Coal Reserve Assessment and Database Development of the Danville and Springfield Coal Members in Indiana: Final Report

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COAL RESERVE ASSESSMENT AND DATA BASE DEVELOPMENT OF THE DANVILLE AND SPRINGFIELD COAL MEMBERS IN INDIANA

Carol L. Conolly and John A. Rupp

ABSTRACT

This study assesses the coal resources of the Danville and Springfield Coal Members (Dugger and Petersburg Formations, respectively) in Indiana and provides new estimates of the tonnage of coal in the following categories as of January 1, 2000: original resources in place, resources remaining after mining, identified resources, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves. In addition, the sulfur, heat, and ash content of the Danville and Springfield Coals were mapped in order to allocate indicated reserves, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves according to specified categories of sulfur, heat, and ash content.

The resources and reserves categories are defined based upon criteria for minimum coal thickness, overburden thickness, and reliability category. Three reliability categories are used to express the relative degree of geologic assurance or reliability of the resource estimate based upon the density of coal thickness data points that are used to derive the resource estimate. The reliability categories are: measured (0-0.5 miles from the data point), indicated (0.5-2.0 miles), and inferred (2.0-4.0 miles).

The geologic and land use factors which limit the mining of the Danville and Springfield Coal were identified through interviews with geologists and mining engineers from companies mining these coals in Indiana and Illinois. These factors were mapped and then applied to the tonnage of demonstrated reserve base in order to calculate the tonnage of accessible reserve base. Recovery-rate factors for surface and underground mining (80% and 50%, respectively) were estimated using proprietary mine recovery rate data from mines operating in the Danville and Springfield Coals during the 1980s and 1990s. Estimated recoverable reserves were calculated by multiplying the accessible reserve base by these recovery-rate factors.

The tonnage of original identified resources of Danville and Springfield Coal in Indiana is calculated to be 18.8 billion short tons (tonnage by coal bed is also provided in this report). Of the 18.8 billion short tons, 1.8 billion short tons have been removed by mining or lost in the mining process, thus leaving 17.0 billion short tons of remaining Danville and Springfield resources. Of the remaining resources, 16.4 billion short tons are demonstrated reserve base. Technological and land use restrictions remove 9.2 billion short tons of demonstrated reserve base from potential mining, thus leaving 7.2 billion short tons (38.2% of the original resources or 42.3% of the remaining resources) of accessible reserve base. Of the 7.2 billion short tons of accessible reserve base, 0.9 billion short tons (4.7% of the original resources or 12.3% of the total accessible reserve base) are estimated to be recoverable by surface mining, while 3.1 billion short tons (16.4% of the original resources or 43% of the total accessible reserve base) are estimated to be recoverable by underground mining.

INTRODUCTION

The Coal Reserves Data Base Program

The Coal Reserves Data Base (CRDB) program of the Federal Government's Energy Information Administration (EIA) is a cooperative program that involves State Geological Surveys or other qualified entities in partnerships with the EIA to update its coal reserves data. The CRDB program was created in 1990 in response to a report issued by the National Coal Council (NCC) in 1987; it expressed concerns about the reliability of the EIA's database on coal resources. Although the NCC did not consistently distinguish between EIA's demonstrated reserve base (DRB) and the notion of recoverable economic reserves, it noted correctly that the DRB included non-minable coal, lacked specific provisions for losses due to mining and preparation, and did not quantify coal "sterilized" or restricted by competing land uses (Damberger, 1993; Richard Bonskowski, EIA, personal communication). Based upon these findings, the NCC concluded that the DRB significantly overstated the amount of coal reserves available for future development.

The CRDB program aims to address the NCC's concerns by coordinating CRDB projects with the results emerging from certain Department of the Interior coal research programs. These programs include the Coal Availability Studies (CAS) of the United States Geological Survey (USGS) and the Coal Recoverability Studies (CRS) of the Federal Bureau of Mines (BOM), which have since been assimilated by the USGS. Since 1990, EIA has initiated eight CRDB studies with State Geological Surveys that were engaged in CAS or CRS studies. In both coal availability studies and coal recoverability studies, the various factors that restrict the mining of coal are specifically defined, and their impact on the amount of minable coal is measured (Eggleston and others, 1990; Rohrbacher and others, 1993). The methods used to calculate available resources and recoverable reserves in these studies not only accounts for non-minable coal, but it also produces results which are more accurate than methods which do not specifically define the restrictions to mining, but rather incorporate the restrictions into an availability factor, or a recovery factor (a percentage) which is then applied to the amount of minable coal to derive available resources or recoverable reserves.

The Purpose of this CRDB Study

The CRDB study described in this report assesses the resources of the Danville and Springfield Coal Members in Indiana and provides new estimates of the tonnage of coal in the following categories as of January 1, 2000: original resources in place, resources remaining after mining, identified resources, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves. In addition, the sulfur, heat, and ash content of the Danville and Springfield Coals were mapped in order to allocate indicated reserves, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves according to specified categories of sulfur, heat, and ash content.

In the course of this study, the Indiana Geological Survey (IGS) utilized and expanded upon the results of two statewide CAS studies that were conducted by the IGS to assess the original, remaining, and available resources of the Springfield and Danville Coal Members in Indiana (Conolly and Zlotin, 1999; Conolly and Zlotin, 2000). The Danville and Springfield Coals were selected for analysis in this study and in the aforementioned studies, because they currently (as well as historically) comprise a large percentage of the coal mined within Indiana (Wier, 1973, Indiana Division of Reclamation, unpublished data). Although there are at least 45 different coal beds in Indiana, time and funding did not permit the analysis of additional coals in this study.

The results of CRDB studies are intended to be used to estimate U. S. coal supply and to support analyses of policy and legislative issues related to the nation's energy supply. The results may also be used to supply U.S. energy data for international databases and to answer inquiries from private industry and the public.

GEOLOGY AND MINING OF THE DANVILLE AND SPRINGFIELD COALS IN INDIANA

Coal Production in Indiana

Coal production in Indiana comes from the coal beds within the Pennsylvanian System. The Indiana coal field constitutes the eastern edge of the Illinois Basin, a basin that covers parts of a three-state area, including Illinois and western Kentucky (fig. 1). The maximum thickness of the Pennsylvanian System in Indiana is about 1,500 feet (475 meters). Pennsylvanian rocks in the Illinois Basin are composed of cyclic sequences of dominantly shale, siltstone, and sandstone interstratified with lesser amounts of coal, limestone, and black shale. Coal is found in at least 45 different stratigraphic positions in Indiana, but constitutes only about 3 percent of Pennsylvanian rocks (fig. 2). Based upon vitrinite reflectance values, the rank of the majority of Indiana's coals is high-volatile bituminous C, while the rank of a few of the deeper coals is high-volatile bituminous B (Mastalerz and Padgett, in preparation).

Recent Production of the Danville and Springfield Coals in Indiana

Of the 41 active coal mines in Indiana in 1999, 25 were mining either the Danville or Springfield Coal. The production from these 25 mines represented roughly 80 percent of Indiana's total coal production in 1999 (Indiana Division of Reclamation, unpublished data). It should be noted, however, that this 80 percent included production of the Hymera Coal, which was also being mined at every surface mine that was mining the Danville Coal.

During 1999, the Danville Coal was mined at 14 surface mines and 2 underground mines. The production from these mines accounted for roughly 57 percent of Indiana's total coal production during 1999 (Indiana Division of Reclamation, unpublished data). Figure 3 shows the distribution of active and abandoned surface and underground mines of the Danville Coal in Indiana. Within Indiana, the thickest resources of the Danville Coal occur in southern Vermillion County and northwest Vigo County (fig. 4). Available data on mined thickness range from 1.0 to 8.3 feet. The maximum depth of the Danville Coal in Indiana is 910 feet, in northwest Posey County (fig. 5).

During 1999, the Springfield Coal was mined at 9 surface mines and 2 underground mines. The production from these mines accounted for roughly 34 percent of Indiana's total coal production in 1999 (Indiana Division of Reclamation, unpublished data). Although the Springfield Coal has historically comprised the largest percentage of coal mined within the state, the fact that the combined production of the Danville and Hymera Coals is now greater than that of the Springfield Coal was anticipated based upon a figure that showed the trend of coal production by coal seam in Indiana from 1920-1970 (Wier, 1973, fig. 16). Figure 6 shows the distribution of active and abandoned surface and underground mines of the Springfield Coal in Indiana.

The thickest resources of the Springfield Coal in Indiana occur in central Gibson County and central Knox County (fig. 7). Available data on mined thickness range from 2.3 to 12.6 feet. The maximum depth of the Springfield Coal in Indiana is 1,010 feet, in northwestern Posey County (fig. 8).

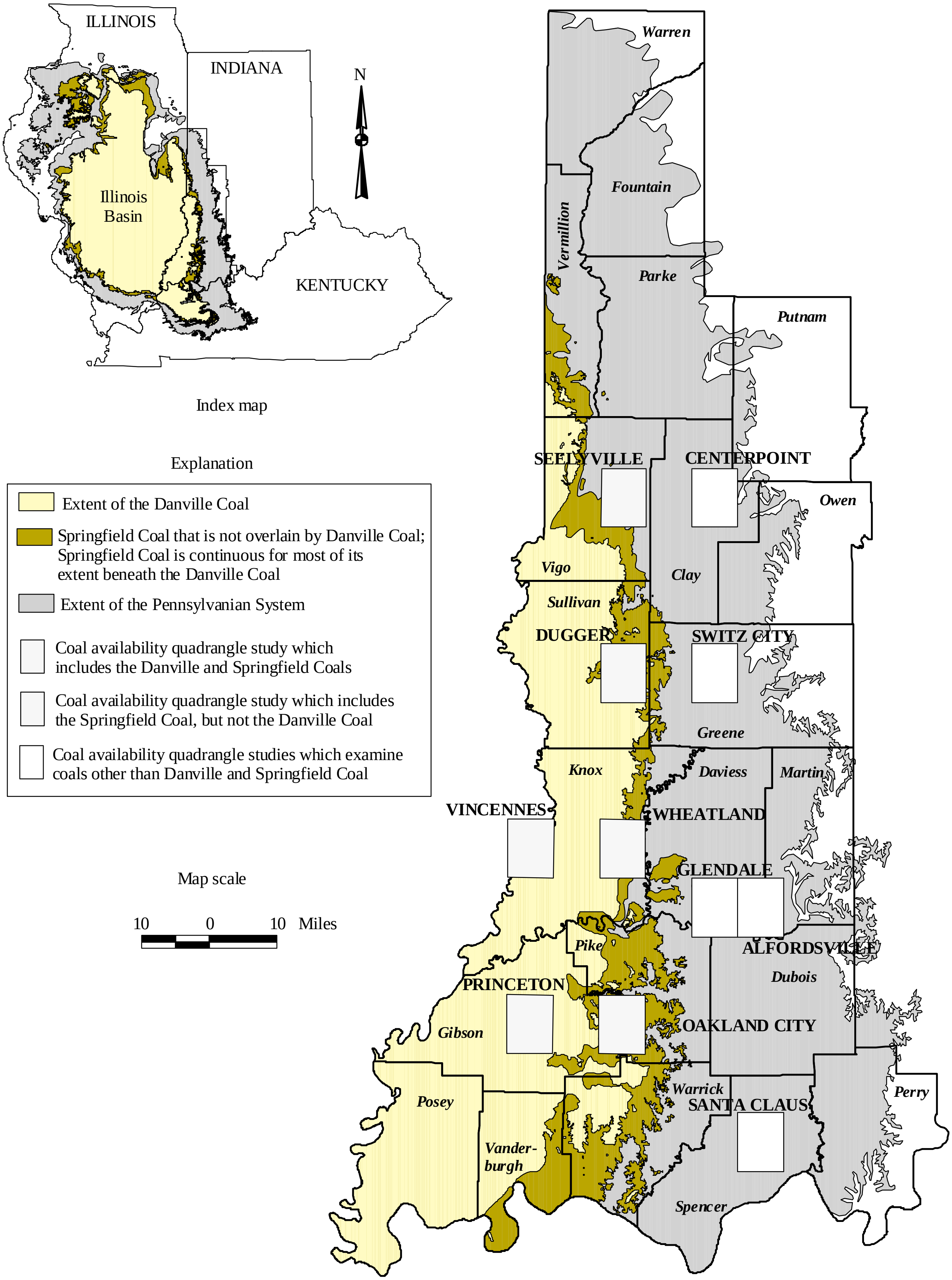


Figure 1. Map of southwestern Indiana showing the ten coal availability quadrangle studies that have been completed by the Indiana Geological Survey (IGS) since 1993. A study of the Vincennes Quadrangle was conducted by the Illinois State Geological Survey, in cooperation with the IGS. Also shown are the extent of the Danville Coal Member, Springfield Coal Member, and the Pennsylvanian System in Indiana and in the Illinois Basin (Index map). Quadrangle names are capitalized; county names are in italics.

PENNSYLVANIAN SYSTEM

ILLINOIS

McLeansboro Group	Mattoon Fm.	
McLeansboro Group	Bond Fm.	
McLeansboro Group	Patoka Fm.	
McLeansboro Group	Shelburn Fm.	**Danville** Jamestown
Carbondale Group	Carbondale Fm.	Herrin **Springfield** Houchin Creek Survant Colchester Dekoven Davis
Raccoon Creek Group	Tradewater Fm.	Willis Reynoldsburg
Raccoon Creek Group	Caseyville Fm.	Gentry

INDIANA

McLeansboro Gp.	Mattoon Fm.	
McLeansboro Gp.	Bond Fm.	
McLeansboro Gp.	Patoka Fm.	
McLeansboro Gp.	Shelburn Fm.	
Carbondale Group	Dugger Fm.	**Danville** Hymera Herrin
Carbondale Group	Petersburg Fm.	**Springfield** Hourchin Creek
Carbondale Group	Linton Fm.	Survant Colchester
Raccoon Creek Group	Staunton Fm.	Seelyville Unnamed Staunton Fm. Coals
Raccoon Creek Group	Brazil Fm.	Minshall/Buffaloville Upper Block Lower Block
Raccoon Creek Group	Mansfield Fm.	Mariah Hill Blue Creek Pinnick St. Meinrad French Lick

W. KENTUCKY

McLeansboro Group	Mattoon Fm.	
McLeansboro Group	Bond Fm.	
McLeansboro Group	Patoka Fm.	
McLeansboro Group	Shelburn Fm.	**Danville** Baker Paradise
Carbondale Group	Carbondale Fm.	Herrin **Springfield** Houchin Creek Survant Colchester Dekoven Davis
Raccoon Creek Group	Tradewater Fm.	Bancroft Mining City Empire Number 4 Dunbar Ice House Smith Bell
Raccoon Creek Group	Caseyville Fm.	

Figure 2. Lithostratigraphy of the Pennsylvanian System in the Illinois Basin, showing major coal beds; modified from Mastalerz and Harper (1998).

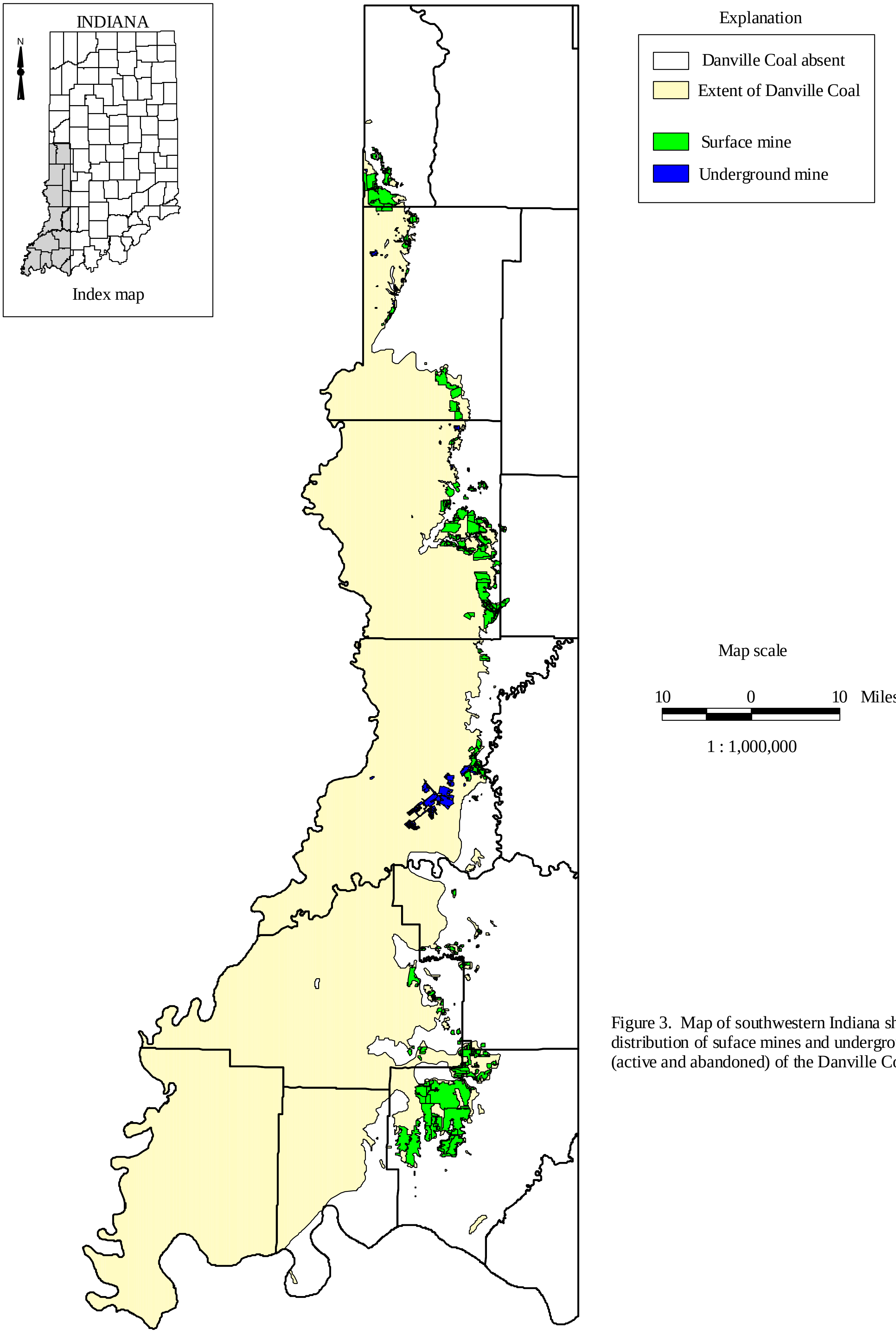


Figure 3. Map of southwestern Indiana showing the distribution of suface mines and underground mines, (active and abandoned) of the Danville Coal.

