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COAL RESOURCE OCCURRENCE MAPS AND COAL DEVELOPMENT POTENTIAL MAPS OF THE HUERFANO TRADING POST SW QUADRANGLE, SAN JUAN COUNTY, NEW MEXICO

[Report includes 11 plates]

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HUERFANO TRADING POST SW 7 1/2-MINUTE QUADRANGLE

INTRODUCTION

Purpose

This text is to be used in conjunction with the Coal Resource Occurrence (CRO) Maps and the Coal Development Potential (CDP) Map of the Huerfano Trading Post SW 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 Huerfano Trading Post SW 7 1/2-minute quadrangle is located in southeastern San Juan County, New Mexico, approximately 28 miles (43 km) southeast of Farmington and 68 miles (106 km) northeast of Gallup, New Mexico.

Accessibility

The area is accessible by light-duty and unimproved dirt roads which extend southwest into the quadrangle from State Route 44, approximately 5 miles (8 km) to the east. State Route 44 connects with State Route 17 and U.S. Highway 64 at Bloomfield, 13 miles (20 km) east of Farmington. State Route 56 crosses the southeastern corner of the area. The nearest rail transportation is the Atchison, Topeka, and Santa Fe Railway line which lies approximately 68 miles (106 km) to the southwest at Gallup, New Mexico, and connects Gallup, Grants, and Albuquerque to the east.

Physiography

The quadrangle is located in the southwestern portion of the Central Basin area (Kelley, 1950) of the larger structural depression known as the San Juan Basin. Total relief in the area is 680 ft (204 m), with elevations which range from 6,280 ft (188 m) in the southeastern corner to 6,960 ft (208 m) at the eastern boundary. The area is characterized by relatively featureless, rolling plains, gently incised by intermittent streams which flow west-southwest. The northwestern corner of the quadrangle is dissected by intermittent streams with up to 100 ft (30 m) of relief, resulting in badlands topography. Streams at the northern edge of the area drain to the north-northeast.

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 over 100°F (38°C). Snowfall occurs from November to April, with an average of 18 inches (46 cm) in the southern part of the basin.

Land Status

The quadrangle lies within the south-central portion of the San Juan Basin Known Recoverable Coal Resource Area, and the Federal Government owns the coal rights for approximately 91 percent of the KRCRA land, 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 within the quadrangle 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, lay 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 beds in the Menefee Formation. Subsequently, several hundred feet of beach sands of the La Ventana Tongue (Cliff House Sandstone) were deposited over the Menefee in the quadrangle. Shoreward (southwest) and contemporaneous with the La Ventana beach deposits, swamps developed above the older Menefee deposits. Subsequently, coals formed in these younger deposits which are called the Hogback Mountain Tongue of the Menefee (Beaumont, 1971). Minor fluctuations of the sea resulted in interfingering of the La Ventana (Cliff House) and Hogback Mountain (Menefee) Tongues in the southwest part of the quadrangle.

Onlap continued as the sea moved southwestward across the basin area. 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 which overlies the La Ventana Tongue. 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 Chacra Tongue, 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 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 sediments covered the quadrangle as indicated by 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 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: (two of the three formations of the Mesaverde Group), Menefee Formation (undifferentiated) and the Cliff House Sandstone; the 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 these 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. It is about 800 to 1,000 ft (244-305 m) thick and consists of a gray shale with plant fossils and carbonaceous partings, interbedded thin, light gray sandstone, and lenticular coal beds. The entire Menefee Formation falls below the 3,000-foot (914 m) study limit in the northeastern part of the quadrangle; however, due to both the gentle regional dip of about 1° to the northeast and the topographic influence, more than 400 ft (122 m) of the upper part of the formation are above the study limit in the southernmost drill hole in the quadrangle (drill hole 7, refer to CRO Plate 1).

In previous studies the Menefee has been divided, from the base upward, into the Cleary Coal Member, the barren Allison Member, an unnamed upper coal-bearing member (Beaumont and others, 1956), and the coal-bearing Hogback Mountain Tongue (Beaumont, 1971). The first three members were grouped together as undifferentiated Menefee Formation for the purposes of this report only; they were not distinguished because of the difficulty and inaccuracy in determining a consistent division between them on geophysical logs.

