Text to accompany:

Open-File Report 78-043

1978

COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE HALFWAY HILL QUADRANGLE, CARBON COUNTY, WYOMING

(Report includes 31 plates)

Prepared for:

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Prepared by:

TEXAS INSTRUMENTS INCORPORATED
DALLAS, TEXAS

CONTENTS

ILLUSTRATIONS

[Plates are in pocket]

Plates 1-28 Coal resource occurrence maps:

TABLES

APPENDICES

INTRODUCTION

Purpose

This text is to be used along with the accompanying Coal Resource Occurrence (CRO) maps and the Coal Development Potential (CDP) maps of the Halfway Hill quadrangle, Carbon County, Wyoming (31 plates; U.S. Geol. Survey Open File Report 78-043), prepared by Texas Instruments Incorporated under contract to the U.S. Geological Survey. This report was prepared to support the land planning work of the U.S. Bureau of Land Management's Energy Minerals Activities Recommendation System (EMARS) program, and to contribute to a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA) in the western United States. The Coal Resource Occurrence maps and the Coal Development Potential maps for this quadrangle cover part of the southeastern portion of the KRCRA of the Hanna coal field.

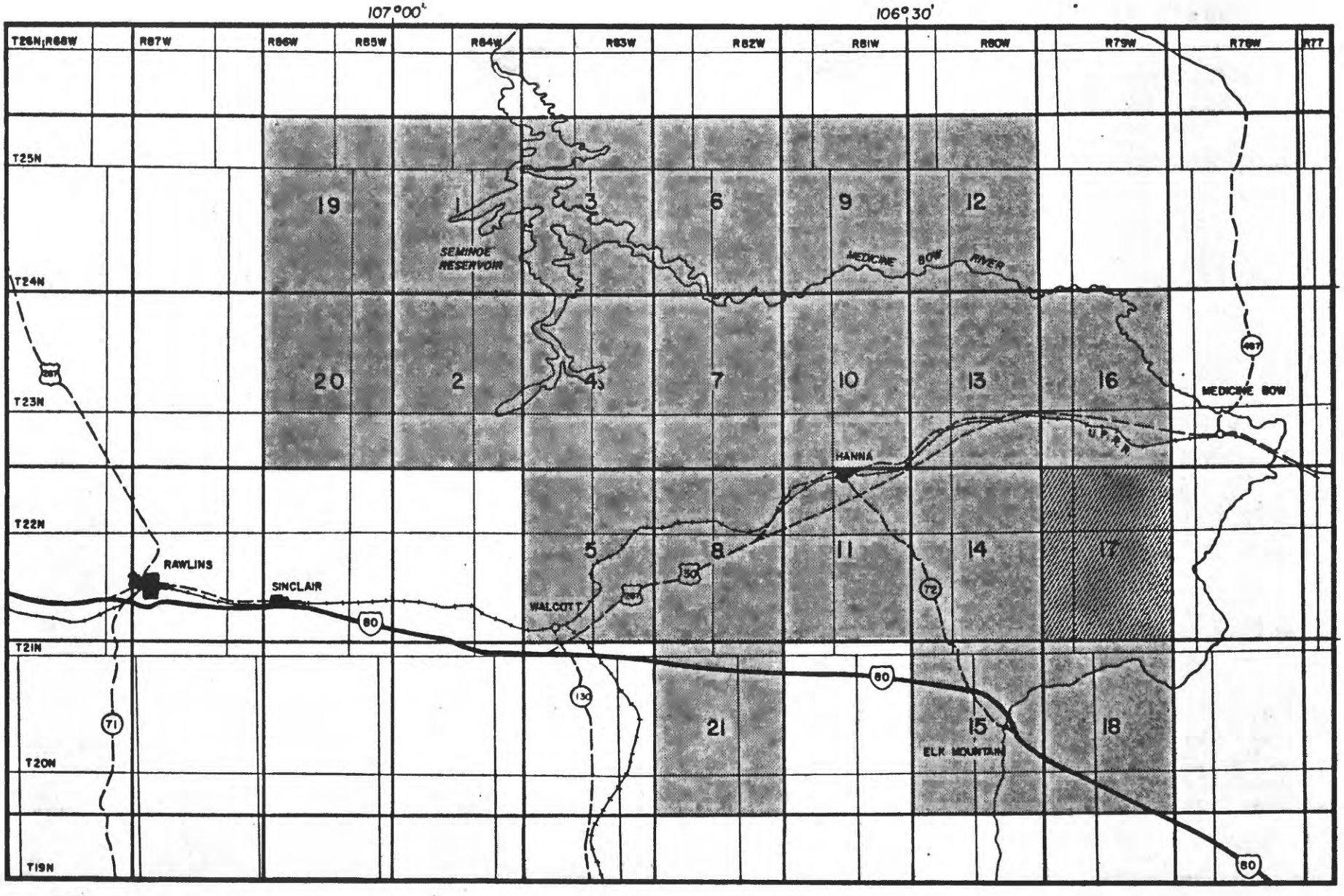
Acknowledgment

Texas Instruments Incorporated acknowledges the cooperation of the Rocky Mountain Energy Company, a wholly owned subsidiary of the Union Pacific Railroad Company, in supplying copies of survey sheets, drillers reports, electric logs, and coal analyses from the Union Pacific coal inventory program.

The Hanna and Carbon coal basins were studied as part of the inventory program and test drilling was conducted in 1970-1971. More than 650 Union Pacific coal drill holes have been evaluated as part of this contract study of 21 quadrangles in Carbon County, Wyoming, and the results and 230 coal analyses have been incorporated into these reports.

Location

The Halfway Hill 7½-minute quadrangle is in the northeastern part of Carbon County, Wyoming. The center of the quadrangle is approximately 9 miles (14 km) southwest of Medicine Bow and 13 miles (21 km) southeast of Hanna, Wyoming (Figure 1).



Halfway Hill quadrangle (17)

Scale 1:446,000

Figure 1. — Map of Hanna and Carbon Basins study area

Accessibility

Access to the Halfway Hill quadrangle from Elk Mountain and Medicine Bow, 11 miles (18 km) to the southwest and 9 miles (14 km) to the northeast, respectively, is provided by a light-duty road which enters at the northeastern border of the quadrangle. This road crosses the eastern half of the quadrangle in a southerly direction to the base of Halfway Hill, turns southwest, and follows the valleys of Second Sand and Third Sand Creeks. Immediately northeast of Halfway Hill, in sec. 2, T. 21 N., R. 79 W., two subsidiary light-duty roads leave the main road. One travels west for approximately 2 miles (3 km) and provides access to drill hole locations in the center of the quadrangle; the other is an unimportant local by-pass for about 1 mile (1.6 km). In sec. 15, T. 21 N., R. 79 W. the main road forks. The east fork traverses southeasterly to provide access to the Kyle Oil Camp and to an airstrip for light aircraft in sec. 26, T. 21 N., R. 79 W.; the west fork continues southwest toward the town of Elk Mountain. A light-duty road in the extreme northwest corner of the quadrangle connects U.S. Highway 30/287 to the north with State Highway 72 to the southwest. Several unimproved dirt roads provide ready access from the light-duty roads to most parts of the quadrangle.

