UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Text to accompany:

OPEN-FILE REPORT 79-1038

1985

FEDERAL COAL RESOURCE OCCURRENCE AND COAL DEVELOPMENT POTENTIAL MAPS OF THE LA VENTANA 7 1/2-MINUTE QUADRANGLE, SANDOVAL COUNTY, NEW MEXICO

[Report includes 9 plates]

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INTRODUCTION

Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the La Ventana 7½ minute quadrangle, Sandoval 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.

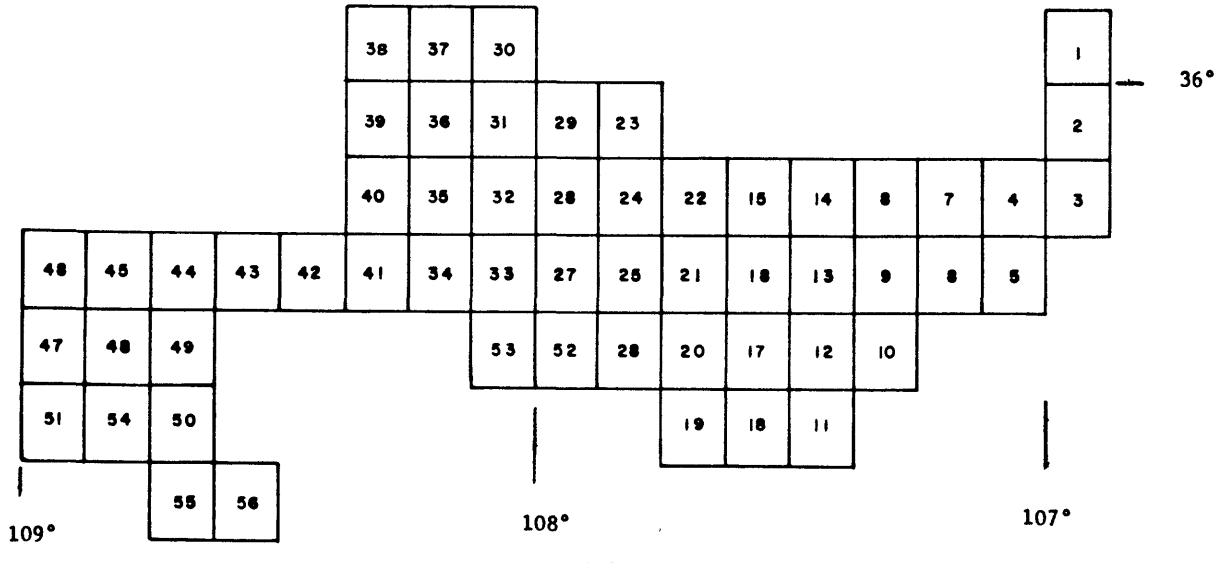
This report is limited to coal resources which are 3,000 ft (914 m) or less below ground surface. Published and unpublished public information was used as the data base for this study. No new drilling or field mapping was performed as part of this study, nor were any confidential data used.


LOCATION OF PROJECT AREA
PROJECT AREA
AREA OF THIS REPORT
COLORADO
ARIZONA
FARMINGTON
ALBUQUERQUE

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 La Ventana 7½ minute quadrangle includes acreage in Tps. 18 and 19 N., Rs. 1 E., 1 and 2 W. of the New Mexico Principal Meridian, Sandoval County, northwestern New Mexico (see figs. 1 and 2). The town of La Ventana is in the northeastern part of the quadrangle.

Accessibility

Access to the La Ventana quadrangle is provided by State Highway 44 from the town of Cuba 11 mi (18 km) north and from the town of San Ysidro 21 mi (34 km) south. Several light-duty roads and jeep trails traverse most parts of the area. The Atchison, Topeka and Santa Fe Railroad line passes about 32 mi (51 km) SE. of the quadrangle (see fig. 1).

Physiography

The La Ventana quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). The Nacimiento Mountains cover the eastern one-fourth of the quadrangle. The remainder of the area is characterized by alluvial valley floors and mesas.

The Rio Puerco is the major drainage in the area. Elevations within the quadrangle range from 6,360 ft (1,939 m) in the southwest corner to 9,250 ft (2,819 m) in the northeast corner of the quadrangle.

