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COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE BITTER CREEK NE QUADRANGLE, SWEETWATER COUNTY, WYOMING

[Report includes 27 plates]

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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INTRODUCTION

Purpose

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 Published and unpublished public information available through May, 1978, was used as the data base for this study.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

Location

The Bitter Creek NE quadrangle is located in central Sweetwater County, Wyoming, approximately 31 airline miles (50 km) northeast of the city of Rock Springs, 8 airline miles (12.9 km) east of the town of Point of Rocks and 5 airline miles (8.0 km) north of the town of Bitter Creek, Wyoming. The area is unpopulated.

Accessibility

Interstate Highway 80 crosses east-west through the southern part of the quadrangle. A paved, medium-duty road extends south from Interstate Highway 80 to the town of Bitter Creek south of the quadrangle boundary. An improved light-duty road extends north from Interstate Highway 80 and crosses the western half of the quadrangle with a branch extending east to the Patrick Draw oil and gas field which is located in the southeastern part of the quadrangle. Numerous unimproved dirt roads and trails provide access through the remainder of the quadrangle.

The main east-west line of the Union Pacific railroad passes through the town of Bitter Creek south of the quadrangle boundary. This line provides railway service across southern Wyoming, connecting Ogden, Utah, to the west with Omaha, Nebraska, to the east.

Physiography

The Bitter Creek NE quadrangle lies on the eastern flank of the Rock Springs uplift and on the southwestern edge of the Great Divide Basin. The landscape is characterized by badland topography with moderately steep escarpments and draws in the western third of the quadrangle and gently dipping terrain in the eastern two thirds of the quadrangle. The Continental Divide extends north-south through the western part of the quadrangle and then turns easterly through the southern third of the quadrangle. Altitudes range from approximately 6,720 feet (2,048 m) on Tenmile Draw in the northwestern corner of the quadrangle, to 7,200 feet (2,195 m) along the Continental Divide in the southwestern part of the quadrangle.

Tenmile Draw, flowing southwesterly across the northwestern corner of the quadrangle, and Patrick Draw, in the southeastern part of the quadrangle, drain the quadrangle south and west of the Continental Divide. Both are tributaries of Bitter Creek and the Green River that lie west of the quadrangle boundary. The northeastern quarter of the quadrangle, northeast of the Continental Divide, drains into the Great Divide Basin. All of the streams in the quadrangle are intermittent, flowing mainly in response to snowmelt in the spring.

Climate and Vegetation

The climate of southwestern Wyoming is semiarid and is characterized by low precipitation, rapid evaporation, and large daily temperature changes. Summers are usually dry and mild, and winters are cold. The annual precipitation averages 9 inches (23 cm), with approximately two thirds falling during the spring and early summer months (Wyoming Natural Resources Board, 1966).

The average annual temperature is 42°F (6°C). The temperature during January averages 18°F (-8°C), with temperatures typically ranging from 8°F (-13°C) to 28°F (-2°C). During July temperatures typically range from 54°F (12°C) to 84°F (29°C), with an average of 69°F (21°C) (Wyoming Natural Resources Board, 1966; U.S. Bureau of Land Management, 1978).

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

Principal types of vegetation in the area include sagebrush, saltbush, rabbitbrush, greasewood, and grasses (U.S. Bureau of Land Management, 1977).

Land Status

The Bitter Creek NE quadrangle lies on the eastern edge of the Rock Springs Known Recoverable Coal Resource Area (KRCRA). Only the western edge of the quadrangle, approximately 6 percent of the quadrangle's total area, lies within the KRCRA boundary. However, the entire quadrangle will be covered in this report. The Federal government owns the coal rights for approximately 45 percent of the quadrangle as shown on plate 2. No outstanding Federal coal leases, prospecting permits, or licenses occur within the quadrangle.

