson, 1961, Roehler, 1977, and Roehler and others, 1977).

Extrusive leucite-rich igneous flows of Quaternary (LaPoint, 1977) or Tertiary (Carey, 1955) age crop out on Emmons Mesa, Zirkel Mesa, Hatcher Mesa and Spring Butte.

Recent deposits of alluvium cover the stream valleys of Horsethief Canyon, Deadman Wash, Potash Wash, Table Wash, Black Rock Creek, and their tributaries.

The Upper Cretaceous formations in the southwest quarter of the Superior 15-minute quadrangle indicate the transgressions and regressions of a broad, shallow, north-south-trending seaway that extended across central North America. These formations accumulated near the western edge of the Cretaceous sea and reflect the location of the shoreline (Weimer, 1960 and 1961).

The Blair Formation, composed of intertonguing nearshore sandstones and offshore marine shales, was deposited in a shallow-water marine sequence as the Cretaceous sea regressed eastward (Douglass and Blazzard, 1961, and Gosar and Hopkins, 1969).

Both marine and continental deposits are contained in the Rock Springs Formation. Northwest of a strand line extending from approximately the southeastern corner of T. 16 N., R. 106 W., northeastward through T. 22 N., R. 100 W., the Rock Springs Formation consists of sediments deposited in swamp, deltaic and fluvial environments. Southeast of the strand line the Rock Springs Formation consists mainly of shallow-water marine deposits (Burger, 1965, Douglass and Blazzard, 1961, and Gosar and Hopkins, 1969).

Sandstones of the Ericson Sandstone were deposited in stream and floodplain environments with a source area to the northwest (Douglass and Blazzard, 1961, and Gosar and Hopkins, 1969).

The Almond Formation reflects deposition in fresh-water coastal swamps, brackish-water lagoons and shallow-water marine environments (Hale, 1950).

The Lewis Shale is composed of neritic shale and siltstone deposited in water depths ranging from a few tens of feet to several hundred feet (Land, 1972).

As the Cretaceous sea regressed eastward, the Fox Hills Sandstone was deposited in estuary, littoral and shallow neritic environments (Land, 1972).

The Lance Formation, consisting of swamp, lagoonal, floodplain and channel sand deposits, was deposited on the landward side of the Cretaceous sea shoreline as the sea retreated to the east (Gosar and Hopkins, 1969, and Roehler and others, 1977).

After the final withdrawal of the Cretaceous sea, the Fort Union Formation was deposited mainly in paludal or fresh-water swamp environments across the Rock Springs uplift (Roehler, 1961).

Volcanic activity resulted in leucite-rich surface lava flows which covered Upper Cretaceous and early Tertiary deposits (Carey, 1955).

Structure

The southwest quarter of the Superior 15-minute quadrangle lies on the northeastern flank of the Rock Springs uplift which separates the Great Divide and Green River structural basins. The Rock Springs uplift is a doubly plunging asymmetric anticline with the west limb having the steeper dips (5° to 30° to the west). Dips along the east limb are from 5° to 8° to the east (Roehler and others, 1977).

The strike of the beds in the quadrangle is generally northwest, with the beds dipping 4° to 6° to the northeast. In the southern half of the quadrangle, several normal faults perpendicular to the strike of the beds have formed down-dropped blocks. Horizontal displacement of these Tertiary-age faults can be as great as 3 miles (4.8 km) with vertical movement of several hundred feet (Yourston, 1955).

COAL GEOLOGY

Four formations contain coal in the southwest quarter of the Superior 15-minute quadrangle. They are, in ascending order, the Rock Springs, the Almond, the Lance, and the Fort Union Formations. The Rock Springs coal zone is approximately 1,250 feet (381 m) thick and contains seven isopached coal beds. The Almond coal zone, located approximately 650 feet (198 m) above the Rock Springs coal zone, is approximately 150 feet (46 m) thick. The Almond coal zone does not contain isopached coal beds in this quadrangle, although a few measurements greater than Reserve Base thickness (5 feet or 1.5 meters) have been included in the Isolated Data Points section of this report. The Lance coal zone, located approximately 1,200 feet (366 m) stratigraphically above the Almond coal zone, is approximately 100 feet (30 m) thick, and contains one isopached coal bed. Several coal beds of the Fort Union Formation are identified approximately 300 feet (91 m) above the Lance coal zone. Two of these coal beds are of isopachable thickness and are described in this report. Strike and dip measurements taken by LaPoint (1977) indicate that the average dip of the coal beds in this quadrangle dip is 6° to the northeast, with overburden thicknesses increasing in the same direction.