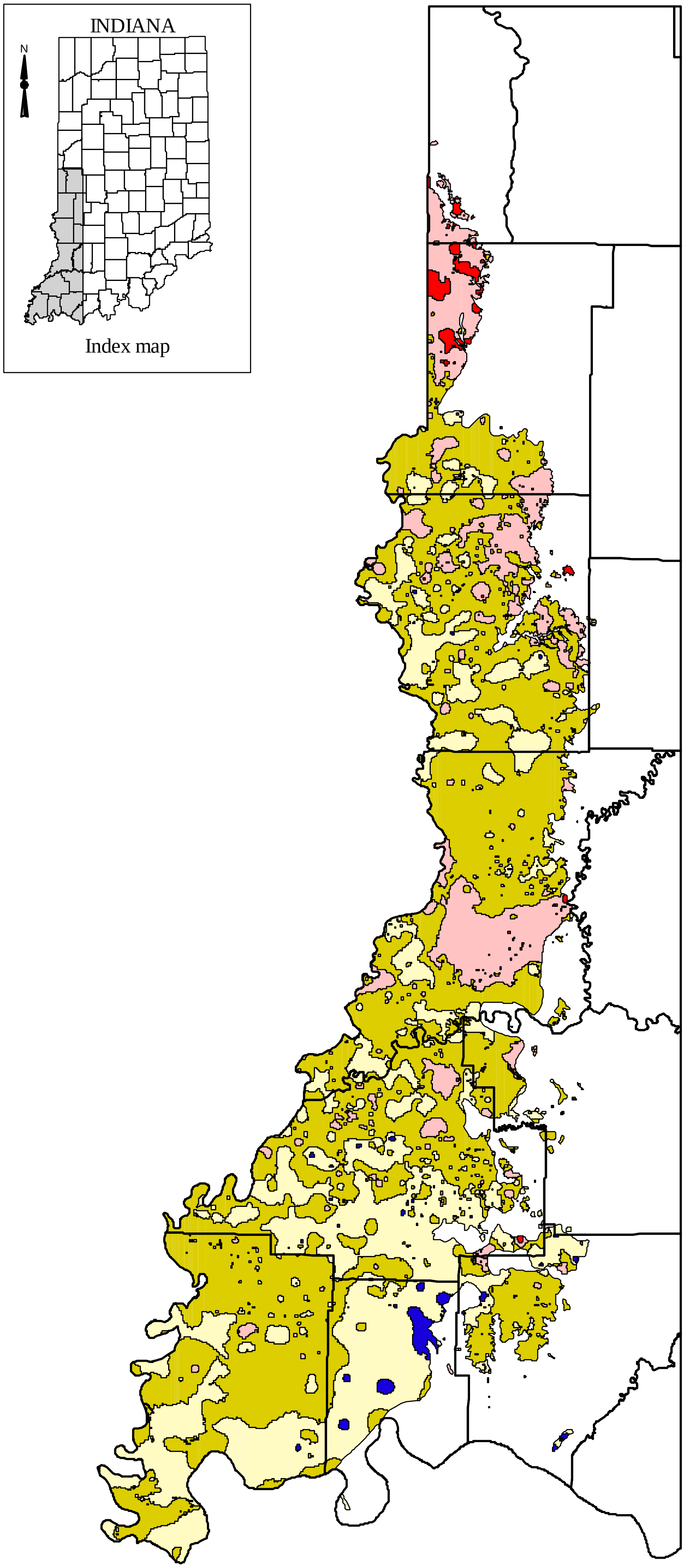


Figure 4. Map of southwestern Indiana showing the thickness of the Danville Coal.

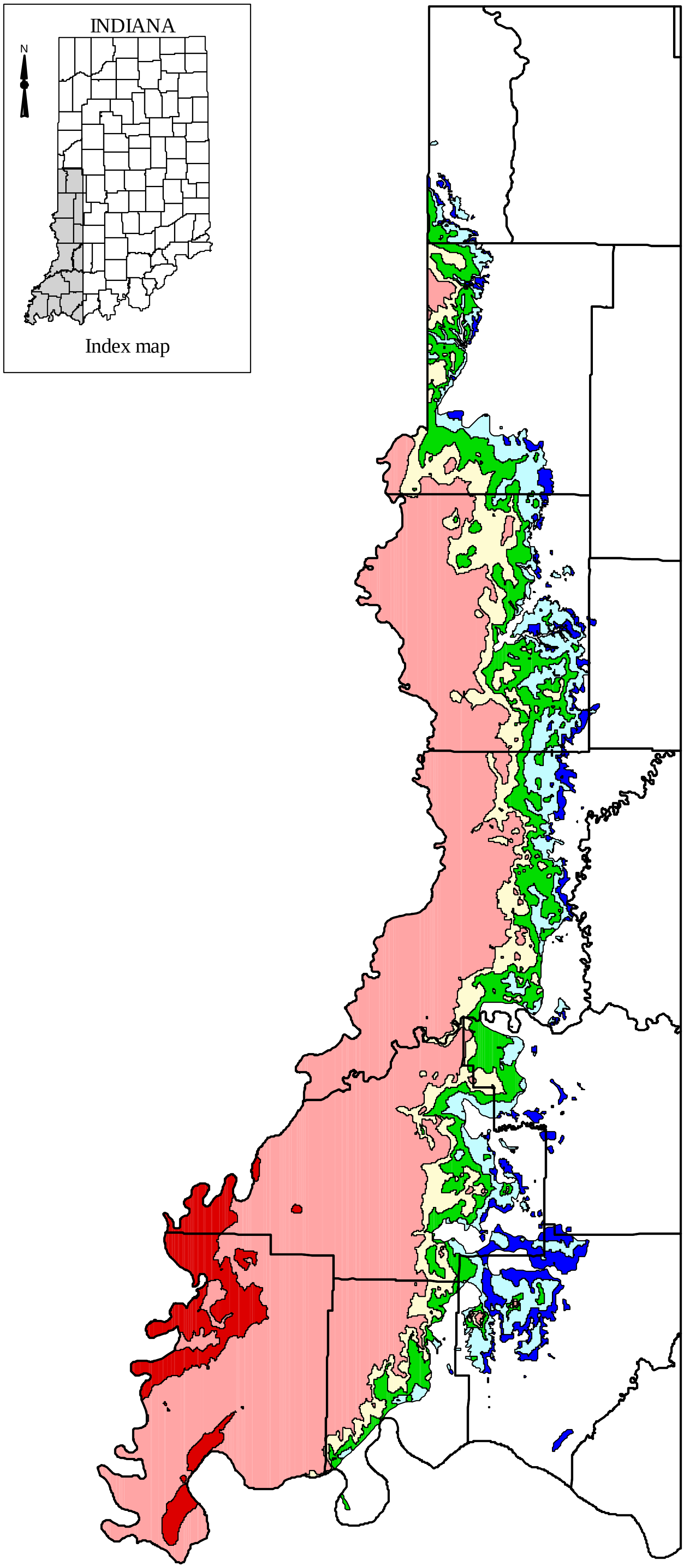


Figure 5. Map of southwestern Indiana showing the depth of the Danville Coal. For this study, the depth of surface minable coal is 0 to 200 feet, and that of underground minable coal is 200 to 1,000 feet.

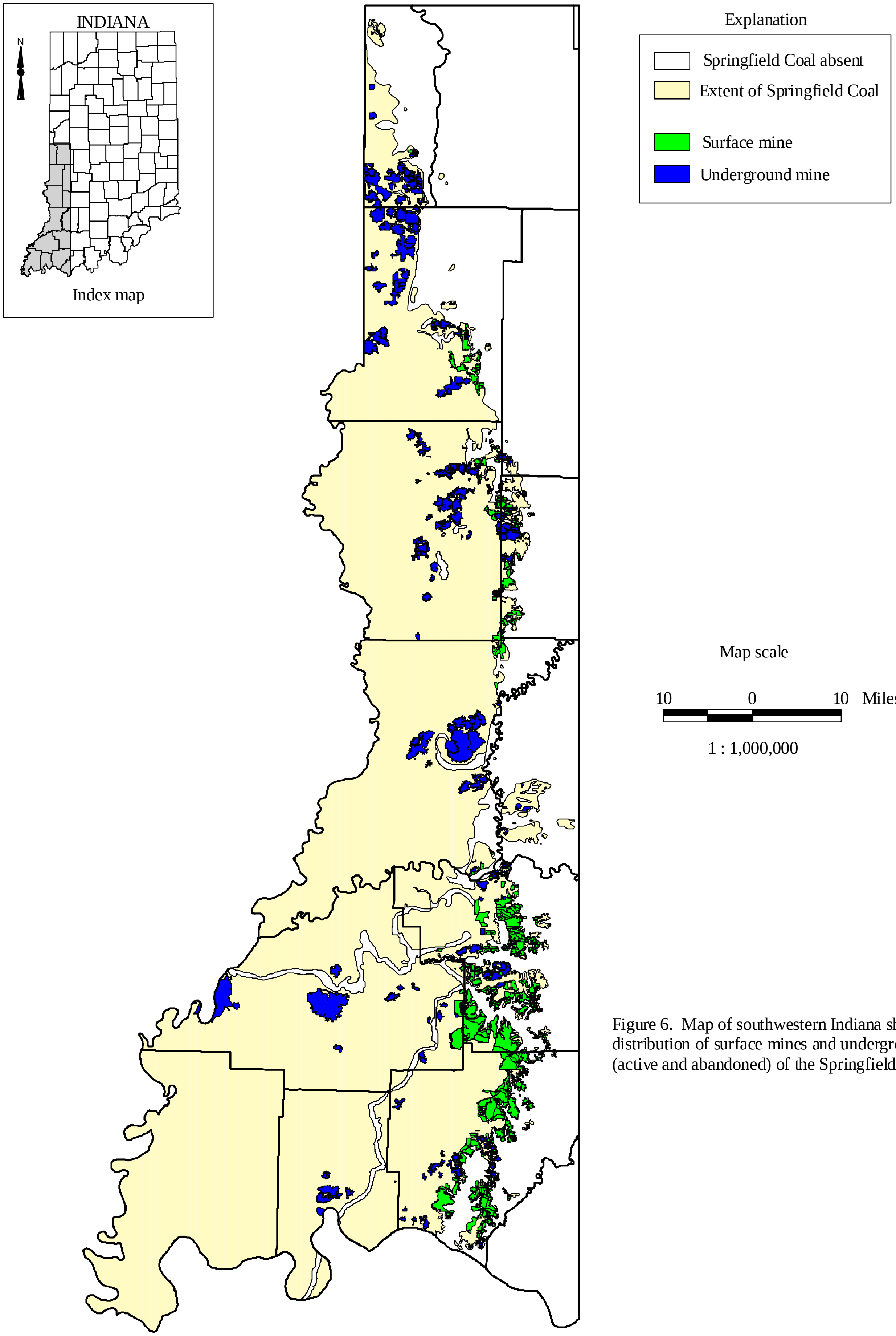


Figure 6. Map of southwestern Indiana showing the distribution of surface mines and underground mines, (active and abandoned) of the Springfield Coal.

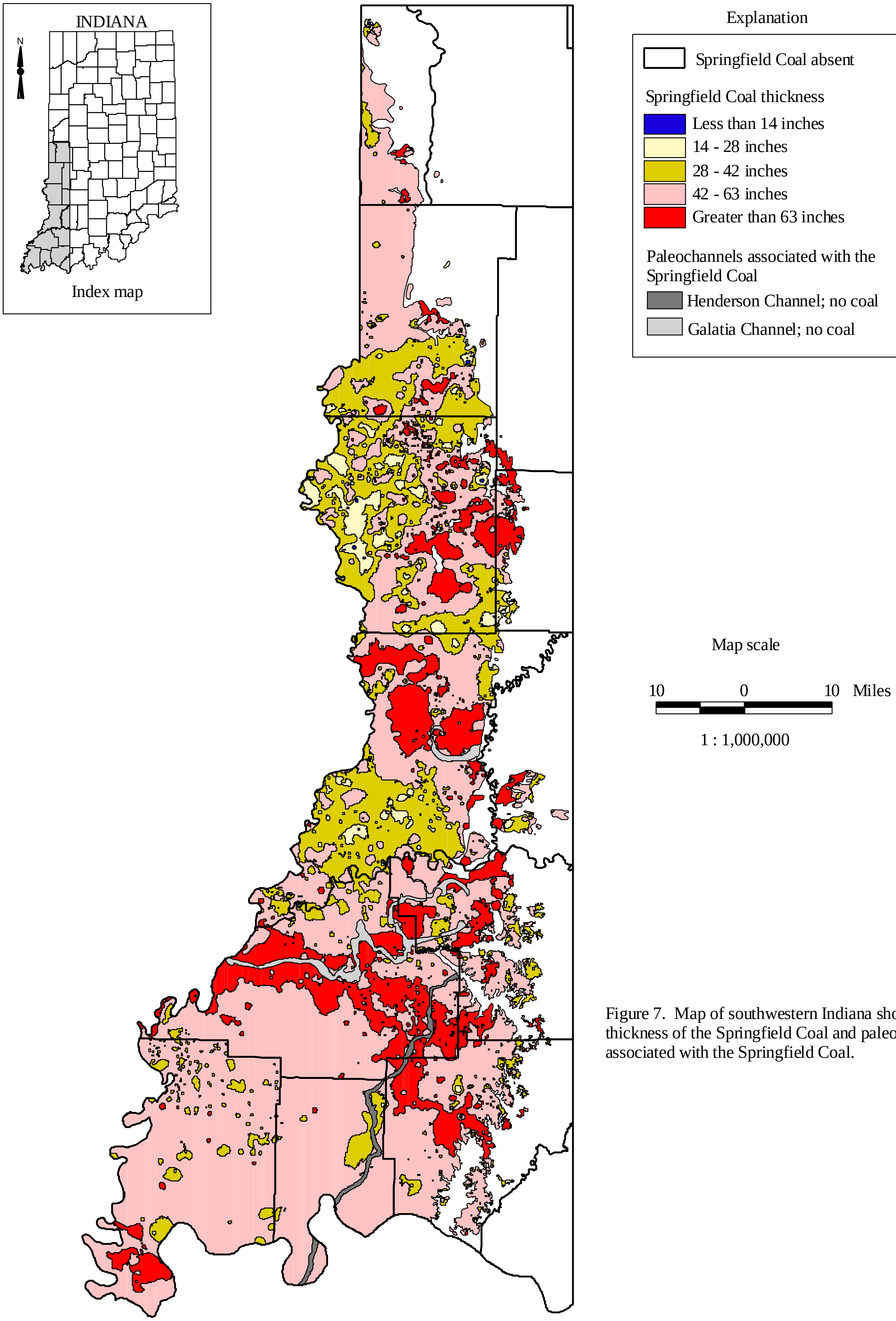


Figure 7. Map of southwestern Indiana showing the thickness of the Springfield Coal and paleochannels associated with the Springfield Coal.

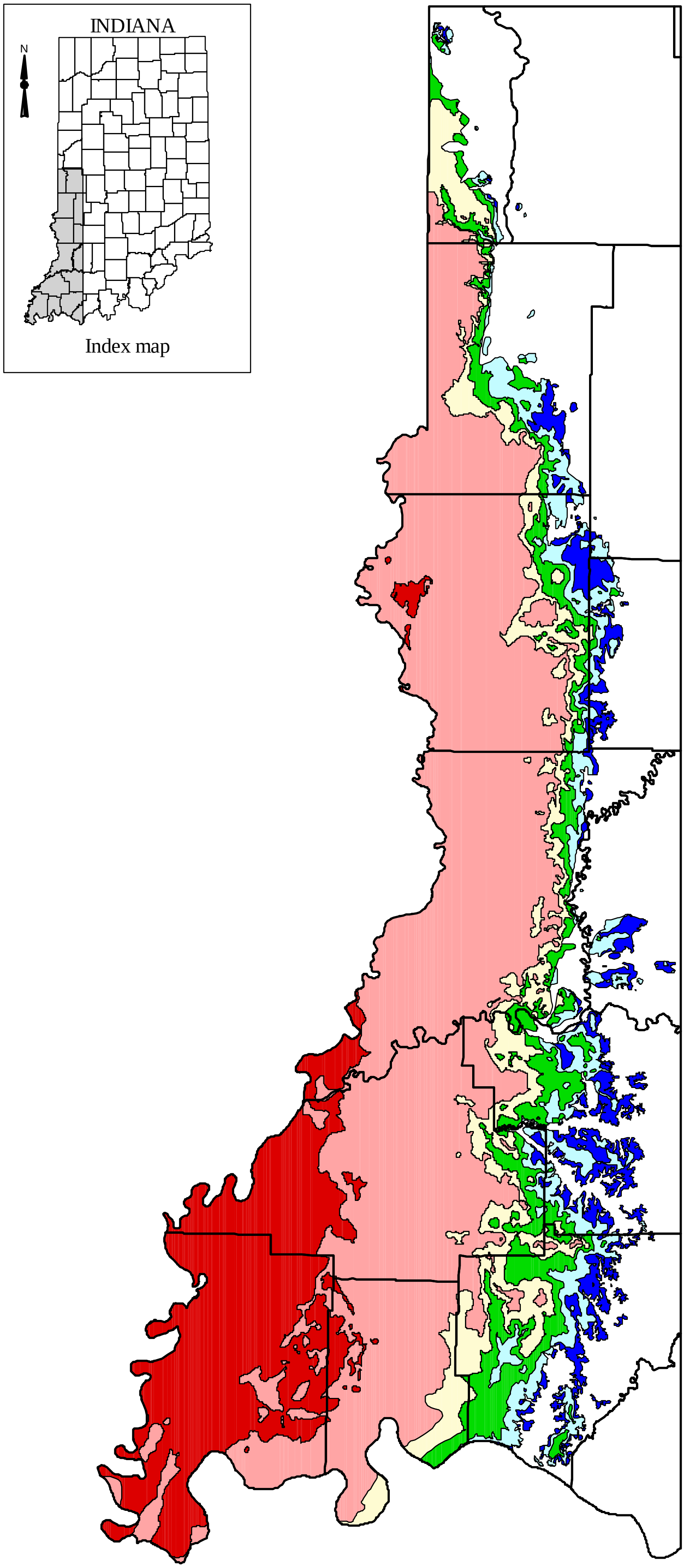


Figure 8. Map of southwestern Indiana showing the depth of the Springfield Coal. For this study, the depth of surface minable coal is 0 to 200 feet, and that of underground minable coal is 200 to 1,000 feet.