The main east-west track of the Union Pacific Railroad is 6 miles (10 km) north of the center of the quadrangle, and it connects the town of Medicine Bow to the east with Hanna, Walcott, Sinclair, and Rawlins to the west.

Physiography

The quadrangle contains the eastern part of the Carbon structural basin, which, in this area, is bounded on the west by the Saddleback Hills anticline and on the east by the Medicine Bow anticline.

Most of the quadrangle has topography typical of the high plains grasslands of southern Wyoming. The only prominent topographic feature is a ridge, south and east of Second Sand Creek, that defines the western flank and nose of the Medicine Bow anticline. Maximum elevation of the ridge crest is 7,207 feet (2,197 m) and the local relief is about 350 feet (107 m). Spade Flats, in the northeast quarter of the quadrangle, is an area of very low relief with numerous small enclosed lake basins.

Elevations within the quadrangle range from less than 6,580 feet (2,006 m) in the northeast corner, to over 7,440 feet (2,268 m) west of Chapman Draw.

All streams in the quadrangle are intermittent. First Sand Creek and Carbon Creek, flowing north and northeast, drain much of the northern half of the quadrangle. Second Sand and Third Sand Creeks, flowing to the northeast and east, drain most of the southern half of the quadrangle.

Climate

Climate data for the Halfway Hill quadrangle were obtained by evaluating and averaging the data recorded at two nearby weather stations. The Elk Mountain station is located 11 miles (18 km) southwest of the center of the quadrangle at an elevation of 7,270 feet (2216 m); precipitation records are available for 65 years to 1970 and temperature records are available for 22 years to 1970. The Medicine Bow station is located 9 miles (14 km) northeast of the center of the quadrangle at an elevation of 6,570 feet (2,003 m); precipitation and temperature records are available for 23 years to 1970. The climate is semiarid with a mean annual temperature of 41°F (5° C) and extremes ranging from 96° to -44°F (36 to -42°C). July is the warmest month with a mean monthly temperature of 64°F (18°C) and January is the coldest month with 22°F (-6°C). For seven months of the year, April to October, the mean monthly temperature exceeds 32°F (0°C). Average annual precipitation is 12 inches (30 cm) with 54 percent of this total falling in the five months of March through July. Part of the precipitation in March, April, and May is in the form of snow. Average annual snowfall is 108 inches (274 cm) with 64 percent falling in the four months of January to April. Snow rarely falls in July and August but an inch or more snow may fall in any other month. March is the month of maximum snowfall (18 inches or 46 cm). Snowfall data were obtained from the Elk Mountain station; no data on snowfall were available from the Medicine Bow station.

High winds are common throughout most of the year. The prevailing wind direction, as recorded at four weather stations around the perimeter of the Hanna and Carbon Basins, is westerly for all twelve months of the year. The growing season is restricted to less than 100 days between late May and early September which are the average times of the last killing spring frost and the first killing fall frost, respectively.

Land Status

The quadrangle is in the extreme southeastern part of the KRCRA of the Hanna and Carbon Basins. The Federal Government owns approximately 37 percent of the coal rights in the quadrangle; the remaining 63 percent is non-federally owned. Approximately 60 percent of the area of the quadrangle is included in the KRCRA, and within this region about 25 percent of the land is federally owned. Plate 2 of the CRO maps illustrates the ownership status of land in the quadrangle and the boundary of the KRCRA.

Five abandoned underground mines are shown on Plate 1. The Carbon No. 1, No. 2, and No. 6 mines in sec. 26, T. 22 N., R. 80 W. and the Carbon No. 7 mine in sec. 36, T. 22 N., R. 80 W., were all owned by the Union Pacific Railway Company. The Wissler Mine (sec. 22, T. 22 N., R. 79 W.) was owned and operated by J. Albert Wissler.

There are no known active leases, permits, or licenses and no known active mining operations.

GENERAL GEOLOGY

Previous Work

Dobbin, Bowen, and Hoots (1929) mapped the Halfway Hill quadrangle as part of their study of the geology and coal and oil resources of the Hanna and Carbon Basins. Weitz and Love (1952) compiled a geologic map of Carbon County which incorporates available data, published and unpublished, to that date. Gill, Merewether, and Cobban (1970) provide a detailed description and discussion of the more important sedimentary rock formations of the area. The geology of the quadrangles adjoining on the south and southeast has been mapped more recently by Hyden and McAndrews (1967) and by Hyden (1966), respectively.

Stratigraphy

Rocks exposed in the quadrangle range in age from Late Cretaceous to Quaternary. Coal beds occur in the Mesaverde and Medicine Bow Formations of Late Cretaceous age, and in the Hanna Formation of Tertiary age.

Elsewhere in the Hanna coal field, coal beds crop out in the Ferris Formation of Late Cretaceous/Tertiary age, but no outcrops of Ferris coal

have been mapped in the Halfway Hill quadrangle. It is possible that the deep drill holes 53, 54, 55, 59, and 61 penetrated the base of the Hanna Formation and then intersected sediments of the Ferris or the Medicine Bow Formation. However, Ferris or Medicine Bow sediments could not be identified in the electric logs of these drill holes; therefore, until further data become available from the geologic logs of these drill holes, the local coal lenses that occur in the lowest 150 to 400 feet (46 to 122 m) of four of five drill holes are included with the Hanna coal beds in this report.

The oldest formation exposed in the quadrangle is the Steele Shale, a marine formation of Late Cretaceous age. The formation crops out in the northeast corner of the quadrangle, where the shales dip southwest at 45° toward the center of the Carbon Basin, and in the core of the Medicine Bow anticline in sec. 23, T. 21 N., R. 79 W. (Veronda, 1951). At the type locality near Fort Steele, 35 miles (56 km) west of the center of this quadrangle, the Steele Shale is 3,000 feet (914 m) thick; in an oil well drilled in sec. 17, T. 21 N., R. 80 W., 7 miles (11 km) west-southwest of the center of this quadrangle, the unit is 2,357 feet (718 m) thick; and in an oil well drilled in this quadrangle, in sec. 4, T. 21 N., R. 79 N., the unit is 1,364 feet (416 m) thick. The Steele Shale consists of dark-gray shales that contain sparse layers of gray-weathering limestone concretions and thin beds of very fine grained sandstone and siltstone.

