Text to accompany:

Open-File Report 79-604

1979

COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAP OF THE PILLAR 3 NE QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

[Report includes 8 plates]

by

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This report has not been edited for conformity with U.S. Geological Survey editorial standards or stratigraphic nomenclature.

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THE PILLAR 3 NE 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 Map of the Pillar 3 NE 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) in 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 Pillar 3 NE 7 1/2-minute quadrangle is in south-central San Juan County, New Mexico. A portion of the Navajo Indian Reservation occupies the western four-fifths of the quadrangle. The quadrangle is approximately 36 miles (58 km) south of Farmington and 52 miles (84 km) northeast of Gallup.

Accessibility

The area is accessible from Farmington by a light-duty road which extends south 35 miles (56 km) to the northern boundary of the quadrangle. Numerous unimproved dirt roads provide access to more remote parts of the area. The Atchison, Topeka, and Santa Fe Railway operates an east-west route 52 miles (84 km) to the southwest at Gallup, New Mexico.

Physiography

This quadrangle is in the southwestern portion of the Central Basin area (Kelley, 1950) of the larger structural depression known as the San Juan Basin. Elevations range from 5,640 ft (1,719 m) in the Chaco River Valley to 6,269 ft (1,911 m) in the southeastern corner of the area. The northernmost edge of the area has been dissected by intermittent, northward-draining tributaries of Hunter Wash. The remainder of the northern half of the area is a gently sloping, featureless plain. The major drainage system, the Chaco River, is an intermittent stream which flows west through the center of the area. The southern half of the area has been dissected by intermittent streams which flow north and west to the Chaco River. Numerous intermittent streams, including De-na-zin Wash and Indian Creek, flow into the Chaco River. The southern and eastern portions of the quadrangle are typified by more steeply dissected mesas.

Climate

The climate of the San Juan Basin is arid to semi-arid. Annual precipitation is usually less than 10 inches (25 cm) but varies across the basin due to elevational differences. Rainfall is rare in the early summer and winter; most precipitation occurs in July and August as intense afternoon thundershowers. Annual temperatures in the basin range from below 0°F (-18°C) to over 100°F (38°C). Snowfall may occur from November to April with an average of 18 inches (46 cm) in the southwestern part of the basin.

Land Status

Approximately 19 percent of the quadrangle area is east of the Navajo Indian Reservation. Approximately 25 percent of this land is within the western portion of the San Juan Basin Known Recoverable Coal Resource Area. The Federal government owns the coal rights for this entire area as shown on Plate 2 of the Coal Resource Occurrence Maps. Federal coal leases (NM 0186613 and NM 19986) in the north cover 83 percent of the KRCRA land. The Federal Government owns the coal rights for approximately 94 percent of the land within the quadrangle that is outside the San Juan Basin Known Recoverable Coal Resource Area.

GENERAL GEOLOGY

Previous Work

Bauer and Reeside (1921) have mapped the Fruitland Formation within the quadrangle with detailed emphasis on outcrops of Fruitland coal and clinker. Reeside (1924) has mapped the Upper Cretaceous and Tertiary formations of the San Juan Basin. Shomaker (1971a) described in detail the surface coal occurrences of the Fruitland Formation in the area and estimated the strippable reserves by township and range. A publication by Fassett and Hinds (1971) includes subsurface interpretations of the Fruitland Formation coal deposits throughout the San Juan Basin. Lease (1971) has mapped an upper Menefee coal bed in the La Vida Mission subarea of the Chaco Canyon area.

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.

The first basin-wide retreat of the Late Cretaceous sea is indicated by the nearshore deposits of the Point Lookout Sandstone. These ancient barrier beaches formed a generally northwest-southeast-trending strandline, behind which swamps developed. Organic material accumulated in the swamps and later became coal in the paludal deposits of the lower Menefee Formation. Deposition of materials which formed the coal beds was influenced by the strandline. This is shown by the more consistent thickness and greater lateral extent of the coals parallel to the strandline and also by the lack of continuity perpendicular to it, to the northeast, where the Menefee and underlying Point Lookout deposits interfinger. Streams which crossed the swamps also influenced deposition of organic matter; stream deposits may terminate even the most continuous coal beds.