From the southwest, extending northeast across half of the quadrangle area, the informally-named Hogback Mountain Tongue represents the thick paludal deposits shoreward of the massive marine sand of the La Ventana Tongue of the Cliff House Sandstone. The Hogback Mountain Tongue is distinguished as a major coal-bearing unit as a result of its deposition in a coastal-swamp environment. The stratigraphic equivalence and complex intertonguing of the Hogback Mountain Tongue with the La Ventana Tongue make it distinguishable in the area of intertonguing. The Hogback Mountain

Tongue, which is wedged between thick tongues of La Ventana sand, averages 150 ft (46 m) in thickness within the quadrangle area. Similar in lithology to the underlying undifferentiated member of the Menefee Formation, it consists of gray carbonaceous shale, interbedded cream to brown, calcareous sandstone, and random coal beds.

The undifferentiated member of the Menefee is overlain by the Cliff House Sandstone. However, in the southernmost portion of the quadrangle the Hogback Mountain Tongue overlies the undifferentiated member and intertongues with basal Cliff House deposits (La Ventana Tongue). Conformably overlying and intertonguing with the Menefee Formation is the basal member of the Cliff House Sandstone, the La Ventana Tongue. Consequently, in the northeastern portion of the quadrangle the La Ventana lies directly above the undifferentiated Menefee Formation, but southwestward (shoreward) the La Ventana intertongues and is contemporaneous with the Hogback Mountain Tongue of the Menefee. This sandstone sequence of exceptional thickness (650 ft [198 m]) is composed primarily of light gray, slightly calcareous sandstone.

The upper Cliff House Sandstone member, the Chacra Tongue (informal name of local usage), is about 370 ft (113 m) thick in this area; it overlies the La Ventana Tongue. The Chacra Tongue in the quadrangle consists of light gray, slightly calcareous, silty, thinly-bedded sandstone with abundant interbedded gray to brown shale and sandy shale. This lithology is transitional from the thickly-bedded sandstone of the type section at Chacra Mesa, south of the area, to the marine shale of the Lewis. The transition facies of the Chacra extends from the southwest across the quadrangle to the northeastern part of the area, where the lower 160 ft (49 m) of the Chacra Tongue interfinger with the Lewis Shale.

The Mesaverde Group is conformably overlain by the transgressive marine deposits of the Lewis Shale. Due to the presence of both the La Ventana and the Chacra Tongues (Cliff House Sandstone) in the southwestern and western portions of the quadrangle, the Lewis is very thin and averages 260 ft (79 m) in thickness in those areas. To the northeast (seaward), the Lewis is stratigraphically lower; where it is equivalent to the Chacra, it conformably overlies the La Ventana Tongue. The Lewis Shale is predominantly a gray to brown calcareous shale with local plant fossils.

The Pictured Cliffs Sandstone is a regressive sandstone of nearshore marine origin which conformably overlies the Lewis Shale. It consists of a light gray, friable, argillaceous, calcareous sandstone interbedded with gray shale in the lower part of the formation. The lower boundary of this formation is gradational, difficult to establish and, therefore, inconsistent. This may explain the wide variation in reported thickness which averages about 90 ft (27 m) in this quadrangle. The upper contact of the Pictured Cliffs is more sharply defined than the basal contact. Intertonguing of the overlying Fruitland Formation results in minor variations in the formation top, and, consequently, local Fruitland coal beds are present in the Pictured Cliffs Sandstone. The Pictured Cliffs Sandstone is, nevertheless, a consistent formation throughout the basin. The authors have used the consistency and distinctive character of the formation on geophysical logs to determine the top of the Pictured Cliffs Sandstone as a lithologic datum for correlation of the overlying Fruitland coals.

Conformably overlying the Pictured Cliffs Sandstone is the Fruitland Formation, the major coal-bearing unit in the quadrangle. The Fruitland in the area ranges in thickness from approximately 150 to 400 ft (46-122 m). It is composed of gray to brown, carbonaceous shale with plant fossils and siderite nodules; interbedded light green to gray-brown siltstone; and coal beds of varying thickness. The coal beds of greatest continuity and thickness 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 determining the contact between the Fruitland and Kirtland. For the purposes of this report the uppermost coal bed in the Fruitland Formation was used as the contact (after Fassett and Hinds, 1971).

