VIRGINIA DIVISION OF MINERAL RESOURCES
PUBLICATION 111

COAL RESOURCE ESTIMATE FOR LEE COUNTY, VIRGINIA

Elizabeth V. M. Campbell, James A. Henderson, Jr., and Lesley L. Myers

COMMONWEALTH OF VIRGINIA

DEPARTMENT OF MINES, MINERALS AND ENERGY
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Robert C. Milici, State Geologist

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RICHMOND, VIRGINIA
O. Gene Dishner, Director

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Coal Resource Estimate for Lee County, Virginia

Elizabeth V. M. Campbell, James A. Henderson, Jr.[1], and Lesley L. Myers[2]

ABSTRACT

A re-evaluation of the coal resources in Lee County indicates 944-million short tons of coal originally existed, of which 72-million short tons have been mined, leaving 871-million short tons of remaining coal. The new estimate is almost twice the coal estimated to be remaining by the last detailed coal resources evaluation for Lee County (Brown and others, 1952). An increase in the amount of available data, particularly drill hole data, allowed the coal resources to be extended into areas where previous investigators assumed they did not exist. Conversely, more coal probably has been mined than is here reported.

INTRODUCTION

Lee County is the most southwestern county in Virginia. The county is bordered on the south by Tennessee and on the west by Kentucky. The coal-bearing strata of Pennsylvanian-age are exposed only in the northern portion of Lee County in the Appalachia, Benham, Big Stone Gap, Evarts, Keokee, and Pennington Gap 7.5-minute quadrangles (Figure 1). The coal-bearing portions of these quadrangles are in the Appalachian Plateaus physiographic province which is characterized by a highly dissected topography with V-shaped valleys and sharp crested ridges. The elevations range from 1,380 feet along the North Fork of the Powell River in the Pennington Gap quadrangle to 3,732 feet on the crest of Little Black Mountain in the Keokee quadrangle.

Giles (1925) made the first estimate of the coal resources in Lee County, but did not describe his methodology. The last assessment of the coal resources in Lee County was compiled by Brown and others (1952), who calculated resource estimates for 21 coals. Although the methodology of Brown and others (1952) was not fully described, we assume that the data used in the 1952 report were extracted from Giles (1925) and expanded with data obtained from additional field work and from mining companies. The areal extent of each coal bed was multiplied by the average coal bed thickness to obtain the volume of coal. The volume, in acre-feet, was then multiplied by a coal density of 1800 tons per acre-foot to obtain the tonnage for each coal bed. Estimated coal tonnage is described in both thickness and reliability categories.

Each year the Virginia Division of Mines (VDM) subtracts the annual coal production (Table 1), as reported by mine operators, from the values of Brown and others (1952) to maintain an annual estimate of the remaining coal resources in Virginia. The reported annual coal production tonnages do not include coal left or lost in the mining operations. Furthermore, the coal bed names used for reporting the annual production are those used by the mine operators, which may not agree with current stratigraphic usage (Table 2). The Energy Information Administration of the U.S. Department of Energy (EIA-DOE) also estimates the remaining coal resources for individual states. Using the estimate of Brown and others (1952), the EIA-DOE subtracts the annual production values which have been multiplied by a depletion factor of 2.00 for deep mines and 1.25 for strip mines (Energy Information Administration, 1981). EIA-DOE has not calculated resources for individual counties or coal beds since 1974, when EIA-DOE assumed the responsibility for coal resource estimates from the U.S. Bureau of Mines. The coal resource estimate methods used by the VDM and the EIA-DOE do not take into account the new geologic and resources data obtained since the publishing of the report of Brown and others (1952).

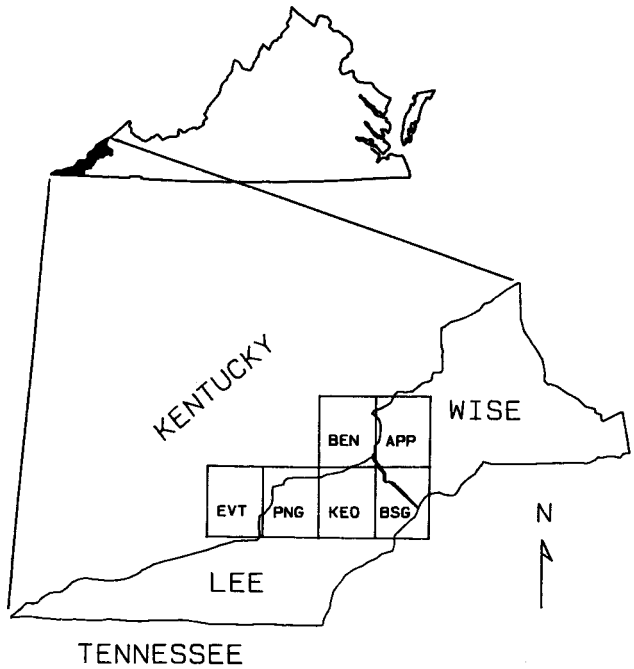

Figure 1. Location map for Lee County, Virginia, showing area underlain by coal and the quadrangles involved in the study.

Recent detailed geologic mapping in Virginia's southwestern coalfields has led to a revision of the Pennsylvanian stratigraphy in this area. This revised stratigraphy, as well as additional drill hole data in Lee County, accumulated during the past three decades, enables the Virginia Division of Mineral Resources (VDMR) to quantify the original coal

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Table 1. Lee County annual coal production from 1951 to 1988 as reported to the Virginia Division of Mines (millions of short tons).

Coal Bed	1951-60a	1961-69a	1970-71b	1972b	1973b	1974b	1975b	1976b	1977b	1978b	1979b	1980b	1981b	1982b	1983b	1984a	1985c	1986c	1987c	TOTAL	Resources on 1/1/52 +	Resources on 1/1/88 ++
34 Inch/Cedar Grove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Blair	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.12	9.24	9.12
Clintwood	0.21	0.04	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.32	84.66	84.34
Dorchester	0.10	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.03	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.45	2.01	1.56
Eagle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gin Creek	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	1.63	1.59
High Splint	0.64	0.00	0.00	0.04	0.01	0.05	0.08	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.07	0.04	0.00	1.08	0.84	-0.24
Imboden/ Campbell Creek	0.82	0.14	0.02	0.01	0.00	0.00	0.12	0.09	0.07	0.22	0.01	0.02	0.18	0.01	0.03	0.04	0.02	0.02	0.00	1.82	55.48	53.66
Kelly	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	15.98	15.95
Kirk	0.16	0.21	0.07	0.00	0.01	0.01	0.03	0.05	0.07	0.05	0.01	0.03	0.01	0.15	0.01	0.02	0.00	0.00	0.00	0.89	1.76	0.87
Low Splint	0.15	0.22	0.09	0.04	0.09	0.03	0.03	0.02	0.16	0.14	0.11	0.18	0.03	0.14	0.10	0.12	0.08	0.05	0.13	1.91	21.41	19.50
Lower St. Charles	0.02	0.03	0.02	0.12	0.03	0.30	0.09	0.24	0.12	0.15	0.08	0.09	0.10	0.05	0.11	0.05	0.27	0.06	0.15	2.08	33.63	31.55
Lyons	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	5.77	5.73
Morris	0.01	0.02	0.00	0.00	0.02	0.04	0.08	0.02	0.00	0.03	0.06	0.00	0.00	0.24	0.27	0.00	0.00	0.00	0.00	0.79	2.77	1.98
Norton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pardee	0.02	0.03	0.01	0.05	0.06	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.04	0.01	0.04	0.17	0.01	0.18	0.39	1.04	2.31	1.27
Phillips	0.62	0.85	0.66	0.08	0.30	0.28	0.18	0.14	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.21	13.17	9.96
Pinhook	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.13	9.13
Stone Creek	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.63
Taggart	2.22	3.13	0.50	0.00	0.62	0.63	0.11	0.22	0.31	0.31	0.49	0.53	0.51	0.78	0.77	0.78	0.80	1.17	1.52	15.40	46.59	31.19
Taggart Marker	1.70	2.35	0.16	0.00	0.01	0.03	0.04	0.01	0.00	0.00	0.01	0.07	0.02	0.03	0.01	0.00	0.00	0.00	0.00	4.44	32.89	28.45
Upper St. Charles	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.15	6.68	6.53
Wax	0.01	0.02	0.00	0.04	0.15	0.00	0.00	0.02	0.05	0.00	0.00	0.00	0.07	0.16	0.36	0.48	0.42	0.48	0.54	2.80	2.46	-0.34
Wilson/Upper Standiford/Harlan	3.10	0.44	0.44	0.09	0.31	0.10	0.26	0.29	0.26	0.20	0.15	0.19	0.11	0.11	0.20	0.27	0.10	0.34	0.38	7.34	117.67	110.33
TOTAL	9.80	7.66	1.97	0.47	1.62	1.48	1.06	1.30	1.22	1.13	0.96	1.18	1.21	1.70	1.90	2.06	1.77	2.34	3.12	43.95	466.71	422.75

a. Coal production values from Annual Report of the Virginia Department of Labor and Industry for the respective years.

b. Coal production values calculated from the Annual Reports of the Virginia Department of Labor and Industry for the respective years.

c. Coal production values from the Virginia Department of Mines, Minerals, and Energy, Division of Mines.

\+ Brown and others, 1952.

++ Total production from 1951 to 1989 subtracted from the resources as calculated by Brown and others (1952).

Table 2. Generalized stratigraphic column of Lee County and coal nomenclature.

	VIRGINIA			KENTUCKY
THIS REPORT	MILLER	BROWN	ADDITIONAL LOCAL NAMES	
WISE FORMATION (Campbell, 1893)				
High Splint	High Splint	High Splint	#12	Hazard #7
Morris	Morris	Morris	#11	Cornett
MAGOFFIN MEMBER of the WISE FORMATION (Morse, 1931)				
Pardee	Pardee	Pardee	#10,Limestone Hamlin, Smith	
Wax	Wax	Wax	#9	
Gin Creek	—	Gin Creek	#8	
Phillips	Fire Clay	Phillips	#7, Wallins, 6 Inch Fire Clay,	Fire Clay Dean
KENDRICK SHALE MEMBER of the WISE FORMATION (Jillson, 1919)				
Low Splint	Low Splint	Low Splint	#6, Creveling	Amburgy
34 Inch	—	Cedar Grove	—	
MARCUM HOLLOW SANDSTONE MEMBER of the WISE FORMATION (Miller, 1969)				
Taggart	Taggart	Taggart	#5, Darby, 42 Inch, Roda, McConnell, Keokee	Darby
Taggart Marker	Taggart Marker	Taggart Marker		Kelioka
CLOVER FORK SANDSTONE MEMBER of the WISE FORMATION (Miller, 1969)				
Kirk	—	Kirk	#4	
Wilson	Wilson	Harlan, Upper Standiford	#3, Jackrock	Harlan
Upper St. Charles	—	Upper St. Charles	#2A	
Kelly	Jackrock, #3		Mason #3, Upper Bolling	Path Fork
Imboden	Upper St. Charles, #2	Imboden	#1, Mason #2, Campbell Creek	
Imboden Marker	Lower St. Charles, Imboden	—	Mason #1	
CANNELTON SHALE MEMBER of the WISE FORMATION (White, 1885)				
Addington	—	—	—	
Clintwood	—	Clintwood	North Fork	Hance
Blair	Penn Lee	Blair	Bentley	
Lyons	—	Lyons	Thompson	
Dorchester	—	Dorchester	Cornett, Marsee	Mason
GLADEVILLE SANDSTONE (Campbell, 1893)				
NORTON FORMATION (Campbell, 1893)				
Norton	North Fork			
Hagy	—			

resources more accurately than was possible for previous investigators.

The coal resources estimates in this report are calculated using computer techniques developed by the U. S. Geological Survey (USGS) for the National Coal Resource Data System (NCRDS). The research is a cooperative effort between the VDMR and the USGS. This study was funded in part under contract number 14-08-0001-A-0100.

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STRATIGRAPHY

INTRODUCTION

A detailed understanding of the Pennsylvanian stratigraphy in Lee County is necessary to evaluate coal resources. This understanding leads to more accurate coal bed correlations and thus to better resources estimates. Campbell (1893) subdivided the Pennsylvanian-age rocks in Lee County into five formations: the Lee Conglomerate, the Norton Formation, the Gladeville Sandstone, the Wise Formation, and the Harlan Sandstone. Giles (1925) further refined the stratigraphy by describing and naming several coal beds and included a detailed description of the coal resources of Lee County. In some places, coal bed correlations between stream valleys were determined by identifying prominent sandstone ledges on the assumption that sandstone beds, particularly the Gladeville Sandstone, were laterally persistent (Giles, 1925). Subsequent stratigraphic work (Miller, 1965; Miller, 1969; Miller and Roen, 1971, 1973; Nolde and others, 1987) used the nomenclature establish by Campbell (1893) and Giles (1925).

The most recent geologic mapping in Wise County utilized gamma-ray profiles of measured sections and drill holes to aid in the correlation of coal beds (Henika, 1988; Whitlock and others, 1988). Marine zones, interpreted as bay-fill sequences (Nolde and others, 1988), are used as datum horizons because they yield characteristically high readings on the gamma-ray profiles and are more persistent regionally than the sandstone beds. Further refinement of the stratigraphy during the GEOHY project lead to an informal subdivision for the Norton and Wise formations. This subdivision is lower and upper Norton Formation, unit 1, unit 2, and unit 3 of the Wise Formation and Wise Formation of Atokan-age (rocks above the Magoffin Member). In Lee County, the Lee Formation includes the rock strata that comprise the lower Norton Formation; the remaining Norton rock strata is the equivalant only to the rocks of the upper Norton Formation in Wise County.

Stratigraphic and geophysical logs from 111 drill holes were used to establish the Pennsylvanian stratigraphic sequence in Lee County (Figure 2). These drill holes were correlated with drill holes from Wise County and the adjacent part of Kentucky to obtain internal consistency with recent geologic mapping (Figure 3). It was determined during this evaluation that, while individual coal beds may be difficult to correlate with confidence, distinct lithologic sequences persist throughout Lee and Wise counties which can be correlated with confidence. These sequences generally contain coal zones consisting of either several coal beds or coal laminations. The coal-bearing intervals are commonly separated by thick non-coal-bearing intervals of shale and discontinuous sandstone bodies. The thicknesses and lithologies of the non-coal-bearing intervals differ laterally. In addition, thin (6 inches or less) coal beds, commonly associated with bay-fill sequences, in the lower portions of thick shale intervals, are laterally persistent. One example in Lee County is the Addington coal, a thin (3 to 6 inches) coal bed at the base of a thick marine shale and siltstone sequence immediately above the Clintwood coal. Bay-fill sequences (marine zones) and these thin, regionally extensive coal beds were used as key stratigraphic horizons to aid in the correlation of the drill logs. Bay-fill sequences used for correlations in this report are the Cannelton Shale Member of the Wise Formation (White, 1891) that is above the Clintwood coal, an un-named shale above the Kelly coal, the Kendrick Shale Member of the Wise Formation (Jillson, 1919) above the Low Splint coal, and the Magoffin Member of the Wise Formation (Morse, 1931; Outerbridge, 1976) above the Pardee coal (Table 2).

Relatively few drill holes penetrate the rocks below the Dorchester coal bed resulting in too few data points to calculate resources with statistical confidence for coal beds below this interval. Coal resources were calculated for only the thickest and most extensive coal and for previously mined coals (Table 3), not for all of the coals described below.

POCAHONTAS AND LEE FORMATIONS

The Pocahontas and Lee formations, undivided, average 1650 feet in thickness and consist of quartzose conglomeratic sandstone interbedded with feldspathic sandstone, siltstone, shale, and coal. Several coal beds are present in drill holes in the Big Stone Gap and Keokee quadrangles (Englund and others, 1983) which penetrate the Lee and Pocahontas forma-

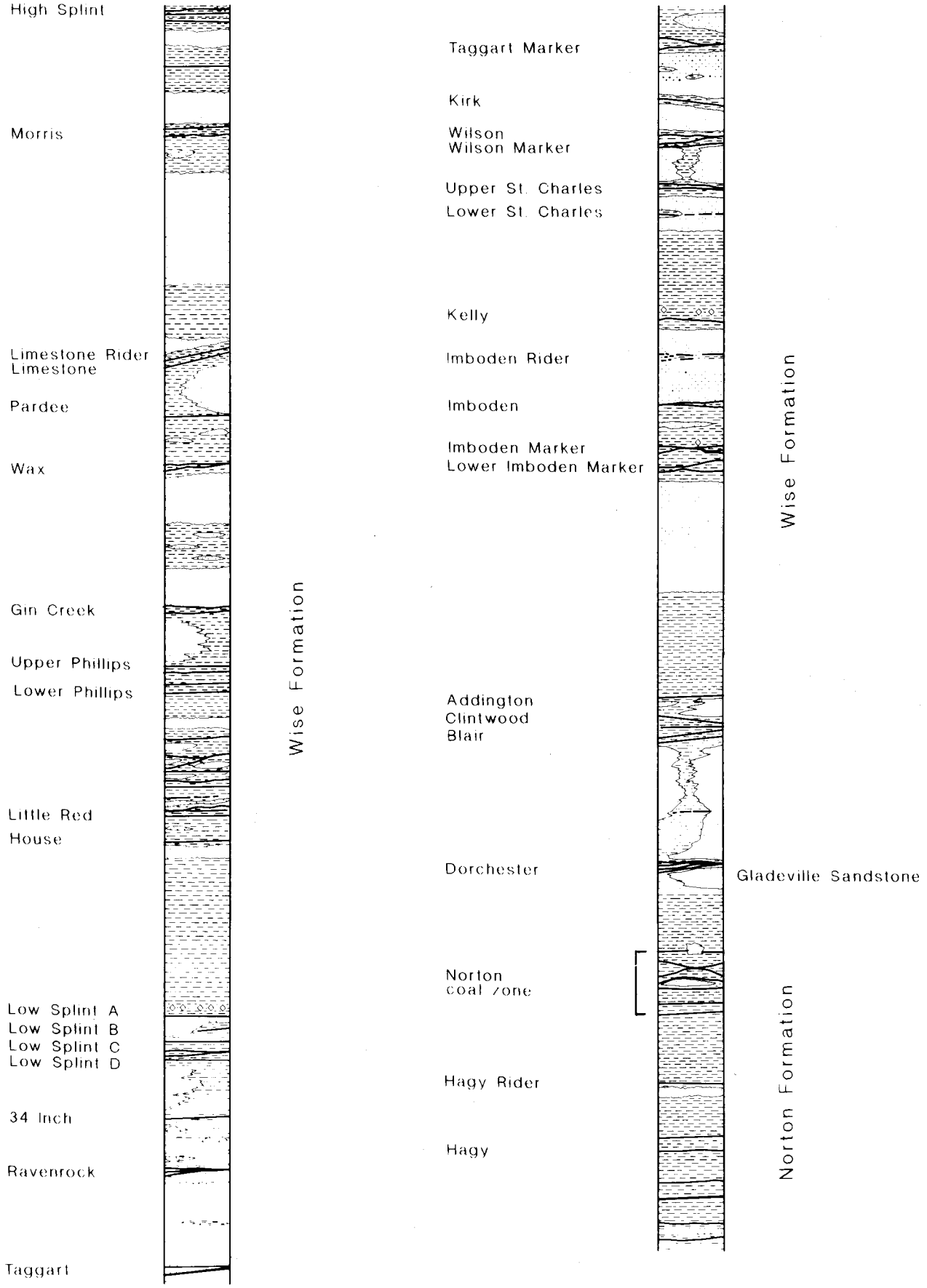

Figure 2. Pennsylvanian stratigraphic column for Lee County.

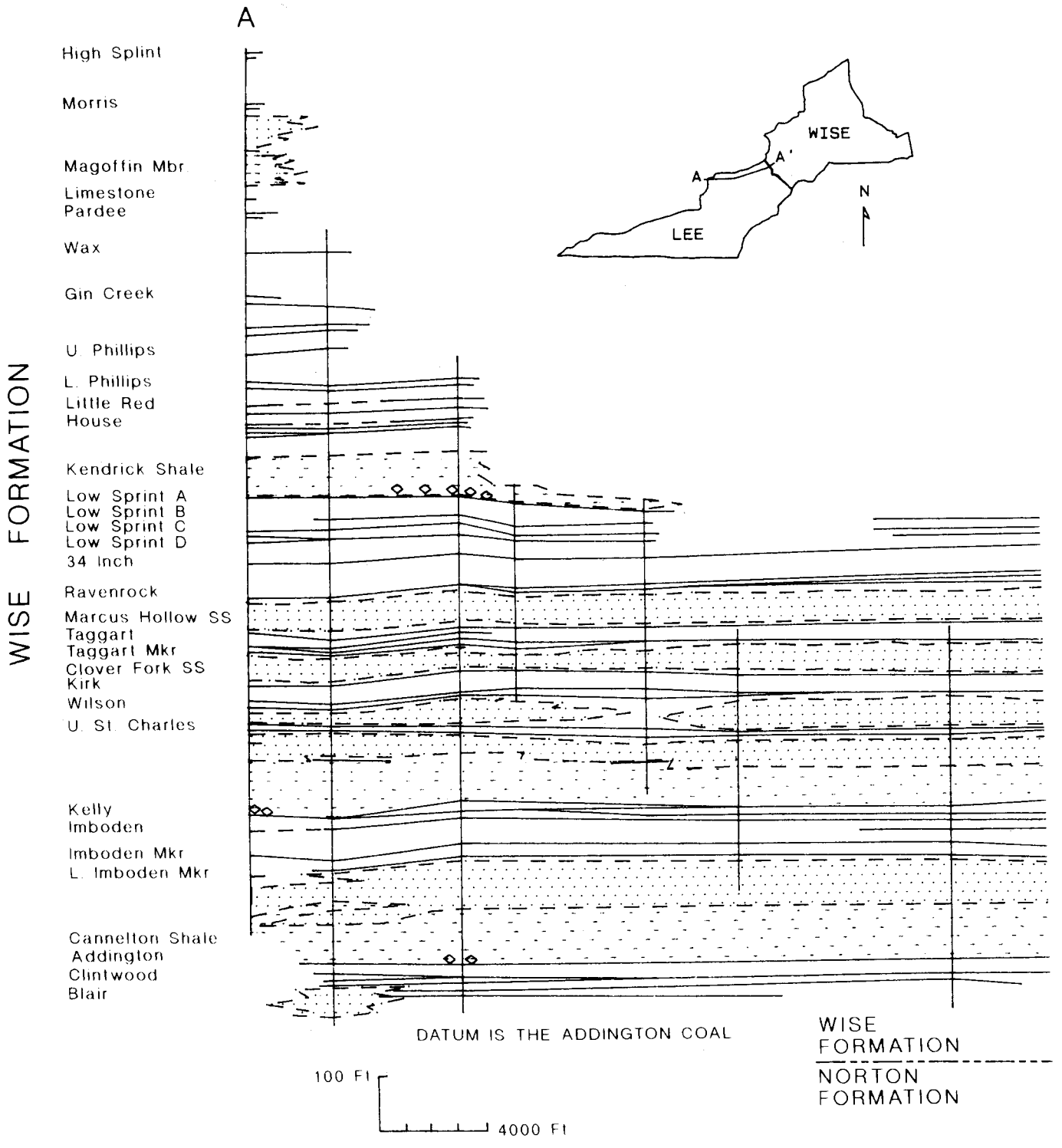

Figure 3. Generalized cross-section across Lee County, Virginia.