During the continued retreat of the sea, the depositional environments in the quadrangle area became more terrestrial. This is evidenced by the transition within the lower Menefee from carbonaceous to noncoal-bearing deposits, in which there is an upward decrease in the occurrence and lateral continuity of the coals. As the sea retreated, the sediments of the Point Lookout Sandstone and overlying Menefee Formation were deposited in successively higher stratigraphic positions to the northeast.

The sea then reversed the direction of movement, and the transgressive sequence of paludal upper 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 the coal beds in the upper part of the Menefee Formation. Subsequently, several hundred feet of beach sands of the Chacra Tongue (informal name of local usage) (Cliff House Sandstone) were deposited over the Menefee. The main body of the Chacra sand trends across the quadrangle in a northwest-southeast direction. The marine facies which developed northeast of the strandline as it moved to the southwest is represented by 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.

Evidence of the final retreat of the Late Cretaceous sea are the nearshore regressive Pictured Cliffs Sandstone and the overlying paludal Fruitland Formation which were deposited in successively higher stratigraphic positions to the northeast. Southwest (shoreward) of the beach deposits, swamps accumulated organic matter which became coals of the Fruitland Formation. Again, deposition of organic material was influenced by the strandline as shown by the continuity of the coal beds parallel to the northwest-southeast strandline and discontinuity perpendicular to it to the northeast.

The brackish-water swamp environment of the Fruitland moved northeast of the quadrangle as the regression continued in that direction. Terrestrial freshwater sediments then covered the area 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 deposits of the Nacimiento during continuous nonmarine deposition. 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, Nacimiento Formation, Ojo Alamo Sandstone, Kirtland Shale, and the upper part of the Fruitland Formation from the area.

Stratigraphy

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

The Point Lookout Sandstone, the basal formation of the Mesaverde Group, consists of cream to light gray, kaolinitic, argillaceous, calcareous sandstone, and interbedded gray shale. It is fairly massive, averages about

165 ft (50 m) thick in this area, and displays a distinctive and consistent character on geophysical logs. This characteristic was used by the authors in designating the top of the Point Lookout as a lithologic datum for correlation of the overlying Menefee coals.

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 an unnamed upper coal-bearing member (Beaumont and others, 1956). These three members are referred to as undifferentiated Menefee Formation for the purposes of this report only. The formation in this area is about 2,060 ft (628 m) thick and is predominantly dark gray, carbonaceous to noncarbonaceous shale with abundant plant fossils, interbedded white, coarse-grained to pebbly, friable, calcareous sandstone, and random coal beds.

The Chacra Tongue (informal name of local usage) of the Cliff House Sandstone overlies the Menefee Formation and is about 350 ft (107 m) thick in this area. It is exposed in the drainage of the Chaco River which trends east-west across the southern part of the quadrangle. The Chacra Tongue consists of thickly bedded, light gray, calcareous sandstone with interbedded dark gray, calcareous, silty shale.

The marine Lewis Shale conformably overlies the Mesaverde Group. In contrast to the underlying Cliff House Sandstone, it is predominantly a gray, flaky, calcareous shale with siderite nodules. The Lewis averages 215 ft (66 m) in thickness in the northeastern part of the quadrangle. The upper contact of the Lewis Shale is gradational with the overlying Pictured Cliffs Sandstone, and, therefore, a distinct contact is difficult to determine.

The Pictured Cliffs Sandstone consists of about 130 ft (40 m) of white, quartzitic, poorly indurated sandstone interbedded with thin, gray shale near the base of the formation where it grades into the Lewis Shale. The upper contact of the formation is more sharply defined than the basal contact, even though intertonguing with the overlying Fruitland Formation results in minor variations in the formational top. Since the Pictured Cliffs is present throughout most of the basin and displays a distinctive character on geophysical logs, the authors have used the top of the unit as a lithologic datum for correlation of the overlying Fruitland coals.

The Fruitland Formation is the major coal-bearing unit in the quadrangle. It consists of approximately 260 ft (79 m) of gray to brown, carbonaceous, calcareous shale with plant fossils, interbedded light gray to tan sandstone, and coal beds of varying thickness. The thickest and most continuous coal beds occur near the base of the formation, while discontinuous and lenticular coals are characteristic of the upper portion.