Conformably overlying the Steele Shale is the Upper Cretaceous Mesaverde Formation of Dobbin, Bowen, and Hoots (1929). Later studies in south-central Wyoming by Gill, Merewether, and Cobban (1970) have resulted in elevating the Mesaverde to group status and in measuring and defining four separate formations within the group. Surface mapping delineating the formations of the Mesaverde Group has not been extended into the Halfway Hill quadrangle, however, and the group is here treated as a single unit. The Mesaverde Formation is exposed in the northeastern and southeastern corners of the quadrangle; in the southeast, the sediments delineate the nose and northwest flank of the Medicine Bow anticline. Dobbin, Bowen, and Hoots (1929) describe the Mesaverde Formation from a stratigraphic section north of Fort Steele and give a total thickness of 2,279 feet (695 m) for the unit. The oil well in the southeast of sec. 4, T. 21 N., R. 79 W. intersected 2,029 feet (618 m) of Mesaverde. The Mesaverde Formation contains a lower unit of indurated white to gray massive to thin-bedded

and cross-bedded sandstones, alternating with thinner beds of gray shales. This lower unit is of marine origin. A middle member of the formation consists of gray to brown thin-bedded to massive sandstones, alternating with beds of gray carbonaceous shales and thin irregular beds of coal. The depositional environment for this unit was fresh to brackish water. The top member of the formation consists of white to gray sandstones, alternating with beds of gray shales and thin beds of carbonaceous shale and coal. The unit is primarily nonmarine but grades into shallow marine at the top.

The Upper Cretaceous Lewis Shale conformably overlies the Mesaverde Formation with a gradational contact. Lewis Shale is exposed in two broad bands, one across the southeast part of the quadrangle, and the other across the northeast part. The oil well drilled in this quadrangle in the southeast of sec. 4, T. 21 N., R. 79 W. intersected 2,343 feet (714 m) of Lewis Shale. The formation consists for the most part of dark-gray marine shales with numerous intercalated beds of sandy shale and gray ripple-marked and cross-bedded to massive sandstone. Dobbin, Bowen, and Hoots (1929) state that the Fox Hills Sandstone is represented in the upper part of the Lewis Shale but they did not differentiate it in their mapping.

The Upper Cretaceous Medicine Bow Formation conformably overlies the Lewis Shale where it is exposed in a broad band across the northeast and east-central parts of the quadrangle but, to the south, it is completely covered by the onlapping Hanna Formation in sec. 29, T. 21 N., R. 79 W. Dobbin, Bowen, and Hoots (1929) give a thickness of 6,200 feet (1,890 m) for the Medicine Bow Formation in the western part of the Hanna Basin. They describe the formation as consisting of yellow, gray and carbonaceous shales, beds of coal, and gray and brown sandstones. The lower part of the formation is made up of brown massive to cross-bedded sandstones that contain numerous beds of coal. These sandstones are overlain by an intermediate group of gray shales and brown fine-grained thin-bedded sandstones with some beds of massive white sandstone. The sandstones at the top of the formation are coarse grained, massive, and friable and are interbedded with thick beds of dark-gray shale. The depositional environment of the formation is dominantly freshwater with occasional brackish-water elements, except in the lower part where there are sandstone beds with a marine fauna of Fox Hills type.

Conformably overlying the Medicine Bow Formation is the Ferris Formation of Late Cretaceous/Paleocene age. The lower part of the Ferris Formation is exposed as a narrow band in the unnamed syncline of the north-central part of the quadrangle. The upper part of the Ferris Formation is completely covered by the overlying Hanna Formation. The Ferris Formation is about 6,500 feet (1,981 m) thick at its type locality near the old Ferris Ranch on the North Platte River, approximately 34 miles (55 km) west-northwest of the center of the Halfway Hill quadrangle. The formation consists of a thick sequence of continental rocks that can be divided into two parts: a lower unit of Late Cretaceous age which is about 1,100 feet (335 m) thick and an upper unit of Paleocene age which is about 5,400 feet (1,646 m) thick. The basal 300 feet (91 m) of the lower unit consists of dark-gray shales and buff to yellow coarse-grained friable massive sandstones with irregular thin beds of conglomerate. The overlying 800 foot (244-m) section of the lower unit is made up largely of conglomerate which occurs as pockets, lenses, and thin beds irregularly distributed throughout the sandstone. The upper unit of the Ferris Formation consists of gray, brown and yellow sandstones interbedded with numerous thick beds of coal. Since the upper part of the Ferris Formation is concealed by the onlap of Hanna sediments, no Ferris coal beds are exposed at the surface in the Halfway Hill quadrangle.

Overlying the Ferris Formation is the Hanna Formation that occupies the central portions of the Hanna and Carbon Basins and contains many of the thick coal beds of the region, particularly in the neighborhood of the town of Hanna. The Hanna Formation is normally not only unconformable on the underlying Ferris Formation but also transgresses across all underlying formations; this includes the Medicine Bow Formation and the Lewis Shale in the southern part of the Halfway Hill quadrangle, and in the quadrangles to the south and west. In this quadrangle the Hanna Formation, as mapped by Dobbin, Bowen, and Hoots (1929), crops out in the western half of the area and as an outlier capping the top of Halfway Hill in sec. 2, T. 21 N., R. 79 W.

Dobbin, Bowen, and Hoots (1929) first mapped the Hanna Formation and they consider it to be about 7,000 feet (2,134 m) thick in the Hanna and Carbon Basins. Gill, Merewether, and Cobban (1970), when reviewing the Ferris and Hanna Formations, conclude from the measured sections of Knight

(1951) and their own field observations that the Hanna Formation may be as much as 13,500 feet (4,115 m) thick. The Hanna Formation consists of conglomerate, conglomeratic sandstone, sandstone, shale, and many thick beds of coal. The conglomerate occurs throughout the formation but is most abundant in the lower half. Thick conglomeratic sandstone and, locally, massive conglomerate mark the base of the formation. The sandstones of the formation range from coarse-grained massive or thick-bedded varieties to fine-grained thin- bedded sandstones which weather brown and white, commonly conglomeratic, and highly feldspathic. The conglomerates of the Hanna Formation differ from those of the Ferris in color and in the size and composition of the clasts. Apparently, the conglomerates of the Ferris were derived from a distant source and those of the Hanna from a nearby source (Gill and others, 1970, p. 47). The age of the Hanna Formation is in doubt; fossils from the Hanna indicate a late Paleocene age but in the center of the Hanna Basin the formation may be as old as late early Paleocene or middle Paleocene.

Quaternary alluvium was not mapped as such by Dobbin, Bowen, and Hoots (1929) but may be assumed to occur as scattered deposits along most of the intermittent drainage channels.

Structure

The western and northern parts of the Halfway Hill quadrangle lie on the eastern edge of the Carbon structural basin. The Medicine Bow anticline in the southeastern corner of the quadrangle lies on the extreme western edge of the Laramie structural basin. The Hanna and Carbon Basins form a comparatively small but very deep intermontane structural trough. The trough extends about 53 miles (85 km) east-west, 30 miles (48 km) north-south, and in the central portion contains approximately 30,000-35,000 feet (9,140-10,670 m) of sediments overlying crystalline basement. The Saddleback Hills (or Simpson Ridge) anticline in the quadrangles to the west and southwest of this quadrangle serves to separate the Hanna Basin from the Carbon Basin.