Chemical analyses of coal.--Analyses of samples from this quadrangle as well as analyses of samples from the Black Buttes, Point of Rocks, Rock Springs, and southeast quarter of the Superior 15-minute quadrangles are shown in table 1. In general, coal beds in the Rock Springs Formation rank as high-volatile C bituminous, coals from the Almond and Lance Formations rank as subbituminous B, and the Fort Union Formation coals rank as subbituminous B or C. These coals were ranked on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (ASTM, 1977).

Rock Springs Coal Zone

The Rock Springs coal zone crops out in the southwestern corner of the quadrangle. Numerous coal beds in this coal zone were identified by the Union Pacific Coal Company using a numeric designation (e.g., Rock Springs No. 15). Seven of these coal beds are greater than Reserve Base thickness (5 feet or 1.5 meters) and are described in the following paragraphs. Nine coal beds in the Rock Springs Formation have been identified in an oil and gas test hole located in sec. 24, T. 22 N., R. 102 W. Two of these coal beds, the Rock Springs No. 4(?) and the Rock Springs No. 7(?), are greater than Reserve Base thickness and have been treated as isolated data points (see Isolated Data Points section of this report) because the lack of data between the test hole and near the outcrops make the correlations questionable.

Rock Springs No. 15 Coal Bed

The Rock Springs No. 15 coal bed is stratigraphically the lowest isopached coal bed in the Rock Springs coal zone. Its maximum thickness is 7.0 feet (2.1 m), measured in a drill hole in sec. 31, T. 21 N., R. 102 W. However, the coal bed is generally less than 5 feet (1.5 m) thick in this quadrangle. To the west in the southeast quarter of the Boars Tusk 15-minute quadrangle the coal bed averages 7 feet (2.1 m) in thickness with a maximum thickness of 13.3 feet (4.1 m) recorded. To the south in the Thayer Junction quadrangle, the Rock Springs No. 15 coal bed is generally less than 5 feet (1.5 m) thick, with a maximum recorded thickness of 6 feet (1.8 m). The coal bed dips between 2° and 5° to the northeast as calculated from plate 4.

Rock Springs No. 9 (Van Dyke) Coal Bed

This coal bed, referred to as both the Rock Springs No. 9 and the Van Dyke coal bed by the Union Pacific Coal Company, is located approximately 140 feet (43 m) stratigraphically above the Rock Springs No. 15 coal bed. Although a subsurface mine has extracted an unknown quantity of the Rock Springs No. 9 coal bed, its maximum measured thickness in this quadrangle is 8.6 feet (2.6 m) with an average thickness of 5 feet (1.5 m). In the southeast quarter of the Boars Tusk 15-minute quadrangle, the coal bed averages 6 feet (1.8 m) in thickness. To the south in the Thayer Junction quadrangle, the coal bed thins to an average thickness of 2 feet (0.6 m). In this quadrangle the Rock Springs No. 9 coal bed dips between 2° and 5° to the northeast as calculated from plate 7.

Rock Springs No. 7 Coal Bed

The Rock Springs No. 7 coal bed is stratigraphically above and separated from the Rock Springs No. 9 coal bed by approximately 190 feet (58 m) of sandstone and carbonaceous shale. The average thickness of this coal bed is 7 feet (2.1 m) with a maximum recorded thickness of 8.5 feet (2.6 m) in sec. 20, T. 21 N., R. 101 W. In the southeast quarter of the Boars Tusk 15-minute quadrangle, this coal bed averages 8 feet (2.4 m) in thickness. To the south in the Thayer Junction quadrangle, the Rock Springs No. 7 coal bed thins to an average thickness of 2 feet (0.6 m). The coal bed dip, calculated from plate 10, ranges from 2° to 7° to the northeast.

