UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Text to accompany:

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1985

FEDERAL COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE EL DADO 7 1/2-MINUTE QUADRANGLE, McKINLEY COUNTY, NEW MEXICO

[Report includes 14 plates]

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EL DADO QUADRANGLE
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INTRODUCTION

Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the El Dado 7½ minute quadrangle, McKinley County, New Mexico. These maps and report are part of an evaluation of fifty-six 7½ minute quadrangles in northwestern New Mexico which were completed under U. S. Geological Survey Contract No. 14-08-0001-17459 (see figs. 1 and 2).

The purpose of this Coal Resource Occurrence-Coal Development Potential program, which was conceived by Congress as part of its Federal Coal Leasing Amendments Act of 1976, is to obtain coal resource information and to determine the geographical extent of Federal coal deposits. In addition, the program is intended to provide information on the amount of coal recoverable by various mining methods and to serve as a guide for land-use planning.

The U. S. Geological Survey initiated the program by identifying areas underlain by coal resources. These areas were designated Known Recoverable Coal Resource Areas based on the presence of minable coal thicknesses, adequate areal extent of these coal deposits, and the potential for developing commercial quantities of coal at minable depths.

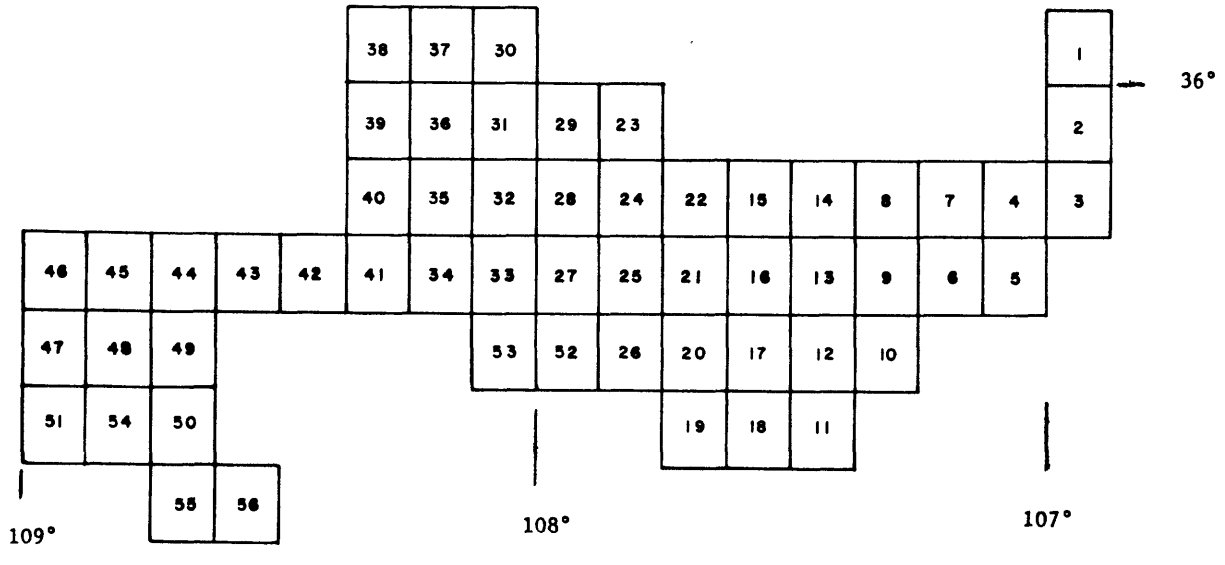
This report is limited to coal resources which are 3,000 ft (914 m) or less below ground surface. Published and unpublished public information was used as the data base for this study. No new drilling or field mapping was performed as part of this study, nor were any confidential data used.

LOCATION OF PROJECT AREA

FIGURE 1

FIGURE 2.--Index to USGS 7 1/2-minute quadrangles and coal resource occurrence/ coal development potential maps for the southern San Juan Basin area, New Mexico

Map No.	Quadrangle	Open-file report
1	Cuba	79- 623
2	San Pablo	79- 624
3	La Ventana	79-1038
4	Headcut Reservoir	79-1043
5	San Luis	79-1044
6	Arroyo Empedrado	79-1045
7	Wolf Stand	79-1046
8	Tinian	79- 625
9	Canada Calladita	79- 626
10	Cerro Parido	79- 627
11	El Dado Mesa	79- 628
12	Mesa Cortada	79- 629
13	Mesita del Gavilan	79- 630
14	Rincon Marquez	79- 631
15	Whitehorse Rincon	79- 632
16	Mesita Americana	79- 633
17	El Dado	79- 634
18	Cerro Alesna	79- 635
19	San Lucas Dam	79- 636
20	Piedra de la Aguila	79-1039
21	Hospah	79- 637
22	Whitehorse	79-1040
23	Seven Lakes NE	79- 638
24	Kin Nahzin Ruins	79- 639
25	Orphan Annie Rock	79-1041
26	Mesa de los Toros	79-1122
27	Laguna Castillo	79- 640
28	Seven Lakes	79-1042
29	Seven Lakes NW	79-1123
30	Kin Klizhin Ruins	79-1047
31	Nose Rock	79- 641
32	Becenti Lake	79-1124
33	Heart Rock	79- 642
34	Crownpoint	79-1125
35	Antelope Lookout Mesa	79-1376
36	Milk Lake	79-1377
37	La Vida Mission	79-1378
38	The Pillar 3 SE	79-1379
39	Red Lake Well	79-1380
40	Standing Rock	79-1381
41	Dalton Pass	80- 026
42	Oak Spring	80- 027
43	Hard Ground Flats	80- 028
44	Big Rock Hill	80- 029
45	Twin Lakes	80- 030
46	Tse Bonita School	80- 031
47	Samson Lake	80- 032
48	Gallup West	80- 033
49	Gallup East	80- 034
50	Bread Springs	80- 035
51	Manuelito	80- 036
52	Borrego Pass	80- 037
53	Casamero Lake	80- 038
54	Twin Buttes	80- 039
55	Pinehaven	80- 040
56	Upper Nutria	80- 041



