Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
Illinois Geologic Quadrangle Map: IGQ Vincennes-CR
William W. Shilts, Chief
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RESOURCES MAPS AND AVAILABILITY FOR MINING OF THE DANVILLE, JAMESTOWN/ HYMERA, SPRINGFIELD, SURVANT AND SEELYVILLE COALS

Vincennes Quadrangle, Knox County, Indiana and Lawrence County, Illinois

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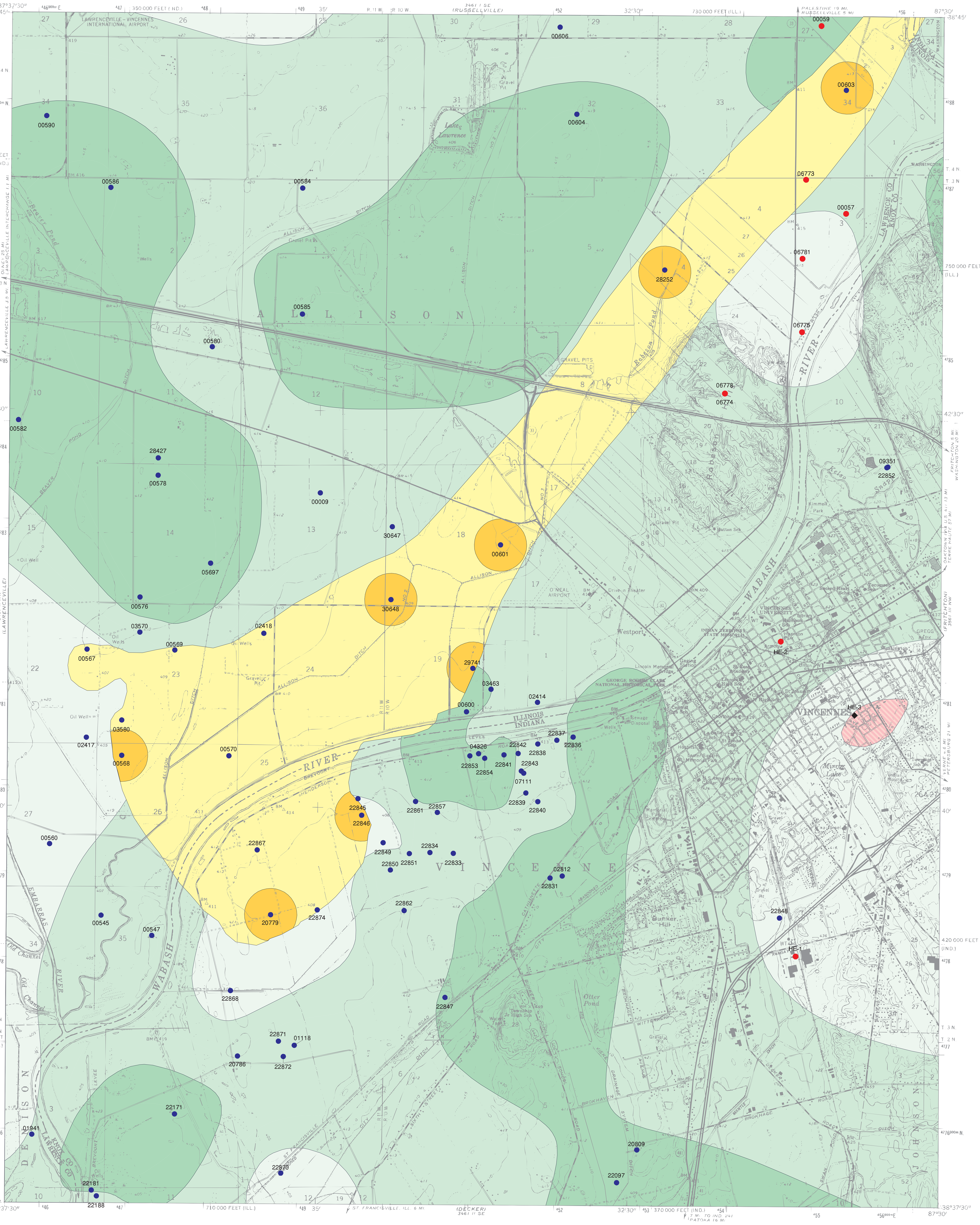

Thickness of the Danville Coal

Scale 1:24,000

0 — 2 miles
0 — 2 kilometers
0 — 2000 feet

Base map compiled at the Illinois State Geological Survey (ISGS) from digital data provided by the U.S. Geological Survey and the ISGS.
1927 North American datum
Universal Transverse Mercator projection - Zone 16

Coal Thickness (feet)	Coal Mining and Erosion	Well ID and Type
2.5 to 3.5	Coal closely overlain by sandstone, and may be partially eroded	Oil And Gas Test
3.5 to 4.5	Coal partially eroded in this area	Coal Test
4.5 to 5.5	Approximate area of mining	Mine Shaft
		22188 ISGS index number

DISCLAIMER: This map was prepared for the purpose of quadrangle mapping, resource evaluation and regional planning. It is based on interpretations of available data obtained from a variety of sources. Location of geologic unit contacts are not surveyed; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist. The accuracy of the unverified data and the interpretations based upon them are not guaranteed by the Illinois State Geological Survey. The information provided on this map cannot be substituted for site-specific investigations.