Rock Springs No. 7 1/2 Coal Bed

The Rock Springs No. 7 1/2 coal bed is located approximately 130 feet (40 m) stratigraphically above the Rock Springs No. 7 coal bed. In this quadrangle the coal bed averages 3 feet (0.9 m) in thickness with a maximum measured thickness of 5.5 feet (1.7 m) in sec. 19, T. 21 N., R. 102 W. This coal bed is apparently absent in the southern part of this quadrangle, but occurs again to the south in the Thayer Junction quadrangle with an average thickness of 2 feet (0.6 m). To the west in the southeast quarter of the Boars Tusk 15-minute quadrangle, the Rock

Springs No. 7 1/2 coal bed thickens to an average of 6 feet (1.8 m). The coal bed dips between 2° and 5° to the northeast as derived from plate 13.

Rock Springs No. 1 Coal Bed

The Rock Springs No. 1 coal bed is located approximately 175 feet (53 m) stratigraphically above the Rock Springs No. 7 1/2 coal bed. This coal bed has been partially removed from secs. 17 and 18, T. 21 N., R. 102 W., by the D. O. Clark mine operations. The coal bed is 10 feet (3.0 m) thick in a measured section in sec. 28, T. 21 N., R. 102 W., but averages 6 feet (1.8 m) thick in this quadrangle. In the southeast quarter of the Boars Tusk 15-minute quadrangle, the Rock Springs No. 1 coal bed averages 6 feet (1.8 m) thick with a maximum thickness of 15 feet (4.6 m). To the south in Thayer Junction quadrangle the coal bed thins, averaging approximately 3 feet (0.9 m) in thickness. The coal bed dips to the northeast between 2° and 5°, as derived from plate 16.

Rock Springs No. 3 Coal Bed

The Rock Springs No. 3 coal bed occurs approximately 160 feet (49 m) stratigraphically above the Rock Springs No. 1 coal bed. In this quadrangle the coal bed averages 4 feet (1.2 m) thick with a maximum thickness of 7.5 feet (2.3 m) recorded in sec. 35, T. 21 N., R. 102 W. Another measurement of 7.3 feet (2.2 m) thick occurs in sec. 20, T. 21 N., R. 102 W. To the west in the southeast quarter of the Boars Tusk 15-minute quadrangle, the coal bed is generally less than 5 feet (1.5 m) thick with local thickness measurements of up to 12 feet (3.7 m). To the south in the Thayer Junction quadrangle, the Rock Springs No. 3 coal bed is identified in only one drill hole, where it measures 5 feet (1.5 m) thick. This coal bed dips between 2° and 7° to the northeast as calculated from plate 19.

Rock Springs No. 4 Coal Bed

The Rock Springs No. 4 coal bed occurs approximately 90 feet (27 m) above the Rock Springs No. 3 coal bed. This coal bed averages only 4 feet (1.2 m) thick in this quadrangle; however, one measurement in sec. 20, T. 21 N., R. 102 W., indicates a thickness of 7.4 feet (2.3 m). The Rock Springs No. 4 coal bed is not found in adjacent quadrangles. An areal distribution and identified resources map was not prepared for this coal bed because measurements greater than Reserve Base thickness occur only on non-Federal land or Federal land already leased for coal mining. The coal bed dip, as calculated from plate 22, ranges between 2° and 5° to the northeast.

Lance Coal Zone

The Lance coal zone crops out in a graben in the east-central part of the quadrangle and again in the northeastern corner of the quadrangle. There are no measurements of the Lance Formation coal beds that exceed Reserve Base thickness in this quadrangle. However, the 5-foot isopach line of the Lance [3] coal bed extends into the graben in this quadrangle from the southeast quarter of the Superior 15-minute quadrangle. This coal bed has not been formally named but has been desigted the Lance [3] for identification purposes in this quadrangle. In the southeast quarter of the Superior 15-minute quadrangle, the Lance [3] coal bed averages 6 feet (1.8 m) in thickness with a maximum recorded thickness of 6.7 feet (2.0 m). This coal bed dips to northeast at approximately 5° as calculated from structure contour lines drawn on the Lance [3] coal bed in the southeast quarter of the Superior 15-minute quadrangle.