Location

The El Dado 7½ minute quadrangle includes acreage in Tps. 15 and 16 N., Rs. 6 and 7 W. of the New Mexico Principal Meridian, McKinley County, northwestern New Mexico (see figs. 1 and 2).

Accessibility

No paved roads pass through the El Dado quadrangle. A light-duty maintained road provides access to the town of San Mateo, 14 mi (23 km) southwest of the quadrangle. Dirt roads and jeep trails traverse most parts of the area. The Atchison, Topeka, and Santa Fe Railroad line passes about 30 mi (48 km) due south of the quadrangle (see fig. 1).

Physiography

The El Dado quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). The topography of the quadrangle is mesa-and-canyon.

No perennial streams are present in the quadrangle. Local drainage is provided by San Miguel Creek, Chico Arroyo, San Isidro Arroyos and the Alfredo Padilla Arroyo. Elevations within the quadrangle range from less than 6,440 ft (1,963 m) along Chico Arroyo in the northeast to 6,888 ft (2,099 m) on El Dado Peak in the southeastern corner.

Climate

The climate of this area is semiarid to arid. The following temperature and precipitation data were reported by the National Oceanic and Atmospheric Administration for the San Mateo Station. The El Dado quadrangle is about 14 mi (23 km) NNE of the San Mateo Station. Average total annual precipitation for ten of the previous fifteen years is 8.37 in (21.26 cm). Intense thunderstorms in July, August, and September account for the majority of precipitation. The area is susceptible to flash flooding associated with these thunderstorms. Mean annual temperature for four of the previous fifteen years is 48.8°F (9.3°C). The average daily temperatures in January and July are 28.3°F (-2.1°C) and 69.0°F (20.6°C), respectively.

Land status

The Federal Government holds the coal mineral rights to approximately 25 percent of the El Dado quadrangle. For the specific coal ownership boundaries, see plate 2. It is not within the scope of this report to provide detailed land-surface ownership. All of the quadrangle except about 4,480 acres (1,813 ha) in the eastern part is within the Hospah Known Recoverable Coal Resource Area. About 3,100 acres (1,255 ha) in the southeastern part of the quadrangle are within the Felipe Tafoya Land Grant. As of October 26, 1978, there were no Federal coal leases, coal preference right lease applications or coal exploration licenses within the El Dado quadrangle.

GENERAL GEOLOGY

Previous work

Early reports on the area include reconnaissance mapping by Gardner (1910) who measured two coal outcrops within the El Dado quadrangle. Hunt (1936) mapped the area and reported Menefee Cleary coals in lenses up to 2.0 ft (0.6 m) thick. Shomaker, Beaumont, and Kottlowski (1971) reported Menefee Cleary coals, and based upon coal outcrop measurements and coal test holes, they estimated reserves of 20.88 million short tons (18.94 million t) at depths of less than 150 ft (46 m) in T. 15 N., R. 7 W. Approximately 70 percent of T. 15 N., R. 7 W. is within the El Dado quadrangle.

Stratigraphy

Within the San Juan Basin, the shoreline positions of the Cretaceous seaways changed innumerable times. The overall regional alignment of the shorelines trended N. 60° W. - S. 60° E. (Sears, Hunt, and Hendricks, 1941). The transgressive and regressive shoreline migrations are evidenced by the intertonguing relationships of continental and marine facies. Rates of trough (geosynclinal) subsidence and the availability of sediment supplies are the major factors that controlled the transgressive-regressive sequences.

Exposed rock units in the El Dado quadrangle include some of the sedimentary units of Upper Cretaceous age. There is Quaternary alluvium along drainages in the area.

The Dakota Sandstone represents coastal sands, fluvial deposits, and marine shales, and is the basal unit of the Upper Cretaceous section. The Dakota Sandstone is composed of yellowish-brown to buff, fine-to medium-grained sandstone with interbedded dark gray to black, carbonaceous shales, and coals. Thickness of the unit ranges from 290 to 340 ft (88 to 104 m) locally. The "main body" of the Mancos Shale overlies the Dakota Sandstone, and represents transgressive marine deposits. Light to dark gray, silty shales with interbedded brown, calcareous sandstones comprise the lithologies of the Mancos Shales, which ranges from 640 to 725 ft (195 to 221 m) thick locally.