The principle deformation defining the present Hanna and Carbon Basins occurred during the Laramide Orogeny. The bordering highlands were raised and deformed, and the sediments accumulated rapidly in the basins; consequently, the present Hanna and Carbon Basins have complexly folded and

faulted borders, with mild deformation within the basins expressed by a few broad folds and normal faults.

The structures of the Halfway Hill quadrangle reflect features of both borderlands and basins. The Medicine Bow anticline in the southeast corner of the quadrangle is outlined by resistant sandstones of the Mesaverde Formation. The axis of the fold trends northwest and plunges northerly. The fold is asymmetric with steeper dips of 55° or more on its eastern flank; dips along the western flank vary from less than 10° to a maximum of 30° in the Lewis Shale outcrops. The Steele Shale, the oldest formation found at the surface in this quadrangle, is exposed in the core of the structure. The anticline loses its identity north of the Lewis Shale in sec. 11, T. 21 N., R. 79 W.

Northwest of the Medicine Bow anticline a smaller northwest trending anticline in the Medicine Bow Formation is centered on sec. 4, T. 21 N., R. 79 W.; a parallel northwest plunging syncline in the Medicine Bow and Ferris Formations is centered on sec. 29, T. 22 N., R. 79 W. Dip of the sediments associated with these two structures varies from 28° to 45°.

The Hanna Formation covers the western half of the Halfway Hill quadrangle. It also occupies the center of the Carbon Basin in this and the quadrangle to the west. It rests uncomformably on the Ferris, Medicine Bow, and Lewis Shale Formations. Dips in the Hanna sediments are for the most part shallow and toward the center of the basin; 20° to 25° along the northern edge, 15° to 20° along the western edge, 14° and less along the southern edge, and from 2° to 6° within the basin. Exceptions to these shallow dips are reported along the eastern edge of the Carbon Basin: 45° southwest in sec. 4, T. 21 N., R. 79 W., and 33° northeast on the southwest limb of the syncline in sec. 29, T. 22 N., R. 79 W.

Several normal faults trend northeasterly and displace rocks of the Hanna, Medicine Bow, and Lewis Shale Formations in the north half of the quadrangle. The majority of these faults occur in the Hanna Formation, in the southeast part of T. 22 N., R. 80 W. between the Carbon No. 6 and No. 7 mines. An isolated fault located north and northwest of the Wissler mine trends northeasterly, is upthrown on the south, and displaces beds in the Medicine Bow Formation and Lewis Shale. North of the quadrangle boundary

the fault displaces the Mesaverde Formation and loses its identity in the Steele Shale.

COAL GEOLOGY

Previous Work

The coal deposits of the Hanna and Carbon Basins have been studied by Veatch (1907), Dobbin, Bowen, and Hoots (1929), Berryhill and others (1950), and Glass (1972 and 1975).

Twenty-six coal analyses have been published since 1913 for coal beds of the Mesaverde Group and the Medicine Bow, Ferris, and Hanna Formations within the Hanna and Carbon Basins (Appendices 1 and 2). Samples collected and analyzed prior to 1913 have not been considered in this report (American Society for Testing and Materials, 1977, p. 218). An average analysis and an apparent rank of coal beds in each of these four stratigraphic units have also been calculated for the 230 analyses from the Union Pacific Coal inventory program (Appendices 1 and 2). A standard rank determination (ASTM, 1977, p. 216, sec. 6.2.2) cannot be made because: (a) some of the published analyses are from weathered coal samples, and (b) the procedure and quality of sampling for the Union Pacific coal evaluation program are not known.

Glass (1975) and U.S. Department of Interior (1975) published not only proximate coal analyses for 17 samples collected in the Hanna Basin, but also assays for 10 major and minor oxides, 12 major and minor elements, and up to 32 trace elements. Glass (1975, p. 1) stresses that his assay data are insufficient to characterize the chemical and physical properties of any individual coal bed, but that this will be possible at a later date as the study continues. Assay results of the 17 Hanna Basin samples show that these coals contain no significantly greater amounts of trace elements of environmental concern than are found in the 42 samples collected in six other Wyoming coal fields.

General Features

In the Halfway Hill quadrangle, 19 coal beds and 95 local coal lenses either have been mapped by Dobbin, Bowen, and Hoots (1929) or have been identified in the subsurface (Plates 1, 3, and 3A). The coal beds mapped in this quadrangle occur in the Mesaverde, Medicine Bow, and Hanna Formations.

As noted in a preceding section of this report (see Stratigraphy), there is also a possibility that coal may occur in the subsurface in the Ferris Formation. Analyses of samples from coal beds 112, 100 (≈112A), JB, and 106 are shown in Appendix 3. Analyses for one sample were published by U.S. Bureau of Mines (1931); the remaining analyses are of samples collected in the Union Pacific coal inventory program.

The U.S. Geological Survey selected five coal beds for coal resource evaluation: 100 (≈112A), JB (the Johnson Bed), 106, C7 (the Carbon No. 7), and C6 (the Carbon No. 6).

Mesaverde Coal Beds

In the Mesaverde Formation, three coal beds were mapped in outcrops and four local coal lenses were identified in the subsurface. Mesaverde coal beds are exposed at the surface in the northeast and southeast corners of the quadrangle. In the northeast, coal beds 112 and 112-A dip from 25° to 27° southwest. The average thickness of coal bed 112 is less than 2 feet (0.6 m) in this area but thickens to 15 feet (5 m) north of the quadrangle; thicknesses of coal bed 112-A range from 2.8 to 8 feet (0.9 to 2.4 m). In the southeast, coal beds 99 and 100 crop out along the west flank of the Medicine Bow anticline. Strikes vary from northwest to northeast; dips are to the west and northwest and range from less than 10° near the crest of the structure to 30° in secs. 15 and 22, T. 21 N., R. 79 W. Average thickness for coal bed 99 is less than 4 feet (1.2 m); average thickness for coal bed 100 is 7.5 feet (2.3 m).

Medicine Bow Coal Beds

In the Medicine Bow Formation, 5 coal beds were mapped at the surface and 11 local coal lenses were identified in the subsurface. The five coal beds (101, 102, HHL 1, 103, and 104) crop out in the central and east-central areas of the quadrangle, at the nose of the Medicine Bow anticline and on the northeast flank of the unnamed anticline centered on sec. 4, T. 21 N., R. 79 W. Dip of the coal beds is probably 30° and less to the northwest, north, and northeast. Coal bed thicknesses are less than the minimum Reserve Base value of 5 feet (1.5 m), as follows: coal bed 101 is less than 2 feet (0.6 m) thick; coal beds 102, HHL 1, and 103 range

between 1 and 3 feet (0.3 and0.9 m) thick; and coal bed 104 is from 1 to 4 feet (0.3 to 1.2 m) thick.