Fort Union Coal Zone

The Fort Union coal zone, containing the Deadman coal bed, crops out in the northeastern corner of the quadrangle. The name "Deadman", as used by Roehler and others (1977), refers to both splits of the coal bed, called the Upper and Lower Deadman coal beds. In this quadrangle the two coal beds are separated by approximately 17 feet (5.2 m) of shale. To the north in the northwest quarter of the Superior 15-minute quadrangle, the Deadman coal bed is not split. The single coal bed averages 8 feet (2.4 m) thick and reaches a maximum recorded thickness of 20.5 feet (6.2 m) in that quadrangle. According to Roehler and others (1977), the

"Deadman" is located in the lower 100 feet (30 m) of the Fort Union Formation.

Lower Deadman Coal Bed

The Lower Deadman coal bed averages 6 feet (1.8 m) thick in this quadrangle with a maximum recorded thickness of 8 feet (2.4 m) in sec. 19 T. 22 N., R. 101 W. To the east in the southeast quarter of the Superior 15-minute quadrangle, the Lower Deadman coal bed averages 9 feet (2.7 m) in thickness. The coal bed dips to the northeast at 2° as calculated from plate 19.

Upper Deadman Coal Bed

The Upper Deadman coal bed is located approximately 17 feet (5.2 m) stratigraphically above the Lower Deadman coal bed. In this quadrangle the coal bed averages 6 feet (1.8 m) in thickness with a maximum measurement of 6.9 feet (2.1 m) thick recorded in sec. 19, T. 22 N., R. 101 W. To the east in the southeast quarter of the Superior 15-minute quadrangle, the Upper Deadman coal bed is generally less than 4 feet (1.2 m) thick with occasional measurements of 5 feet (1.5 m) or greater. The dip of the coal bed is 2° to the northeast as derived from plate 22.

Isolated Data Points

In instances where isolated measurements of coal beds thicker than 5 feet (1.5 m) are encountered, the standard criteria for construction of isopach, structure contour, mining ratio, and overburden isopach maps are not available. The lack of data concerning these beds limits the extent to which they can be reasonably projected in any direction and usually precludes correlations with other, better known beds. For this reason, isolated data points are included on a separate sheet (in U.S. Geological Survey files) for non-isopached coal beds. The isolated data point found in this quadrangle and the influences from isolated data points in adjacent quadrangles are listed on the next page. Coal beds identified by bracketed numbers are not formally named, but are used for identification purposes in this quadrangle only.

Source	Location	Coal Bed or Zone	Thickness
Prenalta Corp.	sec. 24, T. 22 N., R. 102 W.	RS-7(?)	11 ft (3.4 m)
Prenalta Corp.	sec. 24, T. 22 N., R, 102 W.	RS-4(?)	6 ft (1.8 m)
LaPoint	sec. 30, T. 21 N., R. 101 W.	Al[1]	6 ft (1.8 m)
Rocky Mountain Energy Co.	sec. 7, T. 21 N., R. 101 W.	Al[2]	13 ft (4.0 m)
Rocky Mountain Energy Co.	sec. 7, T. 21 N., R. 101 W.	Al[3]	6 ft (1.8 m)

COAL RESOURCES

Information from oil and gas wells, and coal test holes from the Pacific Power & Light Company, RMEC and the U.S. Geological Survey, as well as measured sections by LaPoint (1977), were used to construct outcrop, isopach, and structure contour maps of the coal beds in the southwest quarter of the Superior 15-minute quadrangle. At the request of RMEC, coal-rock data for some of their drill holes have not been shown on plate 1 or on the derivative maps. However, data from these holes have been used to construct the derivative maps. These data may be obtained by contacting RMEC.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 7, 10, 13, 16, 19, and 22). The coal bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal bed, and by a conversion factor of 1,770 short tons of coal per acre-foot (13,018 metric tons per hectare-meter) for subbituminous coal, or 1,800 short tons of coal per acre-foot (13,238 metric tons per hectare-meter) for bituminous coal, yields the coal resources in short tons for each isopached coal bed. Coal beds thicker than 5 feet (1.5 m) that lie less than 3,000 feet (914 m) below the ground surface are included. These criteria differ somewhat from that used in calculating Reserve Base and Reserve tonnages as stated in U.S. Geological Survey Bulletin 1450-B which calls for a minimum thickness of 28 inches

(70 cm) for bituminous coal and a maximum depth of 1,000 feet (305 m) for bituminous and subbituminous coal.