A major northeastward regression of the Cretaceous seaways resulted in deposition of the Gallup Sandstone in a nearshore or littoral environment. Pink to gray, fine-to very coarse-grained, massive sandstone, interbedded gray shales, and coal beds comprise the lithologies of the unit, which ranges from 180 to 230 ft (55 to 70 m) thick locally. The Dilco Coal Member of the Crevasse Canyon Formation overlies the Gallup Sandstone and represents the continental sediments which were deposited inland from the beach area during the deposition of the Gallup sandstone. Medium to dark gray siltstone with interbedded medium-grained, tan sandstones, and coal beds comprise the lithologies of the Dilco Coal Member, which ranges from 40 to 115 ft (12 to 35 m) thick in the area.

Increased rates of trough subsidence caused the regressive sequence to gradually slow, and finally stop. The seaways deepened and the shorelines advanced southwestward during the succeeding transgressive phase. The Mulatto Tongue of the Mancos Shale was deposited over the Dilco Coal Member and is composed of light gray to tan, silty shale with interbedded reddish-tan, very fine-grained sandstone. Thickness of the unit ranges from 340 to 400 ft (104 to 122 m) in the area. A transitional contact of the Mulatto

Tongue with the overlying Dalton Sandstone Member of the Crevasse Canyon Formation indicates the gradual reversal from transgressive to regressive depositional conditions.

The Dalton Sandstone Member is composed of yellowish-gray, very fine-grained, quartzose sandstone which formed in a nearshore environment and ranges from 0 to 110 ft (0 to 34 m) thick locally. The Gibson Coal Member of the Crevasse Canyon Formation overlies the Dalton Sandstone Member and represents the continental sediments which were deposited inland from the beach area during the deposition of the Dalton Sandstone Member. Medium gray, carbonaceous siltstone with interbedded gray to tan, sandstones and coal beds comprise the lithologies of the Gibson Coal Member, which ranges from 0 to 120 ft (0 to 37 m) thick in the area. Increased rates of trough subsidence resulted in the gradual reversal from regressive to transgressive conditions, and the Hosta Tongue of the Point Lookout Sandstone was deposited during the advancing shoreline sequence. The Hosta Tongue overlies the Gibson Coal Member and is composed of light gray to reddish-brown, fine-to medium-grained sandstone with interbedded shales, and ranges from 70 to 300 ft (21 to 91 m) thick locally.

In this quadrangle, the depositional limits of the Dalton Sandstone Member and Gibson Coal Member occur because the units become undistinguishable in the massive buildup of the Hosta Tongue. Intertonguing of these rock units occurs near the central portion of the quadrangle, and the Dalton Sandstone Member and Gibson Coal Member are not present in the northeastern portion of the El Dado quadrangle.

As the transgression proceeded and the Cretaceous seaways deepened, the Satan Tongue of the Mancos Shale was deposited over the Hosta Tongue. The Satan Tongue is compsed of light to dark gray, silty shales with interbedded

tan to buff sandstone, and ranges from 190 to 230 ft (58 to 70 m) thick locally. The Point Lookout Sandstone overlies the Satan Tongue, and represents nearshore or littoral deposits which formed during the most extensive northeastward retreat prior to the final withdrawal of the Cretaceous seaways in the San Juan Basin (Sears, Hunt, and Hendricks, 1941). Lithology of the Point Lookout Sandstone is similar to the Hosta Tongue. The continental sediments deposited inland from the beach area during the deposition of the Point Lookout Sandstone compose the overlying Menefee Formation.

The Menefee Formation consists of dark gray to brown, carbonaceous to noncarbonaceous shales, light gray sandstones, and coal beds, and is divisible into the basal Cleary Coal Member and upper Allison Member. A massive channel sandstone sequence defines the boundary between the two members. The Cleary Coal Member contains the youngest coal beds identified in this quadrangle. Erosion has reduced the unit thickness to about 250 ft (76 m) in this area. The Allison Member has been eroded in the El Dado quadrangle.

Depositional environments

The Cretaceous System sedimentary units in the quadrangle represent transgressive and regressive depositional conditions. There were innumerable minor cycles of widely varying duration and extent within the major sedimentary sequences. The paucity of data in this quadrangle and the intended scope of this report permit only general interpretations of the depositional environments.

The Cretaceous coal deposits of the San Juan Basin are products of former coastal swamps and marshes. These swamps and marshes were supported by heavy precipitation and a climate conducive to rapid vegetal growth in

moderately fresh water. Due to the relatively low sulfur contents of the San Juan Basin coals, Shomaker and Whyte (1977) suggest the coals formed in fresh water environments.

Most of the coal-bearing units were deposited in coastal plain environments. The majority of the peat deposits formed in a transition zone between lower and upper deltaic sediments during periods of relative shoreline stability. Coals also formed in lake margin swamps inland from the coastal area. Shoreline oscillations and the subsequent influx of continental or marine debris upon the peat accumulations produced the vertical buildup or "stacking" of peat deposits. This sediment debris is represented by variable ash contents, rock partings, and splits within the coal seams.

