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COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAPS OF THE HUGH LAKE QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

[Report includes 12 plates]

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HUGH LAKE 7 1/2-MINUTE QUADRANGLE

INTRODUCTION

Purpose

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps and Coal Development Potential (CDP) Maps of the Hugh Lake quadrangle, San Juan County, New Mexico. These maps were compiled to provide a systematic coal resource inventory of Federal coal lands in Known Recoverable Coal Resource Areas (KRCRA's) of the western United States. The work has been performed under contract with the Conservation Division of the U.S. Geological Survey (Contract No. 14-08-0001-17172).

The resource information gathered in this program is in response to the Federal Coal Leasing Amendments Act of 1976 and is a part of the U.S. Geological Survey's coal program. The information provides basic data on coal resources for land-use planning purposes by the Bureau of Land Management, state and local governments, and the public.

Location

The Hugh Lake 7 1/2-minute quadrangle is located in central San Juan County, New Mexico. The area is approximately 7 miles (11 km) south of Farmington and 75 miles (121 km) northeast of Gallup, New Mexico.

Accessibility

The area is accessible from the north by State Route 371 which extends across the quadrangle from north to southeast. State Route 371 connects with U.S. Highway 550 at Farmington, 10 miles (16 km) to the north. A light-duty road from the east-central border connects with State Route 44, 8 miles (13 km) northeast of the area. Numerous light-duty and unimproved dirt roads provide access to the remainder of the quadrangle. The Atchison, Topeka and Santa Fe Railway operates a route 75 miles (121 km) to the southwest at Gallup, New Mexico, which connects Gallup with Grants and Albuquerque to the east.

Physiography

The Hugh Lake quadrangle is in the Central Basin area (Kelley, 1950) of the San Juan Basin, a structural depression in the Colorado Plateau physiographic province. Total relief in the quadrangle is 770 ft (235 m) with elevations which range from 5,550 ft (1,692 m) in the northernmost extent of Gallegos Canyon to 6,320 ft (1,926 m) in the southwestern corner of the area. The topography is characterized by a gently-sloping, dissected plain which dips to the east. A cuesta escarpment is exposed in the north-central part of the area. The entire eastern half of the quadrangle is highly dissected by intermittent tributary streams which drain into the west fork of Gallegos Canyon. Fields of stabilized sand dunes occur locally on the less-dissected western plain. With few exceptions, most drainage in the area is into the intermittent stream of the West Fork of Gallegos Canyon which flows into the San Juan River to the north.

Climate

The climate of the San Juan Basin is arid to semi-arid. Annual precipitation is usually less than 10 inches (25 cm), with slight variations across the basin due to elevational differences. Rainfall is rare in the early summer and winter; most precipitation is received in July and August as intense afternoon thundershowers. Annual temperatures in the basin range from below 0°F (-18°C) to above 100°F (38°C). Snowfall may occur from November to April.

Land Status

The quadrangle is in the western boundary of the San Juan Basin Known Recoverable Coal Resource Area, and the Federal Government owns the coal rights for approximately 98 percent of the KRCRA land within the quadrangle as shown on Plate 2 of the Coal Resource Occurrence Maps. No Federal coal leases occur within the quadrangle.

GENERAL GEOLOGY

Previous Work

Reeside (1924) mapped the surficial geology of the area as part of a study of the Upper Cretaceous and Tertiary Formations of the San Juan Basin. More recently, Fassett and Hinds (1971) made subsurface interpretations of the Fruitland Formation coals in this area as part of a larger San Juan Basin coal study.

Geologic History

The San Juan Basin, an area of classic transgressive and regressive sedimentation, provided the ideal environment for formation of coals during Late Cretaceous time. At that time a shallow epeiric sea, which trended northwest-southeast, was northeast of the basin. The sea transgressed southwesterly into the basin area and regressed northeasterly numerous times; consequently, sediments from varying environments were deposited across the basin. Noncarbonaceous terrestrial deposition predominated during Paleocene and Eocene time.