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 Cuba Station. The La Ventana quadrangle is about 11 mi (17.7 km) south of the Cuba Station. Average total annual precipitation for thirteen of the previous fifteen years is 13.57 in. (34.47 cm). Intense thunderstorms in July, August, and September account for the majority of precipitation. The area is susceptible to flash flooding associated with these thunderstorsm. Mean annual temperature for seven of the previous fifteen years is 46.2° F (7.9° C). The average daily temperatures in January and July are 25.3 F (-3.7° C) and 68.8° F (20.4° C), respectively.

Land status

The Federal Government holds the mineral coal rights to approximately 96 percent of the La Ventana 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. About 50 percent of the Federal land is within the Ojo del Espiritu Santo grant and this land may only be leased by Indians. About 7,000 acres (2,833 ha) in the northern part of the quadrangle are within the La Ventana Known Recoverable Coal Resource Area. As of October 26, 1978, the Consolidation Coal Company held two Federal coal leases totalling about 586 acres (237 ha) in the northwest corner of the La Ventana quadrangle. There are no coal preference right lease applications or coal exploration licenses in the area.

GENERAL GEOLOGY

Previous work

Early reports on the area include that of Gardner (1910) who described the coal field between San Mateo and Cuba, which covers the La Ventana quadrangle. Dane (1936) mapped and measured coal outcrops in the area. Shomaker, Beaumont and Kottlowski (1971) report the La Ventana field was developed to a minor extent by underground methods and that low sulfur coals of 10,500 Btu's still remain in Cleary Coal and Allison Members of the Menefee Formation. Because of excessive dips and thick sandstone overburden, they consider only small amounts of coal are strippable. Woodward and Schumacher (1973) mapped the surface geology of the quadrangle without respect to coal occurrences.

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^{o} W. - S. 60^{o} 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 influencing the transgressive-regressive shoreline cycles.

Exposed rock units in the La Ventana quadrangle range in age from Precambrian to Quaternary. Precambrian rocks are exposed along the

Nacimiento fault zone along the eastern one-fourth of the quadrangle. Quaternary deposits include alluvium and terrace gravels of the Rio Puerco and its tributaries. Various Tertiary and Upper Cretaceous formations crop out in the area. However, coal occurrences in the La Ventana quadrangle are confined to the upper part of the Allison Member and the Cleary Coal Member of the Menefee Formation.

The Upper Cretaceous Mesaverde Group contains the most important coal-bearing units in the quadrangle. The basal member of this group is the Point Lookout Sandstone in this area, which represents nearshore or littoral deposits that 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). The Point Lookout Sandstone is composed of light gray to reddish-brown, fine to medium-grained sandstone with interbedded shales and is 20 to 150 ft (6 to 46 m) thick locally. The continental sediments deposited inland from the beach area during deposition of the Point Lookout Sandstone compose the 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 averages 230 ft (70 m) thick locally. Sears (1925) defined the Allison Member as the Allison Barren Member containing thin, noncommercial coal beds. In this quadrangle, the Allison Member contains several beds of economic value which were mined in the 1920's and 1930's. Thickness of the member is up to 470 ft (143 m) locally.

Overlying the Menefee Formation, the La Ventana Tongue of the Cliff House Sandstone represents transgressive nearshore or littoral deposits.

The La Ventana Tongue is the youngest Upper Cretaceous unit exposed in this quadrangle, and consists of light gray, medium grained, locally calcareous, massive sandstone with interbedded shales. Erosion has reduced the unit's thickness to about 350 ft (107 m) locally.

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 represents

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

Potions of the La Ventana quadrangle are in the Chaco Slope and Nacimiento Uplift structural divisions in the southern portion of the structural depression known as the San Juan Basin (Kelley, 1950). Numerous faults mapped by Dane (1936) in the northwestern corner of the quadrangle have displaced coal beds of the Menefee Formation. Along the eastern edge of the quadrangle the Nacimiento Uplift, a thrust block, has moved westward at steep angles over basinal strata, bringing Permian-Pennsylvanian rocks in contact with Precambrian rocks (Woodward and Schumacher, 1973). The nearly vertical Pajarito fault is the principal range-marginal fault, and parallels the thrust zone which trends N. - S. The rock units dip less than 10^{o} in the basin and are vertical to overturned west of the fault. East of the fault, dips range from 50^{o} to 85^{o} SE to NE

COAL GEOLOGY

In this quadrangle, the authors identified four coal beds and two coal zones in Dane's (1936) surface outcrop measurements. These beds and coal zones are here informally called the Menefee Allison No. 1 coal bed,

Menefee Allison coal zone, Menefee Cleary coal zone, Menefee Cleary No. 5, No. 4, and No. 1 coal beds.