GENERAL GEOLOGY

Previous Work

Schultz described the geology and coal resources of the northern part of the Rock Springs coal field in 1909. Hale described the stratigraphy and depositional history of the formations cropping out on the flanks of the Rock Springs uplift in 1950 and 1955. Heppe (1960), Weimer (1960, 1961, and 1965), Lewis (1961), and Weichman (1961), described the stratigraphy and discussed the depositional environment of Upper Cretaceous formations in the Rock Springs area. Lawson and Crowson (1961) described the geology of the Arch Unit and adjacent areas including stratigraphy of the Wasatch and Fort Union Formations on the eastern flank of the Rock Springs uplift. Roehler described the Late Cretaceous-Tertiary unconformity (1961) and Early Tertiary depositional environments (1965) present in the Rock Springs area. Burton (1961) described the Patrick Draw oil and gas field. Bradley mapped and discussed the stratigraphy of the Wasatch and Green River Formations in the Rock Springs uplift in 1961 and 1964. Land mapped the Fox Hills Sandstone and associated formations on the eastern flank of the Rock Springs uplift in 1972 and described their stratigraphy and depositional history. Coal analyses, coal quality and measured sections of coals in the Rocks Springs coal field were described by Glass in 1975 and 1976. Roehler and others described the geology and coal resources of the Rock Springs coal field in 1977. Roehler prepared a geologic map of the geology of the Rock Springs uplift and adjacent areas (1977a), and mapped the geology and coal resources of the Sand Butte Rim NW (1977b) and Black Buttes quadrangles (1977c). Madden mapped the geology and coal resources of the Bitter Creek NW quadrangle in 1977.

Stratigraphy

The Tertiary-age Fort Union Formation (Paleocene) and the main body of the Wasatch Formation (Eocene) crop out in the Bitter Creek NE quadrangle. The Almond Formation, Lewis Shale, Fox Hills Sandstone, and Lance Formation, all Late Cretaceous in age, are present in the subsurface.

The Almond Formation of the Mesaverde Group consists of interbedded shale, siltstone, mudstone and sandstone alternating with coal beds of variable thickness and quality. This sequence is overlain by a predominantly buff-colored to light-gray, thick-bedded to massive fine-grained sandstone (Hale, 1950 and 1955, Lewis, 1961). According to Heppe (1960), the Almond Formation thickens rapidly both to the northwest and to the south along the flanks of the Rock Springs uplift. Thicknesses range from 255 to 350 feet (78 to 107 m) where measured in oil and gas wells drilled in the quadrangle.

The Lewis Shale conformably overlies the Almond Formation and consists of silty shale, thin, very fine grained calcareous sandstone, and a number of thin, widespread bentonite beds (Land, 1972; Roehler, 1977b). It ranges in thickness from 950 to 1,150 feet (290 to 351 m) where measured in oil and gas wells drilled in the quadrangle.

The Fox Hills Sandstone conformably overlies and intertongues with the Lewis Shale. It is composed of very fine to fine-grained cross-bedded sandstone, thin interbedded gray shale and siltstone, and occasional coal (Roehler, 1977b). The formation is approximately 150 to 350 feet (46 to 107 m) thick where measured in oil and gas wells drilled in the quadrangle.

The Lance Formation conformably overlies the Fox Hills Sandstone and consists of partly carbonaceous gray shale and carbonaceous shale with interbedded fine-grained sandstone, siltstone, mudstone, and coal (Roehler, 1977b). This formation ranges from approximately 900 to 1,200 feet (274 to 366 m) thick where measured in oil and gas wells drilled in the quadrangle, thinning to the south.

The Fort Union Formation, unconformably overlying the Lance Formation, crops out in the western half of the quadrangle (Roehler, 1977a) and ranges in thickness from 1,300 to 1,650 feet (396 to 503 m). The formation consists of mudstone, interbedded carbonaceous shale and very fine grained sandstone, carbonaceous claystone, coal, gray shale, and some beds of limy siltstone (Roehler, 1977b).

