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COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAP OF THE PUEBLO PINTADO QUADRANGLE, MCKINLEY COUNTY, NEW MEXICO

[Report includes 12 plates]

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PUEBLO PINTADO 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) Map of the Pueblo Pintado quadrangle, McKinley 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 was 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 Pueblo Pintado 7 1/2-minute quadrangle is in northeastern McKinley County, New Mexico. Two detached portions of Chaco Canyon National Monument are located in the northeast quadrant of the quadrangle. The area is approximately 60 miles (97 km) southeast of Farmington and 60 miles (97 km) northeast of Gallup, New Mexico.

Accessibility

A light-duty road and numerous unimproved dirt roads provide access to this quadrangle. The Atchison, Topeka, and Santa Fe Railway operates a route which passes through Gallup, New Mexico, 60 miles (97 km) to the southwest.

Physiography

The Pueblo Pintado quadrangle is in the southern portion of the Central Basin area and the northern portion of the Chaco Slope area (Kelley, 1950) of the larger structural depression known as the San Juan Basin. Elevations range from 6,340 ft (1,932 m) in Chaco Wash to over 7,402 ft (2,256 m) on the southern edge of Chaco Mesa. The northeastern section is characterized by plains which slope gently toward Chaco Wash, which drains to the west. The central portion of the area is occupied by Chaco Mesa, which has been dissected by tributaries of Chaco Wash to form steep-walled canyons, of which Pueblo Pintado Canyon is the largest. The southwestern corner of the quadrangle is characterized by gently sloping terrain slightly dissected by southerly flowing intermittent streams.

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 southern part of the basin.

Land Status

Approximately 7 percent of the quadrangle is in the southeastern part of the San Juan Basin Known Recoverable Coal Resource Area. The Federal Government owns the coal rights for 83 percent of the KRCRA within the quadrangle as shown on Plate 2 of the Coal Resource Occurrence Maps. Preference Right Lease Application NM 8130 covers 50 percent of this area. There are no Federal coal leases in the area. The Federal Government owns the coal rights for 40 percent of the land outside the San Juan Basin Known Recoverable Coal Resource Area.

GENERAL GEOLOGY

Previous Work

Dane (1936) has mapped the Upper Cretaceous strata in the quadrangle with detailed emphasis on the Fruitland and Menefee coal fields which trend northwest-southeast across the quadrangle. A publication by Fassett and Hinds (1971) includes subsurface interpretations of the Fruitland Formation coal deposits throughout the San Juan Basin. Speer (1971) and Shomaker and Lease (1971) have evaluated the strippable coal reserves of the Menefee and Fruitland Formations, respectively, within the quadrangle, as part of larger San Juan Basin coal studies.

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 coal beds in the upper part of the Menefee Formation. The transgressing northwest-southeast-trending strandline is represented in the lithologic record by the Chacra Tongue (informal name of local usage) of the Cliff House Sandstone. 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.

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 sediments 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 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 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, and some of the Kirtland Shale 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 (undifferentiated), and Chacra Tongue of the Cliff House Sandstone; the Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, and Kirtland Shale. A composite columnar section on CRO Plate 3 illustrates the stratigraphic relationships of these formations and is accompanied by lithologic descriptions of each.

The Point Lookout Sandstone, the basal formation of the Mesaverde Group, consists of white to cream to light gray, calcareous, friable sandstone, and interbedded gray shale. This formation is fairly massive, averages about 140 ft (43 m) in thickness, and displays a distinctive and consistent character on geophysical logs. This last characteristic was used by the authors in choosing 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 the undifferentiated Menefee Formation for the purposes of this report only. The formation in this area is about 1,400 ft (427 m) thick and is predominantly a gray to brown, soft, fissile, carbonaceous to noncarbonaceous shale with abundant plant fossils and limy nodules, interbedded white to light gray, 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 320 ft (97 m) thick in this area. It is exposed in the type section, Chacra Mesa, which trends northwest-southeast across the quadrangle. The Chacra consists of thickly bedded, cream-colored, kaolinitic, slightly calcareous sandstone with interbedded shale and siltstone.

The marine Lewis Shale conformably overlies the Mesaverde Group. In contrast to the underlying Cliff House Sandstone, it is predominantly a dark gray, fissile shale with interbedded light brown, calcareous sandstone. The Lewis Shale averages 120 ft (37 m) thick in the quadrangle. The upper contact is gradational with the overlying Pictured Cliffs Sandstone and, therefore, it is difficult to determine.

