UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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

[Report includes 11 plates]

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SEVEN LAKES QUADRANGLE
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INTRODUCTION

Purpose

This text complements the Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps of the Seven Lakes 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. 17-08-0001-17459 (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 that 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 Published and unpublished public information was used as the data base for this study.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.

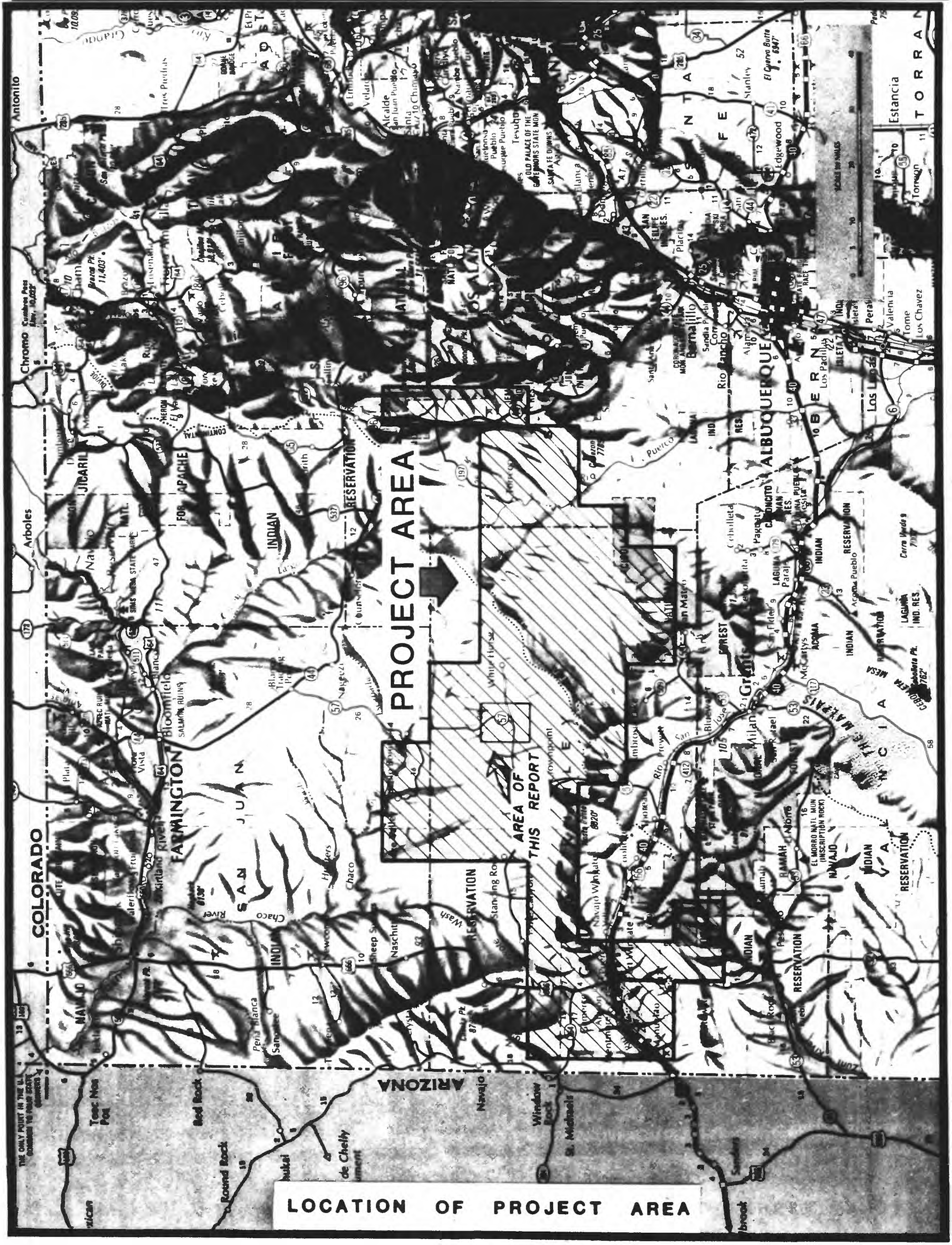
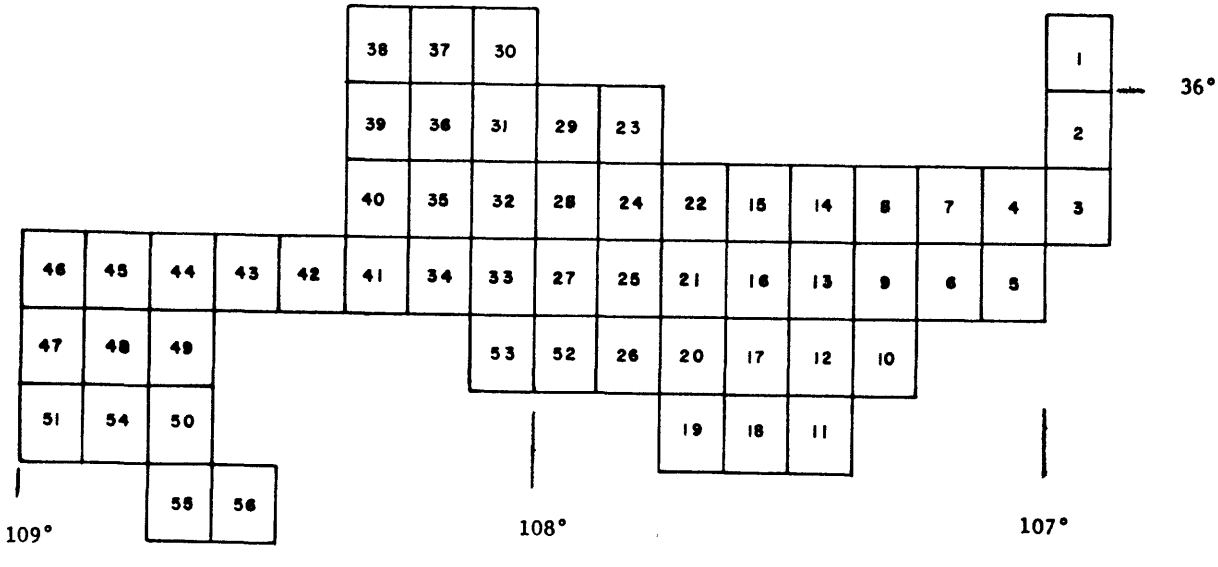