METHODOLOGY

Terminology and Definitions of the Coal Resource and Reserve Categories of this Study

In this study, the IGS uses the terminology and definitions of the USGS coal resource classification system (Wood and others, 1983), as well as those described in the EIA's Procedural Guidelines, with minor modifications.

The USGS classification system uses the terms *measured* (0-0.25 mile from data point), *indicated* (0.25-0.75 mile from data point) and *inferred* (0.75-3.0 miles from data point) to indicate the reliability of resource estimates based upon the density of coal thickness data points. The reliability categories that are used in this report have been modified to measured (0-0.5 mile from data point), indicated (0.5-2.0 miles from data point), and inferred (2.0-4.0 miles from data point) to reflect the more (laterally) continuous nature of the Danville and Springfield Coals relative to other coal beds in Indiana. The term *identified resources* refers to resources within the measured, indicated, and inferred reliability categories.

Each coal resource and coal reserve category of this study is subdivided according to the method of potential mining, namely, *surface* or *underground*. For the purpose of this study, surface minable coal occurs where overburden is 0 to 200 feet thick, and underground minable coal occurs where overburden is 200 to 1,000 feet thick.

The term *resources* include coal within the measured, indicated, and inferred reliability categories, with minimum seam thickness of 14 inches where overburden is less than 200 feet thick, and minimum seam thickness of 28 inches where overburden is 200 to 1,000 feet thick. It should be noted that the data that are used to map coal thickness for this study exclude the thickness of any non-coal partings from the coal seam thickness determinations.

Remaining resources are those resources that remain in the ground after accounting for losses owing to coal removed by mining or coal abandoned due to the mining process (for example, coal left as pillars to provide roof support in underground mines). The term *depleted resources* refers to the tonnage of coal recovered as well as coal not removed but rendered unminable during the mining process. In this study, depleted resources were calculated using mined-out area maps in combination with coal thickness maps rather than using reported production values.

Demonstrated reserve base is remaining coal resources within the measured and indicated reliability categories. The tonnage of demonstrated reserve base is presumed to be a more reliable estimate of the amount of coal in a study area than the tonnage of identified resources because the demonstrated reserve base excludes the inferred reliability category. That is, the demonstrated reserve base excludes resources that are more distant from coal thickness data points than identified resources.

Accessible reserve base is that portion of demonstrated reserve base that is defined by the criteria listed in tables 1 and 2 of this report. The criteria were identified through interviews with geologists and mining engineers from companies that are currently (or have been recently) mining the Danville and Springfield Coals in Indiana and Illinois. Therefore, it is inferred that these criteria reflect current mining practices of these coals in the Illinois Basin. The criteria were initially developed in cooperation with the Illinois State Geological Survey (ISGS) for the purposes of the Springfield Coal Availability Study in Indiana (Conolly and Zlotin, 1999) and the Danville Coal Availability Study in Indiana (Conolly and Zlotin, 2000). Figures that depict these criteria can be found in the aforementioned reports, and therefore are not duplicated in this report. The criteria were mapped separately for the Danville Coal and for the Springfield Coal and then applied to the tonnage of demonstrated reserve base of the Danville Coal and Springfield Coal, respectively, in order to calculate the tonnage of accessible reserve base.

Estimated recoverable reserves are that portion of accessible reserve base that are estimated to be recoverable based upon recent coal mine recovery rate data. No economic minability or engineering data were used to determine estimated recoverable reserves. For this study, estimated recoverable reserves were calculated by multiplying accessible reserve base by recovery rate factors of 80 percent for surface mining and 50 percent for underground mining. These percentages are based upon proprietary EIA recovery rate data reported by mines that were operating in the Danville and Springfield Coals during the 1980s and 1990s.
The underground recovery rate percentage assumes continued reliance upon non-longwall mining methods in Indiana.

In addition to the above-described resource and reserve categories, the sulfur, heat, and ash content of the Danville and Springfield Coals were mapped in order to allocate indicated reserves, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves according to specified categories of sulfur, heat, and ash content.

Table 1. Criteria used to define Danville and Springfield Coal accessible for surface mining in this study.

TECHNOLOGICAL RESTRICTIONS	
Minimum seam thickness	14 inches
Maximum depth	200 feet
Maximum unconsolidated overburden	60 feet
Maximum stripping ratio* (cubic yds. of overburden / ton of raw coal)	25 : 1
Minimum size of mine reserve Less than 50 feet of overburden More than 50 feet of overburden	 175,000 tons of raw coal (150,000 clean) 590,000 tons of raw coal (500,000 clean)
LAND USE RESTRICTIONS	
Towns	no mining within 2,640 feet
Federal and State Parks	no mining within 100 feet
Paved roads	no mining within 100 feet
Railroads	no mining within 100 feet
Pipelines	no mining within 100 feet
Underground mines	no mining within 200 feet
Closely-spaced oil wells	no mining in areas where there are more than 7 oil wells per 40 acres

* Refer to Appendix 3 for an explanation of how stripping ratio was calculated in this report.

Table 2. Criteria used to define Danville and Springfield Coal accessible for underground mining in this study.

TECHNOLOGICAL RESTRICTIONS	
Minimum seam thickness	42 inches
Minimum depth	200 feet
Minimum bedrock cover	75 feet
Minimum ratio of the thickness of bedrock to unconsolidated deposits that overlie the coal	1 : 1
Minimum size of mine reserve	80 million tons of raw coal
Faults	no mining within 800 feet of fault trace
Galatia Channel (Springfield Coal)	
LAND USE RESTRICTIONS	
Towns	no mining within 100 feet
Federal and State Parks	no mining within 100 feet
Interstate highways	no mining within 100 feet
Closely – spaced oil wells	no mining in areas where there are more than 7 oil wells per 40 acres

The resource and reserve categories of this report may be summarized by the following simplified equation:

ORIGINAL COAL RESOURCES
minus
COAL MINED AND COAL LOST DURING MINING
equals
REMAINING COAL RESOURCES
minus
COAL IN THE INFERRED RELIABILITY CATEGORY
equals
DEMONSTRATED RESERVE BASE
minus
COAL RESTRICTED BY LAND USE AND COAL RESTRICTED BY TECHNOLOGICAL FACTORS
equals
ACCESSIBLE RESERVE BASE
multiplied by
PERCENTAGE RECOVERABLE
equals
ESTIMATED RECOVERABLE RESERVES

Calculation of Coal Tonnages: Data Sources and Mapping Procedures

Several steps were completed prior to calculating the resource tonnages, including: collection and compilation of point source coal thickness and depth data; construction of cross sections for stratigraphic correlation of coal beds, and digitization of coal outcrops, land use in the area, and the extent of mined-out area maps. The Danville and Springfield Coal thickness and depth maps were created from public and confidential point source stratigraphic data, including data points in Illinois that lie within five kilometers of the Indiana state border. The data set includes coal thickness and depth measurements taken from rotary drill holes, cores, geophysical logs, and outcrops, and includes data collected as recently as September 1999. Figures 9 and 10 show the location of the public point source data for the Danville and Springfield Coal, respectively.

Danville and Springfield Coal tonnages were calculated using the commercial Geographic Information System (GIS) software ArcInfo (by Environmental Systems Research Institute, Redlands, California). ArcInfo is capable of representing features as vectors, polygons, points, and grids (rasters). All digital maps and grids for this study are in Universal Transverse Mercator (UTM) Projection, zone 16, Clarke 1866 spheroid, North American Datum 27, with x-y coordinates in meters.

ArcInfo provides a program that performs inverse distance weighted (IDW) interpolation on input point data sets to create output in the form of interpolated grids. IDW interpolation was used to create the coal thickness grids for this study using coal thickness data points as input. It should be noted that the coal seam thickness value of each data point represents the combined thickness of coal benches exclusive of the thickness of any non-coal partings. Consequently, the coal thickness grids, and the tonnages calculated from these grids, represent clean coal in the ground. Each grid cell has a coal thickness value in feet (ft.) and a value for the area of the grid cell in square meters (sq. m.). The coal resources were calculated in short tons using a coal density of 1,800 tons per acre per foot of coal thickness. The equation for calculating short tons of coal is:

Tonnage = [(area in sq. m.) / (4046.856 sq. m./acre)] X (thickness in ft.) X (1800 tons/acre X ft. of coal)

Calculation of Depleted Resources: Data Sources and Mapping Procedures

The term *depleted resources* refers to the tonnage of coal removed by mining or coal abandoned due to the mining process (for example, coal left as pillars to provide roof support in underground mines). In this study, maps of mined-out areas were used to calculate the tonnage of depleted resources. The boundaries of the mined areas are current to January 1, 2000, plus or minus 3 months. Mined-out areas were converted from hardcopy format to ArcInfo polygon format via digitization of hardcopy maps. Mine area polygons were then merged with coal thickness polygons (which were created by direct conversion of the coal thickness grids to polygon format). The equation for calculating the tonnage of depleted coal is identical to the equation given above, except that area in the equation now represents the area of the mine.

Table 3 reports the cumulative tonnage of depleted resources of the Danville and Springfield Coal as of January 1, 2000 on a county basis.

Table 3. Cumulative tonnage of depleted resources of the Danville and Springfield Coal Members in Indiana by county as of January 1, 2000, in million short tons. Tonnages are calculated from mined-out areas and are reported according to mine type (surface or underground) rather than overburden class, (0 - 200 feet, or greater than 200 feet).

County	Danville Surface	Danville Underground	Springfield Surface	Springfield Underground	Total by County
Clay			0.78	4.55	5.32
Daviess			0.71	6.70	7.41
Gibson	14.23		29.52	154.19	197.94
Greene	2.42		30.75	29.72	62.89
Knox	18.53	48.90	10.72	161.94	240.10
Pike	5.55		256.69	46.21	308.45
Sullivan	99.14	2.53	24.37	122.51	248.55
Vanderburgh				23.92	23.92
Vermillion	53.00	0.46	4.36	79.08	136.90
Vigo	38.63	5.73	20.69	152.48	217.53
Warrick	145.14		193.27	46.07	384.48
Total	**376.65**	**57.63**	**571.87**	**827.36**	**1,833.50**

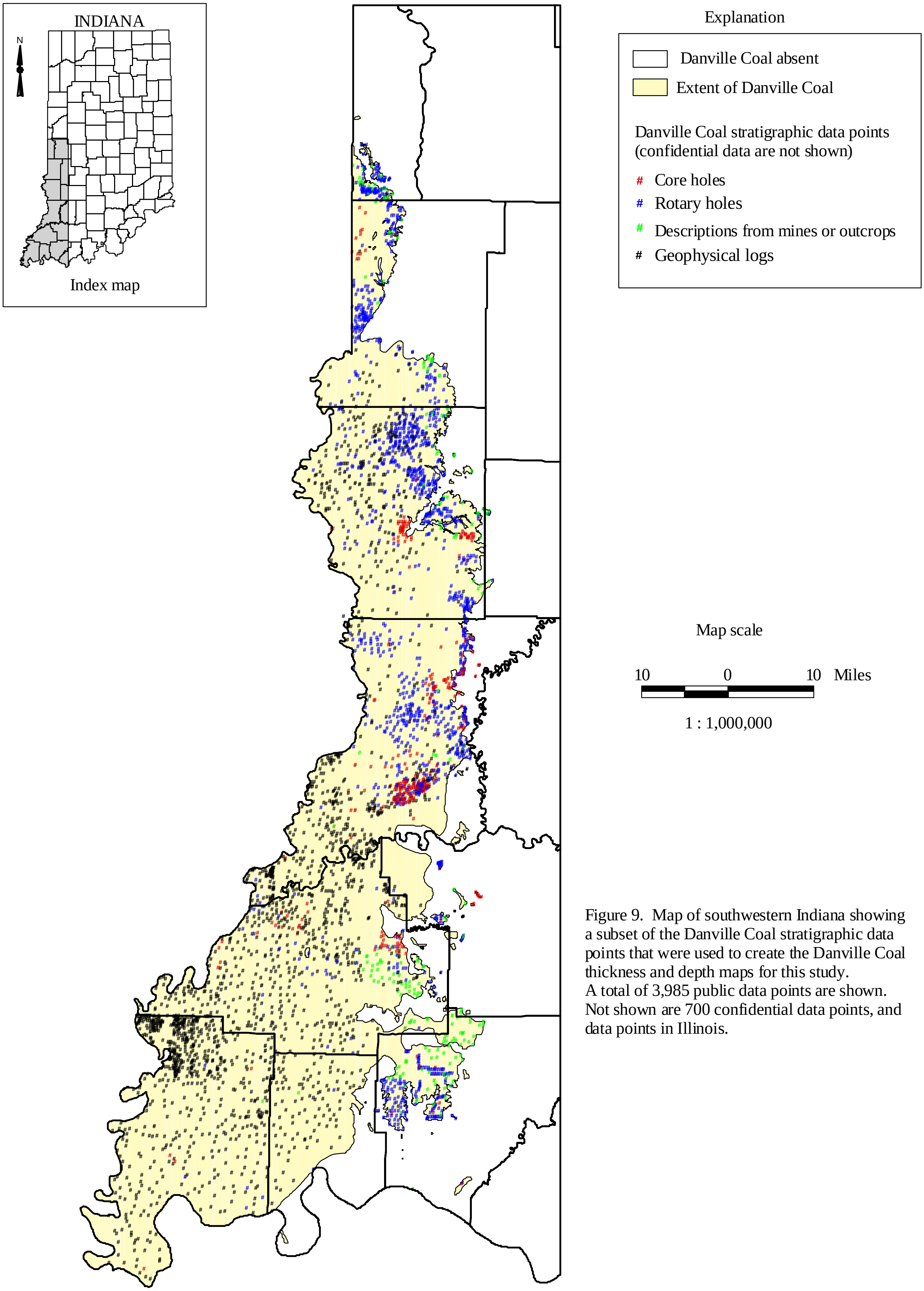


Figure 9. Map of southwestern Indiana showing a subset of the Danville Coal stratigraphic data points that were used to create the Danville Coal thickness and depth maps for this study.
A total of 3,985 public data points are shown.
Not shown are 700 confidential data points, and data points in Illinois.

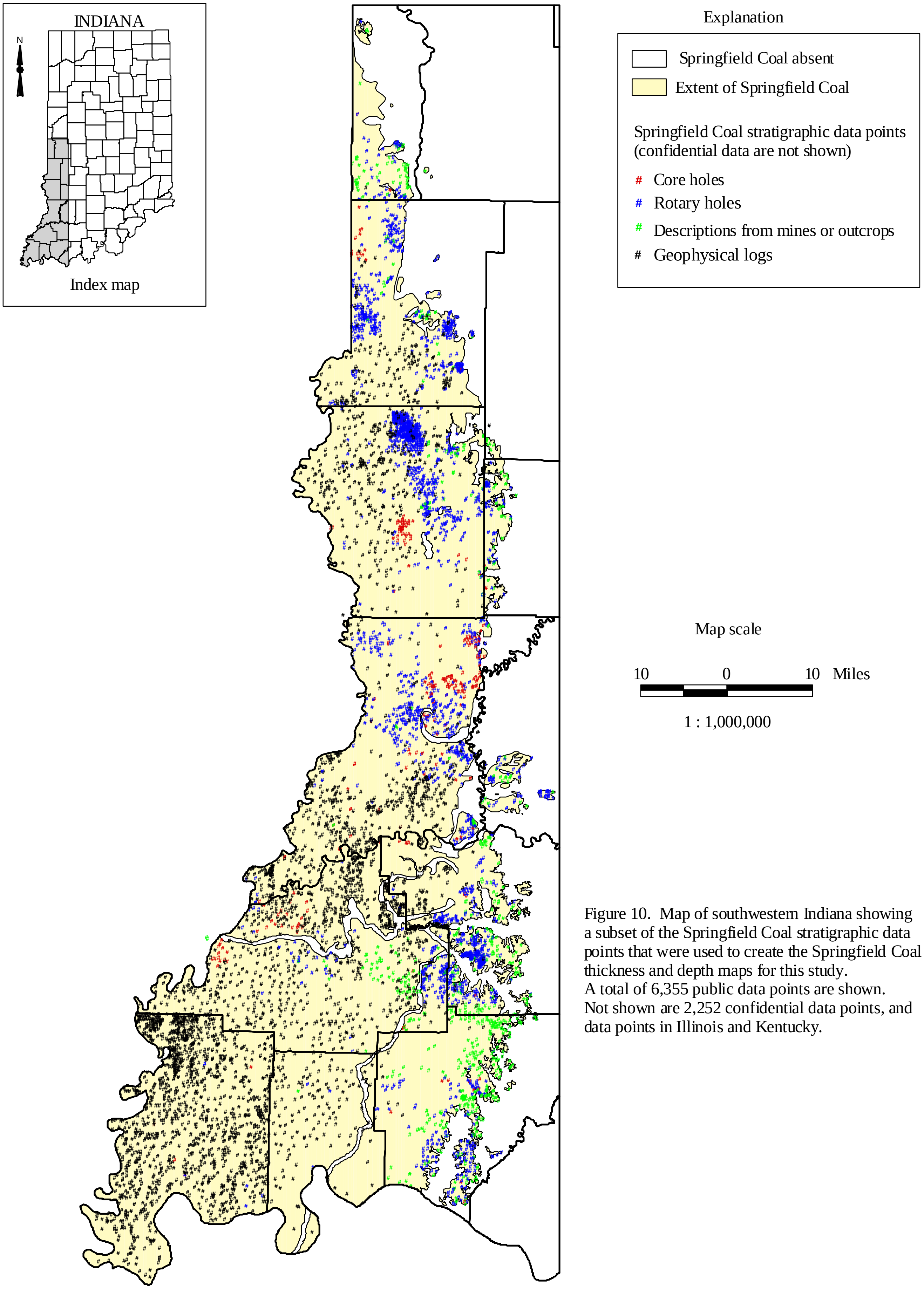


Figure 10. Map of southwestern Indiana showing a subset of the Springfield Coal stratigraphic data points that were used to create the Springfield Coal thickness and depth maps for this study.
A total of 6,355 public data points are shown.
Not shown are 2,252 confidential data points, and data points in Illinois and Kentucky.