Hanna Coal Beds

In the Hanna Formation, 11 coal beds were mapped at the surface and 80 local coal lenses were identified in the subsurface. As noted in a previous section of this report (see Stratigraphy), some of the local coal lenses that were intersected below coal bed JB in some deep drill holes may be Ferris or Medicine Bow coal lenses but, in the absence of confirming data, they are considered Hanna coal lenses in this report. Four of the 11 Hanna coal beds were selected for coal resource evaluation.

Coal bed JB (the Johnson Bed) is the oldest Hanna coal bed mapped by Dobbin, Bowen, and Hoots (1929), with outcrops located in the south-central and southwestern areas of the quadrangle. The coal bed dips to the west and northwest at 30° and less, toward the center of the Carbon Basin located near the northwest corner of sec. 13, T. 21 N., R. 80 W. The thickness of coal bed JB varies from 7.6 to 11 feet (2.3 to 3.4 m) at measured outcrops, and from 2 to 30 feet (0.6 to 9.1 m) in drill hole intersections. The average thickness from 12 measurements (Plates 1 and 3A) is about 18.6 feet (5.7 m). Although not mined in this quadrangle, coal bed JB has been extensively mined in the past in the adjoining quadrangles to the south and southwest.

Coal bed 106 is located 190 to 360 feet (58 to 110 m) above coal bed JB and the outcrops of the two coal beds are closely parallel, with the outcrop of coal bed 106 extending further north by 1 mile (1.6 km). At measured outcrops, coal bed 106 is from 2.2 to 9.8 feet (0.7 to 3.0 m) thick; in drill holes, from 2 to 12 feet (0.6 to 3.7 m) thick; and an average thickness of this coal bed from 14 measurements is 5.8 feet (1.8 m).

Coal beds C7 and C6 crop out in the northwest and south-central areas of the quadrangle, dipping to the southwest, west, and northwest at probably less than 20°. While both coal beds are mapped similar distances southwards to sec. 20, T. 21 N., R. 79 W., coal bed C7 is not mapped north of a westerly trending fault in sec. 36, T. 22 N., R. 80 W. Coal bed C6 has been extensively mined north of this fault, both in this quadrangle and the Carbon quadrangle to the west. Coal bed C7 varies in thickness from 1.1 to

15.4 feet (0.3 to 4.7 m) and averages 4.4 feet (1.3 m); coal bed C6 varies from 3 to 25.9 feet (0.9 to 7.9 m) thick and averages 8.7 feet (2.7 m). An area of burned and clinkered coal that resulted from a mine fire (Glass, 1972) is shown extending down dip from the outcrop of coal bed C6 in secs. 25 and 26, T. 22 N., R. 80 W., to the limit of mining at the Carbon No. 6 underground mine. The electric log of drill hole 1 indicates the presence of coal bed C6, however. Due to this apparent conflict of information, data from drill hole 1 were not used on the derivative maps for the coal bed C6.

COAL RESOURCES AND RESERVES

Previous Work

Coal reserves of the Hanna and Carbon Basins have been estimated or calculated by Dobbin, Bowen, and Hoots (1929), Berryhill and others (1950), and Glass (1972).

Method of Calculating Resources and Reserves

Data from Dobbin, Bowen, and Hoots (1929), oil and gas well logs, and coal drill holes (written communication, Rocky Mountain Energy Company, 1977 and U.S. Geological Survey, 1978) were used to construct a coal data map (Plate 1) and coal data sheets (Plates 3 and 3A). U.S. Geological Survey reviewed these three plates on the basis of Reserve Base criteria and selected five coal beds for the calculation of coal resources in the Halfway Hill quadrangle. In addition, calculation of coal resources was requested for isolated or noncorrelatable data points.

The coal data map and coal data sheets were used to construct structure contour, coal isopach, and overburden isopach maps of the correlatable coal beds (Plates 4-6, 9-11, 14-16, 19-21, 24-26). For single coal beds, the maps were drawn using, as control points, thicknesses measured at outcrop and subsurface data from drill hole information. Where coal beds are split, cumulative coal thicknesses were used, excluding non-coal partings.

Plates 4-6, 9-11, 14-16, 19-21, and 24-26 provide the data for calculating the coal resources and reserves within the KRCRA boundary of the quadrangle in accordance with the classification system given in U.S. Geological Survey Bulletin 1450-B and the instructions provided by U.S. Geological

Survey on approval of these 15 plates. Calculation of the resources and reserves is in accordance with the following criteria:

- Identified coal resources of the quadrangle, as selected by the U.S. Geological Survey, are contained within coal beds 100, JB, 106, C7, and C6, and the resources defined by isolated or noncorrelatable data points.

- Coal bed thicknesses from surface mapping are true thicknesses; thicknesses from subsurface data are apparent thicknesses. Apparent thickness is corrected to true thickness if the dip of the selected coal bed exceeds 25°.

- Strippable coal resources (the resources capable of being extracted by strip-mining methods) are composed of single coal beds at least 5 feet (1.5 m) thick and having 200 feet (61 m) or less of overburden.

- Nonstrippable coal resources (subsurface resources capable of being mined by underground methods) are single or multiple coal beds with a minimum thickness of 5 feet (1.5 m); a maximum dip of 15°; an overburden, or combined overburden and interburden, thickness of 0 to 3,000 feet (914 m). To avoid duplicating strippable coal Reserve Base and reserve values, no nonstrippable coal Reserve Base and reserve values are calculated where a coal bed(s) occurs above the stripping limit. When calculating nonstrippable coal Reserve Base values, an average thickness for each coal bed is determined from the coal bed thicknesses at control points within a measured area. When calculating nonstrippable coal reserve values, the average thickness for each coal bed is determined in a like manner after coal bed thicknesses greater than 12 feet (3.7 m) have been reduced to 12 feet (3.7 m).

- All coal deeper than 3,000 feet (914 m) is excluded.

- Reliability or geologic assurance categories (measured, indicated, and inferred resources) are defined according to proximity of the coal to a data point. Measured resources occur within 0.25 mile (402 m) of a data point; indicated resources occur within an area 0.25 to 0.75 mile (402 m to 1.2 km) from a a data point; inferred resources occur within an area 0.75 to 3 miles (1.2 to 4.8 km) from a data point. A data point is either a measured coal thickness in a drill hole or a measured coal thickness location on a mapped outcrop.

- Coal resources from isolated or noncorrelatable data points are calculated for a single coal bed at least 5 feet (1.5 m) thick or for an aggregate thickness of multiple coal beds each at least 5 feet (1.5 m) thick. The single coal bed, or the stratigraphically highest bed in an aggregate of coal beds, is locally projected up dip to the surface to establish an inferred outcrop. Strippable coal resources for the projected

bed or beds are considered to occur from surface to a depth of 200 feet (61 m); nonstrippable coal resources are considered to occur from surface to a depth of 3,000 feet (914 m). Only the coal resources underlying an area within 0.5 miles (804 m) of a drill hole or a measured surface outcrop are considered, and they are assigned to the inferred category of reliability.