LOCATION OF PROJECT AREA
PROJECT AREA
AREA OF THIS REPORT
COLORADO
ARIZONA
FARMINGTON
Bloomfield
ALBUQUERQUE
Bernalillo
Grants
Milan
Estancia
Window Rock
St. Michaels
Chaco
Arboles
Antonito
Chromo
RESERVATION
JICARILLA
APACHE
INDIAN
SAN JUAN

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 Seven Lakes 7½ minute quadrangle includes acreage in Tps. 18 and 19 N., Rs. 10 and 11 W. of the New Mexico Principal Meridian, McKinley County, northwestern New Mexico (see figs. 1 and 2).

Accessibility

New Mexico State Highway 57 passes through the area and connects to the towns of Crownpoint, 13 mi (21 km) to the west; Whitehorse, 8 mi (13 km) to the east; and Pueblo Bonito, 16 mi (26 km) to the north of the Seven Lakes quadrangle. Highway 57 turns to the north in sec. 17, T. 18 N., R. 10 W., and an improved surface road connects eastward to Whitehorse. Unimproved dirt roads traverse other parts of the area. The Atchison, Topeka, and Santa Fe Railroad line passes about 35 mi (56 km) south of the quadrangle (see fig. 1).

Physiography

The Seven Lakes quadrangle is in the Navajo section of the southernmost part of the Colorado Plateau physiographic province (U. S. Geological Survey, 1965). Gently sloping flatland topography characterizes the area.

No perennial streams are present in the quadrangle. Drainage is provided by several intermittent arroyos. Elevations within the quadrangle range from less than 6,300 ft (1,920 m) along Seven Lakes Wash along the western boundary to over 6,860 ft (2,091 m) near the eastern quadrangle boundary.

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 Chaco Canyon National Monument Station. The Seven Lakes quadrangle is about 13 mi (21 km) south of the Chaco Canyon National Monument Station. Average total annual precipitation for the last thirteen years is 8.75 in. (22.23 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 the last eleven years is 48.4° F (9.1° C). The average daily temperatures in January and July are 26.3° F (-3.2° C) and 72.5° F (22.5° C), respectively.

Land status

The Federal Government holds the coal mineral rights to approximately 5 percent of the Seven Lakes 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 8,700 acres (3,521 ha) along the eastern one-third of the quadrangle is within the Hospah Known Recoverable Coal Resource Area. As of October 26, 1978, there were no Federal coal leases, coal preference right lease applications, or coal exploration licenses within the Seven Lakes quadrangle.

GENERAL GEOLOGY

Previous work

Early reports on the area include that of Dobbin (1932) who mapped the area but indicated no coals outcropping locally. Hunt (1936) reported coals of the Menefee Formation with thicknesses of 14 in (36 cm) or less, and none with significant lateral extent. Shomaker, Beaumont, and Kottlowski (1971) reviewed the area but did not report any strippable coal reserves. Shomaker and Whyte (1977) estimated Menefee Formation coal resources for Tps. 18 and 19 N., R. 10 W., as 11.4 million short tons (10.3 million t). About 60 percent of the quadrangle is within these areas.

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 shoreline sequences.

Exposed rock units in the Seven Lakes 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 siliceous sandstone with interbedded dark gray to black carbonaceous shales and coals, and averages 265 ft (81 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 averages 650 ft (198 m) thick locally.

A major northeastward regression of the Cretaceous seaways followed, resulting in the deposition of the Gallup Sandstone in a beach or littoral environment. The Gallup Sandstone is composed of pink to gray, fine to medium grained massive sandstone with interbedded gray shales, and averages 165 ft (50 m) thick locally.

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 formed from the marine sands, silts, and muds, and is composed of light gray to tan silty shale with interbedded reddish-tan, very fine grained sandstone, averaging 650 ft (198 m) thick locally.

Overlying the Mulatto Tongue of the Mancos Shale, the Hosta Tongue of the Point Lookout Sandstone represents the gradual reversal from regressive to transgressive depositional conditions. The Hosta Tongue is composed of light gray to reddish-brown, fine to medium grained sandstone with interbedded shales and averages 65 ft (20 m) thick locally.

As the transgression proceeded and the Cretaceous seaways deepened, the Satan Tongue of the Mancos Shale formed from the marine sands, silts, and muds. The Satan Tongue is composed of light to dark gray silty shale

with interbedded tan to buff sandstone, and averages 325 ft (99 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 identical to the Hosta Tongue. The continental sediments deposited inland from the beach during 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, which crops out in the southern portion of the area, defines the boundary between the two members. The Cleary Coal Member contains the youngest coal beds identified in this quadrangle and ranges from 380 to 450 ft (116 to 137 m) thick locally. The Allison Member is up to 700 ft (213 m) thick at the northern quadrangle boundary.

Depositional environments

The Cretaceous System sedimentary units in the quadrangle respresent 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 Seven Lakes 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 rock units dip about 1^{o} to 2^{o} N to NE. No localized faulting or folding has been mapped in the area.

COAL GEOLOGY

In this quadrangle, the authors identified two coal beds and two coal

zones in oil and gas well logs. These beds and zones are here informally called the Dakota coal zone, Menefee Cleary No. 1 and No. 3 coal beds, and the Menefee Cleary coal zone. No Allison Member coals have been identified in this area, although they are present in adjacent areas.