After its first basin-wide retreat, the Late Cretaceous sea reversed the direction of movement. As a result, the transgressive sequence of paludal Menefee Formation, nearshore Cliff House Sandstone, and marine Lewis Shale was deposited in the quadrangle. Swamps (Menefee) formed southwest (shoreward) of the transgressing beaches (Cliff House). Organic matter deposited in these swamps ultimately formed coal in the Menefee Formation. A thin, basal sand was deposited over the Menefee in the eastern half of the quadrangle as the La Ventana sandstone was deposited in the west. Subsequently, several hundred feet of beach sands of the La Ventana Tongue (Cliff House Sandstone) were deposited over the basal sand and the older La Ventana deposits throughout the quadrangle. The marine facies which developed northeast of the strandline as it moved to the southwest is the Lewis Shale. This thick sequence, which thins to the southwest, overlies the Cliff House Sandstone and marks the last advance of the Late Cretaceous sea.

The first depositional evidence of the final retreat of the Late Cretaceous sea is the nearshore regressive Pictured Cliffs Sandstone.

Southwest (shoreward) of the beach deposits, swamps, which were dissected by streams, accumulated organic matter which later became coals of the Fruitland Formation. Deposition of organic material was influenced by the strandline as shown by both the continuity of the coal beds parallel to the northwest-southeast strandline and their discontinuity perpendicular to it to the northeast. The less continuous Fruitland coals appear to be noncorrelative, but are lithostratigraphically equivalent in terms of their relative position within the Fruitland Formation.

The brackish-water swamp environment of the Fruitland moved farther to the northeast as the regression continued in that direction. Terrestrial freshwater sediments then covered the quadrangle as indicated by the lacustrine, channel, and floodplain deposits of the Kirtland Shale. This sequence of events is evidenced by both an upward decrease in occurrence and thickness of Fruitland coals and a gradational change to noncarbonaceous deposits of the Kirtland. Continuous deposition during Late Cretaceous time ended with the Kirtland. The sea then retreated to the northeast beyond the limits of the quadrangle area, and modern basin structure began to develop. An erosional unconformity developed in a relatively short time as part of the Cretaceous Kirtland Shale was removed.

Terrestrial deposition resumed in the Paleocene as represented by the Ojo Alamo Sandstone and the overlying Nacimiento Formation. Alluvial plain and floodplain deposits of the Ojo Alamo were followed by the thick, lithologically varied floodplain deposits of the Nacimiento during continuous nonmarine deposition (Powell, 1973). The Nacimiento was later exposed to erosion.

The Eocene San Jose Formation was subsequently deposited over the Nacimiento erosional surface, reflecting various nonmarine environments which developed across the basin. Deposition and structural deformation of the basin then ceased, and the warped strata of the San Juan Basin have been exposed to erosional processes to the present time. A significant amount of erosion has occurred as indicated by the removal of the San Jose Formation and some of the Nacimiento Formation from the area.

Stratigraphy

The formations studied in this quadrangle range from Late Cretaceous to Paleocene in age. They are, in order from oldest to youngest: the Menefee Formation and the Cliff House Sandstone (two of the three formations of the Mesaverde Group); Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Shale, Ojo Alamo Sandstone, and Nacimiento Formation. A composite columnar section on CRO Plate 3 illustrates the stratigraphic relationships of the formations and is accompanied by lithologic descriptions of the individual formations.

The oldest coal-bearing formation in the quadrangle is the Menefee Formation of the Mesaverde Group. In previous studies the Menefee has been divided into the Cleary Coal Member, the barren Allison Member, and the unnamed upper coal-bearing member (Beaumont and others, 1956). These three members were grouped together as undifferentiated Menefee Formation for the purposes of this report only. The Menefee deposits consist primarily of gray, carbona ceous to noncarbonaceous shale with local plant fossils and sandy stringers, interbedded white to light gray, slightly calcareous, clayey sandstone, and lenticular coal beds. The formation has a total thickness of approximately 900 to 1,000 ft (274-305 m) in this area, and it is "nearly horizontal" (Reeside, 1924) in this part of the basin. Consequently, the depth of the formation is a result of the topographic influence. The lower 600 to 850 ft (183-259 m) of undifferentiated Menefee are more than 3,000 ft (914 m) (the overburden study limit) deep throughout the quadrangle area.

The Cliff House Sandstone sequence conformably overlies the Menefee Formation in the eastern part of the area. A thin, basal sand member, referred to as "the Cliff House Sandstone" by Fassett (1977), correlates with the thin, undifferentiated Cliff House Sandstone to the northeast. It is about 45 ft (14 m) thick and consists of light gray, slightly calcareous, argillaceous sandstone.