The Menfeee Allison No. 1 coal bed is stratigraphically the highest bed identified. The bed was mapped at or near the top of the Allison Member. Three thin coal beds which occur from 10 to 22 ft (3 to 7 m) below the Menefee Allison No. 1 bed comprise the Menefee Allison coal zone.

Underlying the Menefee Allison coal zone, the Menefee Cleary coal zone contains several coal beds which occur 18 to 173 ft (5 to 53 m) above the Point Lookout Sandstone. These zone beds may be correlated for limited distances in portions of the area but they lack sufficient continuity with poorly defined stratigraphic position and cannot be designated as persistent coal beds.

The Menefee Cleary No. 5 coal bed was identified in five measured sections and is about 119 to 143 ft (36.3 to 43.6 m) above the Point Lookout Sandstone. The bed thickens to 6.1 ft (1.9 m) at the Cleary Mine in sec. 31, T. 19 N., R. 1 W. Two correlative thin coal beds 0.8 ft (0.2 m) and 1.8 ft (0.5 m) thick occur from 80 to 100 ft (24.4 to 30.5 m) above the Point Lookout Sandstone and were identified as the Menefee Cleary No. 4 coal bed. The bed was mapped by Dane (1936) for about 0.25 mi (0.4 km) in sec. 1, T. 18 N., R. 2 W. and sec. 36, T. 19 N., R. 2 W.

The Menefee Cleary No. 1 coal bed is the lowest bed identified in this quadrangle. The bed occurs 1 to 3 ft (0. 3 to 0.9 m) above the Point Lookout Sandstone in this area, although in nearby areas it is up to 15 ft (5 m) above the Point Lookout Sandstone. Dane (1936) measured the bed at two different outcrops as containing up to 3.5 ft (1.1 m) of total coal.

There are several coal quality analyses for the Cleary Coal Member and Allison Member beds within and 0.6 to 2.3 mi (1.0 to 3.7 km) north to west

of the La Ventana quadrangle. These analyses were reported by the U. S. Bureau of Mines (1936) and are shown in table 1. Rank of the Cleary Coal Member and Allison Member seams is subbituminous C to high volatile C bituminous in this area. The Mitchell prospect sample (sample 3, table 1) is probably a weathered sample because its heating value is well below more typical coal analyses of the area.

Table 1. - Analyses of coal samples from the Allison Member and Cleary Coal Member of the Menefee Formation

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

from U. S. Bureau of Mines, 1936

Sample	Type of sample	Location			Form of analysis	Proximate analysis (percent)				Sulfur	Heating Value (Btu/lb.)
		Sec.	T. N.	R. W.		Moisture	Volatile Matter	Fixed Carbon	Ash		
1	Mine Sample	SE ¼			A	19.1	34.0	40.7	6.2	0.6	10,210
Allison	Anderson	35	19	2	B	----	42.0	50.4	7.6	0.8	12,610
Member	Mine				C	----	45.5	54.5	---	0.9	13,660
2	Prospect	NE ¼			A	17.1	35.0	42.5	4.8	2.1	10,310
Allison	McDonald-Kistler	4	19	1	B	----	42.5	51.7	5.8	2.5	12,530
Member	Prospect Slope				C	----	45.1	54.9	---	2.6	13,300
3	Prospect Sample	SW ¼			A	22.1	35.7	37.7	4.5	0.7	8,790
Cleary Coal	Mitchell prospect	29	19	1	B	----	45.8	48.4	5.8	0.9	11,270
Member					C	----	48.7	51.3	---	1.0	11,970
4	Mine Sample	SW ¼			A	15.7	32.0	45.1	7.2	0.6	10,790
Cleary Coal	Cleary Mine	31	19	1	B	----	38.0	53.5	8.5	0.7	12,800
Member					C	----	41.5	58.5	---	0.8	13,990
5	Mine Sample	SW ¼			A	15.8	34.5	43.8	5.9	0.6	10,900
Cleary Coal	Cleary Mine	31	19	1	B	----	41.0	52.0	7.0	0.7	12,950
Member					C	----	44.1	55.9	---	0.7	13,930
6	Mine Sample	SW ¼			A	11.2	37.3	44.3	7.2	0.9	10,280
Cleary Coal	Wilkins	26	19	1	B	----	42.0	49.9	8.1	1.0	12,570
Member	No. 2 Mine				C	----	45.8	54.2	---	1.1	13,680