Coal Quality Mapping: Data Sources and Mapping Procedures

The sulfur, heat, and ash content of the Danville and Springfield Coals were mapped using proprietary and public coal quality data in order to allocate indicated reserves, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves according to specified categories of sulfur, heat, and ash content. Standard formulas were used to convert input coal quality data to the units required for this project (ASTM, 1991).

The coal quality data used in this study came from samples that were collected and analyzed by staff members of the following organizations: Indiana Geological Survey, Illinois State Geological Survey, Pennsylvania State University, U.S. Bureau of Mines, and coal companies. The samples consist of the following sample types: full seam channel sample, composite channel, composite bench, core, and composite core. Non-coal partings greater than 3/8 inch are excluded from the channel and bench samples, whereas core samples generally do not exclude non-coal parting material. A total of 404 analyses were available for the Springfield Coal and 177 analyses for the Danville Coal.

The number and distribution of coal thickness data points for Danville and Springfield Coals are such that approximately 95 percent of the areal extent of these coals is within the measured and indicated categories, and thus, are demonstrated reserve base. By contrast, the number and distribution of coal quality data points for these coals are such that only roughly 50 percent of the areal extent of these coals lies within the measured and indicated categories. Unlike coal tonnages, which are calculated only for coal located within distances of the coal thickness data points specified by the reliability categories, sulfur, heat, and ash values were extrapolated beyond the reliability category distances of the coal quality data points in order to map these features over the entire extent of the Danville and Springfield Coals. This extrapolation was necessary in order to allocate indicated reserves, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves by coal quality, and was carried out as per instructions from the EIA.

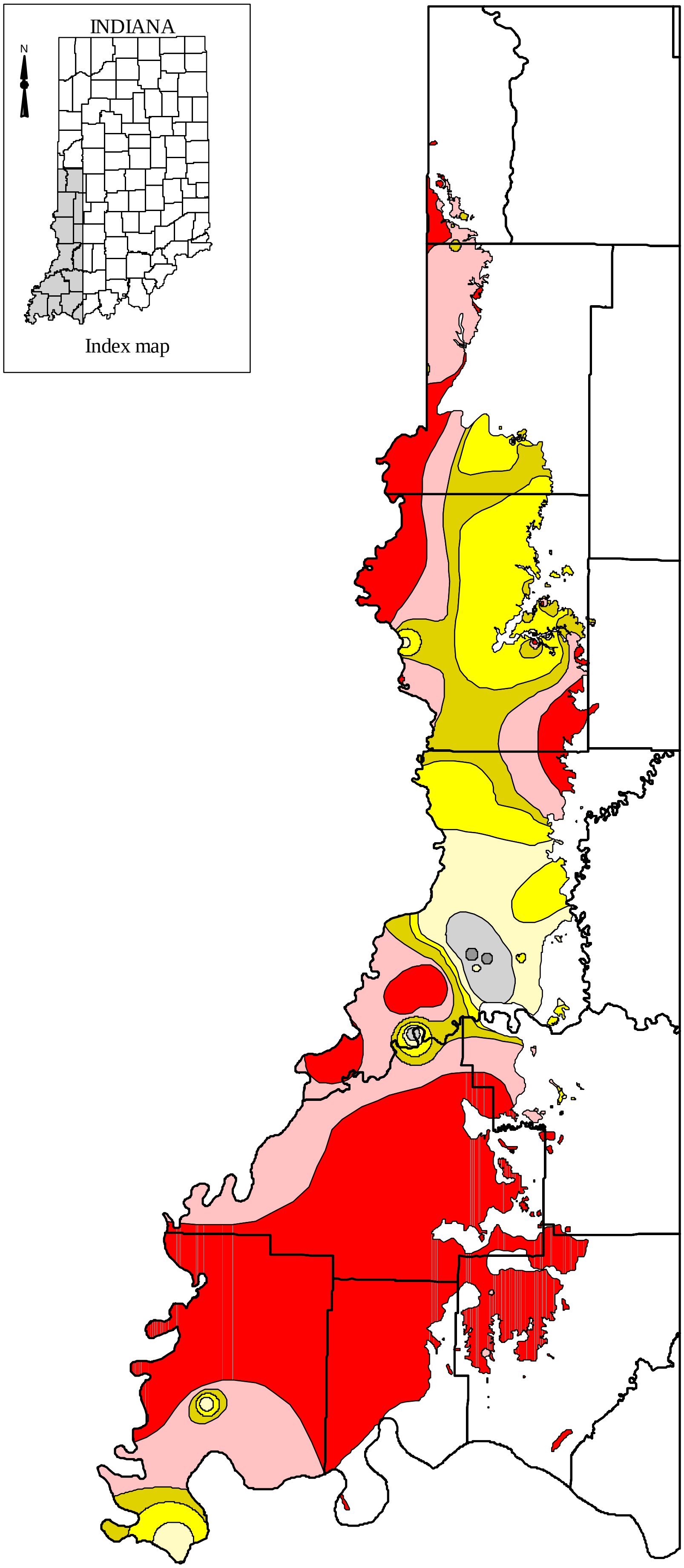
Sulfur content was mapped as pounds of sulfur per million Btu. The sample basis (as-received, dry, or ash-free) is inconsequential provided that the same basis is used for both sulfur and Btu. Input data of total sulfur (weight-percent) and Btu per pound were used to calculate pounds of sulfur per million Btu using the following equation:

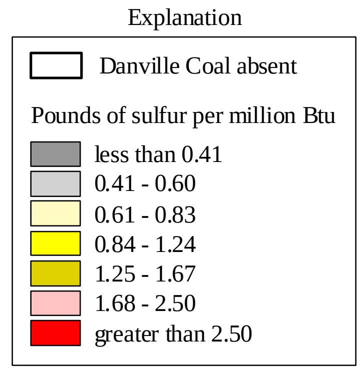
$$\text{Pounds sulfur / million Btu} = (10{,}000 \text{ X total sulfur}) / \text{Btu per pound}$$

Heat content was mapped as million Btu per ton on the as-received basis. Input data of moisture content (weight-percent; as-received basis) and Btu per pound (dry basis) were used to calculate million Btu per ton on the as-received basis using the following equation:

$$\text{Million Btu / ton}_{\text{as-received}} = (100 - \text{moisture}_{\text{as-received}}) \text{ X } (\text{Btu per pound}_{\text{dry}} / 500)$$

Ash content was mapped as weight-percent ash on the as-received basis. The coal quality data for this study were available in this format; therefore, conversions or calculations were unnecessary. Figures 11 to 13 and 14 to 16 illustrate the results of the coal quality mapping for the Danville and Springfield Coal, respectively.





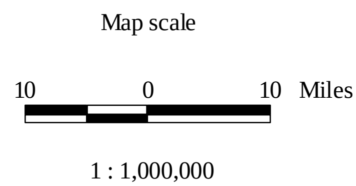


Figure 11. Map of southwestern Indiana showing the sulfur content of the Danville Coal expressed as pounds of sulfur per million Btu.

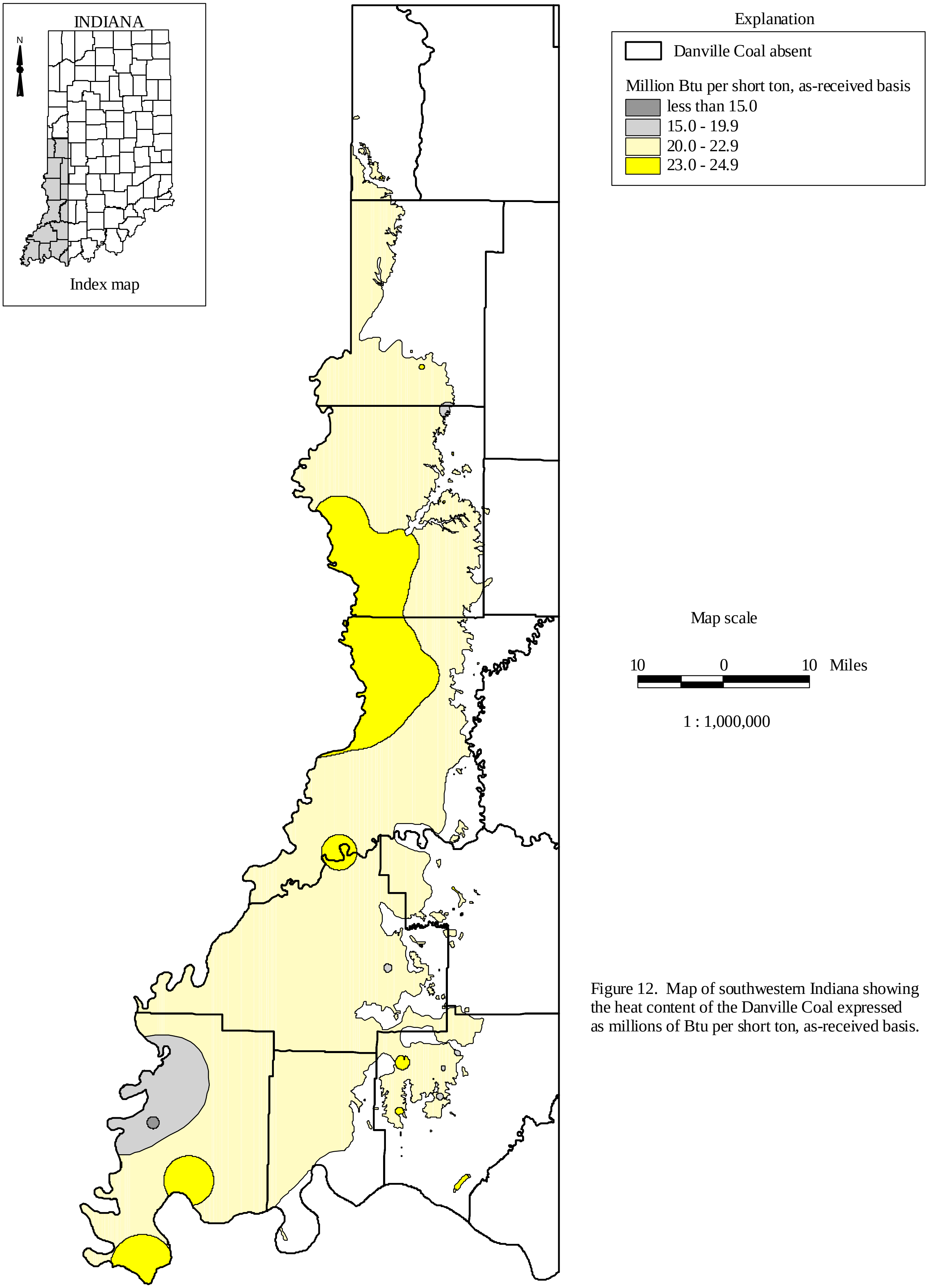


Figure 12. Map of southwestern Indiana showing the heat content of the Danville Coal expressed as millions of Btu per short ton, as-received basis.

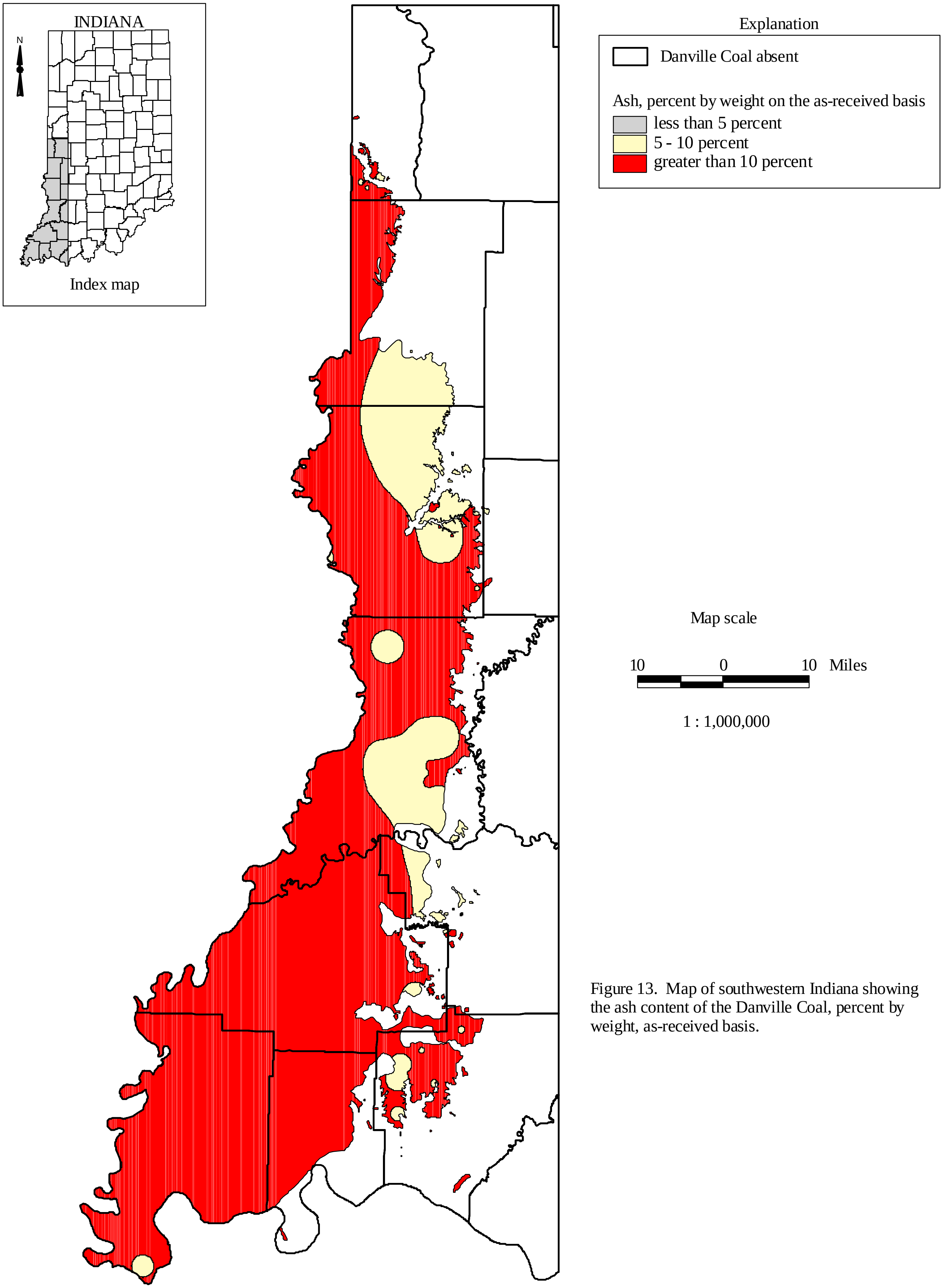


Figure 13. Map of southwestern Indiana showing the ash content of the Danville Coal, percent by weight, as-received basis.

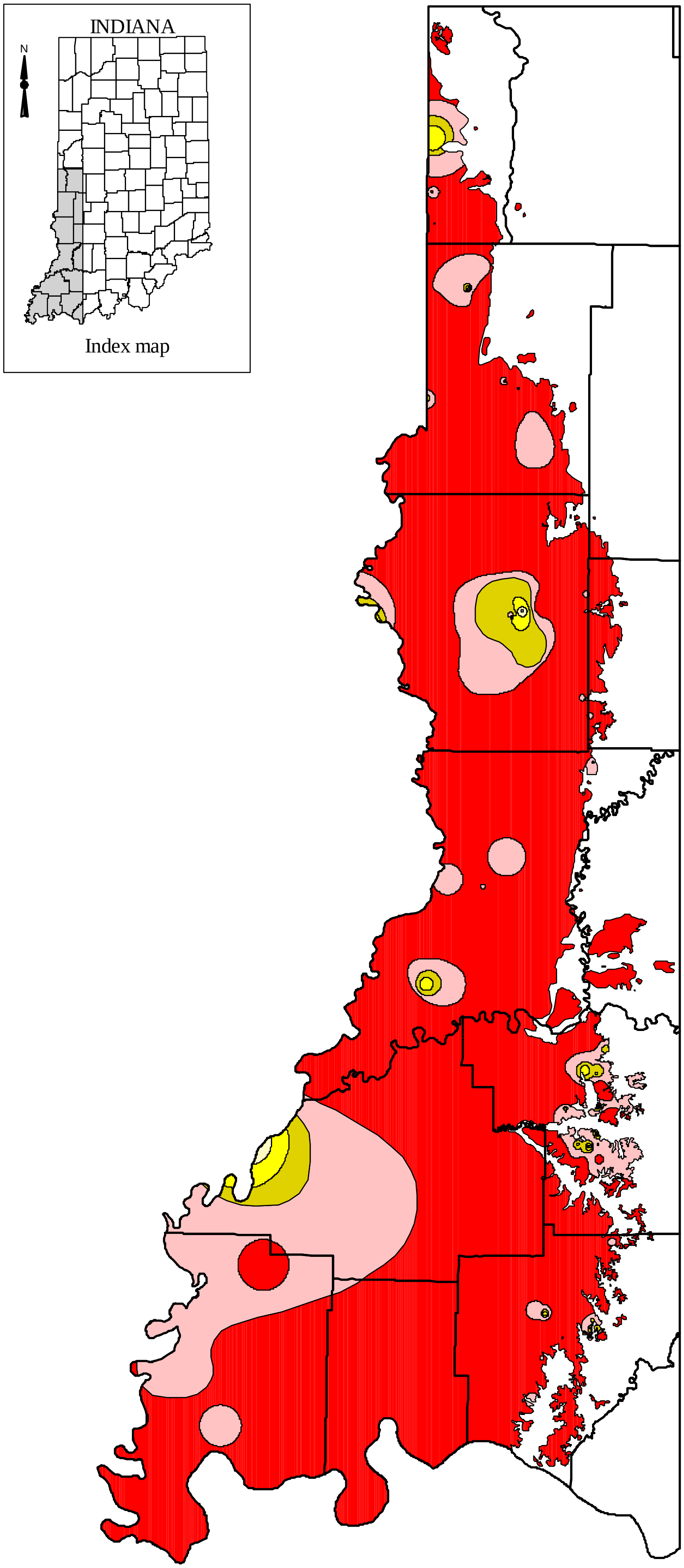


Figure 14. Map of southwestern Indiana showing the sulfur content of the Springfield Coal, expressed as pounds of sulfur per million Btu.