The peat accumulated in lenses or pods which were generally parallel to the ancient shorelines. The coals in the lower portions of the coal-bearing units represent regressive depositional conditions (Sears, Hunt, and Hendricks, 1941). The coals in the upper portions of these units are relatively sporadic in occurrence.

Structure

The El Dado quadrangle is in the Chaco Slope structural division in the southern portion of the structural depression known as the San Juan Basin (Kelley, 1950). The uplifted and eroded San Miguel Creek Dome is a prominent structural feature in the eastern part of the quadrangle. Hunt (1936) mapped several east-west trending faults in the area which are associated with the dome. Dips are variable in the quadrangle, ranging from 1^{o} to 2^{o} NE on the western flank of the San Miguel Creek Dome, to $\frac{1}{2}^{o}$ to 2^{o} NE to NW in the western portion of the quadrangle. Localized folding has been mapped throughout the area.

COAL GEOLOGY

In this quadrangle, the authors identified two coal beds and four coal zones from surface mapping by Hunt (1936), a coal test hole, and an oil and gas well log. Most of the other oil and gas well logs from the quadrangle are unsuitable to conclusively determine the existence and thickness of coal beds, and data from them were not used. These coal beds and coal zones are here informally called the Menefee Cleary coal zone, Menefee Cleary No. 1 and No. 2 coal beds, Crevasse Canyon Gibson coal zone, Crevasse Canyon Dilco coal zone, and Dakota coal zone.

The Dakota coal zone contains, stratigraphically, the lowest identified coal bed in the El Dado quadrangle, which consists of a single 2.0 ft (0.6 m) thick bed. About 1,050 ft (320 m) above the Dakota coal zone, the Crevasse Canyon Dilco coal zone consists of a single 2.0 ft (0.6 m) thick coal bed. The Crevasse Canyon Gibson coal zone is identified in the oil and gas well log about 690 ft (210 m) above the Dilco coal zone, and consists of four beds with 9.0 ft (2.7 m) of total coal.

Other identified coal beds occur within the Cleary Coal Member of the Menefee Formation. The Menefee Cleary No. 1 coal bed was identified in three measured sections, and ranges in thickness from 1.2 to 5.7 ft (0.4 to 1.7). The Menefee Cleary No. 2 coal bed was not identified in drill holes or measured sections, but was inferred to exist in the quadrangle based on data in the western adjacent Piedra de la Aguila quadrangle. Beds of the Menefee Cleary coal zone are stratigraphically the highest beds identified. The zone coal beds range in thickness from 0.7 to 3.0 ft (0.2 to 0.9 m).

There are no published coal quality analyses for coal beds from the El Dado quadrangle. An analysis of Cleary Coal Member beds from a core test hole taken about 12 mi (19 km) NW of the quadrangle has been reported by

Shomaker, Beaumont, and Kottlowski (1971) and is shown in table 1. The Cleary Coal Member bed analyzed is probably similar in quality to the Cleary Coal Member beds in this quadrangle. Rank of the Cleary Coal Member seams is probably subbituminous A to high volatile C bituminous in this area.

There are no published coal quality analyses for Gibson Coal Member beds from this quadrangle. An analysis of Gibson Coal Member seams from the abandoned Boone mine taken about 20 mi (32 km) SW of the quadrangle has been reported by the U. S. Bureau of Mines (1936) and is shown in table 2. The Gibson Coal Member bed analyzed is probably similar in quality to the Gibson Coal Member beds in this quadrangle. Rank of the Gibson Coal Member seams is probably high volatile C bituminous in this area.

Menefee Cleary coal zone

Hunt (1936) measured three coal outcrops along an extensive Menefee Cleary zone outcrop near the base of the Cleary Coal Member, and mapped stratigraphically higher zone outcrops in the northeastern and southwestern parts of the quadrangle. Zone coals were also identified in a coal test hole.

The Menefee Cleary coal zone was inferred to pinch out where no coal was mapped along the basal outcrop. Total zone coal thickness is inferred to exceed 2.0 ft (0.6 m) in the northeast corner of the quadrangle, based on data from adjacent quadrangles. Isopachs with values greater than 7.0 ft (2.1 m) are inferred from coal data in the western adjacent Piedra de la Aguila quadrangle (see plate 4). The zone structure contour map (plate 5) is drawn on the base of the Menefee Cleary coal zone, which is about 40 ft (12 m) above the Point Lookout Sandstone. Existence and character of the Menefee Cleary zone coals are unknown in the northwest part of the quadrangle because of insufficient data.

Table 1. - Analysis of a coal sample from the Cleary Coal Member of the Menefee Formation.

(Core sample from sec. 36, T. 17 N., R. 10 W.)

[Form of analysis; A, as received; B, moisture free; C, moisture and ash free]

from Shomaker, Beaumont, and Kottlowski, 1971

Form of analysis	Proximate analysis (percent)				Sulfur (percent)	Heating value (Btu/lb)
	Moisture	Volatile Matter	Fixed Carbon	Ash		
A	16.5	33.4	40.4	9.7	0.6	10,070
B	----	40.0	48.3	11.7	0.7	12,060
C	----	45.3	54.7	----	0.8	13,650

Remarks:

A moist, mineral-matter-free (MMMF) calculation using Parr formula (American Society for Testing and Materials, 1973) yields a heating value of 11,256 Btu/lb (26,181 kJ/kg). The free-swelling index of the analysis shows the sample to be nonagglomerating.