- Coal resources are calculated for unleased Federal land within the KRCRA boundary (Plate 2). Information pertaining to leased or fee acreage and to non-Federal land is considered proprietary and not for publication.

In preparing a map for evaluating the areal distribution of identified resources for the isolated or noncorrelatable coal beds, some data require a unique solution. For example:

- Where short segments of coal bed outcrop have data points that indicate a coal thickness of 5 feet (1.5 m) or more, an arc with a radius equal to half the outcrop length is drawn down dip from the outcrop, connecting to the ends of the outcrop. The resulting contained area defines the total coal resource, segmented into strippable and nonstrippable resource sections.

- Where a coal bed outcrop has data points with coal thicknesses less than 5 feet (1.5 m), a 5-foot (1.5-m) cut-off point is interpolated and the resulting segments with values greater than 5 feet (1.5 m) are used to generate arcs (radii equal to half the outcrop length) for defining the extent of the coal resources. When several data points occur on the outcrop of a resource area, an average of their coal thickness values is used to calculate a tonnage of coal.

- Where areas within outcrop segment arcs and areas within 0.5 mile (804 m) of a drill hole coincide, they are combined and drill hole coal thickness values are averaged with outcrop coal thickness values.

- When evaluating multiple coal beds of an isolated or noncorrelatable data point, the interburden between subsurface coal beds may be too great to allow the aggregate thickness of coal to be considered as one planar unit. In such instances, a conservative judgment is made and the resources for each coal bed are calculated separately and then totaled.

Results

The areal distribution of leasable Federal coal resources within the KRCRA boundary is shown on Plates 7, 12, 17, 22, and 27 for the five selected coal beds.

The coal resource acreage within each area of unleased Federal land was determined by planimeter. Coal Reserve Base values are obtained by multiplying the coal resource acreage for the planimetric portion of the area of unleased Federal land by the average isopach value of the selected coal bed, times the conversion factor for subbituminous coal, 1,770 short tons (1,606 t) of coal per acre-foot. The coal Reserve Base tonnages are recorded as follows:

- from coal beds 100, JB, 106, C7, and C6: 118.75 million short tons (107.73 million t) assigned to measured, indicated, or inferred categories, shown on Plates 7, 12, 17, 22, and 27; included in the coal Reserve Base totals shown on Plate 2.

- from isolated or noncorrelatable data points: 3.72 million short tons (3.37 million t) of strippable resources and 21.50 million short tons (19.50 million t) of nonstrippable resources, assigned to the inferred resource category, and included in the coal Reserve Base totals shown on Plate 2.

In summary, the total Reserve Base for all coal beds thicker than 5 feet (1.5 m), that lie less than 3,000 feet (914 m) below the ground surface of unleased Federal land within the KRCRA in the Halfway Hill quadrangle, is 143.97 million short tons (130.61 million t).

Coal reserves for the quadrangle are calculated by applying recovery factors to the measured, indicated, and inferred resources of coal beds 100, JB, 106, C7, and C6. The inferred resources determined from the isolated or noncorrelatable data points are excluded from coal reserve calculations. For strippable resources, a recovery factor of 0.85 is used; for nonstrippable resources, the recovery factor is 0.50. Reserve tonnages, to the nearest ten thousand short tons, are shown on Plates 7, 12, 17, 22, and 27. Total coal reserves for unleased Federal land within the KRCRA in the Halfway Hill quadrangle, are 46.87 million short tons (42.52 million t), consisting of 7.26 million short tons (6.59 million t) recoverable by strip mining or by underground mining, and 39.61 million short tons (35.93 million t) recoverable by underground mining only.

COAL DEVELOPMENT POTENTIAL

Method of Calculating Development Potential

Following the calculation of Reserve Base values and coal reserves, the coal resources of the KRCRA of the Halfway Hill quadrangle, except those coal resources determined from isolated or noncorrelatable data points, are evaluated for their development potential in each of two mining-method categories, surface and subsurface.

Strippable and nonstrippable resources are assigned to one of four development potential categories (high, moderate, low, and unknown) according to the following criteria:

Strippable Resources

- Assignment is based on calculated mining ratio values for subsurface data points (wells and drill holes) and for points of intersection of coal isopachs (Plates 5, 10, 15, 20, and 25) and overburden isopachs (Plates 6, 11, 16, 21, and 26).

- The formula used to calculate mining ratios was provided by U.S. Geological Survey as follows:

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

where

MR = mining ratio

t_o = thickness of overburden, in feet

t_c = thickness of coal, in feet

rf = recovery factor (0.85 for strip mining)

0.911 = a constant

- If mining ratio is 0-10, resources have high development potential.

  If mining ratio is 10-15, resources have moderate development potential.

  If mining ratio is greater than 15, resources have low development potential.

- If insufficient data prevent the construction of mining ratio contours, the resources are assigned to unknown development potential category, provided that there is reasonable assurance the coal bed is present in that area.

Nonstrippable Resources

- Coal beds must be more than 5 feet (1.5 m) thick. Coal beds less than 5 feet (1.5 m) thick are excluded from the Reserve Base coal resources. Where coal beds are more than 12 feet (3.7 m) thick, only 12 feet (3.7 m) of the total thickness is used for Reserve Base calculations.

- If the overburden is between 0 and 1,000 feet (0 and 305 m), resources have high development potential; if the overburden is between 1,000 and 2,000 feet (305 and 610 m), resources have moderate development potential; if the overburden is between 2,000 and 3,000 feet (610 and 914 m), resources have low development potential.

- If insufficient data prevents the construction of coal isopachs or overburden isopachs, or if the correlatable coal bed in the area is located completely above the stripping limit, the resources are assigned to the unknown development potential category, provided that there is reasonable assurance the correlatable coal bed is present in the area.

By applying the above criteria, mining-ratio maps (Plates 8, 13, 18, 23, and 28) were prepared for coal beds 100, JB, 106, C7, and C6.

Development potential acreages were then blocked out, as shown on CDP Plates 29 and 30. Acreage for strippable and nonstrippable resources of selected coal beds is shown in Table 1 for each of the four development potential categories. In accordance with a constraint imposed by the U.S. Bureau of Land Management, the highest development potential affecting any portion of a 40-acre (16 ha) parcel is applied to the entire parcel. For example, if 5 acres (2 ha) within a parcel are assigned 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.

Additionally, at the direction of the U.S. Geological Survey, an unknown development potential is assigned to coal resources calculated for any coal bed that, although not selected for coal resource evaluation, is (a) wholly, or partly, of Reserve Base thickness, or (b) of unknown thickness.