Conformably overlying the Menefee Formation in the western part of the area is another member of the Cliff House Sandstone, the La Ventana Tongue. It is composed of about 600 ft (207 m) of light gray, slightly dolomitic, glauconitic, kaolinitic sandstone, interbedded thin, gray shale with sandy stringers and plant fossils, interbedded thin, gray siltstone, and local thin coal beds.

The marine Lewis Shale conformably overlies the Mesaverde Group. In contrast to the underlying Cliff House Sandstone, it is comprised of gray, dolomitic to calcareous, micaceous siltstone, and interbedded gray shale with sandy stringers and plant fossils. The Lewis Shale averages 630 ft (192 m) thick throughout the quadrangle. The upper contact is gradational with the overlying Pictured Cliffs Sandstone and, therefore, a distinct contact is difficult to establish.

The Pictured Cliffs Sandstone consists of about 220 ft (67 m) of light gray to mottled gray, poorly cemented, kaolinitic sandstone with a trace of glauconite and feldspar, commonly interbedded with shale near the base of the formation where it grades into the Lewis. The upper contact is more sharply defined than the basal contact. Intertonguing with the overlying Fruitland Formation results in minor variations in the formation top and the occurrence of local Fruitland coal beds in the Pictured Cliffs Sandstone. Nevertheless, the Pictured Cliffs Sandstone is a fairly consistent formation throughout the basin. The authors have used the consistency and distinctive character of the formation on geophysical logs to designate the top of the Pictured Cliffs as a lithologic datum for correlation of overlying Fruitland Formation coals.

Conformably overlying the Pictured Cliffs Sandstone is the Fruitland Formation, the major coal-bearing unit in the quadrangle. It has an average thickness of 285 ft (87 m) in this area and is composed of gray to brown, carbonaceous shale with plant fossils, sandy, calcareous stringers and siderite nodules, interbedded light gray, calcareous, thin sandstone, and coal beds of varying thicknesses. The thickest and most continuous coal beds occur near the base of the formation, while discontinuous and lenticular coal beds are characteristic of the upper portion. The upper contact is gradational from nonmarine lower coastal plain deposits of the Fruitland to upper coastal or alluvial plain deposits of the Kirtland Shale (Molenaar, 1977). Many authors have utilized various criteria in establishing the upper contact, but, in general, for the purposes of this report the uppermost coal in the Fruitland Formation was used (after Fassett and Hinds, 1971).

The freshwater deposits of the Kirtland Shale are the youngest Cretaceous strata in the San Juan Basin. They average 620 ft (189 m) in thickness and are composed of gray-green, slightly micaceous siltstone and interbedded buff, slightly dolomitic sandstone. The Kirtland Shale has previously been divided into several members by various authors; however, for the purposes of this report the individual members were not differentiated.

Unconformably overlying the Upper Cretaceous strata is the Paleocene Ojo Alamo Sandstone which is composed primarily of about 68 ft (21 m) of buff to brown, medium- to coarse-grained, locally conglomeratic sandstone.

The Nacimiento Formation gradationally overlies the Ojo Alamo. The basal few hundred feet of the Nacimiento are present in the area; they consist predominantly of gray to black shale with plant fossils and interbedded thin sandstone and siltstone.

A total of three formations crop out within the quadrangle area. The outcrop pattern trends in a north-south direction, with the formations becoming successively younger to the northeast. The oldest formation exposed is the upper portion of the Kirtland Shale, present in the northwestern part of the quadrangle. The Ojo Alamo Sandstone crops out in a thin belt across the western and eastern parts of the quadrangle. The lowermost beds of the Nacimiento Formation, the youngest formation in the area, are exposed in the central part of the quadrangle.

Structure

The Hugh Lake quadrangle is located in the Central Basin area (Kelley, 1950) of the major structural depression known as the San Juan

Basin. The axis of the basin is about 15 miles (24 km) north of the quadrangle area near Farmington, New Mexico, and trends in an arcuate pattern across the northern portion of the Central Basin area (Baltz, 1967). Reeside (1924) stated that the strata in the area are "nearly horizontal".

COAL GEOLOGY

Two coal zones (Menefee, Fruitland) and two coal beds (Fruitland 1, Fruitland 2) were identified in the subsurface of this quadrangle (CRO Plate 1). The Menefee Formation coal beds are grouped together into the Menefee coal zone (Me zone). These coal beds are generally noncorrelative, discontinuous, and less than reserve base thickness (5 ft [1.5 m]); exceptions are a 5-ft (1.5-m) coal bed in drill holes 22 and 37 (CRO Plate 3). Therefore, derivative maps were not constructed.

