Bureau of Mines
Report of Investigations 4792

ESTIMATE OF KNOWN RECOVERABLE RESERVES OF COKING COAL IN PIKE COUNTY, KY.

By James J. Dowd, Louis A. Turnbull, Albert L. Toenges, R. F. Abernethy, and D. A. Reynolds

United States Department of the Interior— May 1951

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UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
James Boyd, Director

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May 1951

FOREWORD

Since its creation by Congress in 1910, The Bureau of Mines has borne a heavy responsibility for technical progress in the mining, preparation, and utilization of our national fuel reserves. Similarly, it has pioneered in scientific studies leading to better health and safety in mining and more efficient conservation of fuel resources.

Conservation means a full but prudent use of the national resources with avoidance of waste. Conservation requires an inventory to determine the extent, availability, and condition of our resources, for without these facts it is impossible for either industry or Government to plan for sustained production and maintenance of the industrial capacity so essential to our peacetime prosperity and wartime survival. This is true particularly of fuels needed for special purposes, such as metallurgical coking coals that must possess certain favorable properties. Heavy use of our limited reserves of good coking coal has resulted in severe depletion and, in some areas, exhaustion of the thickest and best beds.

At the request of the Munitions Board, Department of Defense, the Bureau of Mines made preliminary arrangements early in 1948 for an investigation of known minable reserves of coal that were or could be made suitable for the manufacture of metallurgical coke. In August of that year, actual field work began in the low- and medium-volatile coking coal fields of the Appalachian region, specifically central Pennsylvania and southern West Virginia. As both the economic and technologic factors that determine whether a particular coal can be used for producing metallurgical coke will vary with changing conditions, the investigation was planned to cover three phases:

1. Determination, from available data, of coal reserves with coking properties that occur in beds thick enough and within depths considered economically minable by present methods, together with such additional reserves as may become economically minable under future conditions of improved technology and greater need.

2. Study of the preparation characteristics of the reserves thereby developed to determine (a) which coals are suitable under present standards for producting metallurgical coke either as mined or after beneficiation by conventional preparation methods, and (b) which coals would require special and more intensive treatment in mining, preparation, or both.

3. Study of the carbonizing properties of the reserves thus developed to determine the yield and quality of coke, gas, and chemical products that can be obtained from coals carbonized singly and in blends.

This report is one in a series, by counties, covering in detail the estimated known minable coking-coal reserves determined under the first phase of the investigation. It also includes a general assessment of the preparation and carbonizing properties of the most important beds and a table of analyses of typical coals from the county. Publications will be issued later covering in more detail the preparation and carbonization data upon completion of the extensive laboratory work involved in these phases of the survey.

The estimates of coking-coal reserves in these reports were derived from data made available to the Bureau of Mines by coal companies, landowners, Federal, State, and municipal engineers, geologists, land-record officials, and others having authentic records of the occurrence and characteristics of the coal in the respective counties. All of the data were assembled from mine maps, records of core drilling, test pitting and trenching, and related sources of information, for no new core-drilling or geologic exploration was undertaken. Consequently, there are areas covered by these reports wherein the known data now available are inadequate to estimate reserves of measured and indicated coal, as these are defined in the reports. Geologic data also indicate the presence of large reserves of inferred coal in many of these areas, but no estimates of inferred reserves are presented in these reports. As their titles indicate, they include only known, minable reserves of measured and indicated coal and not total estimated reserves of coal. Therefore, any comparison of these and other coal-reserve estimates should be made with this distinction clearly understood.

The percentage recovery shown in these reports is a weighted average, based on the thickness of clean coal, less all partings 3/8-inch or more thick, recovered from the mined-out areas in each bed. Thus, it is an over-all net areal percentage recovery that, in many cases, will be lower than the recovery estimated by operators who eliminate from their calculations coal pillars left at property boundaries, under roads, and elsewhere. It is based on all coal removed since the beginning of mining operations and therefore may vary from that of recent operations in which recovery either has been improved substantially by technologic advances or has declined, owing to flooding or other conditions that make it expedient to leave more coal in the ground. As the estimates are dated and represent a factual record of all past operations in the particular area, the percentage recovery and estimate of minable coal may be adjusted by operators to suit their particular conditions at any given time.

These county reports are being published as rapidly as the available data can be found and analyzed. Later, in cooperation with the U. S. Geological Survey, results of these studies will be combined with those from a complete geologic investigation of all coal reserves in the areas considered. Then, reports can be published, by States, giving estimates of total reserves, including the geologically inferred reserves that have been omitted herein.

This investigation was made possible only through the complete cooperation of the coal operators, landowners, and others who have made available to the Bureau their confidential records and data relating to mining operations, drill-core and test-pit operations, etc. This cooperation and assistance

is appreciated and is gratefully acknowledged. To protect the confidence of data from private records, the Bureau of Mines is assembling and publishing the estimates on a county-wide basis only and will not release any supplementary or more detailed information.

This investigation will serve a triple purpose:

1. By providing an inventory of known, minable reserves of coking coal that are or can be made suitable for the manufacture of metallurgical coke.

2. By providing an inventory of known minable reserves of coal with coking properties but unsuited for metallurgical coking-coal use by present standards and techniques because of high sulfur, high ash, or weakly coking properties. When warranted by economic and technologic developments, these reserves later may be adapted to metallurgical use by suitable preparation, blending, carbonizing, or metallurgical techniques.

3. By ascertaining the approximate location and magnitude of areas in which geologic data indicate the presence of inferred reserves but where exploratory work has been too limited to determine measured and indicated reserves. It is in these areas that more intensive exploratory work is needed in the future to complete the coking-coal inventory.

The first of these objectives is of prime importance for the present and immediate future, and the second for the more distant future. Accomplishment of the third objective will be of major aid to both industry and State and Federal agencies in more effectively planning and executing coal exploratory and testing investigations.

RALPH L. BROWN
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ESTIMATE OF KNOWN RECOVERABLE RESERVES OF COKING COAL IN PIKE COUNTY, KY.

by

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TABLES

ILLUSTRATIONS

CONCLUSIONS

1. The investigation shows that there are four coal beds of major importance in Pike County: Upper Elkhorn No. 3, Upper Elkhorn No. 2, Upper Elkhorn No. 1, and Lower Elkhorn. Beds of secondary importance are the Winifrede, Williamson, and Bingham. Ten other beds, in addition to numerous uncorrelated lenses, are of minor importance.

2. Known (measured plus indicated) reserves in all beds based on a minimum bed thickness of 14 inches and 1,800 tons per acre-foot of coal in place, are estimated at 3,916 million short tons as of January 1, 1948. Of this total, 3,189 million tons are in beds 28 inches and more thick. All known reserves in Pike County are under less than 2,000 feet of overburden. Areas in each bed were omitted from the estimate because available data relative to the bed characteristics are insufficient for making an estimate that would conform to the definitions of measured and indicated coal adopted for this study. Should future drilling or development prove reserves in these areas, such reserves should be added to the total estimated reserves.

3. Recoverable reserves of coal 28 inches and more thick have been estimated. This thickness is about the minimum now being mined by hand loading onto conveyors. The weighted average percentage of recovery for all beds in Pike County, including all mining losses as determined by this investigation, is 55.08. This recovery is based on the percentage of the total thickness of clean coal (less all partings 3/8 inch or more thick) recovered from the mined-out areas in each bed rather than on the percentage of coal recovered from that portion of the bed mined. The highest weighted average percentage of recovery was 65.6 for the Bingham bed in the Regina quadrangle. The lowest was 50.0 percent for the Whitesburg bed in the Matewan quadrangle. Based on the weighted average percentage of recovery for all beds 28 inches and more thick in Pike Counted, the recoverable reserves are estimated at 1,757 million tons.

4. The coals of this county are high-volatile A bituminous.

5. The moisture, ash, and sulfur contents of Pike County coals usually are low. Highly-fissured coke generally is obtained from eastern Kentucky coals when carbonized singly. However, when blended with coal of higher rank and carbonized, a strong coke is produced.

INTRODUCTION

The investigation to evaluate the reserves of coking coal is being made by the Bureau of Mines in three parts: (1) To estimate known (measured plus indicated) recoverable reserves of all coking coal; (2) to upgrade marginal coals through effective preparation; and, (3) to study the carbonizing properties of coal and coal blends not now widely used for metallurgical coke making.

This is the third of a series of reports giving results of studies by counties under part (1) of the investigation.5/ This report covers Pike County, Ky., which comprises parts of the Harold, Williamson, Matewan, Gilbert, Pikeville, Regina, Hurley, Pound, and Clintwood quadrangles. (See fig. 1.)

A base map for each bed in each quadrangle was made to the scale of 1 inch equals 1,200 feet. Maps of mines, locations of drill holes, bed and total coal thicknesses, and the outcrop of the bed were plotted on the maps. With all available data plotted, isopach lines were drawn to limit areas of known unmined reserves in beds 0 to 14 inches thick, 14 to 28 inches thick, 28 to 42 inches thick, and over 42 inches thick. These areas of coal reserves also were divided into "measured" and "indicated" categories. All areas in each thickness range and in each category, mined-out areas, areas excluded from the estimate but which may contain reserves based only on geologic inference, and areas outside of the outcrop were measured by planimeter on the base maps. Estimates of total reserves 14 inches and more thick and maps for individual beds were prepared from these data.

ACKNOWLEDGMENTS

The information contained in this report could not have been obtained without the whole-hearted cooperation of the officials of the companies and individual landowners whose property records were studied, and their cooperation and the courtesies extended are gratefully acknowledged. The advice and assistance of the Coal Resources Committees of both the National Bituminous Coal Advisory Council and American Institute of Mining and Metallurgical Engineers, members of the staffs of the United States Geological Survey, Kentucky Geological Survey, Kentucky Department of Mines and Minerals, coal operator associations, and consulting mining engineers are appreciated. The investigation was under the general supervision of the principal coal-mining engineer, Bituminous Coal Mining Section, Coal Branch, Fuels and Explosives Division, Bureau of Mines, and the cooperation of the staff assigned to this study, particularly Willard A. Cole, mining engineer, Bureau of Mines, who conducted the field work, is acknowledged.

5/ Dowd, James J., Turnbull, Louis A., Toenges, Albert L., Cooper, H. M., Abernethy, R. F., Reynolds, D. A., and Fraser, Thomas: Estimate of Known Recoverable Reserves of Coking Coal in Cambria County, Pa.: Bureau of Mines Rept. of Investigations 4734, 1950, 25 pp.
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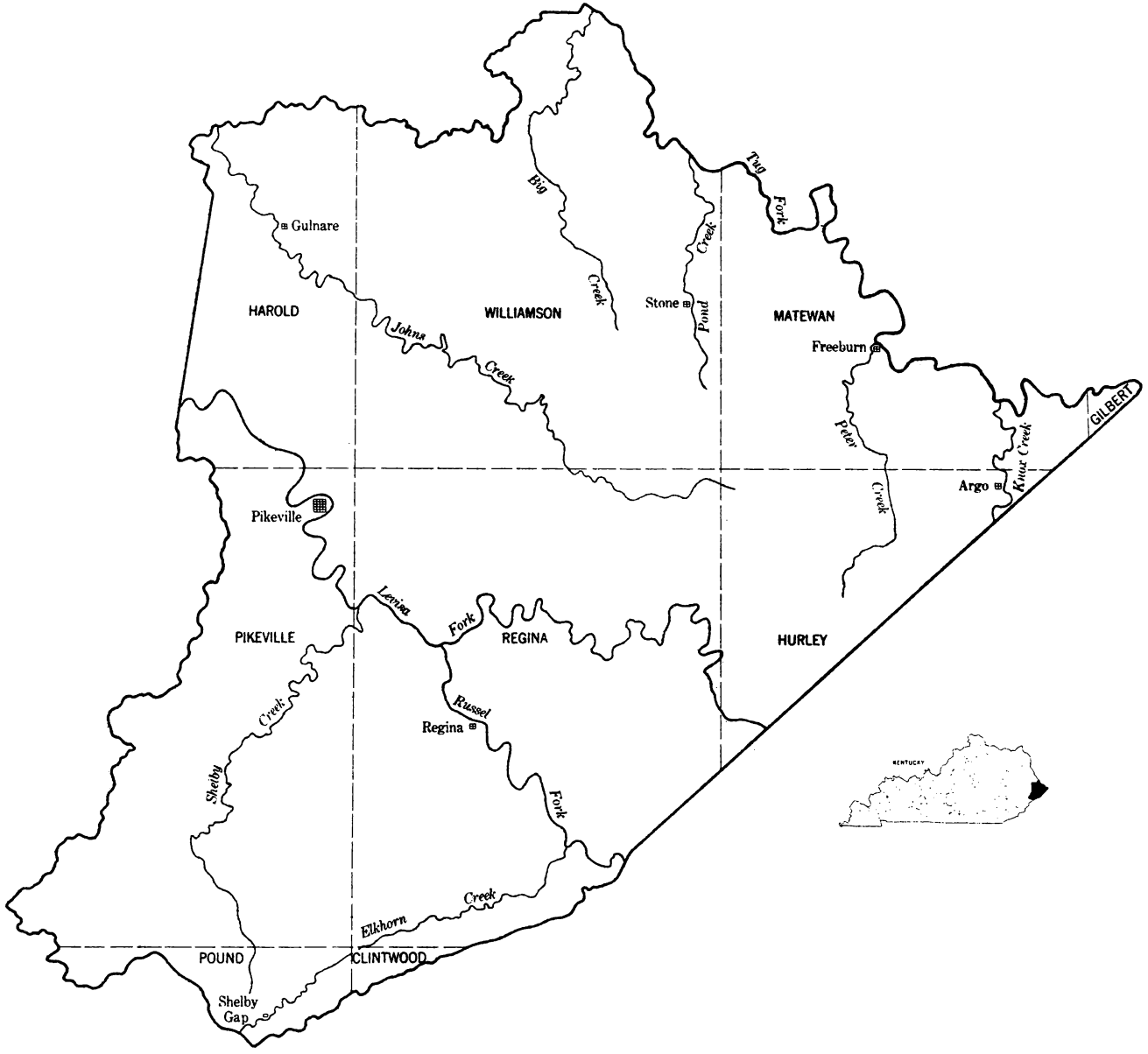

Figure 1. - Key map of Pike County, Ky.

PREMISES AND DEFINITIONS OF TERMS USED

An estimate of coal reserves is the opinion of an individual or a group of individuals based on certain premises and limitations adopted for that estimate. Therefore, in order to make a comparison between estimates, it is necessary to compare not only the final results but also the premises on which the estimates are based. The definitions "measured" and "indicated" coal used in this report have been agreed upon by the Bureau of Mines and the U. S. Geological Survey. The premises and definitions of terms follow:

Coking coal. - All bituminous coals in the Appalachian region are potentially coking, and, therefore, until the carbonization tests in part 3 of the study have been completed to determine the coking quality of the coals, all known reserves of coal in the county are included as coking coal. This should not be construed to mean that all coals included in this report are suitable for the manufacture of metallurgical coke according to present-day standards. However, the general trend is toward the use of lower-quality coals for metallurgical purposes.

Unit area. - The unit area used in estimating reserves is the 5-minute rectangle of the topographic quadrangle. The estimates for the nine 5-minute rectangles of a quadrangle are combined on a county basis.

Bed thickness range. - Reserves in each coal bed are tabulated in bed-thickness ranges as follows:

14 to 28 inches
28 to 42 inches
42 inches and more

These measurements represent total bed thickness, including all coal and partings in the bed. If the top or bottom bench of a coal bed is separated from the remainder of the bed by a parting of equal or greater thickness and usually is not mined, such bench and partings are omitted in determining the bed thickness.

Measured coal. - Measured coal is coal for which tonnage is computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced, and the thickness and extent of the coal are so well-defined that the computed tonnage is judged to be accurate within 20 percent or less of the true tonnage. The limits of accuracy of the estimate should be stated. Although the spacing of the points of observation necessary to demonstrate continuity of coal will vary in different regions according to the habit of the coal beds, the points of observation are, in general, of the order of 1/2 mile apart. The outer limit of a block of measured coal, therefore, shall be of the order of 1/4 mile from the last point of positive information (that is, roughly, one-half the distance between points of observation).

Where no data are available other than measurements along the outcrop, but where the continuity of the outcrop is measured in miles and suggests the presence of coal at great distances in from the outcrop, a smooth line drawn roughly 1/2 mile in from the outcrop is used to mark the limit under cover of a block of coal that can also be classed as measured.