The main body of the Wasatch Formation crops out in the eastern half of the quadrangle where it conformably overlies the Fort Union Formation (Roehler, 1977a). An unknown thickness of the Wasatch Formation is present in this quadrangle. However, it ranges from 1,280 to 2,150 feet (390 to 655 m) thick where measured in the Sand Butte Rim NW quadrangle to the southwest (Roehler, 1977b). It consists of gray sandstone and siltstone with interbedded gray, green, and red mudstone; gray and brown partly carbonaceous shale; and sparce thin beds of gray limestone (Bradley, 1964; Roehler and others, 1977).

Holocene deposits of alluvium cover Patrick Draw and Tenmile Draw.

Formations of Cretaceous age in the Bitter Creek NE quadrangle indicate the transgressions and regressions of a broad, shallow, north-south-trending seaway that extended across central North America. They accumulated near the western edge of the Cretaceous sea and reflect the location of the shoreline (Weimer, 1960 and 1961).

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

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

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

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

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

The main body of the Wasatch Formation was deposited in an intermontane basin in fluvial and fresh-water swamp environments (Bradley, 1964; Roehler, 1965; Roehler and others, 1977).

Structure

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

The strike of the beds in the quadrangle is generally from northwest to northeast with dips of less than 5° to the northeast, east or southeast. The western half of the quadrangle is characterized by a series of normal faults that are perpendicular to the strike of the beds. Fault traces shown on plate 1 were taken from Burton (1961) and Bradley (1961).

COAL GEOLOGY

In the Bitter Creek NE quadrangle, coal beds of the Lance and Fort Union Formations, along with an occasional Fox Hill Sandstone coal bed, have been encountered in oil and gas wells drilled in the Patrick Draw oil and gas field. A few Fort Union Formation coal beds crop out in the northwestern part of the quadrangle, including the Nuttal bed (Roehler and others, 1977 and Madden, 1977). These coal beds could not be correlated with coal beds mapped in the subsurface because casing in the upper part of the drill holes.

Coal beds in the Almond Formation and the Fox Hills Sandstone were encountered in a few oil and gas wells deep within the subsurface. None of these coal beds exceed Reserve Base thickness (5 feet or 1.5 meters).

Chemical analyses of coal.--No chemical analyses were available for the coal beds in this quadrangle, but representative analyses from the Bitter Creek NE area are shown in table 1. Analyses for coal in the Fox Hills Sandstone are not included in table 1. These coals are found at the transitional contact between the Fox Hills and Lance Formations and are believed to be subbituminous in rank, as are the Almond, Lance, and Fort Union coals (Roehler and others, 1977; Glass, 1976).

In general, chemical analyses indicate that coal beds in the Almond, Lance and Fort Union Formations rank as subbituminous A or B on a moist, mineral-matter-free basis according to ASTM Standard Specification D 388-77 (American Society for Testing and Materials, 1977).

Coal Beds of the Lance Formation

Several coal beds in the lower part of the Lance Formation have been identified in geophysical logs of oil and gas wells. Where applicable, names used in the Black Buttes quadrangle (T. 18 N., R. 101 W.) for the Lance Formation coal beds have been applied in this report. They are, in ascending order, the Hall, Maxwell, Black Butte, Gibralter, and Overland coal beds. The Hall, Maxwell, and Gibralter are the most persistent coal beds cropping out in the quadrangle (Roehler and others, 1977). The Overland and Black Butte coal beds are not mapped in this quadrangle because of their thin and lenticular nature. An unnamed coal bed occurring approximately 325 feet (99 m) above the Lance-Fox Hills contact has been given a bracketed number for identification purposes in this quadrangle only.

Hall Coal Bed

The Hall coal bed, located at the base of the Lance Formation, has been mapped in the northwestern part of the quadrangle (plate 4), where it ranges up to 7 feet (2.1 m) in thickness. In outcrop, the Hall coal bed is 8 feet (2.4 m) thick in sec. 4, T. 18 N., R. 100 W., 6 feet (1.8 m) thick in sec. 22, T. 17 N., R. 101 W., and 9.8 feet (3.0 m) in sec. 29, T. 19 N., R. 100 W. (Roehler and others, 1977).