Menefee Formation coals in the western portion of the San Juan Basin are considered subbituminous A to subbituminous B in rank. The rank of the coal has been determined on a moist, mineral-matter-free basis with calorific values averaging 10,837 Btu's per pound (25,207 kj/kg) (Amer. Soc. for Testing and Materials, 1977). The coal is hard, brittle, and black with a bright luster. The coal readily slakes with exposure to weather; however, it stocks fairly well when protected (Bauer and Reeside, 1921; Dane, 1936). The "as-received" analyses indicate moisture content varying from 15.3 to 19.1 percent, ash content ranging from 6.6 to 22.7 percent, sulfur content less than 1.5 percent, and heating values averaging 9,515 Btu's per pound (22,132 kj/kg). Analyses of several Menefee coals are given in Table 1 (Shomaker, 1971).

TABLE 1

Analyses of coal samples from the Menefee Formation

(Form of analysis: A, as received; B, moisture free; C, moisture and ash free)

U.S. Bureau Mines Lab No.	Well or Other Source	Location			Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent					Heating Value (Btu)	Remarks
		Section	T.N.	R.W.			Mois-ture	Volatile matter	Fixed Carbon	Ash	Sulfur		
J-52142	Channel, Open Pit	SW¼ 27	25	17	-------------	A	17.4	35.5	40.5	6.6	0.6	10,410	Coal may be
						B	----	43.0	49.1	7.9	0.7	12,600	slightly
						C	----	46.7	53.3	----	0.8	13,680	weathered.
J-51245	Channel, Open Pit	NW¼ 9	22	14	-------------	A	19.1	33.4	40.7	6.8	0.9	9,280	Coal probably
						B	----	41.3	50.3	8.4	1.2	11,470	weathered
						C	----	45.1	54.9	---	1.3	12,520	
J-51246	Channel, Open Pit	NE¼ 2	22	16	-------------	A	15.3	33.9	42.7	8.1	1.0	10,310	
						B	----	40.1	50.3	9.6	1.1	12,180	
						C	----	44.3	55.7	---	1.3	13,470	
J-61758	Core Sample	SW¼ 36	25	17	-------------	A	15.8	31.6	39.6	13.0	1.2	9,700	
						B	----	37.5	47.1	15.4	1.4	11,510	
						C	----	44.3	55.7	----	1.6	13,610	
J-61759	Core Sample	SW¼ 36	25	17	-------------	A	17.4	31.5	40.4	10.7	1.4	9,730	
						B	----	38.1	48.9	13.0	1.7	11,780	
						C	----	43.8	56.2	----	2.0	13,540	
J-61757	Core Sample	SW¼ 2	23	17	-------------	A	18.5	27.7	31.1	22.7	0.5	7,660	
						B	----	34.0	38.2	27.8	0.7	9,410	
						C	----	47.2	52.8	----	0.9	13,030	

To convert Btu's/lb to kj/kg, multiply Btu's/lb by 2.326.
To convert feet to meters, multiply feet by 0.3048.

The Fruitland 1 (Fr 1) coal bed is defined as the lowermost coal of the Fruitland Formation; it is generally directly above the Pictured Cliffs Sandstone. The Fruitland 2 (Fr 2) coal bed overlies the Fruitland 1 (when present); they are separated by a rock interval varying from 18 to 46 ft (5.5-14.0 m). Although these coal beds have been correlated and mapped as consistent horizons, they may each be several different coal beds that are lithostratigraphically equivalent but not laterally continuous.

The remaining coals of the Fruitland Formation are grouped together as the Fruitland coal zone (Fr zone). These coals are usually discontinuous, noncorrelative, and less than reserve base thickness (5 ft [1.5 m]); exceptions are a 5-ft (1.5-m) coal bed in drill holes 53 and 54 (CRO Plate 3).

Fruitland Formation coals in the western part of the San Juan Basin are considered high volatile A to high volatile C bituminous in rank. The rank of the coal has been determined on a moist, mineral-matter-free basis with calorific values averaging 13,666 Btu's per pound (31,787 kj/kg) (Amer. Soc. for Testing and Materials, 1977). The coal is hard, brittle, and black with a bright luster. The coal readily slakes with exposure to weather; however, it stocks fairly well when protected (Bauer and Reeside, 1921; Dane, 1936). The "as-received" analyses indicate moisture content ranging from 2.6 to 9.5 percent, ash content averaging 14.2 percent, sulfur content varying from 0.6 to 1.8 percent, and heating values on the order of 11,560 Btu's per pound (26,889 kj/kg). Analyses of several Fruitland Formation coals are given in Table 2 (Fassett and Hinds, 1971).

