

OKLAHOMA GEOLOGICAL SURVEY
Charles J. Mankin, *Director*

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COAL GEOLOGY OF ROGERS COUNTY AND WESTERN MAYES COUNTY, OKLAHOMA

LEROY A. HEMISH



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OKLAHOMA GEOLOGICAL SURVEY

CHARLES J. MANKIN, *Director*
KENNETH S. JOHNSON, *Associate Director*

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Title-Page Illustration

Aerial view of coal-mining and reclamation operation in sec. 11, T. 23 N., R. 16 E., Rogers County, Oklahoma. The Iron Post coal bed, 14 in. thick at this location, was mined by Peabody Coal Company. Photograph taken in May 1972 by Kenneth S. Johnson, Oklahoma Geological Survey.

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COAL GEOLOGY OF ROGERS COUNTY AND WESTERN MAYES COUNTY, OKLAHOMA

LEROY A. HEMISH¹

Abstract.—Rogers and Mayes Counties are located in the north-central part of the coal belt in the shelf area of northeastern Oklahoma. Coal-bearing strata of Desmoinesian (Middle Pennsylvanian) age underlie ~860 mi² in the two counties. Remaining resources of coal in the two-county area total 392,918,000 tons (all tonnage figures are in short tons), and reserves total 62,910,000 tons. Of the remaining resources, 75,247,000 tons occur at depths >100 ft and are not considered minable by surface methods; none of this tonnage is considered to be reserves.

Eight coal beds in Rogers and Mayes Counties have commercial importance: Rowe coal, with reserves of 3,068,000 tons; Drywood coal, 1,334,000 tons; Bluejacket coal, 2,559,000 tons; Weir-Pittsburg coal, 12,325,000 tons; Mineral coal, 6,613,000 tons; Croweburg coal, 13,065,000 tons; Iron Post coal, 16,456,000 tons; and Dawson coal, 7,490,000 tons.

Methods used to calculate resources and reserves are adaptations of standard methods used by the U.S. Bureau of Mines and the U.S. Geological Survey, as modified by Friedman (1974). Estimated tonnage figures can be expected to increase significantly as additional mapping and exploratory work are done and new data are introduced.

Coals of the area are predominantly of high-volatile A bituminous (hvAb) rank. With the exception of the Croweburg coal, which averages 0.6% sulfur, the coals have high sulfur contents, averaging >4%.

Of the 525,200 tons of coal produced in 1979 in the study area, all was mined by surface methods in Rogers County. The total value of coal produced by 10 operators in the area during 1979 was estimated at \$12,604,800, which is \$24/ton f.o.b. mines.

The new Oowala Sandstone Member of the Senora Formation is named in this report.

INTRODUCTION

This report is the second in a series of county studies by the Oklahoma Geological Survey evaluating the coal resources and reserves of Oklahoma. The purpose of the study is to determine the location, amounts, and chemical characteristics of the coal deposits, as well as the geologic characteristics of the coal beds and associated strata.

Figure 1 shows the location of the study area, which includes all of Rogers County and the part of Mayes County underlain by coals of commercial importance within the coal belt of eastern Oklahoma. The study area covers ~860 mi² just northeast of Tulsa. It lies mostly within the Claremore Cuesta Plains geomorphic province, which is characterized by resistant sandstones and limestones that dip gently westward, forming cuestas between broad shale plains.

In general the area is thickly populated. Access is made easy by a network of federal and state highways and county roads. Three major railroads serve the area. The area is also served by the Port of Catoosa, in southwestern Rogers County, which is linked to the sea by the McClellan-Kerr Arkansas River Navigation System. The largest city in the two-county area is Claremore, in the south-central part of Rogers County.

Detailed data on estimated original, mined, and remaining coal resources and reserves are tabulated in Appendix 1 ~~for each county~~ according to coal thickness, overburden thickness, and reliability category.

This report contains four coal maps (Pls. 1-4) showing locations of datum points used in the study, thickness of coal beds, mined-out areas, and thickness of overburden. These maps were

¹Oklahoma Geological Survey.

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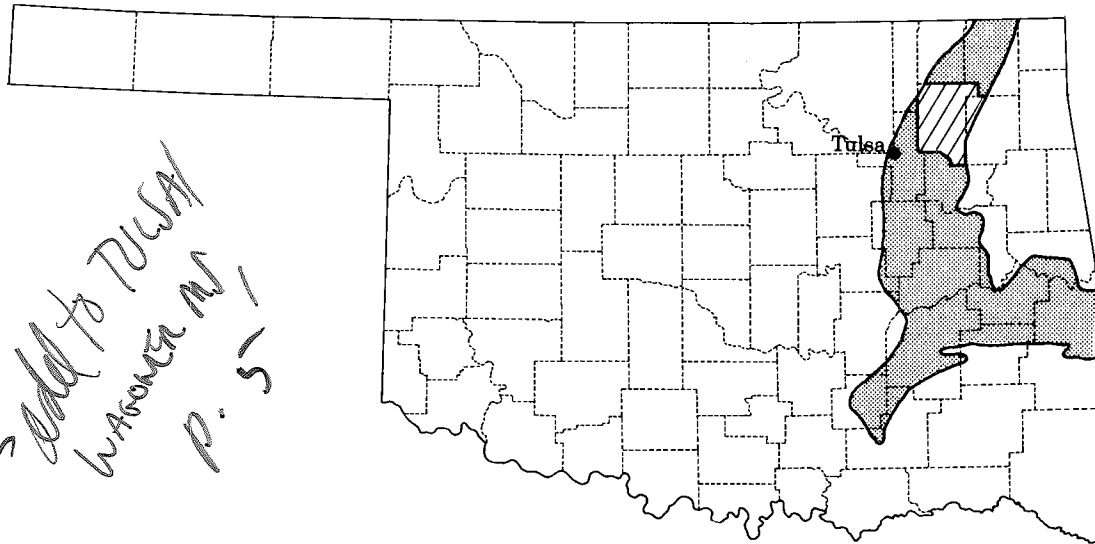


Figure 1. Index map of Oklahoma, showing the eastern Oklahoma coalfield (shaded), and area of this report (ruled).

prepared for the eight coal beds for which resources and reserves were tabulated. Coal beds too thin to have economic importance are discussed briefly, but were not mapped. Six cross sections (Pls. 5-7) show the succession of coals and associated strata throughout the study area.

Summary information on resources and reserves is presented in Table 1 according to township and coal thickness, and in Table 2 according to county and coal bed.

Coal resources are considered to be economically strippable if the thickness of overburden is ≤ 100 ft and the ratio of overburden thickness to coal thickness is $\leq 20:1$ (for all coals except the Crowburg, for which the stripping ratio is set at 30:1, owing to its superior qualities). If the coal is > 100 ft deep, it is considered recoverable only by underground mining. The minimum thickness considered for underground mining is 14 in.

All tonnage figures in this report represent short tons.

Previous Investigations

N. F. Drake (1897) made a survey of the coal beds in the Indian Territory of northeastern Oklahoma, including Rogers and Mayes Counties. He traced the coal-bearing rocks from Kansas across the Cherokee, Creek, and Choctaw Nations to the Arkansas coalfields. Shannon and others (1926) presented a summary description of Oklahoma's coal resources, including data on coal beds in the area of the present investigation. Woodruff and Cooper (1928) briefly discussed the

geology of Rogers County, and Ireland (1930) made a brief mention of coal in a report on the geology of Mayes County. Moose and Searle (1929) made a chemical study of the coals of Oklahoma, including samples from Rogers and Mayes Counties. Analyses of mine samples of coals from Rogers County were performed by Fieldner and others (1928). Oakes (1944) investigated and mapped the Broken Arrow (Crowburg) coal in western Rogers County. Branson (1954) modified the stratigraphic nomenclature of the rocks of the shelf area and proposed names for coal cycles in the area of the present study. Trumbull (1957) reported on the coal resources of Oklahoma and included information from Rogers and Mayes Counties. Friedman (1974, 1976) investigated and reported on the coals of Oklahoma and presented data on coals from Rogers and Mayes Counties. Johnson (1974) mapped the disturbed and surface-mined coal lands of Oklahoma, including the study area.

Additional information on coal in Rogers and Mayes Counties is included in theses by Austin (1946), Lohman (1952), Tillman (1952), Gruman (1954), Morgan (1955), Sparks (1955), McKinney (1959), Stringer (1959), Davis (1961), Gibson (1961), Ruffin (1961), Urban (1962), Bond (1963), Bordeau (1964), Urban (1965), Gregg (1976), and Keasler (1979).

Acknowledgments

The author gratefully acknowledges the cooperation of individual landowners and the various

TABLE 1.—COAL RESOURCES AND RESERVES IN ROGERS AND MAYES COUNTIES
ACCORDING TO TOWNSHIP AND COAL THICKNESS*
(thousands of short tons)

Township, range, county	Remaining resources												Mined or lost in mining		Original resources		Reserves	
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total remaining resources		Acres		Tons		Acres		Tons	
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
T19N, R16E, Rogers	422	742	793	2,355	—	—	—	—	1,215	3,097	—	—	1,215	3,097	116	222		
T19N, R17E, Rogers	754	1,334	2,810	8,814	—	—	—	—	3,564	10,148	272	678	3,636	10,826	908	2,206		
T20N, R14E, Rogers	1,139	2,255	—	—	—	—	—	—	1,139	2,255	—	—	1,139	2,255	—	—		
T20N, R15E, Rogers	2,500	4,648	6,697	16,763	—	—	—	—	9,197	21,411	863	2,578	10,060	23,989	3,044	6,112		
T21N, R15E, Rogers	7,738	14,627	3,300	8,331	—	—	—	—	11,038	22,958	988	2,789	12,026	25,747	1,917	3,591		
T21N, R16E, Rogers	684	1,317	2,797	7,654	—	—	—	—	3,481	8,971	8	15	3,489	8,986	1,440	3,216		
T21N, R17E, Rogers	3,154	5,180	—	—	—	—	—	—	3,154	5,180	—	—	3,154	5,180	1,058	1,412		
T21N, R18E, Rogers	778	1,483	—	—	—	—	—	—	778	1,483	—	—	778	1,483	280	393		
T22N, R15E, Rogers	7,510	13,998	853	1,952	—	—	—	—	8,363	15,950	—	—	8,363	15,950	528	807		
T22N, R16E, Rogers	3,855	8,047	11,114	29,629	—	—	—	—	14,969	37,676	2,624	7,410	17,593	45,086	4,128	8,126		
T22N, R17E, Rogers	3,477	6,204	5,904	18,810	—	—	—	—	9,381	25,014	65	160	9,446	25,174	1,461	2,873		
T22N, R18E, Rogers	2,832	5,209	4,241	10,554	—	—	—	—	7,073	15,763	1	2	7,074	15,765	1,075	1,899		
T23N, R14E, Rogers	—	—	9,433	30,133	—	—	—	—	9,433	30,133	358	1,105	9,791	31,238	1,573	5,314		
T23N, R15E, Rogers	—	—	2,362	7,760	—	—	—	—	2,362	7,760	674	2,256	3,036	10,016	166	434		
T23N, R16E, Rogers	6,289	12,490	5,144	12,644	—	—	—	—	11,433	25,134	2,421	5,468	13,854	30,602	1,508	2,563		
T23N, R17E, Rogers	3,370	5,775	5,591	14,485	—	—	—	—	8,961	20,260	3,188	7,813	12,149	28,073	1,908	3,786		
T23N, R18E, Rogers	2,073	3,667	3,645	8,246	—	—	—	—	5,719	11,915	154	391	5,873	12,306	415	714		
T23N, R19E, Rogers	592	1,094	377	839	—	—	—	—	969	1,933	30	59	999	1,992	250	402		
T24N, R14E, Rogers	326	623	407	972	—	—	—	—	733	1,595	—	—	733	1,595	—	—		
T24N, R15E, Rogers	2,310	4,308	1,202	3,067	—	—	—	—	3,512	7,375	133	382	3,645	7,757	1,062	1,742		
T24N, R16E, Rogers	4,309	7,805	3,194	7,562	—	—	—	—	7,503	15,367	1	1	7,504	15,368	1,598	2,327		
T24N, R17E, Rogers	8,802	15,900	12,434	29,570	—	—	—	—	21,236	45,470	2,478	6,196	23,714	51,666	4,439	7,681		
T24N, R18E, Rogers	3,192	5,876	15,974	50,194	—	—	—	—	19,166	56,070	387	1,388	19,553	57,458	2,759	7,090		
TOTAL	66,106	122,582	96,272	270,334	—	—	—	—	164,379	392,918	14,645	38,691	179,024	431,609	31,603	62,910		

*See Appendix 1 for details.

TABLE 2.—COAL RESOURCES AND RESERVES IN ROGERS AND MAYES COUNTIES
ACCORDING TO COUNTY AND COAL BED*
(thousands of short tons)

Coal	Total remaining resources		Mined or lost in mining		Original resources		Reserves	
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
Rogers County:								
Dawson	16,040	46,863	1,165	3,743	17,205	50,606	2,791	7,490
Iron Post	28,525	55,812	3,160	6,894	31,685	62,706	9,953	16,456
Croweburg	48,263	113,713	8,978	24,400	57,241	138,113	6,479	13,065
Mineral	15,163	34,647	377	826	15,540	35,473	3,223	6,613
Weir-Pittsburg	26,995	74,269	508	1,698	27,503	75,967	4,992	11,893
Bluejacket	8,294	20,568	—	—	8,294	20,568	636	941
Drywood	2,059	5,733	—	—	2,059	5,733	492	1,209
Rowe	4,501	10,219	272	678	4,773	10,897	1,037	1,835
Total	149,840	361,824	14,460	38,239	164,300	400,063	29,603	59,502
Mayes County:								
Weir-Pittsburg	621	1,274	154	391	775	1,665	267	432
Bluejacket	7,209	15,518	—	—	7,209	15,518	868	1,618
Drywood	340	623	5	10	345	633	85	125
Rowe	6,369	13,679	26	51	6,395	13,730	780	4,233
Total	14,539	31,094	185	452	14,724	31,546	2,000	3,408
Grand Total	164,379	392,918	14,645	38,691	179,024	431,609	31,603	62,910

*See Appendix 1 for details.

coal companies who furnished information on coal beds. S. A. Friedman, senior coal geologist at the Oklahoma Geological Survey, gave me access to his unpublished data on the area of Rogers and Mayes Counties. Rebecca Bateman and Atiq Sediqi, research assistants, performed most of the measurements and calculations to derive resource and reserve figures. Research assistants Peter Eidson and Atiq Sediqi prepared a structure-contour map of the area.

METHODS OF INVESTIGATION

Sources of Information

Data for compilation of the maps, cross sections, and coal resource and reserve estimates were obtained from drill and core logs provided by coal companies, from 78 sections (Appendix 2) measured by the author in active and abandoned strip pits and on outcrops, and from sections measured by workers who had previously made geologic studies in the area. Two core holes were

drilled by the Oklahoma Geological Survey in 1988, after compilation of the maps and cross sections in this report. Logs of these holes are included in Appendix 2.

Mapping Techniques

Field reconnaissance in Rogers and Mayes Counties began in September 1979. Information was plotted on 7.5'-topographic quadrangle maps. The general practice was to traverse all roads and trails by vehicle, and then to traverse on foot all areas of importance to the investigation inaccessible by vehicle. Outcrop boundaries of all coals were field-checked, but exposures were difficult to find, because of concealment by unconsolidated surficial materials and dense vegetation over most of the area (see Hemish, 1980). Slumped material and ponded water have largely obliterated most exposures of coal beds in abandoned strip mines; therefore, the best data were gathered from active strip mines.

The term *outcrop* is used broadly herein to describe the areal border of a coal bed, whether it

is exposed at the surface or concealed beneath unconsolidated surface materials. The accuracy of coal-boundary mapping varies with amount of surface cover, nature of topography, and number and distribution of exposures and drill holes. Structural features, erosional gaps, and areas in which coal is lenticular or lacks persistence also hindered mapping.

Additional drill information will modify the outcrop boundaries shown on the maps for some areas. However, boundaries do generally indicate where strippable coal may be found.

Mined Areas

Areas mined by surface methods were mapped on aerial photographs or by visual estimation in the field. Underground mining was not at any time practiced on a large scale in the study area, and the few underground mines have long since been abandoned; their extent is unknown, and only the locations of the entrances were plotted on the coal maps (Pls. 1-4).

Thickness of Coals

Isopach lines on the maps (Pls. 1-4) indicate thicknesses of the various coal beds. The isopach interval was set at 0.2 ft in this study. This small interval allows for more-accurate calculations in areas such as Rogers and Mayes Counties, where average coal-bed thickness is <2 ft.

Overburden Categories

The term *overburden* includes all consolidated or unconsolidated material that overlies useful geologic deposits such as coal. Thickness of overburden is shown on the coal maps (Pls. 1-4) by isopach lines which divide the overburden into four thickness categories: ≤ 20 ft, >20 to ≤ 40 ft, >40 to ≤ 100 ft, and >100 ft. One hundred feet represents the maximum depth at which coal reserves are considered strippable in the study area. Future economic and technological factors may change this limitation, but such predictions are beyond the scope of this report.

Procedures for Calculating Resources and Reserves

Polygons delineating the various categories of coal resources were constructed by superposing coal-thickness lines on a work map (scale 1:24,000) for each coal. Included on the map were lines of outcrop, mined-out areas, and overburden-thickness lines, all color-coded. Circles were drawn around each datum point, defining categories of reliability. (A circle whose radius is 0.25 mi defines an area of measured resources; a circle whose radius segment extends from 0.25 to

0.75 mi defines an area of indicated resources; and a circle whose radius segment extends from 0.75 to 2 mi defines an area of inferred resources; see Friedman, 1974, p. 14.)

The acreage in each polygon was measured with a planimeter. Coal tonnage was then calculated by multiplying the number of acres by the average thickness of the coal (to the nearest tenth of a foot) and by the factor 1,800 tons/acre-ft (assumed for bituminous coal in the ground; Friedman, 1974, p. 17). Calculations and totals were rounded to the nearest 1,000 tons. Original work maps, charts, tables, and records of calculations are kept on file at the Oklahoma Geological Survey and are available for public examination.

Definition of Coal Resources and Reserves

Coal resources comprise maximum estimates of original and remaining coal resources that are identified or presumed to exist within a coalfield, on the basis of interpretation of geologic data and geologic judgment (Friedman, 1974, p. 13). In this study, resources were not determined for coal beds <10 in. thick, regardless of depth, because these beds are not of economic importance. At depths >100 ft, no resource figures were calculated for coal beds <14 in. in thickness. No depth limits were set for this study.

The following definitions of coal resources and reserves are paraphrased and quoted from Friedman (1974, p. 13-14):

Original coal resources. Coal resources determined from coal datum points, including coal resources (based on data from all categories of reliability) that are present in beds now and that were present before mining. New coal data can be used in updating original-resources estimates.

Remaining coal resources. Coal resources (based on data from all categories of reliability) that are now present in beds, but excluding coal that has been mined or lost in mining. These estimates require periodic updating owing to coal production and new coal data. In areas with no mining, original resources equal remaining resources. Remaining resources are updated by subtracting coal production and coal lost in mining from the original-resources estimate.

Reserves. Reserves are calculated from estimates of maximum recoverable resources, using a 50% recovery for underground mining and an 80% recovery for surface mining. In this report, reserves include only the portion of remaining resources that can be mined profitably under current economic conditions. To be considered economically extractable, a coal must have a stripping ratio $\leq 20:1$ for high-sulfur coals (coals containing >3.0% sulfur); for low-sulfur coals (such as the Croweburg), the stripping ratio must be $\leq 30:1$. No deductions from reserves were made for reasons such as adverse governmental regulations and policies, land-use conflicts, poor accessibility, or adverse geologic and engineering conditions. Reserves and recoverable reserves are used in the same sense. Estimates of re-

sources may change owing to additional coal data or coal production, and the recoverable reserves may thus change; both require periodic updating.

Quality of the Coals

Coals of Rogers and Mayes Counties are predominantly of high-volatile A bituminous (hvAb) rank; only a few analyzed samples fall in the high-volatile B range. Rank was determined by calculating Btu values on a moist, mineral-matter-free basis, in accordance with standard procedures of the American Society for Testing and Materials (1979, p. 220–224). Average values for the various analytical properties of each coal are listed in Appendix 3, which includes data from 62 analytical reports; of these 62 analyses, 2 are from publications by the U.S. Bureau of Mines, 11 are from coal companies, and 49 are from the laboratory of the Oklahoma Geological Survey. Twenty-five channel samples were collected in the study area during this investigation, mainly at active coal mines. Analytical work was done by chemists in the laboratory of the Oklahoma Geological Survey.

The average moisture content of coals in the study area is low, averaging slightly more than 3.8%. The Dawson coal has the highest average ash content (18.0%), and the Croweburg coal has the lowest sulfur content (0.6%). Other coals in the area have high sulfur contents, averaging >4%. The high-sulfur coals probably originated in swamps inundated by the sea during or after deposition of peat, whereas the Croweburg coal probably originated in fresh-water swamps. Stach and others (1975, p. 27) stated that sulfur is abundant in coals overlain by marine beds, and that the "high sulfur content is caused by the increased availability of sulphate ions in sea water and by the activity of anaerobic bacteria."

According to Friedman (1974, p. 23) ~20% of the sulfur in some of the high-sulfur coals can be removed by coal-washing plants in Oklahoma. Most of the sulfur is contained in pyrite, which is much denser than coal and tends to sink during the washing process. Friedman said that most of the coal produced in Oklahoma is not washed, but is partly cleaned by being crushed, and sized without the use of water.

The coals of Rogers and Mayes Counties have comparatively high heat values. On a moist, mineral-matter-free basis, the combined average value is >14,000 Btu/lb.

COAL GEOLOGY

Stratigraphy

All of the productive coal beds in Rogers and Mayes Counties are Desmoinesian (Middle Penn-

sylvanian) in age. The Pennsylvanian rocks consist mostly of sandstone, shale, siltstone, and limestone; sandstone and shale predominate. Coal constitutes only a minor percentage of the lithologic column. The rocks have been subdivided for purposes of mapping and correlation into a number of groups, formations, members, and beds (Fig. 2). The previously named major coal beds have been identified, mapped, and correlated throughout the study area (Hemish, 1986). In the following text, the rocks are discussed in stratigraphic order, from oldest to youngest.

Krebs Group

The oldest group which contains coal beds in the study area is the Krebs Group, which includes all rocks between the top of the Atoka Formation (below) and the top of the Boggy Formation (Oakes, 1953, p. 1523). In ascending order, the McAlester, Savanna, and Boggy Formations constitute the coal-bearing rocks in the Krebs Group in Rogers and Mayes Counties.

McAlester Formation.—Ten coal beds are known to be present in the McAlester Formation; however, they are of no economic importance, because they are thin or discontinuous. Tillman (1952, p. 42,65) described a very thin coal below the Warner Sandstone Member which is probably equivalent to the Riverton coal of Pierce and others (1937, p. 62). Gregg (1976, p. 17–18) noted the presence of a thin coal above the Warner Sandstone Member which he thought might be equivalent to the Neutral(?) coal of Branson (1954, p. 6). Gregg (1976, p. 15,17) also recorded the presence of a thin coal bed at the top of the McAlester Formation. Stringer (1959, p. 23) photographed the Spaniard Limestone Member and underlying coal exposed in the SE¼ sec. 27, T. 19 N., R. 17 E. Gruman (1954, p. 98, pl. 2) also noted a thin unnamed coal at the base of the Spaniard Limestone Member. Bennison and others (1979, p. vi,31) used the name "Spaniard" for the coal in this stratigraphic position in east-central Oklahoma.

Savanna Formation.—The base of the Spaniard Limestone Member marks the top of the McAlester Formation and the base of the Savanna Formation on the northeastern Oklahoma platform (Branson, 1954, p. 2). The top of the Savanna Formation is drawn at the base of the Bluejacket Sandstone Member (Branson, 1954, p. 2).

Two commercially important, named coals—and several thin, discontinuous unnamed coals, most of which occur near the bottom of the unit—are present in the Savanna Formation. Stringer (1959, p. 25,26,62) described and photographed a

3-in.-thick unnamed coal beneath the Sam Creek Limestone Member in secs. 26 and 27, T. 19 N., R. 17 E. The name "Sam Creek" coal was first used in print by Bennison and others (1979, p. vi) for this coal bed. Other thin, unnamed coal beds near the bottom of the Savanna Formation have been penetrated by boreholes in the study area (Pl. 7).

Rowe Coal.—The Rowe coal, which occurs below the Doneley Limestone Member, is the stratigraphically lowest coal of commercial value in Rogers and Mayes Counties. It has been mined chiefly in the area southeast of the town of Inola, in the extreme southern part of Rogers County. The Rowe coal has also been mined in T. 23 N., R. 19 E., in northern Mayes County, where a 1.2-ft thickness has been measured (Appendix 2, measured section 56). The Rowe may have economic potential in the northeastern part of T. 22 N., R. 18 E., where it is 1 ft thick on the outcrop (Appendix 2, measured section 34). The measured thickness of the Rowe coal is 1 ft in the Osage Hills area (Tillman, 1952, p. 64; Appendix 2, measured section 15). A small, abandoned strip pit in the SE¼ sec. 31, T. 22 N., R. 18 E., provides further evidence that the Rowe coal is of minable thickness in the Osage Hills area of west-central Mayes County (see Pl. 2).

Drywood Coal.—The Drywood coal is the other named coal of commercial value in the Savanna Formation. It occurs at or near the top of the Savanna, just below the Bluejacket Sandstone Member (or intervening shales) throughout the central and northern parts of the study area (Pl. 7). The Drywood coal is of minable thickness in only scattered places along the outcrop boundary, and in some places it has been cut out by channels at the base of the Boggy Formation. The interval between the base of the Bluejacket Sandstone Member and the Drywood coal increases markedly in the area south of Inola (Pl. 7), as does the interval between the Rowe coal and the Drywood coal. Near the Craig County line in northern Mayes County, the two coals are separated by only 14 ft (Appendix 2, measured section 56), whereas in the area south of Inola, as much as 150 ft of strata separate the two beds (Pl. 7). The northeastward thinning of Desmoinesian rocks has been recognized previously by Branson and others (1965, p. 22); according to these authors, "The Krebs Group is 6,000 to 8,000 feet thick in the Arkoma basin but thins northeastward to 540 feet along the Arkansas River and to 340 feet at the Kansas-Oklahoma line."

The Drywood coal has been mined only on a small scale, as evidenced by abandoned pits on outliers capped by the Bluejacket Sandstone Member in northern Mayes County (Pl. 1). Although the Drywood coal was never mined in the Inola area, evidence from drill cores and a mea-

sured section (Appendix 2, measured section 1) shows that the bed is locally ~2 ft thick along the east edge of T. 19 N., R. 16 E.

Boggy Formation.—The base of the Bluejacket Sandstone Member marks the base of the Boggy Formation, the youngest formation in the Krebs Group. In Rogers and Mayes Counties the Boggy contains sandstone units of various thicknesses that generally form resistant caprocks on east-facing cuestas. Shales separate the sandstones, and a limestone (Inola Limestone Member) is present between the Bluejacket Sandstone Member and the Taft Sandstone Member. A coal bed, not believed to have economic value, occurs just above the first sandstone overlying the shale above the Inola Limestone Member in southern Rogers County (Appendix 2, core-hole log 2). The coal bed is probably correlatable with the coal bed mined around Wainwright in Muskogee County.

Bluejacket Coal.—The Bluejacket coal is the only coal in the Boggy Formation that has commercial value in the study area. It occurs just below the Inola Limestone Member. The Inola locally consists of several beds (Branson, 1954, p. 2; Tillman, 1952, p. 30–32) associated with two thin coals, each <2 in. thick. The Bluejacket coal is of minable thickness in T. 21 N., R. 18 E., where it is locally 22 in. thick, including a 4-in. parting (Appendix 2, core-hole log 1), and in T. 22 N., R. 17–18 E., where it is well over 1 ft thick (Appendix 2, measured section 36; and confidential drill-hole data). Caved-in openings to several abandoned slope mines were located in sec. 16, T. 22 N., R. 18 E. (Pl. 3). In the NE¼ sec. 25, T. 22 N., R. 17 E., the Bluejacket coal is 14 in. thick and crops out in the bed of Seminole Creek, where the landowner mines a small amount for personal use.