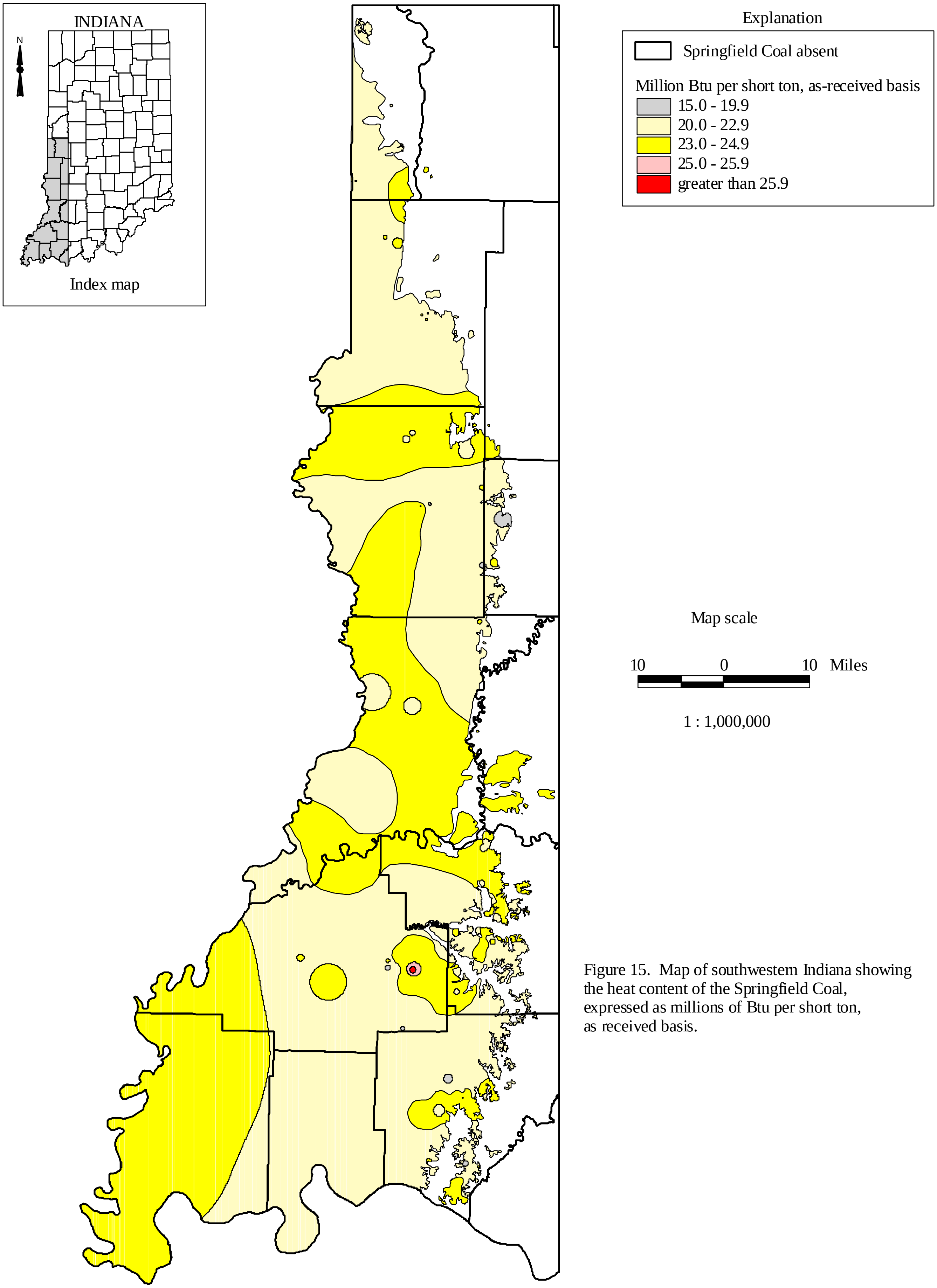


Figure 15. Map of southwestern Indiana showing the heat content of the Springfield Coal, expressed as millions of Btu per short ton, as received basis.

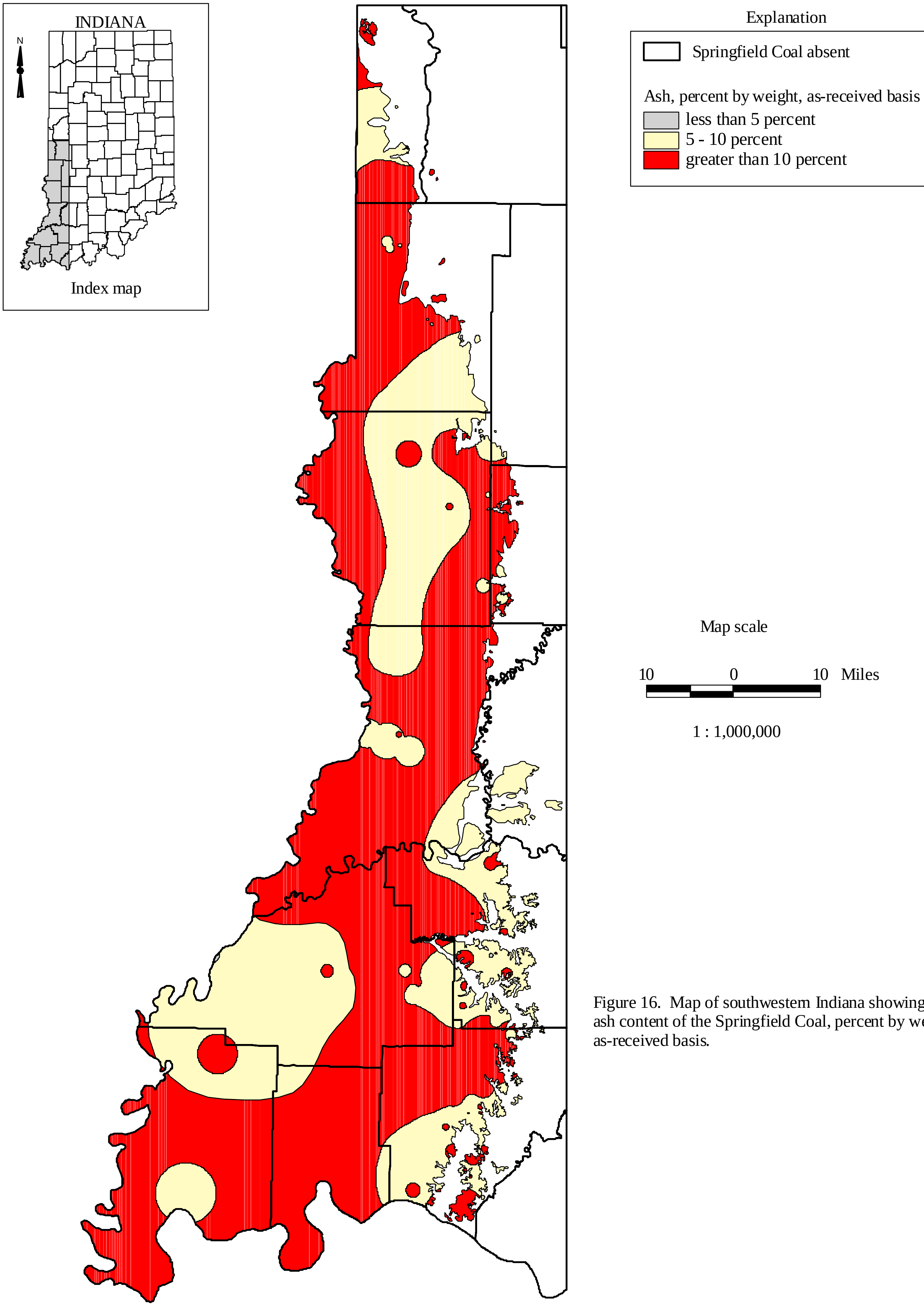


Figure 16. Map of southwestern Indiana showing the ash content of the Springfield Coal, percent by weight, as-received basis.

RESULTS

The results of this study are presented in the tables and figures on the pages that follow. Results are tabulated for both the combined tonnage of the Danville and Springfield Coal, and for the tonnage of each coal separately. Figures 17 to 19 and tables 4 to 6 provide a statewide summary of original resources, remaining resources, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves. Tables 7 to 10 provide a statewide summary of demonstrated reserve base allocated to sulfur, heat, and ash content; tables 10 to 12 provide a statewide summary of accessible reserve base allocated to sulfur, heat, and ash content; tables 13 to 15 provide a statewide summary of estimated recoverable reserves allocated to sulfur, heat, and ash content. Finally, appendix 1 provides demonstrated reserve base allocated to sulfur, heat, and ash content by county and by coal bed.

Discussion of Accessible Reserve Base

The restrictions which had the greatest impact on the accessibility of the Danville Coal for both underground and surface mining were those related to coal thickness. For this study, 42 inches is the minimum coal thickness for accessible underground-minable coal. Although it is technologically possible to mine coal thinner than 42 inches in underground mines, most coal companies in Indiana currently find that it is not economical to do so. An examination of Figure 4 reveals that a significant portion of the Danville Coal is thinner than 42 inches. Approximately 2,403 million short tons, or 80 percent of the total original underground-minable Danville Coal resources are less than 42 inches thick, and therefore are not accessible for underground mining.

The restriction which had the greatest impact on the accessibility of the Danville Coal for surface mining was the maximum stripping ratio. Stripping ratio is the number of cubic yards of overburden that must be removed to recover one ton of coal. For this study, the maximum stripping ratio for accessible surface-minable coal is 25:1. Approximately 1,532 million short tons, or 58 percent of the total original surface-minable Danville Coal resources are not accessible for surface mining due to the stripping ratio restriction.

Although minimum coal thickness and maximum stripping ratio had less impact on the Springfield Coal than the Danville Coal, nonetheless, amongst the restrictions, coal thickness and stripping ratio had the greatest impact on the accessibility of the Springfield Coal for underground and surface mining, respectively. Approximately 1,327 million short tons, or 15 percent of the total original underground-minable Springfield Coal resources are less than 42 inches thick, and therefore are not accessible for underground mining. Stripping ratio excludes 1,482 million short tons, or 35 percent of the total original surface-minable Springfield Coal resources from accessible surface-minable reserves.

Figure 17. Million short tons of combined Danville and Springfield Coal in Indiana by resource category.

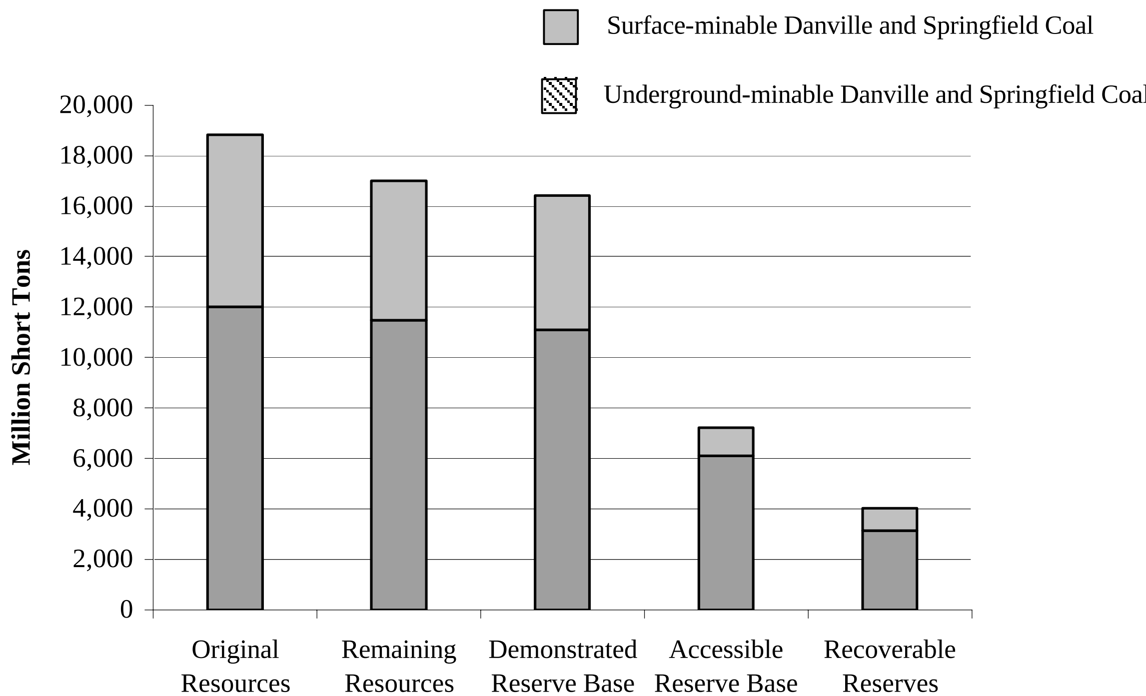


Table 4. Resources and reserves of the Danville and Springfield Coal Members in Indiana, in million short tons. Numbers in parentheses are percent of original resources or reserves in the category. Resources include Danville and Springfield Coal within the measured, indicated, and inferred reliability categories, having coal thickness greater than or equal to 14 inches where overburden is less than 200 feet thick, and coal thickness greater than 28 inches where overburden is 200 to 1,000 feet thick. Demonstrated reserve base includes remaining Danville and Springfield Coal within the measured and indicated reliability categories, having the same coal thickness and overburden criteria as resources. Accessible reserve base is that portion of demonstrated reserves that meet the criteria for accessibility that are listed in tables 1 and 2 of this report. Recoverable reserves are calculated by multiplying accessible reserves by recovery rate factors that are based upon proprietary mine recovery rate data, (80% for surface mining; 50% for underground mining).

			Potential Mining Method			
Category	**Total**		**Surface[1]**		**Underground[2]**	
Original resources		18,824.39		6,822.34		12,002.04
Mined resources	(10%)	1833.50	(19%)	1317.67	(4%)	515.83
Remaining resources	(90%)	16990.89	(81%)	5504.67	(96%)	11486.21
Demonstrated reserve base	(87%)	16430.90	(78%)	5326.42	(92%)	11104.48
Accessible reserve base	(38%)	7210.83	(16%)	1106.60	(51%)	6104.23
Recoverable reserves	(21%)	4026.06	(13%)	887.00	(26%)	3139.05

[1]Tonnages are reported for Danville and Springfield Coal having 0 to 200 feet of overburden.
[2]Tonnages are reported for Danville and Springfield Coal having 200 to 1,000 feet of overburden.

Figure 18. Million short tons of Danville Coal in Indiana by resource category.

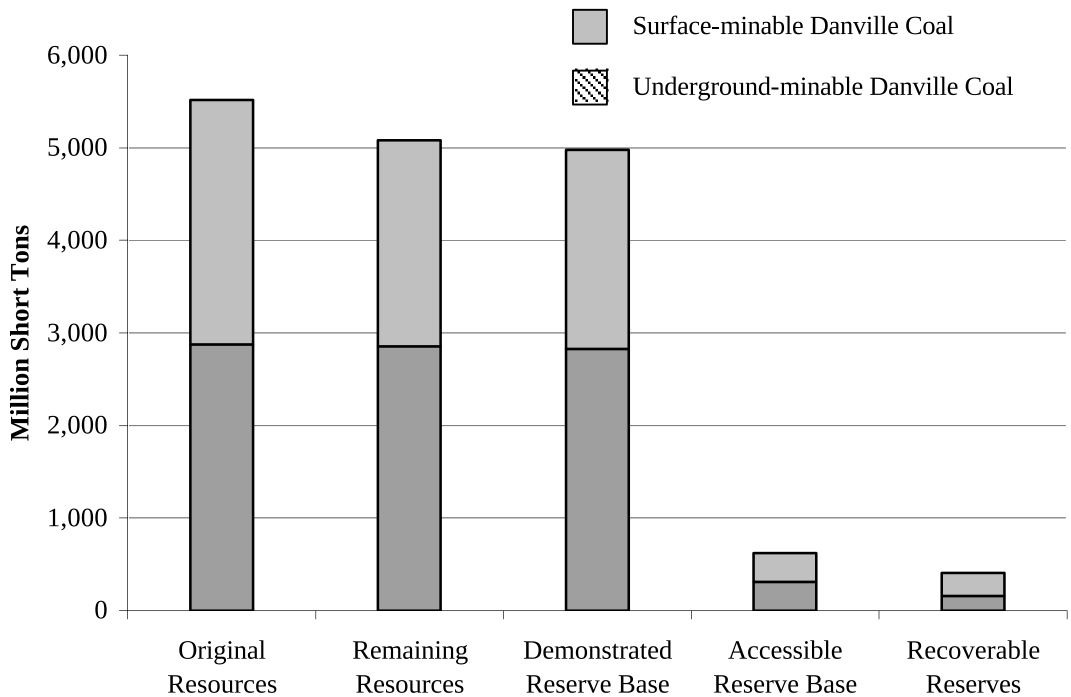


Table 5. Resources and reserves of the Danville Coal Member in Indiana, in million short tons. Numbers in parentheses are percent of original resources or reserves in the category. Resources include Danville Coal within the measured, indicated, and inferred reliability categories, having coal thickness greater than or equal to 14 inches where overburden is less than 200 feet thick, and coal thickness greater than 28 inches where overburden is 200 to 1,000 feet thick. Demonstrated reserve base includes remaining Danville Coal within the measured and indicated reliability categories, having the same coal thickness and overburden criteria as resources. Accessible reserve base is that portion of demonstrated reserves that meet the criteria for accessibility that are listed in tables 1 and 2 of this report. Recoverable reserves are calculated by multiplying accessible reserves by recovery rate factors that are based upon proprietary mine recovery rate data, (80% for surface mining; 50% for underground mining).

			Potential Mining Method			
Category	**Total**		**Surface[1]**		**Underground[2]**	
Original resources		5,518.51		2,640.56		2,877.95
Mined resources	(8%)	434.28	(16%)	414.38	(1%)	19.90
Remaining resources	(92%)	5084.23	(84%)	2226.18	(99%)	2858.05
Demonstrated reserve base	(90%)	4980.67	(81%)	2151.98	(98%)	2828.68
Accessible reserve base	(11%)	623.14	(12%)	310.38	(11%)	312.76
Recoverable reserves	(7%)	404.68	(9%)	248.30	(5%)	156.38

[1]Tonnages are reported for Danville Coal having 0 to 200 feet of overburden.
[2]Tonnages are reported for Danville Coal having 200 to 1,000 feet of overburden.

Figure 19. Million short tons of Springfield Coal in Indiana by resource category.