Remarks: A moist, mineral-matter-free (MMMF) calculation, using the Parr formula (American Society for Testing and Materials, 1973), yields heating values of 10,952 Btu/lb (25,474 kJ/kg; sample 1), 10,977 Btu/lb (25,533 kJ/kg; sample 2), 9,243 Btu/lb (21,499 kJ/kg; sample 3), 11,712 Btu/lb (27,242 kJ/kg; sample 4), 11,654 Btu/lb (27,107 kJ/kg; sample 5) and 11,163 Btu/lb (25,965 kJ/kg; sample 6). No agglomerating characteristics were included with these analyses.

Menefee Allison No. 1 coal bed

The Menefee Allison No. 1 coal bed is a persistent bed that commonly marks the contact between the Allison Member of the Menefee Formation and the La Ventana Tongue. The bed is identified in three sections measured by Dane (1936) and thickens to 6.5 ft (2.0 m) including a 4.5 ft (1.4 m) rock parting. The isopach map shows the bed to thicken to over 8.0 ft(2.4 m) based on data from the western adjacent Headcut Reservoir quadrangle. Local faulting displaces the Menefee Allison No. 1 coal bed in the northwest portion of the quadrangle.

The Menefee Allison No. 1 coal bed was mined in the early 1900's in the La Ventana quadrangle. Abandoned mines and prospects are present along and northwest of the outcrop.

Menefee Cleary No. 5 coal bed

The Menefee Cleary No. 5 coal bed was mapped by Dane (1936) at its outcrop for 1.5 mi (2.4 km) in sec. 1, T. 18 N., R. 2 W., sec. 36, T. 19 N., R. 2 W. and sec. 31, T. 19 N., R. 1 W. The outcrop is truncated by a NE.-SW. trending fault. Measured section #5 (see plate 3) indicates the bed to contain 6.1 ft (1.9 m) of total coal. Because of the limited areal extent of the bed, the isopach, structure contour and overburden isopach maps are included in this text as page-sized figures (figs. 3, 4 and 5).

The bed is inferred to pinch out about 0.75 mi (1.21 km) north of its outcrop (fig. 3) because of the lenticularity of the coals in this area. The Menefee Cleary No. 5 bed dips about 6^{o} NW. and is locally displaced by

