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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE RINER QUADRANGLE, CARBON AND SWEETWATER COUNTIES, WYOMING

[Report includes 32 plates]

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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 Riner quadrangle, Carbon and Sweetwater Counties, 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 1975 (P.L. 94-377). Published and unpublished public information was used as the data base for this study. No new drilling or field mapping was performed, nor was any confidential data used.

Location

The Riner quadrangle is located in south-central Wyoming on the county line between western Carbon County and eastern Sweetwater County. It lies approximately 15 miles (24 km) west of Rawlins and 19 miles (31 km) east of Wamsutter, Wyoming. The area is unpopulated. Riner, a former loading station on the Union Pacific Railroad, has been abandoned.

Accessibility

The main east-west line of the Union Pacific Railroad passes through the northern portion of the quadrangle providing railway service through southern Wyoming. This railway connects Ogden, Utah to the west and Omaha, Nebraska to the east.

Interstate Highway 80 passes east-west across the northwestern corner of the quadrangle. The abandoned station of Riner on the Union Pacific Railroad is accessible by an improved light-duty road from Interstate Highway 80, while the remainder of the quadrangle is served by numerous unimproved dirt roads and trails.

Physiography

The Riner quadrangle is located in the Red Desert region on the southeastern edge of the Great Divide Basin. The landscape within the quadrangle is characterized by northeast-trending, gently rolling hills and small areas of badlands and dunes. Red Rim, a 200-foot (61-m) high hogback, cuts across the southeastern corner of the quadrangle. Cherokee Hill, in the northwest corner of the quadrangle, also rises about 200 feet (61 m) above the surrounding landscape. Altitudes in the quadrangle vary from 6,700 feet (2,042 m) on the northeastern edge of the quadrangle to 7,500 feet (2,286 m) on the Red Rim on the southeastern edge of the quadrangle.

Separation Creek, cutting northeasterly across the Riner quadrangle, forms the major drainage system in the southeastern portion of the Great Divide Basin. Fillmore Creek in the northwest corner of the quadrangle and several other small streams in the quadrangle are tributaries to Separation Creek. All streams in the quadrangle are intermittent, flowing mainly in response to snowmelt in the spring. Some terminate locally in broad, undrained depressions or playas, and may form shallow alkaline lakes which fluctuate in size with the seasons.

Climate and Vegetation

The climate of south-central Wyoming is semiarid, characterized by low precipitation, rapid evaporation, and large daily temperature variations. Summers are usually dry and mild, and winters are cold. The annual precipitation in the area averages 10.4 inches. (26.4 cm). Approximately two thirds of the precipitation falls in the spring and summer during the seven-month period from April through October.

The average annual temperature in the area is 43°F (6°C). The temperature during January averages 21°F (-6°C) and ranges from 12°F (-11°C) to 31°F (-0.6°C). During July the average temperature is 68°F (20°C), and the temperature ranges from 51°F (11°C) to 84°F (29°C) (Wyoming Natural Resources Board, 1966).

The winds are usually from the southwest and the west-southwest with an average wind velocity of 12 miles per hour (19 km per hr) (U.S. Bureau of Land Management, 1978).

The principal types of vegetation in the quadrangle include grasses, sagebrush, greasewood, saltbush, rabbitbrush, and other desert shrubs.

Land Status

The Riner quadrangle lies on the northern edge of the Rawlins Known Recoverable Coal Resource Area. Approximately ninety percent of the quadrangle's total area lies within the KRCRA boundary. The Federal government owns the coal rights for approximately one half of this area, as shown on plate 2. No outstanding Federal coal leases, prospecting permits or licenses occur within the quadrangle.

GENERAL GEOLOGY

Previous Work

Ball (1909) described the coal-bearing Lance, Fort Union, and Wasatch Formations, present in the Riner quadrangle, in his study of the western part of the Little Snake River coal field. Smith (1909) covered a small area in the northern portion of the quadrangle in an investigation of the eastern part of the Great Divide Basin coal field. A detailed report on the geology and ground-water resources of the Rawlins area, to the northeast of the quadrangle, was made by Berry (1960). Pipiringos (1961) described the Tertiary-age formations covering the quadrangle. Welder and McGreevy (1966) included the Riner quadrangle in a report published on the geology and ground-water resources of the Great Divide Basin. Gill, Merewether, and Cobban (1970) described the stratigraphy of the Upper Cretaceous-age rocks in the area adjacent to the Riner quadrangle. Sanders made a detailed investigation of the geology and coal resources of the Riner quadrangle in 1974. Back (1976) mapped the geology and coal resources of the adjacent Creston Junction quadrangle and Edson (in press, a) mapped the geology and coal resources of the Seaverson Reservoir quadrangle to the southwest. Recent unpublished data from the Rocky Mountain Energy Company (RMEC) and Pacific Power and

Light Company (PPL), and from U.S. Geological Survey drilling and reconnaissance mapping provided the location of coal outcrops and coal thickness information.