Table 2. - Analysis of a coal sample from the Gibson Coal Member of the Crevasse Canyon Formation.

(Boone Mine sample from sec. 6, T. 11 N., R. 8 W.)

[Form of analysis: A, as received; B, moisture free; C, moisture and ash free]

from U. S. Bureau of Mines, 1936

Form of analysis	Proximate analysis (percent)				Sulfur (percent)	Heating value (Btu/lb)
	Moisture	Volatile Matter	Fixed Carbon	Ash		
A	13.5	37.9	42.9	5.7	0.6	11,400
B	----	43.8	49.6	6.6	0.7	13,170
C	----	46.9	53.1	---	0.8	14,100

Remarks:

A moist, mineral-matter-free (MMMF) calculation, using the Parr formula (American Society for Testing and Materials, 1973) yields a heating value of 12,159 Btu/lb (28,282 kJ/kg). No agglomerating characteristics were included with the analysis.

Menefee Cleary No. 1 and No. 2 coal beds

The Menefee Cleary No. 1 and No. 2 coal beds are the first and second persistent coal beds above the Point Lookout Sandstone. Both beds are mapped on plates 7, 8, and 9 because there is no overlap of isopach, structure contours or overburden isopachs. A coal bed separation line divides the beds on the plates, and is used to eliminate possible misinterpretations.

The Menefee Cleary No. 1 coal bed is inferred to pinch out in the subfurface west of its outcrop because it is not identified in the coal test hole (drill hole No. 2, plate 3). Because the Menfeee Cleary No. 2 bed is not identified in the test hole it is inferred to pinch out eastward from its inferred occurrence in the western adjacent Piedra de la Aguila quadrangle. Existence and character of both beds are unknown in the northern part of the quadrangle because of insufficient data.

The control point value at outcrop measurement #5 (plate 7) differs from the total coal thicknesses shown in rock/coal measurements on plates 1 and 3. The U. S. Geological Survey specified that coal benches less than 1.0 ft (0.3 m) should not be included in coal bed isopach values. Three coal benches of 0.8, 0.8, and 0.6 ft (0.2, 0.2, and 0.2 m) thick were not included in the total bed thickness (see plate 7).

Crevasse Canyon Gibson coal zone

Four Crevasse Canyon Gibson zone coal beds are identified in a well log from the quadrangle. Map configurations on plates 10, 11, and 12 are generalized, interpretive, and controlled by Crevasse Canyon Gibson zone data in the western adjacent Piedra de la Aguila quadrangle. Existence and character of

the zone coals in the eastern part of the quadrangle are unknown because of insufficient data.

COAL RESOURCES

The U. S. Geological Survey requested resource evaluations of the Menefee Cleary No. 1 and No. 2 coal beds, where the beds are 3.0 ft (0.9 m) or more thick. The evaluation is restricted to Federal coal lands.

The following procedures were prescribed by the U. S. Geological Survey for the calculation of reserve base. Criteria established in U. S. Geological Survey Bulletin 1450-B were used to areally divide both beds into measured, indicated, and inferred reserve base categories. Reserve base was calculated for each category, by section, using data from the isopach and overburden maps (plates 7 and 9). The acreage in each category (measured by planimeter) multiplied by the average coal bed thickness and a bituminous coal conversion factor (1,800 tons of coal per acre-ft) yields the reserve bases for that category. Coal beds with the 3.0 ft (0.9 m) minimum thickness are included in reserve base and reserve data rather than the 28 in (71 cm) minimum thickness prescribed in U. S. Geological Survey Bulletin 1450-B. Reserve figures are derived from reserve base totals by applying recovery factors of 85 percent and 50 percent for coal beds 0 to 200 ft (0 to 61 m) and 200 to 3,000 ft (61 to 914 m) deep, respectively. All reserve base and reserve values are rounded to the nearest 10,000 short tons (9,072 t).

Total reserve base data, which include all reserve base categories, are shown by section on plate 2. Reserve base and reserve data in the various categories are shown on plate 13.

The U. S. Geological Survey also requested resource evaluations of the

Menefee Cleary and Crevasse Canyon Gibson coal zones, where the total zone coal thickness is 5.0 ft (1.5 m) or greater. Total identified resources for the Menefee Cleary coal zone in the El Dado quadrangle are 20.97 million short tons (19.02 million t). Total identified resources for the Crevasse Canyon Gibson coal zone are 25.07 million short tons (22.74 million t).

COAL DEVELOPMENT POTENTIAL

The factors used to determine the development potential are the presence of a potentially coal-bearing formation, and the thickness and overburden of correlative coal beds. The U. S. Geological Survey supplied the criteria to evaluate the coal development potential for Federal lands in this quadrangle. These criteria are based on current industry practice, U. S. Geological Survey Bulletin 1450-B, and anticipated technological advances. All available data were utilized for the surface and subsurface coal development potential evaluations.