A stratigraphic problem concerning the placement of the contact between the Krebs Group and the Cabaniss Group (Boggy Formation and Senora Formation) was encountered in the report area. To the north, in Craig County, the top of the Boggy Formation was drawn at the base of the Weir-Pittsburg coal by Branson and others (1965, p. 23). Hemish (1986) followed this convention. To the south, the section of Desmoinesian rocks thickens, and in Muskogee and Wagoner Counties there are several sandstones in the lower Senora and upper Boggy that do not occur in Craig County (see Oakes, 1977, pl. 1; Govett, 1959, pl. 1). The Taft Sandstone Member was named for sandstones that crop out in the upper part of the Boggy Formation (Wilson, 1935, p. 510; Wilson and Newell, 1937, p. 56–57), although the limits of the Taft have never been adequately established. Oakes (1977) did not use the term Taft formally in his report on the geology of Muskogee County, but rather designated

Coal Geology

SYSTEM	SERIES	GROUP	FORMATION	LITHOLOGY	THICKNESS (ft.)	MEMBER OR UNIT			
PENNSYLVANIAN	MISSOURIAN	Skiatook	Coffeyville		175-230				
			Checkerboard		3-19.5				
			Seminole		48-50				
	DESMOINESIAN	Marmaton	Holdenville			0.1-0.2	Tulsa coal		
						40-125			
					0.7-1.9	Dawson coal			
					25-50				
			Nowata		25-100				
			Oologah		5-15	Altamont Limestone			
					0-10	Bandera Shale			
					50-57	Pawnee Limestone			
					0-3	Anna Shale			
			Labette		40-42	Peru sand			
					80-240				
			Cabaniss	Senora				4.5-5.0	Higginsville Limestone
								6.5-7.0	Little Osage Shale
								5-25	Blackjack Creek Limestone
								3.0-6.2	Excello Shale
								5-11	Breezy Hill Limestone
								0.1-5.0	Kinnison Shale
								0.6-1.8	Iron Post coal
						2-20			
						1-30	Lagonda Sandstone		
						4-28			
	Fort Scott		3-12	Verdigris Limestone					
			5-27						
			6-21	Oowala Sandstone (new)					
			8-36						
		1.0-2.2	Croweburg coal						
		1.6-5.0							
		50-60							
		0.3-2.0	Mineral coal						

Figure 2. Generalized columnar section of Rogers County and western Mayes County, Oklahoma. For simplicity, the term *Member* is omitted here and elsewhere in the report. The formal status of members is

SYSTEM	SERIES	GROUP	FORMATION	LITHOLOGY	THICKNESS (ft)	MEMBER OR UNIT			
PENNSYLVANIAN	DESMOINESIAN	Cabaniess	Senora		10-65	Chelsea Sandstone			
					0-25				
					2-6.3	Tiawah Limestone			
					0.1-0.4	Tebo coal			
					20-45	White sandstone			
						upper Taft sandstone			
					0.1-0.5 +	RC coal			
					20-45	middle Taft sandstone			
					0.1-2.5	Weir-Pittsburg coal			
						Boggy		5-50	Taft Sandstone
		10-60							
		0.8-10	Inola Limestone						
		0.02-1.5	Bluejacket coal						
		5-6							
		0.1-0.6							
		2.5-56	Bluejacket Sandstone						
			Savanna					0-38	
								0.1-2.0	Drywood coal
								14-150	
					0.1-1.5	Doneley Limestone			
					0.2-2.3	Rowe coal			
					15-27				
					0.2-1.5	Sam Creek Limestone			
					0-0.3	Sam Creek coal			
					8.3-30				
					0.3-1.3	Spaniard Limestone			
0-0.6	Spaniard coal								
	McAlester		60-110						
			3-31	Warner Sandstone					
			0-0.2	Riverton coal					

indicated by capitalization of the lithologic term (e.g., Bluejacket Sandstone); lowercase lithologic terms are used for informal units (e.g., White sandstone).

the sandstone units by numbers (PbO₁-PbO₅). Lontos (1952) and Govett (1959) mapped as Taft sandstone units that extend from Wagoner County northward into Rogers and Mayes Counties, where they have been called "upper, middle, and lower Taft" by Gruman (1954, p. 33-39) and Tillman (1952, p. 25-29). The upper and middle Taft sandstones of Gruman and Tillman extend only into sec. 25, T. 23 N., R. 17 E., in Rogers County. The lower Taft sandstone is the most persistent of the Taft sandstones, extending across northern Rogers and Mayes Counties into Craig County (Branson and others, 1965, p. 33). In this report, only the lower Taft sandstone is considered to be correlatable with the Taft Sandstone Member of the Boggy Formation as defined by Wilson (1935, p. 510), and Wilson and Newell (1937, p. 56-57) in Muskogee County.

Cabaniss Group

Senora Formation.—For purposes of this report, and to conform with procedures earlier followed by Hemish (1986), the Boggy-Senora contact is placed at the base of the Weir-Pittsburg coal bed, and the upper and middle Taft sandstones of Tillman (1952) and Gruman (1954) are included in the basal part of the Senora Formation (Fig. 2). In Wagoner County, south of the Verdigris River, Govett (1959, pl. 1) placed two units of the Taft sandstone in the Senora Formation, and three units in the Boggy Formation. Oakes (1977, p. 35-36) reviewed the controversy over placement of the Boggy-Senora contact in the southern part of the shelf area of northeastern Oklahoma.

Weir-Pittsburg Coal.—The Weir-Pittsburg coal at the base of the Senora Formation is the thickest coal bed in the study area. Reported thicknesses range from 1.5 ft to >2.0 ft in northeastern Rogers County and northwestern Mayes County. However, the bed thins to the southwest, and was found to be only 0.2 ft thick in sec. 12, T. 21 N., R. 16 E. (Appendix 2, core-hole log 2).

The Weir-Pittsburg is the first prominent marker bed encountered above the lower Taft Sandstone and below the Tebo coal in Craig County and southward to sec. 25, T. 23 N., R. 17 E., in Rogers County. However, in sec. 25, T. 23 N., R. 17 E., and to the south, the section thickens, and the upper Taft sandstone as well as the White sandstone unit of Tillman (1952, pl. 2) and Gruman (1954, pl. 2) overlies the Weir-Pittsburg coal. The Weir-Pittsburg coal is mappable at least as far south as T. 22 N., R. 17 E., where it has been mined in recent years in sec. 11 (Pl. 4).

RC Coal.—One coal that has only probable economic potential has been mapped in Rogers County (Pl. 2). It occurs discontinuously between the upper and middle units of the Taft Sandstone. Tillman (1952, pl. 2) and Gruman (1954,

pl. 2, p. 37) observed it in central Rogers County, but did not name it. Little is known about this coal, and no favorable sites for sampling were found during this study.

The RC coal is not of minable thickness where observed in outcrops, so no data points could be established for calculating reserves and resources. Conversations with local residents concerning coal encountered during water-well drilling, and evidence of past underground mining (Pl. 2) seemed to justify mapping the RC coal along with the other eight coals having economic potential in the study area.

Other Coals in the Senora Formation.—In addition to the Weir-Pittsburg coal, three other commercial coal beds are present in the Senora Formation in Rogers County: (1) the Mineral coal, which occurs a few feet above the Chelsea Sandstone Member (Fig. 2; Pl. 2); (2) the Croweburg coal, which occurs 50-60 ft above the Mineral coal, and 30 ft (in southwestern Rogers County) to 70 ft or more (in northern Rogers County) below the Verdigris Limestone Member (Fig. 2; Pls. 5,6); and (3) the Iron Post coal, which occurs about 30-40 ft above the Verdigris Limestone Member and ~2 ft below the Breezy Hill Limestone Member (Fig. 2; Pls. 5,6).

Other coal beds also occur in the Senora Formation but they are thin, discontinuous, and commercially insignificant. Named beds include the Tebo coal, just below the Tiawah Limestone (known in the subsurface as the "Pink lime"; Jordon, 1957, p. 157,165,179). In the subsurface, the "Pink lime" is a useful stratigraphic marker and is generally considered to be the boundary between the Krebs Group and the Cabaniss Group (Strong, 1961, p. 70).

A thin coal was observed in the bluffs of Bird Creek in sec. 19, T. 20 N., R. 15 E., ~12 ft below the Iron Post coal (Appendix 2, measured section 5). This bed may be equivalent to the Bevier coal mapped in Craig County (Hemish, 1986).

Branson (1954, p. 5) indicated the presence of a "Sequoyah coal" in the Senora Formation, occurring in an unnamed coal cycle below the Croweburg coal cycle. However, he did not provide information on the location of the bed. Doerr (1961, p. 45) mentioned a "Sequoyah coal" that was mined in Rogers County in secs. 33 and 34, T. 24 N., R. 17 E. This coal correlates with a bed traced southwestward across Craig and Nowata Counties, where it was mapped as the Mineral coal by Hemish (1986). Because of its stratigraphic position in relation to key beds in the area (Pl. 6)—namely, the Croweburg coal and Chelsea Sandstone Member—Doerr's Sequoyah coal is herein considered to be the Mineral bed.

The term "Sequoyah" is also used by miners for a bed mined in the hills northwest of the town of Sequoyah Siding (sec. 13, T. 22 N., R. 16 E., Rogers County); there is little doubt that this is

the Croweburg coal (Appendix 2, measured section 24; Pl. 3). It seems advisable to discontinue use of the name Sequoyah coal, because it apparently has been applied to two different beds, it has not been observed in borehole logs or outcrops, and it is at best only a popular trade name.

Mineral Coal.—In Rogers County exposures of the Mineral coal are difficult to find. Plate 2 shows the erratic character of the bed. The thickness ranges from <4 in. to 2 ft. According to unconfirmed drillers' reports, the thickness of the Mineral coal is ≥ 30 in. in the area of Rogers and Wagoner Counties just south of the Verdigris River. The Mineral coal is 1–1.5 ft thick in an area west of the town of Chelsea, where it has been mined in recent years (Pl. 2).

Croweburg Coal.—The Croweburg coal crops out along a nearly continuous, irregular line extending diagonally from southwest to northeast through the middle of Rogers County (Pl. 3). Its average thickness is 18 in. The Croweburg has long been prized because of its high quality. Plate 3 and Appendix 1 show that the Croweburg coal has been strip-mined extensively along the outcrop belt throughout Rogers County, in many places to depths as great as 60–70 ft (Fig. 3).

Oowala Sandstone Member (New).—During the present study, a persistent sandstone as thick as 20 ft or more was observed in highwalls of

abandoned strip pits in northern and central Rogers County. The sandstone is 5–27 ft below the base of the Verdigris Limestone Member and 8–36 ft above the Croweburg coal. Previous investigators (Oakes, 1944, p. 12; Tillman, 1952, p. 16; Gruman, 1954, p. 26) also observed a sandstone in this same interval, but did not name it. The occurrence of the sandstone over a wide area of central and northern Rogers County makes formal naming appropriate. The sandstone is here named the Oowala Sandstone Member. The name is derived from the Civil Township of Oowala, where exposures of the sandstone are common in abandoned strip pits throughout the area. The type section (Appendix 2, measured section 24; Fig. 4) is ~ 0.75 mi north of the town of Sequoyah Siding, in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 22 N., R. 16 E. The Oowala is a light-brown to light-gray, very fine-grained, micaceous, non-calcareous, thin-bedded, silty sandstone. It is

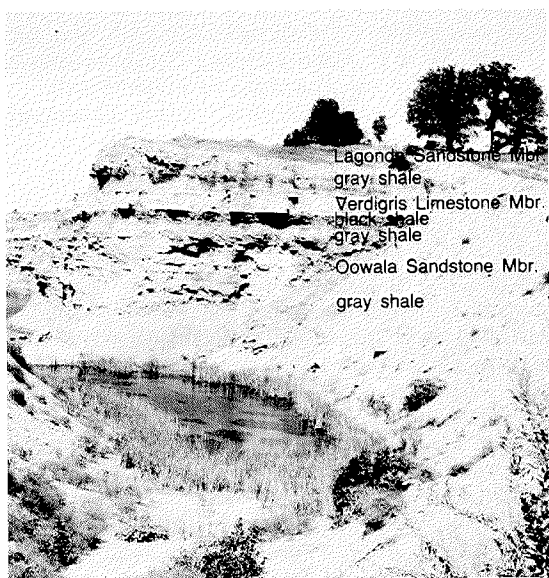


Figure 3. Highwall of a strip pit where the Croweburg coal was mined in the SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 14, T. 24 N., R. 17 E., Rogers County. The Croweburg is covered by slumped material and water. Estimated height of highwall, 65 ft.

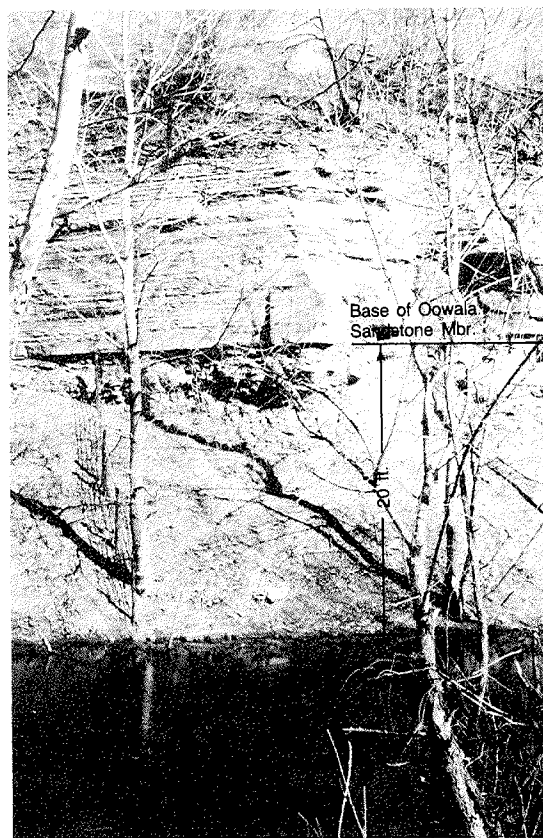


Figure 4. Type section of the Oowala Sandstone Member of the Senora Formation in the highwall of an abandoned strip mine in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T. 22 N., R. 16 E., Rogers County (see Appendix 2, measured section 24). The Croweburg coal was mined at this location in the 1960s.

overlain and underlain by silty gray shale. The basal contact is generally sharp, whereas the upper contact is gradational and difficult to define. The Oowala Sandstone Member is a lenticular and does not appear to correlate with any other unit.

Iron Post Coal.—The Iron Post coal crops out across Rogers County (Pl. 1) in a line roughly parallel to the outcrop line of the Croweburg coal. The Iron Post has not been mined as extensively as the Croweburg, although the quality is good (Appendix 3 shows that the Iron Post coal has an average heat value in excess of 13,000 Btu/lb). The chief reasons for the lack of exploitation are (1) the difference in sulfur content (the Croweburg averages 0.6%, and the Iron Post averages 3.5%; there is less demand for high-sulfur coal); (2) the difference in thickness of the two beds (the Croweburg averages ~1.5 ft and the Iron Post coal averages slightly more than 1 ft); and (3) the lithology of the overburden (the Croweburg is overlain in most places by a thick section of silty shale, whereas the Iron Post coal is overlain by resistant limestones).

The outcrop boundary of the Iron Post coal is highly irregular and is characterized by numerous outliers capped by the Breezy Hill Limestone Member or by the limestone of the Fort Scott Formation (Pl. 1). Figure 5 shows the sequence of rocks overlying the Iron Post coal in the highwall of a strip pit, and Figure 6 shows a recent mining operation in northern Rogers County.

Marmaton Group

The top of the Cabaniss Group (and the Senora Formation) is the base of the Fort Scott Formation (Oakes, 1953, p. 1525). The Marmaton Group overlies the Cabaniss Group and is at the top of the Desmoinesian Series (Jewett and others, 1940, p. 8–9).

Dawson Coal.—The Dawson coal, which crops out in northwestern Rogers County (Pl. 1), is the only coal of economic importance in the Marmaton rocks of the study area. The Dawson coal was believed to be of Missourian age and was placed in the Seminole Formation by Oakes (1940, p. 24), Oakes and others (1952, p. 52), Sparks (1955, p. 7–8), and Friedman (1974, p. 6), all who made studies in the outcrop area. Bennison (1972, p. 46) suggested that rocks containing the Dawson coal were “possibly latest Desmoinesian.” Wilson (1979, p. 234–235) presented palynological evidence showing that the boundary between the Desmoinesian and Missourian Series should be moved up to a position above the Dawson coal. He placed the Dawson coal in the Holdenville Formation, in the upper Marmaton Group.

Although the Desmoinesian–Missourian Series boundary has not been positively established in Oklahoma at this time, lithological, paleon-

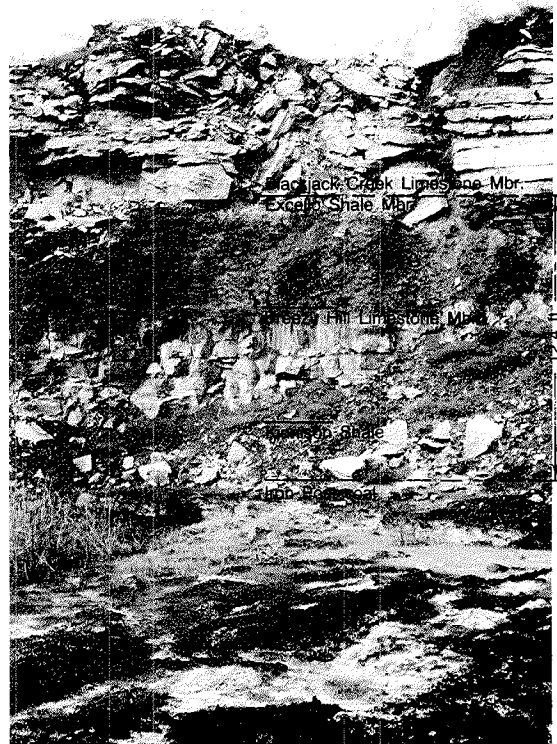


Figure 5. Highwall of a strip pit where the Iron Post coal was mined in the NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 23 N., R. 16 E., Rogers County. Contact between the Senora Formation and the Fort Scott Formation is at the base of the Blackjack Creek Limestone Member (see Appendix 2, measured section 44).

tological, and palynological evidence strongly suggest that it is at or near the base of the Tulsa coal bed. In the area of this report, the Seminole Formation is shown to extend from the base of the Tulsa coal to the base of the Checkerboard Formation (Fig. 2). (The Tulsa coal is a thin, noneconomic coal that occurs only in the extreme northwestern corner of Rogers County in the study area.)

Strip mines extend along the line of outcrop of the Dawson coal across much of northwestern Rogers County (Pl. 1). At the time the field work for this report was done, all of the mines were abandoned. Although the Dawson coal was rarely observed in fresh exposures, available data indicate that the bed ranges from about 1.5 to 1.9 ft in thickness southwest of Talala, thinning to 1.0 ft or less northwest of Talala. At the bound-



Figure 6. Active strip mine operated (Oct. 1979) by Four D Energy, Inc., in the SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 7, T. 24 N., R. 17 E., Rogers County. Overburden above the Iron Post coal is <10 ft thick at this location. Note small oil-well pump on the "island" at the left (see Appendix 2, measured section 67).

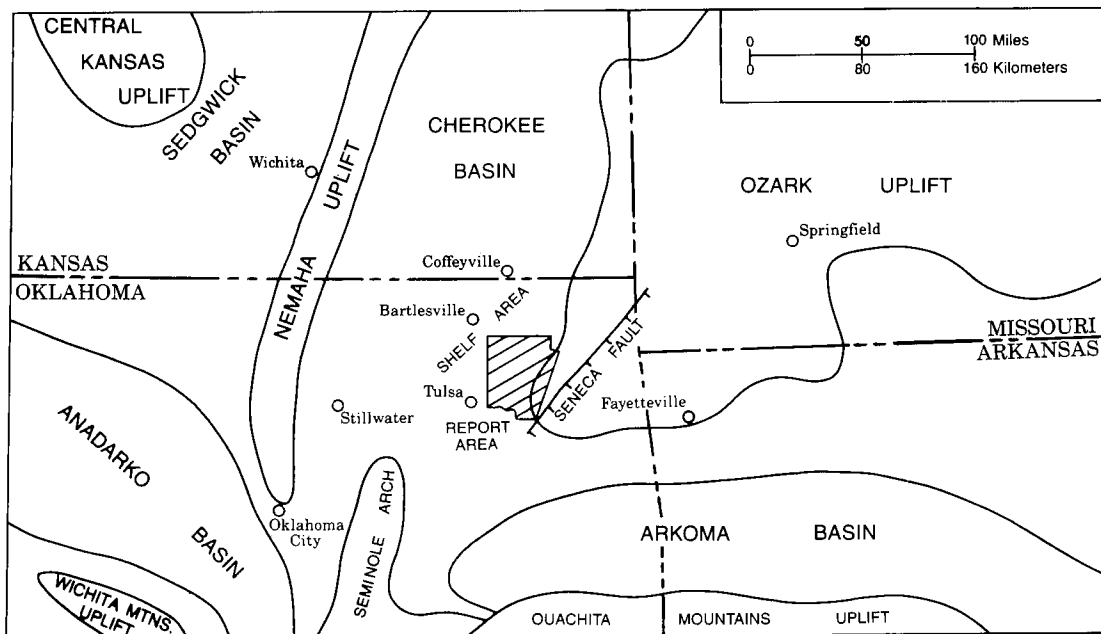


Figure 7. Tectonic map showing the position of the report area in relation to regional structural features (modified from Oetking and others, 1966).

ary between Nowata and Rogers Counties, the Dawson coal is <0.8 ft thick, and therefore not of minable thickness.

Structure

In general, the coal-bearing region of north-eastern Oklahoma consists of two major structural provinces—the northern area, called the shelf or platform, and the southern area, part of the Arkoma basin (Fig. 7). Rogers and Mayes Counties lie in the shelf area, around the southwestern edge of the Ozark uplift. Strata in the study area dip W and NW away from the axis of the uplift at about 25–50 ft/mi (Huffman, 1958, p. 89).

Folds and faults generally trend NE (Pl. 8), and are aligned roughly parallel to the axis of the Ozark uplift. Fault traces are difficult to detect, because of slumping and a cover of colluvium or alluvium; consequently, most are indicated with uncertainty. Faults were mapped in the Rogers and Mayes Counties study area by Lohman (1952), Tillman (1952), Gruman (1954), Stringer (1959), Strong (1961), Gregg (1976), and Keasler (1979). Evidence for locating the faults included alignment of drainage, local interruption of the outcrop pattern, visible displacement, topographic lineament, and interpretation of stratigraphic relationships based on borehole data. Previously mapped faults were examined on aerial photos or

in the field by the writer. If no evidence was found to confirm the existence of a fault, it is not shown on Plates 1–4 and 8 of this report. In some areas, new borehole data from confidential sources were used in mapping faults or extending known faults. Most of the faults are assumed to be normal, but the displacement and sense of movement cannot be determined accurately.

Principal named faults include the Seneca fault, which is shown on the geologic map of Oklahoma (Miser, 1954), Bowlin Spring fault, the Catale fault, the Little Pryor Creek fault, the Condry School fault, the Winganon fault, and the Diver Creek fault (Strong, 1961, pl. 7; Branson and others, 1965, pl. 1).

Structural configuration across the study area is shown by structure-contours drawn on the Rowe, Weir-Pittsburg, and Croweburg coals (Pl. 8).

Rose diagrams (Fig. 8) were constructed from 20 measurements of cleat orientations made with a Brunton compass in the Rogers and Mayes Counties area (Appendix 4). *Cleat* is defined as a vertical joint or system of joints along which coal has naturally fractured (McCulloch and others, 1974, p. 2). *Face cleat* is the major, well-defined joint in a coal bed, and *butt cleat* is the poorly defined joint, commonly at right angles to the face cleat. According to McCulloch and others (1974, p. 1), "face cleats were formed as extension fractures during structural deformation, and

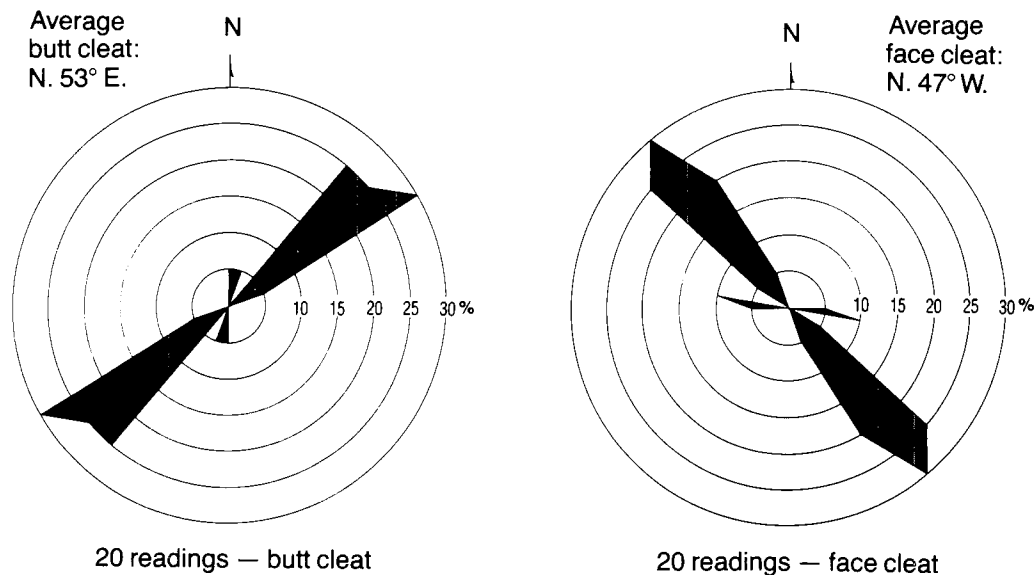


Figure 8. Rose diagrams of cleat orientations in the coal beds.

butt cleats, as release fractures during erosion and uplift." Their studies indicate that "face cleat maintains a perpendicular orientation to the shifting axial trend of local structures."

As the rose diagrams show, the face cleat in general strikes NW, and the butt cleat strikes NE. These trends suggest that the cleat structure was produced by forces related to tectonism associated with the Ozark uplift, which has a NE-trending axis.

COAL ECONOMICS

Production

Eight coals have been mined since 1909 in the area of this report, and these coals are considered to have economic importance at the present time. One additional coal (RC bed) that may have economic potential has been mined on a small scale in the past and has been mapped on Plate 2.

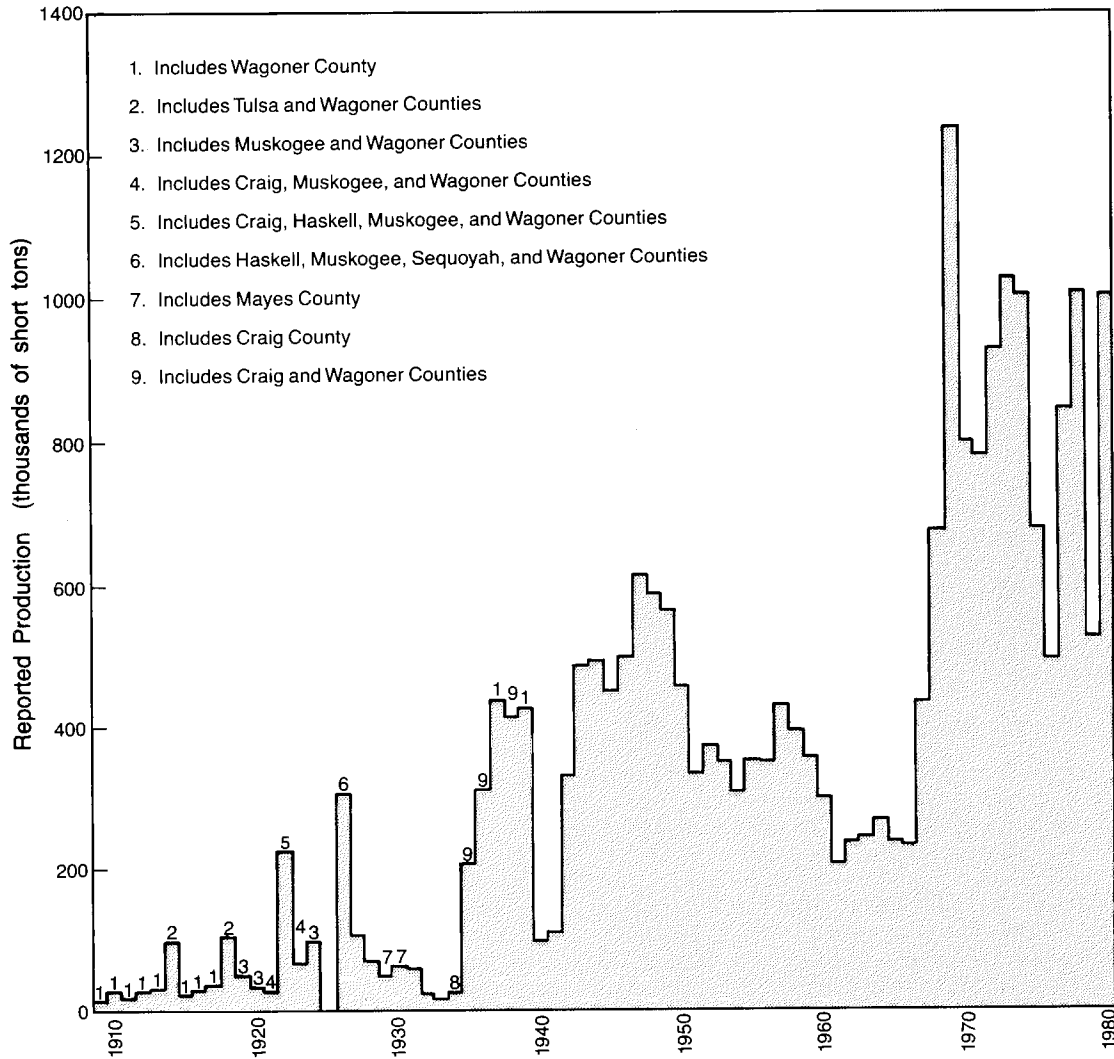


Figure 9. Histogram illustrating reported production of coal in Rogers County, 1909–80. (Data for 1909–33 from USGS, *Mineral Resources of the United States*; for 1933–52 from USBM; for 1953–80 from *Annual Report of the Chief Mine Inspector*, Oklahoma Department of Mines.)