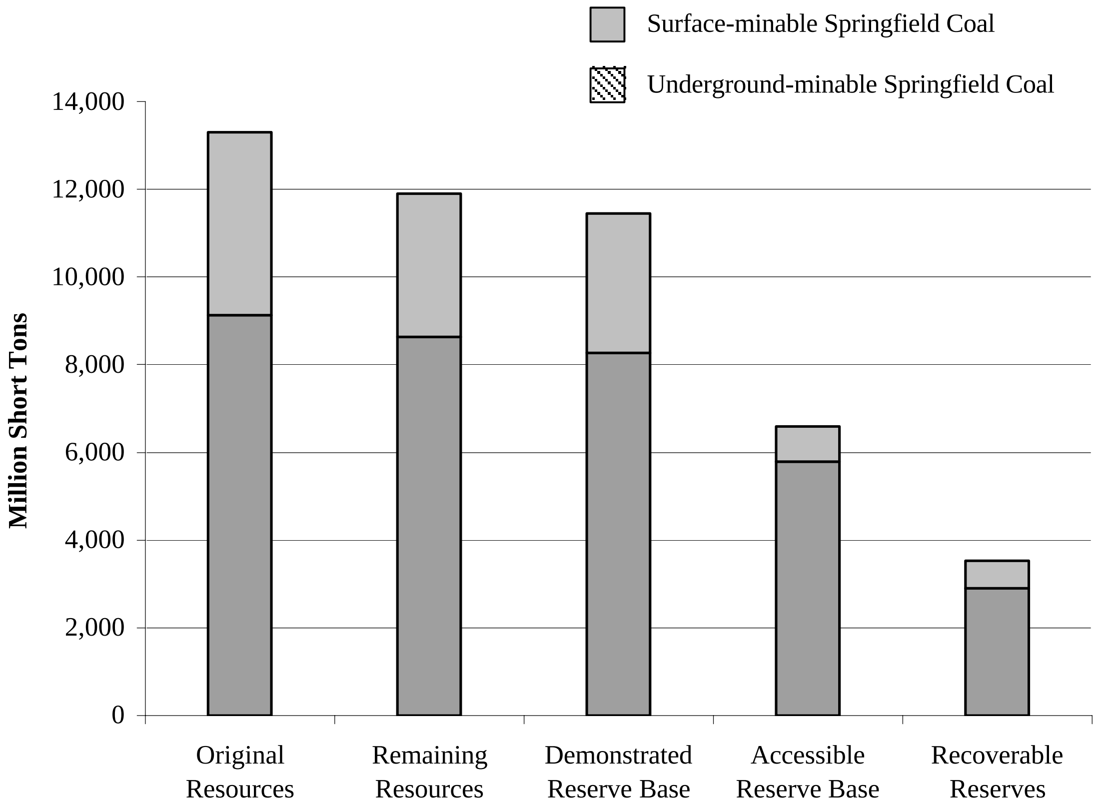


Table 6. Resources and reserves of the Springfield Coal Member in Indiana, in million short tons. Numbers in parentheses are percent of original resources or reserves in the category. Resources include Springfield Coal within the measured, indicated, and inferred reliability categories, having coal thickness greater than or equal to 14 inches where overburden is less than 200 feet thick, and coal thickness greater than 28 inches where overburden is 200 to 1,000 feet thick. Demonstrated reserve base includes remaining Springfield Coal within the measured and indicated reliability categories, having the same coal thickness and overburden criteria as resources. Accessible reserve base is that portion of demonstrated reserves that meet the criteria for accessibility that are listed in tables 1 and 2 of this report. Recoverable reserves are calculated by multiplying accessible reserves by recovery rate factors that are based upon proprietary mine recovery rate data, (80% for surface mining; 50% for underground mining).

			Potential Mining Method			
Category	**Total**		**Surface**[1]		**Underground**[2]	
Original resources		13,305.87		4,181.78		9,124.09
Mined resources	(11%)	1399.22	(22%)	903.30	(5%)	495.93
Remaining resources	(89%)	11906.65	(78%)	3278.48	(95%)	8628.16
Demonstrated reserve base	(86%)	11450.23	(76%)	3174.43	(91%)	8275.79
Accessible reserve base	(49%)	6587.69	(19%)	796.22	(63%)	5791.47
Recoverable reserves	(26%)	3532.71	(15%)	636.97	(32%)	2895.73

[1]Tonnages are reported for Springfield Coal having 0 to 200 feet of overburden.
[2]Tonnages are reported for Springfield Coal having 200 to 1,000 feet of overburden.

Remaining demonstrated reserve base* of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Danville and Springfield Coal												
0-200	>=26							0.68	0.68			0.68
0-200	25-25.99			<0.01	0.04	0.11		4.00	4.15		1.42	2.72
0-200	23-24.99	0.16	0.11	4.75	61.54	54.59	46.62	860.08	1,027.85	1.36	668.93	357.55
0-200	20-22.99	0.10	61.94	144.46	492.59	241.19	669.64	2,650.80	4,260.72		1,404.63	2,856.09
0-200	15-19.99		<0.01	0.11	8.54	1.62	2.49	20.27	33.04		8.53	24.51
0-200	<15											
Total		**0.25**	**62.05**	**149.32**	**562.71**	**297.51**	**718.75**	**3,535.83**	**5,326.42**	**1.36**	**2,083.51**	**3,241.55**
Underground-minable Danville and Springfield Coal												
200-1000	>=26							2.36	2.36		0.04	2.32
200-1000	25-25.99							6.59	6.59		5.40	1.19
200-1000	23-24.99		4.54	161.09	228.65	281.71	1,177.53	2,865.39	4,718.91	1.67	1,866.01	2,851.23
200-1000	20-22.99	8.26	90.06	100.06	94.60	222.67	1,408.98	4,238.07	6,162.69		1,285.42	4,877.27
200-1000	15-19.99			0.03				208.11	208.14		0.03	208.11
200-1000	<15							5.80	5.80			5.80
Total		**8.26**	**94.60**	**261.18**	**323.24**	**504.38**	**2,586.51**	**7,326.31**	**11,104.48**	**1.67**	**3,156.90**	**7,945.91**
Total minable Danville and Springfield Coal												
0-1000	>=26							3.04	3.04		0.04	2.99
0-1000	25-25.99			<0.01	0.04	0.11		10.59	10.74		6.82	3.91
0-1000	23-24.99	0.16	4.65	165.85	290.19	336.30	1,224.15	3,725.47	5,746.76	3.03	2,534.94	3,208.78
0-1000	20-22.99	8.36	152.00	244.51	587.18	463.86	2,078.62	6,888.87	10,423.40		2,690.04	7,733.36
0-1000	15-19.99		<0.01	0.14	8.54	1.62	2.49	228.38	241.17		8.56	232.62
0-1000	<15							5.80	5.80			5.80
Total		**8.52**	**156.65**	**410.50**	**885.95**	**801.89**	**3,305.26**	**10,862.14**	**16,430.91**	**3.03**	**5,240.41**	**11,187.46**

Table 7. Remaining demonstrated reserve base* of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Demonstrated reserve base is defined as coal in the measured and indicated reliability categories, and greater than 14 inches thick for coal less than 200 feet deep, and greater than 28 inches thick for coal 200 to 1000 feet deep.

Remaining demonstrated reserve base* of the Danville Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu) <=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50	Total all sulfur categories	Ash Content (% by weight) <5%	5 - 10%	>10%
Surface-minable Danville Coal												
0-200	>=26											
0-200	25-25.99											
0-200	23-24.99	0.16		4.53	58.43	37.94	1.05	3.36	105.46	0.64	4.12	100.71
0-200	20-22.99	0.10	61.88	142.94	475.70	198.31	484.33	671.62	2,034.89		752.98	1,281.90
0-200	15-19.99			0.03	7.86			3.74	11.64		7.86	3.77
0-200	<15											
Total		**0.25**	**61.88**	**147.51**	**541.99**	**236.25**	**485.38**	**678.73**	**2,151.99**	**0.64**	**764.97**	**1,386.38**
Underground-minable Danville Coal												
200-1000	>=26											
200-1000	25-25.99											
200-1000	23-24.99		4.54	155.89	189.57	125.51	66.44	1.35	543.30		39.64	503.65
200-1000	20-22.99	8.26	90.06	99.92	88.67	117.71	604.50	1,064.40	2,073.53		238.34	1,835.18
200-1000	15-19.99							206.06	206.06			206.06
200-1000	<15							5.80	5.80			5.80
Total		**8.26**	**94.60**	**255.81**	**278.23**	**243.22**	**670.95**	**1,277.61**	**2,828.68**		**277.99**	**2,550.70**
Total minable Danville Coal												
0-1000	>=26											
0-1000	25-25.99											
0-1000	23-24.99	0.16	4.54	160.42	247.99	163.45	67.49	4.71	648.76	0.64	43.76	604.36
0-1000	20-22.99	8.36	151.93	242.87	564.37	316.02	1,088.83	1,736.02	4,108.41		991.33	3,117.08
0-1000	15-19.99			0.03	7.86			209.81	217.70		7.86	209.84
0-1000	<15							5.80	5.80			5.80
Total		**8.52**	**156.48**	**403.32**	**820.23**	**479.47**	**1,156.32**	**1,956.33**	**4,980.67**	**0.64**	**1,042.95**	**3,937.08**

Table 8. Remaining demonstrated reserve base* of the Danville Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Demonstrated reserve base is defined as coal in the measured and indicated reliability categories, and greater than 14 inches thick for coal less than 200 feet deep, and greater than 28 inches thick for coal 200 to 1000 feet deep.

Remaining demonstrated reserve base* of the Springfield Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Springfield Coal												
0-200	>=26							0.68	0.68			0.68
0-200	25-25.99			<0.01	0.04	0.11		4.00	4.15		1.42	2.72
0-200	23-24.99		0.11	0.22	3.11	16.65	45.58	856.72	922.38	0.73	664.81	256.85
0-200	20-22.99		0.06	1.51	16.89	42.88	185.31	1,979.18	2,225.83		651.64	1,574.18
0-200	15-19.99		<0.01	0.08	0.67	1.62	2.49	16.53	21.40		0.67	20.73
0-200	<15											
Total			**0.17**	**1.81**	**20.72**	**61.26**	**233.38**	**2,857.10**	**3,174.44**	**0.73**	**1,318.54**	**1,855.17**
Underground-minable Springfield Coal												
200-1000	>=26							2.36	2.36		0.04	2.32
200-1000	25-25.99							6.59	6.59		5.40	1.19
200-1000	23-24.99			5.20	39.08	156.21	1,111.08	2,864.04	4,175.62	1.67	1,826.37	2,347.58
200-1000	20-22.99			0.13	5.93	104.95	804.48	3,173.67	4,089.16		1,047.07	3,042.09
200-1000	15-19.99			0.03				2.05	2.07		0.03	2.05
200-1000	<15											
Total				**5.37**	**45.01**	**261.16**	**1,915.56**	**6,048.70**	**8,275.80**	**1.67**	**2,878.91**	**5,395.22**
Total minable Springfield Coal												
0-1000	>=26							3.04	3.04		0.04	2.99
0-1000	25-25.99			<0.01	0.04	0.11		10.59	10.74		6.82	3.91
0-1000	23-24.99		0.11	5.42	42.19	172.85	1,156.66	3,720.76	5,098.00	2.40	2,491.18	2,604.42
0-1000	20-22.99		0.06	1.65	22.82	147.83	989.79	5,152.85	6,314.99		1,698.72	4,616.27
0-1000	15-19.99		<0.01	0.11	0.67	1.62	2.49	18.58	23.47		0.69	22.78
0-1000	<15											
Total			**0.17**	**7.18**	**65.73**	**322.41**	**2,148.94**	**8,905.81**	**11,450.24**	**2.40**	**4,197.46**	**7,250.38**

Table 9. Remaining demonstrated reserve base* of the Springfield Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Demonstrated reserve base is defined as coal in the measured and indicated reliability categories, and greater than 14 inches thick for

Accessible reserve base* of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Danville and Springfield Coal												
0-200	>=26											
0-200	25-25.99					0.11		0.41	0.51		0.11	0.41
0-200	23-24.99			0.01	1.19	3.08	21.73	203.84	229.85	0.44	186.50	42.90
0-200	20-22.99		0.03	5.17	84.62	41.01	95.35	634.39	860.56		250.55	610.01
0-200	15-19.99				5.09	0.46	0.57	9.56	15.68		5.55	10.14
0-200	<15											
Total			**0.03**	**5.18**	**90.89**	**44.66**	**117.65**	**848.19**	**1,106.60**	**0.44**	**442.71**	**663.46**
Underground-minable Danville and Springfield Coal												
200-1000	>=26							2.36	2.36		0.04	2.32
200-1000	25-25.99							6.59	6.59		5.40	1.19
200-1000	23-24.99			35.37	24.46	120.98	877.48	1,948.22	3,006.50	1.34	1,409.32	1,595.83
200-1000	20-22.99	7.72	86.15	43.13	14.01	66.45	677.72	2,191.75	3,086.92		968.41	2,118.51
200-1000	15-19.99							1.87	1.87			1.87
200-1000	<15											
Total		**7.72**	**86.15**	**78.50**	**38.47**	**187.43**	**1,555.20**	**4,150.79**	**6,104.23**	**1.34**	**2,383.18**	**3,719.71**
Total minable Danville and Springfield Coal												
0-1000	>=26							2.36	2.36		0.04	2.32
0-1000	25-25.99					0.11		7.00	7.10		5.50	1.60
0-1000	23-24.99			35.38	25.64	124.06	899.21	2,152.06	3,236.35	1.78	1,595.83	1,638.73
0-1000	20-22.99	7.72	86.18	48.30	98.63	107.45	773.06	2,826.14	3,947.48		1,218.96	2,728.52
0-1000	15-19.99				5.09	0.46	0.57	11.43	17.55		5.55	12.00
0-1000	<15											
Total		**7.72**	**86.18**	**83.68**	**129.36**	**232.08**	**1,672.84**	**4,998.98**	**7,210.84**	**1.78**	**2,825.88**	**4,383.17**

Table 10. Accessible reserve base* of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Accessible reserve base includes coal in the measured and indicated reliability categories, and greater than 14 inches thick for coal less than 200 feet deep, and greater than 42 inches thick for coal 200 to 1000 feet deep. Furthermore, accessible reserves are those reserves that remain accessible to mining after the landuse and technological restrictions that are listed in tables 1 and 2 of this report have been applied.

Accessible reserve base* of the Danville Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Danville Coal												
0-200	>=26											
0-200	25-25.99											
0-200	23-24.99			0.01	0.57	0.55	0.99	2.80	4.91	0.44	3.49	0.97
0-200	20-22.99		0.03	5.17	84.43	40.30	58.18	111.33	299.44		128.37	171.07
0-200	15-19.99				5.04			0.99	6.03		5.04	0.99
0-200	<15											
Total			**0.03**	**5.18**	**90.03**	**40.85**	**59.17**	**115.12**	**310.38**	**0.44**	**136.90**	**173.04**
Underground-minable Danville Coal												
200-1000	>=26											
200-1000	25-25.99											
200-1000	23-24.99			33.86					33.86		1.37	32.49
200-1000	20-22.99	7.72	86.15	43.13	12.52	8.36	78.10	42.93	278.91		144.05	134.85
200-1000	15-19.99											
200-1000	<15											
Total		**7.72**	**86.15**	**76.98**	**12.52**	**8.36**	**78.10**	**42.93**	**312.76**		**145.42**	**167.34**
Total minable Danville Coal												
0-1000	>=26											
0-1000	25-25.99											
0-1000	23-24.99			33.87	0.57	0.55	0.99	2.80	38.77	0.44	4.86	33.46
0-1000	20-22.99	7.72	86.18	48.30	96.95	48.66	136.28	154.26	578.35		272.42	305.92
0-1000	15-19.99				5.04			0.99	6.03		5.04	0.99
0-1000	<15											
Total		**7.72**	**86.18**	**82.17**	**102.55**	**49.21**	**137.27**	**158.05**	**623.14**	**0.44**	**282.33**	**340.38**

Table 11. Accessible reserve base* of the Danville Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Accessible reserve base includes coal in the measured and indicated reliability categories, and greater than 14 inches thick for coal less than 200 feet deep, and greater than 42 inches thick for coal 200 to 1000 feet deep. Furthermore, accessible reserves are those reserves that remain accessible to mining after the landuse and technological restrictions that are listed in tables 1 and 2 of this report have been applied.

Accessible reserve base* of the Springfield Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Springfield Coal												
0-200	>=26											
0-200	25-25.99					0.11		0.41	0.51		0.11	0.41
0-200	23-24.99				0.62	2.53	20.75	201.04	224.94		183.01	41.93
0-200	20-22.99				0.19	0.71	37.17	523.06	561.12		122.18	438.94
0-200	15-19.99				0.05	0.46	0.57	8.57	9.65		0.51	9.14
0-200	<15											
Total					**0.86**	**3.81**	**58.48**	**733.07**	**796.22**		**305.80**	**490.42**
Underground-minable Springfield Coal												
200-1000	>=26							2.36	2.36		0.04	2.32
200-1000	25-25.99							6.59	6.59		5.40	1.19
200-1000	23-24.99			1.51	24.46	120.98	877.48	1,948.22	2,972.64	1.34	1,407.95	1,563.34
200-1000	20-22.99			<0.01	1.49	58.09	599.61	2,148.82	2,808.01		824.36	1,983.65
200-1000	15-19.99							1.87	1.87			1.87
200-1000	<15											
Total				**1.51**	**25.95**	**179.06**	**1,477.09**	**4,107.86**	**5,791.47**	**1.34**	**2,237.76**	**3,552.37**
Total minable Springfield Coal												
0-1000	>=26							2.36	2.36		0.04	2.32
0-1000	25-25.99					0.11		7.00	7.10		5.50	1.60
0-1000	23-24.99			1.51	25.08	123.51	898.23	2,149.26	3,197.58	1.34	1,590.97	1,605.27
0-1000	20-22.99			<0.01	1.68	58.79	636.78	2,671.88	3,369.13		946.54	2,422.59
0-1000	15-19.99				0.05	0.46	0.57	10.43	11.52		0.51	11.01
0-1000	<15											
Total				**1.51**	**26.81**	**182.87**	**1,535.57**	**4,840.93**	**6,587.69**	**1.34**	**2,543.56**	**4,042.79**

Table 12. Accessible reserve base* of the Springfield Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Accessible reserve base includes coal in the measured and indicated reliability categories, and greater than 14 inches thick for coal less than 200 feet deep, and greater than 42 inches thick for coal 200 to 1000 feet deep. Furthermore, accessible reserves are those reserves that remain accessible to mining after the landuse and technological restrictions that are listed in tables 1 and 2 of this report have been applied.