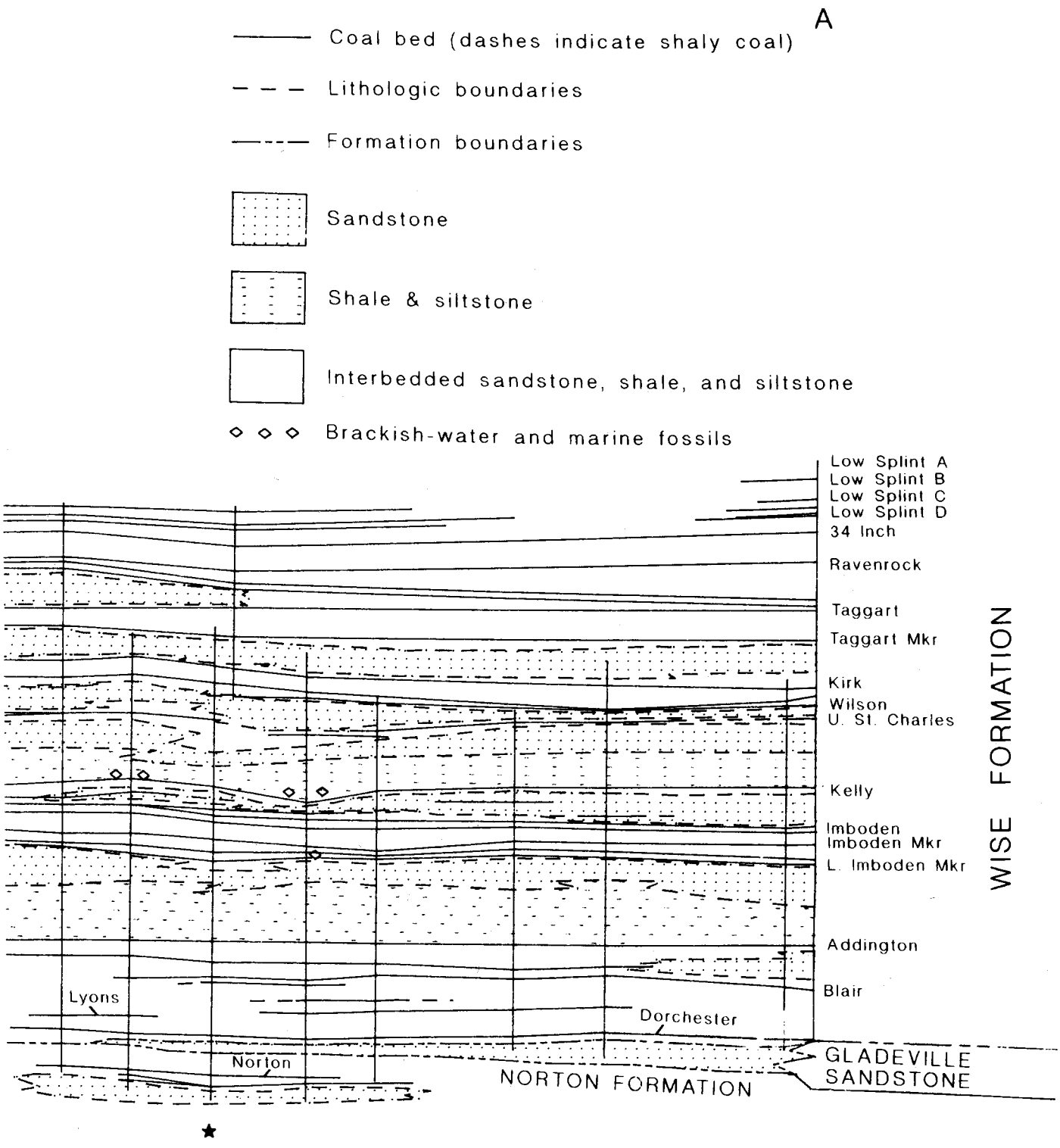
A
Coal bed (dashes indicate shaly coal)
Lithologic boundaries
Formation boundaries
Sandstone
Shale & siltstone
Interbedded sandstone, shale, and siltstone
Brackish-water and marine fossils
Low Splint A
Low Splint B
Low Splint C
Low Splint D
34 Inch
Ravenrock
Taggart
Taggart Mkr
Kirk
Wilson
U. St. Charles
Kelly
Imboden
Imboden Mkr
L. Imboden Mkr
Addington
Blair
WISE FORMATION
Lyons
Norton
Dorchester
NORTON FORMATION
GLADEVILLE SANDSTONE

Table 3. Relation of coal bed nomenclature used in this report to the nomenclature used in the most recent geologic maps of Lee County.

THIS REPORT	VA portion of EVARTS (Tazelaar & Newell, 1974)	PENNINGTON GAP (Miller and Roen, 1973)	KEOKEE (Miller and Roen, 1971)	BIG STONE GAP (Miller, 1965)	BENHAM & APPALACHIA (Lee Co.) (Froelich and Stone, 1973)
High Splint	——	High Splint (No. 12)	——	——	——
Morris	——	Morris (No. 11)	——	——	——
Pardee	——	Pardee (No. 10)	——	——	Pardee
Wax	——	Wax (No. 9)	——	——	——
Gin Creek	——	Gin Creek (No. 8)	——	——	——
Phillips	——	Fireclay (No. 7)	Fire Clay	——	Phillips
Low Splint	——	Low Splint (No. 6) or an un-named coal 30-40 ft below the Kendrick Shale Member	Low Splint	——	Low Splint
34 Inch	@160ft above Darby	@160-200ft above Taggart; @100 ft below Kendrick	@160ft above Taggart; @80ft below Low Splint	——	@60ft below Low Splint
Taggart	Darby	Taggart (No. 5)	Taggart	——	Taggart
Taggart Marker	Kellioka	Taggart Marker; @20ft below the Taggart	Taggart Marker or un-named coal @30ft below Taggart and just above the Clover Fork Sandstone	——	Taggart Marker
Kirk	@40ft above Harlan	@40ft above Wilson just below Clover Fork Sandstone	@30-40ft above Wilson directly under Clover Fork Sandstone where the sandstone exists	——	just below Clover Fork Sandstone; @30ft above Wilson
Wilson	Harlan	Wilson (No. 4) or @40ft below Clover Fork Sandstone	Wilson	Harlan	Wilson
Upper St. Charles	——	@50ft below Wilson & @150ft above Jackrock (No. 3); generally between 2 sandstone bodies; un-named coal in some areas	@50ft below Wilson directly under un-named sandstone body above Keokee Sandstone; partly un-named coal	@60ft below Harlan	Upper St Charles
Kelly	Path Fork	Jackrock (No. 3) sandstone (Pwss) above Imboden; @100ft below Keokee Sandstone; #3	Imboden in east or directly above generally above a sandstone body (Pwss)	@80ft above Imboden;	Kelly
Imboden	un-named coal below Path Fork	Upper St. Charles (No. 2)	un-named coal below sandstone body (Pwss) which is between Robbins Chapel Sandstone and Keokee Sandstone; #2	Imboden	Imboden
Imboden Marker	——	Lower St. Charles or un-named coal @40ft below Upper St. Charles	@40ft below un-named coal mentioned above; correlates with some un-named coals in zone	@40ft below Imboden in creek valleys, probably covered by alluvium	@40ft below Imboden in creek valleys, probably covered by alluvium
Clintwood	@20ft above un-named coal; @80ft below Path Fork	@30ft above Penn Lee; some un-named coals	un-named coal under Gladeville sandstone which is probably the Addington Sandstone of Wise County	un-named coal under Gladeville sandstone which is probably the Addington Sandstone of Wise County	Clintwood
Blair	un-named coal @120ft below Path Fork	Penn Lee (No. 1)	un-named coal 20-40ft below Gladeville; Penn Lee in west	@40ft below the Gladeville	——
Lyons	——	——	@40ft above Clintwood; not in west	@40ft above Clintwood; above sandstone body	——
Dorchester	——	@160ft below Penn Lee	Clintwood in the east; 100ft below Clintwood the Penn Lee in the west & @80ft above un-named coal (Norton?)		Dorchester

tions. Recent stratigraphic work shows that these coals probably correlate with the Jawbone, Tiller, Lee, Middle Horsepen (Little Raleigh), War Creek-Beckley, Pocahontas No. 7 (Cove Creek), Pocahontas No. 6 (Little Fire Creek of Englund and others, 1983), and the Pocahontas No. 1.

NORTON FORMATION

The Norton Formation in Lee County, ranges from 720 to 740 feet in thickness and includes the strata between the top of the Bee Rock Sandstone Member of the Lee Formation and the base of the Gladeville Sandstone. In a corehole log from the Keokee quadrangle (Englund and others, 1983) several Norton Formation coal beds are present. These coal beds are, in ascending order, Kennedy (18 inches) at a drilling depth of 1066 feet, Lower Banner (14.5 inches) at 885 feet, Upper Banner (33 inches) at 729 feet, Splash Dam (19 inches) at 667 feet, and the Norton coal (35 inches) at 402 feet. The Eagle Shale Member is present in the drill hole between 516 and 565 feet. Also the indicated (*) drill hole in Figure 2 extends approximately 375 feet below the Dorchester coal. The Gladeville Sandstone (25 feet thick) is present directly below the Dorchester in this hole. The Norton coal is 85 feet below the Dorchester. The Eagle Shale occupies the interval from 85 to 135 feet below the Norton coal and directly above the Hagy No. 1 coal. The Hagy coal is the lowest coal bed encountered and is about 100 feet below the Eagle Shale.

GLADEVILLE SANDSTONE

In Lee County, the Gladeville is light gray to white, fine to medium grained, moderately quartzose to feldspathic, thick bedded sandstone and commonly has a basal conglomerate. The Gladeville is up to 50 feet thick. The sandstone was mapped from its type section near the town of Wise southwestward through Norton quadrangle (Nolde and others, 1986) and Appalachia quadrangle (Nolde and others, 1988). This mapping shows that the Gladeville Sandstone, an important marker between the Norton and the Dorchester coal beds, laterally grades into shales and siltstones to the southwest. Although this lateral gradation was recognized previously by Miller (1969), field mapping of the sandstone was difficult due to extensive covered areas, structural complications and lack of drill hole information. As a result, other similar sandstones in Lee County appear to have been identified as the Gladeville including a thick sandstone above the Clintwood coal and a sandstone above the Imboden coal. South of Exeter and to the southwest in Big Stone Gap, Keokee, and the Pennington Gap quadrangles, the Gladeville name appears to have been applied to a sandstone approximately 300 feet higher in the section.

WISE FORMATION

Unit 1 of the Wise Formation

Unit 1 consists of strata between the top of the Gladeville Sandstone and the base of the Cannelton Shale Member. The unit crops out in a narrow strip along the North Fork and Pigeon Creek flexures. The interval averages 220 feet in thickness.

The unit is characteristically a sequence of light-olive-gray to medium-gray, thin-bedded siltstone and shale beds containing siderite nodules. Sandstones are light gray, fine to medium grained, discontinuous, and thin to thick bedded. This unit contains the following coal beds, in ascending order, Dorchester, Lyons, Blair, Clintwood, and Addington.

Dorchester Coal Bed

The Dorchester coal bed, at the base of the Wise Formation, is 70 to 120 feet above the Norton coal bed and in many places directly overlies the Gladeville Sandstone. The rock sequence between the Norton and Dorchester coals is thickest in northeastern Lee County, where the Gladeville Sandstone is thickest. The Gladeville Sandstone thins and becomes siltier to the southwest, grading into a siltstone sequence. As a result, the Dorchester coal cannot be identified solely on the assumption that it overlies a thick quartzose sandstone. The Dorchester coal also changes character to the southwest. In the Big Stone Gap quadrangle it is generally a single (average 36 inches) bed with a thin bed of boney coal at its base in some places. In the Keokee quadrangle, however, the Dorchester commonly consists of two splits, approximately equal in thickness, separated by six to eight feet of siltstone. The two beds become further separated and subsequently split into several thinner beds farther to the west.

Lyons Coal Bed

The Lyons coal bed is generally 60 feet above the Dorchester coal bed. The Lyons coal commonly lies directly below a 40- to 80-foot-thick sandstone which inturn is overlain by 8 to 20 feet of shale. The Lyons is locally a single bed, 8 to 18 inches thick, which thins to the west. In drill hole logs from the Pennington Gap quadrangle, the Lyons appears as a very thin coal bed or as coal laminations within a shale interval.

Blair and Clintwood Coal Zone

The Blair and Clintwood coal zone is 100 to 140 feet above the Dorchester coal, and 40 to 80 feet above the Lyons coal where the latter exists. The Blair and Clintwood coal zone contains one to six coal beds (commonly four) within a 10 to 60 foot thick (typically 20 foot) stratigraphic sequence. Where the zone has four coal beds, the top bed (Clintwood) is generally the thickest, ranging from 20 to 40 inches, the two middle beds are thinner, and the bottom-most bed (Blair) is the second thickest on average, ranging from 6 to 80 inches. In places, however, the Blair and its upper split are of equal thickness and only 6 to 10 feet apart. In places, the Blair interval is occupied by a sandstone body. The separation between the upper two coal beds (Clintwood beds) and the lower two coal beds (Blair beds) varies, as does the separation between

the individual coal beds. In Big Stone Gap and Keokee quadrangles, all four coal beds are in a 20-foot interval. In the Pennington Gap quadrangle, the Blair and Clintwood zone is 30 to 50 feet thick with a sandstone separating the Blair beds from the Clintwood beds.

Addington Coal Bed

The Addington coal is a single, persistent, thin (3 to 6-inch) bed at the base of the Cannelton Shale Member. The Addington is present beneath most of the coal-bearing area of Lee County, locally thickening to between 11 and 33 inches in the western portion of the Pennington Gap quadrangle. The coal pinches out completely in the extreme northwestern portion of the quadrangle and appears to be laterally equivalent to a black shale in the northeastern portion of Keokee and the northwestern portion of Big Stone Gap quadrangles. In these quadrangles, the Addington coal or its black shale equivalent is separated from the Clintwood coal by a 30- to 60-foot thick sandstone. In the Pennington Gap quadrangle where the intervening sandstone thins or is absent, the Addington is 10 to 20 feet above the Clintwood.

Unit 2 of the Wise Formation

Unit 2 includes the strata between the base of the Cannelton Shale Member upward to the base of the Kendrick Shale Member. The unit averages 1050 feet in thickness.

This unit is characteristically a sequence of medium-light-gray and light-olive-gray, thin-bedded siltstone and shale. Brackish-water and marine fossils are found in the lower portion of the Cannelton Shale Member and in the shale above the Kelly coal bed. Sandstone in the unit is grayish orange, very fine to medium grained, thin to thick bedded, and locally cross bedded. Unit 2 contains the following formal rock units, the Cannelton Shale, the Clover Fork Sandstone, and the Marcum Hollow Sandstone Members of the Wise Formation. Coal beds or zones in Unit 2 are, in ascending order, Imboden, Kelly, Lower and Upper St. Charles, Wilson and Kirk, Taggart, Ravenrock, 34 Inch, and Low Splint.

Imboden Coal Zone

The Imboden coal zone overlies a 250 to 270 foot thick shale and sandstone interval which includes the Cannelton Shale Member in the lower 90 to 140 feet. The Imboden coal zone is generally 160 feet thick and includes: the Imboden Marker coal, the Imboden coal, and the discontinuous Imboden Rider coal. The Imboden Marker coal generally consists of three coal splits in Keokee quadrangle, but elsewhere may consist of two to four coal splits, with the lower-most split locally being called the Lower Imboden Marker. These splits are in a 30- to 40-foot interval that is 30 to 60 feet below the Imboden coal. The separation between the Imboden and the Imboden Marker increases to the northwest. The Imboden coal generally consists of two or three coal beds within an interval of less than 8 feet. In the Keokee quadrangle, however, the Imboden coal generally is two coal beds that are within 20 feet of each other. Shale, and in places, sandstone separates the beds. The coals merge into a single bed to the northwest. The total coal thickness in this interval is 48 to 66 inches. The Imboden coal has been called the Campbell Creek coal locally. The Imboden coal is overlain by 70 to 90 feet of sandstone and 10 feet of shale. The discontinuous Imboden Rider coal is within this sandstone unit. The Imboden Rider, where present, is either a single bed generally less than two feet thick, two or three very thin beds, or just a carbonaceous sandstone interval.

Kelly Coal Bed

The Kelly coal consists of a single, persistent, 12 to 30-inch thick coal bed 80 to 100 feet above the Imboden coal. It occurs at the base of a thick shale sequence. Within the Pennington Gap quadrangle, the Kelly coal and the Imboden Rider coal merge toward the northwest, and the separation between the Kelly coal and the Imboden coal also decreases. The shale above the Kelly coal contains brackish-water fossils.

Lower and Upper St. Charles Coal Beds

This coal zone includes the Lower St. Charles, the Upper St. Charles and the Upper St. Charles Rider coals. The Lower St. Charles coal lies approximately 120 feet above the Kelly coal, is discontinuous, thin, and is present in only a few drill holes that penetrate the interval. The Upper St. Charles coal consists of a single bed, 12 to 24 inches thick, is approximately 150 feet above the Kelly coal and 200 feet above the Imboden coal. The Upper St. Charles coal is overlain by interbedded argillaceous sandstone and shale. The Upper St. Charles Rider coal is 10 to 50 feet above the Upper St. Charles coal and is thin or locally absent.

Wilson and Kirk Coal Zone

The Wilson and Kirk coal zone includes the Wilson Marker, the Wilson, and the Kirk coal and has an average thickness of 80 feet. The Wilson Marker coal, 2 to 38 inches thick, is generally 10 to 20 feet below the Wilson and approximately 50 feet above the Upper St. Charles and 200 feet above the Kelly. In some areas, either the Wilson Marker merges with the Wilson coal or the Wilson Marker interval is occupied by sandstone. In other places, the Wilson Marker consists of as many as three thin coal beds. The Wilson coal ranges in thickness from 3 inches in Pennington Gap quadrangle to 63 inches in the Keokee quadrangle. Locally, the Wilson is known as the Harlan or the Upper Standiford. The distance between the Wilson and the Kirk ranges from 30 to 50 feet. The Kirk coal averages 12 to 24 inches in thickness and is overlain by a siltstone and sandstone interval which includes the Clover Fork Sandstone Member of the Wise Formation (Miller, 1969).

Taggart Coal Zone

The Taggart coal zone is 40 to 60 feet thick and contains the Lower Taggart Marker, the Taggart Marker, and the Taggart coals. The Lower Taggart Marker bed is generally 50 to 70 feet above the Kirk coal. The Lower Taggart Marker thickness ranges between 2 to 22 inches. The coal may be absent locally with sandstones occupying the interval. The Lower Taggart Marker and the Taggart Marker coal beds are separated by shale or argillaceous sandstone and underlain by the Clover Fork Sandstone Member. The separation between the two coals ranges up to 20 feet; however, it is commonly about 10 feet, decreasing toward the southeast in the Keokee quadrangle where the beds merge. The Taggart Marker coal consists of a single, relatively persistent, 12 to 27-inch bed. The rock sequence between the Taggart Marker and the Taggart is 10 to 55 feet thick and, in many places, includes a 12-foot thick sandstone. The interval increases to 100 feet in the Keokee quadrangle. The Taggart coal is 16 to 116 inches thick (commonly 48 inches thick). In places, the overlying Marcum Hollow Sandstone Member (Miller, 1969) extends down into the Taggart interval. This sandstone is typically 100-feet thick and inturn overlain by 40 to 90 feet of shale containing discontinuous sandstone bodies.

Ravenrock Coal Bed

The Ravenrock coal appears in Lee County as a group of very thin coal beds or carbonaceous shales in a 12-foot shale sequence at the top of the Marcum Hollow Sandstone and at the base of the overlying shale interval. The shale above the Ravenrock coal locally contains brackish-water fossils.

34 Inch Coal Bed

The 34 Inch coal is a single, consistent, 24 to 36 inch thick bed at the top of the thick shale interval described above and is 170 to 190 feet above the Taggart coal zone. The 34 inch coal is overlain by 50 to 80 feet of shale or interbedded sandstone and shale. The 34 Inch is locally called the Cedar Grove or the Low Splint E.

Low Splint Coal Zone

The Low Splint coal zone is 40- to 100-feet thick and consists of four distinct coal beds separated by shale. The lower-most coal beds, the Low Splint D and the Low Splint C, are the thickest and most persistent of the four coal beds. In many places, the Low Splint D is two coal splits of equal thickness, 10 feet apart. The total coal thickness of the Low Splint D ranges from 8 to 52 inches. Twenty to 45 feet of shale separate the Low Splint D coal from the overlying Low Splint C coal. The Low Splint C is commonly a single bed averaging 26 inches in thickness. Low Splint B coal is separated from Low Splint C by 15 to 30 feet of gray shale. The Low Splint B coal bed commonly has a thin marker coal bed 5 to 10 feet below it. The Low Splint B coal bed does not appear in many of the drill hole logs. The Low Splint A coal, at the base of the Kendrick Shale Member (Jillson, 1919), commonly consists of a single bed, 1 to 39 inches thick. The Low Splint A and the Low Splint B, where it occurs, are separated by either 10 feet of sandstone, 10 feet of shale, or 10 feet of sandstone overlain by 10 feet of shale.

Unit 3 of the Wise Formation

Unit 3 consists of rock strata between the base of the Kendrick Shale Member upward to the base of the Magoffin Member. The unit averages 690 feet in thickness.

This unit is characterized by the dominance of sandstone and siltstone. Sandstones in Unit 3 are light to medium gray, medium grained, and thin to thick bedded. The siltstones are medium gray, thin bedded, and contain siderite nodules.

Within Lee County, the Kendrick Shale Member ranges from 160 to 200 feet in thickness, but is generally 180 feet thick. The shale is dark gray to black, thinly laminated and may contain ellipsoidal, calcareous lenses with cone-in-cone structures. Brackish-water and marine fossils are found in the lower 10 feet. The Kendrick is the highest stratigraphic unit in the drill hole logs from Big Stone Gap and Keokee quadrangles. The Unit 3 coal beds or zone which are identified in the drill hole logs from the Pennington Gap quadrangle are, in ascending order, House, Little Red, Phillips, Gin Creek, Wax, Pardee, and Limestone.

House and Little Red Coal Beds

The House coal, when present, consists of a single bed, 1 to 26 inches thick, lying above the Kendrick Shale; approximately 185 to 245 feet above the Low Splint C coal. Thirty to 40 feet of shale or siltstone separate the House coal from the overlying Little Red coal. The Little Red coal is generally two or three thin coal beds within an interval of less than 10 feet. The Little Red commonly is separated from the overlying Phillips coal by 20 feet of sandstone, 10 feet of shale or siltstone, a 60 to 80-foot siltstone interval containing six to seven thin coal beds, and 50 feet of interbedded sandstone and shale.