Stratigraphy

The formations exposed in the Riner quadrangle range in age from Upper Cretaceous to Recent. The Upper Cretaceous-age Lance Formation and the Paleocene-age Fort Union Formation contain coal. The coals of the Mesaverde Group, present only in the subsurface, lie at depths of over 2,900 feet (884 m) in the quadrangle (Sanders, 1974).

The Upper Cretaceous-age Lewis Shale overlies the Mesaverde Group and is present in the subsurface in the quadrangle. It is composed of dark-gray to olive-gray fissile shale which grades into a buff-colored sandy shale (Berry, 1960). The middle or upper part of the Lewis Shale often contains a distinctive and widespread unit of interbedded sandstone and sandy shale called the Dad Sandstone Member, a tongue of the overlying Fox Hills Sandstone (Gill and others, 1970). The Lewis Shale is approximately 2,150 feet (655 m) thick in the Riner quadrangle, and contains no coal.

The Fox Hills Sandstone of Upper Cretaceous age, also present in the subsurface, intertongues with the underlying marine Lewis Shale and with the overlying brackish-water and fluvial sandstones and shales of the Lance Formation. The Fox Hills Sandstone is composed of thick units of pale-yellowish-gray, very fine to fine-grained friable sandstone, and thin units of olive-gray to dark-gray sandy shale. Thin units of carbonaceous shale containing brackish-water fossils and thin coal beds may occur in the formation (Berry, 1960, and Gill and others, 1970).

The Fox Hills Sandstone grades into the overlying Lance Formation of Upper Cretaceous age which crops out in a small area southeast of the Red Rim hogback. The Lance Formation, composed of light-brown to dark-gray and greenish-gray, sandy carbonaceous shale containing lignite and coal near the base, grades upward into dark-gray, fissile carbonaceous shale. The shale is interbedded with brown to light-brown, very fine to

fine-grained sandstone, which may occur in intervals up to 20 feet (6.1 m) thick throughout the formation. Several fossiliferous zones are present in the upper portion of the formation (Sanders, 1974). The combined thickness of the Fox Hills Sandstone and the Lance Formation is approximately 3,800 feet (1,158 m) in the quadrangle.

Unconformably overlying the Lance Formation, the Fort Union Formation of Paleocene age crops out over most of the northwestern portion of the quadrangle from the Red Rim hogback northwest to Cherokee Hill. According to Sanders (1974) the Fort Union Formation is approximately 3,300 to 3,500 feet (1,006 to 1,067 m) thick in the Riner quadrangle. At the base of the formation is approximately 500 to 600 feet (152 to 183 m) of light-gray, thick-bedded to massive, medium- to coarse-grained, generally cross-bedded sandstone which often contains lenses of well-rounded chert pebbles. This is overlain by approximately 1,500 feet (457 m) of interbedded light-brown to orange argillaceous siltstone, light-gray fine- to medium-grained sandstone, light- to dark-gray shale, and generally thin, discontinuous coal beds with lenticular thickenings to as much as 9 feet (2.7 m). Above this is approximately 700 to 800 feet (213 to 244 m) of poorly exposed beds of arenaceous siltstone and carbonaceous shale. The upper 600 feet (183 m) of the Fort Union Formation consists of gray-brown argillaceous siltstone, brown micaceous sandstone, shale, thick coal and lignite (Sanders, 1974).

Unconformably overlying the Fort Union Formation are approximately 200 feet (61 m) of Eocene-age Wasatch Formation sediments. These are composed of intertonguing white to yellowish-white, coarse-grained to granulitic, ferruginous arkose and dark gray-green to black fossiliferous shale (Sanders, 1974).

Recent deposits of alluvium cover the stream valleys of Separation and Fillmore Creeks. Terrace remnants of unconsolidated gravel cap Cherokee Hill, and areas of windblown sand and playa-lake clays occur throughout the quadrangle (Sanders, 1974).

Upper Cretaceous-age sediments in the Riner quadrangle indicate the transgressions and regressions of a widespread Cretaceous sea. The sediments exposed in the quadrangle accumulated near the western edge of the sea and reflect the location of the shoreline.

Deposition of the Lewis Shale marked a landward movement of the sea. The marine sediments of the Lewis Shale were deposited in water depths ranging from a few tens of feet to several hundred feet. Deposition of the Lewis Shale ended in the quadrangle with the regression of the sea.

The Fox Hills Sandstone represents a transitional depositional environment between the deeper-water marine environment of the Lewis Shale, and the lagoonal and continental environments of the Lance Formation. Deposition of the Fox Hills Sandstone sediments occurred in shallow marine, barrier bar, beach, estuarine, and tidal channel environments.

During the gradual recession of the last Cretaceous sea, marking the close of Cretaceous time in the Riner quadrangle, the carbonaceous shales, mudstones, and coal beds of the Lance Formation were deposited in broad areas of estuarine, marsh, lagoonal, and coastal swamp environments.

After the final withdrawal of the Cretaceous sea, thick sections of detrital material, eroded from older deposits, were deposited as the coarse conglomerates and sandstones of the Fort Union Formation. The sandstones, shales, and coals of the Fort Union Formation were deposited in stream, lake, and swamp environments.