TABLE 2

Analyses of coal samples from the Fruitland Formation

(Form of analysis: A, as received; B, moisture free; C, moisture and ash free)

U.S. Bureau Mines Lab No.	Well or Other Source	Location			Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent					Heating Value (Btu)	Remarks
		Section	T.N.	R.W.			Mois-ture	Volatile matter	Fixed Carbon	Ash	Sulfur		
H-40806	Standard of Texas State No. 1	SW¼ 16	25	13	1,156-1,208	A	9.5	30.9	43.3	16.3	1.8	10,270	Abnormal moisture content may be due to inadequate drying of sample during preparation process.
						B	---	34.1	47.9	18.0	2.0	11,340	
						C	---	41.6	58.4	----	2.5	13,820	
H-3031	Southwest Production Cambell No. 2	NE¼ 26	27	12	1,900-1,910	A	2.6	41.2	40.5	15.7	0.6	11,810	
						B	---	42.3	41.6	16.1	0.6	12,120	
						C	---	50.4	49.6	----	0.7	14,440	
H-36175	Royal Development Ojo Amarillo No. 2	SW¼ 6	27	13	1,214-1,245	A	4.3	39.7	44.6	11.4	0.7	11,970	
						B	---	41.4	46.7	11.9	0.7	12,500	
						C	---	47.0	53.0	----	0.8	14,190	
H-24567	Sunray Mid-Continent Gallegos No. 122	NW¼ 18	28	12	1,305-1,315	A	3.0	38.9	44.4	13.7	0.6	12,010	
						B	---	40.1	45.8	14.1	0.6	12,390	
						C	---	46.8	53.2	----	0.7	14,430	
H-7225	Pan American Holder No. 7	NW¼ 16	28	13	1,705-1,715	A	4.1	39.4	42.8	13.7	0.6	11,740	
						B	---	41.1	44.6	14.3	0.6	12,240	
						C	---	47.9	52.1	----	0.7	14,290	

To convert Btu's/lb to kj/kg, multiply But's/lb by 2.326.
To convert feet to meters, multiply feet by 0.3048.

Fruitland 1 Coal Bed

As illustrated by the structure contour map (CRO Plate 5), the coal bed dips less than 1° to the northeast. As a result of topography, overburden (CRO Plate 6) varies from less than 1,100 ft (335 m) at the West Fork of Gallegos Canyon in the southeast to greater than 1,600 ft (488 m) in the extreme north-central portion of the quadrangle. The isopach map (CRO Plate 4) indicates that the coal bed is greater than 15 ft (4.6 m) thick in the southeast. The thickness decreases in all directions, and the coal is absent in the central and parts of the northwestern and eastern portions of the quadrangle.

Chemical Analyses of the Fruitland 1 Coal Bed - Analyses of several coals from the area surrounding this quadrangle are given in Table 2 (Fassett and Hinds, 1971). These coals are assumed to be similar in quality to those found in this quadrangle.

Fruitland 2 Coal Bed

As illustrated by the structure contour map (CRO Plate 9), the coal bed dips less than 1° to the northeast. Overburden in the area of Fruitland 2 coal (CRO Plate 10) varies from less than 1,100 ft (335 m) at the West Fork of Gallegos Canyon in the southeast to greater than 1,400 ft (427 m) in the northwest. The isopach map (CRO Plate 8) indicates that the coal bed occurs in the southern and east-central parts of the quadrangle. The coal bed is greater than 10 ft (3.0 m) thick in the south and decreases in thickness in all directions.

Chemical Analyses of the Fruitland 2 Coal Bed - Analyses of several Fruitland coals from the area surrounding this quadrangle are given in Table 2 (Fassett and Hinds, 1971).

COAL RESOURCES

Coal resource data from oil and gas wells and pertinent publications were utilized in the construction of isopach and structure contour maps of coals in this quadrangle. All of the coals studied in the Hugh Lake quadrangle are more than 935 ft (285 m) below the ground surface and, thus, have no outcrop or surface development potential.