Phillips Coal Zone

The Phillips coal zone commonly contains four or five coal beds within a 25 to 50 foot thick shale sequence. The lower-most one or two beds comprise the Lower Phillips coal. The two coal beds are commonly of equal thickness and less than 10 feet apart. A third thin coal bed 10 to 15 feet above them, is discontinuous, laterally grading from coal to carbonaceous shale and back to coal. The Upper Phillips coal consists of the upper-most one or two beds in the Phillips zone and is separated from the underlying discontinuous coal by 10 to 30 feet of shale. The coals in the Upper Phillips zone are generally less than 5 feet apart, but are separated by as much as 10 or 15 feet of rock in some places, with the upper-most coal bed being the thickest.

Gin Creek Coal Zone

The Gin Creek coal is separated from the Upper Phillips coal by 40 to 50 feet of shale or 40 feet of sandstone and 10 feet of shale. The Gin Creek zone is up to 20 feet thick, commonly consists of two coal beds less than 10 feet apart but may include as many as five coal beds. The Gin Creek zone is overlain by 40 feet of sandstone, 50 to 60 feet of shale with discontinuous sandstone bodies and a continuous but unnamed coal overlain by another 40 to 60 feet of sandstone.

Wax Coal Zone

The Wax coal zone lies 130 to 160 feet above the Gin Creek coal and consists of a zone that commonly contains two coal beds separated by less than 5 feet of shale. The upper bed in the Wax zone ranges in thickness from 16 to 23 inches and the lower bed is 14 to 30 inches thick. Where the two beds coalesce, the Wax coal has a thickness of at least 59 inches. The Wax is overlain by 50 to 60 feet of sandstone.

Pardee and Limestone Coal Beds

The Pardee coal is generally a single bed, 21 to 92 inches in thickness. It is overlain by either 20 feet of shale or 60 to 90 feet of sandstone overlain by shale.

The Limestone coal zone includes the Limestone coal and the Limestone Rider coal. The Limestone coal bed averages 27 inches in coal thickness and is 20 to 110 feet above the Pardee coal bed. The Limestone Rider coal is 7 to 13 inches thick. The two coals are separated by 20 feet of either shale or sandstone. The Limestone coal zone is overlain by 20 feet of sandstone, the Magoffin Member of the Wise Formation (approximately 60 feet in thickness) and 170 to 180 feet of shale and lenticular sandstone bodies.

Wise Formation of Atokan Age

This unit consists of strata between the base of the Magoffin Member and the top of the High Splint coal bed. The unit averages 260 feet in thickness.

The sequence is dominated by siltstone with local development of thick sandstone units. The siltstones are dark gray, medium laminated to thin bedded. The sandstones are light gray, medium grained and thick bedded.

Formal rock units are the Magoffin and the Reynolds Sandstone Members of Wise Formation. The coal beds included in the interval are the Morris, Middle Splint, and High Splint.

Morris and Middle Splint Coal Beds

The Morris coal lies approximately 250 feet above the Pardee. The Morris is comprised of two coal splits which have a combined thickness ranging from 24 to 38 inches. The Morris coal bed is locally overlain by a thinner coal bed known as the Middle Splint. The Middle Splint coal lies about 60 feet above the Morris, with the interval being occupied by approximately 40 feet of sandstone and 20 feet of overlying shale. The Middle Splint coal is overlain by 15 feet of shale beneath 15 feet of sandstone.

High Splint Coal Bed

The High Splint coal is commonly three beds within less than a 10-foot interval of shale. The upper-most High Splint bed is usually the thickest (12 to 54 inches). The High Splint coal beds are the highest stratigraphic units described in the drill hole logs from Pennington Gap Quadrangle.

HARLAN FORMATION

The Harlan Formation extends upwards for as much as 650 feet above the High Splint coal bed outside of Lee County. The formation consists of a basal cliff-forming sandstone and overlying interbedded siltstone, shale, sandstone, and coal. As many as six to seven coals are present with the No. 13 being the thickest and most widespread just above the basal sandstone unit.

The Taggart, Wax, Pardee, and Wilson coal zones accounted for 91 percent of the coal produced in Lee County in 1987 (Table 1). The largest amount of coal was mined from the Taggart coal zone. The second and third largest amounts of coal were mined from the Wax and Pardee coal beds, respectively.

The Morris, High Splint, Phillips, Kirk, Gin Creek, Imboden, Kelly, Clintwood, Blair and Dorchester coal zones have all been mined in Lee County. Approximately twice as much Clintwood coal as Blair coal has been mined. Coal production from the Upper St. Charles interval is minimal. The Addington, Imboden Marker, Imboden Rider, Ravenrock, 34 Inch, House, Little Red, and Limestone coal beds or zones have not been mined in Lee County since 1951 and no production has been reported from the Lyons coal zone since 1969.

RESOURCE CALCULATION METHODOLOGY

The Virginia Division of Mineral Resources began collecting data in 1979 to re-assess the coal resources in Virginia's southwestern coalfield. This re-assessment includes Buchanan, Dickenson, Lee, Russell, Scott, Tazewell, and Wise counties. As part of the Lee County study, we assembled published data and information from mine maps and drill holes for 21 coal beds. To augment the coal thickness data base, Division personnel measured the coal thickness at active underground and surface coal mines. Additional coal thickness measurements were taken at natural and man-made exposures in Lee and Wise counties. The locations of all data points were plotted on 1:24,000 scale topographic maps and the stratigraphic data were recorded on standardized computer data forms. The completed data forms were submitted to the USGS for entry into the NCRDS.

Once entered, all data were checked and errors were corrected. The effort resulted in coal information from a total of 475 surface points and 111 drill holes in Lee County.

Line data consisting of coal outcrops and the outlines of underground, surface, and auger mines were transferred to mylar overlays for each 7.5-minute quadrangle and digitized at 1:24,000 scale. The coal crop lines were based on geologic maps of the Big Stone Gap, Keokee, Pennington Gap, Evarts, Benham, and Appalachia quadrangles (Miller, 1965; Miller and Roen, 1971; Miller and Roen, 1973; Tazelaar and Newell, 1974; Froelich and Stone, 1973; and Nolde and others, 1988). Some of our correlations, based on drill hole information which was not available to earlier workers, differ from the correlations as shown on published geologic maps. These differences are shown in Table 3. The stratigraphy used in this report is that used by Nolde and others (1988). We traced the outlines of the underground mine areas from mine maps (updated to 1987) obtained from the Virginia Division of Mines (VDM). The majority of the information for the surface mines came from 7.5-minute topographic maps (updated in 1977) and low-altitude aerial photographs (flown in 1969). It was not possible to obtain accurate information on the location of very old deep mines or reclaimed surface and augered mines or to identify the coal bed or beds actually mined.

All of the information was processed using the graphical analysis programs of the NCRDS: PACER, the data base formatting, storage and retrieval software, and GARNET, the graphic analysis and volume calculation software. A working data base, created from the NCRDS master files using PACER, contained stratigraphic information for Lee County and a three mile wide strip around the county. The additional data reduced the edge effect at the county line when the data were contoured. We correlated the coal beds using 1-inch to 20-foot scale stratigraphic log plots of the drill hole data created by the USGS LOGPLOT program. Following the approach used by Brown and others (1952), for all coal beds in this study, where a parting was greater than one-half of the total coal thickness, the coal bed was considered split and the coal resources for the thinner split were not calculated. The resources were calculated using only coal thickness, not seam thickness which would include the thickness of the partings in addition to the coal thickness.

We divided the working data base into 21 individual coal bed files, excluding data with either no latitude and longitude values or with zero as the surface elevation. The data in each file were processed to produce one file containing coal thicknesses summed vertically and another file containing the elevation of the top of coal beds at each point location.

We gridded and contoured the thickness and elevation data for each coal bed using GARNET software to produce isopach and structural maps for each of the 21 coal beds. A planar gridding algorithm with a 0.2 mile grid spacing was used because the data were unevenly distributed. We compared structural contour maps based on the correlated drill hole data with structural contour maps based on both drill hole and surface data for a single coal to identify anomalous coal data point elevations. The anomalous elevations pointed to coal miscorrelations in the surface measured data.

Using GARNET, overburden thicknesses were calculated by subtracting each elevation data grid from the grid of the surface elevation created from the USGS DEM (Digital Elevation Model) data. Contouring the resulting grids produced an isopach map of the overburden for each of the 21 coal beds. We separated the overburden grid files into six thickness category files for each coal bed: 0 to 200 feet, 200 to 500 feet, 500 to 1000 feet, 1000 to 2000 feet, 2000 to 3000 feet, and greater than 3000 feet. A similar operation was performed on the coal thickness grid files, separating them into four thickness category files for each coal bed: 14 to 28 inches, 28 to 42 inches, 42 to 84 inches, and greater than 84 inches. The overburden thickness category files and the coal thickness category files for each coal bed were combined to create the resource category files, 24 files total, for each coal bed. Each resource category file contained the portion of a single coal bed that is in a particular overburden category with a particular coal thickness. We calculated the amount of coal in each resource category, or the "original resource" tonnage, using the GARNET resource command.

The GARNET software uses a point location file, a gridded coal thickness isopach file, and a boundary file to calculate the volume of coal. Reliability categories are defined by the radial distance from a data point. The reliability categories used were: measured, 0 to 0.25 miles; indicated, 0.25 to 0.75 miles; inferred, 0.75 to 3.0 miles; and hypothetical, 3.0 to 6.0 miles (Wood and others, 1983). Coal resource volumes are calculated by determining the area and the average thickness for all of the nodes of the coal isopach grid that fall within the area defined by the boundary file and a reliability category. Volumes are then multiplied by a density factor of 1800 tons per acre-foot, as chemical analyses of Lee County coal indicate that the majority of the coal is bituminous (Wilkes and others, 1989).

We then calculated the volume of the remaining coal. Resource category files were combined with the digitized boundaries for deep mines, surface mines and auger mined areas to create a new "remaining resource" file for each of the 24 resource category files for each coal bed. The amount of coal in a specific "remaining resource" file was calculated using the GARNET resource command. The "original resources" tonnage minus the "remaining resources" tonnage yields the "mined" tonnages. The final resource values are classified using thickness, overburden, and reliability categories for each bed (Wood and others, 1983).

SUMMARY OF RESULTS

Resource analysis indicates that Lee County had 944-million short tons of "original coal resources". Table 4 summarizes the tonnages of original, mined, and remaining coal for each coal bed in Lee County. As of 1987, a total of 73-million short tons of coal had been mined, leaving 871-million short tons of remaining unmined coal. An estimated 202-million short tons of remaining coal has 200 feet or less of overburden (Table 5). Demonstrated reserves, defined as measured and indicated remaining resources of coals that are thicker than 28 inches and have less than 1000 feet of overburden, are 415-million short tons.

In the appendix, Tables 9 to 29 show a detailed break-

Table 4. Summary of coal resources for Lee County by coal bed as of 1/1/88 (millions of short tons).

COAL BED	MEASURED	INDICATED	INFERRED	HYPO-THETICAL	TOTAL ORIGINAL	MINED	REMAINING
High Splint	0.53	0.41	1.23	0.00	2.17	0.00	2.17
Morris	0.35	1.31	0.24	0.00	1.90	0.25	1.65
Pardee	5.29	5.83	1.36	0.00	12.48	5.47	7.01
Wax	1.43	4.04	1.97	0.00	7.44	1.08	6.36
Gin Creek	1.03	6.40	3.55	0.00	10.98	0.00	10.98
Phillips	0.98	2.15	5.80	1.76	10.69	0.00	10.69
Low Splint C	1.36	2.62	2.54	0.08	6.60	2.47	4.13
Low Splint D	1.13	4.05	4.95	0.37	10.50	2.82	7.68
34 Inch	3.75	13.01	7.60	0.00	24.36	0.00	24.36
Taggart	23.32	41.16	1.73	0.00	66.21	44.48	21.73
Taggart Marker	7.56	19.64	12.92	0.00	40.12	0.00	40.12
Kirk	6.11	9.18	3.77	0.00	19.06	0.04	19.02
Wilson	14.24	22.78	3.98	0.00	41.00	4.87	36.13
Upper St. Charles	9.16	20.35	7.78	0.00	37.29	0.00	37.29
Kelly	42.87	57.81	10.19	0.00	110.87	7.83	103.04
Imboden	38.57	68.30	18.81	0.00	125.68	3.35	122.33
Imboden Marker	33.53	73.28	27.05	0.21	134.07	0.00	134.07
Clintwood	27.28	57.70	30.22	0.00	115.20	0.00	115.20
Blair	21.32	44.54	15.47	0.00	81.33	0.00	81.33
Lyons	0.38	0.27	0.00	0.00	0.65	0.00	0.65
Dorchester	28.44	45.25	11.71	0.00	85.40	0.00	85.40
TOTAL	268.63	500.08	172.87	2.42	944.00	72.66	871.34
Percentage	28.46%	52.97%	18.31%	0.26%			
AUGERED	0.04	0.05	0.01	0.00	0.10		
STRIPPED	3.61	5.50	1.53	1.14	11.78		
DEEP MINED	27.81	30.89	2.08	0.00	60.78		
TOTAL MINED	31.46	36.44	3.62	1.14	72.66		
TOTAL REMAINING	237.17	463.64	169.25	1.28	871.34		
Percentage	27.22%	53.21%	19.42%	0.15%			

down for each coal bed, of the coal tonnage in each of the four reliability categories by coal bed thickness and by overburden thickness. The coal resources for each of the 21 coal beds in Lee County are illustrated by an isopach map showing the 14-, 24-, and 42-inch coal thickness lines, and the 200-foot and 1000-foot overburden lines, the outcrop line, the state and county boundaries (Figures 4 to 34).

COMPARISON OF RESULTS TO PREVIOUS RESOURCE CALCULATIONS

New research estimates total remaining resources for all coals studied in Lee County to be 871-million short tons compared to the estimate by Brown and others (1952) of 466-million short tons (Table 6). As a result, the new estimates are also higher than the 1984 value published by VDM of 432-million short tons (Clutter, 1988) and the 1974 EIA-DOE estimate of 443-million short tons (Energy Information Administration, 1982), both of which were based on the estimates of Brown and others (1952). This study estimates the demonstrated reserves for Lee County to be 415-million short tons, compared to the estimate of Brown and others (1952) of 250-million short tons and the 1974 EIA-DOE estimate of 232-million short tons (Table 7).

Brown and others (1952) calculated the remaining resources for 21 coal beds in Lee County. When the remaining resource estimates for individual coal beds are compared with the results of this study, 12 coal beds have more remaining resources and 6 coal beds have less than those of Brown and others (1952). In this study, remaining resources for the Lower St. Charles, Pinhook, and Stone Creek coal beds were not calculated because they are either discontinous, very thin, or are impossible to correlate. This study calculates resources for the Imboden Marker coal bed which Brown and others (1952) did not.

Table 5. Summary of the total original and remaining coal in each resource category for Lee County, VA as of 1/1/88 (thousands of short tons).

ORIGINAL COAL RESOURC

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	17,728	26,470	28,712	3,091	37,008	40,108	37,328	2,409	17,931	14,763	10,870	170	449	103	207	0	237,347
200 - 500	23,569	39,129	34,550	1,029	45,963	65,411	49,501	2,625	21,027	21,492	5,990	9	0	357	0	0	310,631
500 - 1000	23,913	29,352	20,372	500	47,527	55,206	40,842	625	19,443	21,752	3,768	393	0	1,180	0	0	264,873
1000 - 2000	6,433	6,012	7,335	0	21,638	30,010	20,016	0	9,087	16,313	6,114	0	0	125	0	0	123,083
> 2000	48	184	192	0	576	1,215	2,083	0	1,750	1,525	525	0	0	0	0	0	8,098
TOTAL	71,691	101,147	91,161	4,620	152,712	191,950	149,770	5,659	69,238	75,824	27,267	572	449	1,765	207	0	944,032*

REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN																	
0 - 200	17,422	19,878	17,752	2,070	34,977	35,609	30,490	1,887	16,242	14,509	10,755	146	0	103	207	0	202,047
200 - 500	23,329	34,841	28,401	532	44,394	59,304	43,757	2,316	20,888	21,164	5,735	9	0	357	0	0	285,027
500 - 1000	23,909	29,055	19,438	224	46,873	52,846	37,031	302	19,335	21,672	3,419	393	0	1,180	0	0	255,677
1000 - 2000	6,433	6,011	7,138	0	21,569	29,381	18,840	0	8,922	16,150	5,936	0	0	125	0	0	120,505
> 2000	48	184	192	0	576	1,215	2,083	0	1,750	1,525	525	0	0	0	0	0	8,098
TOTAL	71,141	89,969	72,921	2,826	148,389	178,355	132,201	4,505	67,137	75,020	26,370	548	0	1,765	207	0	871,354*

* Differences in the total sums on Tables 4 and 5 are due to rounding.

Table 6. Comparison of remaining resources estimates for Lee County, Virginia (millions of short tons).

	THIS REPORT FOR 1987[1]	VDM FOR 1984[2]	EIA-DOE FOR 1974[3]	BROWN FOR 1952[4]
High Splint	2.17	0.00	1.70	0.84
Morris	1.65	1.98	5.80	2.77
Pardee	7.01	2.02	NC	2.31
Wax	6.36	1.57	0.43	2.46
Gin Creek	10.98	1.59	1.63	1.63
Phillips	10.69	9.58	10.86	13.17
Low Splint	*11.81	19.88	20.81	21.41
34 Inch (Cedar Grove)	24.36	NC	28.67	NC
Taggart	21.73	36.34	NC	46.59
Taggart Marker	40.12	28.43	31.95	32.89
Kirk	19.02	0.85	1.32	1.76
Wilson (Harlan) (Upper Standiford)	36.13	111.42	116.79	117.67
Upper St. Charles	37.29	6.53	6.68	6.68
Lower St. Charles	NC	32.08	33.41	33.63
(Pinhook)	NC	9.13	9.13	9.13
Kelly	103.04	15.95	15.94	15.98
(Stone Creek)	NC	0.63	0.63	0.63
Imboden (Campbell Creek)	122.33	53.74	55.39	55.48
Imboden Marker	134.07	NC	NC	NC
Clintwood	115.20	84.35	84.61	84.66
Blair	81.33	9.12	9.24	9.24
Lyons	0.65	5.73	5.76	5.77
Dorchester	85.40	1.56	1.99	2.01
TOTAL	871.34	432.48	442.74	466.71

NC Not Calculated.
* Resource estimates for Low Splint C and Low Splint D are combined.
1. Campbell and others, 1991.
2. Clutter, 1988.
3. U.S. Department of Energy, Energy Information Administration, 1981.
4. Brown and others, 1952.

In this study, measured resources account for 28.5 percent of the total remaining resources (Table 4), whereas only 7.6 percent of the total remaining resources of Brown and others (1952) are classified as measured resources. This difference indicates a significant increase in the number of data points available for this study.

DISCUSSION

The insight gained from recent geologic mapping in adjacent counties and the increased number of data points in Lee County, especially the drill hole data with gamma-ray profiles, provide better stratigraphic control than was available to Brown and others (1952). Therefore, the estimates calculated for the original coal resources are probably much more accurate than those of previous investigators. Another strength of this study is that the revised stratigraphy of Lee County used in this report is correlative with the stratigraphy established through recent geologic mapping in Wise County and the rest of the southwestern Virginia coalfields. Refinement is still needed, particularly with detailed correlations of individual coal beds within a coal zone.

The resource estimates are slightly depressed due to several factors. Coal less than 14 inches thick was not included as an original or remaining resource in this report, even though coal less than 14 inches can be and is surface mined in Lee County. Mining companies use total seam thickness as opposed to coal thickness to determine minability, so some sub-surface coal beds with total coal thicknesses less than 14 inches also might be mined. Furthermore, reserve calculations were not made for coals below the Dorchester coal because of the lack of data. These coals are known to exist in Lee County and could possibly be mined in the future.

Conversely, because of the difficulty in obtaining complete information on previous mining, it is probable that not all of the deep mines, surface mines, and augered areas were identified and subtracted from the original resources estimate of this study. Therefore, the remaining resources estimates may be inflated. Specifically, the total amount of coal reported by the mining companies as being produced from the beginning of recorded mining in Lee County (1907 to 1987) is 90.5 million short tons (Table 8). If that total is multiplied by a production factor of 2.0, the total amount of mined out

Table 7. Comparison of demonstrated coal reserve estimates for Lee County, Virginia (millions of short tons).

	THIS REPORT FOR 1987[1]	EIA-DOE FOR 1974[2]	BROWN FOR 1952[3]
High Splint	0.78	1.70	0.84
Morris	0.49	3.50	1.67
Pardee	6.00	NC	1.94
Wax	4.50	0.36	2.46
Gin Creek	7.43	1.63	NC
Phillips	2.81	8.73	11.04
Low Splint	*0.72	18.50	16.49
34 Inch (Cedar Grove)	5.32	28.67	NC
Taggart	17.54	NC	46.59
Taggart Marker	7.05	6.15	5.36
Kirk	3.77	0.00	0.00
Wilson (Harlan) (Upper Standiford)	20.16	106.61	107.41
Upper St. Charles	0.88	3.52	3.52
Lower St. Charles	NC	5.48	5.70
(Pinhook)	NC	0.88	0.88
Kelly	65.76	9.19	9.23
(Stone Creek)	NC	0.00	0.00
Imboden (Campbell Creek)	79.88	25.42	25.35
Imboden Marker	73.61	NC	NC
Clintwood	42.23	12.12	12.03
Blair	26.32	0.00	0.00
Lyons	0.00	0.00	0.00
Dorchester	50.23	0.00	0.00
TOTAL	415.48	232.46	250.51

Demonstrated coal reserves are measured and indicated remaining resources for coals that are thicker than 28 inches and with less than 1000 feet of overburden.

NC Not Calculated.
* Resource estimates for Low Splint C and Low Splint D are combined.
1. Campbell and others, 1989.
2. U.S. Department of Energy, Energy Information Agency, 1981.

coal should be 181 million short tons. However, the total amount of mined out coal calculated using the mine outlines available for this study is 72.6 million short tons (Table 4). The difference in these numbers indicate that a significant amount of older mining information was not available for this study. An alternative method of calculating the total remaining coal resources for Lee County is to subtract the total reported coal production multiplied by a production factor from the original resources (Table 9). A similiar method can be used to calculate the demonstrated coal resources. The resulting estimates (remaining coal resources = 763-million short tons, demonstrated coal resources = 296-million short tons) are closer to the estimates of Brown and others (1952) than the estimates calculated using the mine outlines (Table 10). Using the demonstrated coal resources estimate of 296-million short tons and assuming a production factor of 2.0, the remaining producible coal is 148-million short tons (Table 9).

Additionally, the numerous changes in the the stratigraphic nomenclature and coal bed names during the last 90 years makes it difficult to determine which coal bed was actually produced at an old mine (Tables 6 and 7). Because of the confusion of coal names, mine outlines and production figures from individual beds may be assigned to the wrong coal bed. Therefore, resource estimates for individual coal beds may be in error. Futhermore, many surface mines produce from two or more coal beds. Because many of the surface mines are reclaimed, it is difficult to determine which coal beds were mined. Also, at a map scale of 1:24,000 and with the uneven and sparse data point distribution available, it is difficult to locate accurately sandstone channels or other local stratigraphic irregularities in the coal beds.

Table 8. Relative importance of the different methods of mining coal in Lee County, Virginia (short tons).