Maxwell Coal Bed

The Maxwell coal bed is located approximately 60 to 80 feet (18 to 24 m) above the Hall coal bed and has been mapped in the subsurface in the central and northwestern parts of the quadrangle (plate 7). The maximum recorded thickness of the coal bed in this quadrangle is 6 feet (1.8 m). The Maxwell coal bed is 6.5 feet (2.0 m) thick where measured along the crop line in the Bitter Creek NW quadrangle and ranges up to 9.5 feet (2.9 m) thick where mapped in the Black Buttes quadrangle to the southwest.

Gibralter Coal Bed

The Gibralter coal bed is located, stratigraphically, approximately 175 feet (53 m) above the base of the Lance Formation. Two local thickenings of the Gibralter coal bed are shown on plate 10. The coal bed ranges in thickness from 3 to 6 feet (0.9 and 1.8 m) where mapped in this quadrangle and from 4 to 9.7 feet (1.2 to 3.0 m) in the Black Buttes quadrangle.

Lance [1] Coal Bed

The Lance [1] coal bed is, stratigraphically, the uppermost of the isopached coal beds in the Lance Formation. Areas where coal thicknesses exceed Reserve Base are shown on plate 13, where the maximum recorded coal thickness for the Lance [1] coal bed is 7 feet (2.1 m).

Coal Beds of the Fort Union Formation

Several thick Fort Union Formation coal beds have been located in the subsurface using oil and gas well information. The coal beds occupy a stratigraphic interval approximately 1,600 feet (488 m) thick. The thicker coal beds usually occur in the lower part of the formation, although intraformational thickening toward the southeast (down-dip) gradually raises their stratigraphic position in relation to the Fort Union-Lance contact. Coal beds that are not formally named have been given bracketed numbers and letters for identification purposes in this quadrangle.

Fort Union [1] Coal Bed

The Fort Union [1] coal bed, lowest stratigraphically of the Fort Union coal beds, has been mapped in the subsurface in the southeastern corner of the quadrangle (plate 7). Measured thicknesses range from 3 to a maximum of 12 feet (0.9 to 3.7 m) in this quadrangle. It is reported to be 13 feet (4.0 m) thick to the south in the Bitter Creek.

Fort Union [2] Coal Bed

The Fort Union [2] coal bed is located approximately 30 to 50 feet (9 to 15 m) above the Fort Union [1] coal bed. It has been isopached in the eastern half of the quadrangle (plate 10) where it ranges from 3 to 7 feet (0.9 to 2.1 m) in thickness. This coal bed was not encountered in the Bitter Creek quadrangle.

Fort Union [2A] Coal Bed

The Fort Union [2A] coal bed was penetrated by three oil and gas wells in the Bitter Creek quadrangle, approximately 130 feet (40 m) above the Fort Union [1] coal bed. Based on this information, the coal bed has been inferred to exist in the Bitter Creek NE quadrangle at thicknesses of between 8 and 9 feet (2.4 and 2.7 m). The isopach and structure maps are shown on plate 10.

Fort Union [3] Coal Bed

The Fort Union [3] coal bed has been mapped over much of the Bitter Creek NE quadrangle (plate 16). This coal bed lies approximately 110 feet (34 m) below the Lower Deadman coal bed and does not correlate with the Fort Union [3L] or [3U] coal beds mapped in the Bitter Creek quadrangle. Thicknesses for the Fort Union [3] coal bed range from 2 to 8 feet (0.6 to 2.4 m) where encountered in oil and gas wells in the quadrangle.

Lower Deadman Coal Bed

The Lower Deadman, or lower split of the Deadman coal bed (Roehler and others, 1977), has been mapped over most of the quadrangle and ranges from 4 to 17 feet (1.2 to 5.2 m) in thickness. As indicated by the subsurface data, the Lower Deadman coal bed thickens to the northeast and southeast (plate 19). This coal bed has been tentatively correlated with the Fort Union [3L] coal bed mapped in the Bitter Creek quadrangle where it ranges up to 10 feet (3.0 m) in thickness. In the adjacent Bitter Creek NW quadrangle to the west, thicknesses of 12.5 and 14 feet (3.8 and 4.3 m) have been recorded along the outcrop (Madden, 1977). The Lower Deadman coal bed is commonly split. However, only the thicker, more persistant beds have been included as isopachable coal.