The U.S. Geological Survey designated the Fruitland 1 and Fruitland 2 coal beds for the determination of coal resources in this quadrangle. Coals of the Fruitland and Menefee zones were not evaluated because they are discontinuous, noncorrelative, and generally less than the reserve base thickness (5 ft [1.5]).

For Reserve Base and Reserve calculations, each coal bed was areally divided into measured, indicated, and inferred resource categories (CRO Plates 7 and 11) according to criteria established in U.S. Geological Survey Bulletin 1450-B. Data for calculation of Reserve Base and Reserves for each category were obtained from the respective coal isopach (CRO Plates 4 and 8) and areal distribution maps (CRO Plates 7 and 11) for each coal bed. The surface area of each isopached bed was measured by planimeter, in acres, for each category, then multiplied by both the average isopached thickness of the coal bed and 1,800 short tons of coal per acre-foot (13,239 tons/hectare-meter), the conversion factor for bituminous coal. This yields the Reserve Base coal, in short tons, for each coal bed.

In order to calculate Reserves, a recovery factor of 50 percent was applied to the Reserve Base tonnages for underground coal. However, in areas of underground coal exceeding 12 ft (3.7 m) in thickness, the Reserves (mineable coal) were calculated on the basis of a maximum coal bed thickness of 12 ft (3.7 m), which represents the maximum economically mineable thickness for a single coal bed in this area by current underground mining technology.

Reserve Base and Reserve values for measured, indicated, and inferred categories of coal for the Fruitland 1 and Fruitland 2 beds are shown on CRO Plates 7 and 11, respectively, and are rounded to the nearest hundredth of a million short tons. The total coal Reserve Base, by section, is shown on CRO Plate 2 and totals approximately 407 million short tons (369 million metric tons).

The coal development potential for each bed was calculated in a manner similar to the Reserve Base, from planimetered measurements, in acres, for areas of high, moderate, and low potential for subsurface mining methods. The Hugh Lake quadrangle has development potential for subsurface mining methods only (CDP Plate 12).

COAL DEVELOPMENT POTENTIAL

Coal beds of 5 ft (1.5 m) or more in thickness which are overlain by 200 to 3,000 ft (61-914 m) of overburden are considered to have potential for underground mining and are designated as having high, moderate, or low development potential according to the overburden thickness: 200 to 1,000 ft (61-305 m), high; 1,000 to 2,000 ft (305-610 m), moderate; and 2,000 to 3,000 ft (610-914 m), low. Table 3 summarizes the coal development potential, in short tons, for underground coal of the Fruitland 1 and Fruitland 2 coal beds.

TABLE 3

COAL RESOURCE DATA FOR UNDERGROUND MINING METHODS FOR FEDERAL COAL LANDS (in short tons) IN THE HUGH LAKE QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

(To convert short tons to metric tons, multiply by 0.9072)

Coal Bed	High Development Potential	Moderate Development Potential	Low Development Potential	Total
Fruitland 2	--	74,760,000	--	74,760,000
Fruitland 1	--	331,930,000	--	331,930,000
TOTAL	--	406,690,000	--	406,690,000

Development Potential for Surface Mining Methods

All coals studied in the Hugh Lake quadrangle occur more than 935 ft (285 m) below the ground surface and, thus, they have no coal development potential for surface mining methods.

Development Potential for Subsurface Mining Methods

Underground coal of the Fruitland 1 coal bed has moderate development potential in the northeast, south, and west-central parts of the quadrangle (CDP Plate 12). Coal bed thickness in these areas ranges from 5 to 17 ft (1.5-5.2 m) (CRO Plate 4) and the overburden increases from 1,100 ft (335 m) in the southeast to 1,600 ft (488 m) in the north (CRO Plate 6). The Fruitland 2 coal bed has moderate potential along the southern border of the quadrangle and in the southern half of the northeast quadrant where the coal bed thickness ranges from 5 to 13 ft (1.5-4.0 m) (CRO Plate 8) and the overburden thickness varies from 1,100 ft (335 m) in the southeast to 1,400 ft (427 m) in the southwest part of the quadrangle (CRO Plate 10).

The northwest, west-central, and east-central areas have unknown development potential where the Fruitland 1 and Fruitland 2 coal beds are less than the reserve base thickness of 5 ft (1.5 m). An area of no development potential is located in the center of the quadrangle where no Fruitland 1 or Fruitland 2 coal is present.

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