Indicated coal. - Indicated coal is coal for which tonnage is computed partly from specific measurements and partly from projection of visible data for a reasonable distance on geologic evidence. In general, the points of observation are of the order of 1 mile apart, but may be as much as 1-1/2 miles for beds of known geologic continuity. For example, if drilling on 1/2-mile centers has proved a block of measured coal of fairly uniform thickness and extent, the area of measured coal, according to the judgment of the estimator, is larger than the actual area of drilling by as much as 1/4 mile on all sides. If, from geologic evidence, the bed is believed to have greater continuity, the area of measured coal is surrounded by a belt of indicated coal, which, according to the judgment of the appraiser, may be as much as 1-1/2 miles wide.

Where no data are available other than measurements along the outcrops, but where the continuity of the outcrop is measured in miles and suggests the presence of coal at great distances in from the outcrop, two lines drawn roughly parallel to the outcrop, one 1/2 mile in from the outcrop and one 2 miles in from the outcrop, define a block of coal that may be classed as indicated.

Inferred coal. - As no estimate of reserves has been made from geologic inference alone, inferred coal is not included in this report. This category normally would contain the largest reserves.

Areas excluded from estimate. - In each bed there are areas where coal may be present but for which no estimates of reserves have been made. There are too few or no bed sections from drill holes, mine workings, or coal outcrops in the area on which to base estimates that would qualify under the definitions of "measured" or "indicated" reserves. These areas may contain additional geologically inferred reserves.

Overburden. - All known reserves in Pike County are under less than 2,000 feet of overburden.

Thickness of coal. - In computing the volume of reserves in each thickness category for each bed, the total thickness of clean coal in the bed section is used. If the top or bottom bench of coal described under definition of "bed thickness range" usually is not mined, the thickness of the bench is not used to compute the volume of reserves. A weighted average thickness in each thickness category for each 5-minute rectangle of each bed is computed.

Weight of coal. - Estimated coal in place is based on 1,800 short tons per acre-foot.

Percentage of recovery. - The weighted average percentage of recovery is computed for each bed in each quadrangle. The total number of tons of coal produced from each mine is obtained from either the mine operator or the published reports of the Kentucky Department of Mines and Minerals. An estimate is made of the tons of coal originally in place in the mined-out area of each mine. The percentage of recovery for each mine is the ratio of the total number of tons produced from a mine (to January 1, 1948, the date of this estimate) to the total tons originally in place in the mined-out area. The weighted average percentage of recovery for all mines in the same bed in a quadrangle is the percentage of recovery used in calculating recoverable reserves for that bed in the quadrangle.

All coal remaining for any reason within the mined-out area of a mine is considered a loss. No distinction is made between avoidable or unavoidable losses. Included in these losses is some coal considered too thin to mine, also coal that legally is required to be left unmined, such as coal under some highways, railroads, and rivers; coal left to protect gas and oil wells; and coal left in barrier pillars between mines and adjacent to property boundaries.

Recoverable reserves. - The recoverable reserves are estimated tons of unmined coal in beds 28 inches and more thick, as of the date of the estimate, multiplied by the percentage of recovery. Twenty-eight inches is about the minimum thickness of coal being mined mechanically (hand-loaded conveyors). Some areas in some of the beds in this county may not be considered economically minable at present because of conditions considered adverse today.

COAL RESERVES

The large number of coal beds in Pike County present a difficult problem of correlation. Except for the Elkhorn beds, on which there is general agreement, there are about as many different correlations as there are reports on the coal beds. Hunt6/ describes 13 valuable beds in the county and states that there are 48 additional beds that are generally thin but locally minable. The names of the coal beds given in this report are those most widely used by consulting mining engineers and the larger coal and land companies. However, to avoid confusion the several names by which each coal bed is known also are given. The 17 coal beds, in descending order, for which estimates of reserves have been made follow:

Name of bed	Other names of beds
Hindman No. 9	High Splint, Lower Kittanning, Richardson
Coalburg	Hazard 6, Peach Orchard
Winifrede	Flatwoods
Fire Clay	Taylor, Chilton, Upper Bevins, Hazard 4
Whitesburg	Lower Bevins, Hernshaw

6/ Hunt, Charles B., Briggs, Guy H., Jr., Munyan, Arthur C., and Wesley, George R., Coal Deposits of Pike County, Kentucky: U. S. Geol. Survey Bull. 876, 1937, 92 pp.

Name of bed	Other names of bed
Williamson	Amburgy, Low Splint
Upper Elkhorn No. 3	Thacker, Cedar Grove
Upper Elkhorn No. 2	Lower Thacker, Lower Cedar Grove
Upper Elkhorn No. 1	Alma, Penny
Lower Elkhorn	Pond Creek, Freeburn, Warfield, No. 2 Gas, Campbell Creek, Shelby Gap
Bingham	Clintwood, Feds Creek, Matewan
Eagle	
Millard	Glamorgan, Cedar
Hagy	
Auxier	Splash Dam, Glenalum Tunnel
Upper Banner	
Elswick	

Detailed estimates of known reserves of measured and indicated coal in Pike County, Ky., as of January 1, 1948, are given in tables 1 to 17, inclusive.

Table 18 is a recapitulation of known coal reserves by beds in Pike County. Reserves in all beds 14 inches and more thick are 3,915,761,000 short tons. Of this total, 3,189,366,000 short tons are in beds 28 inches and more thick. Recoverable reserves in beds 28 inches and more thick are estimated at 1,756,624,000 tons. It must be remembered that these estimates are only the known reserves. When more extensive drilling is done to obtain information, particularly on the lower beds, much larger reserves will be found to exist in the county.

The weighted average percentage of recovery for each bed in the county is shown in tables 1 to 17, inclusive. The highest percentage of recovery is 65.6 for the Bingham bed in the Regina quadrangle. The lowest percentage of recovery is 50.0 for the Whitesburg bed in the Matewan quadrangle. The weighted average percentage of recovery, including all mining losses for all beds in the county, is 55.08. Based on this recovery for all beds, the estimated known recoverable reserves 28 inches and more thick in Pike County are 1,756,624,000 short tons as of January 1, 1948.

TABLE 1. - RESERVES IN HINDMAN NO. 9 BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Pikeville ..	81,235	80,926	-	-	309	-	309	Measured	-	-	260	1,131	49	463	309	1,594	309	1,594		797
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	-	-	260	1,131	49	463	309	1,594	309	1,594	2/50.0	797
Total	81,235	80,926	-	-	309	-	309	Measured	-	-	260	1,131	49	463	309	1,594	309	1,594		797
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	-	-	260	1,131	49	463	309	1,594	309	1,594	2/50.0	797

TABLE 2. - RESERVES IN COALBURG BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Williamson	119,244	86,094	32,949	-	201	119	82	Measured	-	-	-	-	82	677	82	677	82	677		410
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	-	-	-	-	82	677	82	677	82	677	60.5	410
Pikeville	87,537	71,119	14,733	-	1,685	-	1,685	Measured	-	-	-	-	1,194	10,030	1,194	10,030	1,194	10,030		6,068
								Indicated	-	-	-	-	491	4,124	491	4,124	491	4,124		2,495
								Total	-	-	-	-	1,685	14,154	1,685	14,154	1,685	14,154	60.5	8,563
Total	206,781	157,213	47,682	-	1,886	119	1,767	Measured	-	-	-	-	1,276	10,707	1,276	10,707	1,276	10,707		6,478
								Indicated	-	-	-	-	491	4,124	491	4,124	491	4,124		2,495
								Total	-	-	-	-	1,767	14,831	1,767	14,831	1,767	14,831	60.5	8,973

TABLE 3. - RESERVES IN WINIFREDE BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Harold	49,446	22,547	26,397	-	502	-	502	Measured	-	-	33	178	114	914	147	1,092	147	1,092		601
								Indicated	-	-	355	1,864	-	-	355	1,864	355	1,864		1,025
								Total	-	-	388	2,042	114	914	502	2,956	502	2,956	2/55.0	1,626
Williamson ..	119,244	10,898	99,555	153	8,638	453	8,185	Measured	409	1,445	1,355	6,422	4,605	37,291	6,369	45,158	5,960	43,713		27,670
								Indicated	49	154	967	5,161	800	7,128	1,816	12,443	1,767	12,289		7,779
								Total	458	1,599	2,322	11,583	5,405	44,419	8,185	57,601	7,727	56,002	63.3	35,449
Matewan	50,660	89	49,919	-	652	117	535	Measured	-	-	-	-	310	2,871	310	2,871	310	2,871		1,579
								Indicated	-	-	-	-	225	2,067	225	2,067	225	2,067		1,137
								Total	-	-	-	-	535	4,938	535	4,938	535	4,938	2/55.0	2,716
Pikeville ...	87,537	1,712	83,197	-	2,628	-	2,628	Measured	-	-	-	-	1,187	10,327	1,187	10,327	1,187	10,327		5,680
								Indicated	-	-	806	3,748	635	5,398	1,441	9,146	1,441	9,146		5,030
								Total	-	-	806	3,748	1,822	15,725	2,628	19,473	2,628	19,473	2/55.0	10,710
Regina	136,536	-	136,046	-	490	21	469	Measured	-	-	-	-	112	884	112	884	112	884		486
								Indicated	-	-	-	-	357	2,999	357	2,999	357	2,999		1,649
								Total	-	-	-	-	469	3,883	469	3,883	469	3,883	2/55.0	2,135
Total	443,423	35,246	395,114	153	12,910	591	12,319	Measured	409	1,445	1,388	6,600	6,328	52,287	8,125	60,332	7,716	58,887		36,016
								Indicated	49	154	2,128	10,773	2,017	17,592	4,194	28,519	4,145	28,365		16,620
								Total	458	1,599	3,516	17,373	8,345	69,879	12,319	88,851	11,861	87,252	60.49	52,636

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Estimated

PIKE COUNTY

TABLE 4. - RESERVES IN FIRE CLAY BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Williamson ...	119,244	25,265	85,535	999	7,445	-	7,445	Measured	-	-	855	4,416	1,620	11,050	2,475	15,466	2,475	15,466		7,733
								Indicated	1,774	4,793	1,280	6,335	1,916	13,228	4,970	24,356	3,196	19,563		9,781
								Total	1,774	4,793	2,135	10,751	3,536	24,278	7,445	39,822	5,671	35,029	2/ 50.0	17,514
Matewan	50,660	22,117	22,606	466	5,471	-	5,471	Measured	1,182	3,829	1,011	5,052	1,274	13,561	3,467	22,442	2,285	18,613		9,307
								Indicated	339	1,170	1,057	5,708	608	5,746	2,004	12,624	1,665	11,454		5,727
								Total	1,521	4,999	2,068	10,760	1,882	19,307	5,471	35,066	3,950	30,067	2/ 50.0	15,034
Pikeville	87,537	82,468	4,883	-	186	-	186	Measured	-	-	33	149	153	987	186	1,136	186	1,136		568
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	-	-	33	149	153	987	186	1,136	186	1,136	2/ 50.0	568
Regina	136,536	136,345	-	-	191	-	191	Measured	-	-	-	-	-	-	-	-	-	-		-
								Indicated	-	-	73	318	118	779	191	1,097	191	1,097		549
								Total	-	-	73	318	118	779	191	1,097	191	1,097	2/ 50.0	594
Hurley	43,716	26,960	14,517	-	2,239	-	2,239	Measured	-	-	939	5,071	305	2,150	1,244	7,221	1,244	7,221		3,610
								Indicated	-	-	690	3,726	305	2,059	995	5,785	995	5,785		2,892
								Total	-	-	1,629	8,797	610	4,209	2,239	13,006	2,239	13,006	2/ 50.0	6,502
Pound	12,825	1,585	10,867	18	355	-	355	Measured	-	-	21	110	334	2,785	355	2,895	355	2,895		1,448
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	-	-	21	110	334	2,785	355	2,895	355	2,895	2/ 50.0	1,448
								Measured	1,182	3,829	2,859	14,798	3,686	30,533	7,727	49,160	6,545	45,331		22,666
								Indicated	2,113	5,963	3,100	16,087	2,947	21,812	8,160	43,862	6,047	37,899		18,949
Total	450,518	294,740	138,408	1,483	15,887	-	15,887	Total	3,295	9,792	5,959	30,885	6,633	52,345	15,887	93,022	12,592	83,230	2/ 50.0	41,615

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Estimated

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PIKE COUNTY

TABLE 5. - RESERVES IN WHITESBURG BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Harold	49,446	18,369	26,019	-	5,058	-	5,058	Measured	-	-	30	149	122	787	152	936	152	936		468
								Indicated	1,570	5,152	1,667	7,788	1,699	10,959	4,906	23,899	3,336	18,747		9,373
								Total	1,570	5,152	1,697	7,937	1,821	11,746	5,058	24,835	3,488	19,683	2/ 50.0	9,841
Williamson ..	102,440	30,061	49,450	-	22,929	-	22,929	Measured	453	1,565	2,318	11,349	1,621	10,568	4,392	23,482	3,939	21,917		10,958
								Indicated	2,936	9,321	12,085	56,987	3,516	22,847	18,537	89,155	15,601	79,834		39,917
								Total	3,389	10,886	14,403	68,336	5,137	33,415	22,929	112,637	19,540	101,751	2/ 50.0	50,875
Matewan	50,660	50,349	-	-	311	73	238	Measured	-	-	-	-	238	1,999	238	1,999	238	1,999		1,000
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	-	-	-	-	238	1,999	238	1,999	238	1,999	2/ 50.0	1,000
Pound	12,825	2,233	9,499	-	1,093	-	1,093	Measured	285	1,154	169	862	639	4,449	1,093	6,465	808	5,311		2,656
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	285	1,154	169	862	639	4,449	1,093	6,465	808	5,311	2/ 50.0	2,656
								Measured	738	2,719	2,517	12,360	2,620	17,803	5,875	32,882	5,137	30,163		15,082
								Indicated	4,506	14,473	13,752	64,775	5,215	33,806	23,443	113,054	18,937	98,581		49,290
Total	215,371	101,012	84,968	-	29,391	73	29,318	Total	5,244	17,192	16,269	77,135	7,835	51,609	29,318	145,936	24,074	128,744	2/ 50.0	64,372

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Estimated

PIKE COUNTY

TABLE 6. - RESERVES IN WILLIAMSON BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Harold	49,446	43,209	4,479	-	1,758	-	1,758	Measured	923	3,110	835	3,616	-	-	1,758	6,726	835	3,616		1,916
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	923	3,110	835	3,616	-	-	1,758	6,726	835	3,616	2/ 53.0	1,916
Williamson ..	119,244	58,267	34,076	70	26,831	2,554	24,277	Measured	516	1,580	3,451	17,885	9,264	65,860	13,231	85,325	12,715	83,745		50,666
								Indicated	1,671	5,075	7,112	36,677	2,263	14,290	11,046	56,042	9,375	50,967		30,835
								Total	2,187	6,655	10,563	54,562	11,527	80,150	24,277	141,367	22,090	134,712	60.5	81,501
Matewan	50,660	4,708	33,069	-	12,883	288	12,595	Measured	1,670	5,485	1,474	7,383	5,849	45,475	8,993	58,343	7,323	52,858		28,015
								Indicated	564	1,692	684	2,930	2,354	16,032	3,602	20,654	3,038	18,962		10,050
								Total	2,234	7,177	2,158	10,313	8,203	61,507	12,595	78,997	10,361	71,820	53.0	38,065
Pikeville ...	87,537	73,228	9,219	-	5,090	26	5,064	Measured	48	194	575	2,760	-	-	623	2,954	575	2,760		1,474
								Indicated	1,567	4,767	1,547	6,998	1,327	11,346	4,441	23,111	2,874	18,344		9,796
								Total	1,615	4,961	2,122	9,758	1,327	11,346	5,064	26,065	3,449	21,104	53.4	11,270
Hurley	40,612	19,899	18,741	225	1,747	-	1,747	Measured	178	561	47	226	132	950	357	1,737	179	1,176		623
								Indicated	360	972	114	496	916	5,908	1,390	7,376	1,030	6,404		3,394
								Total	538	1,533	161	722	1,048	6,858	1,747	9,113	1,209	7,580	2/ 53.0	4,017
Pound	12,825	5,480	5,768	-	1,577	-	1,577	Measured	707	2,516	155	684	-	-	862	3,200	155	684		363
								Indicated	685	1,764	30	126	-	-	715	1,890	30	126		67
								Total	1,392	4,280	185	810	-	-	1,577	5,090	185	810	2/ 53.0	430
Total	360,324	204,791	105,352	295	49,886	2,868	47,018	Measured	4,042	13,446	6,537	32,554	15,245	112,285	25,824	158,285	21,782	144,839		83,057
								Indicated	4,847	14,270	9,487	47,227	6,860	47,576	21,194	109,073	16,347	94,803		54,142
								Total	8,889	27,716	16,024	79,781	22,105	159,861	47,018	267,358	38,129	239,642	57.25	137,199

