UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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1985

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

[Report includes 16 plates]

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BORREGO PASS QUADRANGLE

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INTRODUCTION

Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the Borrego Pass 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.

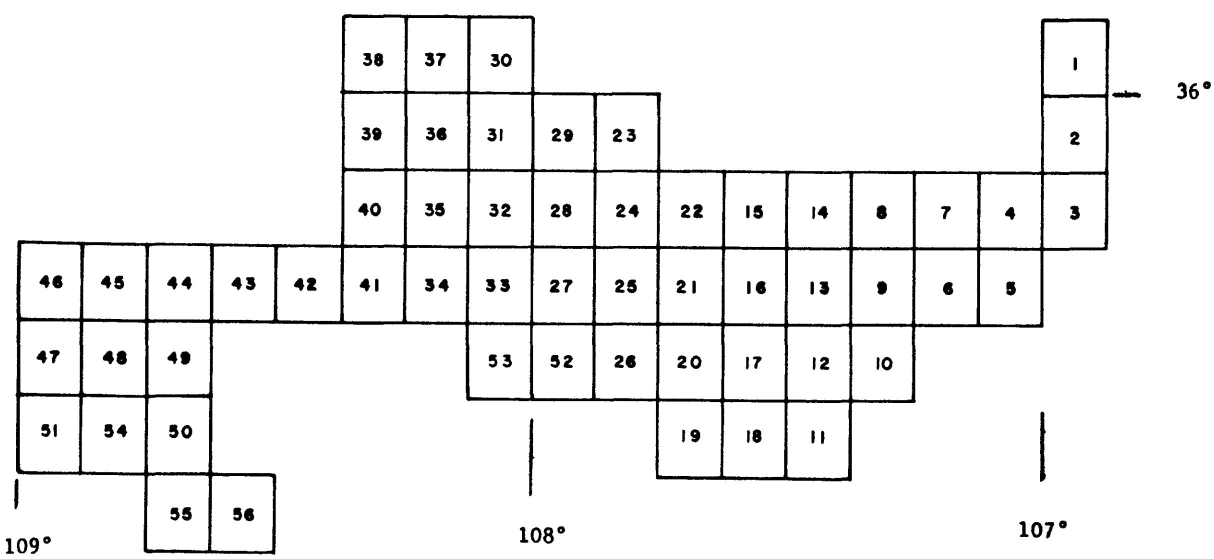
This report is limited to coal resources which are 3,000 ft (914 m) or less below ground surface. Published and unpublished public information was used as the data base for this study. No new drilling or field mapping was performed as part of this study, nor were any confidential data used.

LOCATION OF PROJECT AREA
PROJECT AREA
AREA OF THIS REPORT
COLORADO
ARIZONA
FARMINGTON
ALBUQUERQUE
Grants
Bloomfield
Aztec
Shiprock
Gallup
Window Rock
Estancia
Bernalillo

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



Location

The Borrego Pass 7½ minute quadrangle includes acreage in Tps. 15 and 16 N., Rs. 10 and 11 W. of the New Mexico Principal Meridian, McKinley County, northwestern New Mexico (see figs. 1 and 2).

Accessibility

No paved roads pass through the Borrego Pass quadrangle. A light-duty maintained road in the northwestern part of the quadrangle provides access to the town of Prewitt, 16 mi (26 km) southwest, and to State Route 57, 9 mi (14 km) west of the quadrangle. Ambrosia Lake which is accessible by State Route 509 is about 3.5 mi (5.6 km) southeast of the quadrangle. Unimproved dirt roads traverse most parts of the area. The Atchison, Topeka, and Santa Fe Railroad line passes about 9 mi (14 km) southwest of the quadrangle (see fig. 1).

Physiograhy

The Borrego Pass 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. The Continental Divide passes through the northern portion of the quadrangle.

No perennial streams are present in the quadrangle. Local drainage is provided by several intermittent arroyos. Elevations within the quadrangle range from less than 6,900 ft (2,103 m) along the northern quadrangle boundary to 8,188 ft (2,496 m) on Mesa de Jaramillo in the southeast.

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 Thoreau 5 ENE Station. The Borrego Pass quadrangle is about 10 mi (16 km) northeast of the Thoreau 5ENE Station. Average total annual precipitation for thirteen of the previous fifteen years is 10.84 in. (27.53 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 thirteen of the previous fifteen years is 49.4^{o}F (9.7^{o}C). The average daily temperatures in January and July are 30.8^{o}F (-0.7^{o}C) and 70.9^{o}F (21.6^{o}C), respectively.