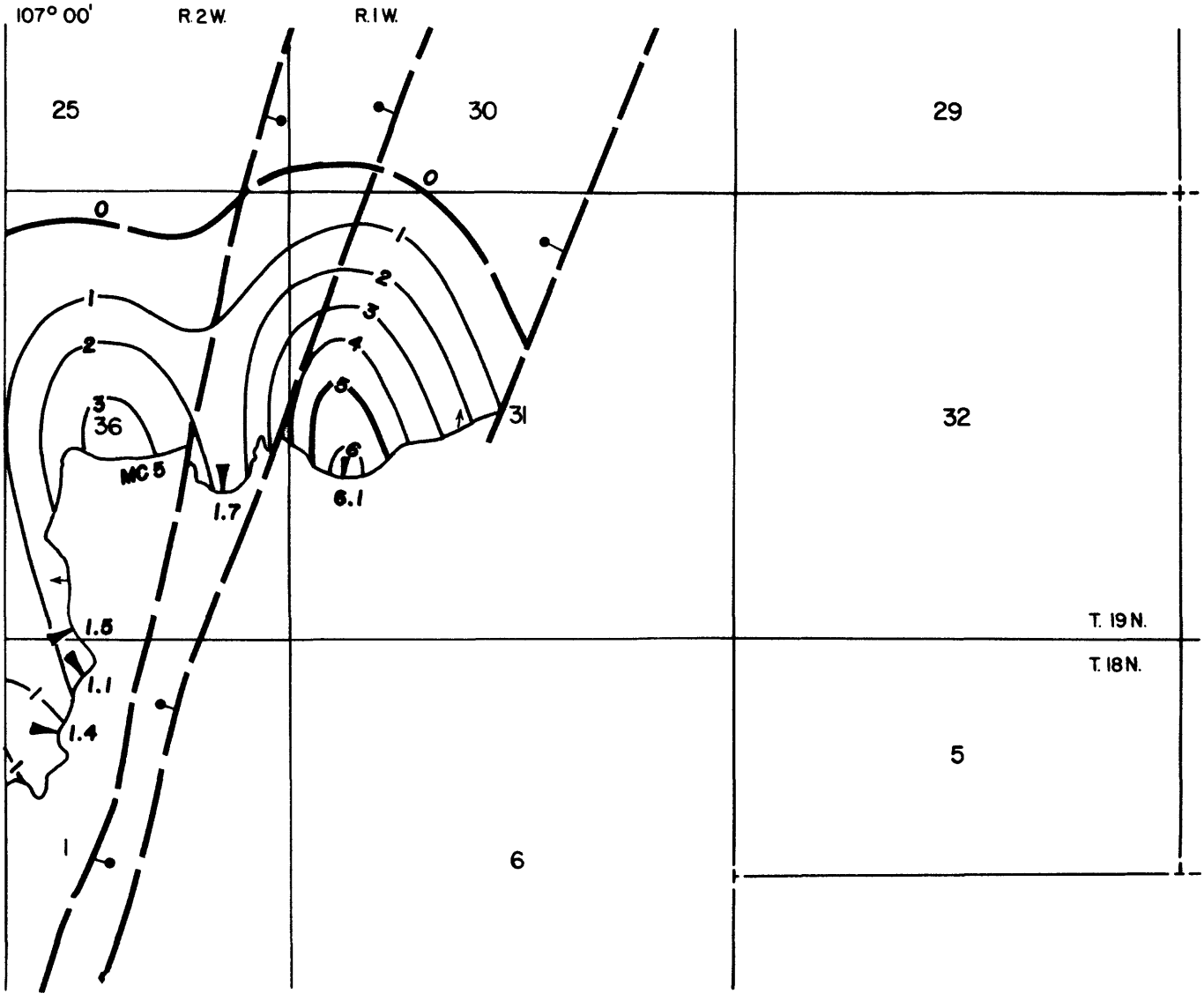
faulting (fig. 4). Overburden and mining ratio contours are shown in fig. 5.

During 1925-27, the San Juan Coal and Coke Company's Cleary Mine in NW ¼ SW ¼ sec. 31, T. 19 N., R. 1 W. produced about 500 short tons (454 t) of the Menefee Cleary No. 5 coal bed. Dane (1936) reports mine production of 58,500 short tons (53,071 t) for 1928-31.

Figure 3

ISOPACH MAP OF THE MENEFEE
CLEARY NO.5 COAL BED

(See explanation p. 18)