YEAR	TOTAL	STRIP TONNAGE	%	AUGER TONNAGE	%	LONGWALL TONNAGE	%	CONTINUOUS TONNAGE	%	HAND TONNAGE	%	OTHER TONNAGE	%
1987	3,118,439	119,722	3.8	98,545	3.2	307,043	9.8	2,353,951	75.4	0	0.0	239,178	7.7
1986	2,330,742	70,663	3.0	130,280	5.6	732,168	31.4	1,225,394	52.6	0	0.0	172,237	7.4
1985	1,775,807	12,778	0.7	7,230	0.4	210,127	11.8	1,412,073	79.5	0	0.0	133,599	7.6
1984	2,043,687	66,397	3.2	10,607	0.5	0	0.0	1,669,968	81.7	80	0.0	296,635	14.5
1983	1,891,987	69,652	3.7	24,049	1.2	0	0.0	1,613,533	85.3	250	0.0	184,503	9.8
1982	1,701,096	173,269	10.2	38,391	2.3	0	0.0	1,263,243	74.2	1,083	0.1	225,110	13.2
1981	1,212,572	151,345	12.5	95,829	7.9	0	0.0	757,448	62.5	0	0.0	207,950	17.1
1980	1,179,697	195,673	16.6	76,926	6.5	0	0.0	697,245	59.1	3,213	0.2	206,640	17.6
1979	957,688	112,330	11.7	66,325	6.9	0	0.0	717,706	74.9	0	0.0	61,327	6.4
1978	1,003,848	302,069	30.1	108,769	10.8	0	0.0	510,597	50.9	0	0.0	82,413	8.2
1977	1,325,554	529,571	40.0	242,930	18.3	0	0.0	413,204	31.2	100	0.0	139,749	10.5
1976	1,300,172	562,716	43.3	111,703	8.6	0	0.0	523,948	40.3	3,000	0.2	98,805	7.6
1975	1,048,070	398,796	38.1	130,212	12.4	0	0.0	456,434	43.5	0	0.0	62,628	6.0
1974	966,287	195,485	20.3	65,952	6.8	0	0.0	685,414	70.9	0	0.0	19,436	2.0
1973	1,138,148	239,360	21.0	92,173	8.1	0	0.0	690,580	60.7	6,339	0.6	109,696	9.6
1972	1,045,300	226,930	21.7	135,281	12.9	0	0.0	516,846	49.5	20,679	2.0	145,564	13.9
1971	878,609	327,813	37.3	72,996	8.3	0	0.0	314,242	35.8	13,602	1.5	149,956	17.1
1970	1,126,983	322,215	28.6	258,481	22.9	0	0.0	319,806	28.4	56,917	5.1	169,564	15.0
1969	886,614	290,346	32.7	189,440	21.4	0	0.0	213,831	24.1	58,689	6.6	134,308	15.2
1968	1,231,525	307,146	25.0	109,594	8.9	0	0.0	549,614	44.6	118,370	9.6	146,801	11.9
1967	840,006	306,876	36.5	73,771	8.8	0	0.0	15,962	1.9	214,675	25.6	228,722	27.2
1966	435,614	57,431	13.2	18,928	4.3	0	0.0	0	0.0	261,203	60.0	98,052	22.5
1965	488,733	8,368	1.7	0	0.0	0	0.0	0	0.0	433,504	88.7	46,861	9.6
1964	485,345	1,024	0.2	8,807	1.8	0	0.0	0	0.0	396,934	81.8	78,580	16.2
1963	519,890	6,317	1.2	36,997	7.1	0	0.0	0	0.0	407,976	78.5	68,600	13.2
1962	469,561	7,500	1.6	25,082	5.3	0	0.0	0	0.0	431,628	91.9	5,351	1.2
1961	475,967	38,900	8.2	59,713	12.5	0	0.0	0	0.0	376,929	79.2	425	0.1
1960	642,523	91,513	14.2	147,101	22.9	0	0.0	0	0.0	403,294	62.8	615	0.1
1959	454,631	57,006	12.5	0	0.0	0	0.0	0	0.0	391,855	86.2	5,770	1.3
1958	385,618	12,034	3.1	11,671	3.0	0	0.0	0	0.0	346,443	89.9	15,470	4.0
1957	393,367	1,481	0.4	0	0.0	0	0.0	0	0.0	319,880	81.3	72,006	18.3
1956	666,023	0	0.0	0	0.0	0	0.0	0	0.0	532,637	80.0	133,386	20.0
* 1955	705,714	3,792	0.5	0	0.0	0	0.0	0	0.0	0	0.0	701,922	99.5
** 1954	591,171	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
* 1953	908,813	31,150	3.4	76,105	8.4	0	0.0	0	0.0	0	0.0	801,558	88.2
** 1952	745,357	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
** 1951	933,089	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
** 1950	785,224	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
SUB-TOTAL	39,089,471	5,297,668		2,523,888		1,249,338		16,921,039		4,799,280		5,243,417	
1907-1949[1]	51,456,799	0		0		0		0		0		0	
TOTAL	90,546,270	5,297,668		2,523,888		1,249,338		16,921,039		4,799,280		5,243,417	

* Tonnage mined by Hand not differentiated from tonnage mined by other methods in the Annual Report of the Dept. of Labor & Industry.

** Annual Report of the Dept. of Labor & Industry not available for this year. Used total tonnage for Lee Co. from USBM.

[1] Summed coal production for Lee Co. from the USGS (1883 to 1923) and the USBM (1924 to 1951) as reported by Brown and others (1952) with the exception of the years 1946 and 1947 where the VDLI numbers were available.

Note 1: Total produced tonnages for 1952 to 1988 are from the Annual Report of the Dept. of Labor & Industry. Annual reports are available back to 1922, but mining methods are not differentiated prior to 1952.

Note 2: The USGS and the USBM did not count coal tonnages from mines that produced less than 1000 short tons a year.

Note 3: "Other methods" is predominately conventional underground mining by machine.

Table 9. An alternative method for calculating remaining and demonstrated coal resources for Lee County using reported coal production figures. (Values are in millions of short tons.)

CALCULATING REMAINING COAL RESOURCES

944 = Total original coal resources as calculated using the NCRDS programs (Table 5).

minus

(90.5 x 2.0)=181 = Total reported coal production (Table 8) multiplied by a production factor of 2.0.

763 = Total remaining coal resources.

CALCULATING DEMONSTRATED COAL RESOURCES

477 = Measured and indicated original coal resources with a coal thickness greater than 28 inches and with less than 1000 feet of overburden as calculated using the NCRDS programs (Table 5).

minus

(90.5 x 2.0)= 181 = Total reported coal production (Table 8) multiplied by a production factor of 2.0.

296 = Demonstrated coal resources.

148= Remaining producible coal resources, assuming 2.0 production factor.

Table 10. A table comparing remaining and demonstrated coal resource estimates for Lee County which have been calculated using different methods. (Values in millions of short tons.)

	TOTAL REMAINING	TOTAL DEMONSTRATED
This report for 1987[1]	871	415
This report- alternative method - 1987[2]	763	296
VDM for 1984[3]	432	NC
EIA-DOE for 1974[4]	442	232
Brown and others for 1952[5]	466	250

NC Not Calculated

1. Campbell and others, 1989.
2. Campbell and others, 1989.
3. Clutter, 1988.
4. U.S. Department ofEnergy, Energy Information Administration, 1981.
5. Brown and others, 1952.

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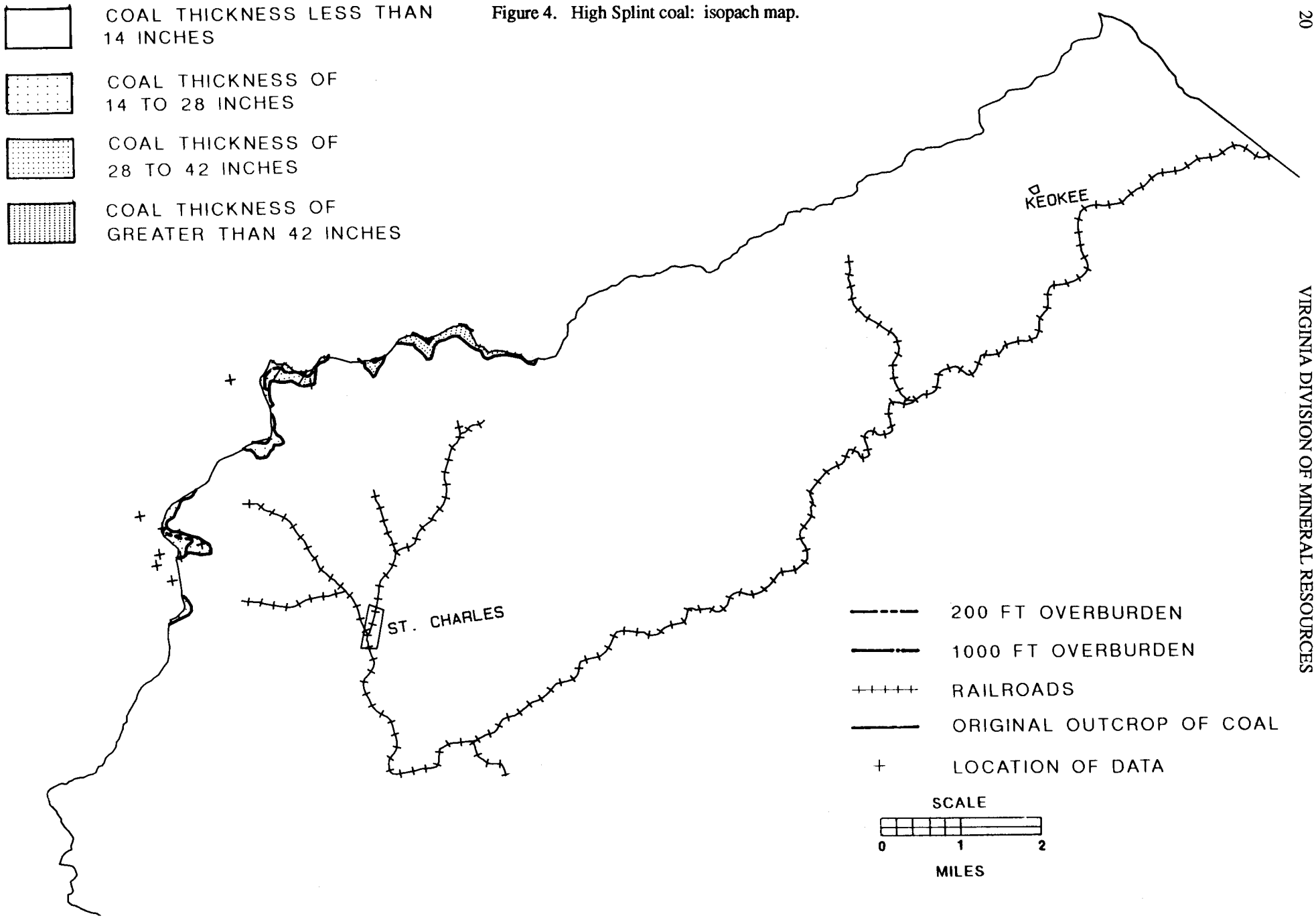

Figure 4. High Splint coal: isopach map.

Table 11. Summary of the original, mined, and remaining coal resources in each resource category for High Splint coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	7	284	87	0	84	107	104	0	0	200	872	0	0	0	0	0	1,745
200 - 500	0	128	23	0	64	47	0	0	0	22	143	0	0	0	0	0	427
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	7	412	110	0	148	154	104	0	0	222	1,015	0	0	0	0	0	2,172

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	7	284	87	0	84	107	104	0	0	200	872	0	0	0	0	0	1,745
200 - 500	0	128	23	0	64	47	0	0	0	22	143	0	0	0	0	0	427
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	7	412	110	0	148	154	104	0	0	222	1,015	0	0	0	0	0	2,172

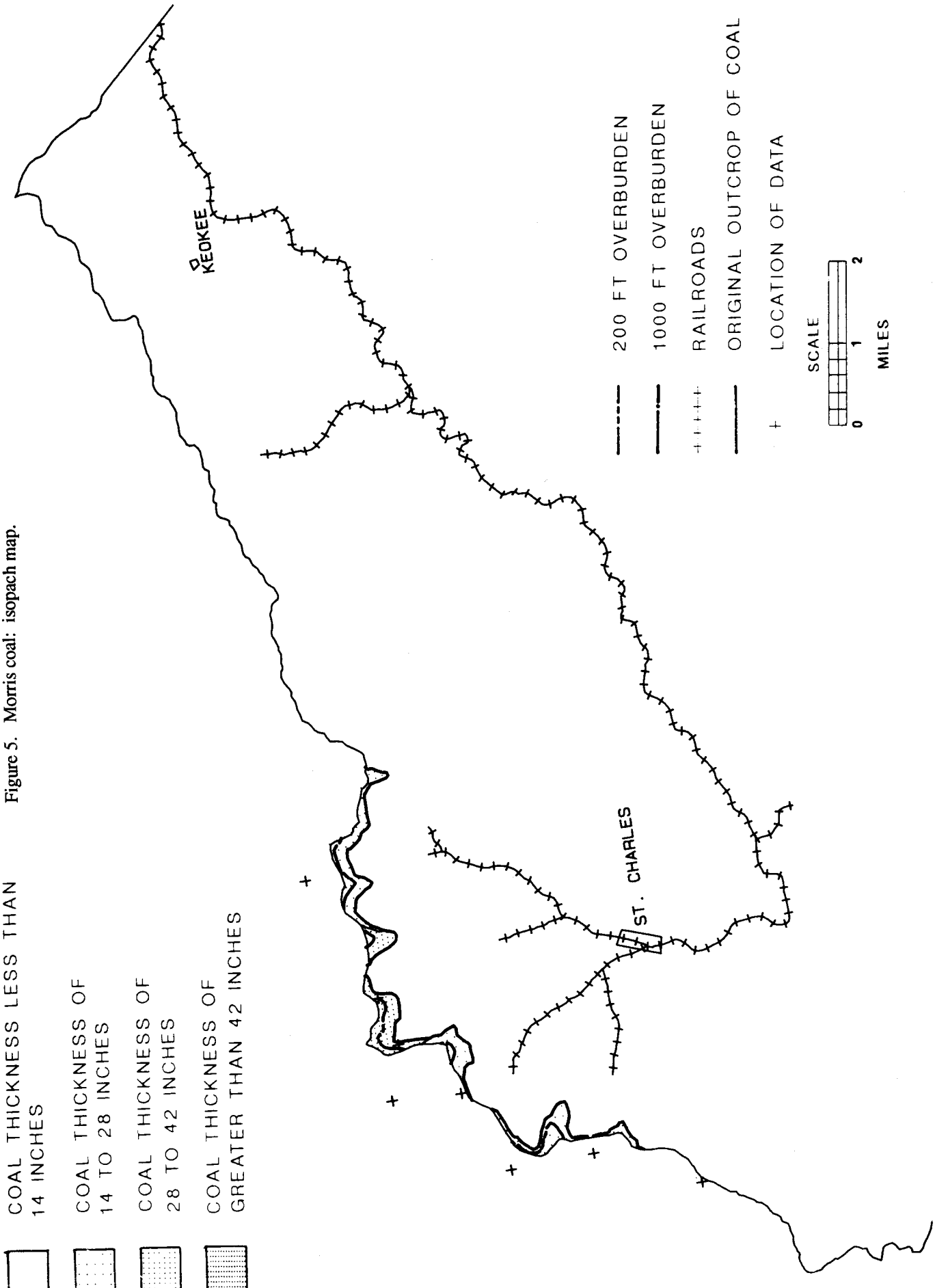

Figure 5. Morris coal: isopach map.

Table 12. Summary of the original, mined, and remaining coal resources in each resource category for Morris coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	8	340	0	0	800	241	0	0	198	33	0	0	0	0	0	0	1,620
200 - 500	0	0	0	0	242	25	0	0	0	12	0	0	0	0	0	0	278
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	8	340	0	0	1,041	266	0	0	198	45	0	0	0	0	0	0	1,898

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	5	82	0	0	135	30	0	0	0	0	0	0	0	0	0	0	251
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	5	82	0	0	135	30	0	0	0	0	0	0	0	0	0	0	251

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	3	259	0	0	665	211	0	0	198	33	0	0	0	0	0	0	1,369
200 - 500	0	0	0	0	242	25	0	0	0	12	0	0	0	0	0	0	278
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	259	0	0	906	236	0	0	198	45	0	0	0	0	0	0	1,647

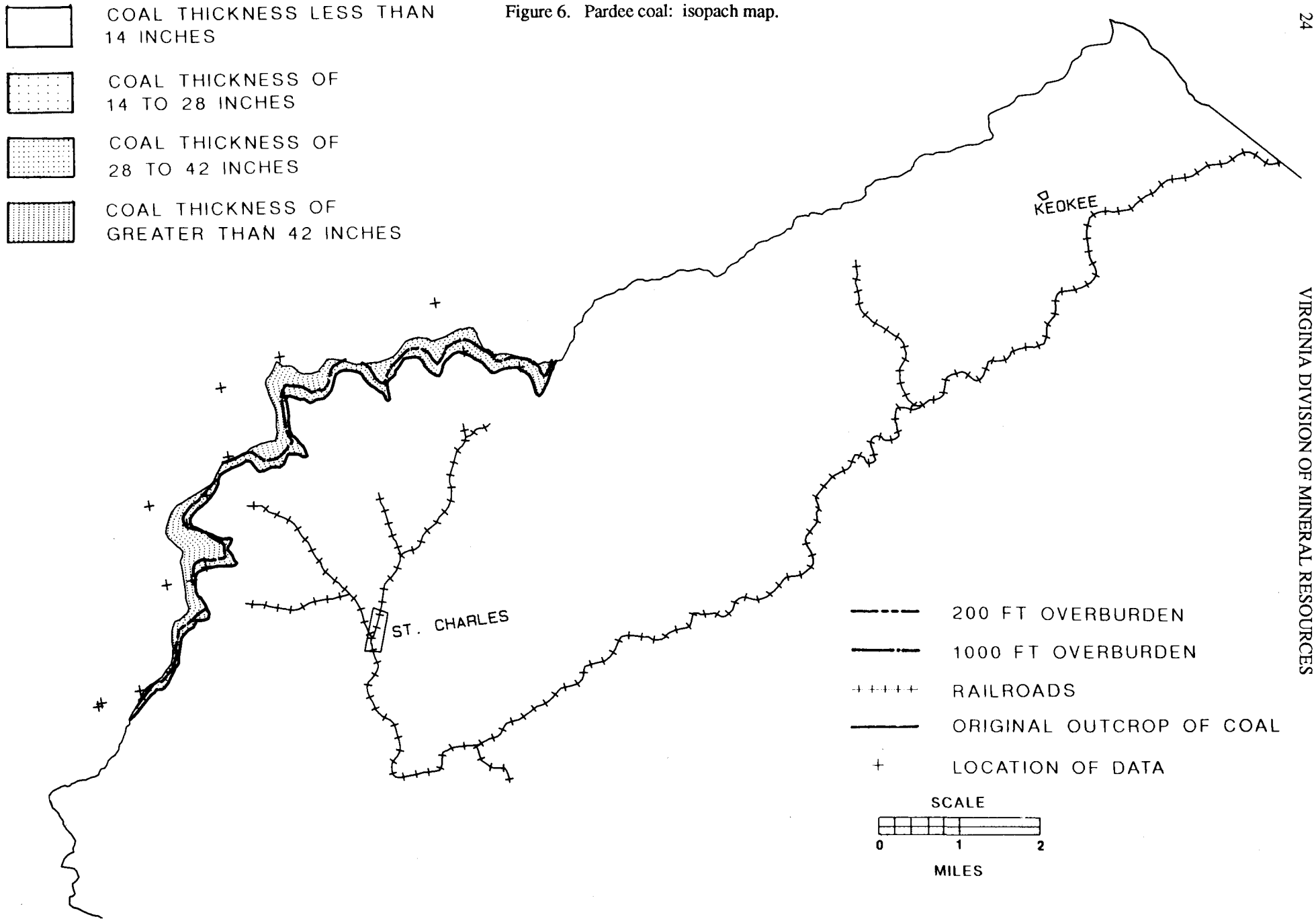

Figure 6. Pardee coal: isopach map.

Table 13 . Summary of the original, mined, and remaining coal resources in each resource category for Pardee coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	17	7	1,284	687	15	15	1,280	770	0	0	604	79	0	0	0	0	4,759
200 - 500	0	16	1,753	727	22	42	1,857	704	0	0	563	9	0	0	0	0	5,693
500 - 1000	0	0	296	500	0	0	700	428	0	0	107	0	0	0	0	0	2,031
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	17	23	3,333	1,914	38	57	3,837	1,902	0	0	1,274	88	0	0	0	0	12,483

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	587	142	0	0	805	253	0	0	18	24	0	0	0	0	1,829
200 - 500	0	0	451	385	0	0	1,191	251	0	0	255	0	0	0	0	0	2,533
500 - 1000	0	0	31	275	0	0	373	323	0	0	107	0	0	0	0	0	1,108
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	1,069	803	0	0	2,369	827	0	0	380	24	0	0	0	0	5,472

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	17	7	697	545	16	15	475	517	0	0	586	55	0	0	0	0	2,930
200 - 500	0	16	1,302	342	22	42	666	453	0	0	308	9	0	0	0	0	3,160
500 - 1000	0	0	265	224	0	0	327	105	0	0	0	0	0	0	0	0	921
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	17	23	2,264	1,111	38	57	1,468	1,075	0	0	894	64	0	0	0	0	7,011

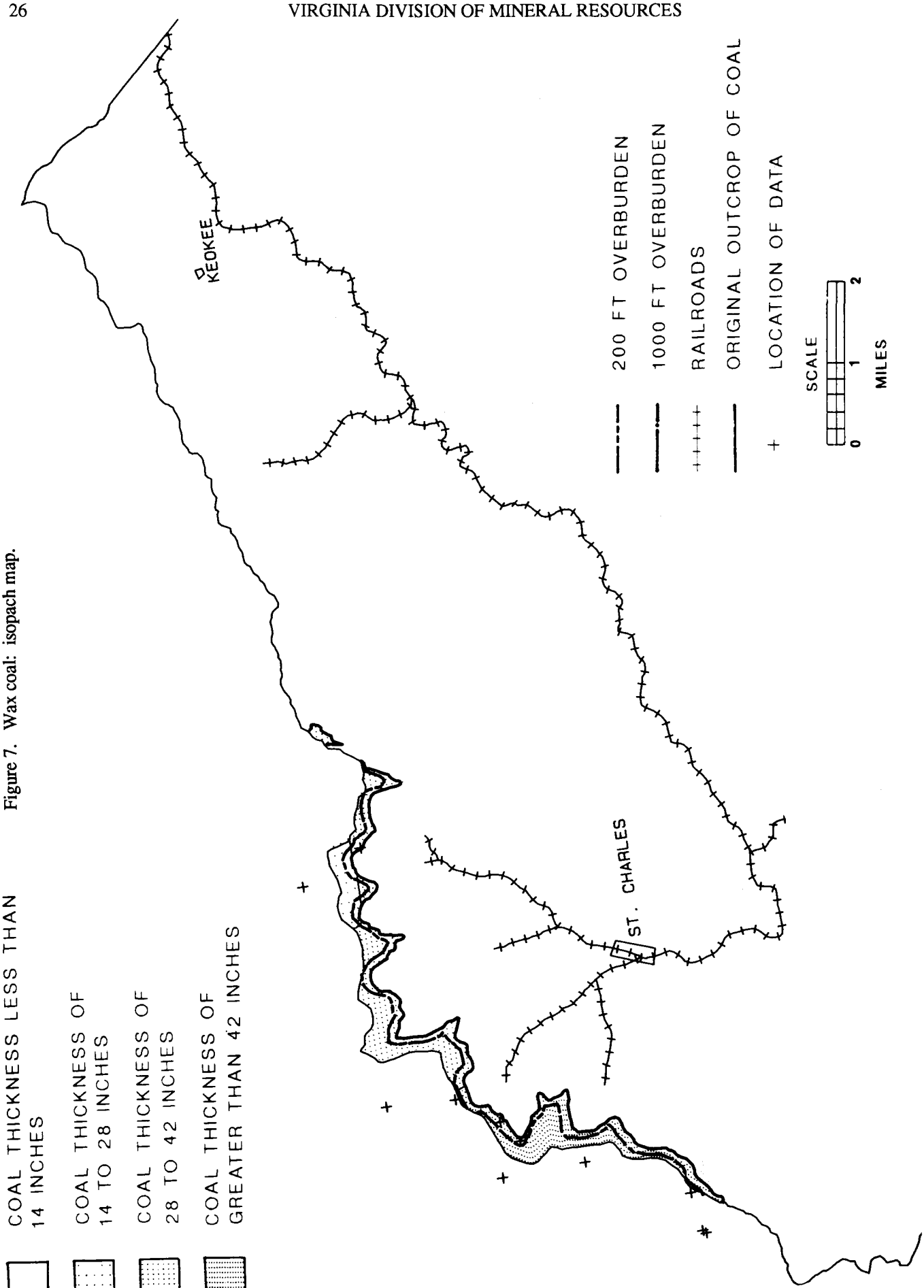

Figure 7. Wax coal: isopach map.