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1	2	3
4		5
6	7	8

1 Birds
2 Russellville
3 Oaktown
4 Lawrenceville
5 Fritchton
6 St. Francisville
7 Decker
8 Iona

ADJOINING 7.5-MINUTE QUADRANGLES

DIGITAL CARTOGRAPHY: S.K. Beaverson and B.J. Stiff

ACKNOWLEDGMENTS: This map is one of a series of multidisciplinary geological maps of the USGS 7.5-minute Vincennes Quadrangle compiled by a team of geologists from the Illinois State Geological Survey and the Indiana Geological Survey. The maps characterize surface soils, geological landscapes, Quaternary, bedrock, and engineering geology, aquifer sensitivity, and delineate coal, oil, and sand and gravel resources. David G. Morse, Project Coordinator, helped conceive the project and organized and coordinated the project teams. Support and funding for the project was provided by the Illinois and Indiana state geological surveys. The criteria and methodology for assessing the availability of coal resources were developed through a series of projects funded by the U.S. Geological Survey (143492A0940, 93A1137, 94A1266, 95A01346, HQ96AG01460, HQ97AG01759).

Coal Resources in the Vincennes Quadrangle

The Vincennes Quadrangle is underlain by 1,300 to 1,500 feet of Pennsylvanian strata consisting of shales, siltstones, sandstones, limestones, and coals. Five coal seams are thick enough (a minimum of 2.5 feet) to be considered resources: the Danville, Jamestown (equivalent to the upper bench of what is known in Indiana as the Hymera), Springfield, Survant, and Seelyville Coal Members. Two maps are presented for each of these seams except the Survant: a map of coal thickness (the main map plus figs. 4a, 5a, 6, and 7a) and a map showing our classification of the availability of the resources for mining (figs. 3, 4b, 5b, and 7b). Because of the limited data for the Survant Coal no map of available resources was created.

The Danville Coal, the uppermost of the seams mapped and the most attractive from an economic standpoint, is at an elevation of about 120 feet above sea level (about 300 feet deep) in the northeast corner of the quadrangle and dips to the south and west to an elevation of 10 to 50 feet above sea level (about 400 feet deep) in the southwest quarter of the quadrangle (fig. 1). The elevations of the other coals follow a similar pattern at correspondingly lower intervals below the Danville (fig. 2).

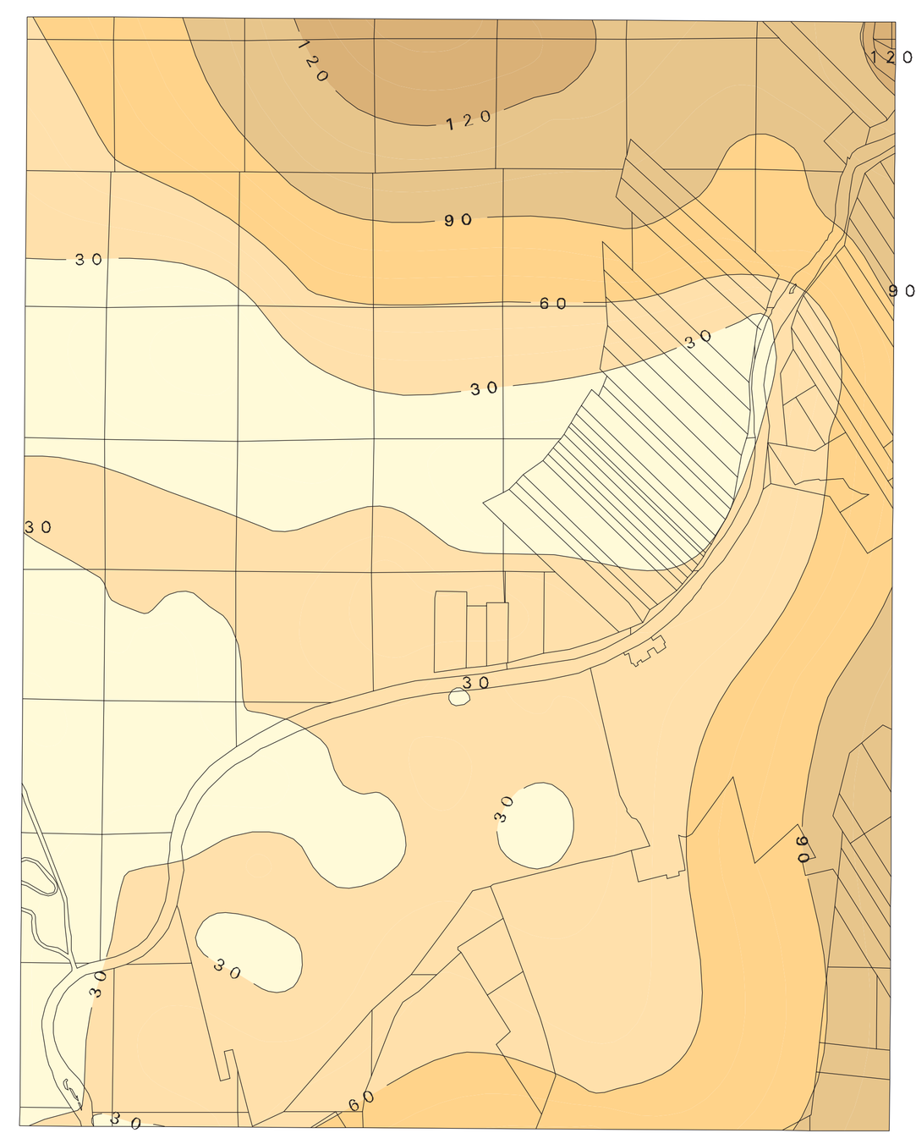

Figure 1. Structure Contour Map of the Danville Coal
Contour interval 30 feet. Elevations are relative to 1927 North American datum.