Estimated recoverable reserves* of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Danville and Springfield Coal												
0-200	>=26											
0-200	25-25.99					0.08		0.33	0.41		0.08	0.32
0-200	23-24.99			0.01	0.95	2.46	17.39	163.07	183.88	0.35	149.20	34.32
0-200	20-22.99		0.02	4.14	67.69	32.80	76.28	507.51	688.45		200.44	488.01
0-200	15-19.99				4.07	0.37	0.45	7.65	12.55		4.44	8.11
0-200	<15											
Total			**0.02**	**4.15**	**72.72**	**35.72**	**94.12**	**678.55**	**885.28**	**0.35**	**354.16**	**530.76**
Underground-minable Danville and Springfield Coal												
200-1000	>=26							1.18	1.18		0.02	1.16
200-1000	25-25.99							3.29	3.29		2.70	0.60
200-1000	23-24.99			17.68	12.23	60.49	438.74	974.11	1,503.25	0.67	704.66	797.92
200-1000	20-22.99	3.86	43.07	21.56	7.00	33.22	338.86	1,095.88	1,543.46		484.21	1,059.25
200-1000	15-19.99							0.93	0.93			0.93
200-1000	<15											
Total		**3.86**	**43.07**	**39.25**	**19.23**	**93.71**	**777.60**	**2,075.39**	**3,052.12**	**0.67**	**1,191.59**	**1,859.86**
Total minable Danville and Springfield Coal												
0-1000	>=26							1.18	1.18		0.02	2.38
0-1000	25-25.99					0.08		3.62	3.70		2.78	10.19
0-1000	23-24.99			17.69	13.18	62.95	456.13	1,137.18	1,687.13	1.02	853.87	4,229.15
0-1000	20-22.99	3.86	43.10	25.70	74.70	66.03	415.14	1,603.39	2,231.91		684.65	5,148.46
0-1000	15-19.99				4.07	0.37	0.45	8.58	13.48		4.44	31.40
0-1000	<15											
Total		**3.86**	**43.10**	**43.39**	**91.95**	**129.44**	**871.72**	**2,753.95**	**3,937.40**	**1.02**	**1,545.75**	**9,421.58**

Table 13. Estimated recoverable reserves* of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Estimated recoverable reserves include coal in the measured and indicated reliability categories, and greater than 14 inches thick for coal less than 200 feet deep, and greater than 42 inches thick for coal 200 to 1000 feet deep. Furthermore, recoverable reserves are that portion of accessible reserves that are estimated to be recoverable based on recovery rates of 80 percent and 50 percent for surface mining and underground mining, respectively.

Estimated recoverable reserves* of the Danville Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.

Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Danville Coal												
0-200	>=26											
0-200	25-25.99											
0-200	23-24.99			0.01	0.45	0.44	0.79	2.24	3.93	0.35	2.79	0.78
0-200	20-22.99		0.02	4.14	67.54	32.24	46.54	89.06	239.55		102.70	136.86
0-200	15-19.99				4.03			0.79	4.83		4.03	0.79
0-200	<15											
Total			**0.02**	**4.15**	**72.03**	**32.68**	**47.33**	**92.10**	**248.30**	**0.35**	**109.52**	**138.43**
Underground-minable Danville Coal												
200-1000	>=26											
200-1000	25-25.99											
200-1000	23-24.99			16.93					16.93		0.69	16.24
200-1000	20-22.99	3.86	43.07	21.56	6.26	4.18	39.05	21.47	139.45		72.03	67.43
200-1000	15-19.99											
200-1000	<15											
Total		**3.86**	**43.07**	**38.49**	**6.26**	**4.18**	**39.05**	**21.47**	**156.38**		**72.71**	**83.67**
Total minable Danville Coal												
0-1000	>=26											
0-1000	25-25.99											
0-1000	23-24.99			16.94	0.45	0.44	0.79	2.24	20.86	0.35	3.48	45.54
0-1000	20-22.99	3.86	43.10	25.70	73.80	36.42	85.60	110.53	379.01		174.72	932.73
0-1000	15-19.99				4.03			0.79	4.83		4.03	13.68
0-1000	<15											
Total		**3.86**	**43.10**	**42.64**	**78.29**	**36.86**	**86.39**	**113.56**	**404.69**	**0.35**	**182.23**	**991.96**

Table 14. Estimated recoverable reserves* of the Danville Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.

* Estimated recoverable reserves include coal in the measured and indicated reliability categories, and greater than 14 inches thick for coal less than 200 feet deep, and greater than 42 inches thick for coal 200 to 1000 feet deep. Furthermore, recoverable reserves are that portion of accessible reserves that are estimated to be recoverable based on recovery rates of 80 percent and 50 percent for surface mining and underground mining, respectively.

Estimated recoverable reserves* of the Springfield Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.												
Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
		<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Surface-minable Springfield Coal												
0-200	>=26											
0-200	25-25.99					0.08		0.33	0.41		0.08	0.32
0-200	23-24.99				0.50	2.03	16.60	160.83	179.95		146.41	33.54
0-200	20-22.99				0.15	0.56	29.73	418.45	448.90		97.74	351.15
0-200	15-19.99				0.04	0.37	0.45	6.85	7.72		0.41	7.31
0-200	<15											
Total					**0.69**	**3.05**	**46.79**	**586.46**	**636.98**		**244.64**	**392.34**
Underground-minable Springfield Coal												
200-1000	>=26							1.18	1.18		0.02	1.16
200-1000	25-25.99							3.29	3.29		2.70	0.60
200-1000	23-24.99			0.75	12.23	60.49	438.74	974.11	1,486.32	0.67	703.98	781.67
200-1000	20-22.99			<0.01	0.74	29.04	299.81	1,074.41	1,404.01		412.18	991.83
200-1000	15-19.99							0.93	0.93			0.93
200-1000	<15											
Total				**0.75**	**12.97**	**89.53**	**738.55**	**2,053.93**	**2,895.73**	**0.67**	**1,118.88**	**1,776.18**
Total minable Springfield Coal												
0-1000	>=26							1.18	1.18		0.02	2.38
0-1000	25-25.99					0.08		3.62	3.70		2.78	10.19
0-1000	23-24.99			0.75	12.72	62.52	455.34	1,134.94	1,666.27	0.67	850.39	4,183.60
0-1000	20-22.99				0.90	29.61	329.54	1,492.86	1,852.90		509.92	4,215.72
0-1000	15-19.99				0.04	0.37	0.45	7.79	8.65		0.41	17.71
0-1000	<15											
Total				**0.75**	**13.66**	**92.58**	**785.33**	**2,640.38**	**3,532.71**	**0.67**	**1,363.52**	**8,429.61**

Table 15. Estimated recoverable reserves* of the Springfield Coal Member in Indiana as of January 1, 2000, million short tons of bituminous coal.

CONCLUSIONS

The tonnage of original identified resources of Danville and Springfield Coal in Indiana is calculated to be 18.8 billion short tons. Of the 18.8 billion short tons, 1.8 billion short tons have been removed by mining or lost in the mining process, thus leaving 17.0 billion short tons of remaining Danville and Springfield resources. Of the remaining resources, 16.4 billion tons are demonstrated reserve base. Technological and land use restrictions remove 9.2 billion short tons of demonstrated reserve base from potential mining, thus leaving 7.2 billion short tons (38.2% of the original resources or 42.3% of the remaining resources) of accessible reserve base. Of the 7.2 billion short tons of accessible reserve base, 0.9 billion short tons (4.7% of the original resources or 12.3% of the total accessible reserve base) are estimated to be recoverable by surface mining, while 3.1 billion short tons (16.6% of the original resources or 43.5% of the total accessible reserve base) are estimated to be recoverable by underground mining.

The tonnage of original Danville Coal resources in Indiana is calculated to be 5.5 billion short tons. Of the 5.5 billion short tons, 0.4 billion short tons have been removed by mining or lost in the mining process, thus leaving 5.1 billion short tons of remaining Danville resources. Of the remaining resources, 5.0 billion short tons are demonstrated reserve base. Technological and land use restrictions remove 4.4 billion short tons of demonstrated reserve base from potential mining, thus leaving 0.6 billion short tons (11.2% of the original resources or 12.2% of the remaining resources) of accessible reserve base. Of the 0.6 billion short tons of accessible reserve base, 0.2 billion short tons (4.4% of the original resources or 39.8% of the total accessible reserve base) are estimated to be recoverable by surface mining, while 0.1 billion short tons (2.8% of the original resources or 25% of the total accessible reserve base) are estimated to be recoverable by underground mining.

The tonnage of original Springfield Coal resources in Indiana is calculated to be 13.3 billion short tons. Of the 13.3 billion short tons, 1.3 billion short tons have been removed by mining or lost in the mining process, thus leaving 12 billion short tons of remaining Springfield resources. Of the remaining resources, 11.4 billion short tons are demonstrated reserve base. Technological and land use restrictions remove 4.8 billion short tons of demonstrated reserve base from potential mining, thus leaving 6.6 billion short tons (49.5% of the original resources or 55.3% of the remaining resources) of accessible reserve base. Of the 6.6 billion short tons of accessible reserve base, 0.6 billion short tons (4.7% of the original resources or 9.6% of the total accessible reserve base) are estimated to be recoverable by surface mining, while 2.9 billion short tons (21.7% of the original resources or 43.9% of the total accessible reserve base) are estimated to be recoverable by underground mining.

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Appendix 1. Remaining Demonstrated Reserve Base of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

County	Coal bed	Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
				<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Clay County by coal bed														
Clay	Springfield	0-200	23-24.99							14.26	14.26		10.89	3.37
Clay	Springfield	0-200	20-22.99							1.49	1.49			1.49
Clay County Total all categories										**15.75**	**15.75**		**10.89**	**4.86**
Daviess County by coal bed														
Daviess	Danville	0-200	20-22.99			0.08	0.09				0.17			0.17
Daviess	Springfield	0-200	23-24.99							101.86	101.86		99.79	2.07
Daviess	Springfield	0-200	20-22.99							<0.01	<0.01			<0.01
Daviess County Total all categories						**0.08**	**0.09**			**101.86**	**102.03**		**99.79**	**2.24**
Gibson County by coal bed														
Gibson	Danville	0-200	23-24.99			0.43	0.58	0.25			1.26			1.26
Gibson	Danville	0-200	20-22.99					3.69	4.31	317.94	325.95		7.73	318.22
Gibson	Danville	0-200	15-19.99							2.09	2.09			2.09
Gibson	Danville	200-500	23-24.99		1.66	1.61	6.12	4.94			14.33			14.33
Gibson	Danville	200-500	20-22.99					10.23	194.74	303.96	508.93			508.93
Gibson	Danville	500-1000	20-22.99						44.27	18.46	62.73			62.73
Gibson	Springfield	0-200	>=26							0.68	0.68			0.68
Gibson	Springfield	0-200	25-25.99							4.00	4.00		1.28	2.72
Gibson	Springfield	0-200	23-24.99						0.11	130.20	130.31		89.50	40.81
Gibson	Springfield	0-200	20-22.99							182.14	182.14		16.32	165.82
Gibson	Springfield	0-200	15-19.99							0.80	0.80			0.80
Gibson	Springfield	200-500	>=26							2.36	2.36		0.04	2.32
Gibson	Springfield	200-500	25-25.99							6.59	6.59		5.40	1.19
Gibson	Springfield	200-500	23-24.99						59.05	175.30	234.34		98.31	136.03
Gibson	Springfield	200-500	20-22.99						396.28	852.82	1,249.10		495.40	753.70
Gibson	Springfield	200-500	15-19.99							2.05	2.05			2.05
Gibson	Springfield	500-1000	23-24.99			5.20	38.96	125.61	268.01	6.21	443.99	1.67	431.78	10.54
Gibson	Springfield	500-1000	20-22.99					14.15	156.70	11.68	182.53		167.17	15.36
Gibson County surface-minable														
Gibson		0-200	>=26							0.68	0.68			0.68
Gibson		0-200	25-25.99							4.00	4.00		1.28	2.72
Gibson		0-200	23-24.99			0.43	0.58	0.25	0.11	130.20	131.57		89.50	42.07
Gibson		0-200	20-22.99					3.69	4.31	500.08	508.09		24.05	484.04
Gibson		0-200	15-19.99							2.89	2.89			2.89
Gibson County Total surface-minable						**0.43**	**0.58**	**3.94**	**4.42**	**637.85**	**647.23**		**114.82**	**532.41**

Appendix 1. Remaining Demonstrated Reserve Base of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

County	Coal bed	Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
				<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Gibson County deep-minable														
Gibson		200-500	>=26							2.36	2.36		0.04	2.32
Gibson		200-500	25-25.99							6.59	6.59		5.40	1.19
Gibson		200-500	23-24.99		1.66	1.61	6.12	4.94	59.05	175.30	248.67		98.31	150.36
Gibson		200-500	20-22.99					10.23	591.02	1,156.78	1,758.03		495.40	1,262.63
Gibson		200-500	15-19.99							2.05	2.05			2.05
Gibson		500-1000	23-24.99			5.20	38.96	125.61	268.01	6.21	443.99	1.67	431.78	10.54
Gibson		500-1000	20-22.99					14.15	200.97	30.14	245.26		167.17	78.09
Gibson County Total deep-minable					**1.66**	**6.82**	**45.08**	**154.92**	**1,119.05**	**1,379.42**	**2,706.95**	**1.67**	**1,198.11**	**1,507.18**
Gibson County Total all categories					**1.66**	**7.25**	**45.66**	**158.87**	**1,123.48**	**2,017.27**	**3,354.18**	**1.67**	**1,312.93**	**2,039.58**
Greene County by coal bed														
Greene	Danville	0-200	20-22.99					0.53	0.14	0.12	0.79		0.65	0.14
Greene	Springfield	0-200	23-24.99						0.01	1.54	1.55		1.55	
Greene	Springfield	0-200	20-22.99						0.56	95.40	95.96		3.29	92.67
Greene	Springfield	0-200	15-19.99							14.37	14.37			14.37
Greene County surface-minable														
Greene		0-200	23-24.99						0.01	1.54	1.55		1.55	
Greene		0-200	20-22.99					0.53	0.70	95.52	96.75		3.94	92.81
Greene		0-200	15-19.99							14.37	14.37			14.37
Greene County Total surface-minable								**0.53**	**0.71**	**111.42**	**112.66**		**5.49**	**107.17**
Greene County Total all categories								**0.53**	**0.71**	**111.42**	**112.66**		**5.49**	**107.17**
Knox County by coal bed														
Knox	Danville	0-200	23-24.99			4.08	24.27	21.64			50.00			50.00
Knox	Danville	0-200	20-22.99		61.54	140.52	81.88	18.45	60.11	24.50	387.00		183.38	203.62
Knox	Danville	200-500	23-24.99		2.88	149.68	138.55	29.31	1.47		321.89		37.97	283.92
Knox	Danville	200-500	20-22.99	8.26	90.06	97.00	15.48	32.45	152.25	91.74	487.23		167.13	320.11
Knox	Springfield	0-200	23-24.99						0.26	181.53	181.79		123.42	58.37
Knox	Springfield	0-200	20-22.99					0.01	3.25	142.24	145.50			145.50
Knox	Springfield	0-200	15-19.99					0.07	0.04		0.10			0.10
Knox	Springfield	200-500	23-24.99						69.79	925.25	995.04		284.63	710.41
Knox	Springfield	200-500	20-22.99				0.22	7.38	66.35	446.37	520.31		25.10	495.21
Knox	Springfield	500-1000	23-24.99							4.46	4.46			4.46
Knox	Springfield	500-1000	20-22.99						2.18	94.34	96.52		0.13	96.39
Knox County surface-minable														
Knox		0-200	23-24.99			4.08	24.27	21.64	0.26	181.53	231.79		123.42	108.36
Knox		0-200	20-22.99		61.54	140.52	81.88	18.46	63.36	166.74	532.49		183.38	349.11
Knox		0-200	15-19.99					0.07	0.04		0.10			0.10
Knox County Total surface-minable					**61.54**	**144.60**	**106.15**	**40.17**	**63.65**	**348.27**	**764.39**		**306.81**	**457.58**

Appendix 1. Remaining Demonstrated Reserve Base of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

County	Coal bed	Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu) <=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50	Total all sulfur categories	Ash Content (% by weight) <5%	5 - 10%	>10%
Knox County deep-minable														
Knox		200-500	23-24.99		2.88	149.68	138.55	29.31	71.26	925.25	1,316.93		322.60	994.33
Knox		200-500	20-22.99	8.26	90.06	97.00	15.70	39.83	218.59	538.10	1,007.55		192.23	815.32
Knox		500-1000	23-24.99							4.46	4.46			4.46
Knox		500-1000	20-22.99						2.18	94.34	96.52		0.13	96.39
Knox County Total deep-minable				**8.26**	**92.93**	**246.68**	**154.25**	**69.14**	**292.03**	**1,562.15**	**2,425.46**		**514.95**	**1,910.50**
Knox County Total all categories				**8.26**	**154.47**	**391.29**	**260.40**	**109.32**	**355.69**	**1,910.42**	**3,189.84**		**821.76**	**2,368.08**
Parke County by coal bed														
Parke	Springfield	0-200	23-24.99							2.02	2.02			2.02
Parke County Total all categories										**2.02**	**2.02**			**2.02**
Pike County by coal bed														
Pike	Danville	0-200	23-24.99					0.03	0.53		0.56	0.48	0.08	
Pike	Danville	0-200	20-22.99			0.23	2.49	11.04	36.66	28.73	79.15		33.06	46.09
Pike	Danville	200-500	20-22.99					1.04	2.35	0.19	3.58			3.58
Pike	Springfield	0-200	25-25.99			<0.01	0.04				0.04		0.04	
Pike	Springfield	0-200	23-24.99		0.11	0.22	1.42	7.42	41.09	153.09	203.35	0.73	155.94	46.68
Pike	Springfield	0-200	20-22.99				0.25	1.33	50.81	216.25	268.64		86.27	182.37
Pike	Springfield	0-200	15-19.99				0.05	0.21			0.26			0.26
Pike	Springfield	200-500	23-24.99							49.87	49.87			49.87
Pike	Springfield	200-500	20-22.99							91.68	91.68			91.68
Pike County surface-minable														
Pike		0-200	25-25.99			<0.01	0.04				0.04		0.04	
Pike		0-200	23-24.99		0.11	0.22	1.42	7.45	41.62	153.09	203.90	1.21	156.02	46.68
Pike		0-200	20-22.99			0.23	2.74	12.37	87.47	244.99	347.79		119.32	228.47
Pike		0-200	15-19.99				0.05	0.21			0.26			0.26
Pike County Total surface-minable					**0.11**	**0.45**	**4.26**	**20.02**	**129.09**	**398.07**	**552.00**	**1.21**	**275.38**	**275.41**
Pike County deep-minable														
Pike		200-500	23-24.99							49.87	49.87			49.87
Pike		200-500	20-22.99					1.04	2.35	91.87	95.26			95.26
Pike County Total deep-minable								**1.04**	**2.35**	**141.74**	**145.14**			**145.14**
Pike County Total all categories					**0.11**	**0.45**	**4.26**	**21.06**	**131.44**	**539.82**	**697.14**	**1.21**	**275.38**	**420.55**
Posey County by coal bed														
Posey	Danville	0-200	20-22.99						2.29	0.53	2.82			2.82
Posey	Danville	200-500	23-24.99			2.22	16.33	2.93	17.11		38.59		1.47	37.12
Posey	Danville	200-500	20-22.99			2.92	7.79	25.21	81.87	380.45	498.24			498.24
Posey	Danville	200-500	15-19.99							78.41	78.41			78.41
Posey	Danville	200-500	<15							1.68	1.68			1.68