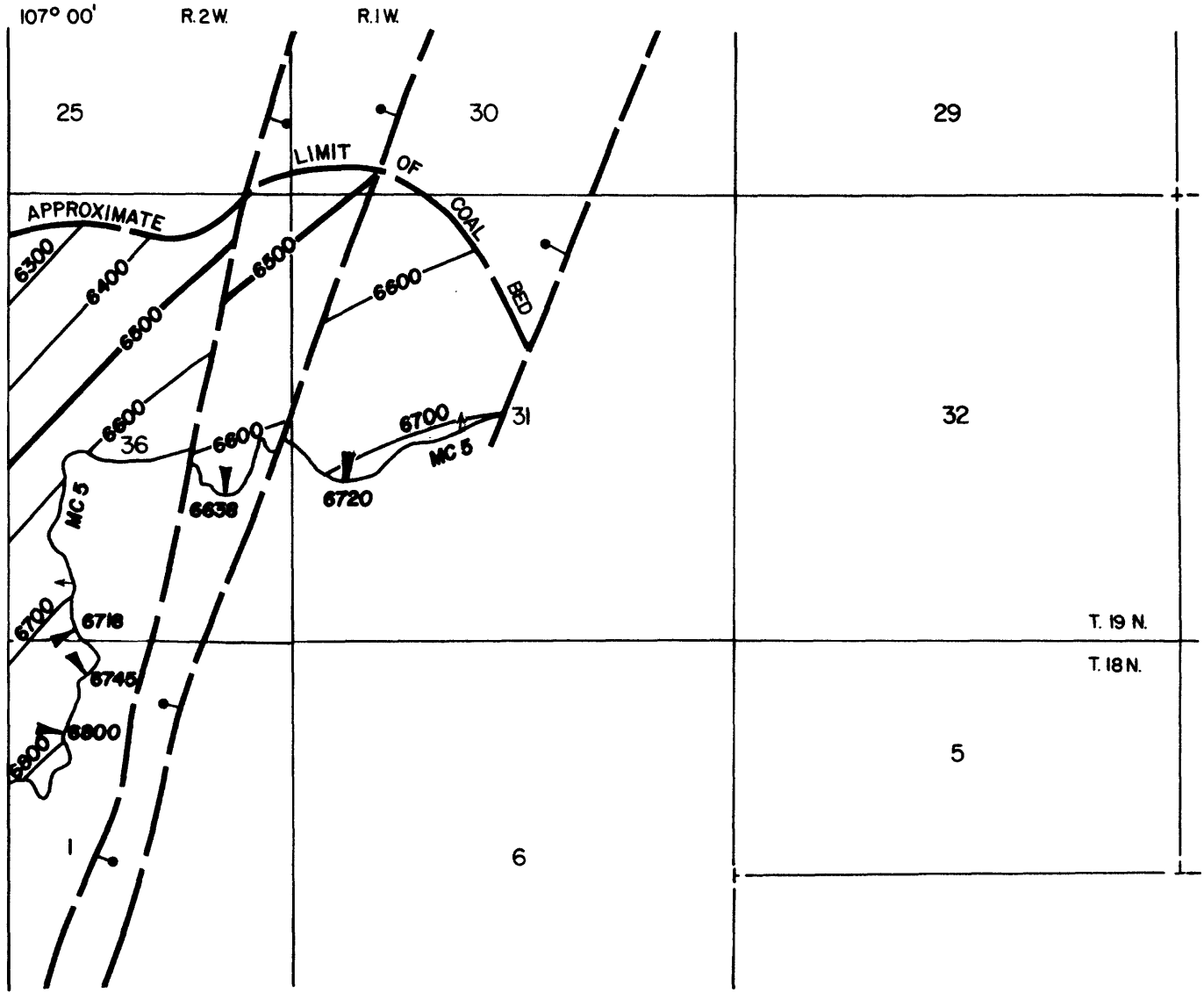


SCALE 1:24,000

Figure 4

STRUCTURE CONTOUR MAP OF THE MENEFEE CLEARY NO.5 COAL BED

(See explanation p. 18)