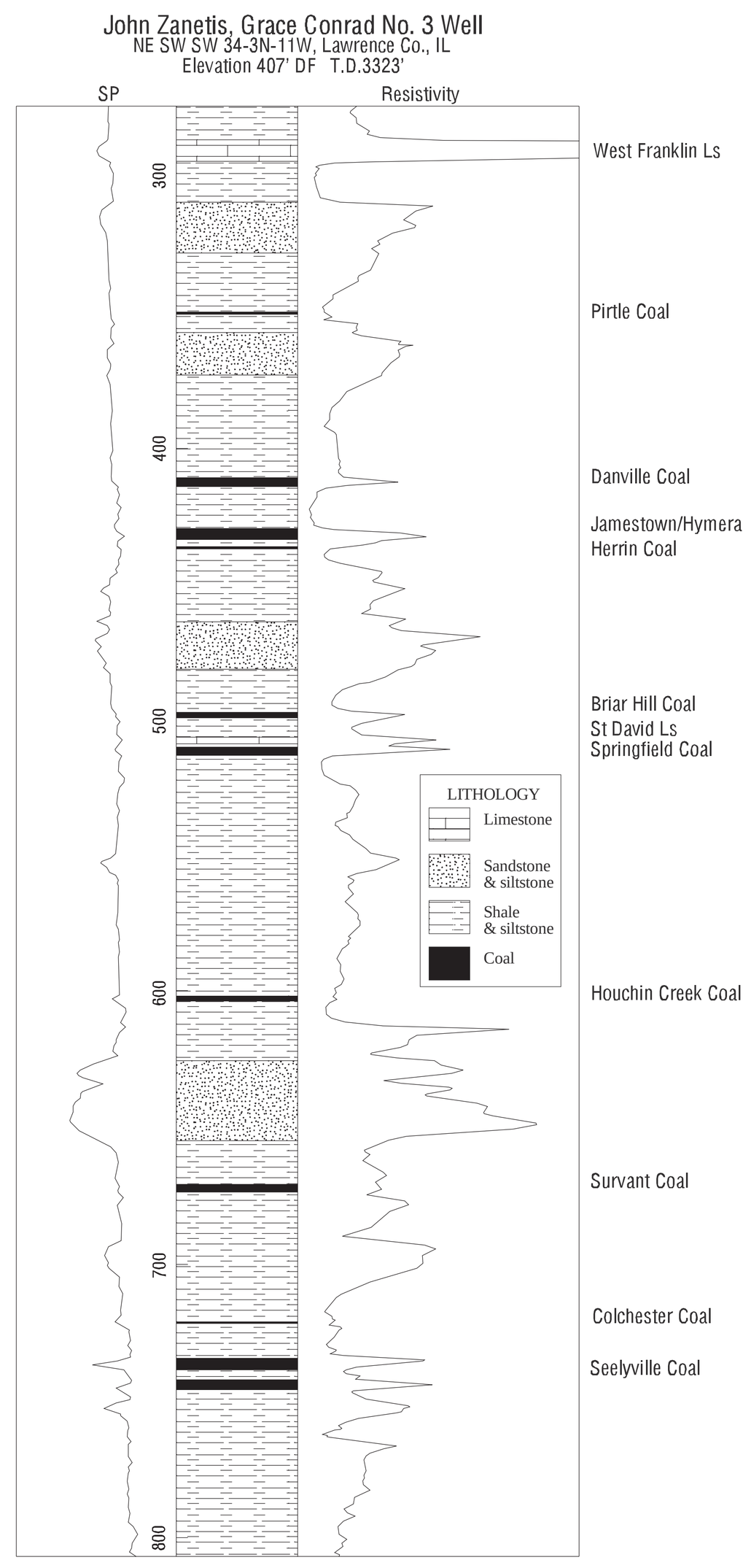

Figure 2. Stratigraphic Succession of Major Coals
Showing typical response of geophysical logs. (SP = Spontaneous Potential)

Previous Investigations

Resources of the Danville, Hymera, Springfield, and Survant Coals in Knox County Indiana, including the Indiana portion of the Vincennes Quadrangle, were previously mapped by Harper and Eggert (1995). No resources of the Seelyville Coal were mapped. Useful information on the Hymera and Survant Coals in Indiana can also be found in Harper (1994) and Harper (1988), respectively. Resources of the Danville, Jamestown, and Springfield Coals in Lawrence County Illinois, including the Illinois portion of the Vincennes Quadrangle were previously mapped by Treworgy and others (1997). Resources of the Seelyville Coal in Lawrence County were previously mapped by Treworgy (1981) and resources of the Survant Coal were mapped by Cady (1952).