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Estimated

4225

PIKE COUNTY

TABLE 7. - RESERVES IN UPPER ELKHORN NO. 3 BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Harold	49,446	33,885	6,774	-	8,787	1,993	6,794	Measured	311	1,213	1,032	4,740	237	1,920	1,580	7,873	1,269	6,660		3,650
								Indicated	1,204	4,334	2,555	11,181	1,455	11,620	5,214	27,135	4,010	22,801		12,495
								Total	1,515	5,547	3,587	15,921	1,692	13,540	6,794	35,008	5,279	29,461	54.8	16,145
Williamson ..	119,244	105,714	8,501	1,061	3,968	146	3,822	Measured	-	-	-	-	328	2,412	328	2,412	328	2,412		1,322
								Indicated	1,039	3,223	538	2,536	1,917	12,078	3,494	17,837	2,455	14,614		8,008
								Total	1,039	3,223	538	2,536	2,245	14,490	3,822	20,249	2,783	17,026	54.8	9,330
Matewan	50,660	18,726	20,607	1,602	9,725	1,369	8,356	Measured	1,720	3,725	358	1,681	1,111	8,454	3,189	13,860	1,469	10,135		5,503
								Indicated	2,180	4,630	709	2,972	2,278	14,786	5,167	22,388	2,987	17,758		9,643
								Total	3,900	8,355	1,067	4,653	3,389	23,240	8,356	36,248	4,456	27,893	54.3	15,146
Pikeville ...	87,537	5,038	45,413	-	37,086	3,791	33,295	Measured	679	2,356	5,916	30,719	12,524	96,223	19,119	129,298	18,440	126,942		68,676
								Indicated	1,205	3,775	5,457	25,807	7,514	50,065	14,176	79,647	12,971	75,872		41,047
								Total	1,884	6,131	11,373	56,526	20,038	146,288	33,295	208,945	31,411	202,814	54.1	109,723
Regina	136,536	96,523	30,749	-	9,264	129	9,135	Measured	130	507	1,559	8,376	643	4,475	2,332	13,358	2,202	12,851		6,850
								Indicated	174	548	6,178	31,709	451	2,987	6,803	35,244	6,629	34,696		18,493
								Total	304	1,055	7,737	40,085	1,094	7,462	9,135	48,602	8,831	47,547	53.3	25,343
Pound	12,825	4,589	3,864	-	4,372	1,685	2,687	Measured	-	-	62	298	1,847	13,372	1,909	13,670	1,909	13,670		7,177
								Indicated	1	4	145	609	632	4,302	778	4,915	777	4,911		2,578
								Total	1	4	207	907	2,479	17,674	2,687	18,585	2,686	18,581	52.5	9,755
								Measured	2,840	7,801	8,927	45,814	16,690	126,856	28,457	180,471	25,617	172,670		93,178
								Indicated	5,803	16,514	15,582	74,814	14,247	95,838	35,632	187,166	29,829	170,652		92,264
Total	456,248	264,475	115,908	2,663	73,202	9,113	64,089	Total	8,643	24,315	24,509	120,628	30,937	222,694	64,089	367,637	55,446	343,322	54.01	185,442

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

PIKE COUNTY

TABLE 8. - RESERVES IN UPPER ELKHORN NO. 2 BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Harold	49,445	30,114	6,537	-	12,794	513	12,281	Measured	-	-	3,443	17,803	976	7,135	4,419	24,938	4,419	24,938		12,644
								Indicated	2,901	9,620	3,539	16,828	1,422	10,854	7,862	37,302	4,961	27,682		14,035
								Total	2,901	9,620	6,982	34,631	2,398	17,989	12,281	62,240	9,380	52,620	50.7	26,679
Williamson ..	119,244	71,844	19,576	14	27,810	8	27,802	Measured	242	757	1,219	6,168	2,407	16,208	3,868	23,133	3,626	22,376		11,345
								Indicated	6,516	21,061	12,802	60,888	4,616	31,332	23,934	113,281	17,418	92,220		46,756
								Total	6,758	21,818	14,021	67,056	7,023	47,540	27,802	136,414	21,044	114,596	2/ 50.7	58,101
Matewan	50,660	8,749	27,509	-	14,402	60	14,342	Measured	839	2,768	3,998	20,760	872	5,624	5,709	29,152	4,870	26,384		13,377
								Indicated	3,127	9,252	4,675	22,144	831	5,360	8,633	36,756	5,506	27,504		13,945
								Total	3,966	12,020	8,673	42,904	1,703	10,984	14,342	65,908	10,376	53,888	50.7	27,322
Pikeville ...	87,537	7,249	40,691	-	39,597	2,903	36,694	Measured	161	496	6,578	34,523	19,217	135,419	25,956	170,438	25,795	169,942		88,200
								Indicated	349	1,099	4,783	21,888	5,606	36,348	10,738	59,335	10,389	58,236		30,224
								Total	510	1,595	11,361	56,411	24,823	171,767	36,694	229,773	36,184	228,178	51.9	118,424
Regina	136,536	17,691	91,035	4	27,806	4,600	23,206	Measured	556	1,805	4,224	21,617	9,509	70,053	14,289	93,475	13,733	91,670		46,477
								Indicated	910	3,083	5,195	24,094	2,812	18,902	8,917	46,079	8,007	42,996		21,799
								Total	1,466	4,888	9,419	45,711	12,321	88,955	23,206	139,554	21,740	134,666	50.7	68,276
Hurley	43,716	17,770	17,835	274	7,837	-	7,837	Measured	-	-	668	2,935	937	6,184	1,605	9,119	1,605	9,119		4,623
								Indicated	2,290	7,901	3,139	13,764	803	5,371	6,232	27,036	3,942	19,135		9,701
								Total	2,290	7,901	3,807	16,699	1,740	11,555	7,837	36,155	5,547	28,254	2/ 50.7	14,324
Pound	12,825	4,861	5,939	-	2,025	-	2,025	Measured	109	311	68	367	1,059	7,307	1,236	7,985	1,127	7,674		3,891
								Indicated	189	539	129	581	471	3,038	789	4,158	600	3,619		1,835
								Total	298	850	197	948	1,530	10,345	2,025	12,143	1,727	11,293	2/ 50.7	5,726
								Measured	1,907	6,137	20,198	104,173	34,977	247,930	57,082	358,240	55,175	352,103		180,557
								Indicated	16,282	52,555	34,262	160,187	16,561	111,205	67,105	323,947	50,823	271,392		138,295
Total	499,963	158,278	209,122	292	132,271	8,084	124,187	Total	18,189	58,692	54,460	264,360	51,538	359,135	124,187	682,187	105,998	623,495	51.14	318,852

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Estimated

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PIKE COUNTY

TABLE 9. - RESERVES IN UPPER ELKHORN NO. 1 BED, January 1, 1945

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Harold	49,446	41,764	3,124	2/229	4,329	603	3,726	Measured	-	-	183	1,043	461	3,804	644	4,847	644	4,847		2,734
								Indicated	337	1,213	2,745	14,051	-	-	3,082	15,264	2,745	14,051		7,924
								Total	337	1,213	2,928	15,094	461	3,804	3,726	20,111	3,389	18,898	56.4	10,658
Williamson ..	119,244	71,466	13,099	715	33,964	30	33,934	Measured	4,419	14,477	6,894	32,832	992	6,281	12,305	53,590	7,886	39,113		24,054
								Indicated	11,358	35,417	10,020	43,191	251	1,506	21,629	80,114	10,271	44,697		27,489
								Total	15,777	49,894	16,914	76,023	1,243	7,787	33,934	133,704	18,157	83,810	61.5	51,543
Matewan	50,660	6,215	18,215	486	25,744	2,252	23,492	Measured	2,504	8,786	11,677	60,441	6,560	46,760	20,741	115,987	18,237	107,201		67,965
								Indicated	1,236	3,913	1,515	7,727	-	-	2,751	11,640	1,515	7,727		4,899
								Total	3,740	12,699	13,192	68,168	6,560	46,760	23,492	127,627	19,752	114,928	63.4	72,864
Pikeville ...	87,537	63,471	12,752	-	11,314	-	11,314	Measured	903	3,241	1,756	8,956	275	1,938	2,934	14,135	2,031	10,894		5,992
								Indicated	2,768	9,923	5,195	24,321	417	2,521	8,380	36,765	5,612	26,842		14,763
								Total	3,671	13,164	6,951	33,277	692	4,459	11,314	50,900	7,643	37,736	3/55.0	20,755
Regina	136,536	37,112	2/96,638	-	2,786	34	2,752	Measured	343	1,262	763	4,042	399	2,904	1,505	8,208	1,162	6,946		3,820
								Indicated	373	1,175	407	1,954	467	3,209	1,247	6,338	874	5,163		2,840
								Total	716	2,437	1,170	5,996	866	6,113	2,752	14,546	2,036	12,109	3/55.0	6,660
Hurley	43,716	14,852	2/18,628	-	10,236	-	10,236	Measured	1,680	5,414	1,036	5,418	404	2,666	3,120	13,498	1,440	8,084		4,446
								Indicated	4,945	15,577	2,171	9,770	-	-	7,116	25,347	2,171	9,770		5,374
								Total	6,625	20,991	3,207	15,188	404	2,666	10,236	38,845	3,611	17,854	3/55.0	9,820
Pound	12,825	9,561	2/3,264	-	-	-	-	Measured	-	-	-	-	-	-	-	-	-	-		-
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	-	-	-	-	-	-	-	-	-	-		-
								Measured	9,849	33,180	22,309	112,732	9,091	64,353	41,249	210,265	31,400	177,085		109,011
								Indicated	21,017	67,218	22,053	101,014	1,135	7,236	44,205	175,468	23,188	108,250		63,289
Total	499,964	244,441	165,720	1,430	88,373	2,919	85,454	Total	30,866	100,398	44,362	213,746	10,226	71,589	85,454	385,733	54,588	285,335	60.44	172,300

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Upper Elkhorn No. 1 and No. 2 beds come together and are mapped as Upper Elkhorn No. 2.

3/ Estimated.

TABLE 10. - RESERVES IN LOWER ELKHORN BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Williamson	119,244	61,762	4,188	474	52,820	12,968	39,852	Measured	2,089	6,813	6,744	30,362	18,244	129,843	27,077	167,018	24,988	160,205		87,632
								Indicated	-	-	10,932	45,913	1,843	12,717	12,775	58,630	12,775	58,630		32,071
								Total	2,089	6,813	17,676	76,275	20,087	142,560	39,852	225,648	37,763	218,835	54.7	119,703
Matewan	50,660	5,791	11,570	7	33,292	12,939	20,353	Measured	129	464	2,287	11,226	15,482	110,565	17,898	122,255	17,769	121,791		68,447
								Indicated	-	-	1,997	10,025	458	3,160	2,455	13,185	2,455	13,185		7,410
								Total	129	464	4,284	21,251	15,940	113,725	20,353	135,440	20,224	134,976	56.2	75,857
Pikeville	87,537	59,664	8,985	-	18,888	605	18,283	Measured	1,060	3,518	1,966	9,693	10,159	67,286	13,185	80,497	12,125	76,979		39,952
								Indicated	859	2,598	930	4,381	3,309	20,847	5,098	27,826	4,239	25,228		13,093
								Total	1,919	6,116	2,896	14,074	13,468	88,133	18,283	108,323	16,364	102,207	51.9	53,045
Regina	136,536	24,093	58,717	-	53,726	4,485	49,241	Measured	1,896	5,693	8,151	42,551	35,960	288,949	46,007	337,193	44,111	331,500		171,054
								Indicated	-	-	1,240	6,510	1,994	14,787	3,234	21,297	3,234	21,297		10,989
								Total	1,896	5,693	9,391	49,061	37,954	303,736	49,241	358,490	47,345	352,797	51.6	182,043
Hurley	43,716	-	19,470	-	24,246	1,006	23,240	Measured	-	-	994	4,899	18,783	162,943	19,777	167,842	19,777	167,842		109,097
								Indicated	-	-	194	948	3,269	25,354	3,463	26,302	3,463	26,302		17,096
								Total	-	-	1,188	5,847	22,052	188,297	23,240	194,144	23,240	194,144	65.0	126,193
Pound	12,825	6,394	1,777	-	4,654	42	4,612	Measured	26	86	2,481	11,909	720	4,644	3,227	16,639	3,201	16,553		8,541
								Indicated	138	352	1,190	5,712	57	368	1,385	6,432	1,247	6,080		3,137
								Total	164	438	3,671	17,621	777	5,012	4,612	23,071	4,448	22,633	51.6	11,678
Total	450,518	157,704	104,707	481	187,626	32,045	155,581	Measured	5,200	16,574	22,623	110,640	99,348	764,230	127,171	891,444	121,971	874,870		484,723
								Indicated	997	2,950	16,483	73,489	10,930	77,233	28,410	153,672	27,413	150,722		83,796
								Total	6,197	19,524	39,106	184,129	110,278	841,463	155,581	1,045,116	149,384	1,025,592	55.43	568,519

TABLE 11. - RESERVES IN BINGHAM BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Pikeville ..	87,537	81,596	4,120	451	1,370	-	1,370	Measured	756	2,041	614	2,306	-	-	1,370	4,347	614	2,306		1,384
								Indicated	-	-	-	-	-	-	-	-	-	-		-
								Total	756	2,041	614	2,306	-	-	1,370	4,347	614	2,306	60.0	1,384
Regina	136,536	65,141	32,338	1,790	37,267	209	37,058	Measured	3,465	10,754	12,305	61,792	3,879	26,801	19,649	99,347	16,184	88,593		58,117
								Indicated	15,925	47,635	1,356	6,353	128	842	17,409	54,830	1,484	7,195		4,720
								Total	19,390	58,389	13,661	68,145	4,007	27,643	37,058	154,177	17,668	95,788	65.6	62,837
Hurley	43,716	20,486	8,093	-	15,137	312	14,825	Measured	1,168	3,855	1,461	8,307	5,691	42,054	8,320	54,216	7,152	50,361		29,914
								Indicated	3,232	10,148	3,136	17,404	137	945	6,505	28,497	3,273	18,349		10,899
								Total	4,400	14,003	4,597	25,711	5,828	42,999	14,825	82,713	10,425	68,710	59.4	40,813
Total	267,789	167,223	44,551	2,241	53,774	521	53,253	Measured	5,389	16,650	14,380	72,405	9,570	68,855	29,339	157,910	23,950	141,260		89,415
								Indicated	19,157	57,783	4,492	23,757	265	1,787	23,914	83,327	4,757	25,344		15,619
								Total	24,546	74,433	18,872	96,162	9,835	70,642	53,253	241,237	28,707	166,804	62.97	105,034

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

TABLE 12. - RESERVES IN EAGLE BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Hurley	43,716	20,673	3,600	281	19,162	-	19,162	Measured	2,293	7,221	2,677	12,783	477	3,148	5,447	23,152	3,154	15,931		7,966
								Indicated	11,552	34,719	2,163	10,723	-	-	13,715	45,442	2,163	10,723		5,361
								Total	13,845	41,940	4,840	23,506	477	3,148	19,162	68,594	5,317	26,654	2/ 50.0	13,327
								Measured	2,293	7,221	2,677	12,783	477	3,148	5,447	23,152	3,154	15,931		7,966
								Indicated	11,552	34,719	2,163	10,723	-	-	13,715	45,442	2,163	10,723		5,361
Total ...	43,716	20,673	3,600	281	19,162	-	19,162	Total	13,845	41,940	4,840	23,506	477	3,148	19,162	68,594	5,317	26,654	2/ 50.0	13,327

TABLE 13. - RESERVES IN MILLARD BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Matewan ...	50,660	38,244	4,211	512	7,693	3	7,690	Measured	1,172	3,516	373	1,958	8	64	1,553	5,538	381	2,022		1,072
								Indicated	4,608	13,825	1,496	7,896	33	218	6,137	21,939	1,529	8,114		4,300
								Total	5,780	17,341	1,869	9,854	41	282	7,690	27,477	1,910	10,136	2/ 53.0	5,372
Regina	136,536	67,937	16,713	402	51,484	-	51,484	Measured	21,436	68,656	6,101	26,938	900	5,721	28,437	101,315	7,001	32,659		17,309
								Indicated	23,047	70,556	-	-	-	-	23,047	70,556	-	-		-
								Total	44,483	139,212	6,101	26,938	900	5,721	51,484	171,871	7,001	32,659	2/ 53.0	17,309
Hurley	43,716	16,460	4,072	-	23,184	-	23,184	Measured	2,710	9,156	2,688	13,467	148	1,033	5,546	23,656	2,836	14,500		7,685
								Indicated	17,185	54,134	453	2,378	-	-	17,638	56,512	453	2,378		1,260
								Total	19,895	63,290	3,141	15,845	148	1,033	23,184	80,168	3,289	16,878	2/ 53.0	8,945
								Measured	25,318	81,328	9,162	42,363	1,056	6,818	35,536	130,509	10,218	49,181		26,066
								Indicated	44,840	138,515	1,949	10,274	33	218	46,822	149,007	1,982	10,492		5,560
Total ...	230,912	122,641	24,996	914	82,361	3	82,358	Total	70,158	219,843	11,111	52,637	1,089	7,036	82,358	279,516	12,200	59,673	2/ 53.0	31,626