The Dakota coal zone contains one bed that is about 202 ft (62 m) below the top of the Dakota Sandstone. The zone bed is 2 ft (0.6 m) thick and was identified in an oil and gas well log. Areal extent of Dakota coal zone in this quadrangle is unknown.

The first persistent coal bed above the Point Lookout Sandstone is the Menefee Cleary No. 1 coal bed. It occurs from 3 to 10 ft (0.9 to 3 m) above the Point Lookout Sandstone in this quadrangle. The Menefee Cleary No. 3 coal bed occurs from 71 to 112 ft (22 to 34 m) above the Point Lookout Sandstone, as identified in the eastern adjacent Kin Nahzin Ruins quadrangle. These coal beds are inferred to be continuous although they may be several individual beds that are stratigraphically equivalent.

The Menefee Cleary coal zone contains up to five individual beds which occur from 10 to 77 ft (6 to 23 m) above the Point Lookout Sandstone. These zone beds are thin, correlative over limited distances, and total not more than 5.0 ft (1.5 m) in thickness.

There are no published coal quality analyses for coal beds from the Seven Lakes quadrangle. An analysis of an Allison Member coal sample from the abandoned Pueblo Bonito mine taken about 15 mi (24 km) north of the quadrangle has been reported by the U. S. Bureau of Mines (1936) and is shown in table 1. Shomaker, Beaumont, and Kottlowski (1971) sampled coal beds from the Cleary Coal Member in a core test hole about 6.5 mi (10.5 km) southeast of the area, and are included in table 1. The Allison Member and Cleary Coal Member beds analyzed are probably similar in quality to all

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

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

Sample 1 from U. S. Bureau of Mines, 1936
Sample 2 from Shomaker, Beaumont, and Kottlowski, 1971

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 Allison Member	Mine sample (Pueblo Bonito Mine)	14	21	10	A	14.4	34.8	42.3	7.5	1.5	10,220
					B	----	40.7	50.5	8.8	1.8	11,940
2 Cleary Coal Member	Core test hole	NE¼ 36	17	10	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 the Parr formula (American Society for Testing and Materials, 1973) yields heating values of 11,139 Btu/lb (25,909 kJ/kg, sample 1) and 11,256 Btu/lb (26,181 kJ/kg, sample 2). No agglomerating characteristics are available for sample 1; sample 2 is non-agglomerating.

beds in this quadrangle. Rank of the Cleary Coal Member seams is subbituminous A to high volatile C bituminous in this area.

Menefee Cleary No. 3 coal bed

The Menefee Cleary No. 3 coal bed was identified in the Kin Nazhin Ruins quadrangle and thickens to over 6.0 ft (1.8 m) in this quadrangle. Since the Menefee Cleary No. 3 coal bed was not identified in any drill hole logs within the Seven Lakes quadrangle, it was inferred to pinch out toward the west.

Menefee Cleary No. 1 coal bed

The Menefee Cleary No. 1 coal bed is identified in five drill hole logs and does not exceed 6.0 ft (1.8 m). The bed exists throughout the entire quadrangle, except in the west central and southeast corner. Since the bed was not identified in drill hole logs in the above areas, the Menefee Cleary No. 1 coal bed was inferred to pinch out.

COAL RESOURCES

The U. S. Geological Survey requested a resource evaluation of the Menefee Cleary No. 1 and No. 3 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 (plates 4 and 7) and overburden maps (plates 6 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 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 a recovery factor of 50 percent for coal beds 200 to 3,000 ft (61 to 914 m) deep. 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 Cleary No. 1 and No. 3 coal beds, which include all reserve base categories, are shown by section on plate 2. Because of the limited areal extent of the Menefee Cleary No. 3 coal bed, the areal distribution and identified resources map was included in this text as a page-sized map (fig. 3). Reserve base and reserve data in the various categories for the Menefee Cleary No. 1 and No. 3 coal beds are shown on plate 10 and figure 3, respectively.