Appendix 1. Remaining Demonstrated Reserve Base of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

County	Coal bed	Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu) <=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50	Total all sulfur categories	Ash Content (% by weight) <5%	5 - 10%	>10%
Posey County by coal bed (continued)														
Posey	Danville	500-1000	23-24.99			0.48	9.02	0.01	10.25		19.75			19.75
Posey	Danville	500-1000	20-22.99				0.16	1.39	8.80	71.71	82.06			82.06
Posey	Danville	500-1000	15-19.99							127.65	127.65			127.65
Posey	Danville	500-1000	<15							4.12	4.12			4.12
Posey	Springfield	200-500	23-24.99						11.73	218.01	229.74		43.61	186.13
Posey	Springfield	200-500	20-22.99						6.29	137.67	143.96		10.14	133.82
Posey	Springfield	500-1000	23-24.99						591.11	850.89	1,442.00		446.95	995.04
Posey	Springfield	500-1000	20-22.99						2.92	90.76	93.68		4.73	88.95
Posey County surface-minable														
Posey		0-200	20-22.99						2.29	0.53	2.82			2.82
Posey County Total surface-minable									**2.29**	**0.53**	**2.82**			**2.82**
Posey County deep-minable														
Posey		200-500	23-24.99			2.22	16.33	2.93	28.84	218.01	268.33		45.09	223.25
Posey		200-500	20-22.99			2.92	7.79	25.21	88.16	518.11	642.20		10.14	632.06
Posey		200-500	15-19.99							78.41	78.41			78.41
Posey		200-500	<15							1.68	1.68			1.68
Posey		500-1000	23-24.99			0.48	9.02	0.01	601.35	850.89	1,461.75		446.95	1,014.79
Posey		500-1000	20-22.99				0.16	1.39	11.72	162.48	175.74		4.73	171.01
Posey		500-1000	15-19.99							127.65	127.65			127.65
Posey		500-1000	<15							4.12	4.12			4.12
Posey County Total deep-minable						**5.62**	**33.29**	**29.54**	**730.07**	**1,961.35**	**2,759.88**		**506.91**	**2,252.97**
Posey County Total all categories						**5.62**	**33.29**	**29.54**	**732.36**	**1,961.88**	**2,762.70**		**506.91**	**2,255.79**
Sullivan County by coal bed														
Sullivan	Danville	0-200	23-24.99	0.16			33.07	15.45			48.67	0.16	0.18	48.34
Sullivan	Danville	0-200	20-22.99	0.10	0.28	1.62	305.84	90.90	68.64	40.76	508.14		345.94	162.20
Sullivan	Danville	0-200	15-19.99			0.03	5.76				5.80		5.76	0.03
Sullivan	Danville	200-500	23-24.99			1.90	19.55	88.32	37.62	1.35	148.74		0.20	148.54
Sullivan	Danville	200-500	20-22.99				65.24	43.56	78.68	104.14	291.62		64.97	226.65
Sullivan	Springfield	0-200	23-24.99				1.68	8.89	0.11	95.04	105.73		53.34	52.39
Sullivan	Springfield	0-200	20-22.99		0.06	1.50	4.68	23.40	13.86	234.77	278.27		87.80	190.47
Sullivan	Springfield	0-200	15-19.99		<0.01	0.08				0.56	0.64		0.08	0.56
Sullivan	Springfield	200-500	23-24.99				0.01	30.59	111.10	545.24	686.95		443.52	243.42
Sullivan	Springfield	200-500	20-22.99			0.13	5.67	82.49	86.57	326.60	501.47		203.55	297.91
Sullivan	Springfield	200-500	15-19.99			0.03					0.03		0.03	
Sullivan	Springfield	500-1000	23-24.99							1.87	1.87			1.87
Sullivan	Springfield	500-1000	20-22.99							16.12	16.12			16.12

Appendix 1. Remaining Demonstrated Reserve Base of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

County	Coal bed	Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu) <=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50	Total all sulfur categories	Ash Content (% by weight) <5%	5 - 10%	>10%
Sullivan County surface-minable														
Sullivan		0-200	23-24.99	0.16			34.75	24.34	0.11	95.04	154.40	0.16	53.52	100.73
Sullivan		0-200	20-22.99	0.10	0.34	3.13	310.52	114.30	82.50	275.53	786.41		433.74	352.67
Sullivan		0-200	15-19.99		<0.01	0.11	5.76			0.56	6.44		5.85	0.59
Sullivan County Total surface-minable				**0.25**	**0.34**	**3.24**	**351.04**	**138.64**	**82.61**	**371.13**	**947.25**	**0.16**	**493.10**	**453.99**
Sullivan County deep-minable														
Sullivan		200-500	23-24.99			1.90	19.56	118.92	148.73	546.59	835.68		443.72	391.96
Sullivan		200-500	20-22.99			0.13	70.91	126.05	165.25	430.74	793.09		268.52	524.56
Sullivan		200-500	15-19.99			0.03					0.03		0.03	
Sullivan		500-1000	23-24.99							1.87	1.87			1.87
Sullivan		500-1000	20-22.99							16.12	16.12			16.12
Sullivan County Total deep-minable						**2.06**	**90.46**	**244.97**	**313.98**	**995.32**	**1,646.78**		**712.27**	**934.51**
Sullivan County Total all categories				**0.25**	**0.34**	**5.29**	**441.50**	**383.61**	**396.59**	**1,366.44**	**2,594.03**	**0.16**	**1,205.37**	**1,388.50**
Vanderburgh County by coal bed														
Vanderburgh	Danville	0-200	20-22.99						<0.01	82.80	82.80			82.80
Vanderburgh	Danville	200-500	20-22.99							55.90	55.90			55.90
Vanderburgh	Springfield	0-200	20-22.99							78.96	78.96		30.61	48.35
Vanderburgh	Springfield	200-500	20-22.99						7.99	503.47	511.45		49.43	462.03
Vanderburgh	Springfield	500-1000	20-22.99						3.09	59.82	62.91		7.01	55.90
Vanderburgh County surface-minable														
Vanderburgh		0-200	20-22.99						<0.01	161.75	161.75		30.61	131.15
Vanderburgh County Total surface-minable									**<0.01**	**161.75**	**161.75**		**30.61**	**131.15**
Vanderburgh County deep-minable														
Vanderburgh		200-500	20-22.99						7.99	559.37	567.36		49.43	517.93
Vanderburgh		500-1000	20-22.99						3.09	59.82	62.91		7.01	55.90
Vanderburgh County Total deep-minable									**11.08**	**619.18**	**630.26**		**56.43**	**573.83**
Vanderburgh County Total all categories									**11.08**	**780.94**	**792.02**		**87.04**	**704.98**
Vermillion County by coal bed														
Vermillion	Danville	0-200	23-24.99					0.57			0.57		0.57	
Vermillion	Danville	0-200	20-22.99					1.37	13.60	14.20	29.18		2.54	26.63
Vermillion	Springfield	0-200	23-24.99							23.93	23.93			23.93
Vermillion	Springfield	0-200	20-22.99				11.81	17.80	68.74	115.24	213.59		142.02	71.56
Vermillion	Springfield	200-500	23-24.99							0.87	0.87		0.05	0.82
Vermillion	Springfield	200-500	20-22.99						1.14	24.31	25.45		1.59	23.85
Vermillion County surface-minable														
Vermillion		0-200	23-24.99					0.57		23.93	24.49		0.57	23.93
Vermillion		0-200	20-22.99				11.81	19.18	82.33	129.44	242.76		144.57	98.19
Vermillion County Total surface-minable							**11.81**	**19.74**	**82.33**	**153.37**	**267.26**		**145.14**	**122.12**

Appendix 1. Remaining Demonstrated Reserve Base of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

County	Coal bed	Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu) <=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50	Total all sulfur categories	Ash Content (% by weight) <5%	5 - 10%	>10%
Vermillion County deep-minable														
Vermillion		200-500	23-24.99							0.87	0.87		0.05	0.82
Vermillion		200-500	20-22.99						1.14	24.31	25.45		1.59	23.85
Vermillion County Total deep-minable									**1.14**	**25.17**	**26.31**		**1.64**	**24.67**
Vermillion County Total all categories							**11.81**	**19.74**	**83.47**	**178.55**	**293.57**		**146.78**	**146.80**
Vigo County by coal bed														
Vigo	Danville	0-200	23-24.99			0.02	0.51				0.53		0.53	
Vigo	Danville	0-200	20-22.99	<0.01	0.07	0.49	85.40	72.32	298.58	76.66	533.53		166.61	366.92
Vigo	Danville	0-200	15-19.99				2.10				2.10		2.10	
Vigo	Danville	200-500	20-22.99					3.84	41.55	36.00	81.38		5.01	76.37
Vigo	Springfield	0-200	23-24.99						0.64	31.13	31.77		25.13	6.64
Vigo	Springfield	0-200	20-22.99				0.05	0.22	34.90	255.37	290.55		83.82	206.72
Vigo	Springfield	0-200	15-19.99							0.21	0.21			0.21
Vigo	Springfield	200-500	23-24.99				0.11	<0.01	0.30	86.08	86.48		77.51	8.97
Vigo	Springfield	200-500	20-22.99				0.04	0.93	72.57	421.54	495.08		82.82	412.26
Vigo County surface-minable														
Vigo		0-200	23-24.99			0.02	0.51		0.64	31.13	32.30		25.66	6.64
Vigo		0-200	20-22.99	<0.01	0.07	0.49	85.46	72.54	333.48	332.04	824.07		250.43	573.64
Vigo		0-200	15-19.99				2.10			0.21	2.31		2.10	0.21
Vigo County Total surface-minable				**<0.01**	**0.07**	**0.51**	**88.07**	**72.54**	**334.12**	**363.37**	**858.68**		**278.18**	**580.49**
Vigo County deep-minable														
Vigo		200-500	23-24.99				0.11	<0.01	0.30	86.08	86.48		77.51	8.97
Vigo		200-500	20-22.99				0.04	4.77	114.12	457.53	576.46		87.83	488.63
Vigo County Total deep-minable							**0.16**	**4.77**	**114.41**	**543.61**	**662.94**		**165.34**	**497.60**
Vigo County Total all categories				**<0.01**	**0.07**	**0.51**	**88.22**	**77.31**	**448.53**	**906.98**	**1,521.62**		**443.53**	**1,078.09**
Warrick County by coal bed														
Warrick	Danville	0-200	23-24.99						0.52	3.36	3.88		2.77	1.11
Warrick	Danville	0-200	20-22.99							85.37	85.37		13.08	72.29
Warrick	Danville	0-200	15-19.99							1.65	1.65			1.65
Warrick	Danville	200-500	20-22.99							1.85	1.85		1.24	0.61
Warrick	Springfield	0-200	25-25.99					0.11			0.11		0.11	
Warrick	Springfield	0-200	23-24.99				<0.01	0.34	3.35	122.13	125.82		105.26	20.56
Warrick	Springfield	0-200	20-22.99			0.01	0.10	0.12	13.19	657.32	670.74		201.51	469.23
Warrick	Springfield	0-200	15-19.99				0.62	1.35	2.46	0.59	5.01		0.59	4.43
Warrick	Springfield	200-500	20-22.99						2.39	96.52	98.91			98.91

Appendix 1. Remaining Demonstrated Reserve Base of the Danville and Springfield Coal Members in Indiana as of January 1, 2000, million short tons of bituminous coal.

County	Coal bed	Depth (feet)	Heat Content (million Btu per short ton)	Sulfur Content (lbs of sulfur / million Btu)							Total all sulfur categories	Ash Content (% by weight)		
				<=0.40	0.41-0.06	0.61-0.83	0.84-1.24	1.25-1.67	1.68-2.50	>2.50		<5%	5 - 10%	>10%
Warrick County surface-minable														
Warrick		0-200	25-25.99					0.11			0.11		0.11	
Warrick		0-200	23-24.99				<0.01	0.34	3.87	125.49	129.71		108.03	21.67
Warrick		0-200	20-22.99			0.01	0.10	0.12	13.19	742.69	756.11		214.59	541.52
Warrick		0-200	15-19.99				0.62	1.35	2.46	2.24	6.66		0.59	6.08
Warrick County Total surface-minable						**0.01**	**0.72**	**1.91**	**19.52**	**870.42**	**892.59**		**323.31**	**569.27**
Warrick County deep-minable														
Warrick		200-500	20-22.99						2.39	98.37	100.75		1.24	99.52
Warrick County Total deep-minable									**2.39**	**98.37**	**100.75**		**1.24**	**99.52**
Warrick County Total all categories						**0.01**	**0.72**	**1.91**	**21.91**	**968.78**	**993.34**		**324.55**	**668.79**

Appendix 2: Format of the digital database of coal resources and reserves provided to the Energy Information Administration The EIA will be provided with a database that contains data on identified resources, demonstrated reserve base, accessible reserve base, and estimated recoverable reserves. Data will be aggregated to the county level by coalbed. For each coalbed in a county, there will be one or more records, depending upon the different combinations of reliability, thickness, depth, Btu, ash, and sulfur. The layout of each record of described below.

Field name	Item type	Explanation
ID	Integer	A unique id number for each record
Area	Decimal	Area in square meters
County	Character	County name
Coalname	Character	Coal seam name: Danville or Springfield
Rely_cat	Character	Reliability category: measured, indicated, inferred
Thick_in	Decimal	Mean coal thickness in inches
Thick_ft	Decimal	Mean coal thickness in feet
Smine_id	Integer	Numeric code used to indicate whether or not coal has been removed by surface mining
Umine_id	Integer	Numeric code used to indicate whether or not coal has been removed by underground mining
Depth_id	Integer	Numeric code to represent coal depth categories
Depagg1	Character	Used to aggregate coal depth categories into 0-200 ft and 200-1000 ft depths
Depagg2	Character	Used to aggregate coal depth categories into 0-200 ft and 200-500 ft and 500-1000 ft depths
Depagg3	Character	Used to aggregate coal depth categories into 0-1000 ft depths
Depth	Character	Coal depth category
Sratio	Character	Stripping ratio (cubic yds. of overburden / ton of coal)
Sulcode	Integer	Numeric code used for sulfur categories
Sulbtu	Character	Sulfur content category: Pounds of sulfur / Million Btu
Btucode	Integer	Numeric code for Btu categories
Btusort	Integer	Numeric code used to sort the Btu categories
BtuTon	Character	Heat content category: Million Btu / Short Ton, as-received basis
Ashcode	Integer	Numeric code for ash categories
Ash	Character	Ash content category: percent ash by weight, as-received basis
Tonnage	Decimal	Short tons of coal
Mton	Decimal	Million short tons of coal = (Tonnage / 1,000,000)
Avail_sf	Integer	Code to indicate if coal is available for surface mining; 1= coal available, all other numbers = coal restricted
Avail_ug	Integer	Code to indicate if coal is available for underground mining; 1= coal available, all other numbers = coal restricted
Recov_sf	Decimal	Short tons of recoverable surface-minable reserves = (Tonnage x 80% recovery rate)
Recov_ug	Decimal	Short tons of recoverable underground-minable reserves = (Tonnage x 50% recovery rate)
Mrec_sf	Decimal	Million Short tons of recoverable surface-minable reserves = (Recov_sf / 1,000,000)
Mrec_ug	Decimal	Million Short tons of recoverable underground-minable reserves = (Recov_ug / 1,000,000)

County FIPS codes

County	FIPS code
Clay	021
Daviess	027
Gibson	051
Greene	055
Knox	083
Parke	121
Pike	125
Posey	129
Sullivan	153
Vanderburgh	163
Vermillion	165
Vigo	167
Warrick	173

Reliability categories

Rely_cat	Explanation
measured	0-0.5 miles from coal thickness data point
indicated	0.5-2.0 miles from coal thickness data point
inferred	2.0-4.0 miles from coal thickness data point

Coal depth categories

Depth_id	Explanation
1	<50 ft
50	50-100 ft
100	100-150 ft
150	150-200 ft
200	200-500 ft
500	500-1000 ft

Btu categories (million Btu/short ton)

Btucode	Explanation
26	>=26
25	25-25.99
23	23-24.99
20	20-22.99
15	15-19.99
1	<15

Appendix 3: Formula for calculating stripping ratio

Stripping Ratio

The stripping ratio is the number of cubic yards of interburden that must be removed to recover 1 ton of coal. Whereas the minimum thickness of coal and maximum thickness of overburden that can be mined are values controlled in part by technical factors such as mining equipment, the maximum stripping ratio is strictly an economic limit. Under present economic conditions, the maximum stripping ratio for a coal deposit is 25:1. This value is one of the criteria for accessible surface minable reserves in this study.

The calculation of stripping ratio in this report is based on raw coal, exclusive of partings, with no allowances made for additional losses in handling and cleaning. In addition, only the thickness of the Danville or Springfield Coal was used to calculate the stripping ratio for the Danville and Springfield Coal, respectively; that is, the thickness of other coal beds that may have been present in the maximum overburden limit of 200 feet were excluded from the stripping ratio calculation.

$$\text{Cubic yards / ton} = \frac{(\text{overburden thickness in feet X acres X 43,560 sq. ft / acre}) / (\text{27 sq. ft. / cubic yd.})}{\text{coal thickness in feet X acres X 1,800 tons / acre}}$$

This equation simplifies to

$$\text{Cubic yards / ton} = \frac{(\text{overburden thickness in feet X 0.896296 cubic yd. / ton})}{\text{coal thickness in feet}}$$