TABLE 14. - RESERVES IN HAGY BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Matewan	50,660	48,871	303	-	1,486	-	1,486	Measured	241	542	-	-	-	-	241	542	-	-		-
								Indicated	1,245	2,802	-	-	-	-	1,245	2,802	-	-		-
								Total	1,486	3,344	-	-	-	-	1,486	3,344	-	-	-	-
Regina	136,536	102,544	23,482	-	10,510	-	10,510	Measured	3,939	14,181	1,273	6,301	-	-	5,212	20,482	1,273	6,301		3,151
								Indicated	5,298	19,073	-	-	-	-	5,298	19,073	-	-		-
								Total	9,237	33,254	1,273	6,301	-	-	10,510	39,555	1,273	6,301	2/ 50.0	3,151
Hurley	43,716	37,921	2,172	-	3,623	-	3,623	Measured	1,001	2,951	607	3,096	-	-	1,608	6,047	607	3,096		1,548
								Indicated	1,895	4,264	120	522	-	-	2,015	4,786	120	522		261
								Total	2,896	7,215	727	3,618	-	-	3,623	10,833	727	3,618	2/ 50.0	1,809
								Measured	5,181	17,674	1,880	9,397	-	-	7,061	27,071	1,880	9,397		4,699
								Indicated	8,438	26,139	120	522	-	-	8,558	26,661	120	522		261
Total	230,912	189,336	25,957	-	15,619	-	15,619	Total	13,619	43,813	2,000	9,919	-	-	15,619	53,732	2,000	9,919	2/ 50.0	4,960

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Estimated

TABLE 15. - RESERVES IN AUXIER BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Matewan	50,660	46,999	1,346	-	2,315	-	2,315	Measured	69	186	302	1,540	-	-	371	1,726	302	1,540		770
								Indicated	1,944	5,249	-	-	-	-	1,944	5,249	-	-		-
								Total	2,013	5,435	302	1,540	-	-	2,315	6,975	302	1,540	2/50.0	770
Regina	136,536	111,936	4,821	-	19,779	167	19,612	Measured	2,352	8,398	2,663	13,141	982	6,650	5,997	28,189	3,645	19,791		9,895
								Indicated	11,279	39,054	2,336	11,672	-	-	13,615	50,726	2,336	11,672		5,836
								Total	13,631	47,452	4,999	24,813	982	6,650	19,612	78,915	5,981	31,463	2/50.0	15,731
Hurley	43,716	32,511	1,316	255	9,634	-	9,634	Measured	1,554	5,785	1,859	9,607	-	-	3,413	15,392	1,859	9,607		4,804
								Indicated	5,904	15,751	317	1,522	-	-	6,221	17,273	317	1,522		761
								Total	7,458	21,536	2,176	11,129	-	-	9,634	32,665	2,176	11,129	2/50.0	5,565
								Measured	3,975	14,369	4,824	24,288	982	6,650	9,781	45,307	5,806	30,938		15,469
								Indicated	19,127	60,054	2,653	13,194	-	-	21,780	73,248	2,653	13,194		6,597
Total	230,912	191,446	7,483	255	31,728	167	31,561	Total	23,102	74,423	7,477	37,482	982	6,650	31,561	118,555	8,459	44,132	2/50.0	22,066

TABLE 16. - RESERVES IN UPPER BANNER BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Regina	136,536	131,083	1,405	3	4,045	72	3,973	Measured	698	2,434	897	4,747	471	3,295	2,066	10,476	1,368	8,042		4,021
								Indicated	679	2,138	1,228	6,448	-	-	1,907	8,586	1,228	6,448		3,224
								Total	1,377	4,572	2,125	11,195	471	3,295	3,973	19,062	2,596	14,490	2/50.0	7,245
								Measured	698	2,434	897	4,747	471	3,295	2,066	10,476	1,368	8,042		4,021
								Indicated	679	2,138	1,228	6,448	-	-	1,907	8,586	1,228	6,448		3,224
Total	136,536	131,083	1,405	3	4,045	72	3,973	Total	1,377	4,572	2,125	11,195	471	3,295	3,973	19,062	2,596	14,490	2/50.0	7,245

TABLE 17. - RESERVES IN ELSWICK BED, January 1, 1948

Quadrangle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Area of quadrangle in county, acres	Areas excluded from estimate, 1/ acres	Area outside outcrop, acres	Underlain by coal 0" to 14" thick, acres	Coal over 14" thick, in place originally, acres	Mined out, acres	Coal over 14" thick remaining, acres	Measured Indicated	Estimated coal reserves, in tons of 2,000 lb.						Total reserves, in tons of 2,000 lb.				Percentage recoverable, including all mining losses	Estimated recoverable reserves 28" and more thick, thousands of tons
									14" to 28" thick		28" to 42" thick		Over 42" thick		14" and more thick		28" and more thick			
									Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons	Acres	Thousands of tons		
Matewan	50,660	47,298	595	-	2,767	-	2,767	Measured	60	243	912	4,651	78	503	1,050	5,397	990	5,154		3,221
								Indicated	720	2,916	997	5,085	-	-	1,717	8,001	997	5,085		3,178
								Total	780	3,159	1,909	9,736	78	503	2,767	13,398	1,987	10,239	62.5	6,399
Regina	136,536	131,039	896	-	4,601	422	4,179	Measured	-	-	1,415	7,853	206	1,329	1,621	9,182	1,621	9,182		5,739
								Indicated	-	-	2,311	11,786	247	1,593	2,558	13,379	2,558	13,379		8,362
								Total	-	-	3,726	19,639	453	2,922	4,179	22,561	4,179	22,561	62.5	14,101
Hurley	43,716	41,854	226	-	1,756	-	1,756	Measured	157	589	427	1,857	-	-	584	2,446	427	1,857		1,161
								Indicated	1,172	4,395	-	-	-	-	1,172	4,395	-	-		-
								Total	1,329	4,984	427	1,857	-	-	1,756	6,841	427	1,857	62.5	1,161
								Measured	217	832	2,754	14,361	284	1,832	3,255	17,025	3,038	16,193		10,121
								Indicated	1,892	7,311	3,308	16,871	247	1,593	5,447	25,775	3,555	18,464		11,540
Total	230,912	220,191	1,717	-	9,124	422	8,702	Total	2,109	8,143	6,062	31,232	531	3,425	8,702	42,800	6,593	34,657	62.5	21,661

1/ No information available from core drilling, mine workings, or coal outcrops on which to base estimates of measured and indicated reserves. These areas may contain additional geologically inferred reserves.

2/ Estimated

TABLE 18. - Recapitulation of reserves, Pike County, Ky., January 1, 1948

Bed	Thousands of tons		Recoverable[1]	
	In beds 14" and more thick	In beds 28" and more thick	Percentage	Thousands of tons
Hindman 9	1,594	1,594	2/50.00	797
Coalburg	14,831	14,831	60.50	8,973
Winifrede	88,851	87,252	60.49	52,636
Fire Clay	93,022	83,230	2/50.00	41,615
Whitesburg	145,936	128,744	50.00	64,372
Williamson	267,358	239,642	57.25	137,199
Upper Elkhorn No. 3	367,637	343,322	54.01	185,442
Upper Elkhorn No. 2	682,187	623,495	51.14	318,852
Upper Elkhorn No. 1	385,733	285,335	60.44	172,300
Lower Elkhorn	1,045,116	1,025,592	55.43	568,519
Bingham	241,237	166,804	62.97	105,034
Eagle	68,594	26,654	2/50.00	13,327
Millard	279,516	59,673	2/53.00	31,626
Hagy	53,732	9,919	2/50.00	4,960
Auxier	118,555	44,132	2/50.00	22,066
Upper Banner	19,062	14,490	2/50.00	7,245
Elswick	42,800	34,657	62.50	21,661
Total	3,915,761	3,189,366	55.08	1,756,624

1/ Based on reserves in beds 28 inches and more thick.
2/ Estimated.

COAL BEDS

The Hindman 9 bed is at the base of the Allegheny group, Pennsylvanian period, and all other beds are in the underlying Pottsville group. Hunt[7] gives the estimated interval between the Winifrede (Flatwoods) and the Lower Elkhorn beds as 700 feet and estimates the interval from the Lower Elkhorn to the Elswick to be 720 feet. A drill hole in the southeastern part of the Pikeville quadrangle shows the Hindman bed to be 1,055 feet above the Lower Elkhorn bed. Thus, the column representing the 17 coal beds from the Hindman 9 down through the Elswick is approximately 1,775 feet.

Four coal beds are of major importance from the standpoint of production and probable future development. These beds are the Upper Elkhorn No. 3, Upper Elkhorn No. 2, Upper Elkhorn No. 1, and the Lower Elkhorn. Beds of secondary importance at present are the Winifrede, Williamson, and Bingham. Little mining has been done in the other ten beds; they are of minor importance at present. Beds above the Winifrede are so high topographically that they are seldom prospected. Erosion has left only comparatively small isolated areas of these coals. Because so many of the lower coal beds are above drainage and accessible by drift, they have not been core-drilled extensively to determine the full extent of the beds. Therefore, the estimates of reserves have been based primarily on outcrop sections and sections of the beds in mined areas.

7/ Hunt, Charles B., Work cited in footnote 6.

Maps have been prepared of the Winifrede,Fire Clay, Whitesburg, Williamson, Upper Elkhorn No. 3, Upper Elkhorn No. 2, Upper Elkhorn No. 1, Lower Elkhorn, Bingham, Millard, Auxier, and Elswick beds. (See figs. 2 to 13.) Maps of other beds were not prepared, because too little information is available regarding the thickness and extent of these beds.

The characteristics of the mapped beds are shown by bed sections furnished by the owners and lessees of the coal. All of the sections given are for beds within the areas of recoverable reserves 28 inches and more thick (black areas on the maps).

Descriptions of the coal beds that have been mapped and bed sections selected to show the irregularities of the beds in areas of recoverable reserves follow:

Winifrede Bed

(See fig. 2 and table 3)

The Winifrede bed (also known as Flatwoods) ranges from 600 to 825 feet (normally 700 feet) above the Lower Elkhorn bed. It usually is overlain by shale containing fossils, which is a marker for the bed. Ordinarily, the bed is over 5 feet thick, and as the thickness increases the partings generally become thicker. Except in the northern part of the county, the Winifrede bed occurs in hilltops. Sections of the bed in areas of recoverable reserves follow:

Northern Part of County

Material	Inches
COAL	14
Parting	2-1/2
COAL	52
Thickness	68-1/2
COAL	53
Parting	5
COAL	11
Thickness	69
COAL	9
Parting	1-1/2
COAL	29-1/2
Thickness	40

Material	Inches
COAL	2
Parting	8
COAL	22
Parting	1
COAL	28
Thickness	61
COAL	39
Parting	12
COAL	34
Thickness	85
COAL	62
Thickness	62

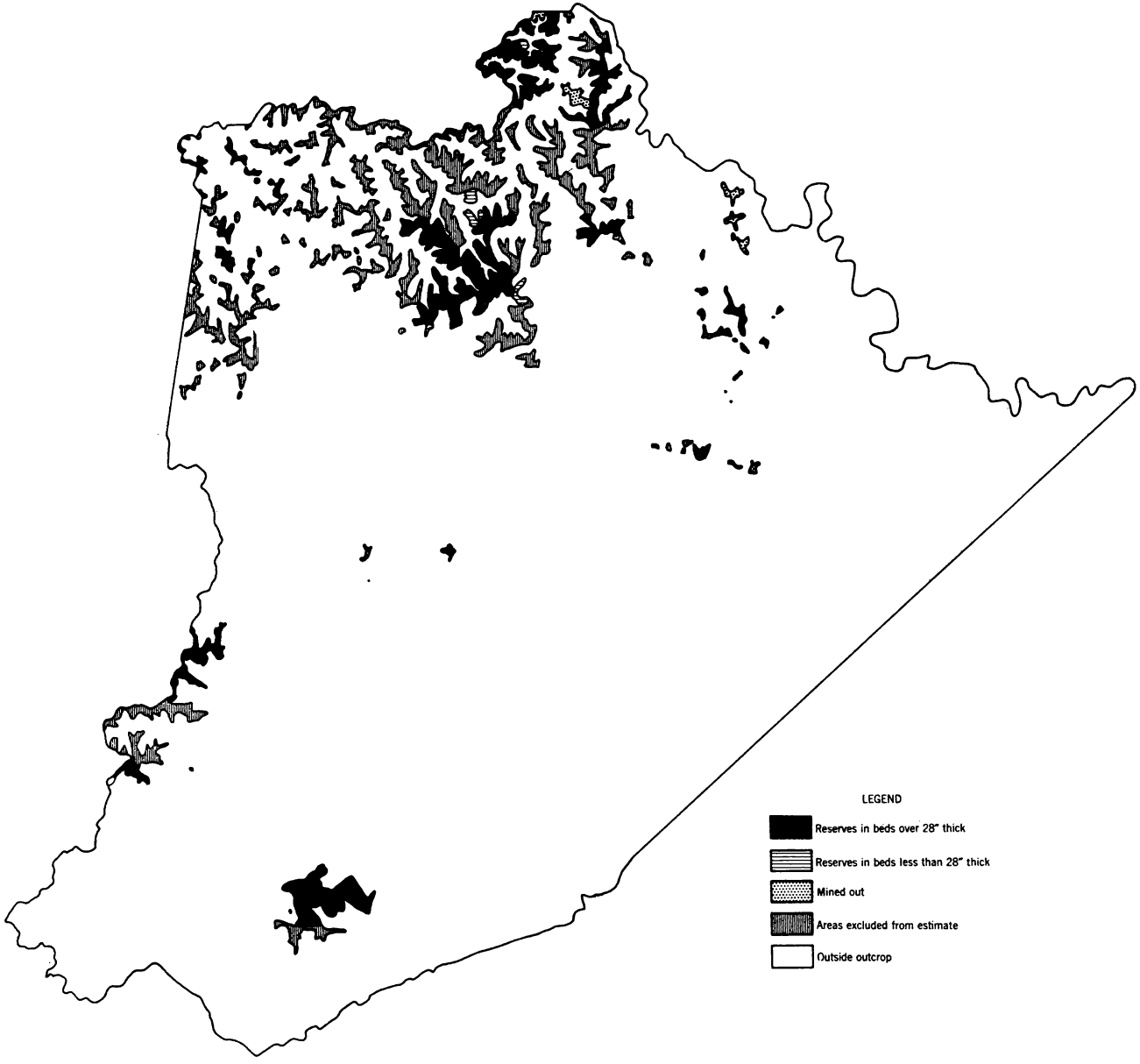

Figure 2. - Winifrede bed, Pike County, Ky., Jan. 1, 1948.