Any area underlain by a potentially coal-bearing formation with 200 ft or less of overburden has potential for surface mining. The U. S. Geological Survey designated the 200 ft (61 m) maximum depth as the stripping limit. Areas where a potentially coal-bearing formation is overlain by more than 200 ft (61 m) of overburden have no potential for surface mining. Areas with no correlative coal bed or a correlative coal bed less than 3.0 ft (0.9 m) in thickness and overlain by 200 ft (61 m) or less of overburden have unknown surface mining potential. These areas which have potential for surface mining are assigned a high, moderate or low development potential based on the mining ratio (cubic yards of overburden per short ton of recoverable coal).

The formula used for calculating mining ratios is:

$$MR = \frac{t_o\ (C)}{t_c (Rf)}$$

Where MR = Mining ratio

t_o = Thickness of overburden in feet

t_c = Thickness of coal in feet

Rf = Recovery factor

C = Volume-weight conversion factor

(.896 yd^3/short ton for bituminous coal)

(.911 yd^3/short ton for subbituminous coal)

High, moderate, and low development potential areas have respective surface mining ratio values of 0 to 10, 10 to 15, and greater than 15.

Any area underlain by a potentially coal-bearing formation with 200 to 3,000 ft (61 to 914 m) of overburden has potential for subsurface mining. Areas where a potentially coal-bearing formation is overlain by more than 3,000 ft (914 m) of overburden have no subsurface mining potential. Development potential for subsurface mining is unknown where a potentially coal-bearing formation within 200 to 3,000 ft (61 to 914 m) of the surface contains no identified correlative coal bed or a correlative coal bed less than 3.0 ft (0.9 m) thick. High, moderate, and low development potential areas have respective overburden values of 200 to 1,000 ft (61 to 305 m), 1,000 to 2,000 ft (305 to 610 m), and 2,000 to 3,000 ft (610 to 914 m).

The no and unknown development potential boundaries for surface mining methods (plate 14) are defined at the contact of the coal-bearing Menefee

Formation with the underlying noncoal-bearing Point Lookout Sandstone. Additional no and unknown development potential boundaries are defined at the contact of the coal-bearing Gibson Coal Member of the Crevasse Canyon Formation with the underlying noncoal-bearing Dalton Sandstone Member. These contacts are approximated due to the inaccuracies of adjusting old geologic maps to modern topographic bases.

Boundaries of coal development potential areas coincide with the boundaries of the smallest legal land subdivision (40 acres or lot). When a land subdivision contains areas with different development potentials, the potential shown on the map is that of the areally largest component area. When an area is underlain by more than one bed, the potential shown on the map is that of the bed with the highest potential.

Reserve base (in short tons) in the various development potential categories for surface and subsurface mining methods are shown in tables 3 and 4, respectively.

The coal development potential maps are subject to revision. Map boundary lines and reserve base values are based on coal resource occurrence map isopachs, overburden isopachs, and coal bed correlations that are interpretive and subject to change as additional coal information becomes available. Coal within the Menefee Cleary and Crevasse Canyon Gibson coal zones were not evaluated for development potential in the El Dado quadrangle.

Development potential for surface mining methods

The coal development potential for surface mining methods in the El Dado quadrangle is shown on plate 14. Based on coal development criteria, all Federal coal lands have high, low, unknown or no surface mining potentials.

Refer to table 5 for reserves and planimetered acreage, by section, for Federal coal lands with surface mining potential.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in the El Dado quadrangle is shown on fig. 3. Based on coal development criteria, all Federal coal lands have high or unknown subsurface mining potentials. Refer to table 6 for reserves and planimetered acreage, by section, for Federal coal lands with subsurface mining potential.

In situ gasification of coal has not been done on a commercial scale in the United States and criteria for rating the development potential of this method are unknown.

Figure 3

COAL DEVELOPMENT POTENTIAL FOR SUBSURFACE MINING METHODS

(See explanation p. 22)