However, no reserves or resources have been calculated for this bed, because data are insufficient.

Records of annual coal production in Rogers County date from the early years of the 20th Century (Fig. 9). The most tonnage was mined during 1969, when reported production was 1,240,319 short tons. According to records from the Oklahoma Department of Mines, coal production was reported from Mayes County during only one year—1977, when 17,440 short tons was mined. An unknown tonnage of coal has been mined on a small scale (mostly for local use) in both Rogers and Mayes Counties.

During the fall of 1979 and the spring of 1980, when the field work for this report was in progress, 10 coal producers were mining coal from three beds in Rogers County: (1) Carbonex Coal Co.—Croweburg; (2) Double-D Mining Co.—Croweburg; (3) Four D Energy, Inc.—Iron Post; (4) Hefner and Son Coal Co.—Croweburg; (5) Hickory Coal Co.—Croweburg; (6) Local Coal Co.—Weir-Pittsburg; (7) McNabb Coal Co.—Croweburg; (8) Russell Creek Coal Co.—Croweburg; (9) Shamrock Coal Co.—Croweburg; and (10) Sweetwater Coal Co.—Croweburg and Iron Post.

On the basis of information provided by coal companies, the average value of the coal produced during 1979 was estimated at \$24/ton. By multiplying the produced tonnage of coal reported to the Oklahoma Department of Mines (525,200 tons) by the average value (\$24/ton), the total value of coal produced from the three beds during 1979 was determined to be \$12,604,800.

Most of the coal mined in the study area is shipped out of Oklahoma to Missouri and Texas, where it is used in steam electric generating plants, and for metallurgical purposes. The coal is transported mainly by truck and rail, but some is moved by barge down the McClellan-Kerr Arkansas River Navigation System.

Mining Methods and Reclamation

At the time of this study, all coal produced in the area was mined by surface methods. Several methods of overburden removal were used in the stripping operations. Carbonex Coal Co., McNabb Coal Co., and Sweetwater Coal Co. used draglines for overburden removal. This system has proved to be efficient in stripping operations when used in conjunction with bulldozers and scrapers for reclamation and topsoil handling. The smaller companies operate with only crawler tractors, dirt scrapers, and front-end loaders for removal of overburden and reclamation work.

In most cases, currently used reclamation practices seem to be quite successful in restoring mined land to productivity in northeastern Oklahoma. Figure 10 shows reclaimed land where the Mineral coal was mined out on the contour after 1971; the area has been revegetated, and a pond has been left in the area of the final cut. Figure 11 shows an area of partly reclaimed land. Figure 12 shows an abandoned strip pit where the Croweburg coal was mined. Prior to the Oklahoma Mining Lands Reclamation Acts of 1968 and 1971, Oklahoma coal companies were not required by law to reclaim mined land (Johnson, 1974, p. 6). Johnson (1974, p. 9, table 2) reported 6,882 acres of disturbed and unreclaimed land in Rogers and Mayes Counties, and 2,904 acres of disturbed and partly reclaimed land in Rogers County, through 30 June 1973; he also reported 1,140 acres of disturbed and reclaimed land in Rogers County. Total disturbed land in Rogers and Mayes Counties thus was reported to be 10,926 acres as of 30 June 1973. Results of the current study in the same area (as of 30 June 1980) show a grand total of 14,645 acres in the "mined or lost in mining" category (Table 1); this is the approximate equivalent of disturbed land, including both reclaimed and unreclaimed areas.

Resources and Reserves

Appendix 1 contains tabulated data on original resources, remaining resources, tonnages of coal mined or lost in mining, and reserves. These data are tabulated by township and include each of the eight economically important coals in the study area: Rowe, Drywood, Bluejacket, Weir-Pittsburg, Mineral, Croweburg, Iron Post, and Dawson.

Table 1 shows a combined grand total of 431,609,000 tons as the original resources of the study area; 392,918,000 tons as the remaining resources; 38,691,000 tons as mined or lost in mining; and 62,910,000 tons as reserves. These figures combine the statistics for all eight commercial coals in Rogers and Mayes Counties. Of the remaining resources, 75,247,000 tons occur at depths of >100 ft and are not considered minable by surface methods. None of this tonnage is considered to be reserves.

Table 2 contains data according to coal bed for each of the two counties. Most of the remaining resources in Rogers County are in the Croweburg coal (113,713,000 tons); the Iron Post coal leads in reserves (16,456,000 tons). In Mayes County, most of the remaining resources are in the Bluejacket coal (15,518,000 tons); the Bluejacket also leads in reserves (1,618,000 tons).



Figure 10. Mined land in sec. 34, T. 24 N., R. 17 E., reclaimed after the Oklahoma Mining Lands Reclamation Act of 1971. Land to the left of the pond in the final cut has been graded and revegetated.



Figure 11. Mined land in the N $\frac{1}{2}$ sec. 3, T. 23 N., R. 17 E., partly reclaimed in accordance with the Oklahoma Mining Lands Reclamation Act of 1968, which required leveling only the tops of spoil ridges to a width of 10 ft. The Iron Post coal was mined at this location between 1968 and June 1971.



Figure 12. Abandoned strip pit in the SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 1, T. 22 N., R. 16 E., where the Croweburg coal was mined prior to the Oklahoma Mining Lands Reclamation Act of 1968. In such areas, which are abundant in central Rogers County, vegetation is sparse, and water generally fills the last cut.

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Appendixes

40-100	33	89	33	89	33	89
>100	33	89	33	89	33	89
Total	33	89	33	89	33	89
Inferred						
0-20						
20-40						
40-100						
>100						
Total						
Grand Total	209	600	209	600	209	600
COMBINED GRAND TOTALS	422	742	793	2,355	1,215	3,097
					1,215	3,097
					116	222

T19N, R17E, ROGERS COUNTY

Measured						
0-20	15	54	15	54	15	54
20-40	7	25	7	25	7	25
40-100	18	70	18	70	18	70
>100	2	8	2	8	2	8
Total	42	157	42	157	42	157
Indicated						
0-20	53	200	53	200	53	200
20-40	74	286	74	286	74	286
40-100	108	454	108	454	108	454
>100	46	175	46	175	46	175
Total	281	1,115	281	1,115	281	1,115
Inferred						
0-20	21	38	131	375	131	375
20-40	64	115	192	507	192	507
40-100	120	226	345	920	345	920
>100	62	162	62	162	62	162
Total	205	379	730	1,964	730	1,964
Grand Total	205	379	1,053	3,236	1,053	3,236
					376	987

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources						Mined or Lost in Mining*		Original Resources		Reserves			
		0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Acres		Tons			
		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons		
	<u>Measured</u>														
	0-20	65	112	130	395			195	507	272	678	467	1,185	195	406
	20-40	108	187	213	660			321	847			321	847	186	483
	40-100	154	270	410	1,283			564	1,553			564	1,553		
	>100			350	1,062			350	1,062			350	1,062		
	Total	327	569	1,103	3,400			1,430	3,969			1,702	4,647	381	889
	<u>Indicated</u>														
	0-20	15	27	45	131			60	158			60	158	60	126
	20-40	62	118	94	263			156	381			156	381	91	204
	40-100	145	241	301	935			446	1,176			446	1,176		
	>100			419	1,228			419	1,228			419	1,228		
	Total	222	386	859	2,557			1,081	2,943			1,081	2,943	151	330
	<u>Inferred</u>														
	0-20														
	20-40														
	40-100														
	>100														
	Total														
	Grand Total	549	955	1,962	5,957			2,511	6,912	272	678	2,783	7,590	532	1,219
	COMBINED GRAND TOTALS	754	1,334	2,810	8,814			3,564	10,148	272	678	3,836	10,826	908	2,206

T20N, R14E, ROGERS COUNTY

IRON POST

Category of Reliability and Depth (ft)	Measured		Indicated		Total	
	Acres	Tons	Acres	Tons	Acres	Tons
0-20	17	33	9	18	26	51
20-40	43	84	9	18	52	102
40-100						
>100						
Total	60	117	9	18	69	135

40-100	428	848	428	848
>100				
Total	437	866	437	866
<u>Inferred</u>				
0-20				
20-40				
40-100	642	1,272	642	1,272
>100				
Total	642	1,272	642	1,272
Grand Total	1,139	2,255	1,139	2,255

T20N, R15E, ROGERS COUNTY

IRON POST										
<u>Measured</u>										
0-20	19	32	19	32	19	32	19	32	19	26
20-40	82	161	82	161	82	161	82	161	82	154
40-100	6	8	6	8	6	8	6	8	6	8
>100										
Total	107	201	107	201	107	201	107	201	104	154
<u>Indicated</u>										
0-20	103	191	104	192	104	192	104	192	104	154
20-40	235	266	235	266	235	266	235	266	235	266
40-100	247	489	247	489	247	489	247	489	247	489
>100										
Total	585	946	586	947	586	947	586	947	104	154
<u>Inferred</u>										
0-20	391	791	436	905	436	905	436	905	436	724
20-40	441	861	461	912	461	912	461	912	20	41
40-100	775	1,434	775	1,434	775	1,434	775	1,434	775	1,434
>100										
Total	1,607	3,086	1,672	3,251	1,672	3,251	1,672	3,251	456	765
Grand Total	2,299	4,233	2,365	4,399	2,365	4,399	2,365	4,399	579	945
CROWEBURG										
<u>Measured</u>										
0-20	9	26	9	26	9	26	9	26	9	21
20-40	84	230	84	230	84	230	84	230	84	184
Total	93	256	93	256	93	256	93	256	93	205

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Depth (ft)	Remaining Resources						Mined or Lost in Mining*						Original Resources									
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres		Tons		Acres		Tons		Acres		Tons	
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons		
40-100	64	179						64	179					64	179							
>100																						
Total	157	435						157	435					1,020	3,013					120	267	
Indicated																						
0-20	116	284						116	284					116	284					116	227	
20-40	299	807						299	807					299	807					299	646	
40-100	855	2,142						855	2,142					855	2,142							
>100	57	139						57	139					57	139							
Total	1,327	3,372						1,327	3,372					1,327	3,372					415	873	
Inferred																						
0-20	292	639						292	639					292	639					292	511	
20-40	975	2,283						1,157	2,659					1,157	2,659					1,157	2,127	
40-100	2,432	5,690						2,432	5,690					2,432	5,690							
>100	626	1,467						626	1,467					626	1,467							
Total	182	376						4,507	10,455					4,507	10,455					1,449	2,638	
Grand Total	182	376						5,991	14,262					6,854	16,840					1,984	3,778	

MINERAL		Measured		Indicated		Inferred	
Category of Reliability and Depth (ft)	Acres	Tons	Acres	Tons	Acres	Tons	Acres
0-20	12	43					
20-40							
40-100							
>100							
Total	12	43					
0-20	129	466					
20-40	87	296					
40-100	17	45					
>100							
Total	233	807					
0-20	44	197					
20-40	209	734					
Total	253	931					

40-100	19	39	324	930	343	969	343	969
>100								
Total	19	39	577	1,861	596	1,900	596	1,900
Grand Total	19	39	822	2,711	841	2,750	841	2,750
COMBINED GRAND TOTALS								
	2,500	4,648	6,697	16,763	863	2,578	10,060	23,989
					9,197	21,411		3,044
								6,112

T21N, R15E, ROGERS COUNTY

IRON POST

<u>Measured</u>								
0-20	209	387	82	203	291	590	291	590
20-40	146	242	52	120	198	362	198	362
40-100	1	1	28	63	29	64	29	64
>100								
Total	356	630	162	386	518	1,016	518	1,016
<u>Indicated</u>								
0-20	484	907	93	232	577	1,139	577	1,139
20-40	291	596	88	222	379	818	379	818
40-100	198	404	37	81	235	485	235	485
>100								
Total	973	1,907	218	535	1,191	2,442	1,191	2,442
<u>Inferred</u>								
0-20	176	329	66	166	242	495	242	495
20-40	382	445	9	22	391	467	391	467
40-100	258	422			258	422	258	422
>100								
Total	816	1,196	75	188	891	1,384	891	1,384
Grand Total	2,145	3,733	455	1,109	2,600	4,842	2,600	4,842
								1,211
								1,983

CROWEBURG

<u>Measured</u>								
0-20			27	68	27	68	988	2,789
20-40			54	143	54	143	54	143
40-100	297	524	214	520	511	1,044	511	1,044
>100			22	51	22	51	22	51
Total	297	524	317	782	614	1,306	1,602	4,095
								75
								172

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Coal Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres	Tons	Acres	Tons	Acres	Tons
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
Indicated																
0-20			101	287			101	287					101	287	101	230
20-40	87	177	172	422			259	599					259	599	128	258
40-100	1,464	2,910	978	2,500			2,442	5,410					2,442	5,410	122	298
>100	55	137	55	137			55	137					55	137		
Total	1,551	3,087	1,306	3,346			2,857	6,433					2,857	6,433	351	786
Inferred																
0-20																
20-40	180	358	16	36			196	394					196	394		
40-100	2,427	4,806					2,427	4,806					2,427	4,806		
>100																
Total	2,607	5,164	16	36			2,623	5,200					2,623	5,200		
Grand Total	4,455	8,775	1,639	4,164			6,094	12,939	988	2,789	7,082	15,728	426	958		
MINERAL																
Measured																
0-20			11	38			11	38					11	38	11	30
20-40	7	11					7	11					7	11		
40-100	460	868					460	868					460	868		
>100																
Total	467	879	11	38			478	917					478	917	11	30
Indicated																
0-20			145	417			145	417					145	417	145	334
20-40	8	15	293	769			301	784					301	784	16	38
40-100	652	1,204	578	1,353			1,230	2,557					1,230	2,557		
>100	50	118	50	118			50	118					50	118		
Total	660	1,219	1,066	2,657			1,726	3,876					1,726	3,876	161	372
Inferred																
0-20			32	92			32	92					32	92	32	74
20-40			76	218			76	218					76	218	76	174
40-100	11	21	21	53			32	74					32	74		
>100																
Total	11	21	129	363			140	384					140	384	108	248
Grand Total	1,138	2,119	1,206	3,058			2,344	5,177	2,344	5,177	2,344	5,177	280	650		

Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves			
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres	Tons	Acres	Tons	Acres	Tons		
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons		
<u>Inferred</u>																		
0-20			282	864					282	864			282	864			282	691
20-40			202	621					202	621			202	621			202	497
40-100			365	1,070					365	1,070			365	1,070			365	326
>100			153	425					153	425			153	425			153	326
Total			1,002	2,980					1,002	2,980			1,002	2,980			1,002	1,514
Grand Total			2,033	5,692					2,033	5,692			2,033	5,692			2,033	1,830
MINERAL																		
<u>Measured</u>																		
0-20																		
20-40			21	77					21	77			21	77			21	62
40-100			42	79	12	27			54	106			54	106			54	346
>100																		
Total			42	79	33	104			75	183			75	183			75	62
<u>Indicated</u>																		
0-20			37	77	115	355			152	432			152	432			152	346
20-40			120	227	71	164			191	391			191	391			191	346
40-100			276	499	100	233			376	732			376	732			376	346
>100																		
Total			433	803	286	752			719	1,555			719	1,555			719	346
<u>Inferred</u>																		
0-20			37	73	279	728			316	801			316	801			316	641
20-40			19	38	31	76			50	114			50	114			50	15
40-100			53	111	40	92			93	203			93	203			93	15
>100					3	7			3	7			3	7			3	7
Total			109	222	353	903			462	1,125			462	1,125			462	656
Grand Total			584	1,104	672	1,759			1,256	2,863			1,256	2,863			1,256	1,064
COMBINED GRAND TOTALS																		
			684	1,317	2,797	7,654			3,481	8,971	8	15	3,489	8,986	1,440	3,216		

T2IN, R17E, ROGERS COUNTY

WEIR-PITTSBURG

<u>Measured</u>									
0-20									
20-40									
40-100	39	71	39	71	39	71	39	71	
>100									
<u>Total</u>	39	71	39	71	39	71	39	71	
<u>Indicated</u>									
0-20	80	144	80	144	80	144	80	144	115
20-40	162	292	162	292	162	292	162	292	
40-100	278	501	278	501	278	501	278	501	
>100									
<u>Total</u>	520	937	520	937	520	937	520	937	80
<u>Inferred</u>									
0-20	473	851	473	851	473	851	473	851	681
20-40	224	403	224	403	224	403	224	403	
40-100	117	211	117	211	117	211	117	211	
>100									
<u>Total</u>	814	1,465	814	1,465	814	1,465	814	1,465	473
<u>Grand Total</u>	1,373	2,473	1,373	2,473	1,373	2,473	1,373	2,473	553
									796

ROWE

<u>Measured</u>									
0-20									
20-40									
40-100	47	69	47	69	47	69	47	69	55
>100									
<u>Total</u>	47	69	47	69	47	69	47	69	47
<u>Indicated</u>									
0-20	226	337	226	337	226	337	226	337	270
20-40	133	197	133	197	133	197	133	197	
40-100	72	107	72	107	72	107	72	107	
>100									
<u>Total</u>	431	641	431	641	431	641	431	641	226
<u>Inferred</u>									
0-20	232	364	232	364	232	364	232	364	291
20-40	203	311	203	311	203	311	203	311	

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Depth (ft)	Remaining Resources						Mined or Lost in Mining*			Original Resources			Reserves					
	0.8-1.2 ft		1.2-2.4 ft		>3.5 ft		Total Remaining Resources			Acres			Tons					
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons		
40-100	868	1,322					868	1,322					868	1,322				
>100																		
Total	1,303	1,997					1,303	1,997					1,303	1,997	232	291		
Grand Total	1,781	2,707					1,781	2,707					1,781	2,707	505	616		
COMBINED GRAND TOTALS	3,154	5,180					3,154	5,180					3,154	5,180	1,058	1,412		

T21N, R18E, MAYES COUNTY

ROWE

Measured	0-20			20-40			40-100			>100			Total				
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons					
0-20	26	50					26	50					26	50	26	40	
20-40	19	36					19	36					19	36			
40-100	27	51					27	51					27	51			
>100																	
Total	72	137					72	137					72	137	26	40	
Indicated	58	116					58	116					58	116	58	93	
0-20	49	97					49	97					49	97			
20-40	116	230					116	230					116	230			
>100																	
Total	223	443					223	443					223	443	58	93	
Inferred	176	325					176	325					176	325	176	260	
0-20	117	218					117	218					117	218			
20-40	190	360					190	360					190	360			
40-100																	
>100																	
Total	483	903					483	903					483	903	176	260	
Grand Total	778	1,483					778	1,483					778	1,483	260	393	

Category of Reliability and Depth (ft)	Remaining Resources						Mined or Lost in Mining*			Original Resources			Reserves				
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Mined or Lost in Mining*		Original Resources		Reserves		
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	
40-100	296	564								296	564			296	564		
Total	296	564							296	564			296	564			
Grand Total	1,369	2,690	572	1,333					1,941	4,023			1,941	4,023			
COMBINED GRAND TOTALS	7,510	13,998	853	1,952					8,363	15,950			8,363	15,950	528	807	

T22N, R16E, ROGERS COUNTY

IRON POST

Category of Reliability and Depth (ft)	Remaining Resources						Mined or Lost in Mining*			Original Resources			Reserves				
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	
0-20	719	1,523	898	2,104					1,617	3,627	101	217	1,718	3,844	1,617	2,902	
20-40	606	1,259	75	170					681	1,429			681	1,429			
40-100	96	194	5	12					101	206			101	206			
Total	1,421	2,976	978	2,286					2,399	5,262			2,500	5,479	1,617	2,902	
Indicated																	
0-20	544	1,188	368	823					912	2,011			912	2,011	912	1,609	
20-40	840	1,797	126	277					966	2,074			966	2,074			
40-100	309	611							309	611			309	611			
Total	1,693	3,596	494	1,100					2,187	4,696			2,187	4,696	912	1,609	
Inferred																	
0-20	106	211	145	338					251	549			251	549	251	439	
20-40	34	61	5	11					39	72			39	72			
40-100	77	153							77	153			77	153			
Total	217	425	150	349					367	774			367	774	251	439	
Grand Total	3,331	6,997	1,622	3,735					4,953	10,732	101	217	5,054	10,949	2,780	4,950	

CROWBURG

Category of Reliability and Depth (ft)	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
Measured														
0-20	7	23	63	166	7	23	63	166	7	23	63	166	7	18
20-40														
Total	7	23	63	166	7	23	63	166	7	23	63	166	7	18

40-100	1,133	3,661	1,133	3,661	1,133	3,661	116	290
>100	556	1,177	556	1,177	556	1,177	186	441
Total	1,759	5,027	1,759	5,027	4,282	12,220	186	441
<u>Indicated</u>								
0-20	92	270	92	270	92	270	92	216
20-40	136	356	136	356	136	356	136	285
40-100	15	30	3,656	10,074	3,671	10,104	435	1,033
>100	1,926	4,995	1,926	4,995	1,926	4,995	663	1,534
Total	30	30	5,810	15,695	5,825	15,725	663	1,534
<u>Inferred</u>								
0-20	169	514	169	514	169	514	169	411
20-40	115	349	115	349	115	349	115	279
40-100	509	1,020	1,771	4,334	1,771	4,334	215	511
>100	377	995	377	995	377	995	499	1,201
Total	509	1,020	1,923	5,172	2,432	6,192	1,348	3,176
Grand Total	524	1,050	9,492	25,894	10,016	26,944	2,523	7,193
COMBINED GRAND TOTALS	3,855	8,047	11,114	29,629	14,969	37,676	2,624	7,410

T22N, R17E, ROGERS COUNTY

WEIR-PITTSBURG								
<u>Measured</u>								
0-20	14	25	86	276	100	301	65	160
20-40	28	55	73	238	101	293	101	293
40-100	21	34	163	498	184	532	184	532
>100	12	40	12	40	12	40	12	40
Total	63	114	334	1,052	397	1,166	462	1,326
<u>Indicated</u>								
0-20	155	300	270	872	425	1,172	425	1,172
20-40	125	231	221	698	346	929	346	929
40-100	292	507	807	2,538	1,099	3,045	1,099	3,045
>100	866	2,816	866	2,816	866	2,816	866	2,816
Total	572	1,038	2,164	6,924	2,736	7,962	2,736	7,962
<u>Inferred</u>								
0-20	274	472	45	149	319	621	319	621
20-40	373	651	160	442	533	1,093	533	1,093
Total	647	1,123	205	591	852	1,714	852	1,714

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves		
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres	Tons	Acres	Tons	Acres	Tons	
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons							
40-100	799	1,397	559	1,774					1,358	3,171			1,358	3,171			
>100			2,461	8,102					2,461	8,102			2,461	8,102			
Total	1,446	2,520	3,225	10,467					4,671	12,987			4,671	12,987	334	539	
Grand Total	2,081	3,672	5,723	18,443					7,804	22,115	65	160	7,869	22,275	1,052	2,258	
BLUEJACKET																	
<u>Measured</u>																	
0-20	19	37	22	49					41	86			41	86	41	69	
20-40	18	33	4	8					22	41			22	41			
40-100																	
>100																	
Total	37	70	26	57					63	127	63	127	63	127	41	69	
<u>Indicated</u>																	
0-20	114	227	58	135					172	362			172	362	172	290	
20-40	227	440	34	80					261	520			261	520			
40-100	57	105	4	8					61	113			61	113			
>100																	
Total	398	772	96	223					494	995	494	995	494	995	172	290	
<u>Inferred</u>																	
0-20	194	316	2	4					196	320			196	320	196	256	
20-40	196	349	32	24					228	373			228	373			
40-100	571	1,025	25	59					596	1,084			596	1,084			
>100																	
Total	961	1,690	59	87					1,020	1,777	1,020	1,777	1,020	1,777	196	256	
Grand Total	1,396	2,532	181	367					1,577	2,899	1,577	2,899	1,577	2,899	409	615	
COMBINED GRAND TOTALS																	
	3,477	6,204	5,904	18,810					9,381	25,014	65	160	9,446	25,174	1,461	2,873	

T22N, R18E, MAYES COUNTY

4EIR-PITTSBURG

Measured
0-20
20-40

Coal Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres	Tons	Acres	Tons	Acres	Tons
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons						
Measured																
0-20	6	12					6	12	1	2	7	14	7	14	12	10
20-40	7	14					7	14			7	14	7	14		
40-100	27	54					27	54			27	54	27	54		
>100																
Total	40	80					40	80			41	82	41	82	12	10
Indicated																
0-20	16	27	10	12			26	39			26	39	26	39	26	32
20-40	16	19	40	90			56	109			56	109	56	109		
40-100	82	171	105	235			187	406			187	406	187	406		
>100			51	115			51	115			51	115	51	115		
Total	114	217	206	452			320	669			320	669	320	669	26	32
Inferred																
0-20	42	79					42	79			42	79	42	79	42	63
20-40	31	57	5	11			36	68			36	68	36	68		
40-100	67	126	97	217			164	343			164	343	164	343		
>100			551	1,239			551	1,239			551	1,239	551	1,239		
Total	140	262	653	1,467			793	1,729			793	1,729	793	1,729	42	63
Grand Total	294	559	859	1,919			1,153	2,478			1,154	2,480	1,154	2,480	80	105
COMBINED GRAND TOTALS	2,832	5,209	4,241	10,554			7,073	15,763			7,074	15,765	7,074	15,765	1,075	1,899

T23N, R14E, ROGERS COUNTY

DAWSON

Measured																
0-20	129	403					129	403	358	1,105	487	1,508	487	1,508	129	322
20-40	504	1,482					504	1,482			504	1,482	504	1,482	504	1,186
40-100	211	652					211	652			211	652	211	652		
>100																
Total	844	2,537					844	2,537			1,202	3,642	1,202	3,642	633	1,508
Indicated																
0-20	152	439					152	439			152	439	152	439	152	351
20-40	685	4,000					685	4,000			685	4,000	685	4,000	685	3,200

40-100	2,780	8,636	2,780	8,636	2,780	8,636
>100	50	137	50	137	50	137
Total	3,667	13,212	3,667	13,212	3,667	13,212
<u>Inferred</u>						
0-20						
20-40	200	580	200	580	200	580
40-100	3,480	10,637	3,480	10,637	3,480	10,637
>100	1,242	3,167	1,242	3,167	1,242	3,167
Total	4,922	14,384	4,922	14,384	4,922	14,384
Grand Total	9,433	30,133	9,433	30,133	358	1,105
					9,791	31,238
					1,573	5,314

T23N, R15E, ROGERS COUNTY

DAWSON

<u>Measured</u>						
0-20	2	6	2	6	674	2,256
20-40	80	262	80	262	80	262
40-100	139	468	139	468	139	468
>100	5	15	5	15	5	15
Total	226	751	226	751	900	3,007
<u>Indicated</u>						
0-20	64	211	64	211	64	211
20-40	925	3,061	925	3,061	925	3,061
40-100	184	610	184	610	184	610
>100						
Total	1,173	3,882	1,173	3,882	1,173	3,882

<u>Inferred</u>						
0-20						
20-40	20	61	20	61	20	61
40-100	875	2,840	875	2,840	875	2,840
>100	68	226	68	226	68	226
Total	963	3,127	963	3,127	963	3,127
Grand Total	2,362	7,760	2,362	7,760	674	2,256
					3,036	10,016
					166	434