Surface exposures in the quadrangle are influenced by the regional dip to the northeast, which exposes progressively younger Cretaceous strata in that direction. The oldest unit exposed is the Menefee Formation in the southern half of the area. The Cliff House Sandstone (Chacra Tongue) crops out in the canyon walls of the Chaco River. The younger Lewis Shale is exposed in a belt across the northern part of the quadrangle. The entire section of the Pictured Cliffs Sandstone is exposed in the northern part of the quadrangle. Excluding the uppermost beds, the Fruitland (the youngest formation exposed) crops out across the northeastern corner of the quadrangle.

Structure

The axis of the San Juan Basin is about 39 miles (63 km) northeast of the Pillar 3 NE quadrangle area and trends in an arcuate pattern across the northern portion of the Central Basin (Baltz, 1967). Regional dip in this area, as measured in T. 23 N., R. 14 W., is to the north-northeast and decreases from 4° in the south to 1°30' in the north (Reeside, 1924).

COAL GEOLOGY

Individual coal beds are not continuous across the San Juan Basin because the coal related strata are progressively younger from southwest to northeast; the strata rise in steps due to minor transgressions which occurred during the overall retreat of the sea. However, for the exclusive purpose of reserve and reserve base calculations, the Fruitland 1 coal bed has been correlated and mapped as if it was a single bed, continuous throughout the basin.

A lithologic datum was used for correlation of the coals (CRO Plate 3). The primarily marine sandstone units (Point Lookout, Pictured Cliffs) which underlie the coal-bearing formations (Menefee, Fruitland) were used as datums since they represent a more laterally continuous boundary than any of the overlying paludal, fluvial, and lacustrine deposits of the coal-bearing formations. Also, the sandstone units are more easily recognized on geophysical logs. As shown on CRO Plate 3, the sandstone units have been used as datums for the drill holes and measured sections; the coals have been correlated based upon their position relative to the datum. In this quadrangle, the Fruitland-Pictured Cliffs contact from geologic maps (Bauer and Reeside, 1921) was used as the datum for determining Fruitland coal correlations (refer to composite columnar section of CRO Plate 3).

Two coal beds (Menefee 1, Fruitland 1) and a coal zone (Fruitland) were mapped on the surface, and one coal zone (Menefee) was identified in the subsurface of this quadrangle. The coal beds of the Menefee Formation have been designated as the Menefee coal zone (Me zone) since these coals are generally noncorrelative and less than the reserve base thickness of 5 ft (1.5 m) as specified by the U.S. Geological Survey. Due to these characteristics, derivative maps were not constructed. In the upper portion of the Menefee Formation there is a coal bed which is correlative for several miles. This bed crops out in the eastern portion of the quadrangle and has been informally named the Menefee 1 (Me 1) by the authors. Since this coal bed is less than 5 ft (1.5 m) thick in this quadrangle, derivative maps were not constructed.

The Menefee Formation coals in the southwestern portion of the San Juan Basin vary from subbituminous B to high volatile C bituminous in rank. The rank has been determined on a moist, mineral-matter-free basis with calorific values ranging from 10,021 to 11,312 Btu's per pound (23,309-26,312 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. The "as received" analyses indicate moisture content varying from 14.4 to 19.1 percent, sulfur content generally less than one percent, ash content ranging from 5.4 to 10.2 percent, and heating values on the average of 9,912 Btu's per pound (23,055 kj/kg). Analyses of several Menefee Formation coals are given in Table 1 (Bauer and Reeside, 1921; Dane, 1936; Lease, 1971; Shomaker, 1971b).

The Fruitland 1 (Fr 1) coal bed is defined by the authors as the lowermost coal of the Fruitland Formation; it is generally directly above the Pictured Cliffs Sandstone. The coal bed crops out in the northern portion of the quadrangle. The upper Fruitland Formation coal bed was designated as part of the Fruitland coal zone (Fr zone), which includes coals that are generally less than reserve base thickness (5 ft [1.5 m]). One coal of the Fruitland zone crops out in the northern portion of the quadrangle. The traces of outcrop of both the Fruitland 1 and Fruitland zone coal bed have been modified from the original data source to conform with modern topographic maps. Since the coals of the Fruitland zone are less than reserve base thickness throughout this quadrangle, derivative maps were not constructed.