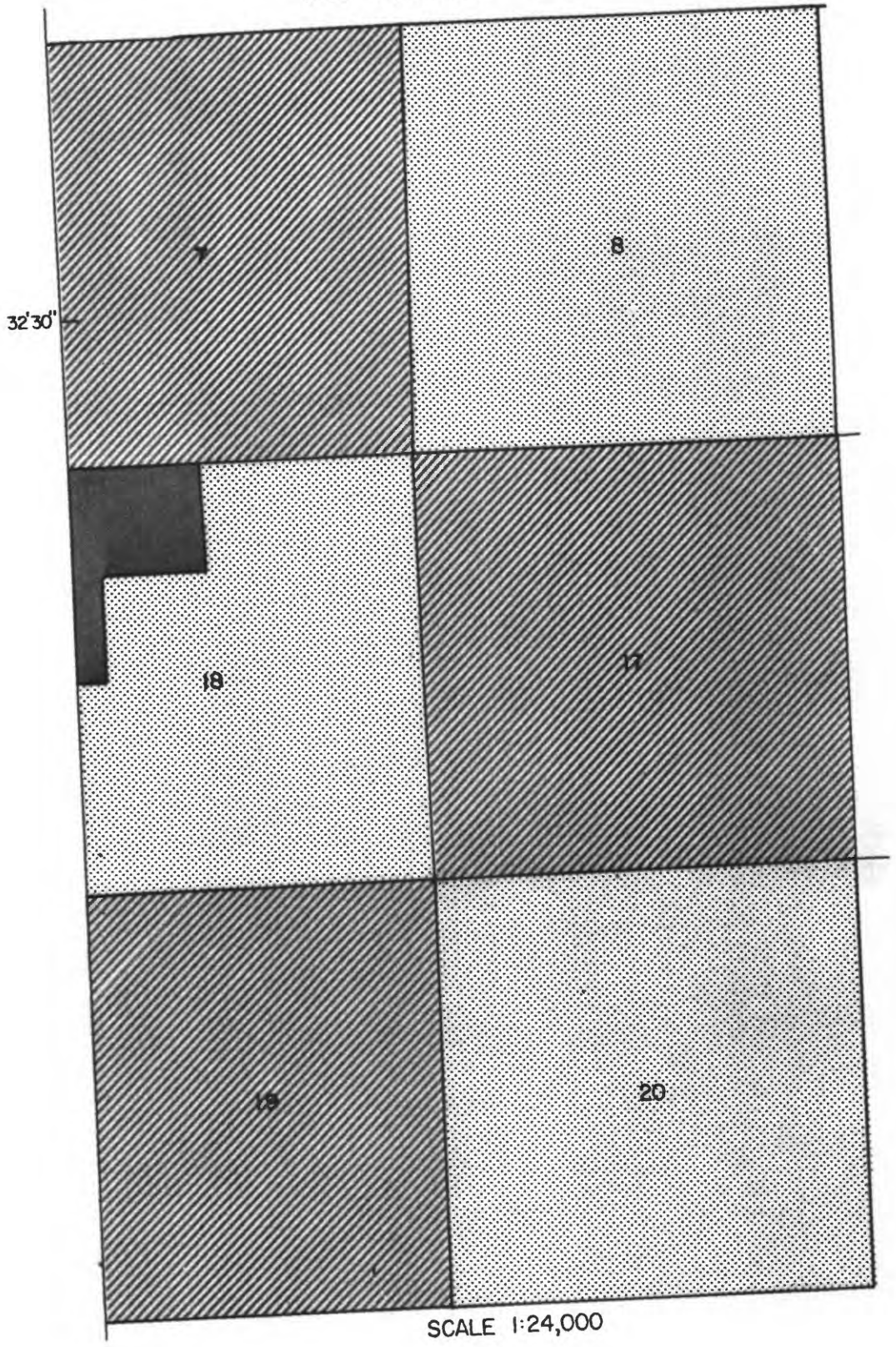
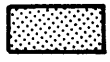


Figure 3

EXPLANATION

NON-FEDERAL COAL LAND-Land for which the Federal Government does not own the coal rights, and for which the coal development potential is not rated.

AREA OF HIGH COAL DEVELOPMENT POTENTIAL FOR SUBSURFACE MINING METHODS-For the Menefee Cleary No. 2 coal bed in areas where the overburden ranges in thickness from 200 to 1,000 feet (61-305 meters).



AREA OF UNKNOWN COAL DEVELOPMENT POTENTIAL FOR SUBSURFACE MINING METHODS-Includes areas where the overburden is less than 3,000 feet (914 meters) with coal thickness less than 3.0 feet (0.9 meters), areas with insufficient data, areas outside the coal outcrop or limit of coal beds within the Menefee or Crevasse Canyon Formation.

To convert feet to meters, multiply feet by 0.3048.

Table 3. - Reserve base data (in short tons) for surface mining methods for Federal coal lands in the El Dado quadrangle, McKinley County, New Mexico.

[Development potentials are based on mining ratios (cubic yards of overburden/ton of underlying coal). To convert short tons to metric tonnes, multiply by 0.9072; to convert mining ratios in yds^3/ton coal to m^3/t, multiply by 0.842].

Coal Bed	High Development Potential (0-10 Mining Ratio)	Moderate Development Potential (10-15 Mining Ratio)	Low Development Potential (greater than 15 Mining Ratio)	Total
Menefee Cleary No. 1	1,850,000	80,000	-------	1,930,000
Menefee Cleary No. 2	---------	------	860,000	860,000
Total	1,850,000	80,000	860,000	2,790,000

Table 4. - Reserve base data (in short tons) for subsurface mining methods for Federal coal lands in the El Dado quadrangle, McKinley County, New Mexico.

[Development potentials are based on thickness of overburden. To convert short tons to metric tonnes, multiply by 0.9072].

Coal Bed	High Development Potential (200'-1,000' overburden)	Moderate Development Potential (1,000'-2,000' overburden)	Low Development Potential (2,000'-3,000' overburden)	Total
Menefee Cleary No. 2	360,000	---	---	360,000
Total	360,000	---	---	360,000

Table 5. - Reserves and planimetered acreage, by section, for Federal coal lands in the El Dado quadrangle with surface mining potential.