Table 14. Summary of the original, mined, and remaining coal resources in each resource category for Wax coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	26	123	456	0	84	412	837	0	72	725	27	0	0	0	0	0	2,762
200 - 500	32	70	595	0	233	565	1,046	0	24	742	0	0	0	0	0	0	3,307
500 - 1000	0	0	127	0	195	294	373	0	0	383	0	0	0	0	0	0	1,372
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	58	193	1,178	0	512	1,271	2,256	0	96	1,850	27	0	0	0	0	0	7,441

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	3	57	173	0	59	6	140	0	0	118	0	0	0	0	0	0	556
200 - 500	32	13	0	0	115	10	0	0	22	138	0	0	0	0	0	0	330
500 - 1000	0	0	0	0	142	0	0	0	0	55	0	0	0	0	0	0	197
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	35	70	173	0	316	16	140	0	22	311	0	0	0	0	0	0	1,083

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	23	66	283	0	25	406	697	0	72	607	27	0	0	0	0	0	2,206
200 - 500	0	57	595	0	118	555	1,046	0	2	604	0	0	0	0	0	0	2,977
500 - 1000	0	0	127	0	53	294	373	0	0	328	0	0	0	0	0	0	1,175
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	23	123	1,005	0	196	1,255	2,116	0	74	1,539	27	0	0	0	0	0	6,358

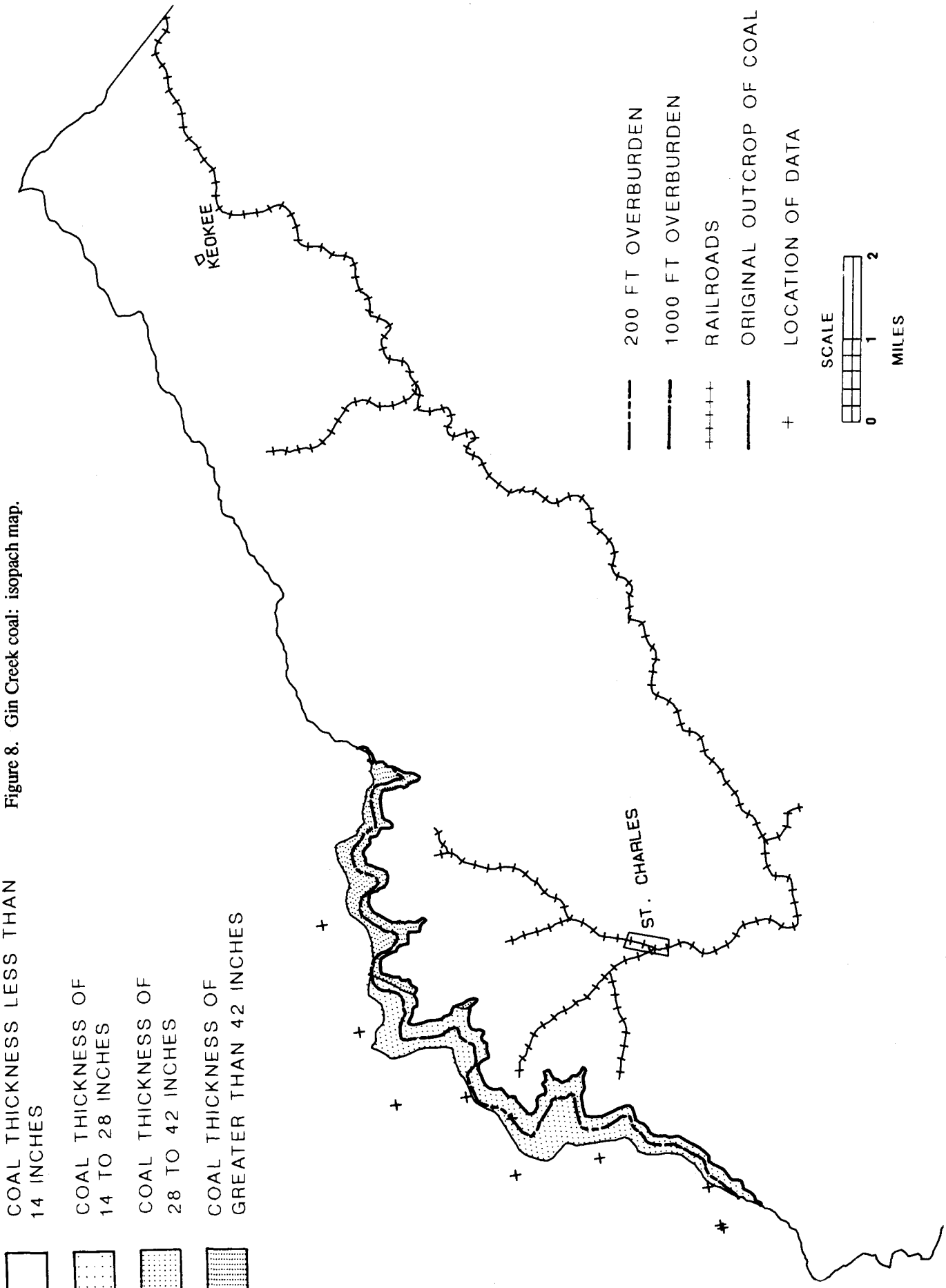

Figure 8. Gin Creek coal: isopach map.

Table 15. Summary of the original, mined, and remaining coal resources in each resource category for Gin Creek coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	517	0	0	0	1,743	352	0	0	664	1,399	0	0	0	0	0	4,675
200 - 500	0	414	0	0	0	1,815	484	0	0	146	1,088	0	0	0	0	0	3,947
500 - 1000	0	97	0	0	0	1,560	447	0	0	15	240	0	0	0	0	0	2,359
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	1,028	0	0	0	5,118	1,283	0	0	825	2,727	0	0	0	0	0	10,981

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	517	0	0	0	1,743	352	0	0	664	1,399	0	0	0	0	0	4,675
200 - 500	0	414	0	0	0	1,815	484	0	0	146	1,088	0	0	0	0	0	3,947
500 - 1000	0	97	0	0	0	1,560	447	0	0	15	240	0	0	0	0	0	2,359
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	1,028	0	0	0	5,118	1,283	0	0	825	2,727	0	0	0	0	0	10,981

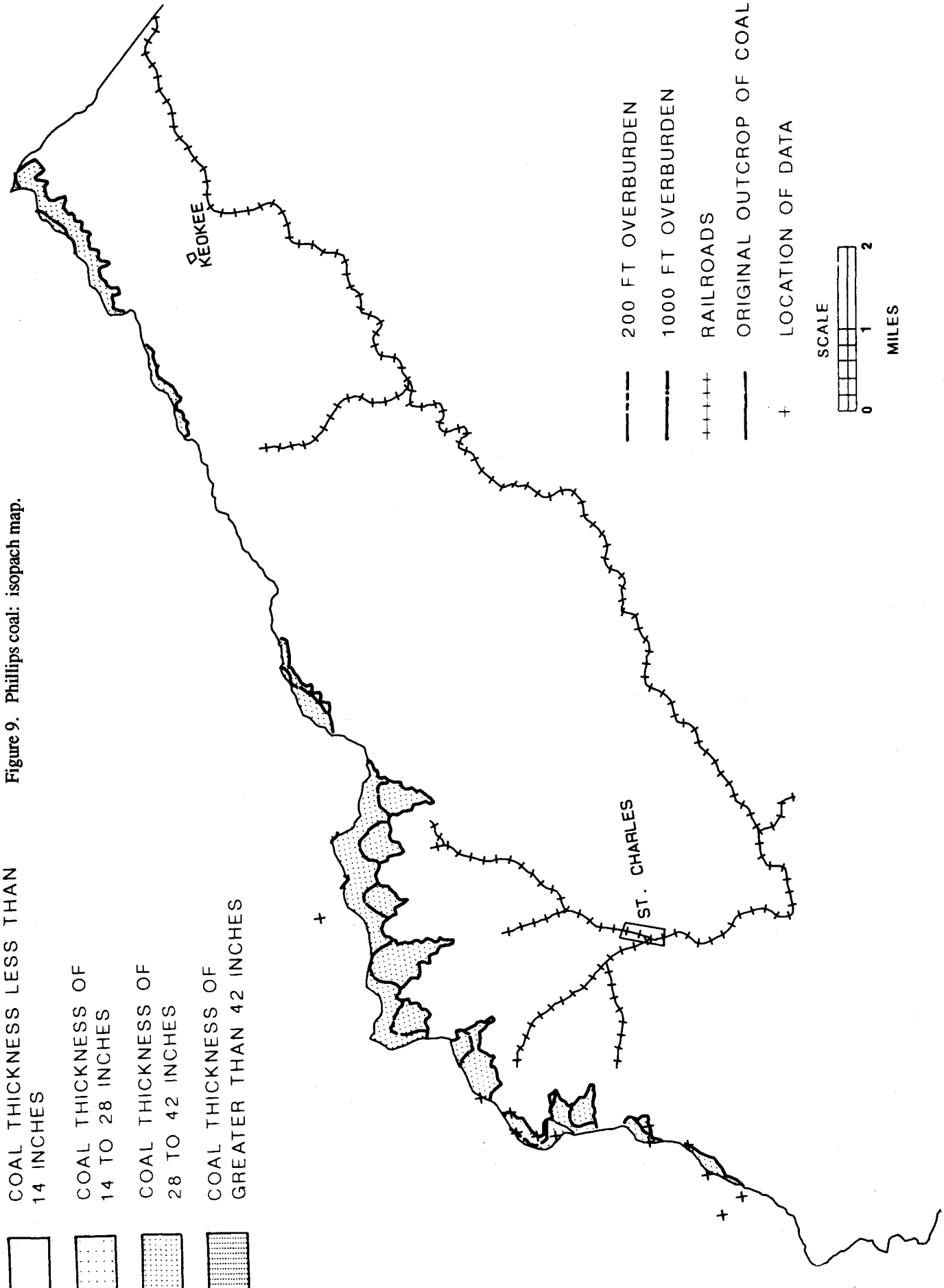

Figure 9. Phillips coal: isopach map.

Table 16. Summary of the original, mined, and remaining coal resources in each resource category for Phillips coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	180	285	0	0	0	903	0	0	0	3,096	0	0	0	103	0	0	4,567
200 - 500	108	377	0	0	0	644	0	0	0	1,676	0	0	0	357	0	0	3,162
500 - 1000	25	2	0	0	0	597	0	0	0	1,001	0	0	0	1,180	0	0	2,805
1000 - 2000	0	0	0	0	0	9	0	0	0	24	0	0	0	125	0	0	158
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	313	664	0	0	0	2,153	0	0	0	5,797	0	0	0	1,765	0	0	10,692

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN																	
0 - 200	180	285	0	0	0	903	0	0	0	3,096	0	0	0	103	0	0	4,567
200 - 500	108	377	0	0	0	644	0	0	0	1,676	0	0	0	357	0	0	3,162
500 - 1000	25	2	0	0	0	597	0	0	0	1,001	0	0	0	1,180	0	0	2,805
1000 - 2000	0	0	0	0	0	9	0	0	0	24	0	0	0	125	0	0	158
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	313	664	0	0	0	2,153	0	0	0	5,797	0	0	0	1,765	0	0	10,692

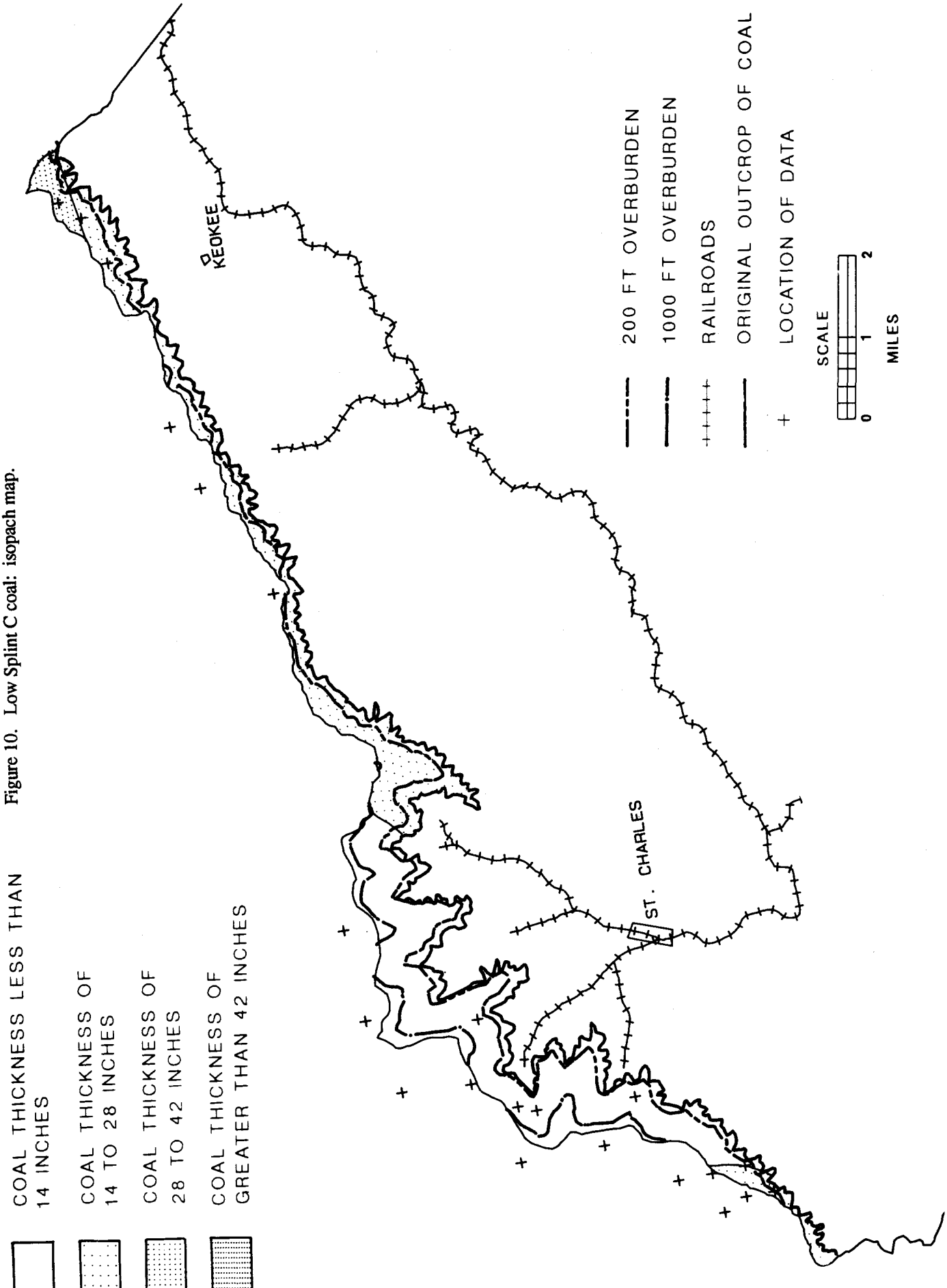

Figure 10. Low Splint C coal: isopach map.

Table 17. Summary of the original, mined, and remaining coal resources in each resource category for Low Splint C coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	251	17	0	0	1,266	48	0	0	1,321	0	0	0	81	0	0	0	2,984
200 - 500	452	180	0	0	877	218	0	0	792	0	0	0	0	0	0	0	2,519
500 - 1000	209	251	0	0	75	120	0	0	416	0	0	0	0	0	0	0	1,071
1000 - 2000	0	5	0	0	0	11	0	0	10	0	0	0	0	0	0	0	26
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	912	453	0	0	2,218	397	0	0	2,539	0	0	0	81	0	0	0	6,600

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	16	0	0	0	740	20	0	0	749	0	0	0	81	0	0	0	1,606
200 - 500	0	0	0	0	614	107	0	0	72	0	0	0	0	0	0	0	793
500 - 1000	0	0	0	0	32	8	0	0	33	0	0	0	0	0	0	0	73
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	16	0	0	0	1,386	135	0	0	854	0	0	0	81	0	0	0	2,472

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	235	17	0	0	526	28	0	0	572	0	0	0	0	0	0	0	1,378
200 - 500	452	180	0	0	263	111	0	0	720	0	0	0	0	0	0	0	1,726
500 - 1000	209	251	0	0	43	112	0	0	383	0	0	0	0	0	0	0	998
1000 - 2000	0	5	0	0	0	11	0	0	10	0	0	0	0	0	0	0	26
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	896	453	0	0	832	262	0	0	1,685	0	0	0	0	0	0	0	4,128

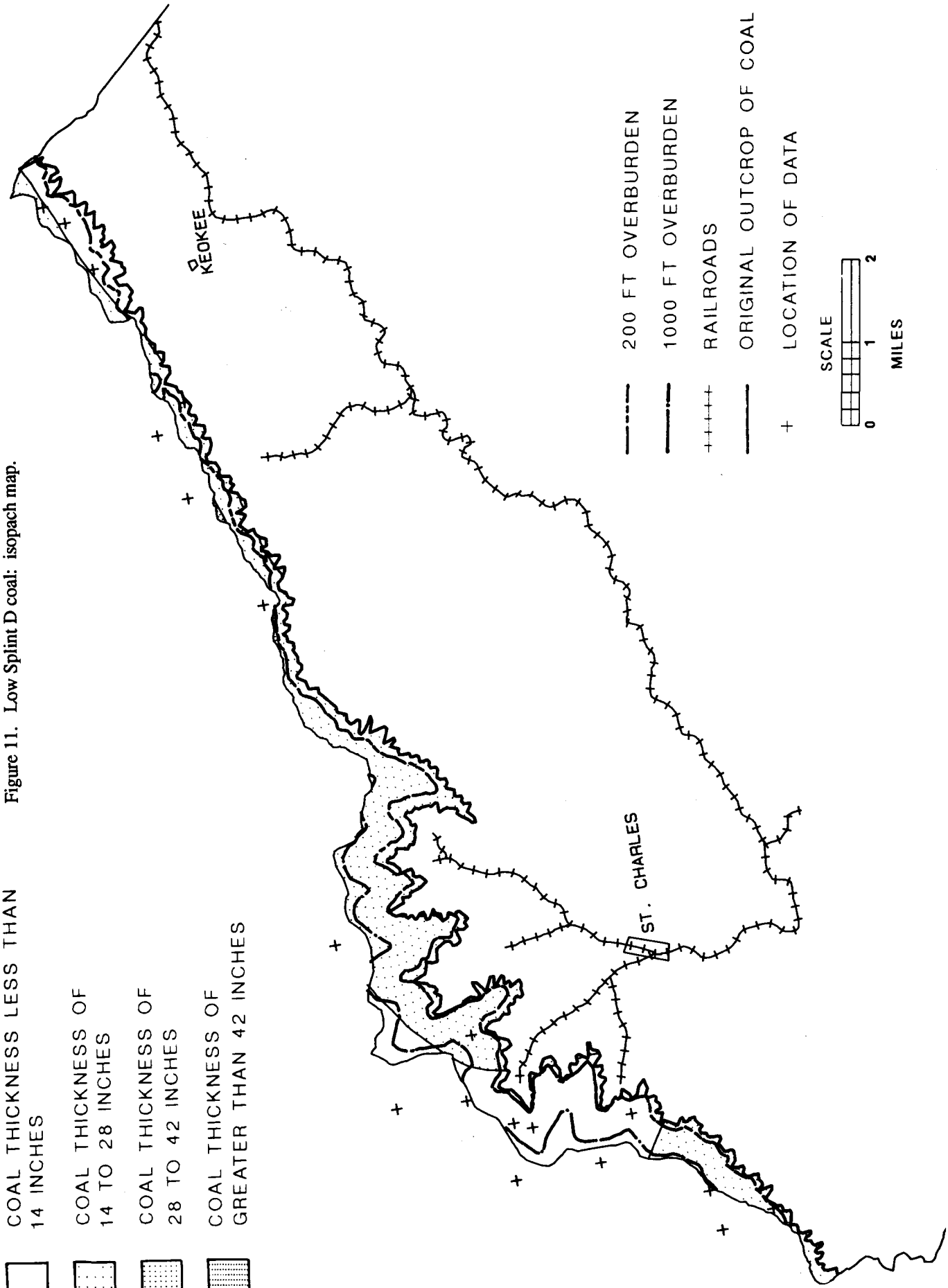

Figure 11. Low Splint D coal: isopach map.