The Pictured Cliffs Sandstone consists of white to cream, kaolinitic, calcareous sandstone interbedded with thin, gray shale near the base of the formation where it grades into the underlying Lewis. The upper contact is more sharply defined than the basal contact, even though intertonguing with the overlying Fruitland 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 as a lithologic datum for correlation of overlying Fruitland coals.

The Fruitland Formation is a major coal-bearing unit in the quadrangle. It consists of approximately 200 ft (61 m) of dark gray, carbonaceous shale with plant fossils, interbedded sandstone and siltstone, and coal beds of varying thicknesses. 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. 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). Authors have used various criteria in establishing the upper contact but, in general, for the purposes of this report the uppermost coal was chosen (after Fassett and Hinds, 1971).

The freshwater deposits of the Kirtland Shale are the youngest Cretaceous strata in the area. These deposits consist of brown to gray shale with local plant fossils, and interbedded sandy shale. The formation has previously been divided into several members by various authors; however, for the purposes of this report it was not necessary to distinguish between the individual members.

Surface exposures in the quadrangle are influenced by the regional dip of 1° to the northeast, with progressively younger Cretaceous strata cropping out in a northeasterly direction. The oldest unit exposed in the quadrangle is the Menefee Formation in the southwestern corner of the area. The Cliff House Sandstone crops out on Chacra Mesa. The younger Lewis Shale crops out in Chaco Wash as a thin belt across the northeastern portion of the quadrangle. The entire sections of both the Pictured Cliffs Sandstone and the Fruitland Formation are exposed in the northeastern corner of the quadrangle. Only the basal portion of the Kirtland Shale, the youngest formation, crops out across the extreme northeastern corner of the quadrangle.

Structure

The axis of the basin is about 47 miles (76 km) northeast of the Pueblo Pintado quadrangle and trends in an arcuate pattern across the northern portion of the Central Basin area (Baltz, 1967). Regional dips within the quadrangle measured in T. 20 N., R. 8 W. range from 1° to 3° to the northeast (Dane, 1936). Two small faults form a graben structure in the northern part of the quadrangle (Dane, 1936).

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 coal beds have been correlated and mapped as if each were 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 generally more easily recognized on geophysical logs. As shown on CRO Plate 3, the top of the Point Lookout Sandstone has been used as a datum for the oil and gas test holes (El Paso Natural Gas Co., 1978, unpublished data in well log library, Farmington, New Mexico); the Menefee coals have been plotted in the columns and correlated based upon their position relative to the datum. Correlation of Menefee coals in measured sections are based upon geologic maps (Dane, 1936). Correlation of Fruitland coals in coal test holes (Chaco Energy, unpublished data) and measured sections (Beaumont and Speer, 1976) are based upon previous correlations and geologic maps (Beaumont and Speer, 1976).

A coal zone (Menefee) and three coal beds (Fruitland 1, 2, and 3) were identified on the surface of the quadrangle (CRO Plate 1). The Menefee Formation coals were designated as the Menefee coal zone (Me zone). Some of the coals in the Menefee are correlative over short distances; however, they are all less than the reserve base thickness of 5 ft (1.5 m) as set by the U.S. Geological Survey. Due to these characteristics, derivative maps were not constructed. In the southwestern part of the quadrangle Menefee zone coal beds crop out in two areas (CRO Plate 1). The traces of the outcrops have been modified from the original data source to conform with modern topographic maps.

No analyses of the quality of Menefee Formation coals in this quadrangle have been published. However, information on the quality of coals from surrounding areas is assumed to be similar to that of the coals from this quadrangle. There is no apparent consistent difference between the various Menefee Formation coal beds. In the southern part of the San Juan Basin they vary from subbituminous B to high volatile C bituminous in rank. The rank is determined on a moist, mineral-matter-free basis with calorific values ranging from 9,983 to 11,966 Btu's per pound (23,220-27,833 kj/kg) (Amer. Soc. for Testing 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 12.1 to 20.0 percent, sulfur content generally less than 2 percent, ash content ranging from 4.9 to 10.2 percent, and heating values on the order of 10,269 Btu's per pound

(23,885 kj/kg) (Bauer and Reeside, 1921; Dane, 1936; Lease, 1971; Shomaker, 1971). Analyses of several Menefee Formation coals are included in reports by Lease (1971) and Shomaker (1971). The results of these analyses are given in Table 1.