[To convert acres to hectares, divide acres by 2.471; to convert short tons to metric tonnes (t), multiply short tons by 0.9072].

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
High	Menefee Cleary No. 1	10	15	7	187.0	960,000
		26	16	7	16.7	70,000
		34			98.8	530,000
Moderate	Menefee Cleary No. 1	34	16	7	13.7	60,000
Low	Menefee Cleary No. 2	18	15	7	137.7	720,000

Table 6. - Reserves and planimetered acreage, by section, for Federal coal lands in the El Dado quadrangle with subsurface mining potential.

[To convert acres to hectares, divide acres by 2.471; to convert short tons to metric tonnes (t), multiply short tons by 0.9072].

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
High	Menefee Cleary No. 2	18	15	7	50.1	180,000

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coal bed--A stratified sequence of coal, composed of relatively homogeneous material, exhibiting some degree of lithologic unity and separated from the rocks above and below by physically rather well defined boundary planes.

coal bed separation line--A line on a map plate separating areas where different coal beds or zones are mapped.

coal bench--One of two or more divisions of a coal bed separated by rock.

coal conversion factor--A factor used to convert acre-feet of coal into short tons of coal; bituminous coal is 1800 tons/acre-ft; subbituminous coal is 1770 tons/acre-ft.

coal development potential--A subjective determination of the comparative potential of Federal coal lands for development of a commercially viable coal mining operation.

coal exploration license--An area of Federal coal lands in which the licensee is granted the right, after outlining the area and the probable methods of exploration, to investigate the coal resources. An exploration license has a term not to exceed 2 years and does not confer rights to a lease.

coal lease--An area of Federal coal lands in which the Federal Government has entered into a contractual agreement for development of the coal deposits.

coal split--A coal bed resulting from the occurrence of a noncoal parting within the parent coal bed which divides the single coal bed into two or more coal beds.

coal zone--A distinctive stratigraphic interval containing a sequence of alternating coal and noncoal layers in which the coal beds may so lack lateral persistence that correlating individual beds in the zone is not feasible.

Federal coal land--Land for which the Federal Government holds title to the coal mineral rights, without regard to surface ownership.

hypothetical resources--Undiscovered coal resources in beds that may reasonably be expected to exist in known mining districts under known geologic conditions. In general, hypothetical resources are in broad areas of coal fields where points of observation are absent and evidence is from distant outcrops, drill holes or wells. Exploration that confirms their presence and reveals quantity and quality will permit their reclassification as a Reserve or Identified Subeconomic Resource.

identified resources--Specific bodies of coal whose location, rank, quality, and quantity are known from geologic evidence supported by engineering measurements.

indicated--Coal for which estimates for the rank, quality, and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.

inferred--Coal in unexplored extensions of demonstrated resources for which estimates of the quality and quantity are based on geologic evidence and projections.

isopach--A line joining points of equal bed thickness.

Known Recoverable Coal Resource Area (KRCRA)--Formerly called Known Coal Leasing Area (KCLA). Area in which the Federal coal land is classified (1) as subject to the coal leasing provisions of the Mineral Leasing Act of 1920, as amended, and (2) by virtue of the available data being sufficient to permit evaluation as to extent, location, and potential for developing commercial quantities of coal.

measured--Coal for which estimates for rank, quality, and quantity can be computed, within a margin of error of less than 20 percent, from sample analyses and measurements from closely spaced and geologically well known sample sites.

mining ratio--A numerical ratio equating the in-place volumes, in cubic yards, of rocks that must be removed in order to recover 1 short ton of coal by surface mining.

overburden--A stratigraphic interval (composed of noncoal beds and coal beds) lying between the ground surface and the top of a coal bed. For coal zones, overburden is the stratigraphic interval lying between the ground surface and the structural datum used to map the zone.

parting--A noncoal layer occurring along a bedding plane within a coal bed.

Preference Right Lease Application (PRLA)--An area of Federal coal lands for which an application for a noncompetitive coal lease has been made as a result of exploration done under a coal prospecting permit. PRLA's are no longer obtainable.

quality or grade--Refers to measurements such as heat value; fixed carbon; moisture; ash; sulfur; phosphorus; major, minor, and trace elements; coking properties; petrologic properties; and particular organic constituents.

rank--The classification of coal relative to other coals, according to degree of metamorphism, or progressive alteration, in the natural series from lignite to anthracite (Classification of coals by rank, 1973, American Society for Testing and Materials, ASTM Designation D-388-66).

recovery factor--The percentage of total tons of coal estimated to be recoverable from a given area in relation to the total tonnage estimated to be in the Reserve Base in the ground.

reserve--That part of identified coal resource that can be economically mined at the time of determination. The reserve is derived by applying a recovery factor to that component of the identified coal resource designated as the reserve base.

reserve base--That part of identified coal resource from which Reserves are calculated.

stripping limit--A vertical depth, in feet, measured from the surface, reflecting the probable maximum, practical depth to which surface mining may be technologically feasible in the forseeable future. The rock interval, expressed in feet, above the stripping limit is the "strippable interval."

structure contour--A line joining points of equal elevation on a stratum or bed.