Table 18. Summary of the original, mined, and remaining coal resources in each resource category for Low Splint D coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	283	0	0	0	1,191	0	0	0	2,021	0	0	0	368	0	0	0	3,863
200 - 500	427	0	0	0	1,511	43	0	0	1,778	0	0	0	0	0	0	0	3,759
500 - 1000	395	0	0	0	986	9	0	0	1,025	0	0	0	0	0	0	0	2,415
1000 - 2000	22	0	0	0	308	0	0	0	132	0	0	0	0	0	0	0	462
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,127	0	0	0	3,996	52	0	0	4,956	0	0	0	368	0	0	0	10,499

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	131	0	0	0	587	0	0	0	940	0	0	0	368	0	0	0	2,026
200 - 500	197	0	0	0	459	22	0	0	45	0	0	0	0	0	0	0	723
500 - 1000	4	0	0	0	17	9	0	0	45	0	0	0	0	0	0	0	75
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	332	0	0	0	1,063	31	0	0	1,030	0	0	0	368	0	0	0	2,824

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	152	0	0	0	604	0	0	0	1,081	0	0	0	0	0	0	0	1,837
200 - 500	230	0	0	0	1,052	21	0	0	1,733	0	0	0	0	0	0	0	3,036
500 - 1000	391	0	0	0	969	0	0	0	980	0	0	0	0	0	0	0	2,340
1000 - 2000	22	0	0	0	308	0	0	0	132	0	0	0	0	0	0	0	462
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	795	0	0	0	2,933	21	0	0	3,926	0	0	0	0	0	0	0	7,675

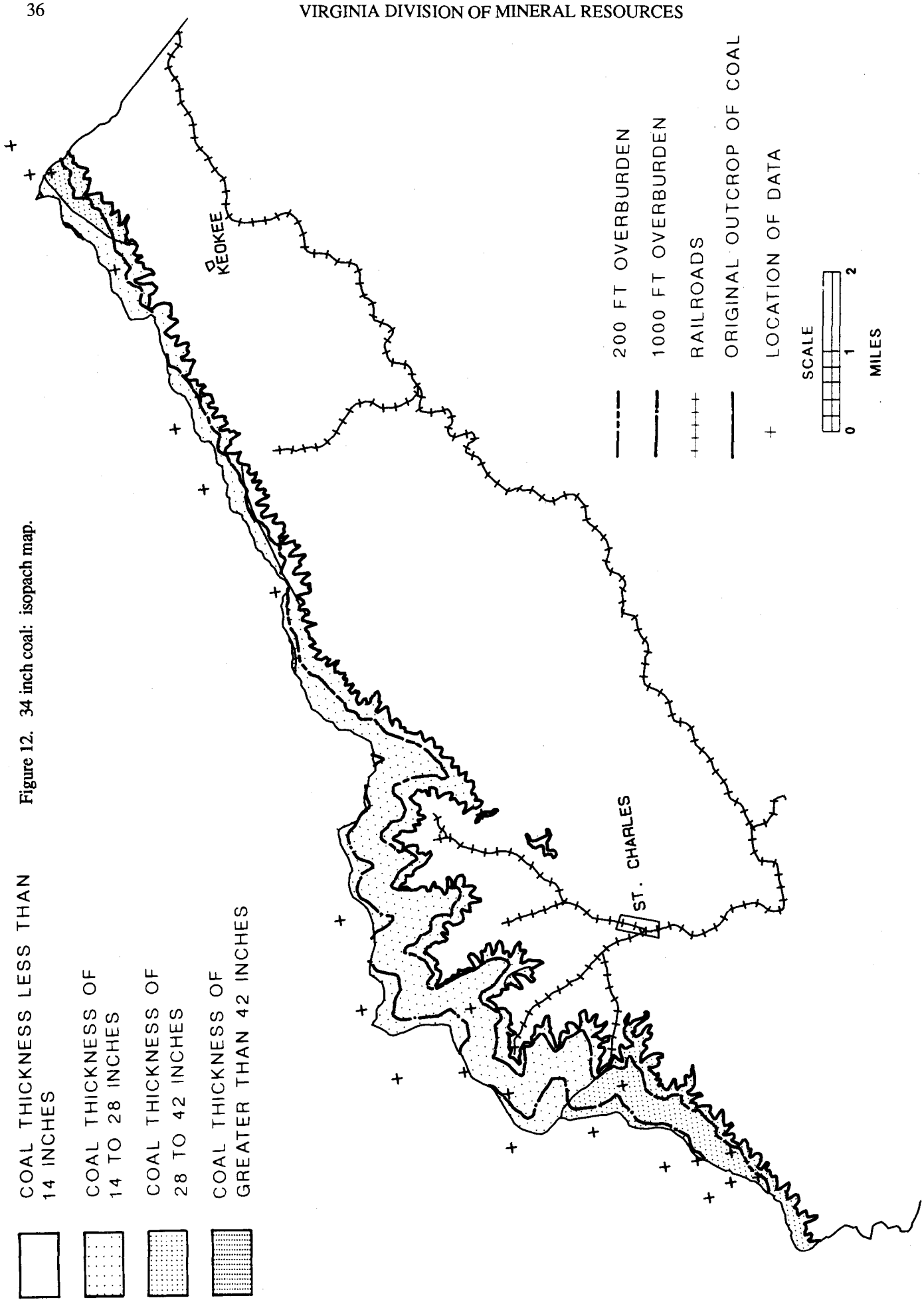

Figure 12. 34 inch coal: isopach map.

Table 19. Summary of the original, mined, and remaining coal resources in each resource category for 34 Inch coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	369	352	0	0	2,416	1,893	0	0	2,991	497	0	0	0	0	0	0	8,518
200 - 500	625	830	0	0	2,687	934	0	0	2,492	24	0	0	0	0	0	0	7,592
500 - 1000	795	550	0	0	2,421	757	0	0	1,384	0	0	0	0	0	0	0	5,907
1000 - 2000	137	87	0	0	1,532	373	0	0	215	0	0	0	0	0	0	0	2,344
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,926	1,819	0	0	9,056	3,957	0	0	7,082	521	0	0	0	0	0	0	24,361

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	369	352	0	0	2,416	1,893	0	0	2,991	497	0	0	0	0	0	0	8,518
200 - 500	625	830	0	0	2,687	934	0	0	2,492	24	0	0	0	0	0	0	7,592
500 - 1000	795	550	0	0	2,421	757	0	0	1,384	0	0	0	0	0	0	0	5,907
1000 - 2000	137	87	0	0	1,532	373	0	0	215	0	0	0	0	0	0	0	2,344
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,926	1,819	0	0	9,056	3,957	0	0	7,082	521	0	0	0	0	0	0	24,361

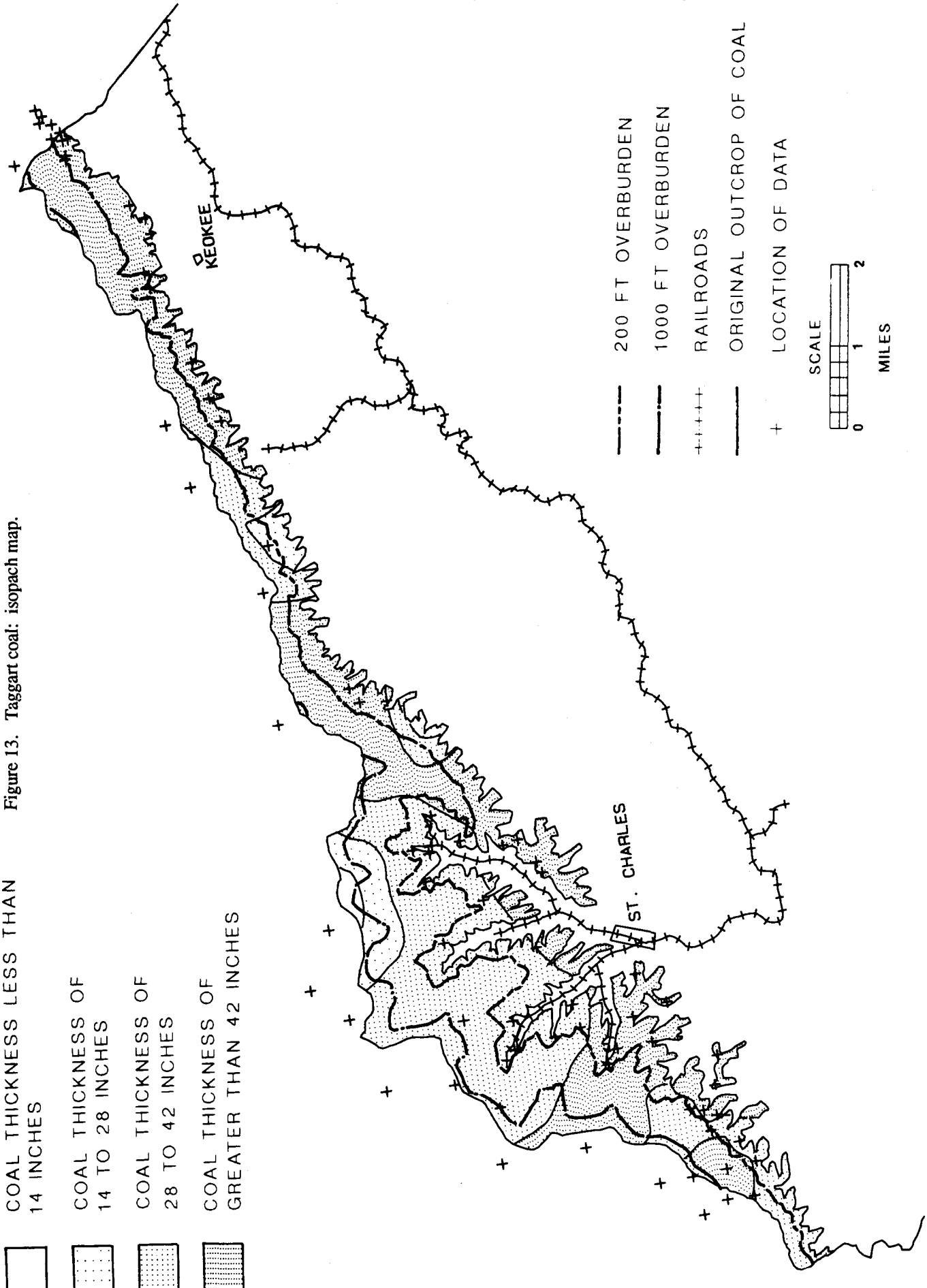

Figure 13. Taggart coal: isopach map.

Table 20. Summary of the original, mined, and remaining coal resources in each resource category for Taggart coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	123	4,902	9,010	749	369	3,732	7,902	145	0	254	212	0	0	0	0	0	27,398
200 - 500	194	2,660	3,174	0	233	6,039	7,753	0	0	223	107	0	0	0	0	0	20,383
500 - 1000	0	1,007	835	0	917	4,037	5,962	0	39	25	261	0	0	0	0	0	13,083
1000 - 2000	0	458	212	0	335	2,157	1,582	0	165	163	277	0	0	0	0	0	5,349
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	317	9,026	13,231	749	1,854	15,965	23,199	145	204	665	857	0	0	0	0	0	66,213

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	62	4,882	7,254	43	246	3,085	4,888	25	0	132	88	0	0	0	0	0	20,706
200 - 500	11	2,493	2,614	0	140	4,473	3,894	0	0	101	0	0	0	0	0	0	13,726
500 - 1000	0	296	761	0	464	2,339	3,315	0	31	25	242	0	0	0	0	0	7,472
1000 - 2000	0	1	197	0	69	629	1,176	0	165	163	178	0	0	0	0	0	2,578
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	73	7,672	10,826	43	919	10,526	13,274	25	195	421	508	0	0	0	0	0	44,482

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	61	20	1,756	706	122	647	3,014	120	0	122	124	0	0	0	0	0	6,692
200 - 500	183	167	560	0	93	1,566	3,859	0	0	122	107	0	0	0	0	0	6,657
500 - 1000	0	711	74	0	454	1,698	2,646	0	9	0	19	0	0	0	0	0	5,611
1000 -2000	0	457	15	0	266	1,528	406	0	0	0	99	0	0	0	0	0	2,771
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	244	1,355	2,405	706	935	5,439	9,925	120	9	244	349	0	0	0	0	0	21,731

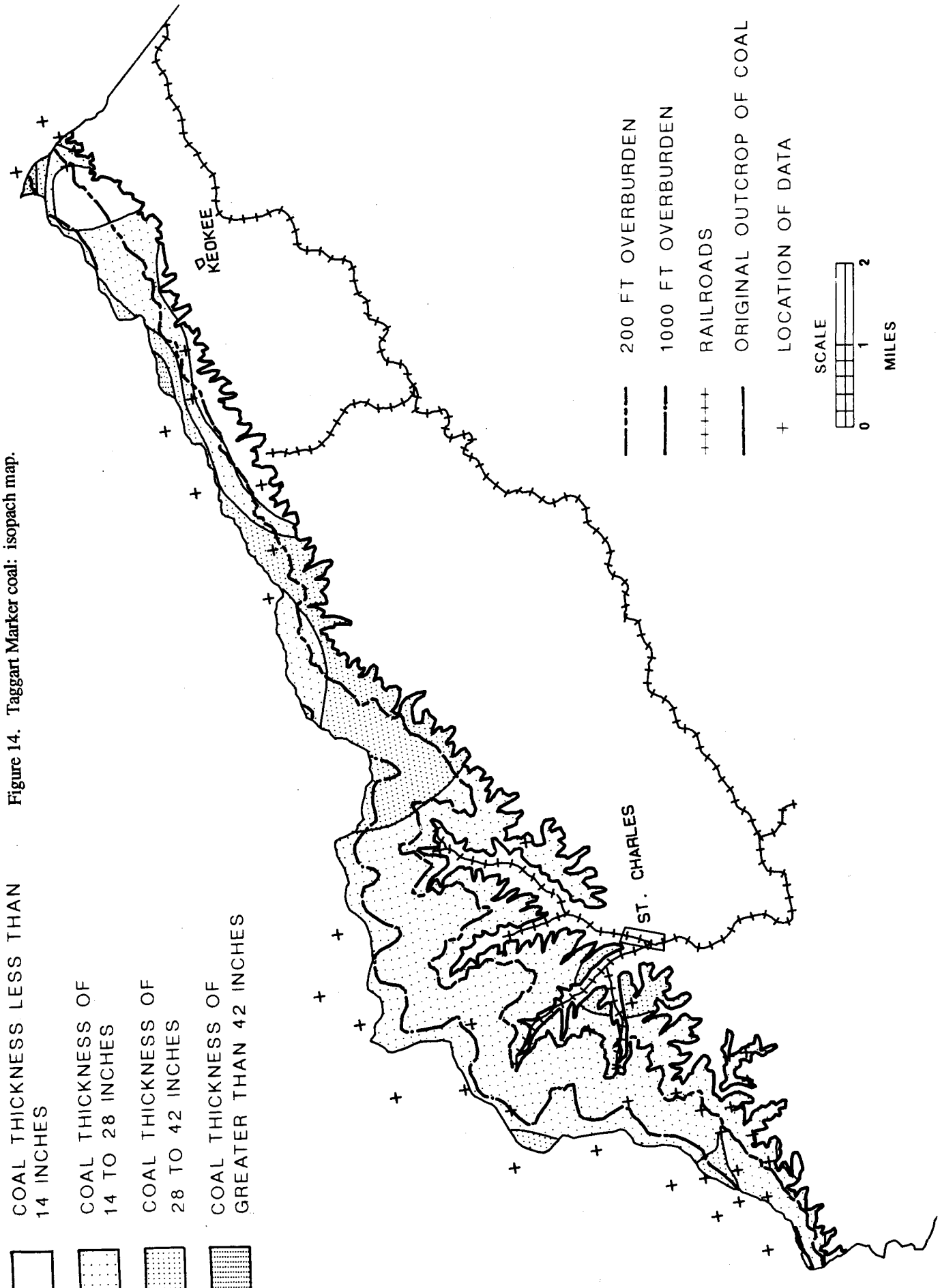

Figure 14. Taggart Marker coal: isopach map.

Table 21. Summary of the original, mined, and remaining coal resources in each resource category for Taggart Marker coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	2017	881	0	0	4347	2459	0	0	3853	617	0	0	0	0	0	0	14174
200 - 500	1842	504	0	0	3761	1588	229	0	3340	971	0	0	0	0	0	0	12235
500 - 1000	1222	404	67	0	3215	855	63	0	1819	1497	0	0	0	0	0	0	9142
1000 - 2000	489	110	26	0	2855	229	37	0	403	423	0	0	0	0	0	0	4572
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	5570	1899	93	0	14178	5131	329	0	9415	3508	0	0	0	0	0	0	40123

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	2017	881	0	0	4347	2459	0	0	3853	617	0	0	0	0	0	0	14174
200 - 500	1842	504	0	0	3761	1588	229	0	3340	971	0	0	0	0	0	0	12235
500 - 1000	1222	404	67	0	3215	855	63	0	1819	1497	0	0	0	0	0	0	9142
1000 - 2000	489	110	26	0	2855	229	37	0	403	423	0	0	0	0	0	0	4572
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	5570	1899	93	0	14178	5131	329	0	9415	3508	0	0	0	0	0	0	40123

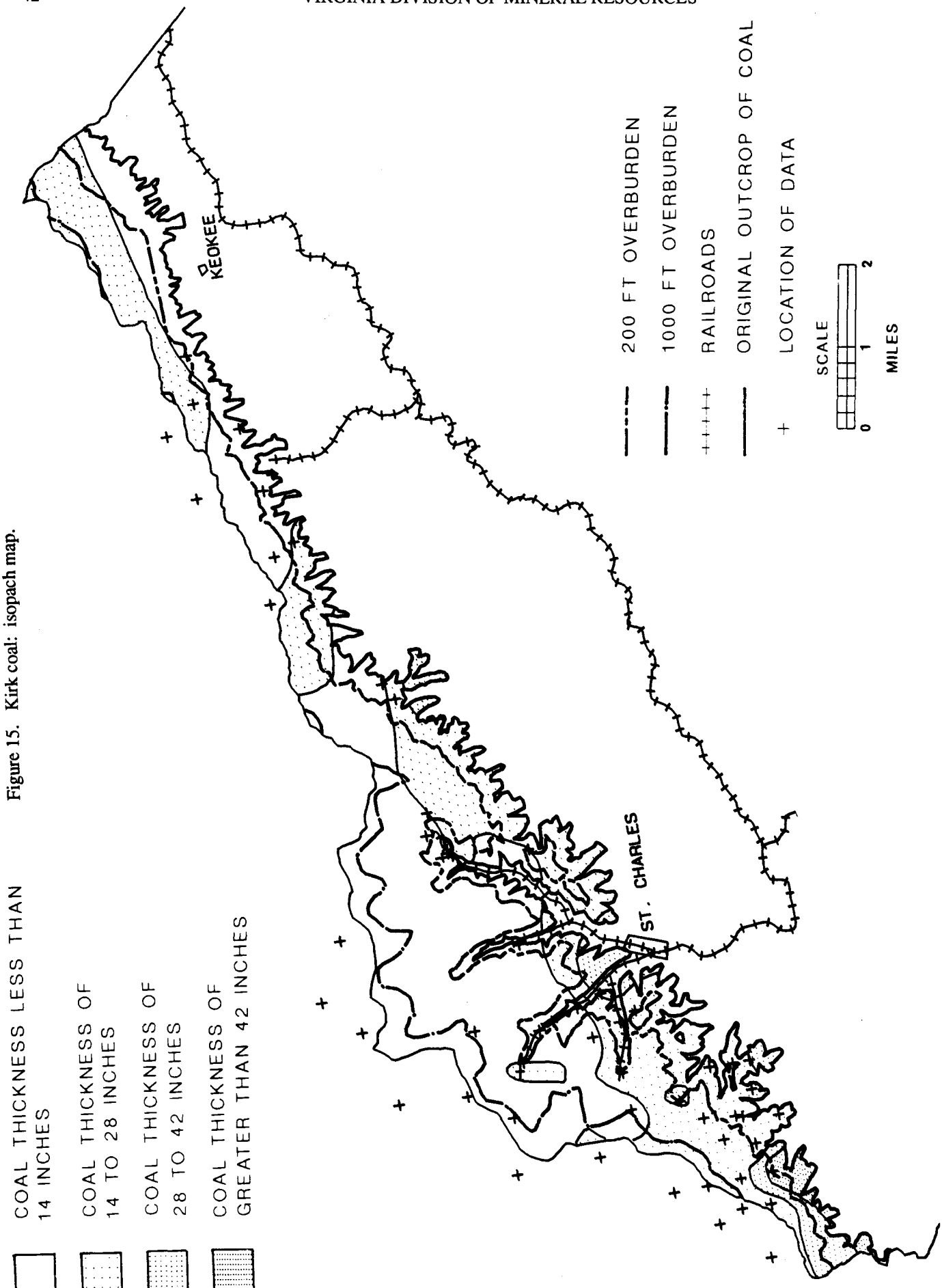

Figure 15. Kirk coal: isopach map.

Table 22. Summary of the original, mined, and remaining coal resources in each resource category for Kirk coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	2,135	418	213	0	2,788	1,325	606	0	929	313	248	0	0	0	0	0	8,975
200 - 500	1,871	421	221	0	2,742	552	27	0	994	0	0	0	0	0	0	0	6,828
500 - 1000	685	18	0	0	877	0	0	0	1,078	0	0	0	0	0	0	0	2,658
1000 - 2000	117	0	0	0	265	0	0	0	212	0	0	0	0	0	0	0	594
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4,808	857	435	0	6,672	1,877	633	0	3,213	313	248	0	0	0	0	0	19,055

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	4	32	0	0	0	0	0	0	0	0	0	0	36
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	4	32	0	0	0	0	0	0	0	0	0	0	36

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	2,135	418	213	0	2,784	1,293	607	0	929	313	248	0	0	0	0	0	8,939
200 - 500	1,872	421	221	0	2,742	552	27	0	994	0	0	0	0	0	0	0	6,828
500 - 1000	685	18	0	0	877	0	0	0	1,078	0	0	0	0	0	0	0	2,658
1000 - 2000	117	0	0	0	265	0	0	0	212	0	0	0	0	0	0	0	594
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	4,808	857	434	0	6,668	1,845	633	0	3,213	313	248	0	0	0	0	0	19,019

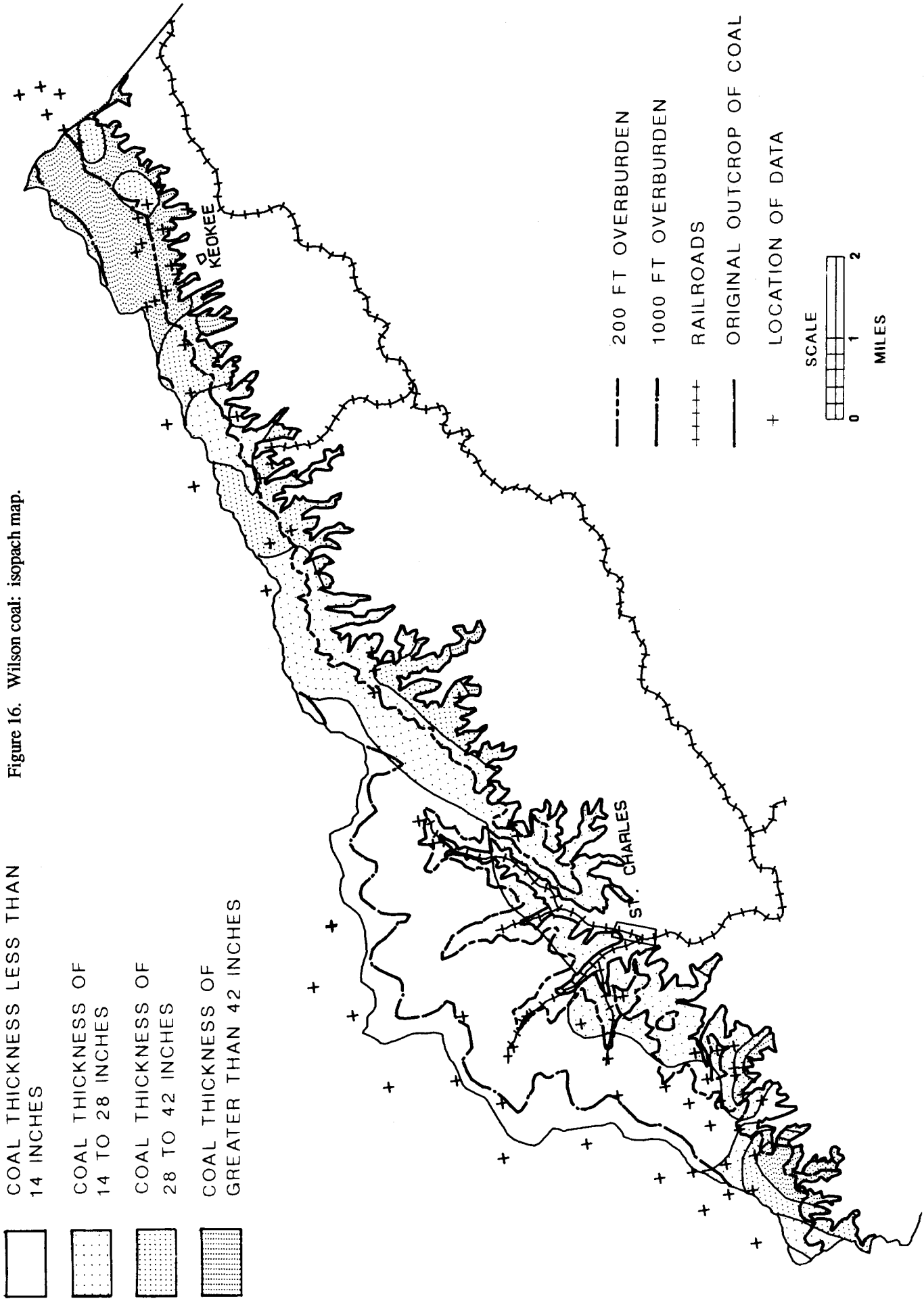

Figure 16. Wilson coal: isopach map.