Reliability of Resource Estimates

Coal resources for this study were re-mapped using additional data from geophysical logs from oil test holes in addition to the data used in previous studies. The reliability and accuracy of estimates of coal thickness vary depending on whether the information came from coal test logs or various combinations of geophysical logs (e.g. gamma/density, resistivity/self-potential). Measurements of coal thickness from cores can be precise to within fractions of an inch while estimates made from resistivity logs are generally only accurate to within plus/minus one foot. To identify the reliability of estimates, resources are classified as measured, indicated, or inferred based on the source of the data and distance between data points (Treworgy and Bargh 1982). Because of the relatively wide spacing between data points and the inaccuracies inherent in measuring coal thicknesses from many types of oil test geophysical logs, most of the resources mapped in this quadrangle are in the inferred category (table 1).

Table 1. Original coal resources in the Vincennes Quadrangle (millions of tons)

Coal seam	Measured	Indicated	Inferred	Total
Danville	8	39	228	275
Jamestown	8	42	202	252
Springfield	6	28	181	215
Survant	7	30	23	59
Seelyville	2	14	158	174
Total	30	153	792	975

Quality of Resources

The only analyses of coal quality in this area are from a core (HE-1) drilled in the southeastern quarter of the quadrangle (table 2). Additional information on coal quality can be predicted from regional patterns and geologic strata associated with the coals. Damberger (1971) showed that the rank of coals changes systematically across the Illinois Basin. Based on these trends, coals in the quadrangle are projected to straddle the high volatile B and C bituminous ranks; their inherent moisture contents are on the order of 11% and their heat contents are about 13,000 Btu per pound (on a moist, but mineral-matter free basis).

Table 2. Analyses of selected coals from Indiana Geological Survey drill hole HE-1(SDH 259). Moisture reported is on an air-dried basis. All other values are on a dry basis. All values are percent except for heat value which is Btu per pound.

	Danville	Hymera*	Springfield	Survant	Seelyville
Moisture	8.2	5.0	5.1	5.8	4.5
Ash	10.9	19.4	15.1	18.2	15.0
Volatile	35.6	40.0	31.5	31.6	36.0
Fixed Carbon	53.5	40.6	53.4	50.2	49.0
Sulfur	0.9	2.6	4.4	1.8	5.5
Heat Value	12,560	11,316	11,949	11,507	12,031

*Note: this sample includes both benches of the Hymera. These are equivalent to the Jamestown and Herrin in Illinois.

Many studies have shown that coals in the Illinois Basin overlain by marine rocks commonly have sulfur contents of 3% or higher while those overlain by non-marine rocks have lower sulfur contents, commonly in the range of 0.5 to 2.5% (e.g. Gluskoter and Simon 1968, Treworgy and Jacobson, 1986). Based on this observation, the Danville, Jamestown, and Survant Coals in the quadrangle are expected to have a medium to low sulfur content and the Springfield and Seelyville Coals to have a high sulfur content. The analyses of coals from the Indiana core are consistent with this prediction.

Resources Available for Mining

The Vincennes Quadrangle contains almost 1 billion tons of coal (table 1). When or whether these resources are mined depends, in part, on the availability and cost of mining these coals. Criteria for assessing the land use and technological factors that limit the availability of coals in the quadrangle were developed through interviews with engineers and geologists from companies actively mining in the Illinois Basin and are based on current technology and mining practices (table 3). Other important factors that affect whether a deposit is mined, but that are not included in this assessment, are the demand for coal, the supply of coal from other mines and the supply of competing fuels, environmental regulations, transportation infrastructure, coal quality, and land ownership. Future advances in mining technology or significant increases in the price of coal could alter the availability of resources for mining.

Table 3. Criteria used to delineate coal available for underground mining in the Vincennes Quadrangle

* Minimum seam thickness: 3.5 feet
* Minimum interval between seams: 40 feet
* Extractable tonnage of Danville Coal under sandstone channels reduced 25% due to erosion and adverse mining conditions.
* Minimum size of mining block: 80 million tons in place
* Land use restrictions
  No mining within 200 feet of:
  towns
  cemeteries
  churches
  selected highways

Danville Coal The Danville Coal is 3.5 to 5 feet thick throughout a large portion of the quadrangle (see *Thickness of the Danville Coal*). Thinner areas of coal are found near the southeast edge of the quadrangle and underlying and adjacent to a paleochannel that roughly bi-sects the quadrangle from southwest to northeast. The coal was mined from 1897 to 1907 at the Prospect Hill Mine at the city of Vincennes. No map of the workings is available; the mine outline shown represents the approximate area of mining. A total of 144,565 tons were produced (Weir and Powell 1967). The Danville Coal in this mine was described as "a solid coal of very irregular thickness, varying from 1.5 ft to 3.5 ft in thickness, with an average of about 3 ft or a little less. The coal is said to make a good deal of ash, but not to clinker" (Blatchley, 1898).

The Danville Coal is overlain by a sequence of shale, siltstone, and sandstone. These sediments are part of a large clastic wedge that was deposited after the peat was drowned by marine waters (Treworgy and Jacobson, 1986). Sandstone, probably fill from an ancient erosional channel, lies directly on the coal along a narrow, linear zone extending northeastward across the center of the quadrangle. Within this zone are local areas where the coal is thin, due probably to erosion. Drill holes are spaced too far apart to accurately delineate the extent of these eroded areas. Based on mining experience in similar settings in other parts of the Illinois Basin, mining conditions within this zone are expected to be more difficult than adjacent areas. Approximately 25% of the coal within this zone is projected to be at least partially eroded, too thin for mining, or have adverse mining conditions.