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Coal Depth (ft)	Remaining Resources						Mined or Lost in Mining*			Original Resources		Reserves		
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres		Tons	
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
<u>T23N, R16E, ROGERS COUNTY</u>														
IRON POST														
<u>Measured</u>														
0-20	144	279	170	378	314	657	1,399	3,026	1,713	3,683	314	314	526	
20-40	89	188	279	423	368	611			368	611				
40-100	347	711	66	143	413	854			413	854				
>100														
Total	580	1,178	515	944	1,095	2,122			2,494	5,148	314	314	526	
<u>Indicated</u>														
0-20	462	903	150	363	612	1,266			612	1,266	612	612	1,013	
20-40	624	1,288	459	1,073	1,083	2,361			1,083	2,361	1,083	1,083	2,361	
40-100	959	1,763	158	347	1,117	2,110			1,117	2,110	1,117	1,117	2,110	
>100														
Total	2,045	3,954	767	1,783	2,812	5,737			2,812	5,737	612	612	1,013	
<u>Inferred</u>														
0-20	324	643	4	10	328	653			328	653	328	328	522	
20-40	890	1,769	17	38	907	1,807			907	1,807	907	907	1,807	
40-100	570	1,152			570	1,152			570	1,152	570	570	1,152	
>100														
Total	1,784	3,564	21	48	1,805	3,612			1,805	3,612	328	328	522	
Grand Total	4,409	8,696	1,303	2,775	5,712	11,471			7,111	14,497	1,254	1,254	2,061	
CROWBURG														
<u>Measured</u>														
0-20			6	14	6	14			6	14	1,022	2,442	2,456	6
20-40	15	31	60	154	75	185			75	185	75	185	185	148
40-100	4	8	227	559	231	567			231	567	231	567	567	75
>100			195	478	195	478			195	478	195	478	478	75
Total	19	39	488	1,205	507	1,244			1,529	3,686	81	81	159	
<u>Indicated</u>														
0-20	17	34	34	84	51	118			51	118	51	118	51	94
20-40	5	11	98	249	103	260			103	260	103	260	260	199
40-100	396	802	1,352	3,451	1,748	4,253			1,748	4,253	1,748	4,253	4,253	98
>100			575	1,389	575	1,389			575	1,389	575	1,389	1,389	149
Total	418	847	2,059	5,173	2,477	6,020			2,477	6,020	149	149	293	

Coal	Category of Reliability and Depth (ft)	Remaining Resources						Mined or Lost in Mining*		Original Resources		Reserves	
		0.8-1.2 ft.		1.2-2.4 ft.		>3.5 ft.		Total Remaining Resources		Acres		Tons	
		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
40-100													
>100													
Total		17	33			17	33			1,163	2,612	12	18
Indicated													
0-20													
20-40													
40-100													
>100													
Total													
Inferred													
0-20		3	5	33	73			36	78	36	78	36	62
20-40													
40-100													
>100													
Total		3	5	33	73	36	78	36	78	36	78	36	62
Grand Total		20	38	33	73	53	111	1,146	2,579	1,199	2,690	48	80
CROWEBURG													
Measured													
0-20		12	21	10	25			22	46	1,995	5,108	2,017	5,154
20-40		38	69	35	92			73	161	73	161	73	161
40-100		25	45	396	978			421	1,023	421	1,023	421	1,023
>100								111	273	111	273	111	273
Total		75	135	552	1,368	627	1,503	2,622	6,611	2,622	6,611	57	111
Indicated													
0-20		7	13	62	161			69	174	69	174	69	39
20-40		6	11	157	417			163	428	163	428	157	334
40-100		49	97	797	1,901			846	1,998	846	1,998	846	1,998
>100								569	1,405	569	1,405	569	1,405
Total		62	121	1,585	3,884	1,647	4,005	1,647	4,005	1,647	4,005	226	373
Inferred													
0-20								19	48	19	48	19	38
20-40								22	60	22	60	22	48
40-100		5	12	780	1,632			785	1,644	785	1,644	785	1,644
>100								125	312	125	312	125	312
Total		5	12	946	2,052	951	2,064	951	2,064	951	2,064	41	86

Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres	Tons	Acres	Tons	Acres	Tons
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
<u>Inferred</u>																
0-20	131	212	6	22			137	234	137	234	137	234	137	234	137	187
20-40	83	134	83	300			166	434	166	434	166	434	166	434	83	240
40-100	850	1,395	236	639			1,086	2,034	1,086	2,034	1,086	2,034	1,086	2,034		
>100																
Total	1,064	1,741	325	961			1,389	2,702	1,389	2,702	1,389	2,702	220	427		
Grand Total	1,727	2,814	1,259	4,143			2,986	6,957	47	126	3,033	7,083	825	1,967		
BLUEJACKET																
<u>Measured</u>																
0-20																
20-40																
40-100																
>100																
Total																
<u>Indicated</u>																
0-20																
20-40																
40-100																
>100																
Total																
<u>Inferred</u>																
0-20																
20-40																
40-100	161	291					161	291	161	291	161	291	161	291		
>100																
Total	161	291					161	291	161	291	161	291	161	291		
Grand Total	161	291					161	291	161	291	161	291	161	291		
COMBINED GRAND TOTALS																
	3,370	5,775	5,591	14,485			8,961	20,260	3,188	7,813	12,149	28,073	1,908	3,786		

T23N, R18E, MAYES COUNTY

WEIR-PITTSBURG

<u>Measured</u>										
0-20	50	135	50	135	154	391	204	526	50	108
20-40	22	62	22	62	62	22	22	62	22	50
40-100	1	4	1	4		1	1	4		
>100										
<u>Total</u>	73	201	73	201	227	592	72	158		
<u>Indicated</u>										
0-20	66	116	2	6		68	122	122	68	98
20-40	17	31	54	141		71	172	172	71	172
40-100	3	9	3	9		3	3	9		
>100										
<u>Total</u>	83	147	59	156	142	303	142	303	68	98
<u>Inferred</u>										
0-20										
20-40										
40-100										
>100										
<u>Total</u>										
Grand Total	83	147	132	357	215	504	154	391	140	256

BLUEJACKET

<u>Measured</u>										
0-20										
20-40										
40-100	1	2	1	2		1	1	2		
>100										
<u>Total</u>	1	2	1	2	1	2	1	2		
<u>Indicated</u>										
0-20										
20-40	112	181				112	181	181		
40-100	145	245				145	245	245		
>100										
<u>Total</u>	257	426	257	426	257	426	257	426		
<u>Inferred</u>										
0-20										
20-40	24	39	24	39		24	24	39		

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Depth (ft)	Remaining Resources						Mined or Lost in Mining*		Original Resources		Reserves	
	0.8-1.2 ft		1.2-2.4 ft		>3.5 ft		Total Remaining Resources		Acres		Tons	
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
40-100	1,413	2,536					1,413	2,536	1,413	2,536		
>100												
Total	1,437	2,575					1,437	2,575	1,437	2,575		
Grand Total	1,694	3,001					1,695	3,003	1,695	3,003		

DRYWOOD

Measured		Indicated		Total	
0-20	20-40	0-20	20-40	0-20	20-40
14	23	14	23	14	23
21	34	21	34	21	34
34	55	34	55	34	55
69	112	69	112	69	112
Grand Total		69	112	69	112

Inferred		Total		Original Resources		Reserves	
0-20	20-40	0-20	20-40	Acres	Tons	Acres	Tons
14	23	14	23	14	23	14	18
21	34	21	34	21	34	21	34
34	55	34	55	34	55	34	55
69	112	69	112	69	112	69	112
Grand Total		69	112	69	112	69	112

ROWE

Measured		Total		Original Resources		Reserves	
0-20	20-40	0-20	20-40	Acres	Tons	Acres	Tons
4	6	4	6	4	6	4	6
9	15	9	15	9	15	9	15
19	36	19	36	19	36	19	36
32	57	32	57	32	57	32	57
Grand Total		32	57	32	57	32	57

Coal Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves			
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres	Tons	Acres	Tons	Acres	Tons		
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons								
ROWE																		
<u>Measured</u>																		
0-20	5	9	14	30					19	39	25	49	44	88	19	31		
20-40	26	50	18	39					44	89			44	89				
40-100	30	62	3	7					33	69			33	69				
>100	61	121	35	76					96	197			121	246	19	31		
<u>Total</u>	151	262	98	219					249	481			249	481	144	234		
<u>Indicated</u>																		
0-20	64	113	80	180					144	293			141	293	144	234		
20-40	40	70	13	29					53	99			53	99				
40-100	47	79	5	10					52	89			52	89				
>100	151	262	98	219					249	481			249	481	144	234		
<u>Total</u>	109	200	244	544					353	744			353	744	16	30		
<u>Inferred</u>																		
0-20	4	8	12	30					16	38			16	38	16	30		
20-40	21	41	43	95					64	136			64	136				
40-100	84	151	112	248					196	399			196	399				
>100	109	200	244	544					353	744			353	744	16	30		
<u>Total</u>	321	583	377	839					698	1,422	25	49	723	1,471	179	295		
Grand Total	592	1,094	377	839					969	1,933	30	59	999	1,992	250	402		
COMBINED GRAND TOTALS																		
DAWSON																		
<u>T24N, R14E, ROGERS COUNTY</u>																		
<u>Measured</u>																		
0-20																		
20-40																		
40-100	88	167							88	167			88	167				
>100	88	167							88	167			88	167				
<u>Total</u>	88	167							88	167			88	167				
<u>Indicated</u>																		
0-20																		
20-40																		
40-100																		
>100																		
<u>Total</u>																		
<u>Indicated</u>																		
0-20																		
20-40																		
40-100																		
>100																		
<u>Total</u>																		

40-100	231	441	231	441	231	441
>100						
Total	231	441	412	857	412	857
<u>Inferred</u>						
0-20						
20-40		211	211	524	211	524
40-100	7	15	7	15	7	15
>100		15	15	32	15	32
Total	7	226	233	571	233	571
Grand Total	326	623	733	1,595	733	1,595

T24N, R15E, ROGERS COUNTY

DAWSON

<u>Measured</u>												
0-20	443	835	94	221	537	1,056	133	382	670	1,438	537	845
20-40	359	673	104	166	463	839			463	839		
40-100	315	558	62	159	377	717			377	717		
>100												
Total	1,117	2,066	260	546	1,377	2,612			1,510	2,994	537	845
<u>Indicated</u>												
0-20	343	673	92	227	435	900			435	900		
20-40	276	517	88	244	364	761			364	761		
40-100	450	823	311	819	761	1,642			761	1,642		
>100												
Total	1,069	2,013	491	1,290	1,560	3,303			1,560	3,303	460	779
<u>Inferred</u>												
0-20	19	39			19	39			19	39		
20-40			36	109	36	109			36	109		
40-100	105	190	415	1,122	520	1,312			520	1,312		
>100												
Total	124	229	451	1,231	575	1,460			575	1,460	55	118
Grand Total	2,310	4,308	1,202	3,067	3,512	7,375	133	382	3,645	7,757	1,052	1,742

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Coal Depth (ft)	Remaining Resources						Mined or Lost in Mining*		Original Resources		Reserves			
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Acres		Tons			
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons		
<u>IRON POST</u>														
<u>T24N, R16E, ROGERS COUNTY</u>														
<u>Measured</u>														
0-20	215	395	207	467			422	862	1	1	423	863	422	690
20-40	127	233	22	49			149	282			149	282		
40-100														
>100														
<u>Total</u>	342	628	229	516			571	1,144			572	1,145	422	690
<u>Indicated</u>														
0-20	304	364	93	215			397	579			397	579	397	463
20-40	611	1,165	13	28			624	1,193			624	1,193		
40-100														
>100														
<u>Total</u>	915	1,529	106	243			1,021	1,772			1,021	1,772	397	463
<u>Inferred</u>														
0-20	630	1,152	14	33			644	1,185			644	1,185	644	948
20-40	702	1,143					702	1,143			702	1,143		
40-100														
>100														
<u>Total</u>	1,332	2,295	14	33			1,346	2,328			1,346	2,328	644	948
<u>Grand Total</u>	2,589	4,452	349	792			2,938	5,244	1	1	2,939	5,245	1,463	2,101
<u>CROWEBURG</u>														
<u>Measured</u>														
0-20	8	16	11	23			19	39			19	39	19	31
20-40	15	32	9	20			24	52			24	52	24	42
40-100	612	1,234	576	1,316			1,188	2,550			1,188	2,550		
>100			195	452			195	452			195	452		
<u>Total</u>	635	1,282	791	1,811			1,426	3,093			1,426	3,093	43	73
<u>Indicated</u>														
0-20	31	66	6	14			37	80			37	80	37	64
20-40	42	86	3	4			45	90			45	90	45	72
40-100	660	1,285	280	647			940	1,932			940	1,932		
>100			207	455			207	455			207	455		
<u>Total</u>	733	1,437	496	1,120			1,229	2,557			1,229	2,557	82	136

<u>Inferred</u>															
0-20	6	14	14	30	6	14	14	30	14	30	10	17	6	11	6
20-40	4	8	8	8	4	8	4	8	4	8	4	8	4	8	4
40-100	4	8	8	8	4	8	4	8	4	8	4	8	4	8	4
>100															
Total	14	30	14	30	14	30	14	30	14	30	10	17	6	11	6
Grand Total	1,368	2,719	1,301	2,961	2,669	5,680	2,669	5,680	2,669	5,680	135	226	135	226	135

MINERAL

<u>Measured</u>									
0-20									
20-40									
40-100	144	258	100	231	244	489	244	489	244
>100	258	648	258	648	258	648	258	648	258
Total	144	258	358	879	502	1,137	502	1,137	502

<u>Indicated</u>									
0-20									
20-40	67	120	93	219	160	339	160	339	160
40-100	105	186	386	956	491	1,142	491	1,142	491
>100	514	1,276	514	1,276	514	1,276	514	1,276	514
Total	172	306	993	2,451	1,165	2,757	1,165	2,757	1,165

<u>Inferred</u>									
0-20									
20-40	23	44	50	118	73	162	73	162	73
40-100	13	26	35	88	48	114	48	114	48
>100	108	273	108	273	108	273	108	273	108
Total	36	70	193	479	229	549	229	549	229

Grand Total	352	634	1,544	3,809	1,896	4,443	1,896	4,443
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COMBINED GRAND TOTALS	4,309	7,805	3,194	7,562	7,503	15,367	1	1	7,504	15,368	1,598	2,327
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T24N, R17E, ROGERS COUNTY

IRON POST

<u>Measured</u>												
0-20	610	1,148	537	1,269	1,147	2,417	505	1,056	1,652	3,473	1,147	1,934
20-40	139	168	79	183	218	351	218	351	218	351	218	351

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal Depth (ft)	Remaining Resources												Mined or Lost in Mining*		Original Resources		Reserves	
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons								
40-100																		
>100																		
Total	749	1,316	616	1,452					1,365	2,768			1,870	3,824	1,147	1,934		
<u>Indicated</u>																		
0-20	172	335	502	1,115					674	1,450			674	1,450	674	1,160		
20-40			16	35					16	35			16	35	16	35		
40-100																		
>100																		
Total	172	335	518	1,150					690	1,485			690	1,485	674	1,160		
<u>Inferred</u>																		
0-20	72	117	11	24					83	141			83	141	83	113		
20-40	13	21							13	21			13	21	13	21		
40-100																		
>100																		
Total	85	138	11	24					96	162			96	162	96	113		
Grand Total	1,006	1,789	1,145	2,626					2,151	4,415	505	1,056	2,656	5,471	1,904	3,207		
CROWEBURG																		
<u>Measured</u>																		
0-20	331	428	211	534					542	962	1,587	4,290	2,129	5,252	542	770		
20-40	459	867	279	702					738	1,569			738	1,569	324	636		
40-100	1,073	2,137	2,366	5,464					3,439	7,601			3,439	7,601				
>100			447	1,097					447	1,097			447	1,097				
Total	1,863	3,432	3,303	7,797					5,166	11,229			6,753	15,519	866	1,406		
<u>Indicated</u>																		
0-20	82	154	159	268					241	422			241	422	241	337		
20-40	139	274	138	342					277	616			277	616	143	282		
40-100	1,489	2,795	2,341	5,581					3,830	8,376			3,830	8,376				
>100			674	1,592					674	1,592			674	1,592				
Total	1,710	3,223	3,312	7,783					5,022	11,006			5,022	11,006	384	619		
<u>Inferred</u>																		
0-20																		
20-40																		
40-100	279	516	81	185					360	701			360	701	701			
>100			51	42					51	42			51	42	42			
Total	279	516	132	227					411	743			411	743	411	743		

Grand Total 3,852 7,171 6,747 15,807 10,599 22,978 1,587 4,290 12,186 27,268 1,250 2,025

MINERAL

<u>Measured</u>													
0-20	93	188	170	410	263	598	377	826	640	1,424	263	478	8
20-40	353	668	173	424	526	1,092			526	1,092	3		
40-100	391	741	390	915	781	1,656			781	1,656			
>100			103	259	103	259			103	259			
Total	837	1,597	836	2,008	1,673	3,605			2,050	4,431	266	486	
<u>Indicated</u>													
0-20	215	414	584	1,466	799	1,880			799	1,880	799	1,504	
20-40	385	712	315	784	700	1,496			700	1,496	6	11	
40-100	513	936	699	1,654	1,212	2,590			1,212	2,590			
>100			450	1,048	450	1,048			450	1,048			
Total	1,113	2,062	2,048	4,952	3,161	7,014			3,161	7,014	805	1,515	
<u>Inferred</u>													
0-20	66	128	118	297	184	425			184	425	184	340	
20-40	52	96	431	1,082	483	1,178			483	1,178			
40-100	145	241	379	965	524	1,206			524	1,206			
>100			239	617	239	617			239	617			
Total	263	465	1,167	2,961	1,430	3,426			1,430	3,426	184	340	
Grand Total	2,213	4,124	4,051	9,921	6,264	14,045	377	826	6,641	14,871	1,255	2,341	

WEIR-PITTSBURG

<u>Measured</u>													
0-20							9	24	9	24			
20-40													
40-100	79	139			79	139			79	139			
>100													
Total	79	139			79	139			88	163			
<u>Indicated</u>													
0-20													
20-40													
40-100	349	566	25	59	374	625			374	625			
>100			55	125	55	125			55	125			
Total	349	566	80	184	429	750			429	750			

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Category of Reliability and Coal Depth (ft)	Remaining Resources						Mined or Lost in Mining*		Original Resources		Reserves					
	0.8-1.2 ft		1.2-2.4 ft		2.4-3.5 ft		>3.5 ft		Total Remaining Resources		Acres		Tons			
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons		
<u>Inferred</u>																
0-20			30	135					30	135	30	135	30	108		
20-40			381	897					381	897	381	897	381	897		
40-100	1,303	2,111							1,303	2,111	1,303	2,111				
>100																
<u>Total</u>	1,303	2,111	411	1,032					1,714	3,143	1,714	3,143	30	108		
<u>Grand Total</u>	1,731	2,816	491	1,216				9	2,222	4,032	2,231	4,056	30	108		
COMBINED GRAND TOTALS	8,802	15,900	12,434	29,570				2,478	21,236	45,470	23,714	51,666	4,439	7,681		
<u>T24N, R18E, ROGERS COUNTY</u>																
<u>WEIR-PITTSBURG</u>																
<u>Measured</u>																
0-20			239	759					239	759	387	1,388	626	2,147	239	607
20-40			411	1,416					411	1,416			411	1,416	343	1,133
40-100	123	215	1,115	3,584					1,238	3,799			1,238	3,799		
>100			533	1,772					533	1,772			533	1,772		
<u>Total</u>	123	215	2,298	7,531					2,421	7,746			2,808	9,134	582	1,740
<u>Indicated</u>																
0-20	47	90	352	1,081					399	1,171			399	1,171	399	937
20-40	28	48	831	2,938					859	2,986			859	2,986	737	2,163
40-100	420	757	2,862	8,686					3,282	9,443			3,282	9,443		
>100			3,039	9,899					3,039	9,899			3,039	9,899		
<u>Total</u>	495	895	7,084	22,604					7,579	23,499			7,579	23,499	1,136	3,100
<u>Inferred</u>																
0-20	218	447	344	1,014					562	1,461			562	1,461	562	1,169
20-40	252	501	372	1,204					624	1,705			624	1,705	252	755
40-100	53	105	658	2,034					711	2,139			711	2,139		
>100			713	2,142					713	2,142			713	2,142		
<u>Total</u>	523	1,053	2,087	6,394					2,610	7,447			2,610	7,447	814	1,924
<u>Grand Total</u>	1,141	2,163	11,469	36,529				387	12,610	38,692	1,388	12,997	40,080	2,532	6,764	

BLUEJACKET

<u>Measured</u>									
0-20									
20-40	15	31	85	222	15	31	15	31	
40-100	202	380	101	327	287	602	287	602	
>100			186	549	101	327	101	327	
Total	217	411	186	549	403	960	403	960	
<u>Indicated</u>									
0-20	5	7			5	7	5	7	
20-40	283	510			283	510	283	510	
40-100	828	1,491	230	608	1,058	2,099	1,058	2,099	
>100			993	3,031	993	3,031	993	3,031	
Total	1,116	2,008	1,223	3,639	2,339	5,647	2,339	5,647	
<u>Inferred</u>									
0-20	206	366	16	34	222	400	222	400	
20-40	198	357			198	357	198	357	
40-100	316	571	216	619	532	1,190	532	1,190	
>100			2,864	8,824	2,864	8,824	2,864	8,824	
Total	718	1,294	3,096	9,477	3,814	10,771	3,814	10,771	
Grand Total	2,051	3,713	4,505	13,665	6,556	17,378	6,556	17,378	
<u>COMBINED GRAND</u>									
TOTALS	3,192	5,876	15,974	50,194	19,166	56,070	387	1,388	19,553
									57,458
									2,759
									7,090

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

APPENDIX 2: Measured Sections and Cole-Hole Logs

Measured Section 1

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 24, T19N, R16E, Rogers County. Measured in trench dug for footings of building housing nuclear reactor at power-generating site, by LeRoy A. Hemish. Field notebook designation RM-1-78-H. (Estimated elevation at top of section, 575 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Clay, brown, oxidized (derived from highly weathered shale).....	4.0
Shale, dark-gray, fossiliferous.....	1.0
Coal, black, hard (Drywood coal).....	2.0
Underclay, light-gray with orange and purple oxidized zones (thickness varies laterally).....	3.0
Shale, gray, contains stringers of oblate brownish-gray limestone concretions about 6 to 10 in. in diameter (to bottom of trench).....	<u>4.0</u>
Total	14.0

Measured Section 2

NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T19N, R17E, Rogers County. Measured from top of Inola Hill down north side, by LeRoy A. Hemish. Field notebook designation RM-5-80-H. (Estimated elevation at top of section, 830 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, reddish-brown, ferruginous, micaceous, noncalcareous, fine-grained, well-indurated.....	5.0
Shale, brown, highly sandy and silty, poorly exposed.....	20.0
Shale, very dark-gray to black, carbonaceous, platy; includes several layers of dark-purple-brown ironstone concretions that rarely contain marine fossils and occasionally grade into limestone; also includes small, spheroidal, phosphatic nodules in lower part of unit.....	21.0
Limestone, dark-gray, impure, abundantly fossiliferous; bedding thin and irregular; includes a very thin, ferruginous, coaly zone at base of unit.....	0.8
Shale, dark-gray.....	4.7
Coal, black; grades downward into coaly shale (Blue-jacket coal).....	0.3

Underclay, light-gray and black; contains abundant thin layers of compressed, carbonized plant fragments.....	0.6
Sandstone, buff to brown, ferruginous, fine-grained, noncalcareous, thin-bedded.....	3.6
Covered interval.....	2.0
Coal, black, with reddish-brown standing on cleat surfaces (unnamed).....	0.6
Underclay, orange and black; includes layers of carbonized plant material.....	0.4
Shale, gray and reddish-orange, banded, oxidized in part.....	7.0
Sandstone, olive-tan, very fine-grained, noncalcareous, micaceous, thin-bedded; includes scattered ferruginous concretions; weathers to flakes in lower part.....	2.5
Savanna Formation:	
Shale, gray, weathers tan-brown; includes scattered ironstone concretions.....	16.0
Limestone, light-gray, impure, fossiliferous.....	0.4
Shale, black, highly carbonaceous.....	0.1
Coal, black, weathered (Drywood coal).....	0.3
Covered interval.....	44.0
Shale, dark-gray, weathers gray-brown.....	1.7
Covered interval.....	30.0
Sandstone, tannish-brown, micaceous, fine-grained, thin-bedded, poorly exposed.....	<u>2.5</u>
Total	163.5

Measured Section 3

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 26, T19N, R17E, Rogers County. Measured in cutbank on west side of Bull Creek, by LeRoy A. Hemish. Field notebook designation RM-6-80-H. (Estimated elevation at top of section, 564 ft.)

	Thickness (ft)
Silt, brown, gravelly; includes abundant shale clasts (alluvium associated with Bull Creek).....	12.0
Gravel, reddish-brown, highly ferruginous in lower part; includes abundant shale clasts and large chunks of float coal (alluvium associated with Bull Creek).....	4.0
KREBS GROUP	
Savanna Formation:	
Shale, dark-gray, with reddish-brown iron-oxide staining....	1.5
Coal, black (Rowe coal).....	1.3
Underclay, black (to water level in Bull Creek).....	<u>0.2</u>
Total	19.0

Appendix 2

Measured Section 4

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 19, T20N, R15E, Rogers County. Measured in south bluff of Bird Creek just east of old bridge piers, by LeRoy A. Hemish. Field notebook designation RM-63-79-H. (Estimated elevation at top of section, 566 ft.)