The coarse-grained arkose of the Wasatch Formation is probably a fluvial facies of the main Wasatch Formation which formed in a piedmont environment adjacent to the sediment source. The beds of the Wasatch Formation grade southwestward, in adjacent quadrangles, into the fine-grained, thin-bedded, coal-shale-sandstone facies deposited in alternating lake, swamp and stream environments (Masursky, 1962).

Structure

The Riner quadrangle lies near the eastern end of the Wamsutter arch, the broad low structure separating the Great Divide and Washakie structural basins. The formations in the quadrangle strike northeasterly and dip to the northwest into the Great Divide Basin. Dips decrease progressively to the northwest, from about 24° on the Red Rim in the southeastern corner of the quadrangle to 2° to 3° near Cherokee Hill in the northwestern corner of the quadrangle. Sanders (1974) reports that many of the sandstone beds in the upper part of the Fort Union Formation dip more steeply than the underlying shales and coals because of an original sedimentary dip component.

COAL GEOLOGY

Several coal beds of the Upper and Lower Fort Union Coal Zones of the Fort Union Formation and coal beds of the Lance Formation have been identified in the quadrangle (plate 1). The Lance Coal Zone is approximately 2,000 feet (610 m) thick, containing many thin, lenticular coal beds. Approximately 1,900 feet (579 m) of sandstone and shale separates the Lance coals from the overlying Lower Fort Union Coal Zone. The Lower Fort Union Coal Zone is approximately 1,400 feet (427 m) thick and contains the thickest coals of the quadrangle. The coals seem to be thicker and more continuous than indicated by Sanders (1974). The Upper Fort Union Coal Zone lies approximately 1,000 feet (305 m) above the top of the Lower Fort Union Coal Zone and is approximately 500 feet (152 m) thick.

Chemical analyses of coal.--Chemical analyses for coals in the Lower Fort Union Coal Zone are given in table 1 (RMEC, no date). These coals generally rank as subbituminous C and are low in sulfur.

No Upper Fort Union coals were tested in this quadrangle, however, from the Creston Junction quadrangle to the west, analyses of bed B (Upper Cherokee) and bed C (Lower Cherokee) were reported by Smith and others (1972), and range as follows: moisture, 15 to 25 percent; volatile matter, 28 to 36 percent; fixed carbon, 27 to 40 percent; ash, 10 to 25 percent; sulfur, 0.5 to 5.0 percent; Btu per pound, 5,009 to 9,000

(11,651 to 20,934 kilojoules per kilogram) and the coal is ranked high volatile, subbituminous A.

No known analyses were available for the Lance Coal Zone in the Riner quadrangle, however they are believed to be low-sulfur, subbituminous B or C in rank, as are the majority of the coals in the Rawlins area.

Lance Coal Zone

Coal beds of the Lance Formation crop out in the extreme southeastern corner of the quadrangle (plate 1). Lance coal beds have also been identified in the Mule Creek Oil Company well drilled in sec. 3, T. 19 N., R. 90 W. The coal beds are usually thin and of limited areal extent due to the fluvial nature of the deposits. Dips of approximately 20° to the northwest were recorded in the outcrop area.

Although the coals of the Lance Formation have not been formally named, coal beds thicker than Reserve Base thickness (greater than 5 feet or 1.5 meters) are given bracketed numbers for identification purposes in this quadrangle only (plate 3). Inferred areal distributions for some of the thicker beds are shown on the Areal Distribution and Identified Resource Map of Non-Isopached Coal Beds (in the U.S. Geological Survey files).

Lower Fort Union Coal Zone

Coal beds of the Lower Fort Union Coal Zone crop out in a broad area trending northeast-southwest across the southeastern quarter of the quadrangle. Eight major beds have been identified in the zone, although many thin, unnamed coals also exist. The major beds are often identified by two names. Rocky Mountain Energy Company has drilled extensively in the area and identified the coal beds with an alpha-numeric designation (e.g., F2). Generic names (e.g., Red Rim) have been used by Edson (in press, a) to designate some of the same coal beds. Both names are used in this report and on the CRO plates where applicable.

Dips taken in the coal bearing area (Sanders, 1974) range between 12° and 24° in a northwesterly direction. Overburden increases rapidly in the same direction.

G (Daleys Ranch) Coal Bed

The G (Daleys Ranch) coal bed is, stratigraphically, the lowest identified bed in the Lower Fort Union Coal Zone in this quadrangle. This coal bed, designated as the G coal bed by RMEC, was named for Daleys Ranch located in sec. 32, T. 21 N., R. 89 W. The bed occurs in three RMEC drill holes in the quadrangle. One drill hole located in sec. 7, T. 19 N., R. 90 W., contains a cumulative coal thickness of 6 feet (1.8 m) with a 5-foot (1.5-m) parting. The amount of partings within the G bed increase to the east and south of this quadrangle. In the northwest quarter of the Bridger Pass 15-minute quadrangle, to the east, the bed attains a maximum cumulative coal thickness of 13 feet (3.9 m), while to the south, in the Fillmore Ranch quadrangle, the bed thickens to 14 feet (4.3 m). Dips average 11° to the northwest, as calculated from plate 4.