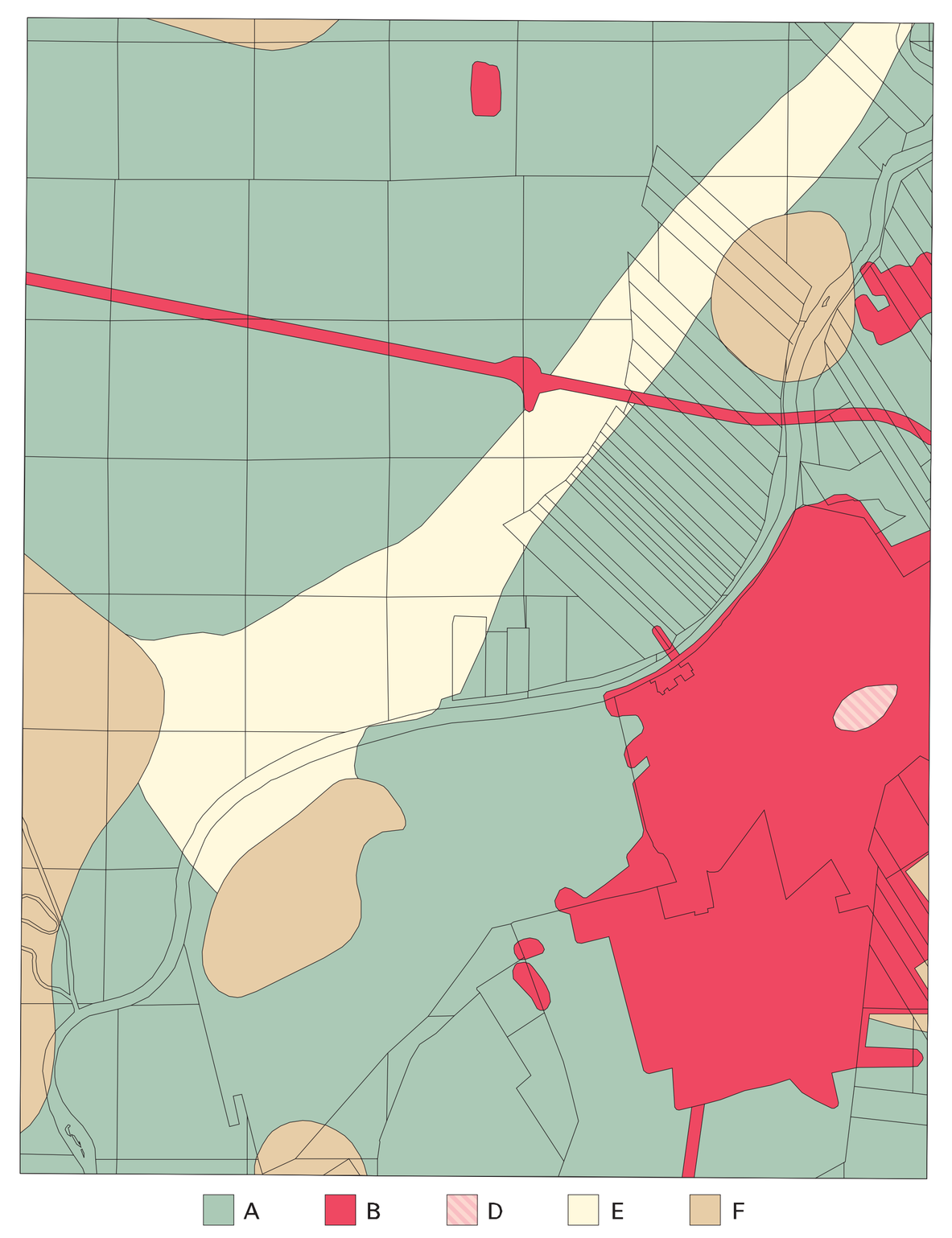

Figure 3. Availability of the Danville Coal

Table 4. Availability of coal resources for mining in the Vincennes Quadrangle; millions of tons and (percent of original resources). Note: all resources are underground minable. Numbers may not add to totals due to rounding.

	Danville	Jamestown	Springfield	Survant	Seelyville	Total
Original	275	252	215	59	174	975
Available	207 (75)	- -	77 (36)	- -	87 (50)	371 (38)
Mined out	0.4 (<1)	- -	- -	- -	- -	0.4 (<1)
Land use restriction	42 (15)	42 (17)	36 (17)	10 (18)	42 (24)	172 (18)
Technological restriction	26 (10)	211 (83)	101 (47)	48 (82)	45 (26)	432 (44)
Land use restrictions						
Towns	38 (14)	38 (15)	35 (16)	10 (17)	40 (23)	161 (17)
Highways	4 (1)	4 (1)	2 (1)	1 (1)	2 (1)	11 (1)
Technological restrictions						
Interburden	- -	171 (68)	- -	- -	- -	171 (18)
Block size	- -	15 (6)	18 (8)	44 (76)	9 (5)	87 (9)
Coal <42" thick	19 (7)	25 (10)	84 (39)	4 (6)	36 (21)	167 (17)
Adverse conditions	8 (3)	- -	- -	- -	- -	8 (1)

Original resources of the Danville Coal are 275 million tons (table 1). Of these resources, 207 million tons (75% of original resources) are estimated to be available for mining (fig. 3 and table 4). Land use, primarily development associated with the city of Vincennes, restricts the mining of 42 million tons (15%) and technological factors (coal less than 3.5 feet thick and adverse mining conditions) restrict 26 million tons (10%). About 0.4 million tons (<1%) have been mined, lost in mining, or left as pillars.