	Thickness (ft)
Clay, dark-brown, silty, organic (soil).....	3.0
MARMATON GROUP	
Fort Scott Formation:	
Limestone, light-gray, weathers yellow-gray, silty, fossiliferous, thin- to medium-bedded; thick-bedded near base of unit.....	10.5
CABANISS GROUP	
Senora Formation:	
Shale, black, platy, brittle; contains small, spheroidal, phosphatic nodules.....	3.0
Limestone, light-gray, weathering buff, silty, fossilif- erous; includes about 0.5 ft of gray, calcareous shale in upper part of unit.....	7.2
Shale, brown, highly calcareous.....	0.3
Shale, black, highly carbonaceous.....	0.4
Coal, black, with reddish-orange staining on cleat surfaces (Iron Post coal).....	1.0
Shale, light-yellow-gray, with orange mottling; becomes increasingly silty downward.....	1.8
Sandstone, reddish-brown, fine-grained, noncalcareous, thin-bedded (to water level).....	<u>1.0</u>
Total	28.2

Measured Section 5

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 19, T20N, R15E, Rogers County. Measured in bluffs of Bird Creek about 150 yd west of railway bridge, by LeRoy A. Hemish. Field notebook designation RM-62-79-H. (Estimated elevation at top of section, 565 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, light-gray, silty, fossiliferous, irregularly bedded; weathers to flagstones.....	1.5
CABANISS GROUP	
Senora Formation:	

Shale, black; weathers grayish-brown.....	5.0
Limestone, buff, silty, fossiliferous, medium- to thick-bedded.....	8.4
Shale, light-brown, highly calcareous, weathered.....	0.3
Shale, olive-gray with yellow streaks, noncalcareous; contains interlaminated coal in lower 1 in.....	0.3
Coal, black, with reddish-brown staining on cleat surfaces (Iron Post coal).....	1.0
Underclay, gray.....	0.2
Shale, light-gray, with orange streaks.....	2.5
Sandstone, light-tannish-gray with reddish-brown staining, very fine-grained, micaceous, noncalcareous, ripple- drift cross-laminated; laterally includes some interbedded shale.....	2.6
Shale, light-tannish-gray, very silty, micaceous.....	2.3
Limestone, dark-gray, weathers brown, very silty and sandy; pelecypod and brachiopod shells abundant.....	1.2
Siltstone, grayish-brown, calcareous, thin-bedded.....	1.8
Shale, dark-gray, silty; some yellow and reddish-brown staining on stratification surfaces.....	1.0
Coal, black, with reddish-brown staining on cleat surfaces, soft, weathered (Bevier coal).....	0.3
Shale, gray, with yellow coating on exposed surfaces, silty.....	0.9
Sandstone, reddish-brown, ferruginous, fine- to medium- grained, noncalcareous, medium- to thin-bedded, well-indurated (to water level).....	<u>3.2</u>
Total	32.5

Measured Section 6

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 33, T20N, R15E, Rogers County. Measured in highwall of active strip pit operated by McNabb Coal Co., by LeRoy A. Hemish. Field notebook designation RM-61-79-H. (Estimated elevation at top of section, 645 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, grayish-brown, hard, massive, abundantly fossiliferous.....	4.2
Shale, black, platy; contains black, phosphatic nodules.....	3.5
Shale, gray, silty; includes some hard, tan, noncalcareous concretionary layers about 2 in. thick.....	26.0
Coal, black, shiny; includes minor white calcite on cleat surfaces (Croweburg coal).....	1.6
Limestone, black to grayish-brown, hard (total thickness not exposed).....	<u>0.1</u>
Total	35.4

Appendix 2

Measured Section 7

SE $\frac{1}{2}$ NE $\frac{1}{2}$ NW $\frac{1}{2}$ SE $\frac{1}{2}$ sec. 10, T21N, R15E, Rogers County. Measured in bluff on east side of the Verdigris River from top of bluff to water, by LeRoy A. Hemish. Field notebook designation RM-50-79-H. (Estimated elevation at top of section, 590 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, whitish-gray, silty, fossiliferous, thin- to medium-bedded; irregular stratification.....	5.0
CABANISS GROUP	
Senora Formation:	
Shale, black, platy; contains black, phosphatic nodules.....	5.2
Limestone, light-yellow-gray, silty, hard, fossiliferous, medium-bedded.....	8.5
Shale, black, brittle, highly carbonaceous.....	1.0
Siltstone, dark-brown-black, sandy and shaly, very calcareous, moderately well-indurated.....	0.3
Shale, brown to reddish-brown, very silty, highly calcareous, soft and crumbly.....	0.3
Coal, black, shiny, hard (Iron Post coal).....	0.9
Siltstone, grayish-brown, micaceous; contains abundant carbonized plant compressions.....	0.8
Covered interval (slope is composed of colluvium with abundant talus from limestone formations above).....	<u>24.0</u>
Total	46.0

Measured Section 8

NE $\frac{1}{2}$ NW $\frac{1}{2}$ SW $\frac{1}{2}$ SE $\frac{1}{2}$ sec. 13, T21N, R15E, Rogers County. Measured in highwall of active strip pit operated by McNabb Coal Co., by LeRoy A. Hemish. Field notebook designation RM-50A-79-H. (Estimated elevation at top of section, 608 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, buff, with reddish-brown concretions, weathered.....	9.0
Shale, medium-gray, silty; includes layers of grayish-brown and reddish-brown, noncalcareous concretions; some pyritic, carbonized plant compressions.....	8.2
Coal, black, shiny; includes white calcite on cleat surfaces (Croweburg coal).....	1.6
Limestone, black, shaly, hard (total thickness not exposed).....	<u>0.1</u>
Total	18.9

Measured Section 9

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 15, T21N, R15E, Rogers County. Measured in road cut from driveway entrance on west side of gravel road to covered part of slope, by LeRoy A. Hemish. Field notebook designation RM-51-79-H. (Estimated elevation at top of section, 598 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff, silty, fossiliferous, hard, medium-bedded; weathers to rounded flagstones.....	8.0
Shale, light-gray, highly calcareous, weathers brown, crumbly.....	0.4
Siltstone, gray and black; contains thin coal stringers.....	0.1
Coal, black, with reddish-brown staining on cleat surfaces, soft, weathered (Iron Post coal).....	0.9
Underclay, yellow-gray, with thin, orange, ferruginous layer at top; contains abundant carbonized fossil plant fragments.....	<u>0.6</u>
Total	10.0

Measured Section 10

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 21, T21N, R15E, Rogers County. Measured in west bluff of small ravine heading back from main bluffs overlooking the Verdigris River flood plain, by LeRoy A. Hemish. Field notebook designation RM-54-79-H. (Estimated elevation at top of section, 610 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, whitish-gray, fossiliferous, irregularly bedded; forms flagstones at the surface.....	6.0
CABANISS GROUP	
Senora Formation:	
Shale, black, brittle; contains black, phosphatic nodules...	6.2
Limestone, light-tannish-gray, medium-bedded, fossiliferous; crinoid columns abundant.....	6.8
Shale, yellow-gray, highly calcareous.....	0.4
Shale, black, with reddish-orange flecks, carbonaceous; very highly calcareous; weakly indurated in middle part of unit.....	1.4

Appendix 2

Coal, black, with purple-brown staining on cleat surfaces (Iron Post coal).....	1.3
Underclay, yellow-gray.....	<u>0.2</u>
Total	22.3

Measured Section 11

SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 34, T21N, R15E, Rogers County. Measured in east-facing bluff of the Verdigris River, by LeRoy A. Hemish. Field notebook designation RM-60-79-H. (Estimated elevation at top of section, 630 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, light-gray, weathers buff, silty, thin- to medium-bedded, highly fossiliferous.....	6.5
Shale, dark-brown, clayey, highly weathered.....	1.0
Coal, black, soft, weathered (Iron Post coal).....	0.6
Underclay, brownish-gray, sticky.....	0.3
Shale, light-gray, mottled orange, clayey.....	2.2
Sandstone, dark-reddish-brown, with black carbonaceous streaks, highly ferruginous.....	0.1
Sandstone, light-brown, highly calcareous, well-indurated, fine-grained.....	0.4
Shale, grayish-brown, with reddish-brown mottling, silty; interbedded with siltstone in lower part of unit.....	3.7
Sandstone, reddish-brown, ferruginous, fine-grained, massive, well-indurated.....	1.6
Siltstone, tan, shaly.....	1.6
Shale, gray, with brown bands; interbedded with siltstone; base of unit covered.....	<u>3.0</u>
Total	21.0

Measured Section 12

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 6, T21N, R16E, Rogers County. Measured in wall of trench dug for telephone cable, by LeRoy A. Hemish. Field notebook designation RM-2-80-H. (Estimated elevation at top of section, 710 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff, silty, fossiliferous; occurs as weathered blocks in dark-gray-brown topsoil.....	0.5
Shale, brown to gray-brown, highly weathered.....	1.2
Shale, black, highly carbonaceous, soft, weathered.....	0.1
Coal, black, with reddish-brown iron-oxide staining on cleat surfaces (Iron Post coal).....	1.2

Underclay, tannish-brown and gray, plastic.....	<u>0.6</u>
Total	3.6

Measured Section 13

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 7, T21N, R16E, Rogers County. Measured in road ditch east side of blacktop road from top of hill north to intermittent stream in valley bottom, by LeRoy A. Hemish. Field notebook designation RM-58-79-H. (Estimated elevation at top of section, 694 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff, silty, fossiliferous; weathered to rounded flagstones mixed with soil.....	12.0
Shale, light-brown, with reddish-brown flecks of iron oxide, highly weathered, weakly calcareous.....	2.3
Shale, black, highly carbonaceous.....	0.2
Coal, black, soft (Iron Post coal).....	1.2
Underclay, dark-brown, highly silty; includes abundant dark-brown fossil plant fragments.....	0.6
Shale, yellow-brown, silty; contains reddish-brown fossil plant fragments and some reddish-orange, well-indurated siltstone stringers.....	2.0
Limestone, orange-brown, impure, silty, fossiliferous, well-indurated.....	0.5
Shale, grayish-brown to dark-gray; contains abundant reddish-brown carbonized plant fragments and black, silty, carbonaceous stringers.....	1.8
Sandstone, orange-brown, ferruginous, micaceous, very fine-grained, silty, laminated.....	9.0
Covered to stream bed.....	<u>16.4</u>
Total	46.0

Measured Section 14

SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T21N, R17E, Rogers County. Measured in wall of abandoned aqueduct directly east of gravel road, by LeRoy A. Hemish. Field notebook designation RM-3-80-H. (Estimated elevation at top of section, 659 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Shale, brown, gray-brown in bottom 2 ft of unit; includes scattered layers and discoidal lenses of reddish-brown clay-ironstone concretions about 1-2 in. thick.....	6.5
Shale, very dark-gray to black.....	2.3

Appendix 2

Limestone, very dark-gray, hard, dense; contains nodules of pyrite 1 in. in diameter.....	0.1
Coal, black, with reddish-brown iron-oxide staining on cleat surfaces; includes a 0.5-in.-thick, gray-brown clay parting 2 in. from bottom of bed (Rowe coal).....	0.8
Underclay, light-gray with orange streaks, sticky.....	<u>2.0</u>
Total	11.7

Measured Section 15

SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 8, T21N, R18E, Mayes County. Measured in wall of excavation dug for basement of new house, by LeRoy A. Hemish. Field notebook designation RM-53-79-H. (Estimated elevation at top of section, 700 ft.)

	Thickness (ft)
Clay, buff; includes angular fragments of shale and sandstone (colluvium).....	6.0
KREBS GROUP	
Savanna Formation:	
Shale, yellow-brown, weathered.....	1.0
Coal, black, soft (Rowe coal).....	1.0
Underclay, gray.....	<u>0.5</u>
Total	8.5

Measured Section 16

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T22N, R15E, Rogers County. Measured in road cut from top of bluff to valley floor, by LeRoy A. Hemish. Field notebook designation RM-49-79-H. (Estimated elevation at top of section, 628 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, yellow-brown to yellow-gray, silty, fossiliferous, thick- to medium-bedded.....	7.0
Shale, brown, highly calcareous, soft.....	0.3
Shale, light-gray, with yellow and orange-brown banding, highly calcareous.....	0.3
Coal, black, with reddish-brown staining on cleat surfaces; interlaminated with gray shale in upper 1 in. of unit (Iron Post coal).....	1.3
Underclay, light-brownish-gray.....	0.8
Sandstone, orange, very fine-grained, noncalcareous; contains fossil shells and black fossil plant fragments; bedding disturbed; grades laterally into gray-brown, silty limestone.....	0.5

Shale, grayish-brown.....	2.5
Limestone, grayish-brown, sandy, highly fossiliferous; bedding disturbed.....	0.5
Shale, grayish-brown, with dark-reddish-brown staining on stratification surfaces, silty; includes some interbedded siltstone.....	12.0
Sandstone, brown, ferruginous, noncalcareous, very fine-grained, medium-bedded to thin-bedded and shaly in lower part.....	1.5
Siltstone, grayish-brown, with dark reddish-brown staining on stratification surfaces and joints; interbedded with very fine-grained, shaly sandstone.....	5.3
Shale, grayish-brown, silty; includes lenses and stringers of brown sandstone and siltstone.....	<u>5.0</u>
Total	37.0

Measured Section 17

NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T22N, R15E, Rogers County. Measured in west bluff of Verdigris River about 0.25 mi north of ranch building site, by LeRoy A. Hemish. Field notebook designation RM-56-79-H. (Estimated elevation at top of section, 595 ft.)

	Thickness (ft)
Sand, dark-brown, grading downward to light-brown; gravelly, organic.....	1.0
Sand, orange-brown, ferruginous; contains scattered rounded pebbles of brown chert.....	1.5
Gravel, brown, sandy; clasts predominantly brown chert with some limestone.....	2.5

MARMATON GROUP

Fort Scott Formation:

Shale, black, stained yellow and reddish-brown on joints and bedding surfaces; platy, brittle; includes abundant black, phosphatic nodules from 0.5 to 1 in. in diameter...	1.2
Limestone, dirty-gray, silty, medium- to thick-bedded, fossiliferous; becomes brownish-gray with irregular stratification in basal 4 ft of unit.....	27.5

CARBANISS GROUP

Senora Formation:

Shale, black, brittle; contains black, phosphatic nodules.....	3.0
Limestone, dirty-gray to buff, silty, fossiliferous, thin- to medium-bedded.....	5.3
Shale, light-gray, with dark-yellowish-tan bands, calcareous.....	0.4
Coal, black, shiny (Iron Post coal).....	1.0
Underclay, tannish-gray, silty; includes a thin streak of coal at base of unit.....	0.5

Siltstone and sandstone, light-gray, with orange banding, shaly, weakly indurated; includes abundant carbonized plant fragments (measured to water level in river).....	3.1
Total	47.0

Measured Section 18

SE $\frac{1}{2}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T22N, R15E, Rogers County. Measured in bluffs of Verdigris River directly east of ranch building site, by LeRoy A. Hemish. Field notebook designation RM-57-79-H. (Estimated elevation at top of section, 583 ft.)

	Thickness (ft)
Silt, brown, sandy, organic.....	1.0
MARMATON GROUP	
Fort Scott Formation:	
Limestone, dirty-gray to cream colored, silty, fossiliferous; weathers to flagstones.....	9.0
CABANISS GROUP	
Senora Formation:	
Shale, black, platy; contains black, phosphatic nodules.....	3.6
Limestone, buff, silty, fossiliferous, thin- to medium-bedded.....	7.1
Shale, light-brown, with orange and gray banding, highly calcareous.....	0.4
Shale, black, brittle, highly carbonaceous.....	0.5
Coal, black, with brown staining on cleat surfaces (Iron Post coal).....	1.0
Underclay, gray, with reddish-brown streaks; includes thin stringers of coal.....	1.0
Shale, light-grayish-tan, with orange-brown streaks; grades downward into sandy, shaly siltstone.....	2.5
Limestone, dirty-gray-brown, impure, sandy, abundantly fossiliferous.....	0.5
Siltstone, gray and orange-brown, shaly, sandy; includes abundant carbonized fossil plant fragments.....	6.4
Sandstone, dark-reddish-brown to grayish-brown, micaceous, thin-bedded, ripple-marked (to water level).....	5.0
Total	38.0

Measured Section 19

SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 33, T22N, R15E, Rogers County. Measured in steep bluff on south side of the Caney River from terrace level formed at top of Fort Scott

limestone to water level, by LeRoy A. Hemish. Field notebook designation RM-59-79-H. (Estimated elevation at top of section, 580 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, dirty-gray, silty, fossiliferous; forms near-vertical bluffs along river.....	20.2
CABANISS GROUP	
Senora Formation:	
Shale, black, hard, brittle; contains black, phosphatic nodules.....	6.0
Limestone, light-gray to pale-buff, silty, fossiliferous, thin- to medium-bedded.....	5.9
Shale, light-gray, with yellow and orange bands, calcareous.	0.5
Shale, black, highly carbonaceous; stained reddish-brown on stratification surfaces.....	0.2
Coal, black, shiny, hard (Iron Post coal).....	1.0
Underclay, light-gray to olive-gray; includes abundant carbonized plant fragments (to water level in Caney River).....	<u>0.2</u>
Total	34.0

Measured Section 20

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 7, T22N, R16E, Rogers County. Measured down east side of point of bluff at junction of Sweetwater Creek and the Verdigris River, by LeRoy A. Hemish. Field notebook designation RM-43-79-H. (Estimated elevation at top of section, 620 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, light-gray, fossiliferous; weathers to flagstones.....	6.0
CABANISS GROUP	
Senora Formation:	
Shale, black; contains phosphatic nodules.....	5.0
Limestone, buff, silty, medium- to thick-bedded, abundantly fossiliferous.....	5.2
Shale, light-grayish-brown; ferruginous in bottom 2 in.....	1.0
Coal, black to reddish-brown, soft (Iron Post coal).....	1.0
Underclay, whitish-gray with yellowish-orange streaks.....	1.8

Appendix 2

Shale, grayish-brown with reddish-brown streaks, silty; (interval is poorly exposed, but float on the slope indicates that brown, shaly, very fine-grained, ferruginous, micaceous sandstone beds are present).....	30.0
Limestone, brown, fossiliferous, thin-bedded, silty and shaly at top of unit, massive in lower part, very hard....	8.0
Shale, black, platy (measured to gravel bar in dry creek bed).....	<u>2.0</u>
Total	60.0

Measured Section 21

NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 8, T22N, R16E, Rogers County. Measured in small test pit in pasture on bluff overlooking tributary of Sweetwater Creek, by LeRoy A. Hemish. Field notebook designation RM-45-79-H. (Estimated elevation at top of section, 650 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, light-gray, silty, weathers buff, hard, abundantly fossiliferous, medium-bedded.....	4.2
Shale, gray-brown, with orange bands, highly calcareous.....	1.2
Shale, black, carbonaceous; includes some hard, brittle layers.....	0.8
Coal, black, with reddish-brown staining on cleat surfaces (Iron Post coal).....	1.3
Underclay, gray and orange, silty.....	<u>0.5</u>
Total	8.0

Measured Section 22

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9, T22N, R16E, Rogers County. Measured in highwall of active strip pit operated by Sweetwater Coal Co., by LeRoy A. Hemish. Field notebook designation RM-39-79-H. (Estimated elevation at top of section, 710 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, light-brown, weathers buff, silty, fossiliferous; occurs as flagstones in a brownish-black, clayey soil zone.....	3.0
Shale, buff to light-gray, highly weathered.....	2.5
Shale, black, highly carbonaceous; very well indurated in upper 1 in.....	0.5
Coal, black, with reddish-brown iron-oxide staining on cleat surfaces (Iron Post coal).....	1.1
Underclay, gray.....	<u>0.3</u>
Total	7.4

Measured Section 23

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 12, T22N, R16E, Rogers County. Measured in road cut just south of driveway at crest of ridge, by LeRoy A. Hemish. Field notebook designation RM-37-79-H. (Estimated elevation at top of section, 833 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, brown, silty, fossiliferous; occurs as weathered flagstones with rounded edges in black topsoil.....	1.0
Shale, yellow-brown to orange, very highly weathered; grades into soil at top of unit.....	1.0
Coal, black, with brown iron-oxide staining on cleat surfaces, laced with white calcite deposits (Iron Post coal).....	1.0
Underclay, whitish-gray, highly calcareous.....	0.1
Siltstone, orange, highly ferruginous and calcareous, slightly indurated.....	<u>0.4</u>
Total	3.5

Measured Section 24

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 13, T22N, R16E, Rogers County. Measured from top of hill along north section line west to bottom of abandoned strip pit, by LeRoy A. Hemish. Field notebook designation RM-4-80-H. (Estimated elevation at top of section, 810 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, light-reddish-brown, fine-grained, ferruginous, noncalcareous, medium-bedded, highly weathered; includes sandy soil zone in upper 2 ft of unit (Lagonda Sandstone Member).....	4.0
Sandstone, reddish-brown, very fine-grained, silty, shaly, ferruginous, poorly indurated, thin-bedded, weathered (Lagonda Sandstone Member).....	4.0
Shale, light-gray-brown, sticky when wet, poorly exposed.....	28.0
Limestone, brown to gray-brown, orange-brown on weathered surfaces, silty, impure, dense, abundantly fossiliferous--brachiopods, crinoid columns, and bryozoans predominant (Verdigris Limestone Member).....	4.4
Shale, black, platy; contains small spheroidal and oblate, phosphatic nodules.....	2.5

Appendix 2

Interval mostly covered; some poorly exposed sandy and silty shale.....	11.0
Sandstone, buff to light-brown to light-gray; ferruginous in part due to differential oxidation of iron, marked by Liesegang banding, very fine-grained, micaceous, non-calcareous, thin-bedded in upper two-thirds of unit to medium-bedded in lower one-third, marked by ripple-drift cross-laminae in part, with black flecks of carbonaceous material and oxidized reddish-brown particles concentrated along stratification surfaces; basal contact sharp; unit grades upward into sandy and silty shale; laterally, becomes thinner and more silty and shaly in upper part (Oowala Sandstone Member [new]).....	21.0
Shale, light-gray, with dark-gray laminae, highly silty, cross-laminated; includes scattered, reddish-brown, discoid limestone concretions as much as 1 ft in diameter and 3 in. thick (total thickness not exposed)....	8.1
Interval covered by slump material from highwall to water in bottom of pit.....	<u>12.0</u>
Total	95.0

Note: Croweburg coal was mined here in the 1960s by Peabody Coal Co.; coal bed is no longer exposed, but a measured thickness of 1.4 ft has been reported from a location approximately 0.5 mi south in the same pit.

Measured Section 25

SE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 16, T22N, R16E, Rogers County. Measured in cutbank of Sweetwater Creek just northwest of barn, by LeRoy A. Hemish. Field notebook designation RM-40-79-H. (Estimated elevation at top of section, 620 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray; weathers tan.....	4.0
Sandstone and siltstone, dark-gray and black, shaly, inter-laminated, very highly carbonaceous, noncalcareous.....	1.5
Coal, black, with reddish-brown and yellow staining on cleat surfaces, soft, highly weathered (Mineral coal)....	0.3
Shale, black, very highly carbonaceous.....	0.2
Shale, gray; well-preserved black and reddish-brown fossil plant compressions on stratification surfaces.....	0.5
Shale and siltstone, interbedded, brownish-gray, with orange-brown banding, noncalcareous; fossil plant compressions abundant (measured to creek bed).....	<u>8.0</u>
Total	14.5

Measured Section 26

NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 17, T22N, R16E, Rogers County. Measured in road cut made for private use, in south bluff of Sweetwater Creek, by LeRoy A. Hemish. Field notebook designation RM-44-79-H. (Estimated evaluation at top of section, 624 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff to light-pinkish-brown, fossiliferous; occurs in dark-brown, clayey soil.....	1.0
Shale, buff, highly calcareous, weathered; includes abundant small marine fossils that have been isolated by weathering.....	1.3
Shale, dark-gray to black, carbonaceous.....	0.7
Limestone, light-gray-brown, impure, shaly and sandy, abundantly fossiliferous.....	0.5
Shale, gray-brown, carbonaceous, fossiliferous, highly calcareous.....	0.1
Coal, black, with reddish-brown iron-oxide staining on cleat surfaces (Iron Post coal).....	1.1
Underclay, gray, streaked with orange and reddish-brown, very silty.....	0.6
Siltstone, light-brown-gray, shaly, noncalcareous; dark-reddish-brown on stratification surfaces; some strata well indurated; includes abundant fossil plant fragments.....	<u>5.7</u>
Total	11.0

Measured Section 27

NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 18, T22N, R16E, Rogers County. Measured in bluff on south side of the Verdigris River from top of escarpment to water level in river, by LeRoy A. Hemish. Field notebook designation RM-48-79-H. (Estimated elevation at top of section, 640 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, whitish-gray, thin- to medium-bedded, fossiliferous; weathers to nodular flagstones.....	15.0
CABANISS GROUP	
Senora Formation:	
Shale, black, brittle; contains phosphatic nodules.....	4.5
Limestone, buff, silty, dense, hard, massive, fossiliferous.....	6.5

Shale, medium-gray to black, with yellow streaks at base of unit.....	0.8
Coal, black, with reddish-brown staining on cleat surfaces (Iron Post coal).....	1.3
Underclay, light-yellowish-gray with reddish-brown streaks.....	1.3
Covered interval; slope littered with clastic material from above; some brown, fine-grained, shaly sandstone poorly exposed near top of interval.....	<u>40.0</u>
Total	69.4

Measured Section 28

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 18, T22N, R16E, Rogers County. Measured in road cut on west side of State Highway 88 about 100 yd south from Sweetwater Creek, by LeRoy A. Hemish. Field notebook designation RM-42-79-H. (Estimated elevation at top of section, 625 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, whitish-gray, fossiliferous; occurs as flagstones in soil zone.....	6.0
CABANISS GROUP	
Senora Formation:	
Shale, black, platy, weathers light-grayish-tan.....	5.5
Limestone, buff, silty, hard, fossiliferous.....	5.5
Shale, medium-gray.....	1.8
Shale, black, highly carbonaceous.....	0.2
Coal, black, with reddish-brown iron-oxide staining on cleat surfaces (Iron Post coal).....	1.2
Underclay, gray-brown-orange, silty, highly weathered.....	0.2
Limestone, grayish-brown, with orange, weathered crust; silty, very hard; smells of sulfur when struck.....	0.4
Shale, grayish-brown, silty; grades into silty sandstone downward (measured to bottom of ditch).....	<u>4.2</u>
Total	25.0

Measured Section 29

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 19, T22N, R16E, Rogers County. Measured in road ditch on south side of gravel road east from top of hill to dry creek bed, by LeRoy A. Hemish. Field notebook designation RM-46-79-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, grayish-white, fossiliferous; occurs as flagstones in dark-brownish-black soil zone.....	2.0
CABANISS GROUP	
Senora Formation:	
Covered interval (black soil at the surface).....	6.0
Limestone, buff, silty, fossiliferous, hard, medium-bedded.....	5.0
Shale, brown, highly weathered; grades into black shale at base of unit.....	1.5
Coal, black, soft, weathered (Iron Post coal).....	1.2
Underclay, yellow-orange, very silty.....	0.8
Interval poorly exposed; includes gray-brown, silty shale grading downward into shaly siltstone and very fine-grained, reddish-brown, shaly sandstone.....	23.0
Limestone, gray, silty, fossiliferous, hard (exposed in floor of creek bed).....	<u>0.5</u>
Total	40.0

Measured Section 30

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T22N, R16E, Rogers County. Measured from top of hill downward into strip pit operated by Sweetwater Coal Co., by LeRoy A. Hemish. Field notebook designation RM-38-79-H. (Estimated elevation at top of section, 675 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, reddish-brown, ferruginous, fine- to medium-grained, noncalcareous; occurs as highly weathered rock fragments in reddish-brown soil.....	4.0
Limestone, gray-brown, buff on weathered surfaces, hard, dense, fossiliferous; occurs as weathered cobbles and boulders; silty and shaly at base of unit.....	1.6
Shale, reddish-brown to yellow-gray, clayey, highly calcareous, weathered.....	0.8
Shale, black; contains phosphatic nodules.....	3.0
Shale, tan to light-gray, with reddish-brown iron-oxide staining on joints and stratification surfaces, silty.....	27.0
Shale and siltstone, interlaminated, medium-gray and light-gray, includes some laminae of very fine-grained sandstone.....	12.0
Shale, gray, silty.....	8.0
Coal, black, hard, shiny (Croweburg coal).....	1.5

Shale, very dark-gray, indurated.....	0.3
Total	58.2

Measured Section 31

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 29, T22N, R16E, Rogers County. Measured at southwest edge of stock pond, by LeRoy A. Hemish. Field notebook designation RM-41-79-H. (Estimated elevation at top of section, 720 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff, silty, fossiliferous; occurs as flagstones in dark-brownish-black, gravelly, organic soil.....	1.0
Shale, dark-gray-brown, highly weathered, grading upwards into soil.....	2.0
Coal, black to reddish-brown, soft (Iron Post coal).....	1.1
Underclay, dark-gray, with tan and reddish-brown streaks....	0.2
Total	4.3

Measured Section 32

SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 26, T22N, R17E, Rogers County. Measured in road cut along west side of curve in gravel road, by LeRoy A. Hemish. Field notebook designation RM-68-79-H. (Estimated elevation at top of section, 840 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, purplish-red, fine- to medium-grained, noncalcareous, ferruginous; orange-brown near base of unit and extensively honeycombed.....	11.0
Shale, orange-brown, highly oxidized.....	1.2
Shale, black, flaky; contains small, spheroidal, black, phosphatic nodules, as well as light-gray, discoidal, phosphatic nodules containing fossil shells; unit at its base includes an impure, smutty coal (Tebo? coal) less than 0.5 in. thick.....	1.2
Underclay, whitish-gray, with reddish-brown streaks; includes two very thin, black, carbonaceous clay layers; weathers purplish-white on exposed surfaces.....	2.8
Sandstone, buff in lower 3.5 ft; light-gray, with orange streaks in upper 1.5 ft; fine- to very fine-grained, noncalcareous, thin-bedded in upper part, thick-bedded in lower part.....	5.0
Siltstone, light-olive-brown, with dark-brown streaks and mottling; grades upward into very fine-grained sandstone; thin-bedded, noncalcareous.....	3.5
Shale, medium-gray, silty, stained purple-brown in part.....	15.3

Sandstone, light-brown, micaceous, shaly, thin-bedded, fine- to very fine-grained, noncalcareous.....	5.0
Shale, gray, weathers light-brown; includes some thin siltstone stringers.....	14.0
Coal, black to dark-brown, very impure (RC coal).....	0.5
Underclay, light-gray.....	0.5
Shale, medium-gray, micaceous, weathers light-brown (lower part poorly exposed).....	<u>30.0</u>
Total	90.0

Measured Section 33

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$, sec. 32, T22N, R17E, Rogers County. Measured in road ditch on east side of gravel road from top of hill west of house northward to creek, by LeRoy A. Hemish. Field notebook designation RM-8-80-H. (Estimated elevation at top of section, 693 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, brick-red to light-brown, noncalcareous, medium-grained, conglomeratic in part, with abundant rounded pebbles of clay-ironstone.....	5.0
Shale, tan, with orange streaks and blotches, highly weathered.....	25.0
Ironstone, purple-brown; contains some poorly preserved fossil shells.....	0.1
Shale, dark-pink, streaked with gray, clayey.....	0.8
Coal, black, soft, weathered (Tebo coal).....	0.4
Underclay, orange and very light-gray, ferruginous; includes abundant root casts; well-indurated siltstone in part.....	0.4
Shale, light-gray and dark-pink; includes abundant carbonized fossil plant fragments.....	1.0
Sandstone, very light-gray, with brown blotches of iron oxides, very fine-grained, silty and clayey in upper part, micaceous, noncalcareous, well-indurated in lower 6 in.; weathers white.....	1.2
Shale, light-gray, with orange streaks; includes thin siltstone stringers; covered to base of hill.....	<u>1.0</u>
Total	34.9