Table 1. — Development potential for identified resources of the selected coal beds within the KRCRA of the Halfway Hill quadrangle

Coal bed	Development potential (acres)							
	Strippable resources			Nonstrippable resources			Unknown category	
	High	Moderate	Low	High	Moderate	Low	Strippable	Nonstrippable
100	0	40	360	0	0	0	0	720
JB	80	80	0	2,560	0	0	120	1,400
106	0	40	160	2,400	0	0	0	1,200
C7	40	0	200	80	0	0	0	2,080
C6	120	40	80	800	0	0	720	3,000
Totals	240	200	800	5,840	0	0	840	8,400

To convert acres to hectares, multiply by 0.4046

Development Potential for Strippable Resources

Development potential for strippable coal resources within unleased Federal land in the KRCRA of this quadrangle, is shown in Table 1 for each selected coal bed. Plate 29 and Table 2 show the highest surface development potentials for the selected coal beds. The totals are obtained after assigning the highest assessed development potential for each coal bed within the smallest legal subdivision to that subdivision.

Table 2. - Highest development potential for identified resources of the selected coal beds within the KRCRA of the Halfway Hill quadrangle

Development potential (acres)							
Strippable resources			Nonstrippable resources			Unknown category	
High	Moderate	Low	High	Moderate	Low	Strippable	Nonstrippable
480	160	600	3,680	0	0	720	1,880

To convert acres to hectares, multiply by 0.4046.

There are approximately 7,280 acres (2,945 ha) of unleased Federal land within the KRCRA of this quadrangle. Of this area, 1,960 acres (793 ha), or 26.9 percent of the total, are estimated to be underlain by coal resources, from the selected coal beds, with development potential for surface mining. Of the 1,960 acres (793 ha), a high development potential is assigned to 480 acres (194 ha), a moderate development potential is assigned to 160 acres (65 ha), a low development potential to 600 acres (243 ha), and an unknown development potential to 720 acres (291 ha).

Of the 7,280 acres (2,945 ha) of unleased Federal land, there are 1,380 acres (558 ha) or 19 percent of the total, which are classifiable as of unknown surface mining potential on the basis of both (a) the presence of outcrops of noncorrelatable coal beds of unknown thickness and (b) data gaps on beds selected for coal resource evaluation.

Development Potential for Nonstrippable Resources

Development potential for nonstrippable coal resources within unleased Federal land in the KRCRA of this quadrangle is shown in Table 1 for each selected coal bed. Plate 30 and Table 2 show the highest subsurface development potentials for the selected coal beds. The totals are obtained after assigning the highest assessed development potential for each coal bed within a planimetric area, to all the resources of the coal bed in that area.

Of the 7,280 acres (2,945 ha) of unleased Federal land within the KRCRA of this quadrangle, 5,560 acres (2250 ha), or 76.4 percent of the total, are estimated to be underlain by coal resources, from the selected coal beds, with development potential for underground mining. Of the 5,560 acres (2250 ha), a high development potential is assigned to 3,680 acres (1489 ha), and an unknown development potential to 1,880 acres (761 ha).

Of the 7,280 acres (2,945 ha) of unleased Federal land, there are 1,820 acres (736 ha) or 25 percent of the total, which are classifiable as of unknown subsurface mining potential on the basis of both (a) the presence of outcrops of non-correlatable coal beds of unknown thickness and (b) data gaps on beds selected for coal resource evaluation.

REFERENCES CITED

American Society for Testing and Materials, 1977, Standard specification for classification of coals by rank, ANSI/ASTM D388-77, in 1977 Annual Book of ASTM Standards, pt. 26, Am. Soc. for Testing and Materials, Philadelphia, Pa., 840 p., p. 214-218.

Berryhill, H.L., Jr., Brown, D.M., Brown, A., and Taylor, D.A., 1950, Coal resources of Wyoming: U.S. Geol. Survey Circ. 81, 78 p., 4 figs.

Dobbin, C.E., Bowen, C.F., and Hoots, H.W., 1929, Geology and coal and oil resources of the Hanna and Carbon Basins, Carbon County, Wyoming: U.S. Geol. Survey Bull. 804, 88 p., 27 pls, 3 figs.

Gill, J.R., Merewether, E.A., and Cobban, W.A., 1970, Stratigraphy and nomenclature of some pper Cretaceous and lower Tertiary rocks in south-central Wyoming: U.S. Geol. Survey Prof. Paper 667, 53 p., 15 figs.

Glass, B.G., 1972, Mining in the Hanna coalfield: Wyoming Geol. Survey Misc. Rept., 45 p., 13 figs.

_____ 1975, Analyses and measured sections of 54 Wyoming coal samples (collected in 1974): Wyoming Geol. Survey Rept. Inv. no. 11, 219 p., 130 figs.

Hyden, H.J., 1966, Geologic map of the McFadden quadrangle, Carbon County, Wyoming: U.S. Geol. Survey Quad. Map GQ-533.

Hyden, H.J., and McAndrews, H., 1967, Geologic map of the TL Ranch quadrangle, Carbon County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-637.

Knight, S.H., 1951, The Late Cretaceous-Tertiary history of the northern portion of the Hanna basin - Carbon County, Wyoming, in Wyoming Geol. Assoc. Guidebook, 6th Ann. Field Conf., south-central Wyoming, p. 45-53, 3 pls., 2 figs.

Love, J.D., Weitz, J.L., and Hose, R.K., 1955, Geologic map of Wyoming: U.S. Geol. Survey, prepared in connection with Wyoming Geol. Survey and Wyoming Univ. Dept. Geology, scale 1:500,000.

Rocky Mountain Energy Company, 1977, Survey sheets, coal drill hole data, and coal analyses from the Union Pacific coal evaluation program: unpublished publicly available data from company files.

U.S. Bureau of Mines, 1931, Analyses of Wyoming coals: U.S. Bur. Mines Tech. Paper 484, 159 p.

U.S. Bureau of Mines and U.S. Geological Survey, 1976, Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey: U.S. Geol. Survey Bull. 1450-B, 7 p., 1 fig.

U.S. Department of Interior, 1975, Hanna Basin study site, Hanna coal field, Wyoming: Bur. Land Management EMRIA rept. no. 2, 193 p., 10 pls., 10 figs.

U.S. Geological Survey, 1977, Plats of surface mines: U.S. Geol. Survey Conserv. Div., unpublished data.

Veatch, A.C., 1907, Coal fields of east-central Carbon County, Wyoming: U.S. Geol. Survey Bull. 316-D, p. 244-260, 1 pl.

Veronda, G.R., 1951, Summary Report on the Geology of the Big Medicine Bow Field, Carbon County, Wyoming, in Wyoming Geol. Assoc. Guidebook, 6th Ann. Field Conf., south-central Wyoming, p. 97-99, 1 pl.

Weitz, J.L., and Love, J.D., 1952, Geologic map of Carbon County, Wyoming: U.S. Geol. Survey, prepared in cooperation with Wyoming Geol. Survey and Wyoming Univ. Dept. Geology, scale 1:159,400.