Table 23. Summary of the original, mined, and remaining coal resources in each resource category for Wilson coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	1,638	2,999	3,120	0	4,466	3,798	3,166	0	1,369	669	637	0	0	0	0	0	21,862
200 - 500	1,357	1,363	2,647	0	3,426	973	2,807	0	476	4	175	0	0	0	0	0	13,227
500 - 1000	277	541	255	0	733	610	2,524	0	250	0	134	0	0	0	0	0	5,324
1000 - 2000	46	0	0	0	9	0	269	0	2	0	263	0	0	0	0	0	589
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3,318	4,903	6,022	0	8,634	5,381	8,766	0	2,097	673	1,208	0	0	0	0	0	41,002

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	23	169	1,245	0	191	537	632	0	0	4	9	0	0	0	0	0	2,810
200 - 500	0	0	1,518	0	0	0	277	0	0	0	1	0	0	0	0	0	1,795
500 - 1000	0	0	142	0	0	0	122	0	0	0	0	0	0	0	0	0	264
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	23	169	2,905	0	191	537	1,030	0	0	4	9	0	0	0	0	0	4,869

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	1,615	2,830	1,875	0	4,275	3,261	2,534	0	1,369	665	628	0	0	0	0	0	19,052
200 - 500	1,357	1,363	1,129	0	3,426	973	2,530	0	476	4	174	0	0	0	0	0	11,432
500 - 1000	277	541	113	0	733	611	2,402	0	250	0	134	0	0	0	0	0	5,060
1000 - 2000	46	0	0	0	9	0	269	0	2	0	263	0	0	0	0	0	589
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3,295	4,734	3,117	0	8,443	4,844	7,735	0	2,097	669	1,199	0	0	0	0	0	36,133

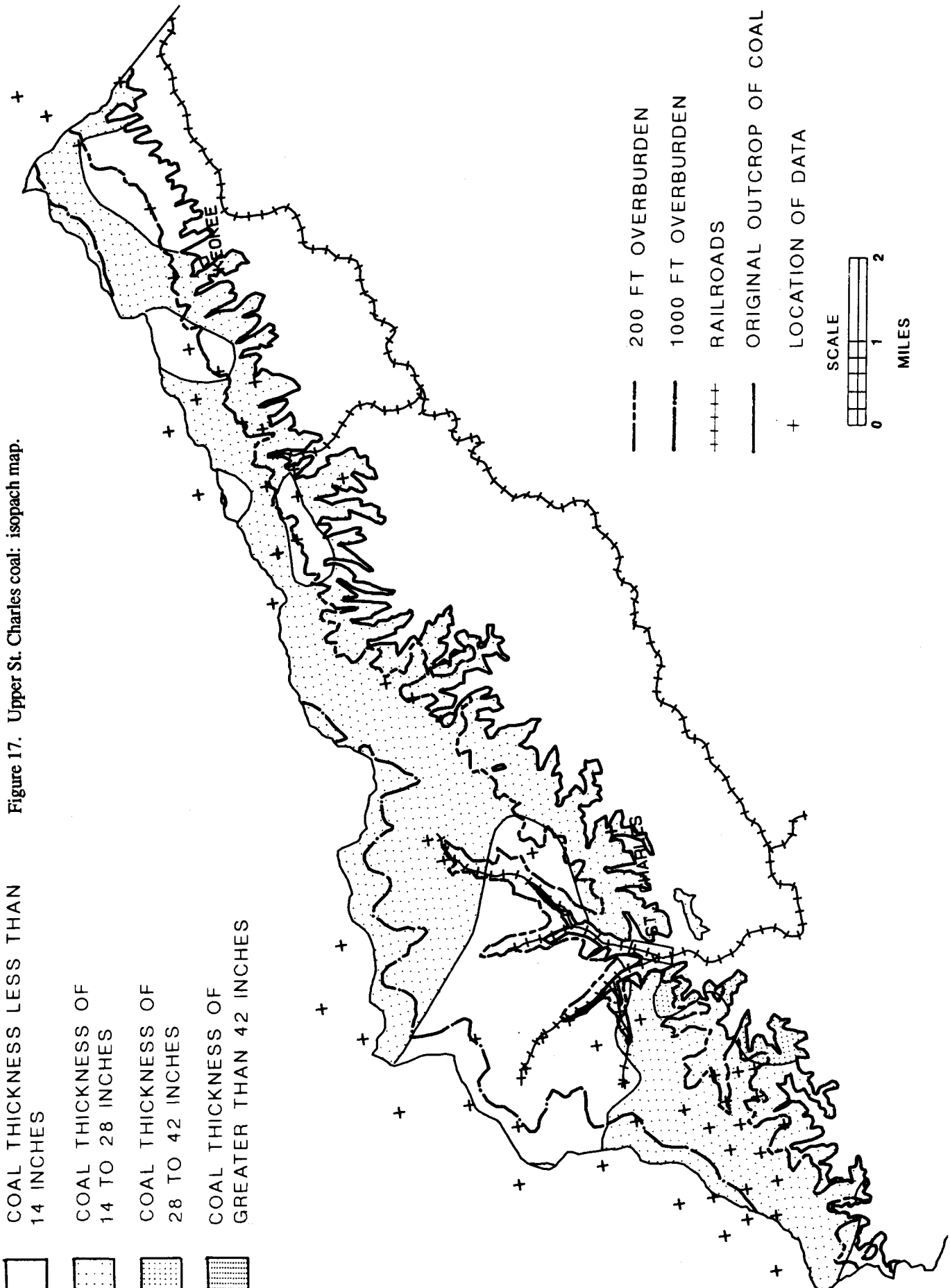

Figure 17. Upper St. Charles coal: isopach map.

Table 24. Summary of the original, mined, and remaining coal resources in each resource category for Upper St. Charles coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	2,902	84	0	0	6,378	795	0	0	3,297	184	0	0	0	0	0	0	13,640
200 - 500	4,193	0	0	0	6,549	0	0	0	1,164	0	0	0	0	0	0	0	11,906
500 - 1000	1,592	0	0	0	4,403	0	0	0	1,875	0	0	0	0	0	0	0	7,870
1000 - 2000	388	0	0	0	2,227	0	0	0	1,264	0	0	0	0	0	0	0	3,879
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	9,075	84	0	0	19,557	795	0	0	7,600	184	0	0	0	0	0	0	37,295

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	2,902	84	0	0	6,378	795	0	0	3,297	184	0	0	0	0	0	0	13,640
200 - 500	4,193	0	0	0	6,549	0	0	0	1,164	0	0	0	0	0	0	0	11,906
500 - 1000	1,592	0	0	0	4,403	0	0	0	1,875	0	0	0	0	0	0	0	7,870
1000 - 2000	388	0	0	0	2,227	0	0	0	1,264	0	0	0	0	0	0	0	3,879
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	9,075	84	0	0	19,557	795	0	0	7,600	184	0	0	0	0	0	0	37,295

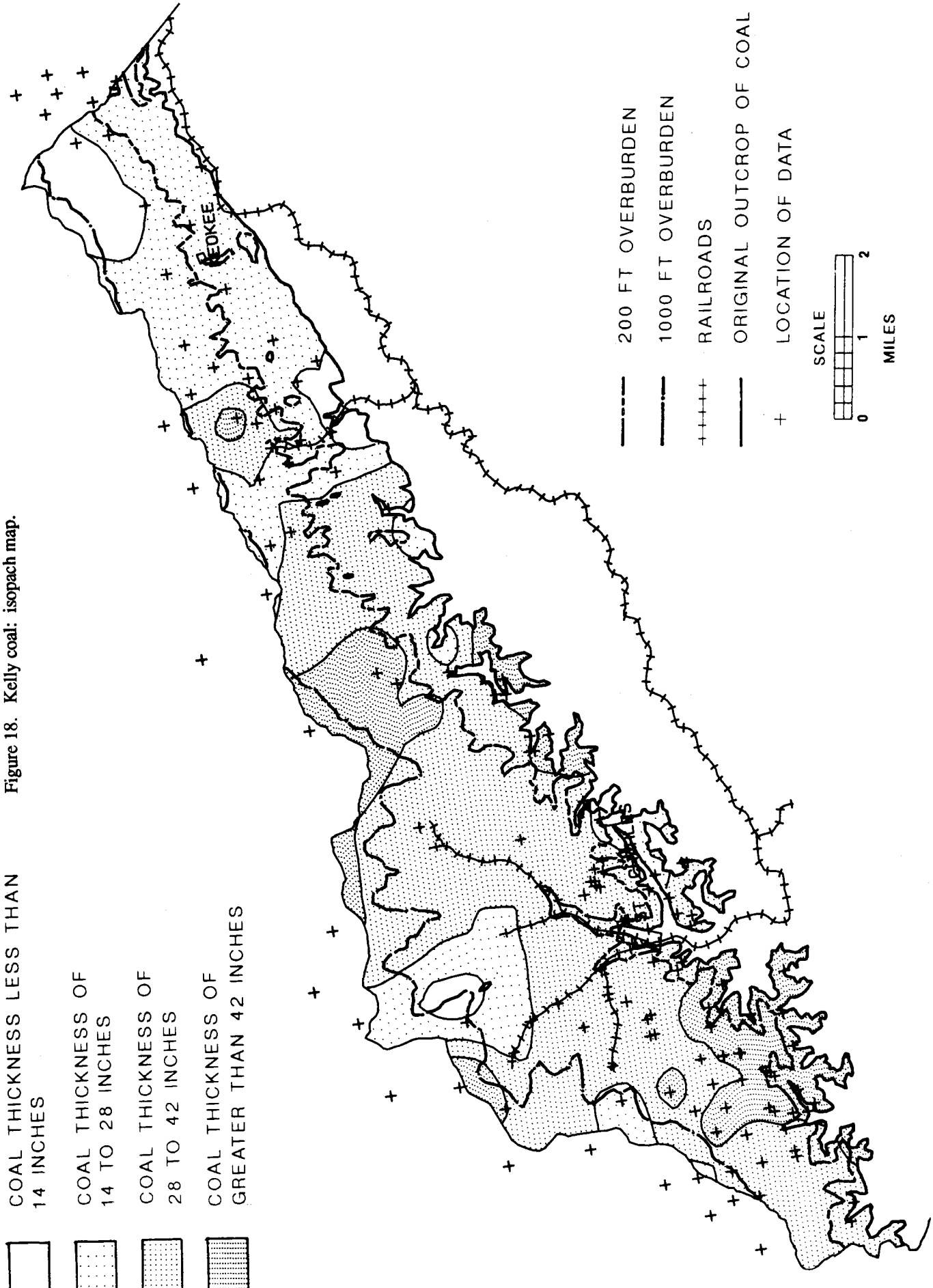

Figure 18. Kelly coal: isopach map.

Table 25. Summary of the original, mined, and remaining coal resources in each resource category for Kelly coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	3,308	5,894	4,958	0	4,156	7,626	3,733	0	0	1,830	65	0	0	0	0	0	31,570
200 - 500	2,808	9,923	6,131	0	1,868	13,743	2,672	0	630	1,587	0	0	0	0	0	0	39,362
500 - 1000	1,305	5,255	1,176	0	2,626	9,486	2,925	0	751	3,132	69	0	0	0	0	0	26,725
1000 - 2000	649	722	735	0	1,480	5,380	1,959	0	81	906	1,127	0	0	0	0	0	13,039
> 2000	10	0	0	0	28	95	32	0	0	0	9	0	0	0	0	0	174
TOTAL	8,080	21,794	13,000	0	10,158	36,330	11,320	0	1,462	7,455	1,270	0	0	0	0	0	110,870

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	27	1,145	1,449	0	48	449	264	0	0	0	0	0	0	0	0	0	3,383
200 - 500	0	2,007	747	0	0	1,482	210	0	0	0	0	0	0	0	0	0	4,446
500 - 1000	0	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	5
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	27	3,153	2,196	0	48	1,935	474	0	0	0	0	0	0	0	0	0	7,834

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	3,280	4,749	3,509	0	4,108	7,177	3,469	0	0	1,830	65	0	0	0	0	0	28,187
200 - 500	2,808	7,916	5,384	0	1,868	12,261	2,462	0	630	1,587	0	0	0	0	0	0	34,916
500 - 1000	1,305	5,254	1,176	0	2,626	9,482	2,925	0	751	3,132	69	0	0	0	0	0	26,720
1000 - 2000	649	722	735	0	1,480	5,380	1,959	0	81	906	1,127	0	0	0	0	0	13,039
> 2000	10	0	0	0	28	95	32	0	0	0	9	0	0	0	0	0	174
TOTAL	8,052	18,641	10,804	0	10,110	34,395	10,847	0	1,462	7,455	1,270	0	0	0	0	0	103,036

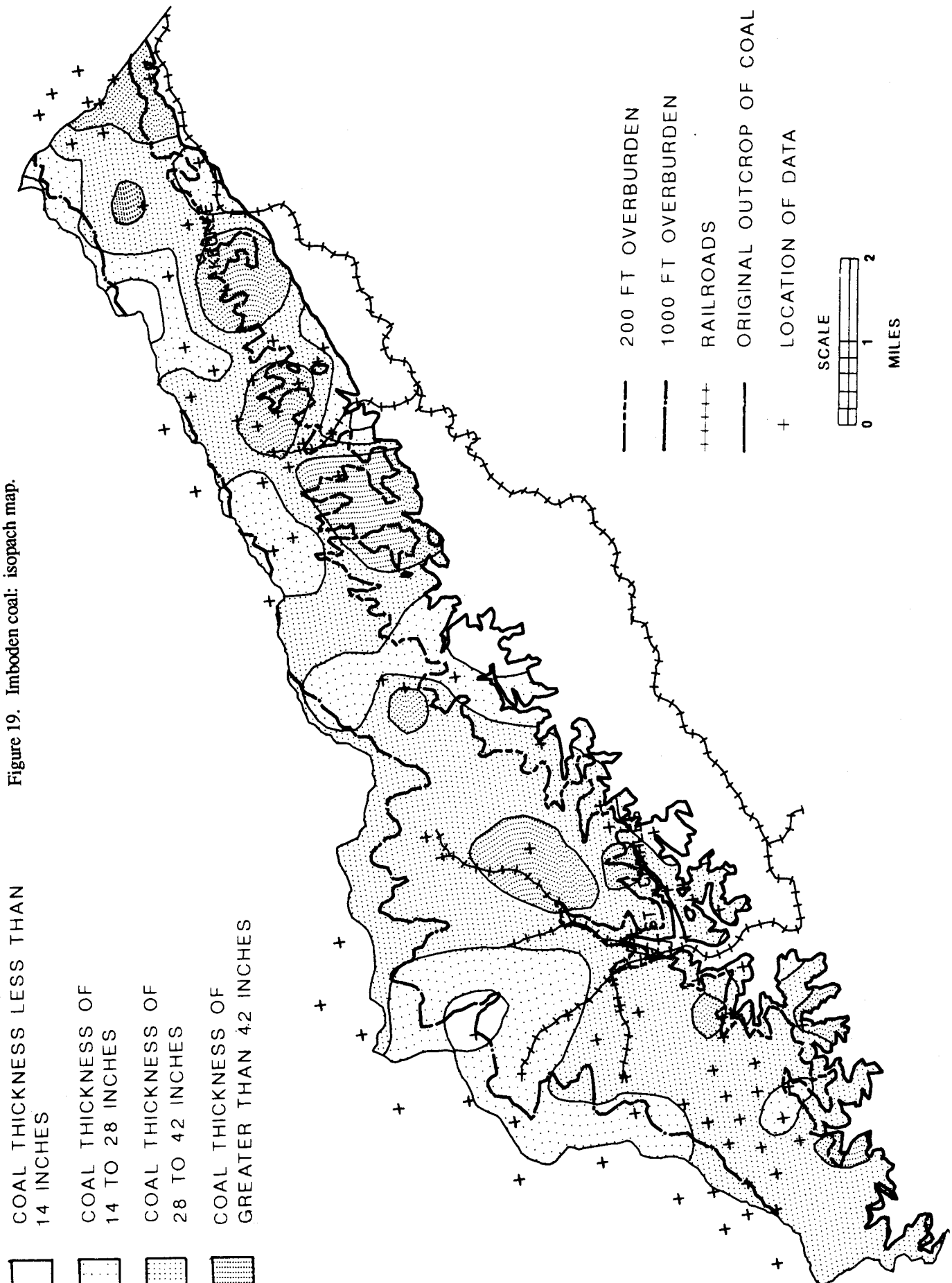

Figure 19. Imboden coal: isopach map.

Table 26. Summary of the original, mined, and remaining coal resources in each resource category for Imboden coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	1,370	5,020	2,111	1,024	2,677	6,400	6,967	464	323	2,146	2,324	0	0	0	0	0	30,826
200 - 500	2,417	10,717	6,470	112	1,884	16,804	8,367	146	348	5,246	1,177	0	0	0	0	0	53,688
500 - 1000	1,302	5,841	623	0	5,237	10,737	1,317	0	976	3,244	63	0	0	0	0	0	29,340
1000 - 2000	922	628	0	0	3,405	3,701	0	0	694	2,264	0	0	0	0	0	0	11,614
> 2000	0	13	0	0	94	97	0	0	0	10	0	0	0	0	0	0	214
TOTAL	6,011	22,219	9,204	1,136	13,297	37,739	16,651	610	2,341	12,910	3,564	0	0	0	0	0	125,682

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	38	258	252	836	20	340	109	244	0	0	0	0	0	0	0	0	2,097
200 - 500	0	16	844	112	0	0	172	58	0	56	0	0	0	0	0	0	1,258
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	38	274	1,096	948	20	340	281	302	0	56	0	0	0	0	0	0	3,355

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	1,332	4,762	1,859	188	2,657	6,060	6,858	220	323	2,146	2,324	0	0	0	0	0	28,729
200 - 500	2,417	10,701	5,626	0	1,884	16,804	8,195	88	348	5,190	1,177	0	0	0	0	0	52,430
500 - 1000	1,302	5,841	623	0	5,237	10,737	1,317	0	976	3,244	63	0	0	0	0	0	29,340
1000 - 2000	922	628	0	0	3,405	3,701	0	0	694	2,264	0	0	0	0	0	0	11,614
> 2000	0	13	0	0	94	97	0	0	0	10	0	0	0	0	0	0	214
TOTAL	5,973	21,945	8,108	188	13,277	37,399	16,370	308	2,341	12,854	3,564	0	0	0	0	0	122,327

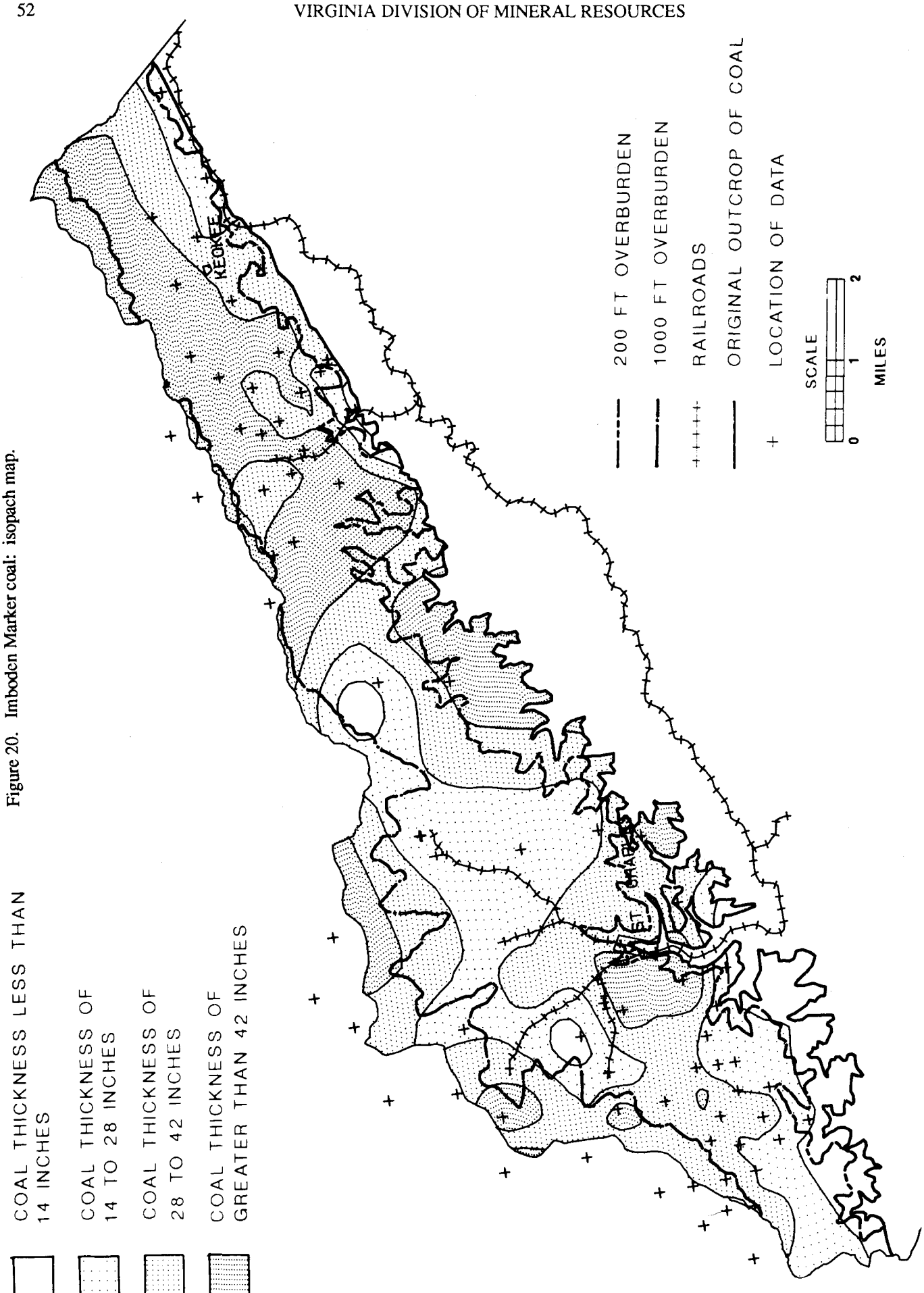

Figure 20. Imboden Marker coal: isopach map.