F2 (Red Rim) Coal Bed

The F2 (Red Rim) coal bed lies approximately 190 feet (58 m) above the G bed. The name Red Rim, as used by Edson (in press.a), was applied to the coal bed because it crops out near the Red Rim hogback in T. 20 N., R. 90 W. The bed attains a maximum thickness of 27 feet (8.2 m) in sec. 18, T. 19 N., R. 90 W., as shown on plate 23. Numerous small partings are common in this bed, attaining a cumulative thickness of 9 feet (2.7 m) in sec. 15, T. 19 N., R. 90 W. To the south, in the Fillmore Ranch quadrangle, the bed thickens to 28.5 feet (8.7 m) in sec. 13, T. 18 N., R. 90 W. To the east, in the northwest quarter of the Bridger Pass 15-minute quadrangle, the bed attains a maximum thickness of 11 feet (3.4 m). Because of its thickness near the outcrop, the F2 bed is believed to exist downdip for some distance. Dips derived from plate 24 average 14° to the northwest.

F1 Coal Bed

The F1 coal bed occurs only in the southern part of the quadrangle, pinching out to the northeast. The bed occurs from 12 to

19 feet (3.7 and 5.8 m) above the F2 coal bed and attains a maximum thickness of 8 feet (2.4 m) in sec. 5, T. 19 N., R. 90 W., as shown on plate 27. The dip of the bed, as calculated from plate 28, ranges from 11° to 14° in a northwesterly direction.

E2 Coal Bed

The E2 coal bed occurs approximately 130 feet (40 m) above the F1 coal bed. The bed reaches a maximum thickness of 12 feet (3.7 m) in sec. 6, T. 19 N., R. 90 W. It pinches out to the southwest and does not occur in the Fillmore Ranch quadrangle. To the northwest it continues as a local bed attaining a maximum thickness of 9.1 feet (2.8 m), but averages less than 5 feet (1.5 m) thick in most areas. Dips calculated from plate 20 range from 7° to 22° in a northwesterly direction.

E1 (Olson Draw) Coal Bed

The E1 (Olson Draw) coal bed lies approximately 150 feet (46 m) above the E2 bed. The bed is named for its occurrence near Olson Draw in the southwestern corner of the Fillmore Ranch quadrangle in T. 18 N., R. 91 W. The bed thicknesses reported on plate 7 are cumulative thicknesses excluding partings. The partings, which are significant, may in some cases exceed 20 feet (6.1 m). The coal thickness increases locally to 18 feet (5.5 m). The bed thins in the southwest part of the quadrangle, but thickens in the Fillmore Ranch quadrangle to 10 feet (3.0 m). To the northwest, the bed thins and becomes local in nature. Dips derived from plate 8 range from 7° to 13° in a northwesterly direction.

D1 (Separation Creek) Coal Bed

The D1 (Separation Creek) coal bed is found approximately 195 feet (59 m) stratigraphically above the E1 bed. This bed is named after Separation Creek in the northeast corner of the Fillmore Ranch quadrangle. Thickness of this bed, as encountered in RMEC drill holes, is persistant throughout the quadrangle and ranges between 3 and 6 feet (0.9 and 1.8 m). The bed thickens to 13.1 feet (4.0 m) in a southwesterly direction, but pinches out in a northeasterly direction. The bed

dips to the northwest at an angle of 7° to 13°, as calculated from plate 12.

C (Muddy Creek) Coal Bed

The C (Muddy Creek) coal bed is located approximately 150 feet (46 m) stratigraphically above the D1 coal bed. The bed was named by Edson (in press, a) for Muddy Creek, located in the northwestern corner of the northeast quarter of the Doty Mountain 15-minute quadrangle. Within the Riner quadrangle the bed thickens locally to 5 feet (1.5 m). No isopach or structure contour maps were drawn for this bed because of the thin lenticular nature of the coal bed. To the south, in the Fillmore Ranch quadrangle, the bed thickens to 12 feet (3.7 m).

B (Fillmore Ranch) Coal Bed

The B (Fillmore Ranch) coal bed lies 30 to 65 feet (9.1 to 19.8 m) stratigraphically above the C bed. It is the uppermost identified bed of the Lower Fort Union Coal Zone in this quadrangle. This bed is named for Fillmore Ranch in sec. 11, T. 18 N., R. 91 W. The B bed locally thickens to 22 feet (6.7 m) with numerous partings up to 13 feet (4.0 m) thick. To the south, in the Fillmore Ranch quadrangle, the bed initially thins to 2 feet (0.6 m) then thickens to 33 feet (10 m) and pinches out before reaching the northern boundary of the northwest quarter of the Bridger Pass 15-minute quadrangle. The average dip of this bed, as derived from plate 16, is 7° in a northwesterly direction.