Land status

The Federal Government holds the coal mineral rights to approximately 48 percent of the Borrego Pass 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 5,200 acres (2,104 ha) in the northwest, southwest, and southeast is within the Crownpoint Known Recoverable Coal Resource Area. There is a Federal coal lease in NW¼ NE¼ Sec. 36, T. 16 N., R. 11 W. in the quadrangle. As of October 26, 1978, there were no coal preference right lease applications or coal exploration licenses within the Borrego Pass quadrangle.

GENERAL GEOLOGY

Previous work

Early reports on the area include reconnaissance mapping by Gardner (1909), who measured coal outcrops in sec. 30, T. 15 N., R. 10 W. within the Borrego Pass quadrangle. Sears (1934) and Hunt (1936) mapped several coal outcrops and reported coal thicknesses of Dilco and Gibson Coal Member beds in the area. Shomaker, Beaumont, and Kottlowski (1971) reviewed the area and outlined several areas within the Borrego Pass quadrangle with potential for strippable Gibson Coal Member beds. They noted, however, that the general thinness and irregularity of the coals in the region would allow little more than speculative consideration of prospects in the area.

Stratigraphy

Within the San Juan Basin, the shoreline positions of the Cretaceous seaways changes 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 shoreline sequences.

Exposed rock units in the Borrego Pass 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, and averages 195 ft (59 m) thick 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 Shale, which ranges from 600 to 725 ft (183 to 221 m) thick locally.

A major northeastward regression of the Cretaceous seaways resulted in the deposition of the Gallup Sandstone in a beach or littoral environment. The Gallup Sandstone overlies the "main body" of the Mancos Shale and is composed of pink to gray, fine-to very coarse-grained, massive sandstone, interbedded gray shales, and coal beds. Thickness of the unit ranges from 150 to 175 ft (46 to 53 m) in the area. 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 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 150 to 220 ft (46 to 67 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 overlies 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 Mulatto Tongue averages 210 ft (64 m) in this 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 85 to 140 ft (26 to 43 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 inalnd from the beach area during the deposition of the Dalton Sandstone Member. Medium gray, carbonaceous siltstone with interbedded gray to tan sandstone, and coal beds comprise the lithologies of the Gibson Coal Member, which ranges from 160 to 250 ft (49 to 76 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 over the Gibson Coal Member during the advancing shoreline sequence. The Hosta Tongue is composed of light gray to reddish-brown, fine-to medium-grained sandstone with interbedded shales, and averages 40 ft (12 m) thick locally.

As the transgression proceeded and the Cretaceous seaways deepened, the Satan Tongue of the Mancos Shale was deposited over the Hosta Tongue. Light to dark gray, silty shales with interbedded tan to buff sandstone comprise the lithologies of the Satan Tongue which ranges from 0 to 80 ft (0 to 24 m) thick locally. The Satan Tongue pinches out in the southern portion of the quadrangle, and the Hosta Tongue and overlying Point Lookout Sandstone merge into an undivided sandstone unit.

The Point Lookout Sandstone 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). Lithology of the Point Lookout Sandstone is similar to the Hosta Tongue. Thickness of the unit ranges from 100 to 200 ft (30 to 61 m) locally. Portions of the Menefee Formation may be exposed in the northern part of the quadrangle, although most of the Menefee Formation has been eroded in the Borrego Pass 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 Borrego Pass 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 Walker Dome is the major structural feature in the eastern part of the quadrangle. Sears (1934) and Hunt (1936) mapped several faults in the area. Hunt (1936) mapped the prominent Ambrosia Fault, a north-south trending,down thrown to the east fault that displaces rock units over 200 ft (61 m). Hackman and Olson (1977) mapped the Casamero Fault that extends into the western part of the quadrangle. Dips of the rock units range from 1^{o} to 3^{o} W on the western flank of the Walker Dome, and 1^{o} to 2^{o} N to NE in other parts of the area.

COAL GEOLOGY

In this quadrangle, the authors identified three coal beds and three coal zones in oil and gas well logs, water well logs, and surface mapping by Sears (1934) and Hunt (1936). These coal beds and coal zones are here informally called the Dakota coal zone, Crevasse Canyon Dilco coal zone, Crevasse Canyon Gibson coal zone, and the Crevasse Canyon Gibson No. 3, No. 3A, and No. 3B coal beds.