Measured Section 34

NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 2, T22N, R18E, Mayes County. Measured in road ditch on south side of curving gravel road climbing escarpment capped by Bluejacket Sandstone, by LeRoy A. Hemish. Field notebook designation RM-14-79-H. (Estimated elevation at top of section, 838 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff to brown, fine-grained, cross-bedded, noncalcareous; thin-bedded at base of unit.....	65.0
Savanna Formation:	
Coal, black, soft (Drywood coal).....	0.2
Underclay, light-gray, with orange root casts and purple-brown fossil plant fragments.....	0.8
Shale, light-gray; weathers tannish-orange.....	13.0
Limestone, purple-brown, highly impure, sandy; contains abundant fossil shell fragments; conglomeratic in part; shale and purple ironstone in basal 2 in.....	1.2
Shale, black, platy; becomes dark-gray downward.....	11.0
Ironstone, purple-black, with reddish-orange rind.....	0.3
Shale, very dark-gray.....	7.0
Sandstone, black, with reddish-brown iron-oxide staining, highly calcareous; black, carbonized plant fragments on lamination surfaces.....	0.1
Shale, black, highly carbonaceous.....	1.0
Coal, black (Rowe coal).....	1.0
Underclay, light-gray and reddish-orange.....	1.5
Shale, gray; weathers purple-brown; covered in lower part of unit to base of hill.....	<u>18.0</u>
Total	120.1

Measured Section 35

NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T22N, R18E, Mayes County. Measured in south ditch of gravel road east of a small ravine, by LeRoy A. Hemish. Field notebook designation RM-15-79-H. (Estimated elevation at top of section, 745 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff, fine-grained, micaceous, noncalcareous, cross-bedded.....	5.0
Sandstone, gray to brown-gray, silty, micaceous, inter- bedded with carbonaceous shale, very thin-bedded.....	1.5
Savanna Formation:	
Coal, black (Drywood coal).....	0.3
Underclay, light-gray, streaked with orange.....	0.6
Shale, light-gray, mottled with orange.....	<u>4.6</u>
Total	12.0

Measured Section 36

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5, T22N, R18E, Mayes County. Measured from bed of stream up hill in road ditch to top of hill on northwest side of road cut on Will Rogers Turnpike, then in road cut on southeast side of turnpike to top of embankment, by LeRoy A. Hemish. Field notebook designation RM-27-79-H. (Estimated elevation at top of section, 810 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, dark-reddish-brown, ferruginous, fine- to medium-grained, noncalcareous, brown near bottom of unit.....	18.0
Shale, dark-gray to black; locally includes reddish-brown, ferruginous, 3-ft-thick sandstone channel-fill deposits that are conglomeratic at the base, and in places cut completely through the underlying coal bed.....	10.0
Coal, black, shiny; thickness extremely variable along the outcrop, ranges from 8 to 18 in.; may be intricately interbedded with gray shale partings up to 6 in. thick (Bluejacket coal).....	1.1
Underclay, light-gray, with orange streaks.....	0.5
Shale, gray, with orange mottling; includes abundant small, thin, silty clay-ironstone concretions; laterally along the outcrop sandy in part, with black, carbonized plant fragments.....	2.2
Sandstone, light-gray-brown to purple-brown, very fine-grained, highly ferruginous, locally, laminated ripple-marked; laterally, occurs directly under the coal bed described above and includes streaks of shiny, black coal.....	2.5
Savanna Formation:	
Shale, very dark-gray.....	2.0
Limestone and ironstone, dark-purple to black, fossiliferous.....	0.2
Shale, dark-gray, clayey.....	7.0
Ironstone, purple-black; occurs as discontinuous concretionary lenses.....	0.3
Shale, very dark-gray.....	13.0
Interval covered by sandy, red-weathering, colluvium.....	7.0
Siltstone, gray, sandy, shaly; weathers tan.....	20.0
Sandstone, buff, micaceous, fine-grained, medium-bedded.....	21.0
Total	104.8

Measured Section 37

NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 9, T22N, R18E, Mayes County. Measured in small ravine adjacent to eastward-flowing intermittent stream about 0.25 mi northwest from Lone Chapel, by LeRoy A. Hemish. Field notebook designation RM-28-79-H. (Estimated elevation at top of section, 790 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, dark-reddish-brown, fine- to medium-grained, ferruginous, noncalcareous.....	20.0
Covered interval; shale with occasional thin sandstone lenses and ironstone concretions, poorly exposed through grass.....	26.0
Limestone, gray, silty; weathers light-creamy-gray; hard, characterized by prominent, well-preserved crinoid columns as much as 1 in. in diameter.....	1.2
Shale, gray; weathers brown.....	1.8
Limestone, cream, with brown and gray mottling, nodular, sparingly fossiliferous.....	1.5
Coal, black, soft (Bluejacket coal).....	0.8
Underclay, gray.....	0.7
Shale, gray; weathers brown; bottom part of unit poorly exposed.....	4.0
Sandstone, buff, silty, shaly, very fine-grained, laminated, stained reddish-brown and black on stratification surfaces.....	3.0
Sandstone, buff, fine-grained, well-indurated, noncalcareous; contains <u>Stigmaria</u>	<u>10.0</u>
Total	69.0

Measured Section 38

NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 10, T22N, R18E, Mayes County. Measured in road ditch on east side of curve in road from fork in road to first bench occupied by dwelling site, by LeRoy A. Hemish. Field notebook designation RM-26-79-H. (Estimated elevation at top of section, 785 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff to orange-brown, fine-grained, medium- to thick-bedded, micaceous, noncalcareous, well-indurated....	20.0
Savanna Formation:	
Shale, light-gray to orange, silty; interbedded with very fine-grained sandstone; includes a 1-in.-thick layer of clay-ironstone concretions at base of unit; carbonized plant fragments abundant.....	1.0
Shale, light-gray, silty; weathers tan.....	5.2
Coal, brownish-black, soft (Drywood coal).....	0.4
Underclay, light-gray.....	0.3

Shale, gray; weathers tan; oxidized, reddish-brown flakes litter the outcrop slope.....	10.0
Total	36.9

Measured Section 39

SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 30, T22N, R18E, Mayes County. Measured in cutbank of tributary of Spencer Creek about 100 yd north from stock pond, by LeRoy A. Hemish. Field notebook designation RM-52-79-H. (Estimated elevation at top of section, 710 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, dark-reddish-brown, micaceous, ferruginous, fine-grained, massive; top of unit eroded.....	1.0
Savanna Formation:	
Shale, buff, oxidized; includes abundant clay-ironstone concretions that weather out and litter slope.....	5.0
Shale, black, brittle.....	1.8
Shale, orange-brown, highly oxidized.....	0.3
Coal, black, soft (Drywood coal).....	0.3
Shale, gray; weathers tan; brownish-gray directly under coal; includes abundant fossil plant compressions on stratification surfaces.....	2.6
Total	11.0

Measured Section 40

SE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T23N, R16E, Rogers County. Measured in bluff on east side of Lake Oologah, directly west of bend in driveway, by Leroy A. Hemish. Field notebook designation RM-29-79-H. (Estimated elevation at top of section, 685 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, gray; weathers light-creamy-gray, thin- to medium-bedded, hard, fossiliferous.....	10.0
CABANISS GROUP	
Senora Formation:	

Appendix 2

Shale, black, platy, contains phosphatic nodules.....	5.8
Limestone, buff, silty, massive, hard, fossiliferous.....	8.0
Shale, dark-gray.....	0.2
Shale, medium-gray; weathers brownish-gray.....	0.4
Shale, black, carbonaceous, fossiliferous; includes thin coal streaks at base of unit; stained yellow by sulfur in places.....	0.9
Coal, black, shiny; stained orange on weathered surfaces by iron oxides; in places coated by yellow sulfur deposits (Iron Post coal).....	1.3
Underclay, dark-gray, streaked with orange and yellow; contains black, carbonaceous plant fragments and pyrite nodules.....	0.4
Shale, light-gray, with orange iron-oxide staining.....	0.9
Sandstone, light-gray and reddish-brown, silty, very fine-grained, thin-bedded; laminated and shaly in part....	2.1
Shale, gray and reddish-brown, silty; contains trails and carbonized plant fragments; interbedded with gray, micaceous siltstone and lenses of very fine-grained sandstone (to water level).....	<u>17.0</u>
Total	47.0

Measured Section 41

SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 24, T23N, R16E, Rogers County. Measured in highwall of active strip pit operated by Double D Mining Co., Inc., by LeRoy A. Hemish. Field notebook designation RM-31-79-H. (Estimated elevation at top of section, 707 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Clay, brown, silty, organic in upper 1 ft (regolith).....	3.0
Sandstone, brown, very fine-grained, interbedded with shale, highly weathered, flaggy.....	4.0
Sandstone, brown, fine-grained, massive.....	1.5
Shale, gray, highly silty; interlaminated with siltstone and very fine-grained sandstone in upper part of unit.....	28.0
Coal, black, shiny, hard (Croweburg coal).....	1.2
Shale, black to dark-gray, very silty, indurated.....	<u>0.3</u>
Total	38.0

Measured Section 42

NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 24, T23N, R16E, Rogers County. Measured in highwall of active strip pit operated by Russell Creek Coal Co., by LeRoy A. Hemish. Field notebook designation RM-1-80-H. (Estimated elevation at top of section, 690 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, brown, fine-grained, massive, noncalcareous.....	5.0
Sandstone and siltstone, light-gray and dark-gray, interlaminated, ripple-marked (small-scale), micaceous, noncalcareous.....	1.5
Sandstone, dark-reddish-brown, fine-grained, massive, noncalcareous, ferruginous.....	1.1
Sandstone and siltstone, light-gray and dark-gray, interlaminated, micaceous; contains small-scale ripple-drift cross-laminae; noncalcareous; abundant black, carbonized plant fragments on stratification surfaces.....	0.6
Sandstone, light-gray-brown, fine-grained, massive, noncalcareous.....	1.0
Siltstone, light-gray and dark-gray, laminated, non- calcareous; includes abundant black, carbonized plant fragments on stratification surfaces.....	3.0
Shale, light-gray, silty; grades upward into overlying unit.....	27.8
Coal, black, hard, shiny; contains white calcite and pyrite on fracture surfaces (Croweburg coal).....	1.5
Underclay, light-gray with greenish-blue tinge, noncalcareous; contains abundant black, carbonized plant fragments and minor coalified stringers.....	<u>0.4</u>
Total	41.9

Measured Section 43

SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 25, T23N, R16E, Rogers County. Measured in excavation at head of stock pond directly under barbed wire fence, by LeRoy A. Hemish. Field notebook designation RM-34-79-H. (Estimated elevation at top of section, 798 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, gray, silty; occurs as weathered flagstones in black, organic topsoil and highly weathered black, carbonaceous shale.....	1.5
Coal, black, weathered; upper part grades into black soil (Iron Post coal).....	1.0
Underclay, light-tan to brownish-gray, porous; contains black coal fragments and noncalcareous pisolites.....	0.2
Siltstone, light-yellow-gray, with orange streaks, poorly indurated, noncalcareous.....	<u>0.5</u>
Total	3.2

Appendix 2

Measured Section 44

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T23N, R16E, Rogers County. Measured in highwall of inactive strip pit formerly operated by Tri-County Construction Co., by LeRoy A. Hemish. Field notebook designation RM-33-79-H. (Estimated elevation at top of section, 762 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, light-gray, hard, abundantly fossiliferous, medium- to thick-bedded; weathers light-yellow-gray; occurs as flagstones in dark-brownish-black, organic soil in upper 1 ft of unit; includes reddish-brown, pebbly clay in weathered joints.....	10.0
CABANISS GROUP	
Senora Formation:	
Shale, buff, clayey, oxidized.....	0.5
Shale, black, hard, platy; contains black, phosphatic nodules.....	5.3
Limestone, gray, with much orange to yellow-brown staining on joint surfaces, silty, thick-bedded, highly fossiliferous.....	5.5
Shale, light-brown, clayey, calcareous; includes abundant white, calcareous flecks and small masses of limestone.....	0.3
Shale, medium-gray, slightly calcareous; contains small fossil brachiopods.....	0.6
Shale, black, highly carbonaceous.....	0.2
Coal, black; includes thin deposits of orange iron oxide-bearing calcite on cleat surfaces (Iron Post coal).....	1.3
Underclay, light-gray, with yellow streaks, silty.....	0.1
Siltstone, gray, well-indurated, highly pyritic.....	0.2
Total	24.0

Measured Section 45

SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 35, T23N, R16E, Rogers County. Measured in road ditch 5 ft southeast from corner post, by LeRoy A. Hemish. Field notebook designation RM-35-79-H. (Estimated elevation at top of section, 810 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	

Limestone, gray; weathers buff; silty; occurs as flagstones littering surface and mixed with black soil.....	1.0
Shale, light-gray, with white and orange streaks, highly calcareous, weathered.....	0.5
Coal, black to reddish-brown, soft (Iron Post coal).....	1.3
Underclay, orange, highly silty.....	<u>0.2</u>
Total	3.0

Measured Section 46

SE $\frac{1}{2}$ SE $\frac{1}{4}$ sec. 36, T23N, R16E, Rogers County. Measured in road cut from top of escarpment to stock pond north side of road, by LeRoy A. Hemish. Field notebook designation RM-36-79-H. (Estimated elevation at top of section, 842 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, whitish-gray, silty, fossiliferous; weathers to flagstones in soil zone.....	3.0
CABANISS GROUP	
Senora Formation:	
Covered interval (includes some poorly exposed, weathered black shale).....	5.5
Limestone, buff, silty, fossiliferous, medium-bedded.....	6.0
Shale, brownish-gray, with white spots and streaks, highly calcareous, weathered.....	0.8
Coal, black, with reddish-brown staining on cleat surfaces, weathered (Iron Post coal).....	1.2
Siltstone, reddish-brown and black, highly carbonaceous, ferruginous; forms a crust on underlying unit.....	0.1
Shale, light-gray to tan, silty; includes orange, silty, partly indurated clay-ironstone concretions and carbonized plant fragments.....	2.4
Covered interval (occasional very fine-grained sandstone and shale strata are poorly exposed).....	23.0
Sandstone, reddish-brown, ferruginous, massive, well-indurated.....	3.0
Shale, gray, poorly exposed.....	10.0
Limestone, light-orange-brown, silty, fossiliferous, massive, hard; base poorly exposed.....	4.0
Covered interval (gray shale with some thin-bedded, reddish-brown sandstone strata is poorly exposed).....	<u>26.0</u>
Total	85.0

Appendix 2

Measured Section 47

SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 5, T23N, R17E, Rogers County. Measured in highwall of active strip pit operated by Russell Creek Coal Co., by LeRoy A. Hemish. Field notebook designation RM-22-79-H. (Estimated elevation at top of section, 780 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, light-gray with dark-gray laminae; buff to reddish-brown where oxidized; very fine-grained, silty, micaceous, noncalcareous.....	5.0
Shale, light-gray, silty; includes tannish-gray, spheroidal, noncalcareous concretions.....	35.0
Coal, black, shiny, hard; includes white calcite on cleavage surfaces (Croweburg coal).....	1.3
Shale, brownish-gray, silty, highly calcareous, well-indurated.....	<u>0.7</u>
Total	42.0

Measured Section 48

NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5, T23N, R17E, Rogers County. Measured in highwall of active strip pit operated by Russell Creek Coal Co., by LeRoy A. Hemish. Field notebook designation RM-23-79-H. (Estimated elevation at top of section, 780 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sand, brown, silty, organic.....	2.0
Sandstone, brown, oxidized, very fine-grained, micaceous, thick- to medium-bedded, noncalcareous.....	6.0
Shale, light-gray, silty; uniform in character.....	30.0
Coal, black, shiny; white calcite on cleavage surfaces (Croweburg coal).....	1.3
Shale, very dark-gray, silty, highly calcareous, well-indurated.....	<u>0.7</u>
Total	40.0

Measured Section 49

NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 12, T23N, R17E, Rogers County. Measured in highwall of active strip pit operated by Local Coal Co., Inc., by LeRoy A. Hemish. Field notebook designation RM-67-79-H. (Estimated elevation at top of section, 736 ft.)

	Thickness (ft)
Silt, dark-gray-brown, clayey, organic (topsoil).....	1.0
Clay, orange-gray-brown; contains white, calcareous specks and small selenite crystals; highly oxidized (regolith).....	3.0
CABANISS GROUP	
Senora Formation:	
Shale, yellow-gray to brown; includes reddish-brown horizons of lenticular ironstone concretions.....	3.2
Shale, gray; contains scattered fossil marine shells.....	9.8
Coal, black, hard; includes pyrite and white calcite on cleat surfaces (Weir-Pittsburg coal).....	1.0
KREBS GROUP	
Boggy Formation:	
Siltstone, black, well-indurated, pyritic.....	<u>0.1</u>
Total	18.1

Measured Section 50

NE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 19, T23N, R17E, Rogers County. Measured in highwall of active strip pit operated by Hickory Coal Co., by LeRoy A. Hemish. Field notebook designation RM-32-79-H. (Estimated elevation at top of section, 765 ft.)

	Thickness (ft)
Clay, dark-gray, silty, sandy, organic.....	1.5
Clay, light-brown, weathered.....	3.0
Gravel, reddish-brown, immature; clasts mostly angular, occurring in a matrix of sticky clay and consisting predominantly of reddish-brown, weathered sandstone with a minor amount of limestone.....	11.5
CABANISS GROUP	
Senora Formation:	
Shale, brown, weathered.....	3.0
Shale, gray.....	12.0
Coal, black, shiny, hard; includes minor pyrite and white calcite on cleat surfaces (Croweburg coal).....	1.5
Shale, black to dark-gray, carbonaceous; contains abundant black, carbonized plant fragments.....	<u>0.5</u>
Total	33.0

Appendix 2

Measured Section 51

SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T23N, R18E, Mayes County. Measured in dry stream bed and south bank of Diver Creek, by LeRoy A. Hemish. Field notebook designation RM-47-79-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Shale, black, brittle, highly carbonaceous.....	0.3
Coal, black (Bluejacket coal).....	0.2
Underclay, light-gray, with orange and yellow streaks; contains abundant carbonized plant fragments.....	0.5
Shale, gray, silty; contains abundant black fossil plant compressions.....	1.0
Sandstone, yellow-brown, ferruginous in part, fine- grained, well-indurated (total thickness not exposed).....	<u>1.0</u>
Total	3.0

Note: Beds at this site strike N. 42° E. and dip
N. 48° W. at 27° along the Diver Creek fault.

Measured Section 52

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 22, T23N, R18E, Mayes County. Measured in east bank of intermittent stream about 10 yd south of concrete bridge, by LeRoy A. Hemish. Field notebook designation RM-25-79-H. (Estimated elevation at top of section, 674 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, yellow-brown to reddish-brown, fine-grained, micaceous, ferruginous in part, medium- to thick- bedded, noncalcareous.....	4.0
Savanna Formation:	
Coal, black and reddish-brown, soft (Drywood coal).....	0.1
Sandstone, brown, ferruginous, very fine-grained; interlaminated with black, carbonaceous particles.....	0.1
Shale, green-gray, silty; interbedded with ferruginous, brown sandstone; contains coal streaks.....	0.8
Underclay, gray and orange-brown.....	0.3
Shale, very dark-gray to black.....	<u>2.7</u>
Total	8.0

Measured Section 53

NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 23, T23N, R18E, Mayes County. Measured in road cut on south side of gravel road from top of hill to creek, by LeRoy A. Hemish. Field notebook designation RM-9-79-H. (Estimated elevation at top of section, 751 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, light-brown, micaceous, noncalcareous, thin- to medium-bedded, base irregular.....	42.0
Sandstone, light-brown, silty, very fine-grained, noncalcareous, interbedded with light-gray-brown shale; highly ferruginous and carbonaceous at contact with underlying unit; locally includes large, reworked coal fragments.....	0.7
Savanna Formation:	
Coal, purplish-black, soft (Drywood coal).....	0.2
Underclay, light-gray, with orange banding.....	1.1
Shale, light-gray (base not exposed).....	<u>6.0</u>
Total	50.0

Measured Section 54

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T23N, R18E, Mayes County. Measured in road ditch north side of gravel road, by LeRoy A. Hemish. Field notebook designation RM-13-79-H. (Estimated elevation at top of section, 750 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff, fine-grained, noncalcareous, medium-bedded.....	5.0
Sandstone, orange-brown, fine-grained, highly conglomeratic, ferruginous, laminated; includes abundant plant fragments and iron-oxide-stained, carbonized wood fragments.....	1.5
Savanna Formation:	
Coal, purple-black, soft, weathered (Drywood coal).....	0.2
Underclay, whitish-gray, stained orange.....	1.0
Shale, light-gray, weathers light-brown; includes brown clay-ironstone concretionary layers (lower 10 ft poorly exposed).....	<u>20.0</u>
Total	27.7

Appendix 2

Measured Section 55

NW $\frac{1}{2}$ NW $\frac{1}{4}$ sec. 7, T23N, R19E, Mayes County. Measured from top of hill to creek along south side of gravel road, by LeRoy A. Hemish. Field notebook designation RM-5-79-H. (Estimated elevation at top of section, 780 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff, weathers yellowish, fine-grained, medium- to thick-bedded, noncalcareous.....	20.0
Savanna Formation:	
Coal, black, soft (Drywood coal).....	0.1
Underclay, light-gray; stained reddish-orange in upper 1 in.; contains root casts.....	0.9
Shale, gray (poorly exposed).....	3.0
Covered to creek level.....	<u>16.0</u>
Total	40.0

Measured Section 56

SW $\frac{1}{2}$ NW $\frac{1}{4}$ sec. 8, T23N, R19E, Mayes County. Measured in small ravine in the west slope of prominent outlier, by LeRoy A. Hemish. Field notebook designation RM-4-79-H. (Estimated elevation at top of section, 805 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff with brown flecks, fine-grained, micaceous, medium-bedded; in the basal 6 in. becomes very thin-bedded, silty, and carbonaceous, with abundant fossil plant fragments.....	15.0
Savanna Formation:	
Coal, black, soft (Drywood coal).....	0.1
Sandstone, brown, with orange-brown streaks, very fine-grained, interbedded with gray clay layers; includes coalified plant materials, streaks of coal, and fossil plant fragments.....	0.5
Coal, black (Drywood coal).....	0.1
Sandstone, light-gray, with black specks, very fine-grained; interlaminated with gray shale and coal streaks.....	0.2
Underclay, yellow-gray, with brown streaks.....	0.6
Shale, dark-gray; includes abundant orange-brown clay-ironstone concretions; weathers brown-gray.....	2.0

Limestone, dark-gray, with reddish-brown rind, hard, dense; occurs as more or less continuous lenses; nonfossiliferous.....	0.2
Shale, dark-gray to black, with brownish-purple mottling; includes abundant clay-ironstone nodules and layers (base poorly exposed).....	5.0
Shale, gray; weathers yellow-brown.....	6.0
Limestone, black, silty, fossiliferous, hard; contains vugs partly filled with pyrite; weathers reddish-brown....	0.3
Coal, black (Rowe coal).....	1.2
Underclay, gray.....	0.1
Shale, dark-gray.....	<u>7.7</u>
Total	39.0

Measured Section 57

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 8, T23N, R19E, Mayes County. Measured in road cut on south side of Will Rogers Turnpike, by LeRoy A. Hemish. Field notebook designation RM-7-79-H. (Estimated elevation at top of section, 818 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff, micaceous, fine-grained, noncalcareous; base of unit includes laminated, bioturbated, highly ferruginous beds that weather into flakes.....	12.0
Savanna Formation:	
Shale, gray; weathers tan.....	11.0
Limestone, brown; contains fossil root casts; very hard.....	0.4
Shale, black.....	6.6
Limestone, dark-reddish-brown; mostly altered to clay-ironstone; contains scattered fossil shells and burrows.....	0.3
Shale, black.....	6.0
Sandstone, brownish-gray to black, very fine-grained, silty, micaceous, noncalcareous, pyritic; interlaminated with black, highly carbonaceous shale; includes abundant fossil plant fragments on stratification surfaces, as well as fossil shells, burrows, and trails.....	0.5
Coal, black (Rowe coal).....	1.0
Underclay, gray, plastic.....	0.5
Shale, gray; weathers gray-brown; silt content increases downward.....	6.0
Limestone, reddish-brown, ferruginous, oolitic; occurs as nodules 4-12 in. in diameter that grade laterally into impure, sandy limestone.....	0.4
Shale, gray; weathers gray-brown.....	5.0
Sandstone, gray and brownish-purple, very fine-grained, noncalcareous, laminated; on north side of highway this interval is occupied by a 6-in.-thick, reddish- brown, fossiliferous limestone.....	0.3

Appendix 2

Shale, medium-gray; includes scattered lenses of reddish-brown, laminated sandstone that weather out and litter slope (exposed best on north side of highway).....	15.0
Total	65.0

Measured Section 58

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 18, T23N, R19E, Mayes County. Measured on southwest side of outlier capped by Bluejacket Sandstone Member, by LeRoy A. Hemish. Field notebook designation RM-6-79-H. (Estimated elevation at top of section, 792 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, buff, micaceous, fine-grained, noncalcareous, cross-bedded; includes bands of coal and dark-reddish-black ironstone concretions near base of unit; contains excellent specimens of fossil plants; channels into underlying sediments.....	28.0
Savanna Formation:	
Shale, black; contains orange ironstone concretions; middle part of unit poorly exposed.....	6.5
Coal, black (Drywood coal).....	0.9
Underclay, light-gray; stained orange in upper part.....	1.0
Shale, gray, weathers tan, poorly exposed (below this unit slope is grass-covered to base of hill).....	11.0
Total	47.4

Measured Section 59

NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 20, T23N, R19E, Mayes County. Measured on south end of Jesse James Hill, by LeRoy A. Hemish. Field notebook designation RM-8-79-H. (Estimated elevation at top of section, 790 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, yellow-brown, fine-grained, micaceous, ferruginous, noncalcareous, thick- to medium-bedded; conglomeratic in lower 5 ft, with numerous reworked ironstone-concretion fragments.....	15.0
Siltstone, light-brown, micaceous, noncalcareous; inter-laminated with shale; includes brown, carbonized plant fragments on stratification surfaces.....	2.0

Sandstone, reddish-brown, fine-grained, micaceous, ferruginous, noncalcareous, massive; conglomeratic in part.....	0.5
Savanna Formation:	
Shale, black, stained orange and yellow.....	0.2
Coal, black, weathered (Drywood coal).....	1.1
Underclay, orange to light-purple-brown.....	0.2
Shale, light-gray; weathers tan (below this unit, slope is grass-covered to base of hill).....	<u>21.0</u>
Total	40.0

Measured Section 60

SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T24N, R15E, Rogers County. Measured in east bank of small intermittent stream about 8 ft north of bridge, by LeRoy A. Hemish. Field notebook designation RM-65-79-H. (Estimated elevation at top of section, 690 ft.)

	Thickness (ft)
Silt, grayish-brown, clayey, organic (alluvium).....	1.3
Clay, buff, silty; includes white "popcorn" calcareous concretions (regolith).....	0.7
MARMATON GROUP	
Holdenville Formation:	
Shale, yellow-brown, highly oxidized.....	3.5
Shale, black, flaky, highly carbonaceous.....	0.8
Coal, black, with reddish-orange iron-oxide staining on cleat surfaces (Dawson coal).....	0.8
Underclay, light-grayish-orange to orange, plastic.....	0.6
Shale, gray, clayey (to water level).....	<u>0.8</u>
Total	8.5

Measured Section 61

NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T24N, R15E, Rogers County. Measured in east bank of small intermittent stream about 50 yd south of bridge on section-line road, by LeRoy A. Hemish. Field notebook designation RM-66-79-H. (Estimated elevation at top of section, 688 ft.)

	Thickness (ft)
Silt, dark-grayish-brown, organic (alluvium).....	0.5
Gravel, light-orange-brown, very silty (alluvium).....	2.0
MARMATON GROUP	

Holdenville Formation:

Shale, black, platy; contains small, black, phosphatic nodules.....	1.3
Coal, black, with reddish-orange iron-oxide staining on cleat surfaces (Dawson coal).....	1.0
Underclay, purple-gray.....	0.5
Shale, gray to brownish-gray (to water level in creek).....	<u>2.5</u>
Total	7.8

Note: About 50 yd downstream, a buff, well-indurated sandstone crops out in the stream bed.