Reserve Base and Reserve tonnages for the isopached beds are shown on plates 6, 9, 12, 15, 18, 21, and 24, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 42.20 million short tons (38.28 million metric tons) for the entire quadrangle, including tonnages from the isolated data points. Reserve Base tonnages in the various development potential categories for surface and subsurface mining methods are shown in tables 2 and 3. The source of each indexed data point shown on plate 1 is listed in table 4.

Dames & Moore has not made any determination of economic recoverability for any of the coal beds described in this report.

COAL DEVELOPMENT POTENTIAL

Coal development potential areas are drawn so as to coincide with the boundaries of the smallest legal land subdivisions shown on plate 2. In sections or parts of sections where no land subdivisions have been surveyed by the BLM, approximate 40-acre (16-ha) parcels have been used to show the limits of the high, moderate, or low development potentials. A constraint imposed by the BLM specifies that the highest development potential affecting any part of a 40-acre (16-ha) lot, tract, or parcel be applied to that entire lot, tract, or parcel. For example, if 5 acres (2 ha) within a parcel meet criteria for a high development potential, 25 acres (10 ha) a moderate development potential, and 10 acres (4 ha) a low development potential, then the entire 40 acres (16 ha) are assigned a high development potential.

Development Potential for Surface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 200 feet (61 m) or less of overburden are considered to have potential for surface mining and were 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 for surface mining of coal is as follows:

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

where MR = mining ratio

t_o = thickness of overburden in feet

t_c = thickness of coal in feet

rf = recovery factor (85 percent for this quadrangle)

cf = conversion factor to yield MR value in terms of cubic yards of overburden per short tons of recoverable coal:
0.911 for subbituminous coal
0.896 for bituminous coal

Note: To convert mining ratio to cubic meters of overburden per metric ton of recoverable coal, multiply MR by 0.8428.

Areas of high, moderate, and low development potential for surface mining methods are defined as areas underlain by coal beds having respective mining ratio values of 0 to 10, 10 to 15, and greater than 15. These mining ratio values for each development potential category are based on economic and technological criteria and were provided by the U.S. Geological Survey.

Areas where the coal data is absent or extremely limited between the 200-foot (61-m) overburden line and the outcrop are assigned unknown development potentials for surface mining methods. This applies to areas where no known coal beds of 5 feet (1.5 m) or more thick occur and to those areas influenced by isolated data points. Limited knowledge pertaining to the areal distribution, thickness, depth, and attitude of the coals in these areas prevents accurate evaluation of the development potential in the high, moderate, or low categories. The areas influenced by isolated data points in this quadrangle contain approximately 1.38 million short tons (1.25 million metric tons) of coal available for surface mining.

The coal development potential for surface mining methods is shown on plate 25. Of the Federal land areas having a known development potential for surface mining methods, 83 percent are rated high, 1 percent is rated moderate, and 16 percent are rated low. The remaining Federal lands within the KRCRA boundary are classified as having unknown development potential for surface mining methods.

Development Potential for Subsurface and In-Situ Mining Methods

Areas considered to have a development potential for conventional subsurface mining methods are those areas where the coal beds of Reserve Base thickness are between 200 and 3,000 feet (61 and 914 m) below the ground surface and have dips of 15° or less. Coal beds lying between 200 and 3,000 feet (61 and 914 m) below the ground surface, dipping greater than 15°, are considered to have a development potential for in-situ mining methods.

Areas of high, moderate, and low development potential for subsurface mining methods are defined as areas underlain by coal beds at depths ranging from 200 to 1,000 feet (61 to 305 m), 1,000 to 2,000 feet (305 to 610 m), and 2,000 to 3,000 feet (610 to 914 m), respectively.

Areas where the coal data is absent or extremely limited between 200 and 3,000 feet (61 and 914 m) below the ground surface are assigned unknown development potentials. This applies to those areas influenced by isolated data points and to the areas where no known coal beds of Reserve Base thickness occur. The areas influenced by isolated data points in this quadrangle contain approximately 13.17 million short tons (11.95 million metric tons) of coal available for conventional subsurface mining.

The coal development potential for subsurface mining methods is shown on plate 26. Of the Federal land areas having a known development potential for conventional subsurface mining methods, 95 percent are rated high, and 5 percent are rated moderate. The remaining Federal land is classified as having unknown development potential for conventional subsurface mining methods.

Because the coal beds in this quadrangle have dips less than 15°, the development potential for in-situ mining methods is rated as unknown for all Federal lands within the KRCRA boundary.