The freshwater deposits of the Kirtland Shale are the youngest Cretaceous strata in the San Juan Basin. These deposits average about 500 ft (152 m) in thickness and consist of light green to gray, platy, locally silty shale with plant fossils. The Kirtland Shale 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 of the Kirtland Shale cover the southwestern quarter of the area.

Approximately 120 ft (37 m) of the Paleocene Ojo Alamo Sandstone unconformably overlie the Cretaceous deposits. This formation consists of white to light gray, coarse-grained to conglomeratic (with chert and arkosic granules), calcareous, friable sandstone. The Ojo Alamo crops out in a thin belt across the southwestern part of the area.

The Nacimiento Formation gradationally overlies the Ojo Alamo Sandstone. It consists mainly of green to gray, locally silty, fissile shale, with interbedded light gray, poorly indurated quartzitic sandstone and gray siltstone. Only about 600 to 750 ft (183-229 m) of the original thickness of the formation are present in this area. The Nacimiento Formation is the youngest formation exposed in the quadrangle; it crops out in the northeastern two-thirds of the quadrangle area.

Structure

The Huerfano Trading Post SW 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 43 miles (69 km) northeast of the quadrangle area and trends in an arcuate pattern across the northern portion of the Central Basin area (Baltz, 1967). Regional dip is 1° to the northeast, as measured by Reeside (1924).

COAL GEOLOGY

Two coal zones (Fruitland, Menefee) and one coal bed (Fruitland 1) were identified in the subsurface of this quadrangle (CRO Plate 1). The widely-distributed Menefee coals are grouped together into the Menefee coal zone (Me zone) which extends from the top of the La Ventana Tongue to the base of the Menefee Formtion. Many of these coals are noncorrelative, discontinuous, and less than reserve base thickness (5 ft [1.5 m]).

Menefee Formation coal beds in the southern part of the San Juan Basin are considered to be borderline subbituminous A to subbituminous B in rank. The rank has been determined on a moist, mineral-matter-free basis with calorific values ranging from 10,021 to 11,103 Btu's per pound (23,309-25,826 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 ranging from 14.4 to 19.1 percent, ash content varying from 6.8 to 10.2 percent, sulfur content less than one percent, and heating values on the order of 9,575 Btu's per pound (22,271 kj/kg). Analyses of several Menefee Formation coals are given in Table 1 (Bauer and Reeside, 1921; Dane, 1936; Lease, 1971; Shomaker, 1971a). Although no published analyses of the quality of Menefee coal are available for this quadrangle, information on the quality of coal from the surrounding area is assumed to be similar to that of the coal in this quadrangle.

The Fruitland 1 (Fr 1) coal bed is defined as the lowermost coal bed of the Fruitland Formation; it lies directly above the Pictured Cliffs Sandstone. The upper Fruitland Formation coal beds are grouped together as the Fruitland coal zone (Fr zone) since they are generally discontinuous, noncorrelative, and less than reserve base thickness (5 ft [1.5 m]). Due to these characteristics, derivative maps of the Fruitland zone were not constructed.

Fruitland Formation coals in the southern part of the San Juan Basin are considered to be high volatile C bituminous in rank, although they vary from subbituminous A to high volatile A in rank. The rank has been determined on a moist, mineral-matter-free basis with calorific values ranging from 11,246 to 14,102 Btu's per pound (26,158-32,801 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 3.9 to 14.6 percent, sulfur content generally less than one percent, ash content ranging from 13.65 to 35.14 percent, and heating values on the order of 9,627 Btu's per pound (22,392

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-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	
J-51245	Channel, Open Pit	NW¼ 9	22	14	------------	A	19.1	33.4	40.7	6.8	0.9	9,280	Noncaking.
						B	----	41.3	50.3	8.4	1.2	11,470	Coal probably
						C	----	45.1	54.9	----	1.3	12,520	weathered

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

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

Menefee Coal Zone

The structure contour map of the Menefee coal zone (CRO Plate 5) was constructed using the top of the La Ventana Tongue of the Cliff House Sandstone. The La Ventana Tongue is contemporaneous with the coal-bearing Hogback Mountain Tongue of the Menefee Formation (Beaumont, 1971) and exhibits a distinctive character on geophysical logs. Therefore, it portrays the upper boundary of the coal-bearing Menefee zone more consistently than the randomly-occuring uppermost Menefee coal. The correlation of the top of the La Ventana with the top of the Menefee zone was established for use in the surrounding quadrangles and has been continued throughout this quadrangle, even though the Hogback Mountain Tongue is present only in the southern portion.