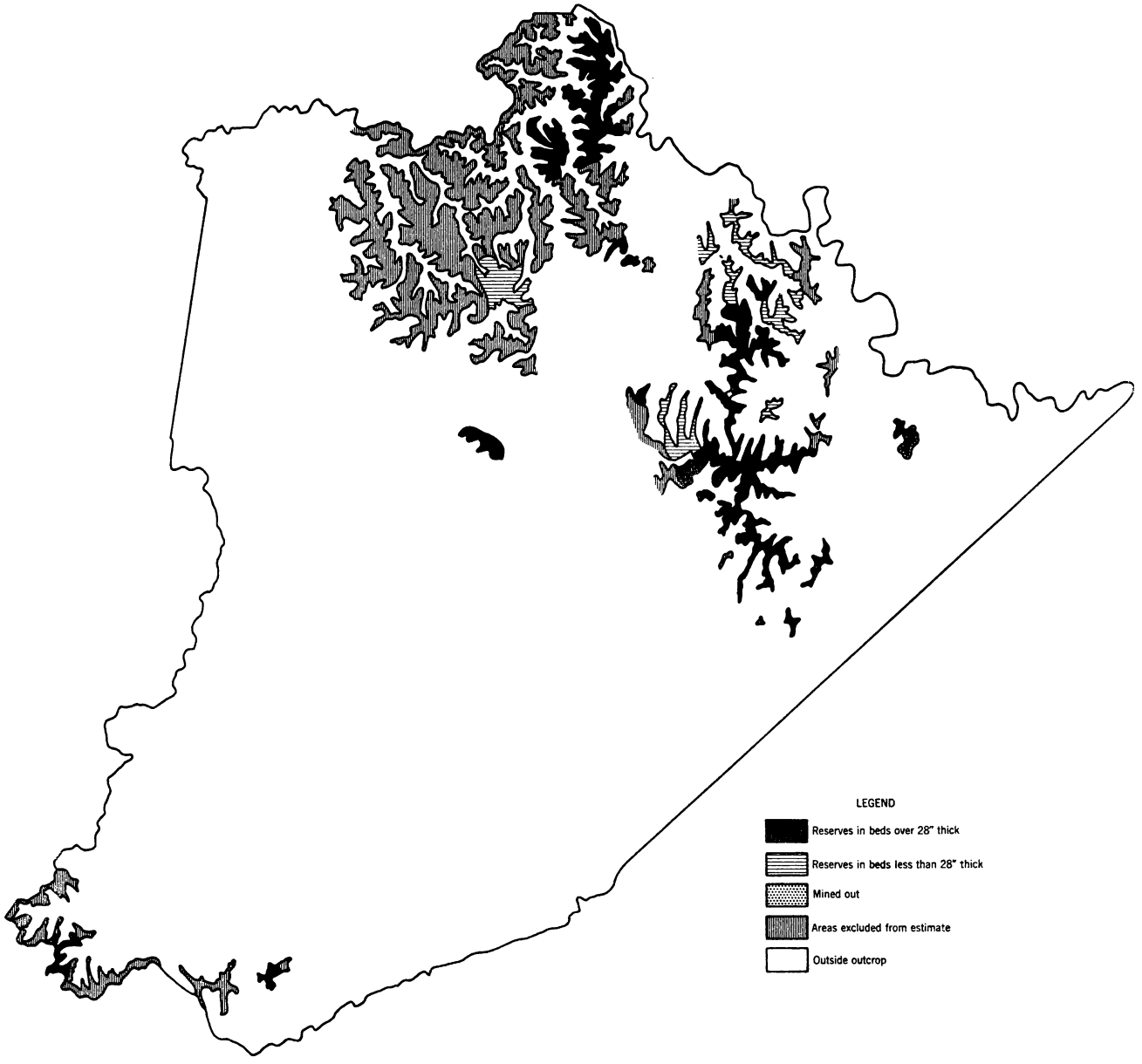

Figure 3. - Fire Clay bed, Pike County, Ky., Jan. 1, 1948.

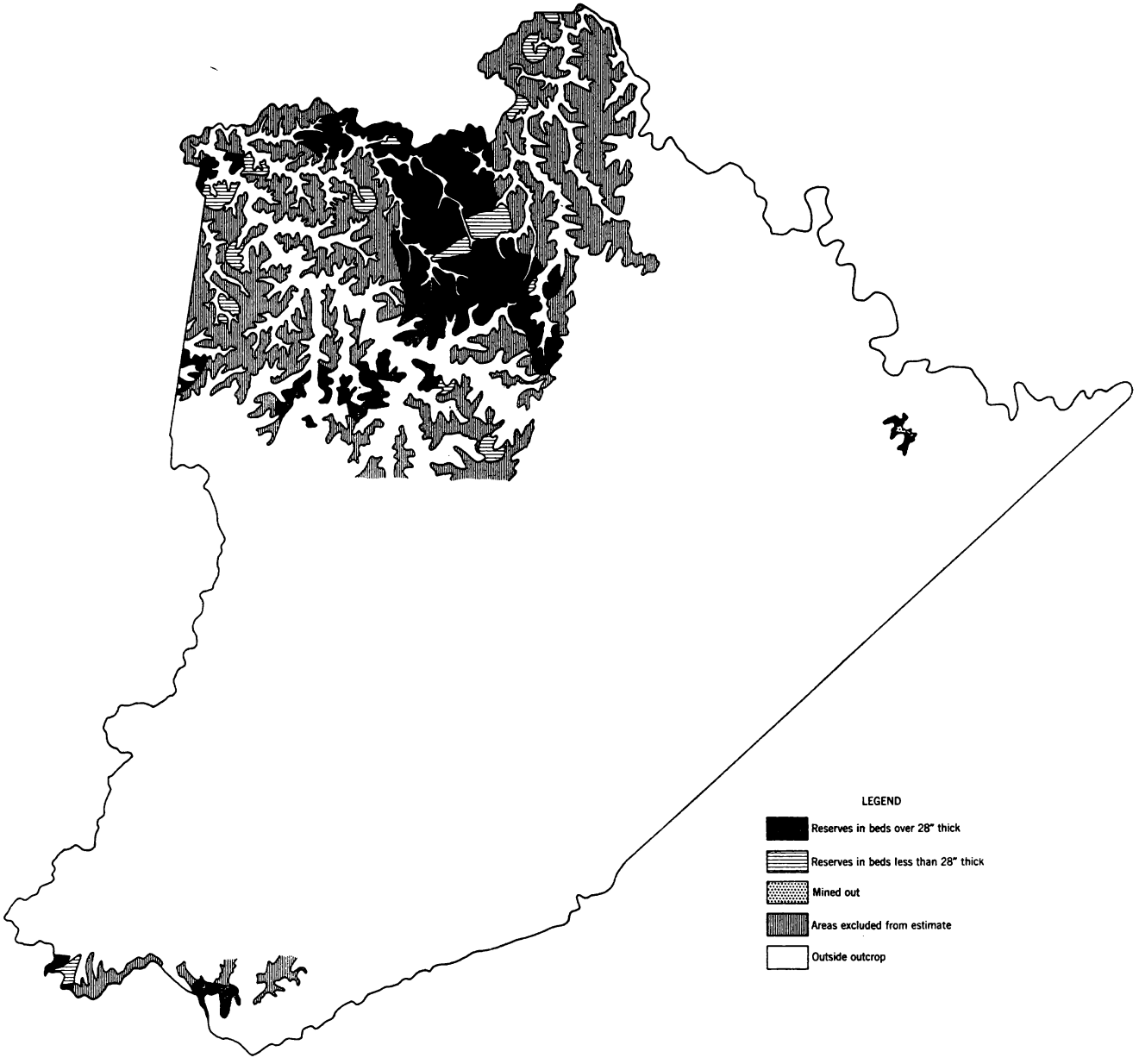

Figure 4. - Whitesburg bed, Pike County, Ky., Jan. 1, 1948.

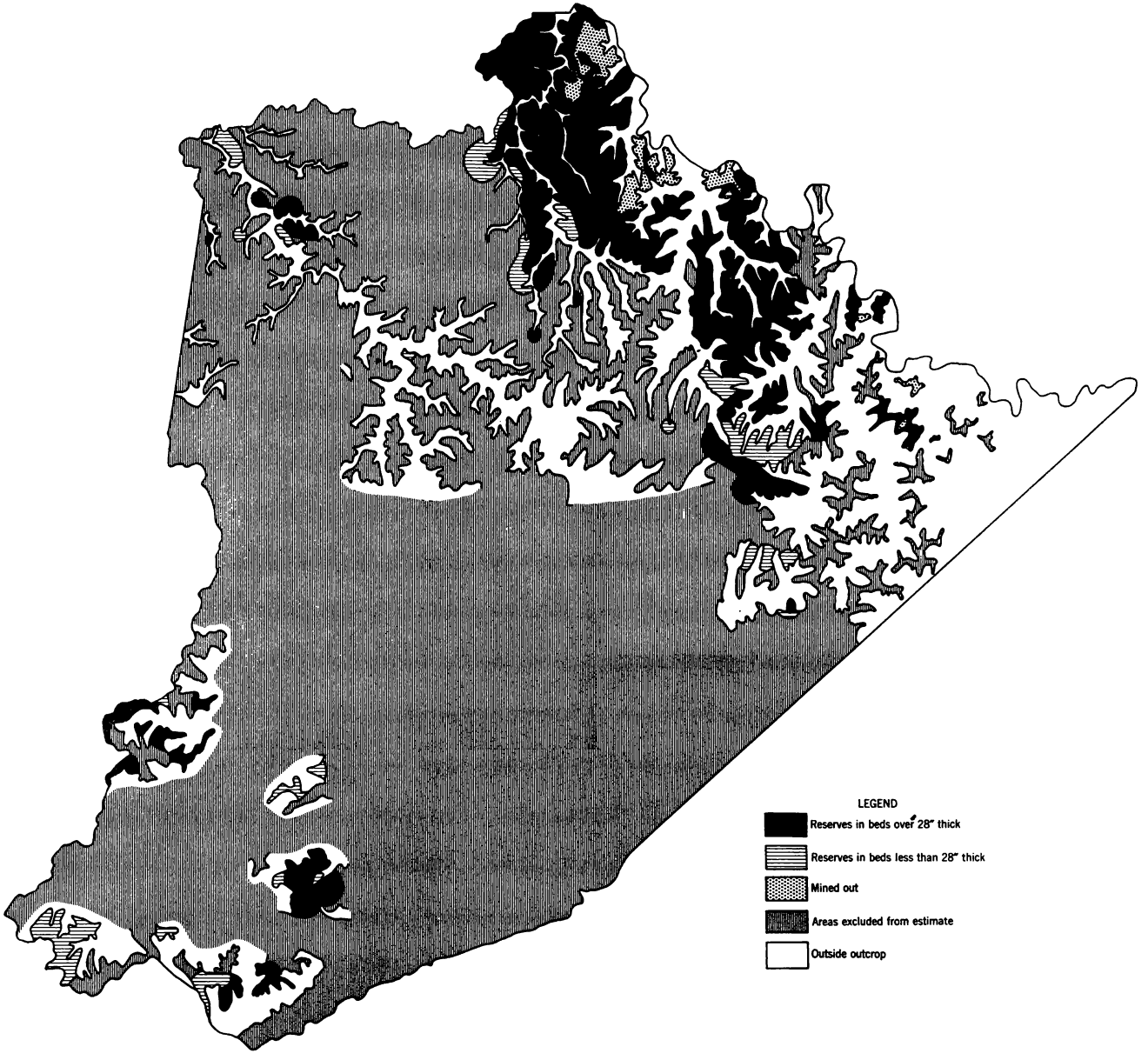

Figure 5. - Williamson bed, Pike County, Ky., Jan. 1, 1948.

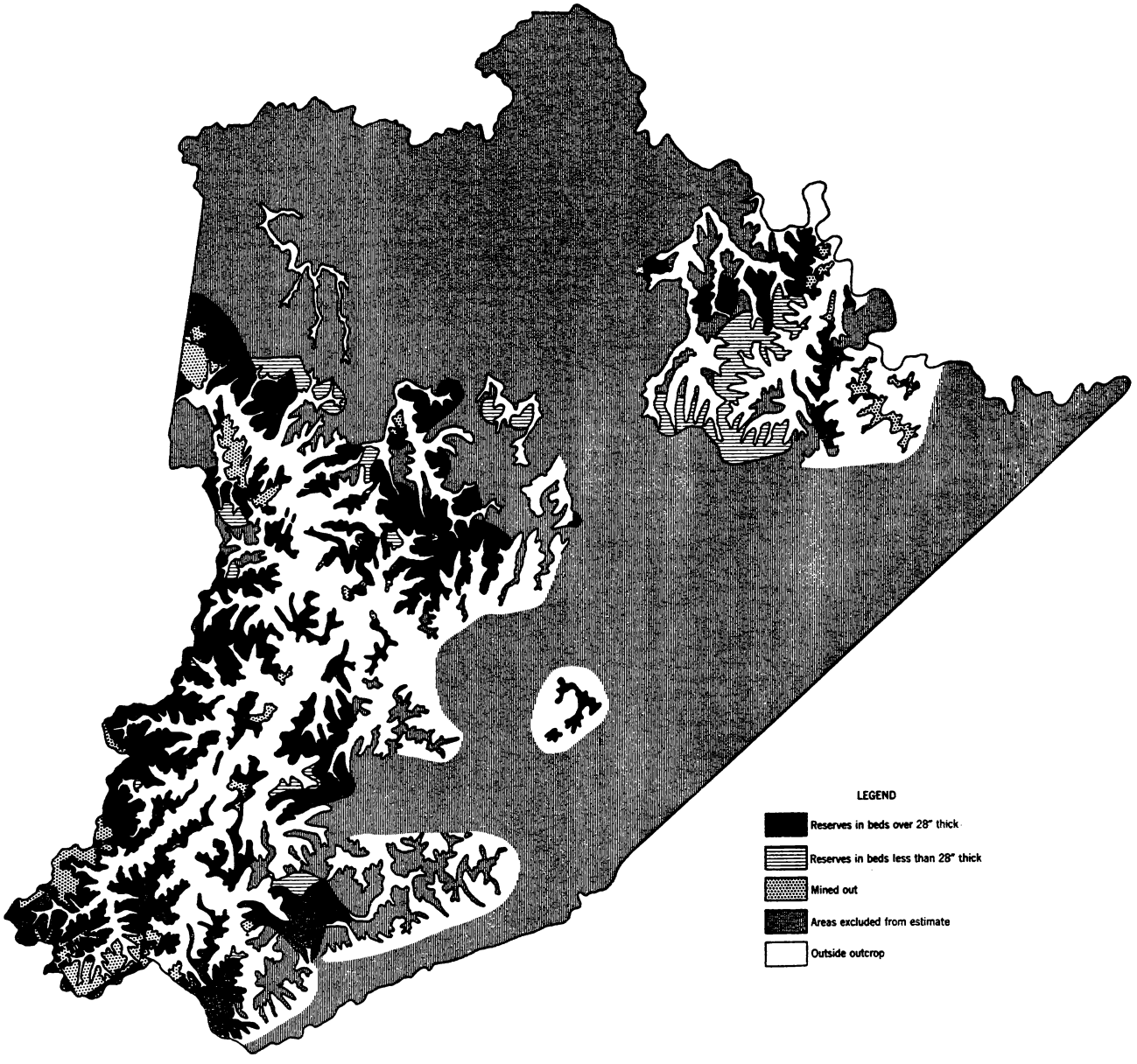

Figure 6. - Upper Elkhorn No. 3 bed, Pike County, Ky., Jan. 1, 1948.

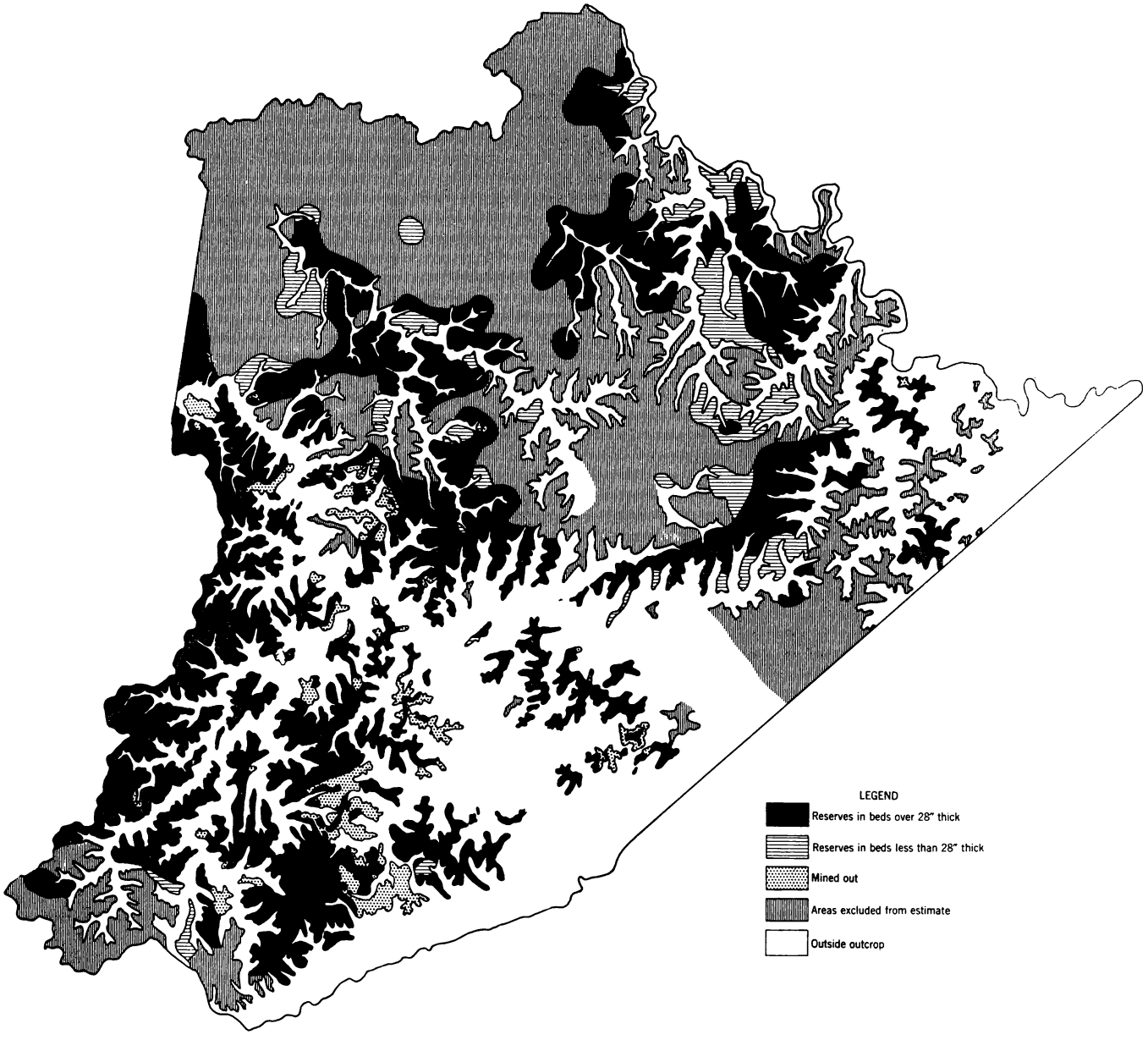

Figure 7. - Upper Elkhorn No. 2 bed, Pike County, Ky., Jan. 1, 1948.