Jamestown, Herrin, and Hymera Coals The Hymera Coal is recognized throughout the Indiana coal field. In Knox County, including the Vincennes Quadrangle, it commonly is described as having two benches. Harper (1994) reports that throughout Knox County, the upper bench is commonly the thicker of the two; with an average thickness of 4.6 feet, while the thicknesses of the lower bench and parting average 1.6 and 2.7 feet, respectively. The upper bench, mapped in Illinois as the Jamestown Coal, is greater than 5.5 feet thick in the Vincennes Quadrangle, but thins to only a trace about 15 miles west of the stateline. The lower bench, correlated as the Herrin Coal, thickens to the west and is the largest resource in Illinois. The interval between these coals in the Vincennes Quadrangle ranges in thickness from 0.3 feet to about 4 feet and is commonly more than 1 foot thick. The interval is described in drillers logs as black shale, blue shale, lime, limestone, and shale and lime. Gamma/density logs in the quadrangle show a high gamma reading in this interval, characteristic of marine black shales. For this study, the Jamestown and Herrin Coals were treated as separate beds. The Jamestown Coal ranged from about 6 feet thick in the northwest quarter of the quadrangle to less than one foot thick in southern parts of the quadrangle (fig. 4a). No resources were mapped in this study for the Herrin Coal (i.e. lower bench of the Hymera) because the parting is too thick to allow economic mining of both seams as a single unit, consequently any underground mining is likely to be of the Jamestown Coal, the thicker of the two benches.

The interval between the Jamestown Coal and the overlying Danville Coal ranges from just over 10 feet to almost 40 feet thick and consists of shale, siltstone, sandstone, and claystone. At the Prospect Hill Mine, the Jamestown Coal was from 13 to 18 feet below the Danville. Although the Jamestown was thicker than the Danville at this location, it was not mined. Blatchley (1898) reported that the coal at this location was "so broken up and with such a soft roof as not to be workable." This thickness and composition of interburden is considered to be too weak to allow mining both the Danville and the Jamestown Coals. Because the Danville Coal has a lower sulfur and ash content, it is likely to be the preferred coal for mining wherever it is more than 3.5 feet thick.

Resources of the Jamestown Coal are 252 million tons (table 1). None of these resources are considered to be available for mining (fig. 4b and table 4). Land use restricts 42 million tons (17% of the original resources). Technological factors, the thin interburden between the Jamestown and the Danville Coal, thin coal, and small mining blocks, restrict 211 million tons (83%).

Springfield Coal The Springfield Coal is less than 3.5 feet thick throughout much of the Vincennes Quadrangle and is more than 4.5 feet thick in only a few test holes (fig. 5a). Resources of the Springfield Coal are 215 million tons (table 1). About 77 million tons (36% of the original resources) are considered to be available for mining (fig. 5b and table 4). Land use, primarily the city of Vincennes, restricts mining of 36 million tons (17%), and technological factors (thin coal and small mining blocks) restrict 101 million tons (47%).

Survant Coal Unlike the other coals mapped for this report, the Survant Coal is not consistently identifiable on oil-test resistivity logs. Consequently, the Survant Coal has been mapped in only a limited area using the information from coal test holes and gamma density logs from oil test holes (fig. 6). About 59 million tons of resources have been mapped (table 1). None are considered available for mining.

Seelyville Coal The Seelyville Coal commonly contains one or more partings in the middle or upper part of the seam that range in thickness from a few inches to several feet. Where less than a foot thick, partings may be difficult to identify or measure with a geophysical log. The thickness map of the Seelyville depicts minable coal thickness (fig. 7a). Where the coal was in two benches separated by a thin parting (less than about 1 foot), the total coal thickness was mapped. Where the parting was more than about 1 foot thick, only the thicker bench of coal was mapped. In the northern portion of the quadrangle, where the Seelyville consists of two or more thin benches of coal separated by partings 1 foot or more in thickness, the coal was mapped as less than 2.5 feet thick in this area. The coal is thicker and the partings thinner in the southern portion of the quadrangle.

Total resources of the Seelyville Coal are 174 million tons (table 1). Slightly more than 87 million tons (50% of the resources) are available for mining (fig. 7b and table 4). Land use restricts 42 million tons (24%) and seam thickness and block size restrict 45 million tons (26%).