Table 27. Summary of the original, mined, and remaining coal resources in each resource category for Imboden Marker coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	848	1,424	1,407	0	1,206	4,868	6,277	0	35	2,968	4,152	0	0	0	207	0	23,392
200 - 500	2,746	6,131	8,693	0	5,580	9,762	11,497	0	1,336	5,179	1,673	0	0	0	0	0	52,597
500 - 1000	1,891	3,653	3,720	0	6,312	6,110	10,065	0	1,735	3,283	1,437	0	0	0	0	0	38,206
1000 - 2000	387	1,338	1,251	0	1,378	5,420	4,250	0	617	1,461	3,134	0	0	0	0	0	19,236
> 2000	0	46	0	0	37	385	137	0	0	0	37	0	0	0	0	0	642
TOTAL	5,872	12,592	15,071	0	4,513	26,545	32,226	0	3,723	12,891	10,433	0	0	0	207	0	134,073

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN																	
0 - 200	848	1,424	1,407	0	1,206	4,868	6,277	0	35	2,968	4,152	0	0	0	207	0	23,392
200 - 500	2,746	6,131	8,693	0	5,580	9,762	11,497	0	1,336	5,179	1,673	0	0	0	0	0	52,597
500 - 1000	1,891	3,653	3,720	0	6,312	6,110	10,065	0	1,735	3,283	1,437	0	0	0	0	0	38,206
1000 - 2000	387	1,338	1,251	0	1,378	5,420	4,250	0	617	1,461	3,134	0	0	0	0	0	19,236
> 2000	0	46	0	0	37	385	137	0	0	0	37	0	0	0	0	0	642
TOTAL	5,872	12,592	15,071	0	14,513	26,545	32,226	0	3,723	12,891	10,433	0	0	0	207	0	134,073

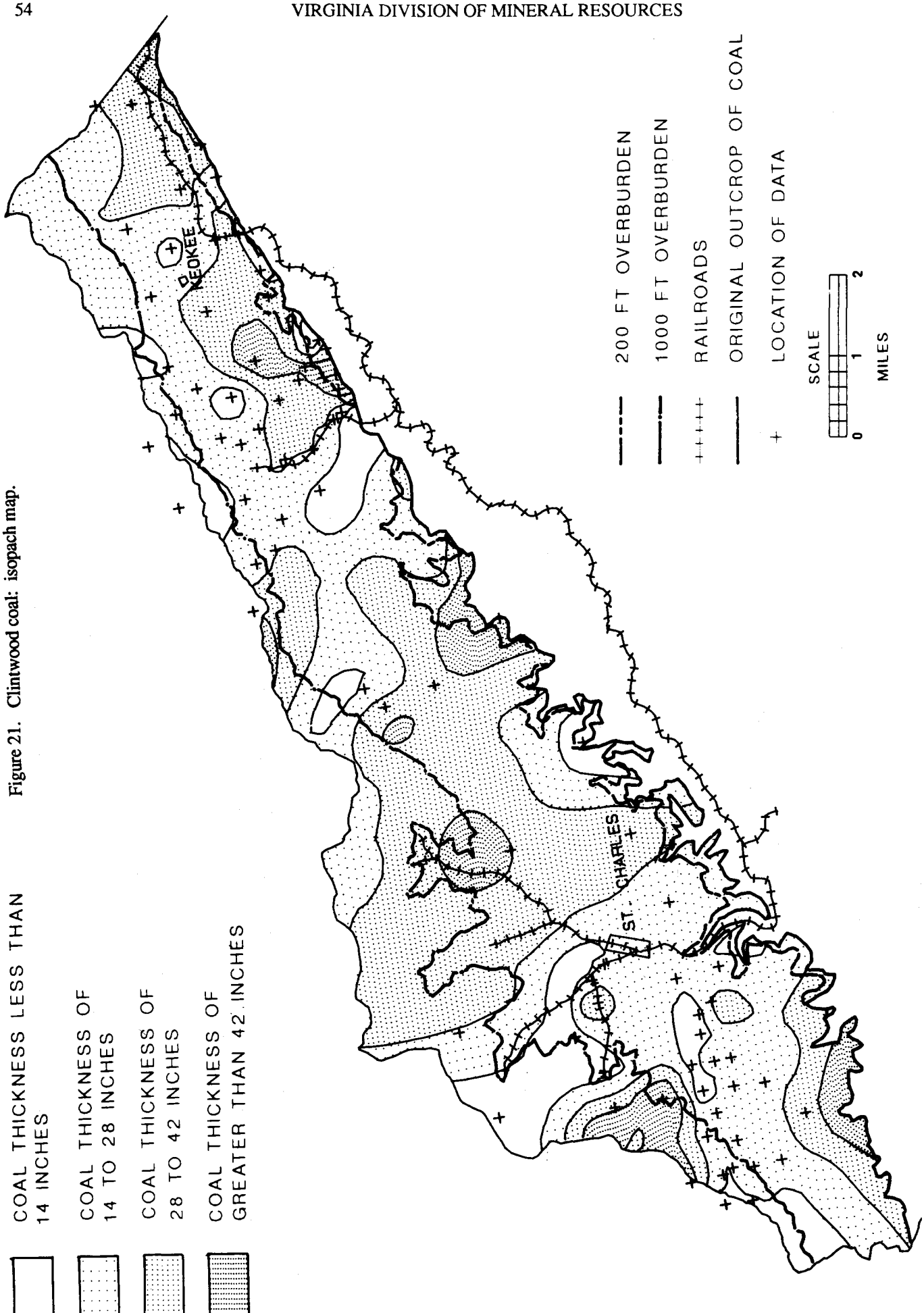

Figure 21. Clintwood coal: isopach map.

Table 28. Summary of the original, mined, and remaining coal resources in each resource category for Clintwood coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	3 59	865	1,016	0	1,638	1,407	1,086	0	398	491	0	0	0	0	0	0	7,260
200 - 500	1,442	4,296	1,177	0	5,477	7,602	4,374	0	2,135	4,233	804	0	0	0	0	0	31,540
500 - 1000	8,506	4,613	1,399	0	10,826	12,211	2,187	0	2,082	6,617	264	0	0	0	0	0	48,705
1000 - 2000	1,665	995	811	0	3,342	4,814	1,841	0	2,753	8,538	159	0	0	0	0	0	24,918
> 2000	38	5	91	0	365	132	400	0	973	776	0	0	0	0	0	0	2,780
TOTAL	12,010	10,774	4,494	0	21,648	26,166	9,888	0	8,341	20,655	1,227	0	0	0	0	0	115,203

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	359	865	1,016	0	1,638	1,407	1,086	0	398	491	0	0	0	0	0	0	7,260
200 - 500	1,442	4,296	1,177	0	5,477	7,602	4,374	0	2,135	4,233	804	0	0	0	0	0	31,540
500 - 1000	8,506	4,613	1,399	0	10,826	12,211	2,187	0	2,082	6,617	264	0	0	0	0	0	48,705
1000 - 2000	1,665	995	811	0	3,342	4,814	1,841	0	2,753	8,538	159	0	0	0	0	0	24,918
> 2000	38	5	91	0	365	132	400	0	973	776	0	0	0	0	0	0	2,780
TOTAL	12,010	10,774	4,494	0	21,648	26,166	9,888	0	8,341	20,655	1,227	0	0	0	0	0	115,203

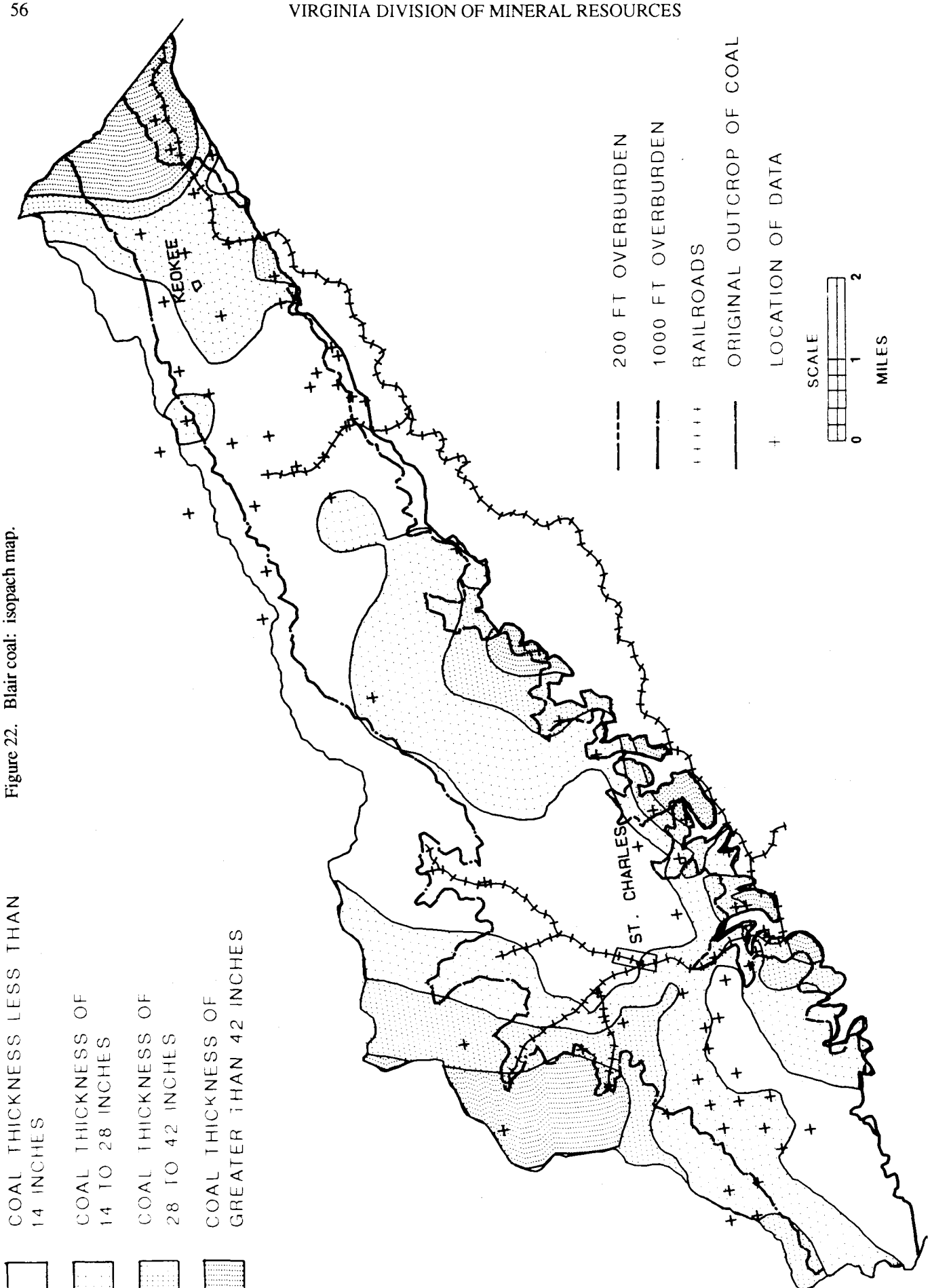

Figure 22. Blair coal: isopach map.

Table 29. Summary of the original, mined, and remaining coal resources in each resource category for Blair coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	1255	1774	3438	631	1179	1704	3380	1030	141	76	255	91	0	0	0	0	14954
200 - 500	1950	877	745	190	5586	2636	2045	1775	2324	576	0	0	0	0	0	0	18704
500 - 1000	5181	1127	337	0	6702	2951	1478	197	3785	301	1193	393	0	0	0	0	23645
1000 - 2000	1290	877	1469	0	2148	3871	5814	0	2003	1547	1154	0	0	0	0	0	20173
> 2000	0	79	101	0	27	506	1514	0	459	698	479	0	0	0	0	0	3863
TOTAL	9676	4734	6090	821	15642	11668	14231	3002	8712	3198	3081	484	0	0	0	0	81339

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	1255	1774	3438	631	1179	1704	3380	1030	141	76	255	91	0	0	0	0	14954
200 - 500	1950	877	745	190	5586	2636	2045	1775	2324	576	0	0	0	0	0	0	18704
500 - 1000	5181	1127	337	0	6702	2951	1478	197	3785	301	1193	393	0	0	0	0	23645
1000 - 2000	1290	877	1469	0	2148	3871	5814	0	2003	1547	1154	0	0	0	0	0	20173
> 2000	0	79	101	0	27	506	1514	0	459	698	479	0	0	0	0	0	3863
TOTAL	9676	4734	6090	821	15642	11668	14231	3002	8712	3198	3081	484	0	0	0	0	81339

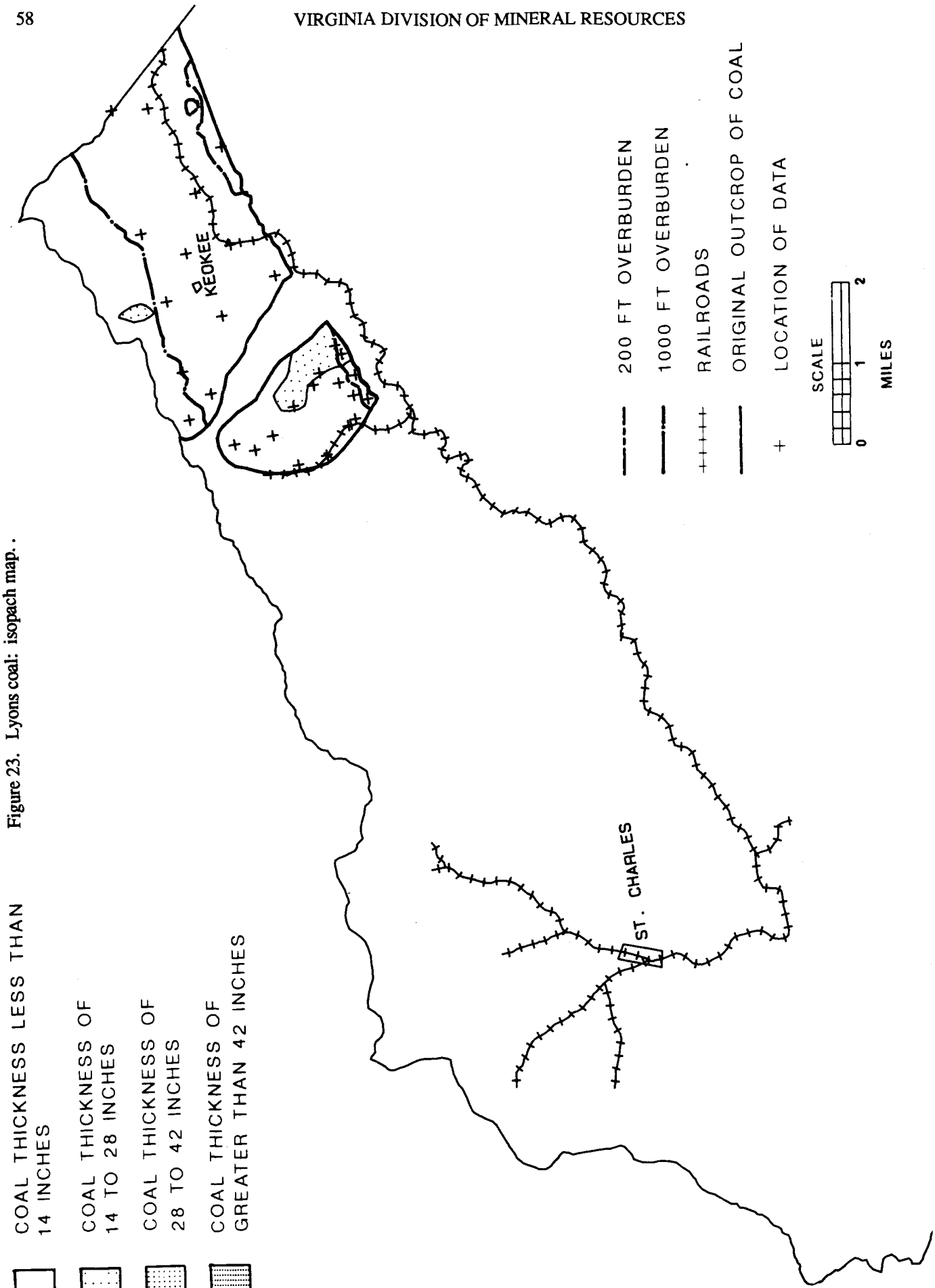

Figure 23. Lyons coal: isopach map. .

Table 30. Summary of the original, mined, and remaining coal resources in each resource category for Lyons coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73
200 - 500	299	0	0	0	186	0	0	0	0	0	0	0	0	0	0	0	485
500 - 1000	9	0	0	0	83	0	0	0	0	0	0	0	0	0	0	0	92
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	381	0	0	0	269	0	0	0	0	0	0	0	0	0	0	0	650

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73
200 - 500	299	0	0	0	186	0	0	0	0	0	0	0	0	0	0	0	485
500 - 1000	9	0	0	0	83	0	0	0	0	0	0	0	0	0	0	0	92
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	381	0	0	0	269	0	0	0	0	0	0	0	0	0	0	0	650

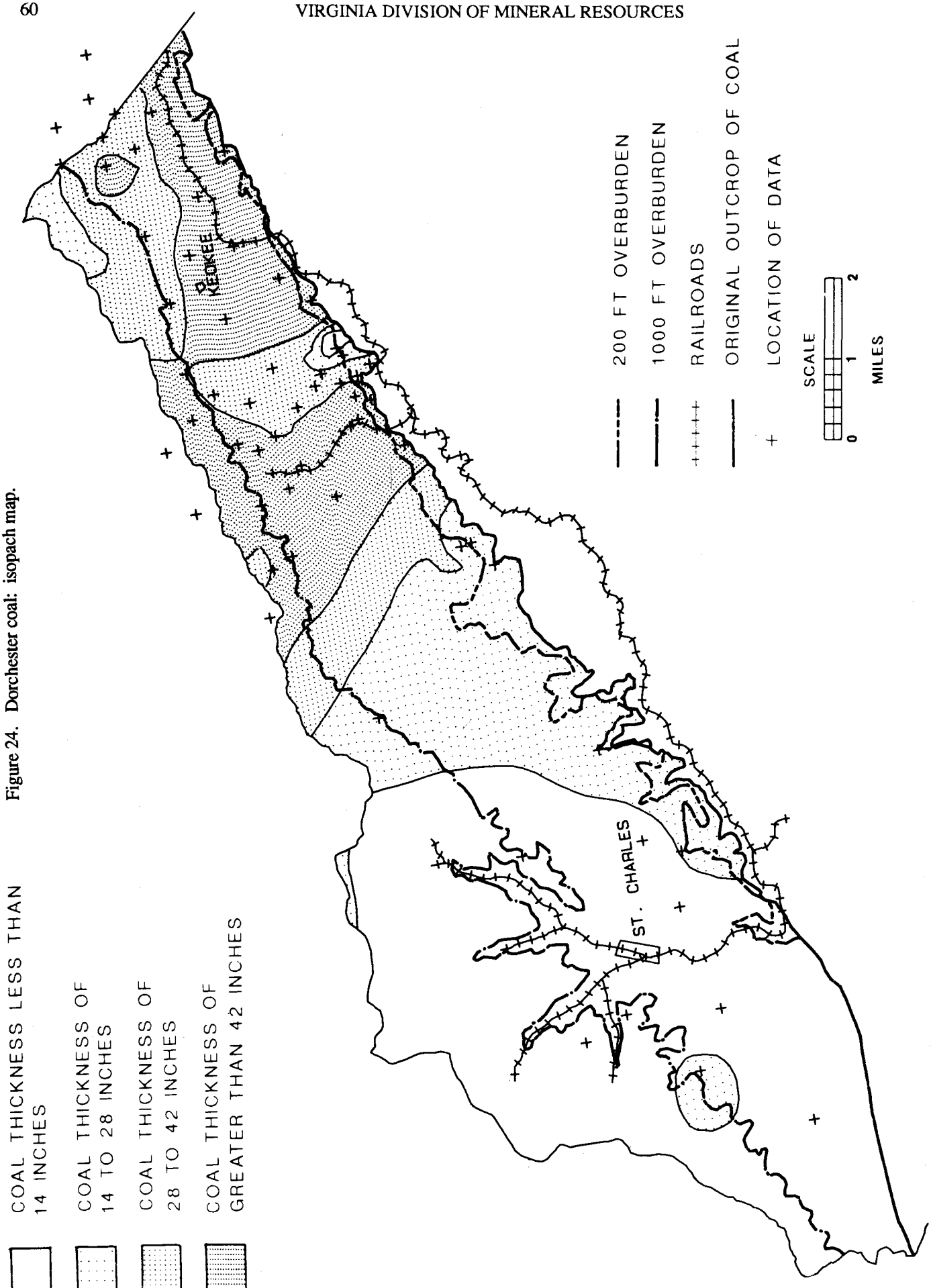

Figure 24. Dorchester coal: isopach map.

Table 31. Summary of the original, mined, and remaining coal resources in each resource category for Dorchester coal in Lee County, VA as of 1/1/88 (thousands of short tons).

I. ORIGINAL COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	559	284	1,612	0	1,947	632	1,638	0	983	0	75	0	0	0	0	0	7,730
200 - 500	806	222	2,921	0	3,036	1,379	6,343	0	3,194	830	261	0	0	0	0	0	18,992
500 - 1000	519	5,993	11,537	0	1,919	4,872	12,801	0	2,228	2,254	0	0	0	0	0	0	42,123
1000- 2000	321	792	2,831	0	2,354	4,045	4,264	0	536	987	0	0	0	0	0	0	16,130
> 2000	0	41	0	0	25	0	0	0	318	41	0	0	0	0	0	0	425
TOTAL	2,205	7,332	18,901	0	9,281	10,928	25,046	0	7,259	4,112	336	0	0	0	0	0	85,400

II. AMOUNT OF ORIGINAL COAL RESOURCES MINED

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200 - 500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
500 - 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1000 - 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

III. REMAINING COAL RESOURCES

	MEASURED				INDICATED				INFERRED				HYPOTHETICAL				TOTAL
THICKNESS	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	14"-28"	28"-42"	42"-84"	>84"	
OVERBURDEN (ft)																	
0 - 200	559	284	1,612	0	1,947	632	1,638	0	983	0	75	0	0	0	0	0	7,730
200 - 500	806	222	2,921	0	3,036	1,379	6,343	0	3,194	830	261	0	0	0	0	0	18,992
500 - 1000	519	5,993	11,537	0	1,919	4,872	12,801	0	2,228	2,254	0	0	0	0	0	0	42,123
1000 - 2000	321	792	2,831	0	2,354	4,045	4,264	0	536	987	0	0	0	0	0	0	16,130
> 2000	0	41	0	0	25	0	0	0	318	41	0	0	0	0	0	0	425
TOTAL	2,205	7,332	18,901	0	9,821	10,928	25,046	0	7,259	4,112	336	0	0	0	0	0	85,400