Stratigraphically, the Dakota coal zone contains the lowest identified coal beds in this quadrangle. Two individual coal beds that are 2.0 and 4.0

ft (0.6 and 1.2 m) thick and occur from 172 to 184 ft (52 to 56 m) below the top of the Dakota Sandstone comprise the Dakota coal zone.

The Crevasse Canyon Dilco coal zone contains up to three individual coal beds that range in thickness from 1.9 to 2.0 ft (0.6 to 0.6 m) and occur from 25 to 102 ft (8 to 31 m) above the top of the Gallup Sandstone. These zone coals, as with all zone coals identified in this quadrangle, 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.

Up to seven individual coal beds that occur from 2 to 262 ft (1 to 80 m) below the base of the Hosta Tongue comprise the Crevasse Canyon Gibson coal zone. The Crevasse Canyon Gibson No. 3, No. 3A, and No. 3B coal beds occur from 49 to 95 ft (15 to 29 m), 30 to 45 ft (9 to 14 m), and 8 to 21 ft (2 to 6 m), respectively, below the base of the Hosta Tongue. These coal beds are inferred to be continuous, although they may be several individual coal beds that are stratigraphically equivalent.

There are no published coal quality analyses for coal beds from the Borrego Pass quadrangle. An analysis of Gibson Coal Member beds taken from the abandoned Crownpoint mine, 10 mi (16 km) northwest of the quadrangle, has been reported by the U. S. Bureau of Mines (1936) and is shown in table 1. The Gibson Coal Member beds analyzed are 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.

Crevasse Canyon Gibson No. 3B coal bed

The Crevasse Canyon Gibson No. 3B coal bed was identified in eight outcrop

Table 1. - Analysis of a coal sample from the Gibson Member of the Crevasse Canyon Formation.

(Crownpoint mine sample from sec. 30, T. 17 N., R. 12 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	Heating value (Btu/lb)
	Moisture	Volatile matter	Fixed carbon	Ash		
A	15.4	36.1	39.0	9.5	1.3	10,520
B	----	42.7	46.1	11.2	1.5	12,440
C	----	48.0	52.0	----	1.7	14,010

Remarks:

A moist, mineral-matter-free (MMMF) calculation using the Parr formula (American Society for Testing and Materials, 1973) yields a heating value of 11,744 Btu/lb (27,317 kJ/kg). No agglomerating characteristics were included with the analysis.

measured sections, and ranges in thickness from 1.8 to 4.3 ft (0.5 to 1.3 m). The coal bed was interpreted to occur in four isolated outcrops, and to pinch out between each outcrop (see plate 4). Existence and character of the Crevasse Canyon Gibson No. 3B coal bed are unknown in most of the quadrangle because of insufficient data.

Crevasse Canyon Gibson No. 3A coal bed

The Crevasse Canyon Gibson No. 3A coal bed was identified in fifteen outcrop measured sections and one oil and gas well log. Thickness of the bed ranges from 1.0 to 6.0 ft (0.3 to 1.8 m). Sears (1934) and Hunt (1936) mapped the bed at several discontinuous outcrops. Faults displace and truncate the Crevasse Canyon Gibson No. 3A coal bed outcrop in several areas (see plates 1 and 7). Because of insufficient data, existence and character of the Crevasse Canyon Gibson No. 3A coal bed are unknown in the central western and southwestern parts of the quadrangle.

Crevasse Canyon Gibson No. 3 coal bed

The Crevasse Canyon Gibson No. 3 coal bed was identified in eighteen outcrop measured sections, and ranges in thickness from 1.1 to 5.0 ft (0.3 to 1.5 m). The bed crops out in most of the quadrangle and is inferred to occur as several isolated pods. Faults displace and truncate the coal bed outcrop in several areas (see plates 1 and 10).

COAL RESOURCES

The U. S. Geological Survey requested resource evaluations of the Crevasse Canyon Gibson No. 3, No. 3A, and No. 3B 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 beds into measured, indicated, and inferred reserve base categories. Reserve base was calculated for each category, by section, using data from the isopach (plates 4, 7, and 10) and overburden (plates 6, 9 and 12) maps. 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, 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 plates 13 and 14. Since the Crevasse Canyon Gibson No. 3A and No. 3B coal beds are limited in areal extent, they were combined on the same Areal Distribution and Identified Resources map (plate 13).