The Fruitland 1 (Fr 1) coal bed which is defined by the authors as the lowermost coal of the Fruitland Formation is generally directly above the Pictured Cliffs Sandstone. The Fruitland 2 (Fr 2) coal bed overlies the Fruitland 1 coal bed, and the Fruitland 3 (Fr 3) coal bed overlies the Fruitland 2. All three of these coals crop out in the northeast. Derivative maps were not constructed for the Fruitland 3 coal bed in this quadrangle because the coal is less than the reserve base thickness of 5 ft (1.5 m).

Fruitland Formation coal beds in the southeastern part of the San Juan Basin are considered high volatile C bituminous, although they vary in rank 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 11,207 to 12,078 Btu's per pound (26,067-28,093 kj/kg) (Amer. Soc. for Testing 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 10.7 to 13.6 percent, ash content ranging from 17.6 to 30.5 percent, sulfur content less than one percent, and heating values on the order of 8,947 Btu's per pound (20,810 kj/kg) (Dane, 1936; Shomaker and Lease, 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 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
A47085	Mine Sample San Juan Mine	SW¼ 31	19	1	——	A	15.8	34.5	43.8	5.9	0.6	10,900	Cleary Member
						B	——	41.0	52.0	7.0	0.7	12,950	
A46366	Mine Sample San Juan Mine	SW¼ 31	19	1	——	A	15.7	32.0	45.1	7.2	0.6	10,790	Cleary Member
						B	——	38.0	53.5	8.5	0.7	12,800	
						C	——	41.5	58.5	——	0.8	13,990	
A47084	Prospect Pit Wilkins No. 2 Prospect	SW¼ 26	19	1	——	A	18.2	34.4	40.8	6.6	0.9	10,280	Cleary Member
						B	——	42.0	49.9	8.1	1.0	12,570	
A60026	Mine Sample Rio Puerco Mine	SE¼ 19	19	1	——	A	12.1	35.8	44.5	7.6	2.8	10,940	Allison Member
						B	——	40.7	50.6	8.7	3.2	12,460	
						C	——	44.6	55.4	——	3.5	13,640	
A64268	Mine Sample Anderson Mine	SE¼ 35	19	2	——	A	20.0	32.5	42.6	4.9	0.7	10,240	Allison Member
						B	——	40.7	53.2	6.1	0.8	12,790	
						C	——	43.3	56.7	——	0.9	13,630	
A46367	Prospect Drift	35	19	2	——	A	14.8	33.9	41.4	9.9	1.2	8,910	Allison Member; sample may have been somewhat weathered
						B	——	39.8	48.6	11.6	1.4	10,460	
						C	——	45.1	54.9	——	1.6	11,840	
3823	Mine Sample	14	20	11	——	A	17.5	32.9	41.2	8.4	2.2	——	
23004	Outcrop Sample	14	20	11	——	A	14.4	34.8	42.3	7.5	1.5	10,220	
						B	——	40.7	50.5	8.8	1.8	11,940	
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	

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

Fruitland 1 Coal Bed

As illustrated by the structure contour map (CRO Plate 5), the coal bed dips about 1° to the northeast. Due to topography and dip, overburden (CRO Plate 6) varies from zero at the outcrop to over 150 ft (46 m) in the northeastern corner. The isopach map (CRO Plate 4) shows that the coal bed thickness is greater than 10 ft (3.0 m) in the north and the coal thickness thins to the south.

Chemical Analyses of the Fruitland 1 Coal Bed - No analyses of Fruitland coal within the Pueblo Pintado quadrangle have been published. However, analyses for several Fruitland coals in the surrounding area were published by Shomaker and Lease (1971). The results of the analyses are given in Table 2.

Fruitland 2 Coal Bed

As illustrated by the structure contour map (CRO Plate 9), the coal bed dips approximately 1° to the northeast. Due to topography and dip, overburden (CRO Plate 10) varies from zero at the outcrop to over 100 ft (30 m) in the northeastern part of the quadrangle. The isopach map (CRO Plate 8) shows the coal bed is greater than 15 ft (4.6 m) thick in the northeast. The thickness decreases to the south.

Chemical Analyses of the Fruitland 2 Coal Bed - No analyses of Fruitland coal within the Pueblo Pintado quadrangle have been published. However, analyses for several Fruitland coals in the surrounding area were published by Shomaker and Lease (1971). The results of the analyses are given in Table 2.