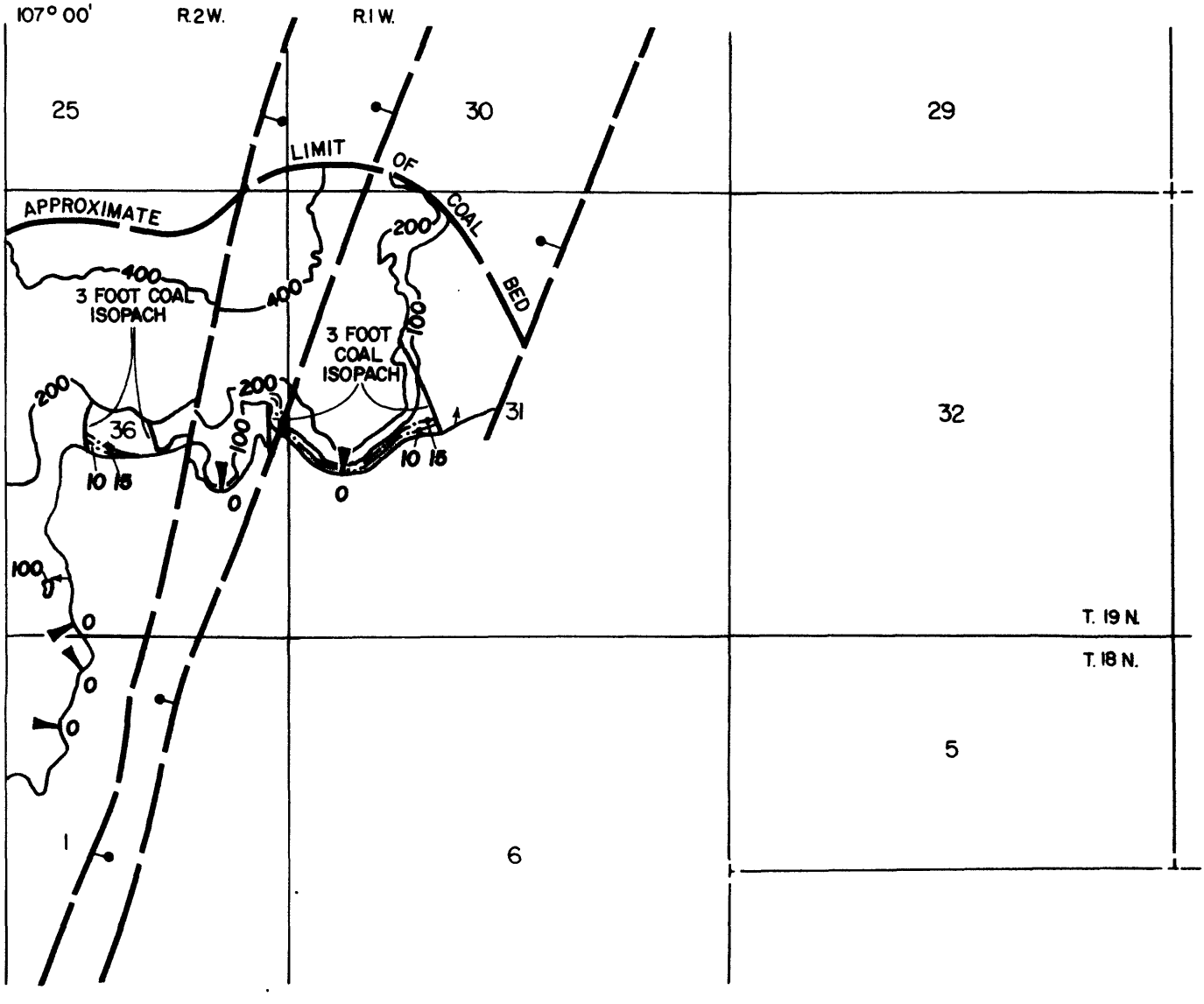


SCALE 1:24,000

Figure 5

ISOPACH MAP OF THE OVERBURDEN OF THE MENEFEE CLEARY NO.5 COAL BED

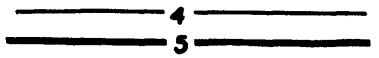
(See explanation p. 18)



SCALE 1:24,000

Figure 3

EXPLANATION



ISOPACHS OF THE MENEFEE CLEARY No. 5 COAL BED-Showing thickness in feet. Isopach interval 1 foot (0.3 meters).

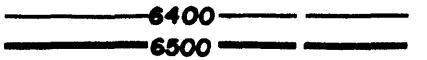
TRACE OF COAL BED OUTCROP-Showing coal thickness, in feet, measured at triangle. Arrow points toward the coal bearing area.

FAULT-Dashed where approximately located; bar and bell on downthrown side.

To convert feet to meters, multiply feet by 0.3048.

Figure 4

EXPLANATION



STRUCTURE CONTOURS-Drawn on top of the Menefee Cleary No. 5 coal bed. Contour interval 100 feet (30 meters). Datum is mean sea level. Contours dashed where inferred.

TRACE OF COAL BED OUTCROP-Showing altitude, in feet, measured at triangle. Arrow points toward the coal-bearing area.

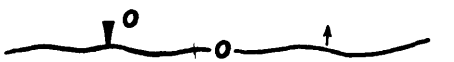
FAULT-Dashed where approximately located; bar and bell on downthrown side.

To convert feet to meters, multiply feet by 0.3048.

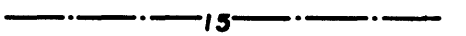
Figure 5

EXPLANATION

OVERBURDEN ISOPACHS-Showing thickness of overburden, in feet from the surface to the top of the Menefee Cleary No. 5 coal bed. Isopach interval 200 feet (61 meters), with a supplemental 100 foot contour. Stripping limit is 200 feet.



TRACE OF COAL BED OUTCROP-Showing no overburden at triangle. Arrow points toward the coal-bearing area.



MINING RATIO CONTOUR FOR THE MENEFEE CLEARY NO. 5 COAL BED-Number indicates cubic yards of overburden per ton of recoverable coal by surface-mining methods. Contours shown only in areas suitable for surface mining within the stripping limit, less than 200 feet (61 meters), of overburden.

FAULT-Dashed where approximately located; bar and bell on downthrown side.

To convert feet to meters, multiply feet by 0.3048.