Table 1 -- Chemical analyses of coals in the southwest quarter of the Superior 15-minute quadrangle, Sweetwater County, Wyoming

Location	COAL BED NAME	Form of Analysis	Proximate				Ultimate					Heating Value	
			Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	Btu/Lb
NW¼ NW¼ sec. 20, T. 21 N., R. 100 W., Jim Bridger Mine (Glass, 1975)	Deadman bed, Fort Union Formation	A	19.5	32.6	42.0	5.9	0.5	--	--	--	--	--	9,270
		C	0.0	40.5	52.1	7.4	0.6	--	--	--	--	--	11,520
SW¼ sec. 16, T. 18 N., R. 100 W., Rock Springs-Gibraltar Mine (Yourston, 1955)	Lance Formation undifferentiated	A	20.8	28.4	47.1	3.7	0.4	--	--	--	--	--	9,910
		C	0.0	35.8	59.5	4.7	0.5	--	--	--	--	--	12,510
SW¼ sec 26, T. 20 N., R. 101 W., Point of Rocks Mine (Dobbin, 1944)	Lower bed, Almond Formation	A	16.6	30.2	44.0	9.2	0.7	--	--	--	--	--	9,410
		C	0.0	36.3	52.7	11.0	0.8	--	--	--	--	--	11,290
NW¼ NW¼ sec. 2, T. 18 N., R. 105 W., Blairtown Mine (U.S. Bureau of Mines, 1931)	Rock Springs No. 3	A	11.5	36.8	50.1	1.6	0.8	--	--	--	--	--	12,220
		C.	0.0	41.6	55.6	1.8	0.9	--	--	--	--	--	13,810
SE¼ NW¼ sec. 20, T. 21 N., R. 102 W., Superior D Mine (U.S. Bureau of Mines, 1931)	Rock Springs No. 1	A	13.8	31.5	50.5	4.2	1.3	--	--	--	--	--	11,430
		C	0.0	36.6	58.5	4.9	1.5	--	--	--	--	--	13,250
NW¼ SE¼ sec. 27, T. 21 N., R. 102 W., Superior A Mine (U.S. Bureau of Mines, 1931)	Rock Springs No. 7	A	12.7	32.8	50.0	4.5	0.8	--	--	--	--	--	11,720
		C	0.0	37.6	57.2	5.2	0.9	--	--	--	--	--	13,430

Form of Analysis: A, as received

C, moisture free

Note: To convert Btu/pound to kilojoules/kilogram, multiply by 2.326

Table 2 -- Coal Reserve Base data for surface mining methods for Federal coal lands (in short tons) in the southwest quarter of the Superior 15-minute quadrangle, Sweetwater County, Wyoming

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Upper Deadman	580,000	70,000	260,000	910,000
Lower Deadman	950,000	220,000	500,000	1,670,000
Lower Lance {3}	20,000	20,000	70,000	110,000
Rock Springs No. 3	160,000	70,000	140,000	370,000
Rock Springs No. 1	1,540,000	150,000	250,000	1,940,000
Rock Springs No. 7½	0	0	0	0
Rock Springs No. 7	1,020,000	250,000	2,400,000	3,670,000
Rock Springs No. 9	370,000	220,000	1,320,000	1,910,000
Rock Springs No. 15	0	0	70,000	70,000
TOTAL	4,640,000	1,000,000	5,010,000	10,650,000

Note: To convert short tons to metric tons, multiply by 0.9072.

Table 3 -- Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the southwest quarter of the Superior 15-minute quadrangle, Sweetwater County, Wyoming

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Upper Deadman	580,000	0	0	580,000
Lower Deadman	240,000	0	0	240,000
Lower Lance {3}	0	0	0	0
Rock Springs No. 3	450,000	0	0	450,000
Rock Springs No. 1	2,410,000	940,000	0	3,350,000
Rock Springs No. 7½	80,000	0	0	80,000
Rock Springs No. 7	5,240,000	90,000	0	5,330,000
Rock Springs No. 9	4,460,000	150,000	0	4,610,000
Rock Springs No. 15	1,030,000	1,330,000	0	2,360,000
TOTAL	14,490,000	2,510,000		17,000,000

Note: To convert short tons to metric tons, multiply by 0.9072.