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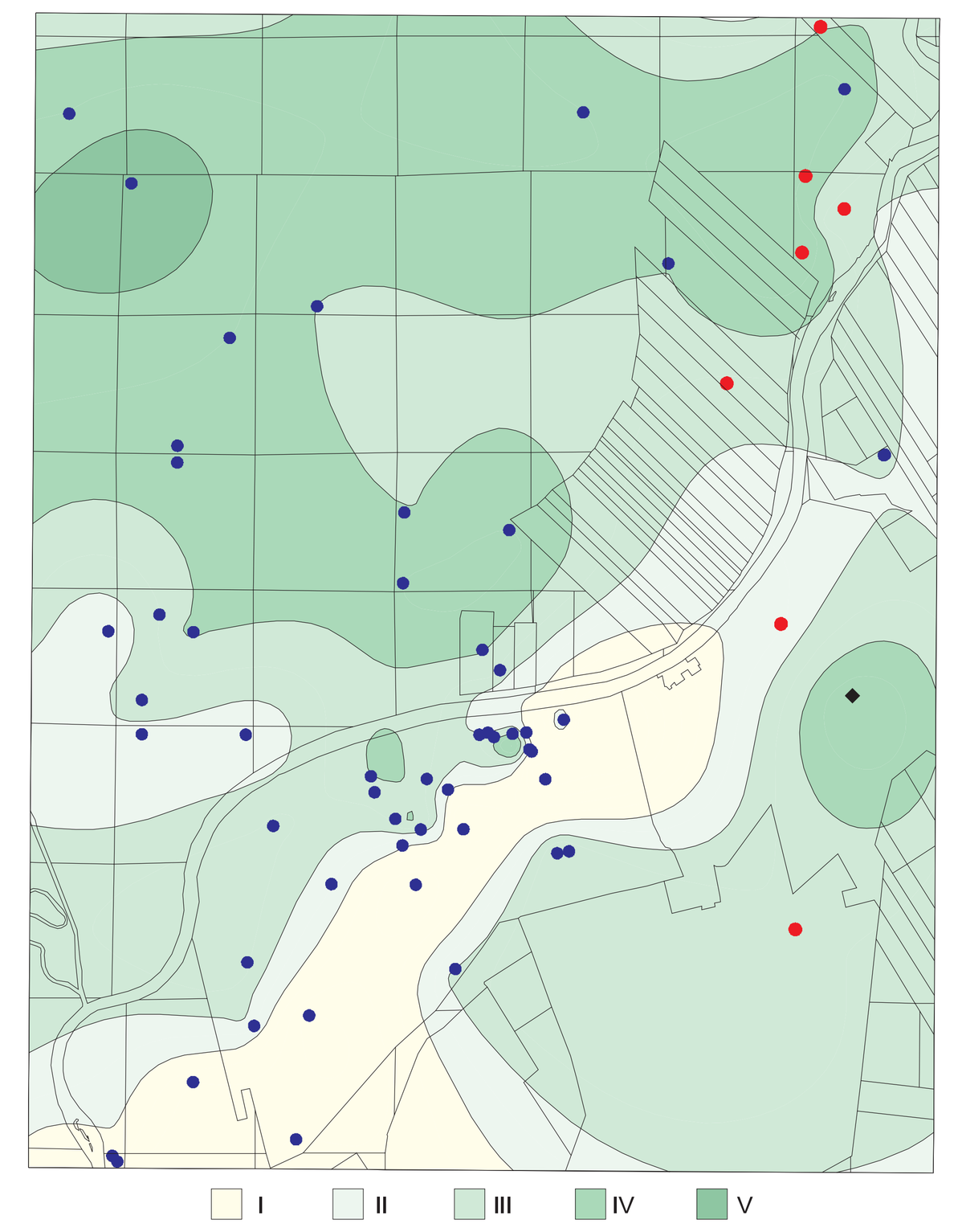