Upper Fort Union Coal Zone

The coal beds of the Upper Fort Union Coal Zone crop out in the northwest quarter of the quadrangle, as shown on plate 1. These coal beds are commonly identified by two names, both of which are used in this report and on the CRO maps. Rocky Mountain Energy Company has identified the coal bed by using an alpha-numeric designation (e.g., E), while generic names (e.g., Horse Butte) have been used by Back (1976) to designate the same coal beds.

The Upper Fort Union Coal Zone contains five major coal beds in this quadrangle. The beds of the Upper Fort Union Coal Zone generally dip to the northwest at approximately 5° (Sanders, 1974) with overburden increasing in the same direction. The coal beds of the Upper Fort Union Coal Zone thin and eventually pinch out to the north.

E (Horse Butte) Coal Bed

The E (Horse Butte) coal bed is, stratigraphically, the lowest identified coal bed in the Upper Fort Union Coal Zone in this quadrangle. The bed, designated as the E coal bed by RMEC, was named for Horse Butte located in sec. 5, T. 19 N., R. 91 W., in the Creston Junction quadrangle. The maximum thickness of the bed in this quadrangle is 3.9 feet (1.2 m) as measured by Sanders (1974). The bed was not encountered in any drill holes, therefore the extent of the bed down dip from the outcrop is unknown.

D (Cow Butte) Coal Bed

The D (Cow Butte) coal bed is found stratigraphically above and separated from the E bed by 85 feet (25.9 m) of siltstone and sandstone. The bed is named for Cow Butte located in sec. 5, T. 19 N., R. 91 W. In this quadrangle, the maximum thickness recorded was 12 feet (3.7 m) in sec. 11, T. 20 N., R. 91 W. To the west in the Creston Junction quadrangle, in sec. 11, T. 19 N., R. 92 W., the bed thickens to 26 feet (7.9 m) with a 2-foot (0.6-m) parting. In general, this bed contains significant amounts of partings, and in some areas of the Creston Junction quadrangle the bed may be split by as much as 100 feet (30.5 m) of siltstone and sandstone. The dip of the bed, calculated from plate 20, is less than 5° in a northwesterly direction.

C (Lower Cherokee) Coal Bed

The C (Lower Cherokee) coal bed is the lower split of the Cherokee coal bed which is named for the abandoned Cherokee loading station on the Union Pacific Railroad in sec. 10, T. 20 N., R. 91 W. In this quadrangle, the upper and lower Cherokee splits are separated by approximately 70 feet (21.3 m) of interburden. The interburden gradually

thins to the south, where in T. 19 N., R. 92 W., the upper and lower splits combine to form the main Cherokee bed.

The C bed is located approximately 130 feet (40 m) above the D bed of the Upper Fort Union Coal Zone and reaches a maximum coal thickness of 18 feet (5.5 m), excluding 9 feet (2.7 m) of partings, as shown on plate 23. To the south and west, in the Creston Junction quadrangle, the bed thickens to more than 30 feet (9.1 m). Measurements derived from plate 24 indicate a dip of 5° or less to the northwest.

B (Upper Cherokee) Coal Bed

The B (Upper Cherokee) coal bed is found approximately 70 feet (21.3 m) above the C (Lower Cherokee) coal bed and reaches a maximum thickness of 8 feet (2.4 m) in secs. 1 and 12, T. 20 N., R. 91 W. The bed runs discontinuously to the southwest averaging between 4 and 8.5 feet (1.2 and 2.6 m) thick. Dips of the C bed are 5° or less in a northwesterly direction as derived from plate 28.

A (High Point) Coal Bed

A (High Point) coal bed is, stratigraphically, the highest bed identified in the Upper Fort Union Coal Zone. It is located approximately 130 feet (40 m) above the B bed. The name High Point as used by Edson (in press, a) was derived from the High Point ridge found in sec. 17, T. 19 N., R. 92 W. The maximum thickness of this bed is only 3.5 feet (1.1 m), well below the minimum Reserve Base thickness of 5 feet (1.5 m).

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 applicable. 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-isopachable coal beds. The isolated

data points used in this quadrangle are listed below. 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
Edson	sec. 14, T. 20 N., R. 91 W.	FU [19]	5.6 ft (1.7 m)
Sanders	sec. 7, T. 20 N., R. 90 W.	FU [18]	10.0 ft (3.0 m)
Davis Oil Co.	sec. 19, T. 20 N., R. 90 W.	FU [17]	9.0 ft (2.7 m)
Davis Oil Co.	sec. 19, T. 20 N., R. 90 W.	FU [16]	7.0 ft (2.1 m)
Davis Oil Co.	sec. 19, T. 20 N., R. 90 W.	FU [15]	10.0 ft (3.0 m)
Davis Oil Co.	sec. 19, T. 20 N., R. 90 W.	FU [14]	9.0 ft (2.7 m)
Davis Oil Co.	sec. 19, T. 20 N., R. 90 W.	FU [13]	7.0 ft (2.1 m)
RMEC	sec. 5, T. 19 N., R. 90 W	FU [12]	7.0 ft (2.1 m)
U.S.G.S.	sec. 28, T. 20 N., R. 90 W	FU [11]	6.0 ft (1.8 m)
U.S.G.S.	sec. 32, T. 20 N., R. 90 W	FU [10]	5.5 ft (1.7 m)
U.S.G.S.	sec. 32, T. 20 N., R. 90 W	FU [9]	7.0 ft (2.1 m)
U.S.G.S.	sec. 32, T. 20 N., R. 90 W	FU [8]	8.0 ft (2.4 m)
Sanders	sec. 8, T. 19 N., R. 90 W.	FU [7]	9.2 ft (2.8 m)
Edson	sec. 6, T. 19 N., R. 90 W.	FU [6]	6.0 ft (1.8 m)
Edson	sec. 12, T. 19 N., R. 91 W.	FU [5]	6.0 ft (1.8 m)
Edson	sec. 18, T. 19 N., R. 90 W.	FU [4]	9.0 ft (2.7 m)
Edson	sec. 12, T. 19 N., R. 91 W.	FU [3]	8.0 ft (2.4 m)