Measured Section 62

SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 1, T24N, R17E, Rogers County. Measured in highwall of strip pit operated by Four D Energy, Inc., by LeRoy A. Hemish. Field notebook designation RM-18-79-H. (Estimated elevation at top of section, 868 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff, silty, very hard, fossiliferous, finely crystalline, medium-bedded.....	3.5
Shale, gray, with orange streaks, fossiliferous; contains streaks of black, carbonaceous material; weatherbed.....	2.8
Coal, black, with reddish-orange iron-oxide staining on cleat surfaces (Iron Post coal).....	1.2
Sandstone, light-gray, silty, friable; contains streaks of carbonaceous material.....	<u>0.5</u>
Total	8.0

Measured Section 63

SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T24N, R17E, Rogers County. Measured in highwall of active strip pit operated by Hefner and Son Coal Co., by LeRoy A. Hemish. Field notebook designation RM-55-79-H. (Estimated elevation at top of section, 820 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, light-brownish-gray; contains oblate and discoidal, reddish-brown concretions 6-12 in. in diameter.....	6.0
Shale, light-gray, joint surfaces stained reddish-brown; includes reddish-brown and gray clay-ironstone	

concretions about 2-3 in. thick and 6-12 in. in diameter.....	15.0
Coal, black, shiny, hard; white calcite on cleat surfaces (Croweburg coal).....	1.2
Underclay, medium-gray; feels soapy; includes abundant black, carbonized plant fragments.....	<u>0.6</u>
Total	22.8

Measured Section 64

NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T24N, R17E, Rogers County. Measured in highwall of active strip pit operated by Carbonex Coal Co., by LeRoy A. Hemish. Field notebook designation RM-18A-79-H. (Estimated elevation at top of section, 750 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, light-brown, weathered.....	4.0
Shale, light-gray, silty.....	18.0
Coal, black, shiny; minor calcite on cleat surfaces (Croweburg coal).....	1.3
Underclay, medium-gray.....	<u>0.7</u>
Total	24.0

Measured Section 65

NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5, T24N, R17E, Rogers County. Measured in highwall of strip pit operated by Four D Energy, Inc., by LeRoy A. Hemish. Field notebook designation RM-19-79-H. (Estimated elevation at top of section, 742 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, light-gray, abundantly fossiliferous, dense, very hard; weathers yellow-gray; stained orange on joint surfaces; uppermost 2.5 ft of unit occurs as weathered blocks and fragments in dark brown, organic soil; flaggy in middle part of unit.....	7.7
CABANISS GROUP	
Senora Formation:	
Shale, black, brittle, platy; contains oblate and spheroidal, phosphatic nodules about 0.25-0.75 in. in diameter; gray calcite on joint surfaces.....	5.5
Limestone, light-gray, silty, dense, very hard, fossiliferous, stained buff on some joint surfaces.....	8.5

Appendix 2

Shale, dark-gray, silty, fossiliferous, highly calcareous.....	0.3
Limestone, light-gray, silty, fossiliferous.....	0.7
Shale, dark-gray, silty, fossiliferous, highly calcareous.....	0.4
Shale, black, platy, brittle; contains tiny fossil marine shells.....	1.2
Coal, black, hard, shiny (Iron Post coal).....	1.2
Siltstone, medium-gray.....	0.5
Total	26.0

Measured Section 66

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 7, T24N, R17E, Rogers County. Measured at edge of strip pit being opened by Four D Energy, Inc., by LeRoy A. Hemish. Field notebook designation RM-17-79-H. (Estimated elevation at top of section, 708 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, light-gray-brown, silty, fossiliferous, hard; weathers light-gray.....	1.5
Shaly, yellow-brown, with white, calcareous streaks, highly weathered.....	1.8
Coal, black, weathered (Iron Post coal).....	1.2
Total	4.5

Measured Section 67

SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 7, T24N, R17E, Rogers County. Measured in highwall of active strip pit operated by Four D Energy, Inc., by LeRoy A. Hemish. Field notebook designation RM-30-79-H. (Estimated elevation at top of section, 710 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, light-gray, silty, fossiliferous; weathered to flagstones interspersed with black soil.....	0.8
Shale, buff to gray-brown, with reddish-brown streaks and mottling, highly weathered.....	4.6
Shale, black, weathered.....	0.4
Coal, black, with reddish-brown staining on cleat surfaces (Iron Post coal).....	1.1
Underclay, gray, silty; contains carbonaceous plant fragments.....	0.5
Total	7.4

Measured Section 68

NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 18, T24N, R17E, Rogers County. Measured in road cut on east side of gravel road, by LeRoy A. Hemish. Field notebook designation RM-20-79-H. (Estimated elevation at top of section, 680 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff, silty, fossiliferous, hard, highly weathered and broken; occurs with black topsoil.....	2.0
Shale, yellow-brown, clayey, highly weathered.....	1.5
Coal, black, weathered (Iron Post coal).....	0.9
Shale, yellow-brown, highly weathered; base of unit covered to bottom of ditch.....	<u>1.6</u>
Total	6.0

Measured Section 69

SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T24N, R17E, Rogers County. Measured in highwall of abandoned strip pit, by LeRoy A. Hemish. Field notebook designation RM-16-79-H. (Estimated elevation at top of section, 775 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, yellow-brown to orange-brown, hard, massive, fossiliferous.....	5.0
Shale, black, carbonaceous; contains small, black, oblate, phosphatic nodules.....	1.8
Shale, gray; grades into underlying unit.....	9.2
Sandstone, light-gray, very fine-grained, ripple-drift cross-laminated in part, noncalcareous; weathers brown; locally well-indurated and massive-appearing, but laterally becomes interbedded with silty and shaly strata; fines upward and grades into silty shale.....	6.0
Shale, light-gray, silty.....	36.0
Coal, black, shiny (Croweburg coal).....	<u>1.3</u>
Total	59.3

Measured Section 70

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T24N, R17E, Rogers County. Measured in road cut on north side of gravel road, by LeRoy A. Hemish. Field notebook designation RM-24-79-H. (Estimated elevation at top of section, 745 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, buff, silty, hard, highly fossiliferous; weathers to flagstones at the surface.....	2.0
Shale, brown, streaked with orange; highly weathered.....	2.0
Limestone, gray, with orange flecks, silty and sandy, very impure.....	0.3
Shale, black, clayey; contains well-preserved fossil plant fragments.....	0.5
Coal, black, soft (Iron Post coal).....	1.2
Shale, orange to reddish-brown, yellow-gray with depth, away from surface, very silty, highly weathered, contains abundant fossil plant fragments; thin underclay at top of unit.....	6.0
Total	12.0

Measured Section 71

SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T24N, R17E, Rogers County. Measured in highwall of abandoned strip pit, by LeRoy A. Hemish. Field notebook designation RM-21-79-H. (Estimated elevation at top of section, 782 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, orange-brown, fossiliferous, hard.....	3.5
Shale, black, platy; contains phosphatic nodules.....	1.5
Shale, gray; weathers tan.....	8.5
Sandstone, gray, fine-grained, micaceous; medium- to thick-bedded; weathers brown to reddish-brown; unit becomes shaly laterally; thickness variable.....	7.5
Shale, gray; includes tannish-gray, noncalcareous concretions.....	30.0
Coal, black, shiny (Croweburg coal).....	1.4
Total	52.4

Measured Section 72

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ and SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 32, T24N, R17E, Rogers County. Measured in road ditch across road from driveway to junkyard, by LeRoy A. Hemish. Field notebook designation RM-7-80-H. (Estimated elevation at top of section, 682 ft.)

	Thickness (ft)
CABANISS GROUP	

Senora Formation:

Shale, gray to gray-brown, with black, carbonized plant fragments on stratification surfaces; oxidized in part....	5.0
Ironstone, reddish-brown, silty; includes numerous well-preserved molds of plant leaves.....	0.2
Coal, black, soft, weathered (Mineral coal).....	0.8
Shale, black, with dark-gray laminae, stained reddish-brown in part, very coaly.....	1.0
Shale, dark gray, highly carbonaceous; includes abundant black, carbonized plant fragments on stratification surfaces; contact with underlying unit sharp.....	2.4
Shale, olive-gray, very silty; includes abundant black plant compressions.....	2.3
Sandstone, light-tannish-gray, very fine-grained, micaceous, noncalcareous; includes well-preserved fossil plant compressions on stratification surfaces; base not exposed.....	<u>1.3</u>
Total	13.0

Measured Section 73

SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 10, T24N, R18E, Rogers County. Measured in cut in hill on east side of road, by LeRoy A. Hemish. Field notebook designation RM-3-79-H. (Estimated elevation at top of section, 850 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, reddish-brown, ferruginous, fine- to medium-grained; contains purple-black ironstone concretions.....	20.0
Covered interval (slope littered with float from overlying sandstone).....	10.0
Shale, light-gray-brown.....	3.0
Clay-ironstone, orange, with dark-reddish-brown interior surfaces; occurs as concretionary band.....	0.2
Shale, light-gray-brown; includes scattered clay-ironstone concretions similar to unit above.....	4.0
Clay-ironstone, orange, with dark-reddish-brown interior surfaces; occurs as concretionary band; grades laterally into gray, fossiliferous limestone.....	0.2
Shale, medium-gray; weathers tan-gray.....	3.2
Shale, black, hard; contains round, phosphatic nodules about 1 in. in diameter.....	1.3
Shale, gray.....	1.0
Coal, black, weathered (Tebo coal).....	0.3
Shale, medium-gray; base poorly exposed.....	5.0
Sandstone, buff, silty, very fine-grained, thin-bedded (total thickness not exposed).....	<u>1.2</u>
Total	49.4

Measured Section 74

NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 11, T24N, R18E, Rogers County. Measured from farm yard at the SE corner of the NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 11 southward down hill in road ditch to bottom of escarpment, by LeRoy A. Hemish. Field notebook designation RM-2-79-H. (Estimated elevation at top of section, 950 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, dark-reddish-brown to purplish-brown, ferruginous, noncalcareous, fine- to medium-grained; fills channels cut into underlying sediments.....	33.0
Clay-ironstone, dark-reddish-brown to black; laterally cut out where overlying sandstone fills channels.....	0.1
Shale, light-gray; stained reddish-brown in part.....	1.2
Shale, black.....	0.5
Coal, black, with iron-oxide staining on cleat surfaces (upper Tebo coal).....	0.3
Shale, light-brownish-gray; includes abundant black plant compressions on stratification planes.....	3.4
Siltstone, light-green-gray, shaly, laminated; jointed at near right angles (less than 1 in. square) in places.....	6.0
Shale, medium-dark-gray.....	3.0
Shale, black, slaty, hard; contains phosphatic nodules.....	0.7
Coal, black, impure; locally developed at base of overlying black-shale unit (lower Tebo coal).....	0.1
Underclay, gray, with orange staining; contains white flecks and fossil root casts.....	0.3
Shale, light-gray; stained orange on stratification planes.....	4.7
Sandstone, buff, micaceous, fine-grained, noncalcareous; thin-bedded; stained black at contact with overlying shale unit (base not exposed).....	<u>1.0</u>
Total	54.3

Measured Section 75

NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 25, T24N, R18E, Rogers County. Measured in cutbank of Little Pryor Creek about 30 yd east of bridge, by LeRoy A. Hemish. Field notebook designation RM-12-79-H. (Estimated elevation at top of section, 714 ft.)

	Thickness (ft)
Silt, brown, clayey, sandy, gravelly (alluvium associated with Little Pryor Creek).....	6.0

KREBS GROUP

Savanna Formation:

Shale, olive-gray, hard, dark-gray in lower part of unit.....	3.0
Limestone, dark-brown to purple, silty, highly fossiliferous.....	0.4
Shale, dark-gray, fossiliferous; includes scattered dark-gray lenses of fossiliferous limestone.....	2.2
Coal, black, thins laterally (Rowe coal).....	0.4
Underclay, dark-gray with orange iron-oxide staining.....	1.0
Total	13.0

Measured Section 76

NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T24N, R18E, Rogers County. Measured in road cut, west side of blacktop road, by LeRoy A. Hemish. Field notebook designation RM-11-79-H. (Estimated elevation at top of section, 745 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, light-brown, fine-grained, ferruginous, micaceous, noncalcareous, medium- to thin-bedded; contains carbonaceous shale stringers near base of unit.....	3.0
Savanna Formation:	
Coal, black, weathered (Drywood coal).....	0.2
Shale, dark-gray; contains carbonized plant fragments; weathers light-brown (base of unit covered).....	4.8
Total	8.0

Measured Section 77

NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T24N, R18E, Rogers County. Measured from top of hill west along road ditch to abandoned mine along small stream in valley bottom, by LeRoy A. Hemish. Field notebook designation RM-1-79-H. (Estimated elevation at top of section, 842 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, dark-reddish-purplish-brown, ferruginous, fine- to medium-grained, noncalcareous, medium-bedded; locally conglomeratic at the base.....	12.0
Coal, black; bed is disrupted laterally and includes sand (Tebo coal).....	0.1

Ironstone, dark-reddish-brown, with orange interiors; occurs as concretionary masses containing numerous box like structures; thickness varies laterally.....	0.8
Clay, orange, stained by iron oxides precipitating from ground water percolating through overlying strata.....	0.6
Shale, light-gray, fissile; abundant black, carbonized plant fragments on stratification planes; includes brown, dikelike structures composed of silty, very fine-grained, buff sand, interlaminated with dark-brown, highly carbonaceous sand; lower part of unit poorly exposed, but seems to coarsen downwards.....	21.5
Covered interval, probably shale.....	7.0
Sandstone, brown, fine-grained, ferruginous, micaceous, weathers buff; poorly exposed, may be thicker.....	2.0
Shale, gray-brown.....	10.0
Covered interval; slump and slope-wash materials conceal strata to bottom of abandoned strip pit; coal not exposed, but Weir-Pittsburg bed was mined here.....	<u>6.0</u>
Total	60.0

Measured Section 78

NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 35, T24N, R18E, Rogers County. Measured on west side of Little Pryor Creek, about 50 yd south of bridge, by LeRoy A. Hemish. Field notebook designation RM-10-79-H. (Estimated elevation at top of section, 710 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, light-brown, ferruginous, micaceous, fine-grained, cross-bedded; fills channels in underlying sediments (upper part of unit covered).....	5.0
Savanna Formation:	
Coal, black to reddish-brown, weathered; the coal bed thins laterally and is split and disrupted by channel fill deposits of weakly calcareous sandstone at the base of the Bluejacket Sandstone Member (Drywood coal).....	0.4
Shale, black (base of unit covered).....	<u>1.6</u>
Total	7.0

Core-Hole Log 1

SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 18, T. 21 N., R. 18 E., Mayes County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture on hill south of pond. Field notebook designation C-RM-1. (Surface elevation, estimated from topographic map, 815 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Sandstone, moderate-reddish-brown, very fine-grained, noncalcareous, weathered.....	4.0
Sandstone, grayish-orange with dusky-brown flecks, very fine-grained, micaceous, noncalcareous, thin-bedded, weathered.....	4.5
Shale, dark-yellowish-orange to light-brown to pale-yellowish-brown, interlaminated with siltstone and very fine-grained sandstone, noncalcareous, weathered.....	2.0
Shale, grayish-black with dark-yellowish-orange bands, noncalcareous; contains some thin stringers of light-gray siltstone; fractured.....	2.5
Shale, grayish-black with medium-light-gray sideritic bands, noncalcareous.....	7.8
Shale, grayish-black to black, noncalcareous; contains light-brownish-gray sideritic concretions as much as 2 in. thick.....	2.8
Limestone, light-brownish-gray, fine-grained, micritic, nonfossiliferous.....	0.5
Shale, grayish-black, noncalcareous; contains rare pyrite-filled burrows and light-brownish-gray sideritic concretions as much as 1.5 in. thick.....	14.4
Limestone, medium-dark-gray to light-gray, impure, shaly, fossiliferous; contains abundant broken shells and other fossil fragments; becomes darker gray in lower 1 ft, with better-preserved fossil shells; includes a 1/16-in.-thick coal stringer at contact with underlying unit (Inola Limestone).....	3.7
Underclay, medium-dark-gray to medium-light-gray, blocky fracture, carbonaceous in upper part.....	1.5
Shale, greenish-gray, clayey, noncalcareous; contains some bioturbation features in lower 8 in.....	1.1
Limestone, light-gray with very light-gray mottling, fine-grained, hard; contains fossil shells and fossil fragments (Inola Limestone).....	1.5
Underclay, light-gray with minor grayish-black streaks, blocky fracture, silty; grades into underlying unit.....	2.2
Limestone, very light-gray, fine-grained, calcarenitic; contains rare fossil shells and minor disseminated pyrite; cross-bedded (Inola Limestone).....	5.4
Shale, medium-gray, noncalcareous, carbonaceous, pyritic; includes two coal layers totaling 0.75 in. thick at contact with overlying unit.....	0.1

Appendix 2

Coal, black, bright, moderately friable, pyrite and calcite on cleats; includes a 4-in.-thick carbonaceous shale parting from 55.0 to 55.3 ft; 6 in. of coal below parting contains some thin shale laminae (Bluejacket coal).....	1.8
Shale, medium-dark-gray, silty, sandy, coaly in upper part; contains abundant, well-preserved, black, carbonized plant compressions.....	0.4
Sandstone, light-gray with medium-dark-gray shale streaks, micaceous, very fine-grained, noncalcareous, rippled; contains abundant black, carbonized and pyritized plant fragments (upper unit of Bluejacket Sandstone).....	3.9
Siltstone, medium-light-gray, interbedded with medium-dark-gray shale, noncalcareous, wavy-bedded and cross-laminated in part, burrowed; contains black, carbonized plant fragments.....	2.9
Shale, dark-gray with medium-light-gray siltstone bands and streaks, noncalcareous; contains black, carbonized plant fragments and rare light-brownish-gray sideritic concretions; contact with underlying unit sharp.....	10.7
Sandstone, medium-light-gray, fine-grained, noncalcareous, micaceous; contains scattered dark-gray shale streaks and pebbles, as well as numerous streaks of black, coalified plant material; shows flame structure and flasher bedding in places; includes some coal spars as much as 1.5 in. thick in lower 8 in. of unit; contact with underlying unit sharp (basal unit of Bluejacket Sandstone).....	21.4

Savanna Formation:

Ironstone, brownish-gray; contains a thin, diagonal streak of white gypsum.....	0.2
Shale, black, noncalcareous.....	0.7
Limestone, dark-gray, impure, silty, contains abundant fossil shells and fossil fragments.....	0.4
Shale, black, coaly, calcareous.....	0.1
Coal, black, moderately friable; contains pyrite in thin lenses and streaks (Drywood coal).....	0.1
Shale, medium-gray, noncalcareous; silty, wavy-laminated; contains black, carbonized plant fragments; includes about 2 in. of poorly developed underclay at top of unit; contains scattered pyrite-filled burrows and light-brownish-gray sideritic concretions as much as 1.25 in. thick.....	7.5
Shale, medium-dark-gray with grayish-black and black streaks, weakly calcareous; contains carbonaceous and pyritic layers as well as streaks of coal.....	0.1
Underclay, medium-gray, blocky fracture, slickensided, burrowed, silty.....	2.1
Siltstone, medium-light-gray, noncalcareous, shaly.....	0.6
Shale, grayish-black with light-brownish-gray bands in upper 6 ft, noncalcareous, burrowed; contains pyrite masses and sideritic concretions as much as 1.5 in. thick.....	8.1

Shale, grayish-black, noncalcareous; contains rare pyrite-filled burrows, small, calcareous fossil shells, and white calcite in veinlets and on bedding planes; contains some light-brownish-gray sideritic concretions as much as 1 in. thick in lower 2.5 ft of unit.....	11.8
Limestone, grayish-black, impure, silty, fine-grained, fossiliferous; contains shell fragments and small crinoid ossicles.....	0.1
Shale, grayish-black, noncalcareous; includes thin, very light-gray streaks of calcareous siltstone and sandstone..	1.6
Limestone, grayish-black, impure, silty, fossiliferous; contains fossil hash; grades into underlying unit.....	0.1
Shale, black, very calcareous; contains abundant white fossil shells and crinoid ossicles; grades into underlying unit.....	2.4
Limestone, grayish-black, very impure, silty, shaly, carbonaceous; fossiliferous; contains fossil hash (Doneley Limestone).....	0.8
Coal, black, bright, moderately friable, white calcite and pyrite on cleat surfaces (Rowe coal).....	0.7
Underclay, brownish-gray, silty; contains black, carbonized plant fragments.....	1.8
Shale, medium-light-gray, silty, noncalcareous.....	1.5
Mudstone, medium-light-gray, noncalcareous.....	2.2
Sandstone and siltstone, medium-gray, shaly, very fine-grained, noncalcareous, laminated, burrowed.....	2.0
Shale, medium-dark-gray with light-gray streaks of siltstone and very fine-grained sandstone, noncalcareous, extensively burrowed; includes rare, light-brownish-gray sideritic concretions.....	9.3
Shale, medium-dark-gray, noncalcareous; contains rare, thin streaks of light-gray siltstone.....	13.0
Limestone, brownish-gray, impure, shaly, fine-grained; contains abundant fossil hash; includes a 0.5-in.-thick band of black, carbonaceous shale at base of unit (Sam Creek Limestone).....	0.2
Underclay, medium-dark-gray, churned, slickensided.....	1.9
Shale, dark-gray, silty, sandy, noncalcareous; contains large bioturbation features filled with brownish-gray, very fine-grained sandstone.....	2.3
Shale, dark-gray with light-gray siltstone streaks and lenses, noncalcareous; contains rare light-brownish-gray sideritic concretions.....	4.1
Coal, black, interbedded with dark-gray, noncalcareous, slickensided shale and layers of pyrite as much as 1/16 in. thick.....	0.7
Coal, black, bright, moderately friable, pyrite and calcite on cleat surfaces (unnamed coal).....	0.3
Underclay, medium-gray, soft.....	0.4
Shale, medium-light-gray, burrowed, noncalcareous; includes a 0.5-in.-thick layer of fossiliferous limestone 4 in. above base of unit.....	4.8
Limestone, medium-dark-gray with light-brownish-gray sideritic bands about 1 in. thick, impure, shaly, fossiliferous; contains abundant brachiopod shells and fossil hash (Spaniard Limestone).....	1.0

McAlester Formation:

Underclay medium-gray, churned; contains a 2-in.-thick, calcarenitic limestone layer at 178.8 ft.....	1.7
Shale, medium-dark-gray to dark-gray, noncalcareous, brittle; includes rare, light-brownish-gray, sideritic concretions; extensively bioturbated in upper 15 in. of unit; contains rare burrows and streaks of pyrite in remainder of unit, with minor streaks of light-gray siltstone.....	24.1
Coal, black, slightly friable, white calcite on cleat surfaces (unnamed coal).....	0.2
Underclay, medium-light-gray, blocky fracture; contains black, carbonized plant fragments; soft, crumbly.....	1.5
Shale, medium-gray, noncalcareous, blocky fracture.....	1.3
Siltstone, medium-gray, shaly, noncalcareous, hard.....	1.0
Shale, medium-gray, noncalcareous, blocky; contains light-gray siltstone streaks and lenses.....	2.2
Shale, dark-gray to grayish-black, noncalcareous; contains light-gray siltstone streaks and light-brownish-gray sideritic concretions as much as 1.5 in. thick.....	5.8
Coal, black, slightly friable; calcite and minor pyrite on cleats (Keota[?] coal).....	0.3
Underclay, medium-gray, churned; contains black, carbonaceous streaks.....	1.5
Siltstone, medium-light-gray to medium-dark-gray, very shaly, noncalcareous, extensively burrowed, grades into underlying unit.....	2.4
Sandstone, medium-light-gray with dark-gray shale streaks, very fine-grained, noncalcareous, rippled, burrowed.....	1.6
Shale, grayish-black, noncalcareous.....	1.2
Coal, black, moderately friable, white calcite on cleat surfaces (unnamed coal).....	0.2
Underclay, medium-dark-gray, blocky fracture, slickensided.....	0.8
Shale, medium-dark-gray, noncalcareous, silty; grades into shaly sandstone.....	0.6
Sandstone, medium-gray, very fine-grained, very silty and shaly, noncalcareous.....	3.6
Shale, medium-dark-gray, silty and sandy, noncalcareous, burrowed.....	3.7
Shale, dark-gray with light-gray, very fine-grained sandstone streaks, rippled, burrowed, noncalcareous.....	2.5
Shale, grayish-black, noncalcareous; contains rare streaks of light-gray siltstone and pyrite-filled burrows; includes abundant black, macerated plant fragments on some bedding planes.....	32.4
Coal, black, slightly friable; contains pyrite masses and white calcite on cleat surfaces (Tamaha[?] coal).....	0.1
Underclay, medium-gray, rooted, blocky fracture, slickensided; contains black, carbonized plant fragments.....	1.3
Shale, medium-light-gray, noncalcareous; interbedded with light-gray, very fine-grained, calcareous sandstone; extensively bioturbated; includes abundant sandstone-filled burrows.....	2.5
Shale, medium-dark-gray, noncalcareous; includes some 1/8-in.-thick, light-brownish-gray sideritic layers in bottom 1 ft of unit.....	4.8

Limestone, yellowish-gray, fine-grained, hard; contains abundant fossil shells, small crinoid ossicles, and other fossil debris; shaly in bottom 2 in. of unit.....	0.6
Shale, medium-dark-gray, noncalcareous.....	2.1
Shale, medium-gray, sandy, silty, noncalcareous, burrowed...	1.3
Shale, dark-gray, noncalcareous; contains rare, thin streaks of light-gray siltstone in upper 3 in.....	3.6
Shale, grayish-black noncalcareous; contains rare, pyrite-filled burrows; includes light-brownish-gray, sideritic concretions as much as 1.5 in. thick.....	7.4
Limestone, light-brownish-gray, fine-grained, impure, silty; shaly in upper 4 in., with pyritic masses as much as 0.25 in. thick filling burrows; contains abundant fossil hash, including broken shells and small crinoid ossicles.....	1.6
Mudstone, dark-gray, churned; sand- and pyrite-filled burrows abundant, noncalcareous.....	2.1
Shale, medium-gray to dark-gray with abundant light-gray siltstone and very fine sandstone layers as much as 0.75 in. thick, noncalcareous, wavy-bedded, burrowed.....	4.3
Shale, dark-gray with minor light-gray siltstone streaks, noncalcareous; contains rare pyrite-filled lenses and burrows, and small sideritic nodules; includes some black, carbonized plant fragments on bedding planes.....	18.5
Limestone, dark-gray to light-brownish-gray, fine-grained, hard; contains abundant broken fossil shells and small crinoid ossicles.....	0.7
Coal, black, slightly friable, white calcite on cleat surfaces (Stigler rider[?] coal).....	0.1
Siltstone, medium-dark-gray, hard; grades into underlying unit.....	0.8
Shale, medium-dark-gray, silty, noncalcareous.....	0.6
Shale, black, noncalcareous.....	1.0
Siltstone, dark-gray, noncalcareous; very hard; contains scattered fossil shells and crinoid ossicles.....	0.4
Shale, medium-gray, blocky fractured, noncalcareous, burrowed.....	0.5
Shale, grayish-black with thin, scattered streaks of light-gray, very fine-grained sandstone and siltstone, noncalcareous; contains rare, small burrows and minor black plant compressions on bedding planes; includes some pyrite in burrows and lenses.....	22.4
Coal, black, slightly friable; veinlets of white calcite and pyrite occur on bedding surfaces and in cleats (Stigler[?] coal)	0.2
Underclay, medium-gray; contains black, carbonized plant fragments; blocky fracture, slickensided, pyritic.....	2.5
Shale, medium-dark-gray, silty, noncalcareous; contains abundant sandstone-filled burrows, pyritic.....	1.3
Shale, dark-gray to grayish-black, noncalcareous, slickensided; contains rare light-gray siltstone streaks and pyrite-filled burrows.....	6.4
Shale, black, calcareous; contains abundant fossil shell fragments as well as an irregularly shaped, fossiliferous, light-brownish-gray limestone mass about 1 in. thick.....	0.3
Coal, black, moderately friable; contains white calcite on cleats as well as pyrite occurring as lenses and crusts on bedding planes (unnamed coal).....	0.2

Sandstone, medium-light-gray with minor dark-gray shale streaks, noncalcareous, micaceous, very fine-grained, irregularly bedded to wavy-bedded; contains scattered shale pebbles in places	3.9
Sandstone, light-gray with dark-gray shale streaks, calcareous, rippled; scour features and burrows abundant; micaceous.....	1.6
Siltstone, dark-gray, shaly, noncalcareous; includes abundant light-gray, very fine-grained sandstone burrows; pyritic and coaly in lower 1 in. of unit.....	0.8
Coal, black, bright, moderately friable; contains pyrite in cleats (Keefton[?] coal).....	0.4
Siltstone, dark-gray, noncalcareous; contains carbonaceous particles and coal streaks; bioturbated.....	0.3
Sandstone, light-gray to medium-gray, very fine-grained, noncalcareous; churned in upper part; contains some black, carbonized, fibrous plant material; cross-bedded in middle part; flat-bedded in lower part, with some convolute bedding near base of unit (Warner Sandstone)	4.0
Siltstone, medium-dark-gray with light-gray streaks, noncalcareous, sandy, micro-faulted and burrowed; contains siderite-filled burrows just above contact with underlying unit (upper unit of McCurtain Shale Member).....	0.4
Shale, grayish-black, noncalcareous; brittle; contains scattered calcareous and pyritized marine fossils and pyrite-filled burrows; slickensided; includes a 3-in.-thick layer of brownish-gray, mottled ironstone occurring as burrow-fillings.....	15.9
Ironstone, brownish-gray with white, calcite-filled fractures, pyritic.....	0.3
Limestone, medium-dark-gray, impure, shaly; contains broken fossil fragments (basal unit of McCurtain Shale Member).....	0.1
Hartshorne Formation(?):	
Sandstone, medium-gray, very fine-grained, calcareous; includes beds of noncalcareous, medium-gray shale; wavy-bedded; grades into underlying unit.....	0.9
Atoka Formation(?):	
Shale, dark-gray with very light-gray streaks of very fine-grained, calcareous sandstone; contains some burrows.....	1.7
Shale, grayish-black, noncalcareous; contains light-brownish-gray sideritic concretions as much as 2 in. thick; includes rare streaks of light-gray siltstone, small fossil shells, and pyrite lenses; becomes calcareous, and contains some irregular beds and lenses of calcarenitic limestone.....	15.7
Sandstone, light-gray, silty, very fine-grained; contains dark-gray shale clasts and pyritic coal streaks; very calcareous.....	0.3
Underclay, medium-light-gray, sandy, blocky fracture; contains rare disseminated pyrite and black, carbonized plant fragments.....	0.8

Shale, medium-gray, noncalcareous, interbedded with light-gray, very fine-grained, calcareous sandstone.....	0.7
Limestone, light-brownish-gray, fine-grained, hard; contains scattered, broken, shell fragments.....	0.3
Shale, medium-gray to dark-gray, noncalcareous; contains thin streaks of light-gray siltstone and rare burrows.....	4.0
Shale, grayish-black, silty, noncalcareous; contains abundant streaks of white, very fine-grained, calcareous sandstone; burrowed, slickensided; streaks of sandstone occur rarely.....	17.2
Shale, light-brownish-gray, blocky fracture, noncalcareous..	1.3
Sandstone, light-gray, very fine-grained, interbedded with medium-light-gray siltstone and shale, noncalcareous, wavy-bedded in part; brownish-gray, fine-grained, and massive, with some indistinctly defined fossil shells; medium-gray, very fine-grained, silty and shaly in lower 5 in. of unit.....	2.1
Shale, dark-gray to grayish-black, noncalcareous; contains rare pyrite-filled burrows; includes light-brownish-gray sideritic concretions as much as 3.5 in. thick; slickensided.....	5.9
Siltstone, light-bluish-gray to medium-light-gray, very shaly, noncalcareous, flat-bedded to cross-bedded in part; grades into underlying unit.....	2.2
Shale, medium-gray with light-gray streaks of siltstone, noncalcareous, slickensided.....	1.5
Shale, dark-gray with light-gray streaks of siltstone and very fine-grained sandstone, noncalcareous, cross-bedded, burrowed.....	2.5
Sandstone, light-gray with medium-dark-gray shale streaks, very fine-grained, rippled, burrowed; contains a pyritic coal spark in upper 1 in.; noncalcareous, except for lower 2 in., which contain calcarenite-filled burrows.....	0.7

Fayetteville Formation(?) (Mississippian):

Limestone, medium-gray in upper part to light-gray in lower part, calcarenitic; shaly and burrowed in upper part; contains thin, wavy shale streaks in lower part.....	<u>1.3</u>
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Total 441.0

Core-Hole Log 2

SE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 12, T. 21 N., R. 16 E., Rogers County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture 1,540 ft FSL and 2,060 ft FEL. Field notebook designation C-RM-2. (Surface elevation, estimated from topographic map, 773 ft.)