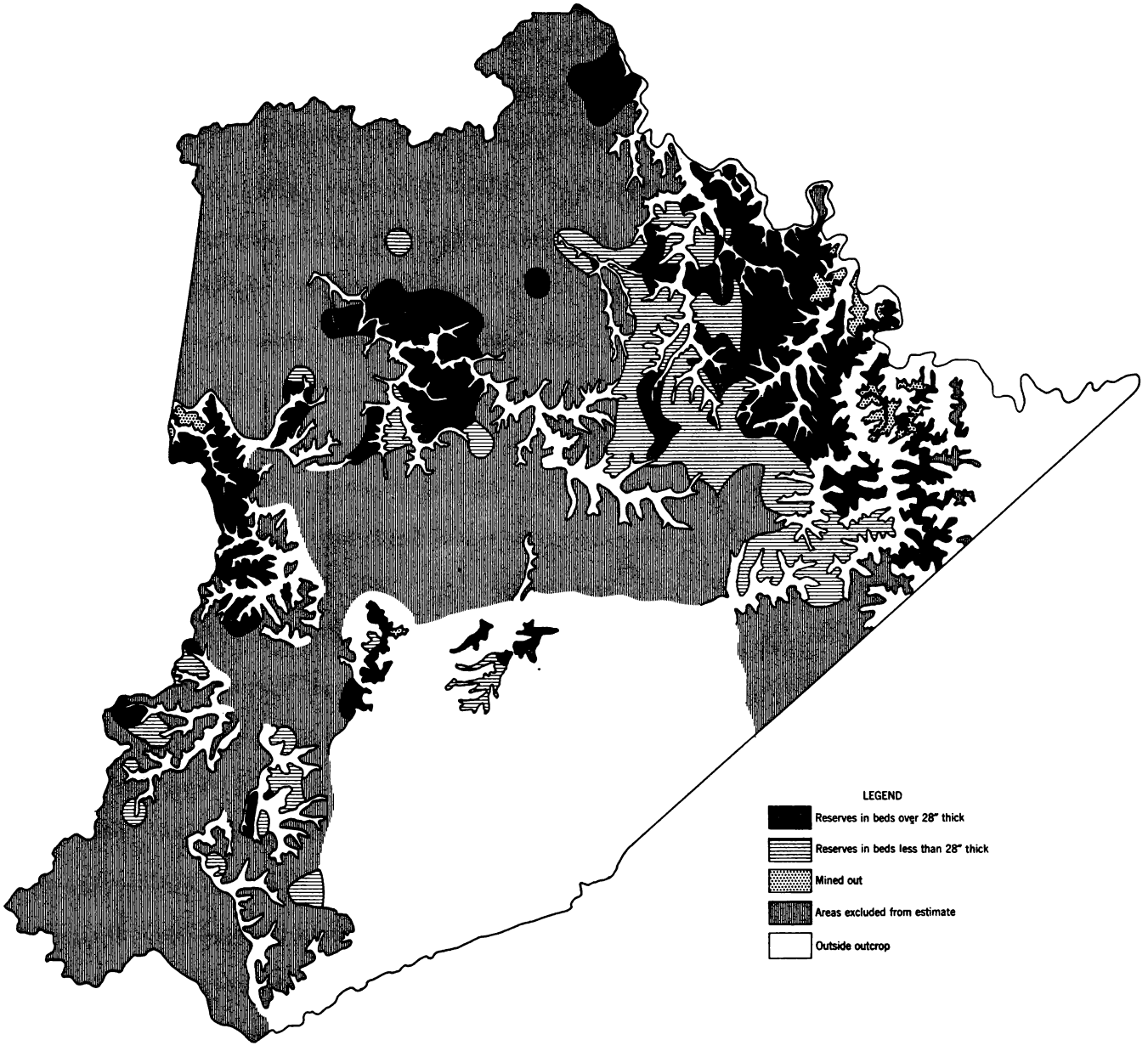

Figure 8. - Upper Elkhorn No. 1 bed, Pike County, Ky., Jan. 1, 1948.

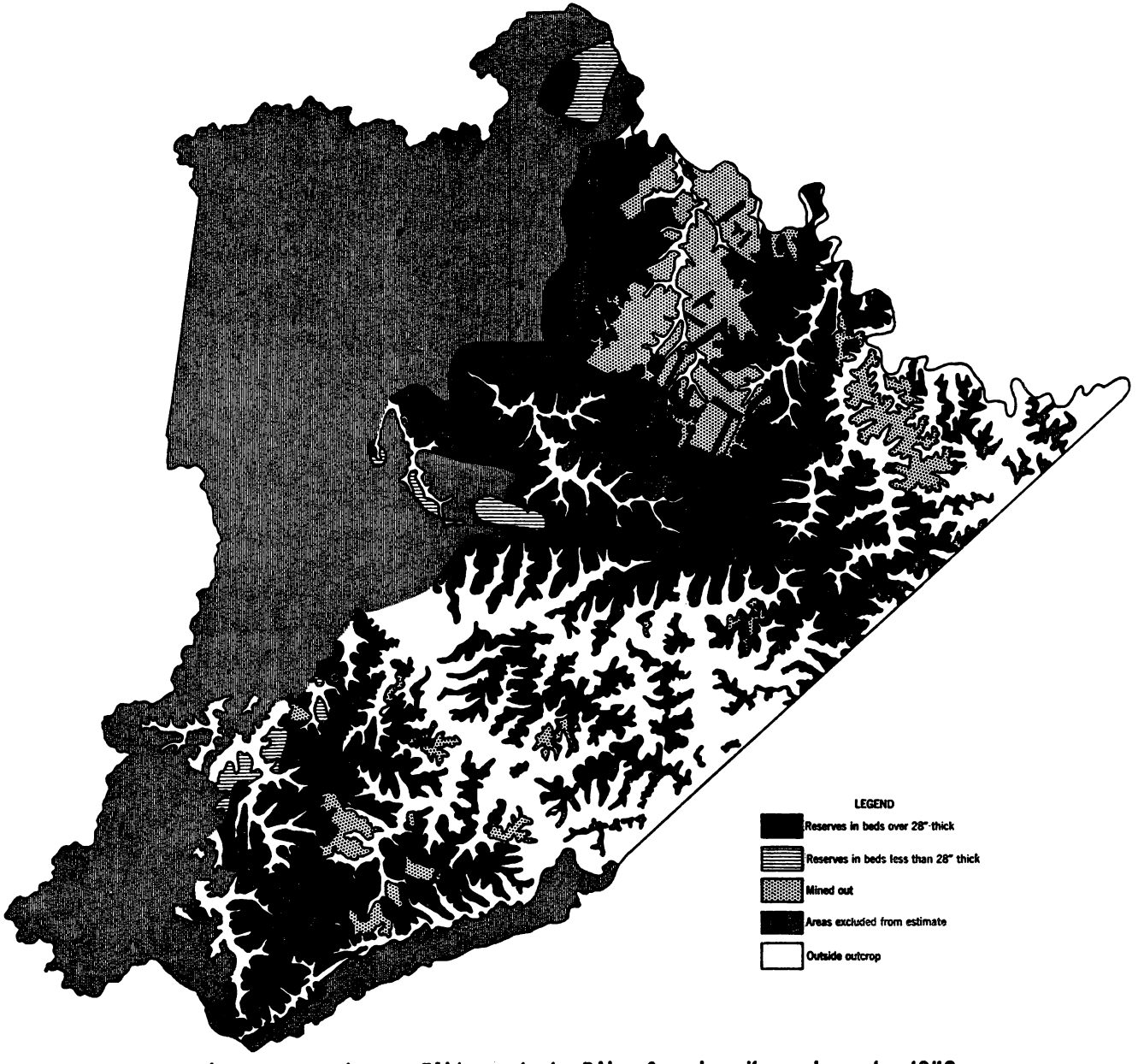

Figure 9. - Lower Elkhorn bed, Pike County, Ky., Jan. 1, 1948.

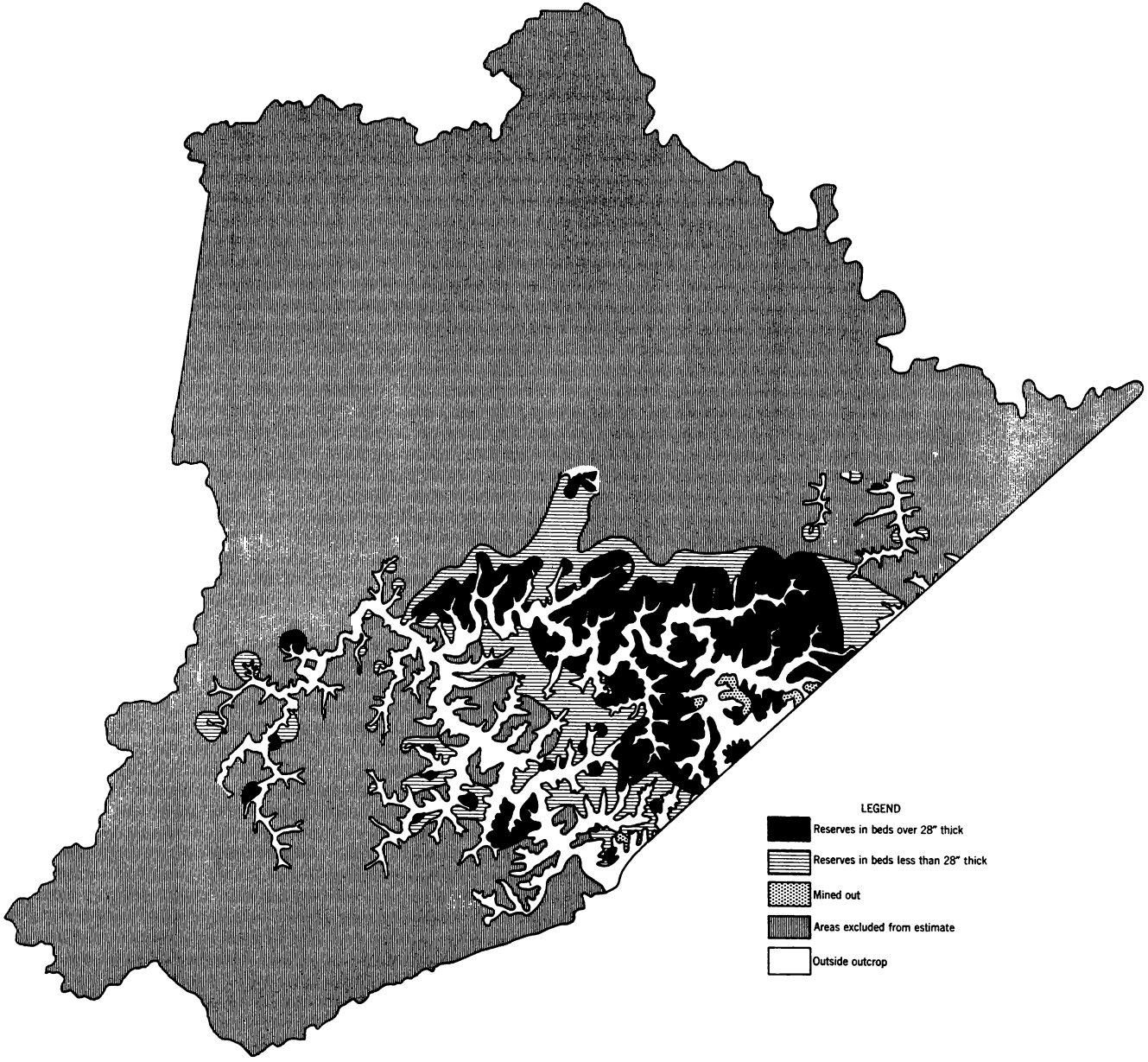

Figure 10. - Bingham bed, Pike County, Ky., Jan. 1, 1948.

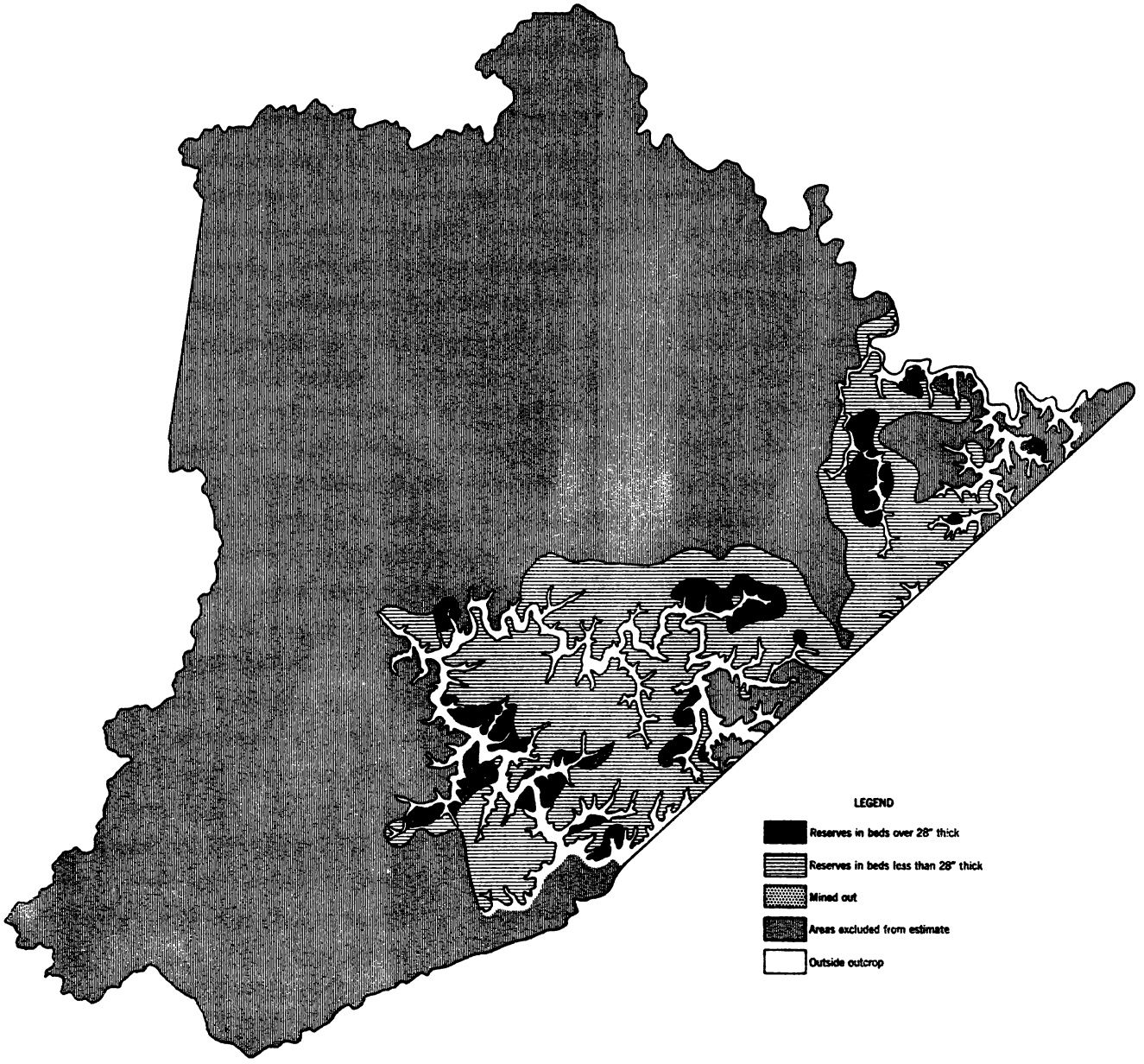

Figure 11. - Millard bed, Pike County, Ky., Jan. 1, 1948.