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 supplies 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 ratio 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 15) are defined at the contact of the coal-bearing Gibson Coal Member with the overlying noncoal-bearing Hosta Tongue, and 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 the 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 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, and coal bed correlations that are interpretive and subject to change as additional information becomes available.

Development potential for surface mining methods

The coal development potential for surface mining methods in the Borrego Pass quadrangle is shown on plate 15. Based on coal development criteria, all Federal coal lands in the quadrangle have moderate, low, unknown or no development potential for surface mining methods. Refer to table 4 for reserves and planimetered acreage, by section, for Federal coal lands in the Borrego Pass quadrangle with surface mining potential.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in the Borrego Pass quadrangle is shown on plate 16. Based on coal development criteria, all Federal coal lands have high or unknown development potential for subsurface mining methods. Refer to table 5 for reserves and planimetered acreage, by section, for Federal coal lands in the Borrego Pass quadrangle 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.

Table 2. - Reserve base data (in short tons) for surface mining methods for Federal coal lands in the Borrego Pass 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
Crevasse Canyon Gibson No. 3	520,000	310,000	1,760,000	2,590,000
Crevasse Canyon Gibson No. 3A	140,000	90,000	1,390,000	1,620,000
Crevasse Canyon Gibson No. 3B	60,000	60,000	360,000	480,000
Total	720,000	460,000	3,510,000	4,690,000

Table 3. - Reserve base data (in short tons) for subsurface mining methods for Federal coal lands in the Borrego Pass 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
Crevasse Canyon Gibson No. 3	960,000	----	----	960,000
Crevasse Canyon Gibson No. 3A	240,000	----	----	240,000
Crevasse Canyon Gibson No. 3B	950,000	----	----	950,000
Total	2,150,000	----	----	2,150,000

Table 4. - Reserves and planimetered acreage, by section, for Federal coal lands in the Borrego Pass 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	Crevasse Canyon Gibson No. 3	30	16	10	59.2	340,000
		25	16	11	10.6	50,000
		3	15	11	1.0	less than 10,000
		10			1.0	less than 10,000
		4	15	10	1.0	less than 10,000
	Crevasse Canyon Gibson No. 3A	30	16	10	15.7	70,000
		4	15	10	1.0	less than 10,000
		8			4.0	less than 10,000
	Crevasse Canyon Gibson No. 3B	3	15	11	1.5	less than 10,000
		13			2.0	less than 10,000
		14			1.0	less than 10,000
		24			1.5	less than 10,000
		28	15	10	1.0	less than 10,000
Moderate	Crevasse Canyon Gibson No. 3	30	16	10	31.9	160,000
		25	16	11	9.1	40,000
		3	15	11	1.0	less than 10,000
		10			1.0	less than 10,000
		4	15	10	1.0	less than 10,000
	Crevasse Canyon Gibson No. 3A	30	16	10	9.1	30,000
		4	15	10	1.0	less than 10,000
		8			4.0	10,000
	Crevasse Canyon Gibson No. 3B	3	15	11	1.0	less than 10,000
		13			1.0	less than 10,000
		14			1.5	less than 10,000
		24			1.5	less than 10,000
		28	15	10	1.0	less than 10,000
Low	Crevasse Canyon Gibson No. 3	30	16	10	125.7	750,000
		25	16	11	24.8	120,000
		3	15	11	43.2	230,000
		10			10.7	50,000
		11			1.0	less than 10,000
		8	15	10	11.6	50,000
		4			36.5	210,000
	Crevasse Canyon Gibson No. 3A	20	16	10	4.6	10,000
		30			50.1	260,000
		4	15	10	36.4	210,000
		8			111.0	640,000
	Crevasse Canyon Gibson No. 3B	3	15	11	15.7	70,000
		13			19.8	100,000
		14			6.1	20,000
		24			6.1	30,000
		28	15	10	7.6	30,000

Table 5. - Reserves and planimetered acreage, by section, for Federal coal lands in the Borrego Pass 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 0.9072].

Potential category	Coal bed	Sec.	T. N.	R. W.	Acres (planimetered)	Reserves (in short tons)
High	Crevasse Canyon Gibson No. 3	30	16	10	38.0	120,000
		3	15	11	38.0	120,000
		10			66.8	220,000
		11			1.0	less than 10,000
	Crevasse Canyon Gibson No. 3A	20	16	10	18.2	50,000
		30			19.7	60,000
	Crevasse Canyon Gibson No. 3B	3	15	11	4.6	10,000
		13			69.3	220,000
		14			49.1	210,000
		24			6.1	20,000

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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.