Source	Location	Coal Bed or Zone	Thickness
Edson	sec. 12, T. 19 N., R. 91 W.	FU [2]	9.0 ft (2.7 m)
Edson	sec. 6, T. 19 N., R. 90 W.	FU [1]	6.0 ft (1.8 m)
Mule Creek Oil Co.	sec. 3, T. 19 N., R. 90 W.	La [4]	10.0 ft (3.0 m)
Mule Creek Oil Co.	sec. 3, T. 19 N., R. 90 W.	La [3]	6.0 ft (1.8 m)
Mule Creek Oil Co.	sec. 3, T. 19 N., R. 90 W.	La [2]	6.0 ft (1.8 m)
Mule Creek Oil Co.	sec. 3, T. 19 N., R. 90 W.	La [1]	6.0 ft (1.8 m)

COAL RESOURCES

Information from oil wells, and from coal test holes drilled by RMEC, PPL, the U.S. Geological Survey, and Union Carbide Corporation (Edson, 1978), as well as surface mapping by Sanders (1974), was used to construct outcrop, isopach, and structure contour maps of the coal beds in this 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 derivitive maps. However, data from these holes have been used to construct the derivitive maps. These data may be obtained by contacting RMEC.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 7, 11, 15, 19, 23, and 27). 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 subbitum inous coal yields the coal resources in short tons (metric tons) of coal for each isopached coal bed. Reserve Base and Reserve tonnages for the isopached beds are shown on plates 6, 10, 14, 18, 22, 26, and 30, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal beds thicker than 5 feet (1.5 m) that lie less than 3,000 feet (914 m) below the ground surface are included, although this criteria differs 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 maximum depth of 1,000 feet (305 m) for subbituminous coal. Only Reserve Base tonnages (designated as indicated or inferred resources) are calculated for areas influenced solely by isolated data points in this quadrangle. Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 338.92 million short tons (307.47 million metric tons) for the entire quadrangle. 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 to coincide with the boundaries of the smallest legal land subdivisions shown on plate 2. In sections or portions 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 portion 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 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 is shown on the next page.

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

where MR = mining ratio
t_o = thickness of overburden
t_c = thickness of coal
rf = recovery factor

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 are defined as areas underlain by coal beds having respective mining ratio values of 0 to 10, 10 to 15, and greater than 15, as shown on plates 5, 9, 13, 17, 21, 25, and 29. 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.

Unknown development potentials have been assigned to those areas where coal data is absent or extremely limited, including areas influenced by isolated data points. Even though these areas contain coal thicker than 5 feet (1.5 m), limited knowledge of the areal distribution of the coal prevents accurate evaluation of development potential. Tonnages included in the unknown potential category for isolated data points total 5.69 million short tons (5.16 million metric tons).

The coal development potential for surface mining methods (less than 200 feet or 61 meters of overburden) is shown on plate 31.

Of those Federal land areas having known development potential, 91 percent is rated high, 4 percent is rated moderate, and 5 percent is rated low. The remaining Federal land is classified as having unknown development potential, implying that no known coal beds 5 feet (1.5 m)

or more thick, not including isolated data points, occur within 200 feet (61 m) of the ground surface but that coal-bearing units are present.

Development Potential for Subsurface and In-Situ Mining Methods

The coal development potential for subsurface mining is shown on plate 32. Areas of high, moderate, and low development potential are defined as areas underlain by coal beds of Reserve Base thickness 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.

Of those Federal land areas having known development potential for conventional subsurface mining methods, 84 percent have high potential and 16 percent have moderate potential. Unknown potential is assigned to the remaining Federal land within the KRCRA, implying that no known coal beds 5 feet (1.5 m) or more thick, not including isolated data points, occur between 200 feet (61 m) and 3,000 feet (914 m) below the ground surface but that coal-bearing units are present. Tonnages for the unknown (subsurface) development potential for isolated data points totals 75.72 million short tons (68.69 million metric tons).

All Federal lands within the KRCRA in this quadrangle have been rated low for in-situ development potential because of the limited areal extent of the coal beds and the low Reserve Base tonnages known to be available for in-situ mining.