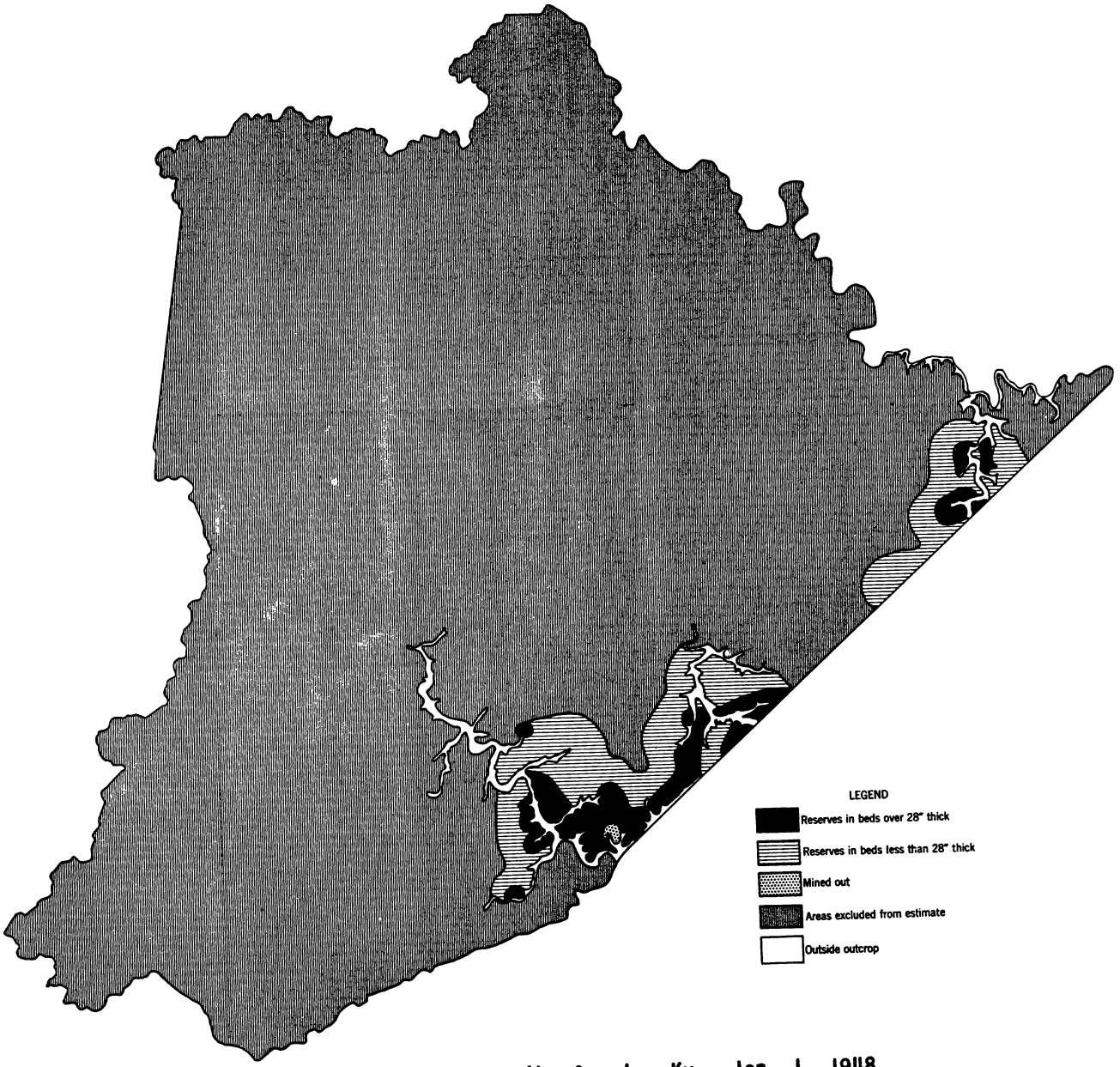

Figure 12. - Auxier bed, Pike County, Ky., Jan. 1, 1948.

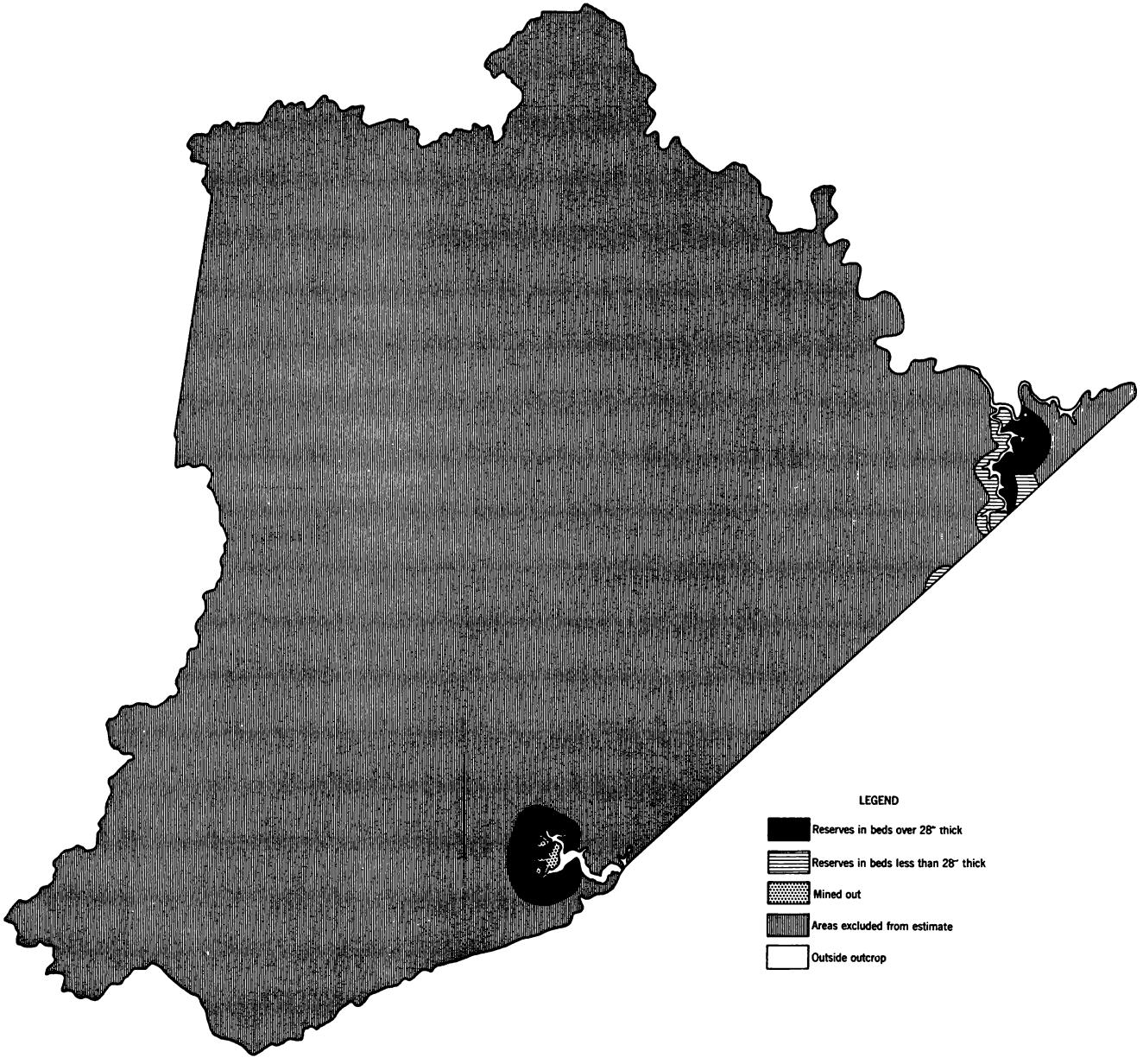

Figure 13. - Elswick bed, Pike County, Ky., Jan. 1, 1948.

Southern Part of County

Material	Inches
COAL	8
Parting	1
COAL	27-1/2
Parting	5
COAL	16
Laminated coal	5
COAL	6
Thickness	68-1/2
COAL	19
Parting	19
COAL	17-1/2
Parting	3-1/2
COAL	29-1/2
Thickness	88-1/2

Material	Inches
COAL	12
Parting	8-1/2
COAL	10
Laminated coal	5
COAL	3
Laminated coal	4
COAL	8
Laminated coal	24
Thickness	74-1/2

Fire Clay Bed

(See fig. 3 and table 4)

The Fire Clay bed (also known as the Taylor, Chilton, Upper Bevins, and Hazard No. 4) is approximately 600 feet above the Lower Elkhorn bed. It has a very wide range in bed thickness. In the eastern part of the county, the lower bench is separated from the upper part of the bed by as much as 40 feet. Known reserves mapped for this bed lie in the northern, eastern, and southwestern parts of the county. Sections of the bed in areas of recoverable reserves follow:

Northeastern Part of County

Material	Inches
COAL	17
Parting	1/2
COAL	25
Parting	1/2
COAL	2
Parting	1
COAL	5-1/2
Thickness	51-1/2
COAL	43
Thickness	43

Material	Inches
COAL	14
Parting	24
COAL	35
Thickness	73
COAL	28
Thickness	28

Eastern Part of County

Material	Inches	Material	Inches
COAL	7	COAL	10
Parting	8-1/2	Parting	1/2
COAL	4-1/2	COAL	27
Parting	1-1/2	Thickness	37-1/2
COAL	11		
Parting	2-1/2		
COAL	2		
Parting	24		
COAL	12		
Thickness	73		

Southwestern Part of County

Material	Inches	Material	Inches
COAL	21	COAL	30
Parting	12	Fire clay	4
COAL	12	COAL	18
Thickness	45	Thickness	52

Whitesburg Bed

(See fig. 4 and table 5)

The largest area of known reserves of the Whitesburg bed (also known as Lower Bevins and Hernshaw) is in the northwest part of the county. Sections of the bed in this area of recoverable reserves follow:

Northwestern Part of County

Material	Inches	Material	Inches
COAL	21	COAL	36
Parting	8	Thickness	36
COAL	12		
Thickness	41	COAL	18
		Parting	2-1/2
COAL	32-1/2	COAL	22
Parting	2-1/2	Thickness	42-1/2
COAL	10		
Thickness	45		

Material	Inches
COAL	17
Parting	2
COAL	11
Thickness	30

Material	Inches
COAL	24
Parting	2
COAL	4
Thickness	30

Material	Inches
COAL	13
Parting	6
COAL	2
Parting	1
COAL	29
Thickness, upper bench	51

Interval - 16 feet

Material	Inches
COAL	9
Parting	1
COAL	11
Thickness, lower bench	21

Williamson Bed

(See fig. 5 and table 6)

The Williamson bed (also known as the Amburgy and Low Splint) is 290 to 350 feet above the Lower Elkhorn. It is 40 to 130 feet (commonly 60 feet) above Elkhorn No. 3 bed. Generally, it is 4 to 5 feet thick in the northern part of the county but thins to the south. In the eastern part of the county it becomes dirty. A large reserve is in the northern part of Pike County. Sections of the bed in areas of recoverable reserves follow:

Northern Part of County

Material	Inches
COAL	12
Shale	1/2
COAL	6
Shale	2
COAL	28
Shale	1
COAL	15
Shale	2
COAL	1-1/2
Thickness	68

Material	Inches
COAL	16
Shale	3
COAL	24
Thickness	43

Material	Inches
COAL	18
Shale	2
COAL	10
Shale	2
COAL	11
Thickness	43

Material	Inches
COAL	4
Shale	1
COAL	7
Shale	4
COAL	44
Thickness	60

Eastern Part of County

Material	Inches
COAL	11
Shale	1/2
COAL	10
Rash	17
COAL	19
Shale	4-1/2
COAL	5-1/2
Shale	4
COAL	8
Thickness	79-1/2

Upper Elkhorn No. 3 Bed

(See fig. 6 and table 7)

The Upper Elkhorn No. 3 bed (also known as the Thacker and Cedar Grove) is 60 to 100 feet above the Upper Elkhorn No. 2 or approximately 250 feet above the Lower Elkhorn. It is multibedded, and in some areas it occurs in two benches separated by a thick parting. Ordinarily, the bed is 3 to 4 feet thick but attains a maximum of 112 inches (including 42 inches of partings) in the southern part of the county. Known reserves are mapped adjacent to mine workings in the northeastern, northwestern, and southwestern parts of the county. Sections of the bed in areas of recoverable reserves follow:

Northeastern Part of County

Material	Inches	Material	Inches
COAL	14	COAL	1
Parting	6	Parting	9
COAL	1	COAL	7-1/2
Parting	12	Parting	1
COAL	3	COAL	14
Parting	1	Parting	3/4
COAL	17	COAL	13-1/2
Parting	5	Thickness	46-3/4
COAL	20		
Thickness	79		

Northwestern Part of County

Material	Inches	Material	Inches
COAL	18	COAL	20
Parting	18	Shale with coal streaks	15-1/2
COAL	24	COAL	21
Thickness	60	Thickness	56-1/2

Material	Inches
COAL	28
Parting	1
COAL	12
Thickness	41
Laminated coal	15
COAL	15
Thickness, upper bench	30

Interval - 13 feet

COAL	21
Parting	9
COAL	14
Parting	16
COAL	13
Thickness, lower bench	73

Material	Inches
Bone	1/2
COAL	14
Bone	1-1/2
COAL	11
Parting	11-1/2
COAL	10
Parting	3-1/2
COAL	15
Thickness	67

Southwestern Part of County

Material	Inches
COAL	10-1/2
Parting	4-1/2
COAL	15
Parting	18-1/2
COAL	20-1/2
Thickness	68-1/2
COAL	4
Parting	11-1/2
COAL	21-1/2
Parting	1/2
COAL	10-1/2
Parting	4
COAL	7
Thickness	59
COAL	36
Parting	7
COAL	32
Thickness	75
COAL	2
Parting	7
COAL	34
Thickness	43

Material	Inches
COAL	24
Parting	1/2
COAL	12
Parting	8
COAL	24
Thickness	68-1/2
COAL	42
Parting	12
COAL	25
Thickness	79
COAL	1
Parting	11
COAL	5
Parting	12
Laminated coal	1
COAL	12
Parting	4
COAL	22
Parting	18
COAL	26
Thickness	112

Upper Elkhorn No. 2 Bed

(See fig. 7 and table 8)

The Upper Elkhorn No. 2 bed (also known as the Lower Thacker and Lower Cedar Grove) is 135 to 175 feet above the Lower Elkhorn. The interval between the Upper Elkhorn No. 2 and No. 1 beds ranges from a few inches to 75 feet. In many localities in the central part of the county (extending from northwest to southeast) the Upper Elkhorn No. 2 and No. 1 beds form a single multibedded bed, which locally attains a maximum thickness of 7 feet. The parting between these beds ranges from a fraction of an inch to 30 feet within the boundaries of a mining property. Where the Upper Elkhorn No. 1 and No. 2 beds are one, they have been mapped as the No. 2 bed. Ordinarily, the Upper Elkhorn No. 2 bed ranges from 3 to 4 feet thick. Laminated coal immediately overlying the coal is characteristic, but frequently a thin layer of fire clay overlies the coal. In the extreme eastern and extreme western parts of the county where this fire clay is found most frequently, the mine roof is difficult to control. Sections of the bed in areas of recoverable reserves follow:

Eastern Part of County

Material	Inches
COAL	7-1/2
Shale	3/4
COAL	33
Shale	3
COAL	3
Thickness	47-1/4

Central Part of County

Material	Inches
Laminated shale and coal	
COAL	18
Shale	12
COAL	54
Thickness	84

Material	Inches
Laminated shale and coal	
COAL	48
Thickness	48

Southern Part of County

Material	Inches
Laminated coal	10
COAL	32
Thickness	42

Material	Inches
Laminated coal	2-1/2
Shale	1-1/2
COAL	29
Shale	5
COAL	12-1/2
Thickness	50-1/2

Material	Inches
Laminated coal	9
Shale	2
COAL	46
Thickness	57
Laminated coal	10
COAL	37
Thickness	47

Upper Elkhorn No. 1 Bed

(See fig. 8 and table 9)

The Upper Elkhorn No. 1 bed (also known as the Alma and the Penny) is approximately 100 feet above the Lower Elkhorn bed, and where mined in the northeastern part of the county it is 3 to 4 feet thick. It thins to the west and south. However, in the central-western part of the county, the bed again thickens to about 3 feet. In the northwestern part of the county the bed contains several thin partings.