Fruitland Formation coal beds in the southwestern part of the San Juan Basin are considered high volatile C bituminous in rank, although the coals vary from subbituminous A to high volatile C bituminous. The rank has been determined on a moist, mineral-matter-free basis with calorific values ranging from 10,567 to 12,782 Btu's per pound (24,579-29,731 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. The "as received" analyses indicate moisture content varying from 6.7 to 17.6 percent, ash content ranging from 10.1 to 27.7 percent, sulfur content generally less than one percent, and heating values on the order of 9,764 Btu's per pound

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.			Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur		
J-57562	Pit Sample	SW¼ 11	22	13	------------	A	14.4	32.6	42.8	10.2	0.9	9,870	
						B	----	38.1	50.0	11.9	1.0	11,530	
						C	----	43.3	56.7	----	1.2	13,090	
23003	Mine Sample Blake's Mine	13	22	13	------------	A	19.0	32.4	43.2	5.4	0.92	10,190	
						B	----	40.0	53.3	6.7	1.14	12,590	
						C	----	42.9	57.1	----	1.22	13,490	
J-51245	Channel, Open Pit	NW¼ 9	22	14	------------	A	19.1	33.4	40.7	6.8	0.9	9,280	Probably weathered
						B	----	41.3	50.3	8.4	1.2	11,470	
						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	

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

(22,711 kj/kg). Analyses of several Fruitland Formation coals are given in Table 2 (Bauer and Reeside, 1921; Dane, 1936; Fassett and Hinds, 1971; Shomaker, 1971a).

Fruitland 1 Coal Bed

The Fruitland 1 coal bed has been mapped exclusively in the area east of the Navajo Indian Reservation boundary. As illustrated by the structure contour map (CRO Plate 5) the Fruitland 1 coal bed dips approximately 1° to the north. Overburden (CRO Plate 6) increases from zero at the outcrop to greater than 50 ft (15.2 m) in the northern portion of the quadrangle. The isopach map (CRO Plate 4) shows a trend of increasing thickness to the north. The coal varies in thickness from less than 5 ft (1.5 m) in the southern portion of the quadrangle to greater than 5 ft (1.5 m) in the northeast.

Chemical Analyses of the Fruitland 1 Coal Bed - Analyses of several Fruitland Formation coals from this quadrangle and the surrounding area are included in reports by Fassett and Hinds (1971) and Shomaker (1971a). The results of these analyses are given in Table 2.

COAL RESOURCES

Coal resource data from oil and gas wells (El Paso Natural Gas Co., 1978, unpublished data in well log library in Farmington, New Mexico) and geologic maps (Bauer and Reeside, 1921; Lease, 1971), were utilized in the construction of outcrop, isopach, and structure contour maps of the coals in this quadrangle. Outcrops of the Fruitland 1 coal bed and Fruitland coal

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 Section	T.N.	R.W.	Approx. Depth Interval of Sample (ft.)	Form of Analysis	Proximate, percent Moisture	Volatile matter	Fixed Carbon	Ash	Sulfur	Heating Value (Btu)	Remarks
H-22722	N.M.P.S.C.C. DH-3-2	SW¼ 3	23	13	42-44	A	6.7	35.9	46.9	10.5	0.6	11,320	Coal core
						B	----	38.5	50.3	11.2	0.6	12,140	not floated
						C	----	43.4	56.6	----	0.7	13,680	in CCl_4
*53	Core Sample	SW¼ 4	23	13	33-40	A	17.6	20.7	34.0	27.7	0.71	8,098	
						B	----	25.1	41.3	33.6	0.86	9,828	
*54	Core Sample	SW¼ 4	23	13	132-140	A	16.4	27.8	45.7	10.1	0.70	10,075	
						B	----	33.2	54.7	12.1	0.84	12,051	
*63	Core Sample	SW¼ 8	23	13	72-81	A	13.2	26.0	47.8	12.3	0.63	9,851	
						B	----	30.2	55.5	14.3	0.73	11,349	
H-19885	N.M.P.S.C.C. DH-32-1	NW¼ 32	24	13	100-112	A	12.0	32.5	39.3	16.2	0.5	9,670	Coal core
						B	----	36.9	44.7	18.4	0.6	10,990	crushed and
						C	----	45.2	54.8	----	0.7	13,460	floated in CCl_4
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
						B	----	34.1	47.9	18.0	2.0	11,340	content may be
						C	----	41.6	58.4	----	2.5	13,820	due to inadequate drying of sample during preparation process
*28	Core Sample	SE¼ 32	24	13	17-21	A	14.4	31.8	40.7	13.1	0.58	9,067	
						B	----	37.1	47.6	15.3	0.63	10,592	

*New Mexico State Bureau of Mines and Mineral Resources

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.

zone in the northern half of the quadrangle (CRO Plate 1) are modified from Bauer and Reeside (1921). The Menefee 1 coal bed outcrop in the east-central part of the quadrangle is modified from Lease (1971).