As illustrated by the structure contour map (CRO Plate 5), the Menefee coal zone dips approximately 1° to the northeast. Consequently, overburden (CRO Plate 6) increases from less than 1,400 ft (427 m) in the southwest to greater than 2,400 ft (731 m) in the northeast. The total amount of interburden within the Menefee zone (CRO Plate 6) varies from less than 1,550 ft (472 m) to greater than 1,750 ft (533 m). These large values are the result of the stratigraphic spread of the coal beds and reflect the thickness of the undifferentiated Menefee Formation plus the interfingering La Ventana and Hogback Mountain Tongues.

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
*29	Drill Cuttings	NW 5	22	10	------------	A	4.52	-----	-----	13.65	0.59	11,035	
						B	-----	-----	-----	14.30	0.62	11,577	
						C	-----	-----	-----	-----	----	13,485	
*34	Drill Cuttings	SE 9	22	10	------------	A	9.28	29.96	38.42	23.04	0.54	9,240	
						B	-----	32.25	42.35	25.40	0.60	10,185	
						C	-----	-----	-----	-----	----	13,653	
J-63526	Core Sample	NE 15	22	10	269.0-290.2	A	12.4	33.9	37.6	16.1	0.49	9,630	
						B	-----	38.7	42.9	18.4	0.56	10,990	
						C	-----	47.5	52.5	-----	0.68	13,470	
*27	Drill Cuttings	NW 12	22	11	104-110	A	5.01	-----	-----	35.14	0.44	7,740	May be
						B	-----	-----	-----	36.99	0.46	8,148	weathered
						C	-----	-----	-----	-----	----	12,931	sample
*	Drill Cuttings	NW 12	22	11	155-159	A	5.42	------	-----	19.41	0.66	10,427	
						B	-----	------	-----	20.52	0.70	10,835	
						C	-----	------	-----	-----	----	13,634	
J-63220	Core Sample	NE 29	23	11	252.5-283.0	A	12.7	31.9	34.3	21.2	0.3	8,680	
						B	-----	36.5	39.3	24.2	0.4	9,940	
						C	-----	48.2	51.8	-----	0.5	13,120	
J-61645	Core Sample	NE 29	23	11	321.5-330.0	A	14.6	30.8	38.6	16.0	0.34	9,440	
						B	-----	36.1	45.2	18.7	0.40	11,050	
						C	-----	44.4	55.6	-----	0.49	13,600	
*21-A	Drill Cuttings	SW 9	23	12	------------	A	5.28	------	----	18.09	0.59	10,206	
						B	-----	------	----	19.10	0.62	10,775	
						C	-----	------	----	-----	----	13,319	
*23	Core Sample	NE¼ 10	23	12	------------	A	9.39	30.11	43.10	17.41	0.72	9,915	
						B	-----	33.23	47.56	19.21	0.79	10,942	
						C	-----	------	-----	-----	----	13,544	
H-5022	Dorfman Production Nancy Fed. No. 1	SE¼ 12	24	8	2,525-2,535	A	3.9	35.4	33.7	27.0	1.1	9,960	
						B	-----	36.8	35.1	28.1	1.1	10,370	
						C	-----	51.2	48.8	-----	1.5	14,410	

*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.

The isopach map (CRO Plate 4) illustrates the total combined thickness of the individual coal beds of the Menefee zone. Throughout most of the quadrangle these coal beds are less than reserve base thickness (5 ft [1.5 m]). Exceptions are drill hole 17, with two 6-ft (1.8-m) beds and one 7-ft (2.1-m) coal bed; drill hole 18, with a 5-ft (1.5-m) coal bed; drill hole 21, with a 7-ft (2.1-m) coal bed; and drill hole 59, with a 5-ft (1.5-m) coal bed. The greatest combined thickness occurs in the southwestern portion of the quadrangle, where the total is more than 30 ft (9.1 m) of coal. To the north, the total coal is less than 5 ft (1.5 m) in thickness.