Table 4. -- Sources of data used on plate 1

Plate 1 Index Number	Source	Data Base
1	Rocky Mountain Energy Co., (no date), unpublished data	Pacific Power & Light Co. Drill hole No. 111
2	↓	Drill hole No. 1, line A
3	↓	Drill hole No. 1, line A
4	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 52
5	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
6	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 53
7	↓	Measured Section No. 54
8	↓	Measured Section No. 55
9	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
10	↓	Drill hole No. 2, line A
11	↓	Drill hole No. 1, line A
12	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 48
13	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
14	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 50

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Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
15	True Oil Co.	Oil/gas well No. 11-10 True-Bluewater-Federal
16	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
17	↓	Drill hole No. 66
18	↓	Drill hole No. 42
19	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	D.O. Clark Mine Drill hole No. 63
20	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 61
21	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	D.O. Clark Mine Drill hole No. 63
22	↓	D.O. Clark Mine Drill hole No. 52
23	↓	D.O. Clark Mine Drill hole No. 60
24	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 95
25	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	D.O. Clark Mine Drill hole No. 19
26	Rocky Mountain Energy Co., (no date), unpublished data	Union Pacific Coal Co. Drill hole No. 18-B

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
27	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	Lower B Mine Drill hole No. 41
28	↓	D.O. Clark Mine Drill hole No. 41
29	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 62
30	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	D.O. CLark Mine Drill hole No. 40
31	↓	D.O. Clark Mine Drill hole No. 28
32	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 63
33	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 92
34	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	Lower B Mine Drill hole No. 43
35	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 64
36	Rocky Mountain Energy Co., (no date), unpublished data	Superior Coal Co. Drill hole No. 23
37	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	Lower B Mine Drill hole No. 26

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
38	Rocky Mountain Energy Co., (no date), unpublished data	Union Pacific Coal Co. Drill hole No. 26
39	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 65
40	U.S. Geological Survey, 1924, Inactive Coal Lease No. Wyoming-07825, Rock Springs Fuel Co.	Drill hole No. 1
41	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 66
42	↓	Measured Section No. 51
43	↓	Measured Section No. 68
44	↓	Measured Section No. 67
45	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 11
46	↓	Drill hole No. 6
47	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	Lower B Mine Drill hole No. 53
48	↓	Lower B Mine Drill hole No. 51
49	↓	Lower B Mine Drill hole No. 54
50	↓	Lower B Mine Drill hole No. 55

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Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
51	Rocky Mountain Energy Co., (no date), unpublished data	Union Pacific Coal Co. Drill hole No. 55
52	↓	Superior Coal Co. Drill hole No. 3
53	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	Lower B Mine Drill hole No. 49
54	↓	Lower B Mine Drill hole No. 47
55	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
56	↓	Union Pacific Coal Co. Drill hole No. 61
57	U.S. Geological Survey, 1937, Inactive Coal Lease Nos. Evanston - 07490 and Evanston - 07849, Union Pacific Railroad	Lower B Mine Drill hole No. 48
58	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
59	↓	Drill hole No. 16
60	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 69
61	↓	Measured Section No. 70
62	↓	Measured Section No. 56
63	↓	Measured Section No. 57
64	↓	Measured Section No. 11

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
65	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
66	↓	Drill hole No. 2, line A
67	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured section No. 12
68	↓	Measured Section No. 25
69	↓	Measured Section No. 13
70	↓	Measured Section No. 26
71	↓	Measured Section No. 27
72	↓	Measured Section No. 28
73	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line B
74	↓	Drill hole No. 2, line A
75	↓	Drill hole No. 1, line A
76	↓	Drill hole No. 2, line A
77	↓	Drill hole No. 1, line A
78	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 22
79	Prenalta Corporation	Oil/gas well No. 23-24-22-102 Gov't.
80	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 23
81	↓	Measured Section No. 24

Table 4. -- Continued

Plate 1 Index Number	Source	Data Base
82	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 2, line A
83	↓	Drill hole No. 1, line A
84	↓	Drill hole No. 2, line A
85	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 47
86	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
87	↓	Drill hole No. 2, line A
88	LaPoint, 1977, U.S. Geological Survey, unpublished map	Measured Section No. 49
89	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1, line A
90	↓	Drill hole No. 2, line A

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