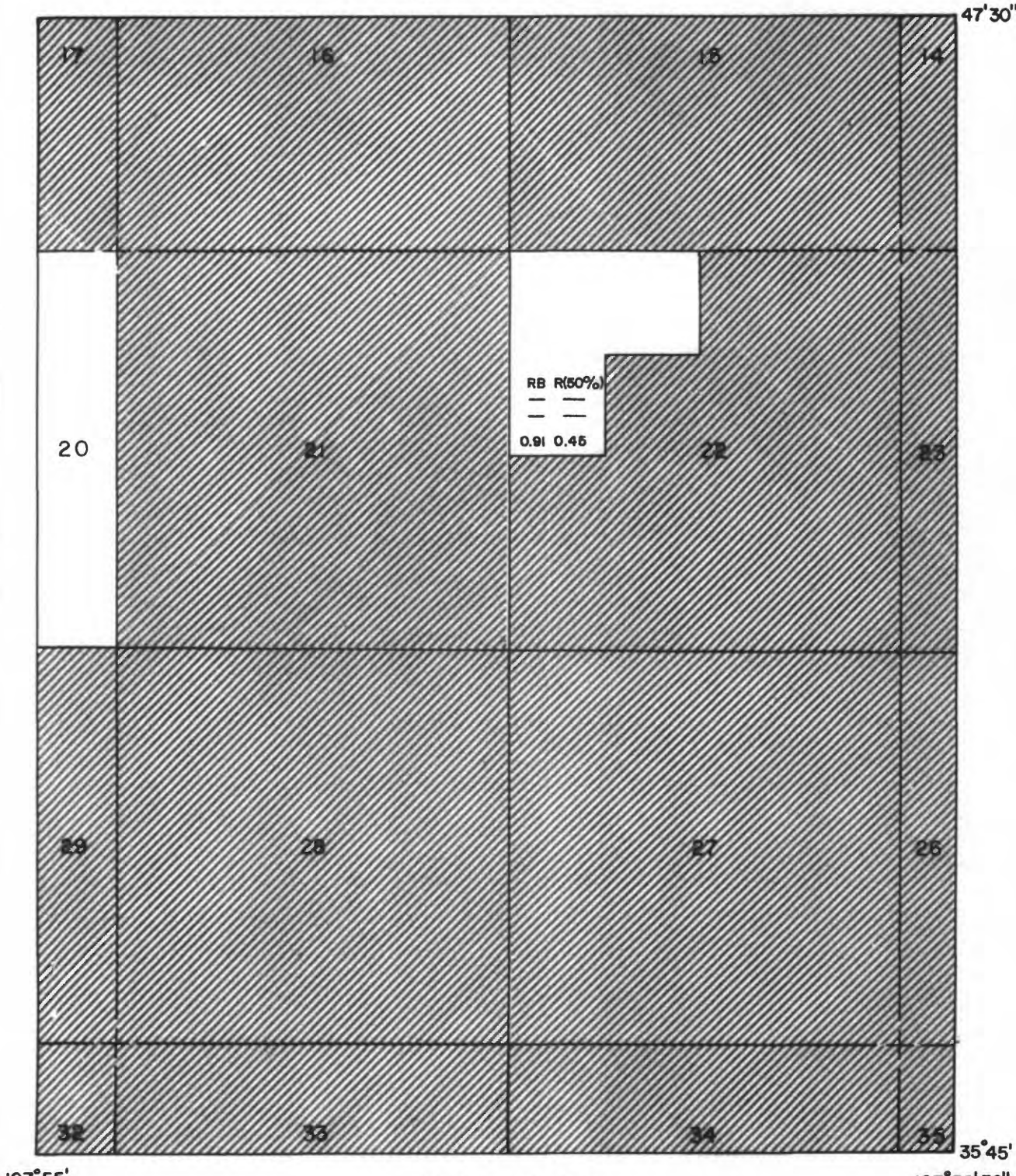
COAL DEVELOPMENT POTENTIAL

The factors used to determine the development potential are the presence of a potentially coal-bearing formation, and 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,