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		
*TH-53400	Core Sample	——	20	6	——	A	12.44	34.95	34.05	18.56	0.56	9,499	
						B	——	39.91	38.89	21.20	0.64	10,848	
+C-14108	Core Sample	——	20	6	——	A	10.7	33.4	37.5	18.4	0.65	9,667	
						B	——	37.4	42.0	20.6	0.72	10,826	
						C	——	47.1	52.9	——	0.91	13,637	
J-62557	Core Sample	SW¼ 26	21	8	——	A	13.6	33.4	35.4	17.6	0.53	9,110	
						B	——	38.6	41.0	20.4	0.62	10,540	
						C	——	48.5	51.5	——	0.77	13,240	
J-62604	Core Sample	SW¼ 26	21	8	——	A	12.6	28.7	28.2	30.5	0.49	7,510	
						B	——	32.8	32.4	34.8	0.56	8,590	
						C	——	50.3	49.7	——	0.86	13,180	

*analysis by Commercial Testing and Eng. Co.
+analysis by Illinois Geological Survey

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.

COAL RESOURCES

Coal resource data from oil and gas wells (El Paso Natural Gas Co., 1978, unpublished data in well log library, Farmington, New Mexico), coal test holes (Chaco Energy, unpublished data), and geologic maps (Beaumont and Speer, 1976; Dane, 1936), were used in the construction of outcrop, isopach, and structure contour maps of coals in this quadrangle.

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 Menefee Formation were not evaluated because the thickness of these coals is less than the reserve base thickness of 5 ft (1.5 m).

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 (CRO Plates 7 and 11) maps 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 bed. In order to calculate Reserves, a recovery factor of 85 percent was applied to the Reserve Base tonnages for strippable coals.

Reserve Base and Reserve values for measured, indicated, and inferred categories of coal for the Fruitland 1 and Fruitland 2 beds are

TABLE 3

STRIPPABLE COAL RESOURCES FOR FEDERAL COAL LANDS (in short tons) IN THE PUEBLO PINTADO QUADRANGLE, MCKINLEY COUNTY, NEW MEXICO

[Development potentials are based on mining ratios (cubic yards of over-burden/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 2	3,780,000	1,750,000	—	5,530,000
Fruitland 1	3,160,000	820,000	3,040,000	7,020,000
TOTAL	6,940,000	2,570,000	3,040,000	12,550,000

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 about 12.6 million short tons (11.4 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 surface and/or subsurface mining methods. The Pueblo Pintado quadrangle has development potential for surface 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 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:

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

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

The recovery factor for bituminous coal as determined by the U.S. Geological Survey for this quadrangle is 85 percent for strippable coal, and the mining ratio values, based on economic and technological criteria, are 0 to 10, high, 10 to 15, moderate, and greater than 15, low. Table 3 summarizes the coal development potential, in short tons, for each of the three categories.

Development Potential for Surface Mining Methods

Strippable coal of the Fruitland 1 and Fruitland 2 beds has high development potential in the northeastern corner of the quadrangle (CDP Plate 12) where both coal beds crop out (CRO Plate 1). In the area with high potential the Fruitland 1 coal is 5 to 7 ft (1.5-2.1 m) thick (CRO Plate 4), and the Fruitland 2 is approximately 5 to 10 ft (1.5-3.0 m) thick (CRO Plate 8). Overburden thickness does not exceed 100 ft (30 m) (CRO Plates 6 and 10) for either coal bed in their respective areas of high development potential.

Coal of the Fruitland 2 has moderate development potential in a small area near the northeast corner of the quadrangle where the coal is approximately 6 to 10 ft (1.8-3.0 m) thick, and the overburden is more than 100 ft (30.5 m) in thickness.

The small area in the northeast with unknown coal development potential is the result of coal of the Fruitland 1 bed which is less than the reserve base thickness of 5 ft (1.5 m). The remainder of the quadrangle area has no development potential in areas outside the outcrops of the Fruitland 1 and Fruitland 2 coal beds.

Development Potential for Subsurface Mining Methods

In the remainder of the quadrangle, the Menefee zone coals are present in the subsurface and as outcrop in the southwest corner. However, these coals have no development potential because they are less than the reserve base thickness of 5 ft (1.5 m).

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