Table 1. Chemical analyses of coals in the Riner quadrangle, Carbon and Sweetwater Counties, 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
NE¼, NW¼, sec. 27, T. 20 N., R. 90 W. (RR-55 - Red Rim)	B	A	24.44	30.59	37.07	7.90	0.42	-	-	-	-	-	8,507
		C	0.0	40.49	49.05	10.46	0.55	-	-	-	-	-	11,259
SW¼, SE¼, sec. 27, T. 20 N., R. 90 W. (RR-59 - Red Rim)	E1	A	22.79	28.32	32.17	16.72	0.59	-	-	-	-	-	7,653
		C	0.0	36.68	41.67	21.65	0.76	-	-	-	-	-	9,912
NW¼, NW¼, NW¼, sec. 35, T. 20 N., R. 90 W. (RR-75 - Red Rim)	Fu, Undifferentiated	A	25.42	29.15	37.16	8.27	0.46	-	-	-	-	-	8,109
		C	0.0	39.09	49.82	11.09	0.62	-	-	-	-	-	10,873
SE¼, SE¼, SE¼, sec. 29, T. 20 N., R. 90 W. (RR-81 - Red Rim)	B	A	21.98	27.42	31.15	19.40	0.36	-	-	-	-	-	7,332
		C	0.0	35.21	39.92	24.87	0.46						9,385
NW¼, SE¼, sec. 7, T. 19 N., R. 90 W. (RR-84 - Red Rim)	D1	A	26.50	29.66	37.64	6.20	0.44						8,432
		C	0.0	40.35	51.22	8.43	0.60						11,472
SE¼, SE¼, sec. 7, T. 20 N., R. 90 W. (RR-102 - Red Rim)	F2	A	24.72	29.19	35.43	10.66	0.25						8,065
		C	0.0	38.78	47.06	14.16	0.33						10,713
SE¼, NE¼, sec. 27, T. 20 N., R. 90 W. (RR-177 - Red Rim)	D1	A	24.55	28.97	39.78	6.70	0.30						8,682
		C	0.0	38.40	52.72	8.88	0.40						11,507
SE¼, SE¼, sec. 29, T. 20 N., R. 90 W. (RR-181 - Red Rim)	F2	A	25.14	28.67	37.17	9.02	0.31						8,223
		C	0.0	38.30	49.65	12.05	0.41						10,935
NE¼, SW¼, sec. 33, T. 20 N., R. 90 W. (RR-184 - Red Rim)	E1	A	24.18	28.61	34.61	12.60	0.51						7,984
		C	0.0	37.74	45.64	16.62	0.67						10,530

Form of analysis: A, as received
C, moisture free

Table 2. Strippable coal Reserve Base data for Federal coal lands (in short tons) in the Riner quadrangle, Carbon and Sweetwater Counties, Wyoming.

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
B (Upper Cherokee)	2,380,000	570,000	2,080,000	5,030,000
C (Lower Cherokee)	12,910,000	960,000	1,220,000	15,090,000
D (Cow Butte)	450,000	180,000	2,610,000	3,240,000
B (Fillmore Ranch)	11,410,000	4,130,000	1,690,000	17,230,000
D1 (Separation Creek)	330,000	350,000	1,060,000	1,740,000
E1 (Olson Draw)	1,430,000	570,000	530,000	2,530,000
E2	750,000	250,000	940,000	1,940,000
F1	900,000	460,000	2,180,000	3,540,000
F2 (Red Rim)	7,810,000	3,500,000	2,140,000	13,450,000
G (Daleys Ranch)	50,000	80,000	270,000	400,000
Total	38,420,000	11,050,000	14,720,000	64,190,000

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 Riner quadrangle, Carbon and Sweetwater Counties, Wyoming.

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
B (Upper Cherokee)	3,270,000	--	--	3,270,000
C (Lower Cherokee)	1,000,000	--	--	1,000,000
D (Cow Butte)	7,990,000	--	--	7,990,000
B (Fillmore Ranch)	32,330,000	3,900,000	--	36,230,000
D1 (Separation Creek)	5,150,000	--	--	5,150,000
E1 (Olson Draw)	10,010,000	130,000	--	10,140,000
E2	4,380,000	4,520,000	--	8,900,000
F1	840,000	--	--	840,000
F2 (Red Rim)	33,840,000	82,860,000	2,730,000	119,430,000
G (Daleys Ranch)	340,000	--	--	340,000
Total	99,150,000	91,410,000	2,730,000	193,290,000

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	Mule Creek Oil Co.	Oil/gas well No. 1-243 UPRR
2	U.S. Geological Survey (no date), unpublished table	Drill hole No. R-D5
3	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
4		Measured section
5	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 187
6		Drill hole No. RR 186
7		Drill hole No. RR 121
8		Drill hole No. RR 188
9		Drill hole No. RR 189
10		Drill hole No. RR 190
11		Drill hole No. RR 191
12		Drill hole No. RR 72
13		Drill hole No. RR 71
14		Drill hole No. RR 192
15		Drill hole No. RR 122
16	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section

Table 4. -- Continued.