Thickness
(ft)

CABANISS GROUP

Senora Formation:

Sandstone, moderate-reddish-orange, fine-grained, noncalcareous; occurs as broken, weathered, angular cobbles in dark-yellowish-brown silty soil.....	1.0
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Appendix 2

Sandstone, dark-yellowish-orange, fine-grained, noncalcareous, micaceous.....	5.0
Sandstone, dark-reddish-brown, fine-grained, noncalcareous, micaceous.....	3.0
Sandstone, dark-yellowish-orange, moderate-reddish-orange, and dark-reddish-brown in alternating layers, fine-grained, noncalcareous, micaceous, ferruginous, fractured; some blackish-red manganese dioxide staining on fracture surfaces; cross-bedded; contains clasts of ironstone in lower 3.5 ft and abundant coal spars in lower 6 in. (base of Chelsea Sandstone).....	12.8
Shale, brownish-black, blocky fracture, noncalcareous.....	0.7
Siltstone, olive-black, muddy, massive, noncalcareous; contains very small fossil shells.....	0.3
Limestone, medium-gray, fine-grained, impure, silty, pyritic, vuggy, fossiliferous; poorly preserved marine shells common; dark-gray in places; very light-gray with light-gray mottling and wavy laminae in lower 4 ft; fossil hash concentrated in lower 4 in. (Tiawah Limestone).....	5.6
Shale, medium-gray with greenish-gray tint, clayey, calcareous in upper 1 in.; contains rare streaks of black, carbonaceous shale and some coaly streaks.....	2.0
Shale, grayish-black, carbonaceous, noncalcareous.....	0.7
Sandstone, light-brownish-gray, shaly, calcareous, very fine-grained, burrowed.....	0.1
Shale, medium-gray, clayey, noncalcareous.....	2.0
Sandstone, light-gray, shaly, very fine-grained, noncalcareous, burrowed.....	0.9
Shale, medium-light-gray with light-gray streaks, noncalcareous, silty.....	1.4
Sandstone, medium-light-gray with medium-dark-gray shale streaks, noncalcareous, very fine-grained; mostly flat-bedded, but contains some low-angle cross-beds and cross-laminae; burrowed in part; includes mica and black, macerated plant material on bedding planes; medium-gray in lower part; grades into underlying unit....	12.5
Siltstone, medium-dark-gray with light-gray streaks of very fine-grained sandstone, noncalcareous, shaly, flat-bedded; contains pyrite-filled burrows; grades into underlying unit.....	2.0
Shale, medium-dark-gray with minor light-gray streaks, silty, hard; contains rare, pyrite-filled burrows.....	13.1
Siltstone, medium-gray with light-gray sandstone streaks, noncalcareous, shaly, flat-bedded; includes rare burrows and black, macerated plant material on some bedding planes.....	1.9
Shale, medium-dark-gray, silty, noncalcareous.....	6.2
Shale, grayish-black, very calcareous; contains irregular bands of limestone composed mostly of shell fragments.....	0.3
Shale, grayish-black, noncalcareous, pyritic, brittle, crumbly, slickensided; includes a 0.25-in.-thick pyritic coal band at base of unit (RC coal).....	1.9
Underclay, light-gray, mottled, slickensided, very sandy, extensively burrowed.....	1.6
Sandstone, very light-gray, noncalcareous, very fine-grained, churned; cross-bedded and wavy-bedded, with some bioturbation features; shaly at base of unit.....	6.7

Siltstone, medium-light-gray, noncalcareous, shaly, flat-bedded; contains rare burrows and some very fine-grained sandstone layers.....	3.8
Shale, medium-gray with light-gray siltstone streaks, noncalcareous, dark-gray in lower 6 in.....	7.5
Sandstone, medium-dark-gray with light-gray streaks, noncalcareous, very fine-grained, shaly, bioturbated.....	0.5
Shale, medium-dark-gray with numerous streaks of light-gray, very fine-grained sandstone, rippled, noncalcareous, burrowed.....	1.4
Sandstone, medium-dark-gray with light-gray streaks, very fine-grained, shaly, noncalcareous; contains some wavy beds and low-angle cross-beds; burrowed.....	0.7
Siltstone, medium-dark-gray with light-gray, very fine-grained sandstone streaks, noncalcareous, shaly, flat-bedded; contains rare burrows, some pyrite-filled; coarse-grained in lower 2 ft.....	10.0
Shale, dark-gray, noncalcareous; contains light-brownish-gray sideritic concretions up to 3 in. thick, and rare pyritized and carbonized plant fragments.....	4.7
Limestone, dark-gray, shaly, fine-grained; contains streaks of coal.....	0.1
Shale, black, carbonaceous; contains coal streaks.....	0.1
Sandstone, medium-gray to medium-light-gray, shaly, calcareous in upper 2 in., very fine-grained, churned in upper 2 ft, cross-bedded in part, burrowed.....	6.0
Shale, medium-gray, silty, noncalcareous; contains numerous streaks of very fine-grained, light-gray sandstone.....	2.5
Sandstone, medium-dark-gray to medium-gray, very fine-grained, cross-bedded, micaceous, noncalcareous, contains scattered dark-gray shale streaks and abundant black, macerated plant debris on bedding planes; burrowed in part; grades into underlying unit.....	29.0
Siltstone, medium-dark-gray with light-gray sandstone streaks and lenses, shaly, noncalcareous; micaceous; mostly flat-bedded, but includes some low-angle cross-beds; contains scattered bioturbation features, minor pyritic and carbonized plant fragments, and rare coal spars; grades into underlying unit.....	19.0
Shale, dark-gray, noncalcareous, silty; contains scattered sandy layers, rare pyrite-filled burrows, and some contorted bedding in the sandy layers; includes rare brachiopod fossils and seed-fern leaves.....	20.3
Shale, black, noncalcareous; contains scattered calcareous fossil shells and rare pyrite-filled burrows.....	2.8
Coal, black, bright, moderately friable; contains white calcite on cleats and layers of pyrite as much as 0.25 in. thick (Weir-Pittsburg coal).....	0.2

KREBS GROUP

Boggy Formation:

Underclay, light-brownish-gray, blocky fracture, rooted in upper part, churned; grades into underlying unit.....	3.0
Shale, light-brownish-gray, noncalcareous, clayey.....	2.4
Sandstone, medium-dark-gray, very fine-grained, massive, hard.....	0.8

Shale, medium-gray, noncalcareous, carbonaceous and coaly in lower 1 in.....	3.9
Mudstone, brownish-gray, churned in part; contains some wavy, carbonaceous layers in upper 6 in.....	1.3
Claystone, greenish-gray, noncalcareous.....	3.0
Shale, medium-gray to dark-gray, noncalcareous; contains light-brownish-gray sideritic concretions as much as 1.25 in. thick in lower 1.5 ft of unit.....	6.8
Sandstone, light-gray with medium-gray streaks, noncalcar- eous, silty, very fine-grained, bioturbated.....	2.1
Shale, medium-dark-gray, silty, noncalcareous; contains burrowed, light-brownish-gray, sideritic concretions as much as 1.75 in. thick; includes rare, pyrite-filled burrows.....	4.7
Shale, medium-dark-gray with light-gray, very fine- grained, micaceous sandstone streaks, noncalcareous.....	0.7
Sandstone, light-gray to medium-light-gray with dark-gray streaks, very fine-grained, shaly, noncalcareous, micaceous; rippled in part, flat-bedded in part, cross- bedded in part; includes black, macerated plant debris on bedding planes; grades into underlying unit.....	13.0
Siltstone, medium-gray with medium-light-gray, sandy streaks, shaly, flat- to wavy-bedded, noncalcareous; grades into underlying unit.....	2.0
Shale, medium-gray with medium-light-gray siltstone and very fine-grained sandstone streaks, noncalcareous; contains rare sandstone- and siderite-filled burrows and minor pyrite; hard; grades into shaly siltstone below.....	13.0
Siltstone, medium-gray, shaly, noncalcareous; contains rare pyrite-filled burrows and disseminated pyrite.....	6.0
Shale, medium-dark-gray, silty, noncalcareous; contains light-brownish-gray, sideritic concretions as much as 1 in. thick.....	8.5
Shale, grayish-black to dark-gray, interbedded with light- gray, very fine-grained sandstone, noncalcareous.....	6.5
Shale, black, carbonaceous.....	0.1
Coal, black, friable, white calcite and minor pyrite on cleats (Wainwright coal).....	0.8
Shale, dark-gray with light-gray, very fine-grained sand- stone streaks, noncalcareous, burrowed.....	2.8
Sandstone, light-gray and medium-dark-gray, very fine- grained, interbedded with shale, noncalcareous, wavy- bedded to cross-bedded, micaceous, black, macerated plant debris on bedding planes, burrowed in part.....	8.3
Shale, dark-gray, interlaminated with light-gray, very fine-grained sandstone, noncalcareous; some sandstone layers show soft-sediment deformation features.....	2.3
Shale, dark-gray; contains rare streaks of very fine- grained, light-gray sandstone; noncalcareous; includes numerous light-brownish-gray, sideritic layers as much as 0.5 in. thick; grades into underlying unit.....	6.7
Shale, grayish-black, noncalcareous; contains rare fossil brachiopods and scattered, pyrite-filled burrows; includes several light-brownish-gray sideritic concre- tions as much as 1.5 in. thick.....	4.7
Ironstone, dark-gray, fractured; limestone containing fossil hash occurs in a 1/8- to 0.75-in.-thick layer at top of unit and in fracture fillings.....	0.3

Shale, grayish-black, noncalcareous; contains rare pyrite-filled burrows and small calcareous shells and shell fragments; includes limestone-filled burrows in lower 2 in.....	5.5
Limestone, light-gray to dark-gray with greenish-gray tint in part, shaly in part, cross-bedded in places, fine-grained, fossiliferous; contains abundant fossil hash composed mostly of shell fragments (Inola Limestone).....	2.3
Sandstone, very light-gray to light-gray with medium-gray streaks, fine- to very fine-grained, micaceous, cross-bedded, very calcareous at base; contains rare burrows and scattered shale laminae (Bluejacket Sandstone).....	<u>6.2</u>
Total	308.0

Township/Range	Coal bed and rank ^a	Sample condition ^b	Proximate analysis (%)				Sulfur (%)	Btu/lb	Free swelling index	Number of analyses (whole seam)	Data source ^d	Year reported
			Moisture ^c	Volatile matter	Fixed carbon	Ash ^c						
<u>T23N, R15E</u>	Dawson --	1	6.0			9.3	3.9	12,219		1	Company	1970
		2	N/A			9.9	4.2	13,004				
		3	N/A			N/A		14,764				
<u>T23N, R16E</u>	Croweburg hvAb	1	2.6	34.9	54.9	7.6	0.8	13,330		1	OGS	1976
		2	N/A	35.8	56.4	7.8	0.8	13,686				
		3	N/A	38.9	61.1	N/A		14,844				
	Iron Post hvAb	1	1.7	40.9	49.6	7.8	4.6	13,387		1	OGS	1976
		2	N/A	41.6	50.5	7.9	4.7	13,619				
		3	N/A	45.2	54.8	N/A		14,787				
	Croweburg hvBb	1	6.0	33.6	55.8	4.6	0.5	13,246	5½	2	OGS	1980
		2	N/A	35.7	59.4	4.9	0.6	14,088				
		3	N/A	37.5	62.5	N/A		14,730				
Iron Post hvAb	1	3.1	40.7	50.7	5.5	3.3	13,603	7½	1	OGS	1980	
	2	N/A	42.0	52.3	5.7	3.4	14,035					
	3	N/A	44.5	55.5	N/A		14,877					
<u>T23N, R17E</u>	Croweburg --	1	8.2	31.5	54.3	6.0	1.0	12,600		1	OGS	1928
		2	N/A	34.3	59.2	6.5	1.1	13,720				
	Croweburg hvBb	1	5.9	31.6	57.6	4.9	0.6	13,301	4½	3	OGS	1980
		2	N/A	33.6	61.2	5.2	0.6	14,138				
		3	N/A	35.4	64.6	N/A		14,911				
	Weir-Pittsburg hvAb	1	2.4	35.5	47.1	15.0	8.0	11,985	7	1	OGS	1980
2		N/A	36.4	48.2	15.4	8.2	12,285					
3		N/A	43.0	57.0	N/A		14,526					
<u>T24N, R15E</u>	Dawson --	1	5.9			24.5	3.1	9,874		3	Company	1970
		2	N/A			26.1	3.2	10,476				
		3	N/A			N/A		14,155				
	Dawson hvBb	1	3.3	41.3	38.1	17.3	1.7	10,938		1	OGS	1975
		2	N/A	42.7	39.4	17.9	1.8	11,311				
		3	N/A	52.0	48.0	N/A		13,777				
	Dawson hvCb	1	3.6	39.4	38.5	18.5	2.1	10,592		3	OGS	1976
		2	N/A	40.9	39.9	19.2	2.2	10,983				
		3	N/A	50.7	49.3	N/A		13,588				
	Dawson --	1	15.9	33.8	41.9	8.4	1.2	10,041		1	OGS	1980
		2	N/A	40.2	49.8	10.0	1.4	11,944				
		3	N/A	44.6	55.4	N/A		13,274				
<u>T24N, R17E</u>	Croweburg hvAb	1	6.1	33.9	55.0	5.0	0.5	13,530		1	OGS	1975
		2	N/A	36.1	58.6	5.3	0.5	14,409				
		3	N/A	38.1	61.9	N/A		15,219				
	Croweburg hvAb	1	5.7	32.4	54.5	7.4	0.5	12,991	3	1	USBM	1977
		2	N/A	34.3	57.9	7.8	0.6	13,770				
		3	N/A	37.2	62.8	N/A	0.6	14,939				
	Croweburg hvAb	1	4.8	33.6	55.0	6.6	0.5	13,233		1	OGS	1977
		2	N/A	35.3	57.7	7.0	0.6	13,896				
		3	N/A	37.9	62.1	N/A		14,936				
	Croweburg hvAb	1	4.0	33.3	58.7	4.0	0.6	13,796	5	2	OGS	1980
		2	N/A	34.4	61.5	4.1	0.7	14,380				
		3	N/A	36.1	63.9	N/A		14,998				
	Iron Post hvAb	1	3.2	40.4	48.9	7.4	4.5	13,189	7	3	OGS	1980
		2	N/A	41.8	50.6	7.6	4.6	13,633				
		3	N/A	45.3	54.7	N/A		14,762				
<u>T24N, R18E</u>	Weir-Pittsburg hvAb	1	2.5	36.1	51.3	10.1	5.8	12,943	8½	1	USBM	1977
		2	N/A	37.1	52.6	10.3	6.0	13,276				
		3	N/A	41.3	58.7	N/A	6.7	14,806				
	Weir-Pittsburg hvAb	1	2.0	36.9	51.8	9.3	6.0	13,194	8½	2	OGS	1977
		2	N/A	37.6	52.8	9.6	6.2	13,464				
		3	N/A	41.6	58.4	N/A		14,707				

^a hvAb, high-volatile A bituminous; hvBb, high-volatile B bituminous; hvCb, high-volatile C bituminous; --, not classified.

^b 1 = as received; 2 = moisture-free; 3 = moisture- and ash-free.

^c N/A, not applicable.

^d Company, coal company or other industry-related source; OGS, Oklahoma Geological Survey; USBM, United States Bureau of Mines.

TABLE A3-2--ANALYSES OF COALS IN ROGERS AND HAYES COUNTIES, OKLAHOMA
(Samples collected by Hemish and tested by Oklahoma Geological Survey Chemistry Laboratory.)

Sample number	Map number ^a (Pls. 1-4)	Coal bed and rank ^b	Sample condition ^c	Proximate analysis (%)				Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site ^d
				Moisture	Volatile matter	Fixed carbon	Ash					
79C6H	36, Pl. 3	Bluejacket hvBb	1	6.6	37.3	53.0	3.1	2.1	13,518	9	1979	RC
			2	N/A	39.9	56.8	3.3	2.3	14,467			
			3	N/A	41.3	58.7	N/A		14,961			
79C2H	64, Pl. 3	Croweburg hvAb	1	4.6	34.5	57.3	3.6	0.6	13,781	5	1979	AcSM
			2	N/A	35.6	60.7	3.7	0.6	14,446			
			3	N/A	37.6	62.4	N/A		15,007			
79C4H	47, Pl. 3	Croweburg hvBb	1	8.3	30.6	56.6	4.5	0.6	13,079	6	1979	AcSM
			2	N/A	33.4	61.7	4.9	0.6	14,258			
			3	N/A	35.1	64.9	N/A		14,999			
79C5H	48, Pl. 3	Croweburg hvAb	1	5.8	32.5	57.4	4.3	0.5	13,494	4½	1979	AcSM
			2	N/A	34.5	60.9	4.6	0.5	14,328			
			3	N/A	36.2	63.8	N/A		15,017			
79C8H	41, Pl. 3	Croweburg hvBb	1	7.5	33.3	54.4	4.8	0.5	12,951	5½	1979	AcSM
			2	N/A	36.0	58.8	5.2	0.5	14,000			
			3	N/A	38.0	62.0	N/A		14,773			
79C9H	50, Pl. 3	Croweburg hvAb	1	3.6	31.7	58.9	5.8	0.6	13,330	3	1979	AcSM
			2	N/A	32.9	61.1	6.0	0.6	13,828			
			3	N/A	35.0	65.0	N/A		14,717			
79C11H Upper 9 in. of split sample	29, Pl. 3	Croweburg hvAb	1	3.5	35.0	60.0	1.5	0.5	14,303	6½	1979	AcSM
			2	N/A	36.3	62.2	1.5	0.5	14,826			
			3	N/A	36.8	63.2	N/A		15,058			
79C12H Lower 9 in. of split sample	29, Pl. 3	Croweburg hvBb	1	6.7	32.5	56.7	4.1	0.6	13,312	6½	1979	AcSM
			2	N/A	34.9	60.7	4.4	0.6	14,270			
			3	N/A	36.4	63.6	N/A		14,933			
79C15H Upper 10 in. of split sample	8, Pl. 3	Croweburg hvBb	1	7.6	32.0	56.9	3.5	0.5	13,203	6	1979	AcSM
			2	N/A	34.6	61.6	3.8	0.5	14,295			
			3	N/A	36.0	64.0	N/A		14,852			
				7.9	33.2	58.9	N/A					
79C16H Lower 10 in. of split sample	8, Pl. 3	Croweburg hvBb	1	9.2	28.8	57.0	5.0	0.4	12,770	5½	1979	AcSM
			2	N/A	31.7	62.9	5.4	0.5	14,058			
			3	N/A	33.6	66.4	N/A		14,868			
79C17H	63, Pl. 3	Croweburg hvAb	1	3.5	32.0	60.1	4.4	0.7	13,812	4	1979	AcSM
			2	N/A	33.2	62.3	4.5	0.7	14,313			
			3	N/A	34.7	65.3	N/A		14,990			
79C18H Upper 10 in. of split sample	6, Pl. 3	Croweburg hvAb	1	5.0	34.2	57.9	2.9	0.5	13,712	6	1979	AcSM
			2	N/A	36.0	60.9	3.1	0.5	14,434			
			3	N/A	37.1	62.9	N/A		14,891			
79C19H Lower 10 in. of split sample	6, Pl. 3	Croweburg hvBb	1	6.1	32.2	55.6	6.1	0.5	12,966	6	1979	AcSM
			2	N/A	34.3	59.2	6.5	0.5	13,806			
			3	N/A	36.7	63.3	N/A		14,766			
80C1H Upper 9 in. of split sample	42, Pl. 3	Croweburg hvAb	1	4.3	33.7	59.3	2.7	0.5	13,881	4½	1980	AcSM
			2	N/A	35.2	62.0	2.8	0.5	14,500			
			3	N/A	36.2	63.8	N/A		14,924			
80C2H Lower 9 in. of split sample	42, Pl. 3	Croweburg hvAb	1	4.7	33.9	55.2	6.2	0.6	13,202	5	1980	AcSM
			2	N/A	35.6	58.0	6.4	0.6	13,853			
			3	N/A	38.0	62.0	N/A		14,810			
79C22H	60, Pl. 1	Dawson --	1	15.9	3.8	41.9	8.4	1.2	11,041		1979	Cb
			2	N/A	40.2	49.8	10.0	1.4	11,944			
			3	N/A	44.6	55.4	N/A		13,274			

Sample number	Map number ^a (Pls. 1-4)	Coal bed and rank ^b	Sample condition ^c	Proximate analysis (%)				Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site ^d
				Moisture	Volatile matter	Fixed carbon	Ash					
78C46H	1, Pl. 1	Drywood hvAb	1	1.2	36.0	47.2	15.6	4.5	12,006	8	1978	CST
			2	N/A	36.5	47.7	15.8	4.6	12,156			
			3	N/A	43.3	56.7	N/A	14,434				
79C1H	62, Pl. 1	Iron Post hvAb	1	2.7	41.5	49.4	6.4	4.7	13,466	8	1979	AcSM
			2	N/A	42.6	50.8	6.6	4.8	13,840			
			3	N/A	45.7	54.3	N/A	14,821				
79C3H	65, Pl. 1	Iron Post hvAb	1	2.1	41.2	46.1	10.6	5.8	12,975	7½	1979	AcSM
			2	N/A	42.1	47.1	10.8	5.9	13,253			
			3	N/A	47.2	52.8	N/A	14,866				
79C7H	67, Pl. 1	Iron Post hvBb	1	4.9	38.6	51.3	5.2	2.9	13,125	6½	1979	AcSM
			2	N/A	40.6	54.0	5.4	3.1	13,807			
			3	N/A	42.9	57.1	N/A	14,598				
79C10H	44, Pl. 1	Iron Post hvAb	1	3.1	40.7	50.7	5.5	3.3	13,603	7½	1979	AcSM
			2	N/A	42.0	52.3	5.7	3.4	14,035			
			3	N/A	44.5	55.5	N/A	14,877				
79C13H	22, Pl. 1	Iron Post hvAb	1	3.0	36.8	50.8	9.4	4.6	12,839	7½	1979	AcSM
			2	N/A	37.9	52.4	9.7	4.7	13,231			
			3	N/A	42.0	58.0	N/A	14,656				
79C14H	28, Pl. 1	Iron Post hvAb	1	2.3	41.0	51.2	5.5	2.9	13,696	7½	1979	RC
			2	N/A	42.0	52.4	5.6	3.0	14,020			
			3	N/A	44.5	55.5	N/A	14,856				
80C3H	14, Pl. 2	Rowe	1	2.7	35.5	39.2	22.6	3.1	10,716	2	1980	AA
			2	N/A	36.5	40.3	23.2	3.2	11,013			
			3	N/A	47.5	52.5	N/A	14,345				
79C23H	49, Pl. 4	Weir-Pittsburg hvAb	1	2.4	35.5	47.1	15.0	8.0	11,985	7	1979	AcSM
			2	N/A	36.4	48.2	15.4	8.2	12,285			
			3	N/A	43.0	57.0	N/A	14,526				

^aData point number on map corresponds to measured section number, Appendix 2, this report.

^bhvAb, high-volatile A bituminous; hvBb, high-volatile B bituminous; --, not classified.

^c1 = as received; 2 = moisture-free; 3 = moisture- and ash-free.

^dAA, abandoned aqueduct; AcSM, active strip mine; Cb, cutbank of stream; CST, construction site trench; RC, road cut.

**APPENDIX 4: Cleat Orientations in Coals Sampled
in Rogers and Mayes Counties**

Coal	Face Cleat	Butt Cleat	Degrees of Separation*	Location
Bluejacket	N. 85° E.	N. 4° W.	89	NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 5, T22N, R18E
Croweburg	N. 54° W.	N. 48° E.	102	NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 33, T20N, R15E
	N. 40° W.	N. 48° E.	88	NE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 13, T21N, R15E
	N. 55° W.	N. 35° E.	90	NW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 20, T22N, R16E
	N. 22° W.	N. 64° E.	86	SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 24, T23N, R16E
	N. 25° W.	N. 69° E.	94	NW $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 24, T23N, R16E
	N. 40° W.	N. 47° E.	87	SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 5, T23N, R17E
	N. 51° W.	N. 35° E.	86	NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5, T23N, R17E
	N. 36° W.	N. 56° E.	92	NE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 19, T23N, R17E
	N. 76° W.	N. 12° E.	88	SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T24N, R17E
N. 53° W.	N. 39° E.	92	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T24N, R17E	
Dawson	N. 77° W.	N. 16° E.	93	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 4, T24N, R15E
Iron Post	N. 35° W.	N. 59° E.	94	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9, T22N, R16E
	N. 29° W.	N. 62° E.	91	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 18, T22N, R16E
	N. 33° W.	N. 56° E.	89	NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T23N, R16E
	N. 44° W.	N. 39° E.	83	SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 1, T24N, R17E
	N. 42° W.	N. 53° E.	95	NE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5, T24N, R17E
	N. 34° W.	N. 58° E.	92	SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 7, T24N, R17E
Rowe	N. 48° W.	N. 47° E.	95	SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T21N, R17E
Weir-Pittsburg	N. 50° W.	N. 42° E.	92	NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 12, T23N, R17E

*Separation is defined as the angular difference between the average face-cleat and butt-cleat directions. Ideal separation is 90°.

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