In many localities in the central part of the county, the Upper Elkhorn No. 1 and No. 2 beds form a single multibedded bed, and in these areas the bed has been mapped as Upper Elkhorn No. 2. Sections of the bed in areas of recoverable reserves follow:

Northeastern Part of County

Material	Inches
COAL	6
Bone	1/4
COAL	29-1/2
Thickness	35-3/4
COAL	42
Thickness	42
COAL	9
Parting	2
COAL	14
Parting	3
COAL	12
Thickness	40

Material	Inches
COAL	37-1/2
Thickness	37-1/2
COAL	4
Parting	1
COAL	6
Parting	1
COAL	28
Parting	1
COAL	4
Thickness	45

Northwestern Part of County

Material	Inches
COAL	14
Parting	4
COAL	15
Parting	1
COAL	2-1/2
Thickness	36-1/2
COAL	17
Parting	8
COAL	24
Thickness	49
COAL	13
Parting	1/8
COAL	3
Parting	1/4
COAL	3-1/4
Parting	1/4
Rash	4
COAL	15
Parting	3-1/2
COAL	3
Parting	2
COAL	1
Thickness	48-3/8

Material	Inches
Rash	4
COAL	9
Parting	3
COAL	4
Parting	11
COAL	12
Thickness	43
COAL	18
Parting	1/4
COAL	3
Parting	13
COAL	10
Parting	1/8
COAL	5
Parting	1/4
COAL	3
Parting	1/8
COAL	2
Thickness	54-3/4

Central-Western Part of County

Material	Inches
COAL	35
Thickness	35
COAL	29-1/2
Thickness	29-1/2

Material	Inches
COAL	40
Thickness	40
COAL	35-1/2
Thickness	35-1/2

Lower Elkhorn Bed

(See fig. 9 and table 10)

The Lower Elkhorn bed (also known as the Pond Creek, Freeburn, Warfield, No. 2 Gas, Shelby Gap, and Campbell Creek) is the most extensive of the four major beds in Pike County. It is normally 4 to 5 feet thick and underlies most of the county. A few inches of laminated coal, which is high in ash, usually is present at or near the top of the bed. Toward the southwest part

of the county the thickness of the laminated coal increases up to 18 inches, which in places is approximately one-third of the bed thickness. The known reserves that have been mapped are in the northeastern and southwestern parts of the county. Sections of the bed in the areas of recoverable reserves follow:

Northeastern Part of County

Material	Inches
COAL	12
Rash	5
COAL	48
Thickness	65
COAL	17
Laminated coal	10
COAL	42
Thickness	69
COAL	8
Rash	8
COAL	47
Thickness	63
COAL	7
Laminated coal	8-1/2
COAL	32
Parting	2
COAL	23-1/2
Thickness	73

Material	Inches
COAL	1/2
Parting	3
COAL	4
Rash	6
COAL	54
Thickness	67-1/2
COAL	6
Parting	6
COAL	12
Parting	3
COAL	27
Thickness	54
Rash	1
COAL	7
Laminated coal	3
COAL	28
Thickness, upper bench	39
Interval - 77 inches	
Lower bench - 20 inches	

Southwestern Part of County

Material	Inches
COAL	7
Parting	6
COAL	35
Thickness	48
COAL	9-1/4
Laminated coal	11-1/2
COAL	39-3/4
Thickness	60-1/2

Material	Inches
Laminated coal	4
COAL	52
Thickness	56
COAL	1-1/2
Laminated coal	10
COAL	23-1/2
Thickness	35

Material	Inches
COAL	10
Parting	6
COAL	7
Laminated coal	13
COAL	21
Thickness	57
Cannel coal	5
COAL	1
Laminated coal	18
COAL	23
Thickness	47

Material	Inches
COAL	4
Laminated coal	10
COAL	26
Thickness	40
COAL	8
Laminated coal	12
COAL	16-1/2
Thickness	36-1/2
COAL	21
Parting	12
COAL	14
Thickness	47

Bingham Bed

(See fig. 10 and table 11)

The first bed of any importance below the Lower Elkhorn is the Bingham bed (also known as the Clintwood, Feds Creek, and Matewan). It lies 170 to 290 feet (averaging 220 feet) below the Lower Elkhorn and is commonly 3-1/2 to 5 feet thick. The principal area of known reserves lies in the southeastern part of the county and sections of the bed in this area follow:

Southeastern Part of County

Material	Inches
COAL	2-1/2
Parting	1/2
COAL	43
Thickness	46
COAL	43
Parting	2
COAL	16
Thickness	61
COAL	12
Parting	3
COAL	34
Thickness	49

Material	Inches
COAL	7-1/2
Parting	1/2
COAL	34
Thickness	42
COAL	24
Parting	2
COAL	24
Thickness	50
COAL	35
Rash	37
COAL	15
Thickness	87

Material	Inches
COAL	14
Parting	3
COAL	30
Thickness	47

Material	Inches
COAL	8
Parting	2
COAL	28
Thickness	38

Material	Inches
COAL	21
Parting	4
COAL	23
Thickness	48

Millard Bed

(See fig. 11 and table 13)

The Millard bed (also known as the Glamorgan and Cedar) overlies a sandstone 40 to 80 feet thick. The coal is thin in virtually all of the area of reserves but locally attains a thickness of about 3 feet. Known reserves are mapped along the Virginia line in the eastern and southeastern parts of the county. Sections of the Millard bed in areas of recoverable reserves follow:

Southeastern Part of County

Material	Inches
COAL	2
Parting	6
COAL	20
Thickness	28

Material	Inches
COAL	6-1/2
Parting	3/4
COAL	13-3/4
Parting	1/4
COAL	11-3/4
Thickness	32-1/2

Material	Inches
COAL	12
Parting	1
COAL	18
Thickness	31

Material	Inches
COAL	20-1/2
Parting	1
COAL	7
Parting	1
COAL	6
Thickness	35-1/2

Material	Inches
COAL	6-3/4
Parting	1/4
COAL	23
Thickness	30

Material	Inches
COAL	9
Parting	3/4
COAL	15
Parting	1/2
COAL	13-1/2
Parting	1/4
COAL	1-3/4
Thickness	40-3/4

Eastern Part of County

Material	Inches	Material	Inches
COAL	4	COAL	3
Parting	1/4	Parting	1-1/2
COAL	32-1/2	COAL	12
Thickness	36-3/4	Parting	1
		COAL	22
COAL	1/2	Thickness	39-1/2
Parting	1		
COAL	4	COAL	4
Bone	1/2	Parting	1/2
COAL	28	COAL	32
Bone	1/4	Thickness	36-1/2
COAL	3/4		
Thickness	35		

Auxier Bed

(See fig. 12 and table 15)

There is considerable controversy as to whether or not the Auxier bed is correlated with the Splash Dam bed. In this report, the names are used synonymously. At and near the Virginia line, the Auxier bed is 3 to 4 feet thick, but it thins to the west and north. Sections of the bed in areas of recoverable reserves follow:

Southeastern Part of County

Material	Inches	Material	Inches
COAL	17	COAL	21
Parting	1-1/2	Parting	1
COAL	20	COAL	23
Thickness	38-1/2	Thickness	45
COAL	2	COAL	2
Parting	2-1/2	Parting	21
COAL	33-1/2	COAL	38
Thickness	38	Thickness	61
COAL	26	COAL	24
Parting	4	Parting	2-1/2
Laminated coal	4	COAL	7
Thickness	34	Thickness	33-1/2

Elswick Bed

(See fig. 13 and table 17)

The Elswick is stratigraphically the lowest correlated bed in the county. Known reserves are mapped in two small areas in the eastern part of the county. No drill logs are available from which to determine the extent of the bed. Thus, the reserve estimates are based on outcrop measurements and bed sections in mined areas. Sections of the bed in areas of recoverable reserves follow:

Eastern Part of County

Material	Inches
COAL	30
Parting	9
COAL	7
Thickness	46
COAL	38
Bone	2
Thickness	40
COAL	17
Parting	1-1/2
COAL	20
Thickness	38-1/2

Material	Inches
COAL	3
Parting	1
COAL	24
Laminated coal	6
Thickness	34
COAL	1-1/2
Parting	1/2
COAL	31
Thickness	33

ANALYSES OF PIKE COUNTY COALS

The chemical analyses[8/] in table 19 are arranged stratigraphically for the coal beds. Most of the analyses are of composite samples made by combining three or more mine samples to obtain a mine average. As these are mine samples, the quality of the coal indicated is generally higher than that of tipple samples. The coal classified according to rank falls into the high-volatile A bituminous group.

The analyses for each bed are arranged alphabetically according to towns.

8/ Bureau of Mines, Analyses of Kentucky Coals: Tech. Paper 652, 1944, pp. 142-151.

TABLE 19. - Analyses of Pike County coals

Location	Bed	Rank[1]	Kind of sample[2]	As received	Dry basis				
				Moist.	Vol.	F.C.	Ash	Sul.	B.t.u.
1	2	3	4	5	6	7	8	9	10
Johns	Winifrede (Flatwoods)	Hvab	M	4.9	37.8	56.0	6.2	0.7	13,780
Rural	do.	do.	M	5.4	39.2	57.5	3.3	.6	14,520
Ransom	Fire Clay (Taylor)	do.	M	3.1	36.6	56.6	6.8	.7	14,020
Simers	do.	do.	M	3.0	35.1	60.5	4.4	.5	14,470
Boldman	Fire Clay (Bevins)	do.	M	4.5	38.2	56.0	5.8	.8	14,010
Goody	Williamson	do.	M	2.9	40.4	53.4	6.2	3.0	14,060
Betsy Layne	Upper Elkhorn No. 3	do.	M	4.3	38.4	57.5	4.1	1.1	14,200
Boldman	do.	do.	M	3.8	38.8	56.1	5.1	1.1	14,100
Pauley	do.	do.	M	3.4	38.7	56.8	4.5	1.0	14,290
Boldman	Upper Elkhorn No. 2	do.	M	4.3	36.6	60.3	3.1	.7	14,440
Dorton	do.	do.	M	3.2	34.3	60.5	5.2	1.1	14,340
Nellier	do.	do.	M	3.0	32.8	64.6	2.6	.6	14,840
Lookout	do.	do.	M	3.1	36.1	62.1	1.8	.6	14,960
Boldman	Upper Elkhorn No. 1 (Alma)	do.	M	4.6	38.0	58.3	3.7	.9	14,340
Elkhorn City	do.	do.	M	2.3	35.3	61.2	3.5	.5	14,860
McCarr	do.	do.	M	2.8	34.7	60.6	4.7	.7	14,430
McCarr	do.	do.	M	2.7	34.6	61.9	3.5	.5	14,770
Vulcan (W. Va.)...	do.	do.	M	2.7	35.5	61.6	2.9	.5	14,940
Aflex	Lower Elkhorn (Pond Creek)	do.	M	3.4	35.2	61.7	3.1	.5	14,650
Dunleary	do.	do.	M	2.4	32.7	63.0	4.3	.6	14,600
Elkhorn City	do.	do.	M	2.6	33.7	62.0	4.3	.6	14,640
Goody	do.	do.	M	3.2	35.3	60.3	4.4	.5	14,380
Huddy	do.	do.	M	2.4	34.7	59.7	5.6	.6	14,300
Lookout	do.	do.	M	4.0	33.7	64.3	2.0	.5	14,890
Majestic	do.	do.	M	2.8	34.3	61.0	4.7	.7	14,630
McVeigh	do.	do.	T	2.8	34.6	58.6	6.8	.5	14,220
Stone	do.	do.	M	2.8	34.8	60.5	4.7	.5	14,450
Praise	Bingham	do.	M	1.1	34.8	57.5	7.7	2.0	14,290
Simers	do.	do.	M	3.5	31.0	59.4	9.6	.9	13,510
Fishtrap 1-2/3 mi. NE. of Jamboree	Millard	do.	M	3.1	32.0	59.6	8.4	.6	13,930
1/3 mi. SW. of Nigh	do.	do.	M	1.7	32.3	61.2	6.5	.6	14,480
3/4 mi. NW. of Praise	do.	do.	M	2.0	33.3	59.1	7.6	.9	14,250
Praise	Auxier	do.	M	2.3	30.8	59.6	9.6	2.5	13,950
Praise	do.	do.	M	1.8	32.5	62.1	5.4	1.2	14,630
Praise	Elswick	do.	M	2.1	30.3	60.6	9.1	2.7	14,000

1/ Hvab = High-volatile A bituminous.
2/ M= ine sample; T = Tipple sample.

CARBONIZATION OF PIKE COUNTY COALS

The coal beds of eastern Kentucky are part of the Appalachian region and possess many of the excellent properties characteristic of West Virginia coals. Their importance in the carbonization industry is indicated by the Preprint from Minerals Yearbook of 1948,[9] which shows that 14,548,607 tons, or about 15 percent of the total coal carbonized that year, was produced in Kentucky. Generally, the coals from the eastermost counties are well-suited chemically for coke making, because they contain low proportions of moisture, ash, and sulfur. Because they are of high-volatile rank, they must be blended with 15 to 30 percent low- or medium-volatile coal to obtain coke with physical properties comparable to those of the cokes now used by metallurgical industries.

Coals from the Lower Elkhorn (Pond Creek), Upper Elkhorn No. 1, Upper Elkhorn No. 2, and Upper Elkhorn No. 3 beds are high-volatile coking coals. Bureau of Mines pilot-scale tests have shown that Lower Elkhorn coal[10, 11] cokes strongly when blended with 20 and 30 percent low-volatile coal.

Although Winifrede bed coal is not known to have been used for the production of metallurgical coke, it probably would be suitable if blended with coking coals of higher rank. Winifrede-bed coal, which is classed as coking, contains relatively high proportions of splint. Fire Clay (Hazard No. 4) coal from nearby Perry County yielded strong coke[12] when blended with 20 and 30 percent Pocahontas No. 3.

9/ United States Dept. of the Interior, Bureau of Mines, Preprint from Minerals Yearbook, 1948, p. 26

10/ Davis, J. D., Reynolds, D. A., Naugle, B. W., Wolfson, D. E., and Birge, G. W., Carbonizing Properties of Thick Freeport and Pittsburgh Coals from Pennsylvania, Elkhorn Coal from Kentucky and America and Mary Lee Coals from Alabama: Bureau of Mines Tech. Paper 726, 1949, 58 pp. With Application of Results to Byproduct Practice by C. H. Flickinger and J. P. Graham.

11/ Fieldner, A. C., Davis, J. D., Selvig, W. A., Reynolds, D. A., Sprunk, G. C., and Auvil, H. S., Carbonizing Properties and Petrographic Composition of Pond Creek-Bed Coal from Majestic Mine, Majestic, Pike County, Ky.: Bureau of Mines Tech. Paper 596, 1939, 46 pp.

12/ Davis, J. D., Reynolds, D. A., Ode, W. H., Holmes, C. R., Elder, J. L., and Wilson, J. E., Carbonizing Properties and Petrographic Composition of Hazard No. 4 Coal from Columbus No. 4 Mine and High-Temperature Carbonizing Properties of Hazard No. 7 Coal from Hardburly Mine, Perry County, Ky.: Bureau of Mines Tech. Paper 672, 1945, 45 pp.

Clintwood-bed coal13/ from Buchanan County, Va., which correlates with the Bingham bed in Pike County, Ky., yielded the highly-fissured coke generally obtained from eastern Kentucky coals when carbonized singly. Blending with suitable low-volatile coal would improve the coking property of this coal.

13/ Fieldner, A. C., Davis, J. D., Thiessen, R., Selvig, W. A., Reynolds, D. A., Jung, F. W., and Sprunk, G. C., Carbonizing Properties and Petrographic Composition of Clintwood-Bed Coal from Buchanan Mines Nos. 1 and 2, Buchanan County, Va.: Bureau of Mines Tech. Paper 570, 1936, 33 pp.

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