The U.S. Geological Survey designated the Fruitland 1 coal bed for the determination of coal resources in this quadrangle. Coals of the Menefee 1 bed and Fruitland zone were not evaluated because the thickness of the coal beds is generally less than the reserve base thickness (5 ft [1.5 m]).

For Reserve Base and Reserve calculations, the Fruitland 1 coal bed was areally divided into measured, indicated, and inferred resource categories categories (CRO Plate 7) 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 coal isopach (CRO Plate 4) and areal distribution maps (CRO Plate 7) for the Fruitland 1 coal bed. The surface area of the 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 the Fruitland 1. In order to calculate Reserves, a recovery factor of 85 percent was applied to the Reserve Base tonnages for strippable coal.

Reserve Base and Reserve values for measured, indicated, and inferred categories of coal for the Fruitland 1 coal bed are shown on CRO Plate 7, 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 0.41 million short tons (0.37 million metric tons).

The coal development potential for Fruitland 1 is calculated in a manner similar to the Reserve Base, from planimetered measurements, in acres, for areas of high, moderate, and low potential for surface mining methods. The Pillar 3 NE quadrangle has development potential for surface mining methods only (CDP Plate 8).

COAL DEVELOPMENT POTENTIAL

Coal beds of 5 ft (1.5 m) or more in thickness which are overlain by 200 ft (61 m) or less of overburden are considered to have potential for strip mining and are designated as having high, moderate, or low development potential according to the mining ratios (cubic yards of overburden per ton of recoverable coal). The formula utilized in the calculation of mining ratios for bituminous coal is:

$$MR = \frac{t_o \ (0.896)}{t_c \ (rf)}$$

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

Based on economic and technological criteria, the U.S. Geological Survey has established standards for the determination of high, moderate, and low coal development potentials for surface and subsurface coal beds of reserve base thickness (5 ft [1.5 m]) or greater. Mining ratio values for strippable coal (overburden less than 200 ft [61 m] thick) are 0 to 10, high; 10 to 15, moderate; and greater than 15, low. There is no coal development potential for underground coals in this quadrangle. Table 3 summarizes the coal development potential, in short tons, for surface coal of the Fruitland 1 coal bed.

TABLE 3

STRIPPABLE COAL RESOURCES FOR FEDERAL COAL LANDS (in short tons) IN THE PILLAR 3 NE QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

[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; to convert mining ratios in yd^3/ton coal to m^3/ton, multiply by 0.842]

Coal Bed	High Development Potential (0-10 mining ratio)	Moderate Development Potential (10-15 mining ratio)	Low Development Potential (15 mining ratio)	Total
Fruitland 1	250,000	160,000	--	410,000
TOTAL	250,000	160,000	--	410,000

Development Potential For Surface Mining Methods

Strippable coal of the Fruitland 1 coal bed has high development potential in two small areas in the northeast corner of the quadrangle (CDP Plate 8). The thickness of the coal bed ranges from 5.2 to 6.7 ft (1.6-2.0 m) in this area (CRO Plate 4). A very small area of moderate development potential extends into the northeastern corner from the adjacent quadrangle, Tanner Lake. Several small areas of unknown development potential occur along the eastern border of the quadrangle where the coal thickness is less than 5 ft (1.5 m) or there is insufficient data. The remainder of the area within the KRCRA has no coal development potential for surface mining methods because it is outside the Fruitland 1 outcrop.

Development Potential For Subsurface Mining Methods

The Fruitland and Menefee coals have no subsurface development potential in this quadrangle. Coals of the Fruitland Formation which occur within the KRCRA area are strippable. Underground Menefee coals are discontinuous and less than the reserve base thickness (5 ft [1.5 m]).

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