(Local) Deadman Coal Bed

The (local) Deadman coal bed, mapped in the west-central part of the quadrangle (plate 4), is a relatively thin intervening coal bed between the thick Upper and Lower Deadman coal beds. It has been mapped separately, however, because of the thickness of rock separating it from the other Deadman coal beds. This coal bed attains a maximum measured thickness of 6 feet (1.8 m) in sec. 28, T. 20 N., R. 99 W.

Upper Deadman Coal Bed

The Upper Deadman coal bed is located approximately 30 to 110 feet (9 to 34 m) above the Lower Deadman coal bed in this quadrangle. The coal bed has been isopached on plate 23, where thicknesses measured in oil and gas wells range from 3 to 13 feet (0.9 to 4.0 m). In the Bitter Creek NW quadrangle, the Upper Deadman coal bed is commonly 14 feet (4.3 m) or more thick, but contains up to 19 feet (5.8 m) of rock in a single parting. This split characteristic is not prevalent in the Bitter Creek NE quadrangle, but does occur in a few drill holes along its western edge where rock intervals of 5 and 13 feet (1.5 and 4.0 m) split the Upper Deadman coal bed.

The Upper Deadman coal bed has been tentatively correlated with the Fort Union [3U] coal bed mapped in the Bitter Creek quadrangle to the south. The Fort Union [3U] coal bed thickens to 8 feet (2.4 m) in the northern part of the Bitter Creek quadrangle, but is more commonly 5 to 6 feet (1.5 to 1.8 m) thick.

The Deadman coal bed (and associated splits) is the thickest and most widely distributed Fort Union Formation coal bed cropping out on the flanks of the Rock Springs uplift. Along the eastern flank, the Deadman coal bed crops out for approximately 60 miles (97 km) or more. Oil and gas well information in the Bitter Creek and Bitter Creek NE quadrangles has revealed thick coal beds at depth that correlate well with existing data for the Deadman coal bed in general. However, intraformational thickening down-dip and gaps in the subsurface data, especially in the southeastern corner of the Bitter Creek NW quadrangle, prevent absolute correlations between outcrop and oil and gas well data.

COAL RESOURCES

Information from representative oil and gas wells in the Patrick Draw oil and gas field was used to construct isopach and structure contour maps of the coal beds in this quadrangle. The source of each indexed data point shown on plate 1 is listed in table 3.

Coal resources were calculated using data obtained from the coal isopach maps (plates 4, 7, 10, 13, 16, 19 and 23). The coal bed acreage (measured by planimeter) multiplied by the average isopached thickness of the coal bed, and by a conversion factor of 1,770 short tons of coal per acre-foot (13,018 metric tons per hectare-meter) for subbituminous coal, yields the coal resources in short tons for each isopached coal bed. Coal beds of Reserve Base thickness (5 feet or 1.5 meters) or greater that lie less than 3,000 feet (914 m) below the ground surface are included. These criteria differ somewhat from that used in calculating Reserve Base and Reserve tonnages as stated in U.S. Geological Survey Bulletin 1450-B which calls for a maximum depth of 1,000 feet (305 m) for subbituminous coal.

Reserve Base and Reserve tonnages are shown on plates 6, 9, 12, 15, 18, 22, and 26, and are rounded to the nearest 10,000 short tons (9,072 metric tons). Coal Reserve Base tonnages per Federal section are shown on plate 2 and total approximately 353.66 million short tons (320.84 million metric tons) for the entire quadrangle. Reserve Base tonnages in the various development potential categories for subsurface mining methods are shown in table 2.

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

COAL DEVELOPMENT POTENTIAL

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

Development Potential for Surface Mining Methods

Areas where the coal beds of Reserve Base thickness are overlain by 200 feet (61 m) or less of overburden are considered to have potential for surface mining. In this quadrangle, lack of data in the upper parts of the oil and gas wells prevents surface and near-surface evaluation. Therefore, all Federal lands within the quadrangle have been rated as having unknown development potential for surface mining methods.