COAL RESOURCES

The U. S. Geological Survey requested resource evaluations of the Menefee Allison No. 1 and Menefee Cleary No. 5 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 the bed 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 4 and 6 and figs. 3 and 5). 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 base for that category. Coal beds with 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 for the Menefee Allison No. 1 and Menefee Cleary No. 5 coal beds, which include all reserve base catagories, are shown by section on plate 2. Because of the limited areal extent of each bed, they were incorporated on the same areal distribution and identified resources

plate (plate 7). Reserve base and reserve data in the various categories are shown on plate 7.

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 (61 m) 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. Areas which have a correlative coal bed 3.0 ft (0.9 m) or more thick with surface mining potential 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 to calculate mining ratios is:

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

MR = Mining ratio

t_o = Thickness of overburden in feet

t_c = Thickness of coal in feet

Rf = Recovery faetor

C = Volume-weight conversion factor

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

(.911 yd^3/short ton 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 and subsurface mining methods (plates 8 and 9) are defined at the contact of the coal-bearing Menefee Formation with the underlying noncoal-bearing Point Lookout Sandstone. 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 acre or lot). When a land

subdivision contains areas with different development potentials, the potential shown on the map is that of the areally largest of the component areas. 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 table 2 and 3, 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.

Development potential for surface mining methods

The coal development potential for surface mining methods in the La Ventana quadrangle is shown on plate 8. The Menefee Allison No. 1 and Menefee Cleary No. 5 coal beds have reserves in the high, moderate, and low surface development potential categories. Refer to table 4 for reserves and planimetered acreage, by section, for Federal coal lands with development potential for surface mining methods. Because the high and moderate surface development potential areas for the Menefee Allison No. 1 coal bed encompass less than 50 percent of the smallest legal land subdivision, they are not shown on plate 8. The Menefee Cleary No. 5 has no areas with high, moderate and low potential for surface mining methods that encompass more than 50 percent of the smallest legal land subdivision. The remaining Federal coal land in the La Ventana quadrangle has either no or unknown development potential for surface mining methods.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in the La Ventana quadrangle is shown on plate 9. The Menefee Allison No. 1 and Menefee Cleary No. 5 coal beds have reserves in the high development potential category for subsurface mining methods in this quadrangle. Refer to table 5 for reserves and planimetered acreage, by section, for Federal coal lands with development potential for subsurface mining methods. The remainder of the Federal coal land in the La Ventana quadrangle has either no or unknown development potential for subsurface mining methods.

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.

Table 2. - Reserve base data (in short tons) for surface mining methods for Federal coal lands in the La Ventana quadrangle, Sandoval 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 0.8421.

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 Allison No. 1	70,000	110,000	2,460,000	2,640,000
Menefee Cleary No. 5	20,000	10,000	110,000	140,000
Total	90,000	120,000	2,570,000	2,780,000

Table 3. - Reserve base data (in short tons) for subsurface mining methods for Federal coal lands in the La Ventana quadrangle, Sandoval 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 Allison No. 1	10,100,000	--------	--------	10,100,000
Menefee Cleary No. 5	380,000	--------	--------	380,000
Total	10,480,000	--------	--------	10,480,000

Table 4. - Reserves and planimetered acreage, by section, for Federal coal lands in the La Ventana quadrangle with surface mining potential.

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

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
High	Menefee Allison No. 1	20	19	1	4.6	10,000
		21	19	1	0.5	less than 10,000
		25	19	2	3.0	30,000
	Menefee Cleary No. 5	31	19	1	3.0	20,000
Moderate	Menefee Allison No. 1	20	19	1	3.0	10,000
		21	19	1	1.1	less than 10,000
		25	19	2	6.1	60,000
	Menefee Cleary No. 5	31	19	1	1.5	10,000
Low	Menefee Allison No. 1	17	19	1	75.5	400,000
		19	19	1	7.2	30,000
		20	19	1	30.4	160,000
		30	19	1	164.2	1,070,000
		25	19	2	35.0	410,000
	Menefee Cleary No. 5	31	19	1	12.2	90,000

Table 5. - Reserves and planimetered acreage, by section, for Federal coal lands in the La Ventana quadrangle with subsurface mining potential.

[To convert acres to hectares, divide acres by 2.471; to convert short tons to metric tonnes, multiply short tons by 0.90721.

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
High	Menefee Allison No. 1	19	19	1	196.1	640,000
		30	19	1	162.7	680,000
		25	19	2	352.7	2,070,000
		24	19	2	395.2	1,640,000
	Menefee Cleary No. 5	31	19	1	45.6	190,000

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GLOSSARY

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.