Chemical Analyses of the Menefee Zone Coal Beds - No published analyses of the quality of Menefee Formation coals are available for this quadrangle. However, information from surrounding areas is assumed to be similar to that of the coals of this quadrangle. Analyses of several coals are given in Table 1 (Lease, 1971; Shomaker, 1971a).

Fruitland 1 Coal Bed

The Fruitland 1 coal bed, informally named by the authors, represents the lowermost coal bed which occurs near the base of the Fruitland Formation. Although the Fruitland 1 coal bed is correlated and mapped as a continuous horizon, it may, in fact, be several different beds that are lithostratigraphically equivalent, but not laterally continuous.

As illustrated by the structure contour map (CRO Plate 8), the coal bed dips approximately 1° to the northeast. Consequently, overburden (CRO Plate 9) increases from less than 600 ft (183 m) in the southwest to greater than 1,600 ft (488 m) in the northeast portion of the quadrangle.

The thickness, as shown by the isopach map (CRO Plate 7), ranges from less than 5 ft (1.5 m) in the north to greater than 20 ft (6.1 m) in the central and northwestern parts.

Chemical Analyses of the Fruitland 1 Coal Bed - No published analyses of the quality of Fruitland Formation coals are available for this quadrangle. However, information from the surrounding area is assumed to be similar to that for the coals of this quadrangle. The results of analyses of several undesignated Fruitland coals are given in Table 2 (Fassett and Hinds, 1971; Shomaker, 1971b).

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 coal beds in the Huerfano Trading Post SW quadrangle are more than 790 ft (241 m) below the ground surface and, therefore, have no outcrop or surface development potential.

The U.S. Geological Survey designated the Fruitland 1 coal bed for the determination of coal resources in this quadrangle. Coals of the Menefee Formation and Fruitland zone were not evaluated; the thickness of the Fruitland zone coal beds is generally less than the reserve base thickness 5 ft [1.5 m]) and the Menefee zone coals are irregular and noncorrelative. In addition, the Fruitland and Menefee zone coals are limited in areal extent.

For Reserve Base and Reserve calculations, the Fruitland 1 coal bed was areally divided into measured, indicated, and inferred resource categories (CRO Plate 10), 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 7) and areal distribution maps (CRO Plate 10). The surface area of the isopached Fruitland 1 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, which 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 coal bed are shown on CRO Plate 10, 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 980 million short tons (889 million metric tons).

The coal development potential for the Fruitland 1 bed is 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 Huerfano Trading Post SW quadrangle has development potential for subsurface mining methods only (CDP Plate 11).

COAL DEVELOPMENT POTENTIAL

Coal beds of 5 ft (1.5 m) or more in thickness which are overlain by more than 200 ft (61 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 coal bed.

Development Potential for Surface Mining Methods

All coal beds of the Huerfano Trading Post SW quadrangle occur 790 ft (241 m) or more below the ground surface, and, therefore, have no development potential for surface mining methods.

Development Potential for Subsurface Mining Methods

Underground coal of the Fruitland 1 coal bed has high development potential in the southwest quarter of the area and along the southern quadrangle boundary. The coal bed thickness varies from less than 10 ft (3.0 m) in the southwest corner to 20 ft (6.1 m) near the center of the quadrangle (CRO Plate 7). Overburden thickness increases from southwest to northeast, ranging from 600 to 1,000 ft (183-305 m) (CRO Plate 9).

The remainder of the quadrangle area has moderate development potential for the Fruitland 1 coal bed with the exception of a small area of

TABLE 3

COAL RESOURCE DATA FOR UNDERGROUND MINING METHODS FOR FEDERAL COAL LANDS (in short tons) IN THE HUERFANO TRADING POST SW 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 1	309,851,000	675,516,000	0	985,367,000
TOTAL	309,851,000	675,516,000	0	985,367,000

unknown potential. Coal bed thickness in the area of moderate potential varies from 5 to 23 ft (1.5-7.0 m) and the overburden ranges from 1,000 ft (305 m) thick at the center of the quadrangle to 1,600 ft (488 m) in the northeast. A 40-acre section with unknown development potential occurs near the north-central border of the quadrangle where the Fruitland 1 coal bed is less than 5 ft (1.5 m) thick.

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