Development Potential for Subsurface and In-Situ Mining Methods

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

Areas of high, moderate, and low development potential for conventional subsurface mining 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), below the ground surface, respectively.

Areas where the coal data is absent or extremely limited between 200 and 3,000 feet (61 and 914 m) below the ground surface are assigned unknown development potentials. This applies to areas where coal beds of Reserve Base thickness are not known, but may occur.

The coal development potential for conventional subsurface mining methods is shown on plate 27. Of the Federal land areas classified as having known development potential for conventional subsurface mining methods, 43 percent are rated high, 53 percent are rated moderate, and 4 percent are rated low. The remaining Federal land in the quadrangle is classified as having an unknown development potential for conventional subsurface mining methods.

Because the coal beds in this quadrangle have dips less than 15°, all Federal land areas have been rated as having an unknown development potential for in-situ mining methods.

Table 1. -- Chemical analyses of coals in the Bitter Creek NE quadrangle, Sweetwater County, Wyoming.

Location	COAL BED NAME	Form of Analysis	Proximate				Ultimate						Heating Value	
			Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen		Calories	Btu/Lb
Representative analysis from Bridger Coal Company, Jim Bridger Mine (Glass, 1975)	Deadman (upper and lower benches combined)	A	20.52	29.09	40.71	9.68	0.47	-	-	-	-		-	9,350
		C	0.0	36.60	51.22	12.18	0.59	-	-	-	-		-	11,759
Average analysis from Black Buttes area (Glass, 1975)	Fort Union Formation, undifferentiated	A	17.7	30.9	43.9	8.4	0.4	-	-	-	-		-	9,730
Typical analysis from Black Buttes area (Glass, 1975)	Gibralter	A	20.6	-	-	4.7	0.5	-	-	-	-		-	9,900
Typical analysis from Black Buttes area (Glass, 1975)	Black Butte	A	20.7	-	-	5.0	0.6	-	-	-	-		-	9,650
Typical analysis from Black Buttes area (Glass, 1975)	Maxwell	A	21.0	-	-	6.0	0.8	-	-	-	-		-	9,670
Typical analysis from Black Buttes area (Glass, 1975)	Hall	A	20.8	-	-	4.6	1.1	-	-	-	-		-	9,900
SW¼, sec. 16, T. 18 N., R. 100 W., Rock Springs-Gibralter Mine (Yourston, 1955)	Lance Formation, undifferentiated	A	20.8	28.4	47.1	3.7	0.4	-	-	-	-		-	9,910
		C	0.0	35.8	59.5	4.7	0.5	-	-	-	-		-	12,510
SW¼, sec. 26, T. 20 N., R. 101 W., Point of Rock Mine (Dobbin, 1944)	Almond Formation, undifferentiated	A	17.9	29.5	49.3	3.3	0.5	-	-	-	-		-	10,220
		C	0.0	36.0	60.0	4.0	0.6	-	-	-	-		-	12,450

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

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

Table 2. -- Coal Reserve Base data for subsurface mining methods for Federal coal lands (in short tons) in the Bitter Creek NE quadrangle, Sweetwater County, Wyoming.

Coal Bed or Zone	High Development Potential	Moderate Development Potential	Low Development Potential	Unknown Development Potential	Total
Upper Deadman	49,290,000	87,950,000	-	-	137,240,000
Lower Deadman	20,990,000	102,470,000	-	-	123,460,000
(Local) Deadman	-	980,000	-	-	980,000
Fort Union {9}	7,500,000	-	-	-	7,500,000
Fort Union {3}	-	23,000,000	-	-	23,000,000
Fort Union {2}	-	17,040,000	17,040,000	-	17,040,000
Fort Union {2A}	1,770,000	-	-	-	1,770,000
Fort Union {1}	-	21,700,000	250,000	-	21,950,000
Lance {1}	-	-	11,190,000	-	11,190,000
Gibralter	-	-	460,000	-	460,000
Maxwell	-	50,000	2,620,000	-	2,670,000
Hall	-	-	6,400,000	-	6,400,000
Totals	79,550,000	253,190,000	20,920,000	-	353,660,000