Figure 3

AREAL DISTRIBUTION AND IDENTIFIED RESOURCES OF THE MENEFEE CLEARY NO.3 COAL BED

(See explanation p. 15)



SCALE 1:24,000

Figure 3

EXPLANATION

NON-FEDERAL COAL LAND-Land for which the Federal Government does not own the coal rights.

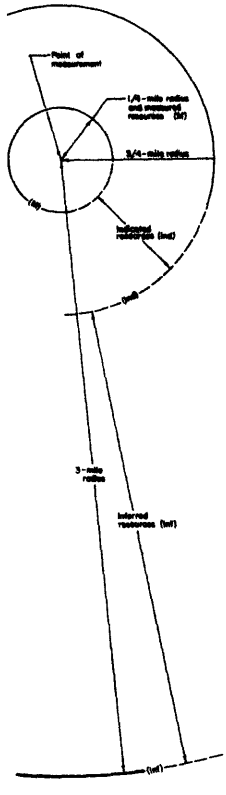
RB R(50%

— — (Measured resources)

— — (Indicated resources)

0.91 0.45 (Inferred resources)

IDENTIFIED COAL RESOURCES-Showing totals for Reserve Base (RB) and Reserves (R), in millions of short tons, for each section of Federal coal land outside the stripping limit line. Dash indicates no resources in that category. Reserve Base (RB) x the Recovery Factor (50 percent) = Reserves (R).



BOUNDARY LINES-Enclosed areas of measured (M), indicated (Ind) and inferred (Inf) coal resources. Diagram not to scale.

To convert short tons to metric tons, multiply short tons by 0.9072.

To convert miles to kilometers, multiply miles by 1.609.

NOTE: BLM coal ownership data current as of Oct. 26, 1978.

NOTE: This figure does not show the areal distribution or quantity of subeconomic resources in this quadrangle.

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 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.

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).

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. Where 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 subsurface mining methods is shown in table 2.

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

Based on coal development potential criteria, all Federal coal land has unknown development potential for surface mining methods in the Seven Lakes quadrangle.

Development potential for subsurface mining methods and in situ gasification

The coal development potential for subsurface mining methods in the Seven Lakes quadrangle is shown on plate 11. The Menefee Cleary No. 1 coal bed has reserves in the high and moderate development potential category, and the Menefee Cleary No. 3 coal bed has reserves in the high development potential category for subsurface mining methods. Refer to table 3 for reserves and planimetered acreage, by section, for Federal coal lands with subsurface mining potential. Since the area of moderate development potential for the Menefee Cleary No. 1 coal bed does not encompass more than 50 percent of the smallest legal land subdivision, there were no areas with moderate potential shown on the coal development

potential map for subsurface mining methods. The remainder of the Federal coal land has unknown development potential for subsurface mining methods.

In situ gasification of coal has not been done on a commerical 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 subsurface mining methods for Federal coal lands in the Seven Lakes 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. 3	910,000	----	----	910,000
Menefee Cleary No. 1	19,940,000	390,000	----	20,330,000
Total	20,850,000	390,000	----	21,240,000

Table 3. - Reserves and planimetered acreage, by section, for Federal coal lands in the Seven Lakes 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	Menefee Cleary No. 1	4	18	10	304.0	1,300,000
		18			626.3	2,830,000
		20			635.5	2,810,000
		22			121.6	430,000
		24	18	11	488.0	2,580,000
	Menefee Cleary No. 3	22	18	10	120.0	450,000
Moderate	Menefee Cleary No. 1	28	19	10	35.0	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.