Plate 1 Index Number	Source	Data Base
17	Edson, 1978, U.S. Geological Survey, written communication (Union Carbide)	Drill hole No. SS 6-1
18	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 88
19		Drill hole No. RR 103
20		Drill hole No. RR 119
21		Drill hole No. RR 193
22		Drill hole No. RR 83
23		Drill hole No. RR 84
24		Drill hole No. RR 194
25		Drill hole No. RR 120
26		Drill hole No. RR 82
27		Drill hole No. RR 102
28	U.S. Geological Survey, (no date), unpublished table	Drill hole No. R-D6
29	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 70
30	Edson, 1978, U.S. Geological Survey written communication (Union Carbide)	Drill hole No. SS 55-2
31		Drill hole No. SS 181-2
32		Drill hole No. SS 185-3

Table 4. -- Continued.

Plate 1 Index Number	Source	Data Base
33	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 118
34		Drill hole No. 1AS
35		Drill hole No. 2AS
36		Drill hole No. 3AS
37		Drill hole No. 1AS
38		Drill hole No. 2AS
39	U.S. Geological Survey, (no date), unpublished table	Drill hole No. BP-D22
40	Davis Oil Co.	Oil/gas well No. 1 Red Rim
41	U.S. Geological Survey, (no date), unpublished table	Drill hole No. R-D7
42		Drill hole No. R-D8
43	Rocky Mountain Energy Co., (no date) unpublished data	Drill hole No. RR 63
44		Drill hole No. RR 61
45		Drill hole No. RR 62
46		Drill hole No. RR 36
47		Drill hole No. RR 59
48		Drill hole No. RR 41
49		Drill hole No. RR 42
50		Drill hole No. RR 40

Table 4. -- Continued.

Plate 1 Index Number	Source	Data Base
51	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
52	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 53
53	↓	Drill hole No. RR 52
54	↓	Drill hole No. RR 54
55	↓	Drill hole No. RR 55
56	↓	Drill hole No. RR 39
57	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
58	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 60
59	↓	Drill hole No. RR 177
60	↓	Drill hole No. RR 56
61	↓	Drill hole No. RR 38
62	↓	Drill hole No. RR 37
63	↓	Drill hole No. RR 179
64	↓	Drill hole No. RR 178
65	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
66	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 58

Table 4. -- Continued.

Plate 1 Index Number	Source	Data Base
67	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 65
68		Drill hole No. RR 180
69		Drill hole No. RR 57
70	U.S. Geological Survey, (no date), unpublished table	Drill hole No. R-D2
71	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
72	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 181
73		Drill hole No. 81
74		Drill hole No. RR 81
75		Drill hole No. RR 182
76	U.S. Geological Survey, (no date), unpublished table	Drill hole No. R-D3
77	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 73
78		Drill hole No. RR 69
79		Drill hole No. RR 77
80		Drill hole No. RR 79
81		Drill hole No. RR 183
82		Drill hole No. RR 79

Table 4. -- Continued.

Plate 1 Index Number	Source	Data Base
83	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 78
84	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
85	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 184
86	↓	Drill hole No. RR 76
87	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
88	Rocky Mountain Energy Co., (no date) unpublished data	Drill hole No. RR 80
89	↓	Drill hole No. RR 144
90	↓	Drill hole No. RR 185
91	U.S. Geological Survey, (no date), unpublished table	Drill hole No. R-D4
92	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Measured section
93	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. RR 75
94	↓	Drill hole No. 3AS
95	↓	Drill hole No. 1AS
96	↓	Drill hole No. 2AS

Table 4. -- Continued.

Plate 1 Index Number	Source	Data Base
97	Pacific Power & Light Co., (no date), unpublished data	Coal test hole
98	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 3AS
99	↓	Drill hole No. 2AS
100	Pacific Power & Light Co., (no date), unpublished data	Coal test hole
101	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
102	↓	Drill hole No. 4AS
103	Pacific Power & Light Co., (no date), unpublished data	Drill hole No. 15-1
104	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AS
105	↓	Drill hole No. 2AS
106	↓	Drill hole No. 3AS
107	↓	Drill hole No. 4AS
108	Sanders, 1974, U.S. Geological Survey Coal Investigations Map C-68	Coal test hole
109	↓	Measured section
110	↓	Coal test hole
111	↓	Measured section
112	↓	Measured section

Table 4. -- Concluded

Plate 1 Index Number	Source	Data Base
113	Pacific Power & Light Co., (no date), unpublished data	Drill hole No. 11-SW
114	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 1AD
115	↓	Drill hole No. 2AD
116		Drill hole No. 3AD
117		Drill hole No. 3AD
118		Drill hole No. 2AD
119		Drill hole No. 1AD
120		Drill hole No. 1AD
121		Drill hole No. 2AD
122		Drill hole No. 3AD
123	Smith, 1909, U.S. Geological Survey Bulletin 341-B, p. 233	Water well
124	Rocky Mountain Energy Co., (no date), unpublished data	Drill hole No. 35
125	↓	Drill hole No. 11

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