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

Table 3. -- Sources of data used on plate 1

Plate 1 Index Number	Source	Data Base
1	Forest Exploration Corp.	Oil/gas well No. 17-7-2 Arch Unit
2	Forest Oil Corp.	Oil/gas well No. 102-7-10 Arch Unit
3	↓	Oil/gas well No. 90-18-7 Arch Unit
4	Kenneth D. Luff, Inc.	Oil/gas well No. 8-31 Champlin NPD
5	Forest Oil Corp.	Oil/gas well No. 49-1-3 Arch Unit
6	↓	Oil/gas well No. 53-1-4 Arch Unit
7	↓	Oil/gas well No. 65-1-7 Arch Unit
8	Forest Exploration Corp.	Oil/gas well No. 27-1-2 Arch Unit
9	Forest Exploration Corp. and Union Pacific Railroad	Oil/gas well No. 25-1-1 Arch Unit
10	Humble Oil & Refining Co. and Mohawk Petroleum Corp.	Oil/gas well No. 1 Chorney-Gov't
11	Forest Oil Corp.	Oil/gas well No. 109-2-6 Arch Unit
12	↓	Oil/gas well No. 69-2-4 Arch Unit
13	↓	Oil/gas well No. 81-3-1 Arch Unit
14	Texas National Petroleum Co.	Oil/gas well No. 3 Gov't-Chapin

Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
15	Texas National Petroleum Co.	Oil/gas well No. 2 Gov't-Chapin
16	↓	Oil/gas well No. 1 Gov't-Chapin
17	Union Pacific Railroad Co.	Oil/gas well No. 41-5 U.P.
18	Texas National Petroleum Co.	Oil/gas well No. 1-6 Gov't-Chapin
19	↓	Oil/gas well No. 1-8 Gov't-Chapin
20	Forest Oil Corp.	Oil/gas well No. 72-10-1 Arch Unit
21	↓	Oil/gas well No. 107-11-8 Arch Unit
22	↓	Oil/gas well No. 71-11-6 Arch Unit
23	↓	Oil/gas well No. 67-11-5 Arch Unit
24	↓	Oil/gas well No. 100-11-7 Arch Unit
25	↓	Oil/gas well No. 55-11-3 Arch Unit
26	↓	Oil/gas well No. 105-12-14 Arch Unit
27	↓	Oil/gas well No. 103-12-12 Arch Unit
28	↓	Oil/gas well No. W-12-1 Arch Unit

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
29	Forest Oil Corp.	Oil/gas well No. W-13-1 Arch Unit
30	↓	Oil/gas well No. 99-14-7 Arch Unit
31	↓	Oil/gas well No. 78-14-6 Arch Unit
32	Union Pacific Railroad Co.	Oil/gas well No. 22-7 U.P.R.R.
33	Union Oil of California	Oil/gas well No. 1-8 Gov't-Damuth
34	Kenneth D. Luff, Inc.	Oil/gas well No. 1-8 Federal-Bitter Creek
35	Pubco Petroleum Corp. and Union Pacific Railroad Co.	Oil/gas well No. 11-9-M Playa Unit
36	Prenalta Corp.	Oil/gas well No. 34-10-20-99 Prenalta-Gov't
37	Pubco Petroleum Corp.	Oil/gas well No. 10-11-D Playa Unit
38	Kenneth D. Luff, Inc.	Oil/gas well No. 1-11 Amoco-Champlin
39	Prenalta Corp.	Oil/gas well No. 22-12-20-99-Gov't
40	↓	Oil/gas well No. 13-14-20-99-Gov't
41	Kenneth D. Luff, Inc.	Oil/gas well No. 1-15 Champlin-U.P.R.R.
42	True Oil Co.	Oil/gas well No. 23-16 Wyco-State