Appendix 1. — Average analyses of coal samples from the Hanna and Carbon Basins

Source of Data	Number of samples (1)	Total footage Ft	in	Average analyses — as received basis, Percent: Moisture	Ash	Volatile matter	Fixed carbon	Sulfur	Btu/lb	Calorific Value, Btu/lb Moist, mineral-matter-free basis (2)	Apparent rank of coal (3)
Published analyses	26	318	6	12.5	7.1	36.2	44.2	0.6	10,553	11,438	sub A or hvCb
Union Pacific coal inventory program	230	1,605	10	12.48	8.74	35.12	43.68	0.82	10,398	11,494	sub A or hvCb

Notes:

(1) Published data from USBM (1931, p. 40-45, sample nos. 2623, 2624, 22800, 22972, 93486, 93488, 93541, A14123, A14124); Glass (1975, p. 16-19, sample nos. 74-23 to 74-34, inclusive); Dept. of Interior (1975, p. 38, sample nos. D169597-99, D169607-08). Union Pacific coal inventory program data from company files, Rocky Mountain Energy Company (1977).

(2) Moist, mineral-matter-free Btu/lb calculated from average analyses, as received basis, using Parr formula (ASTM, 1977, p. 216, sec. 8.2).

(3) Sub A — subbituminous A; hvCb — high volatile C bituminous (ASTM, 1977, p. 215, sec 4.2, and p. 217).

[To convert feet and inches to meters, multiply feet by 0.3048 and inches by 0.0254. To convert Btu/lb to kilojoule/kilogram, multiply by 2.326].

Appendix 2. — Average analyses of coal grouped by coal-bearing formations in the Hanna and Carbon Basins

Source of data	Formation or Group	Number of samples (1)	Total footage Ft	Total footage in	Average analyses — as received basis: Percent: Moisture	Ash	Volatile matter	Fixed carbon	Sulfur	Btu/lb	Calorific Value, Btu/lb: Moist, mineral-matter-free basis (2)	Apparent rank of coal (3)
Published analyses	Mesaverdé	1	4	0	14.1	7.8	36.5	41.6	1.1	10,290	11,251	sub A or hvCb
	Medicine Bow	2	10	1	12.8	3.8	33.3	50.2	0.8	11,050	11,534	hvCb
	Ferris	10	93	1	13.0	8.3	34.3	44.3	0.4	9,970	10,956	sub A or hvCb
	Hanna	13	211	4	12.0	6.6	38.1	43.3	0.7	11,946	11,797	hvCb
Union Pacific coal inventory program	Mesaverde	13	70	5	9.45	8.41	35.42	46.72	0.77	11,112	12,237	hvCb
	Medicine Bow	16	93	4	13.09	4.03	35.46	47.42	0.80	10,927	11,446	sub A or hvCb
	Ferris	114	863	1	12.69	7.96	34.39	44.97	0.44	10,331	11,309	sub A or hvCb
	Hanna	87	579	0	12.51	10.67	35.96	40.85	1.33	10,280	11,640	hvCb

Notes:

(1) Published data from USBM (1931, p. 40-45, sample nos. 2623, 2624, 22800, 22972, 93486, 93488, 93541, A14123, A14124); Glass (1975, p. 16-19, sample nos. 74-23 to 74-34, inclusive); Dept. of Interior (1975, p. 38, sample nos. D169597-99, D169607-08). Union Pacific coal inventory program data from company files, Rocky Mountain Energy Company (1977).

(2) Moist, mineral-matter-free Btu/lb calculated from average analyses, as received basis, using Parr formula (ASTM, 1977, p. 216, sec. 8.2).

(3) Sub A — subbituminous A; hvCb — high volatile C bituminous (ASTM, 1977, p. 215, sec. 4.2, and p. 217).

[To convert feet and inches to meters, multiply feet by 0.3048 and inches by 0.0254. To convert Btu/lb to kilojoule/Kilogram, multiply by 2.326].

Appendix 3. — Coal analyses, Halfway Hill quadrangle

Drill hole	Location			Coal bed	Sample interval				Sample width		Analyses - as received basis					
					From		To				Percent					
	Sec.	Twp.	Rge.		Ft	in	Ft	in	Ft	in	Moisture	Ash	Volatile matter	Fixed carbon	Sulfur	Btu/lb
28	27	21N	79W	100	24	1	29	0	4	11	13.15	8.03	33.37	45.45	0.75	10,265
29	27	21N	79W	100	181	6	186	0	4	6	9.05	12.08	34.08	44.79	1.22	10,622
33	23	22N	79W	112A	190	2	195	0	4	10	13.39	7.16	32.97	46.48	0.83	10,561
34	15	21N	79W	112	40	11	47	11	7	0	9.85	8.01	35.14	47.00	1.12	11,072
9	21	21N	79W	JB	35	10	47	8	11	10	9.36	7.79	38.29	44.56	0.66	11,199
9	21	21N	79W	JB	51	2	58	4	7	2	8.53	8.50	38.79	44.27	0.72	11,314
10	21	21N	79W	106	87	0	93	0	6	0	8.74	8.11	39.29	43.86	0.82	11,303
10	21	21N	79W	106	98	0	104	7	6	7	8.71	12.40	37.64	41.25	0.93	10,764
Sample number																
A14124	22	22N	79W	112A	—	—	—	—	4	0	14.1	7.8	36.5	41.6	1.1	10,290

Drill hole data from Rocky Mountain Energy Company (1977).

Published data of sample A14124 from U.S. Bureau of Mines (1931).

[To convert feet and inches to meters, multiply feet by 0.3048 and inches by 0.0254. To convert Btu per pound to kilojoules per kilogram (kJ/kg), multiply by 2.326].

Appendix 4. — Coal Reserve Base Data for Federal coal lands (in short tons) in the Halfway Hill quadrangle, Carbon County, Wyoming.

Strippable coal Reserve Base data for Federal coal lands (in short tons) in the Halfway Hill quadrangle, Carbon County, Wyoming [Development potentials are based on mining ratios (cubic yards of overburden/ton of underlying coal). To convert short tons to metric tons, multiply by 0.9072]

Coal Bed	High Development Potential (0-10 mining ratio)	Moderate Development Potential (10-15 mining ratio)	Low Development Potential (>15 mining ratio)	Total
106	0	0	220,000	220,000
C6	890,000	560,000	170,000	1,620,000
C7	190,000	20,000	10,000	220,000
100-112A	0	20,000	60,000	80,000
JB	80,000	160,000	200,000	440,000
Total	1,160,000	760,000	660,000	2,580,000

Non-strippable coal Reserve Base data for Federal coal lands (in short tons) in the Halfway Hill quadrangle, Carbon County, Wyoming. (To convert short tons to metric tons, multiply by 0.9072)

Coal Bed	High Development Potential (0-1000 ft of overburden)	Moderate Development Potential (1000-2000 ft of overburden)	Low Development Potential (2000-3000 ft of overburden)	Total
106	19,770,000	0	0	19,770,000
C6	7,190,000	3,310,000	0	10,500,000
JB	77,420,000	5,110,000	0	82,530,000
Total	104,380,000	8,420,000	0	112,800,000