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
43	Texas National Petroleum Co.	Oil/gas well No. 1-U.P.R.R.-Rock Springs Grazing Association
44	Texas National Producing Co.	Oil/gas well No. 1 Gov't-Damuth
45	Reserve Oil, Inc.	Oil/gas well No. 1-19 Amoco-Champlin
46	Texas National Petroleum Co.	Oil/gas well No. 1-20-Gov't
47	Kenneth D. Luff, Inc.	Oil/gas well No. 1-21 Champlin
48	Prenalta Corp.	Oil/gas well No. 11-21-20-99 Prenalta-U.S. Gold
49	Kenneth D. Luff, Inc.	Oil/gas well No. 2-21 WDS-Champlin
50	Pubco Petroleum Corp. and Union Pacific Railroad Co.	Oil/gas well No. 15-22-B Playa Unit
51	Mesa Petroleum Co.	Oil/gas well No. 1-22 Playa-Federal
52	Kenneth D. Luff, Inc.	Oil/gas well No. 2-23 Champlin
53	Pubco Petroleum Corp. and Union Pacific Railroad Co.	Oil/gas well No. 5-24-G Playa Unit
54	Mesa Petroleum Co.	Oil/gas well No. 1-25 Playa-U.P.R.R.
55	Pubco Petroleum Corp.	Oil/gas well No. 9-25-J Playa Unit
56	Pubco Petroleum Corp. and Union Pacific Railroad Co.	Oil/gas well No. 12-26-M Playa Unit

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Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
57	Kenneth D. Luff, Inc.	Oil/gas well No. 4-27 Champlin-P.T.
58	↓	Oil/gas well No. 5-27 Champlin
59	Mesa Petroleum Co.	Oil/gas well No. 28-A-U.P.R.R.
60		Oil/gas well No. 28-E-U.P.R.R.
61	↓	Oil/gas well No. 28-K-U.P.R.R.
62	Kenneth D. Luff, Inc.	Oil/gas well No. 6-29 Champlin (WDS)
63	↓	Oil/gas well No. 5-29 Champlin (WDS)
64	Union Oil of California	Oil/gas well No. 1-30 Gov't-Damuth
65	Union Pacific Railroad Co.	Oil/gas well No. 11-31-A Red Hill-U.P.R.R.
66	Texas National Petroleum Co.	Oil/gas well No. 1 Federal-Withers
67	Union Oil of California	Oil/gas well No. 6-32-Gov't-Withers
68		Oil/gas well No. 2-A-32 Gov't-Withers
69	↓	Oil/gas well No. 5-32 Gov't-Withers
70	Texas National Petroleum Co.	Oil/gas well No. 3 Gov't-Withers

Table 3. -- Continued

Plate 1 Index Number	Source	Data Base
71	Union Pacific Railroad Co.	Oil/gas well No. 21-33 U.P.R.R
72	↓	Oil/gas well No. 23-33 U.P.R.R.
73	Texas National Petroleum Co.	Oil/gas well No. 3-34 Withers
74	↓	Oil/gas well No. 1-34 Gov't
75	↓	Oil/gas well No. 2-34 Gov't
76	Kennth D. Luff, Inc.	Oil/gas well No. 2-35 Champlin
77	Union Pacific Railroad Co.	Oil/gas well No. 42-35 U.P.R.R.
78	Colorado Oil & Gas Corp.	Oil/gas well No. 2-36 State Lease
79	↓	Oil/gas well No. 5-36 State
80	Lion Oil (Monsanto) Co.	Oil/gas well No. 1 Winegardner
81	Graham-Michaelis Drilling Co.	Oil/gas well No. 21-98 U.P.R.R.
82	John L. Kemmerer, Jr.	Oil/gas well No. 4 Ten Mile Draw Unit
83	↓	Oil/gas well No. 2 Ten Mile Draw Unit
84	Chandler & Simpson, Inc.	Oil/gas well No. 3 State-C
85	↓	Oil/gas well No. 4 State-C

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