Figure 4a. Thickness of the Jamestown Coal

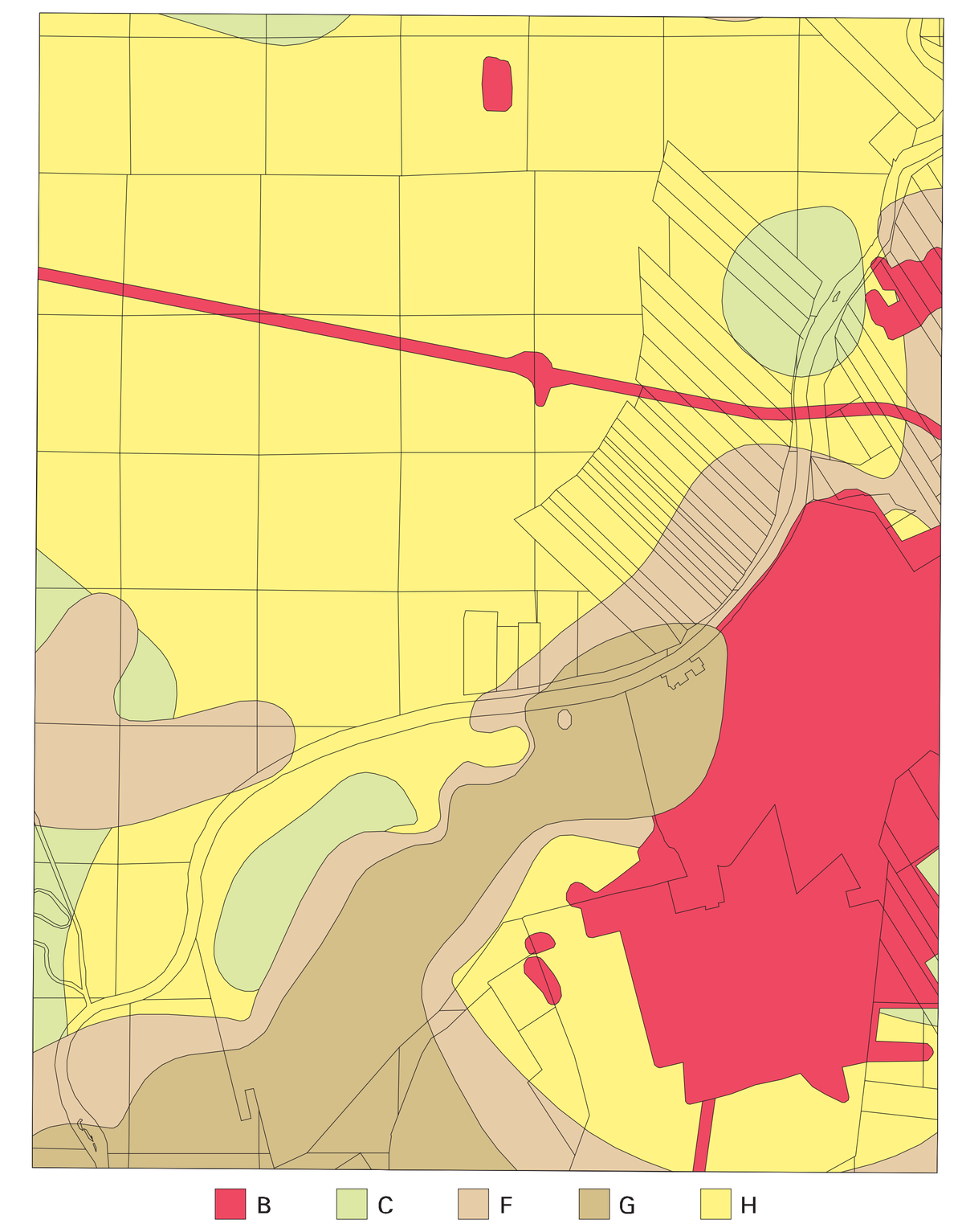

Figure 4b. Availability of the Jamestown Coal

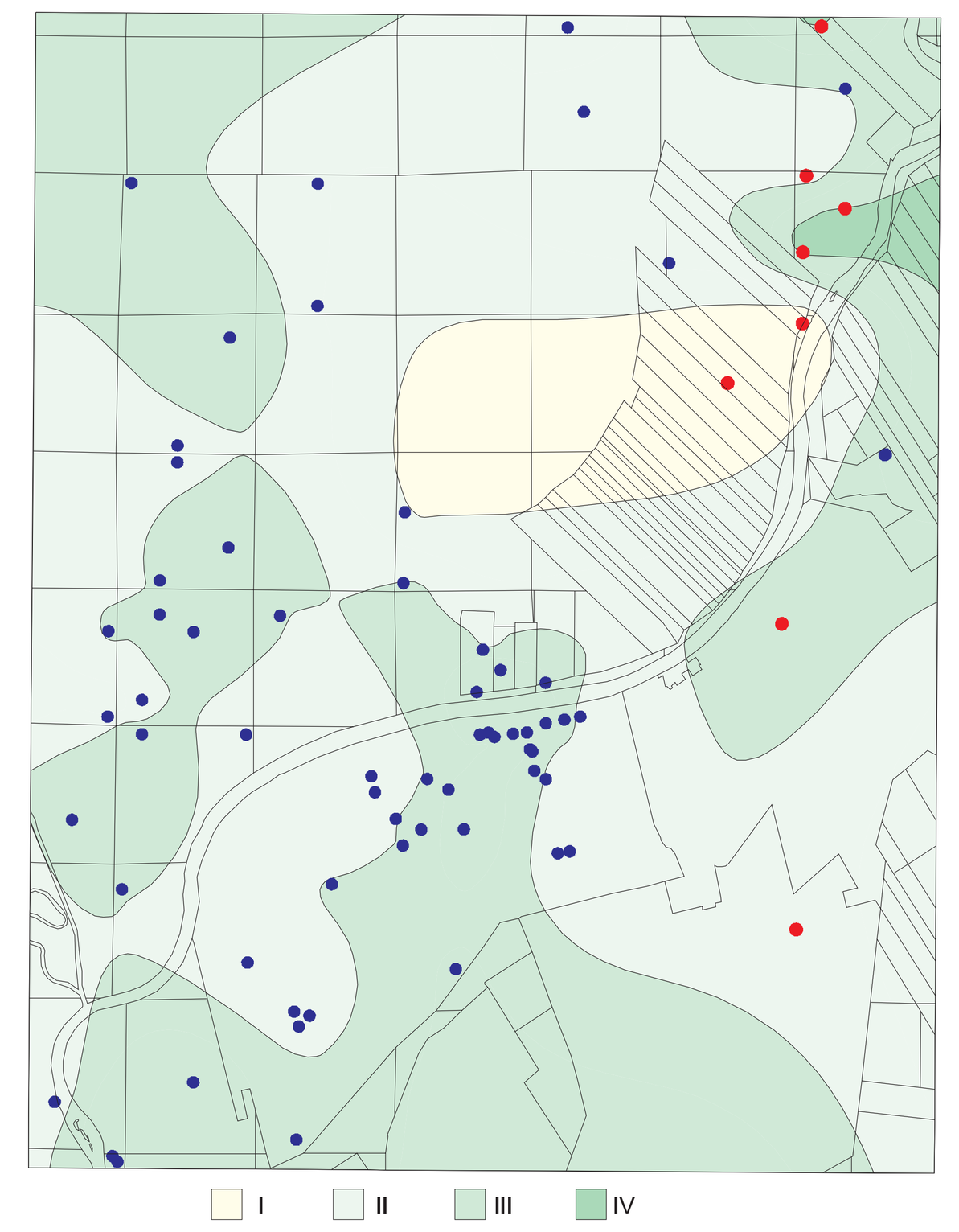

Figure 5a. Thickness of the Springfield Coal

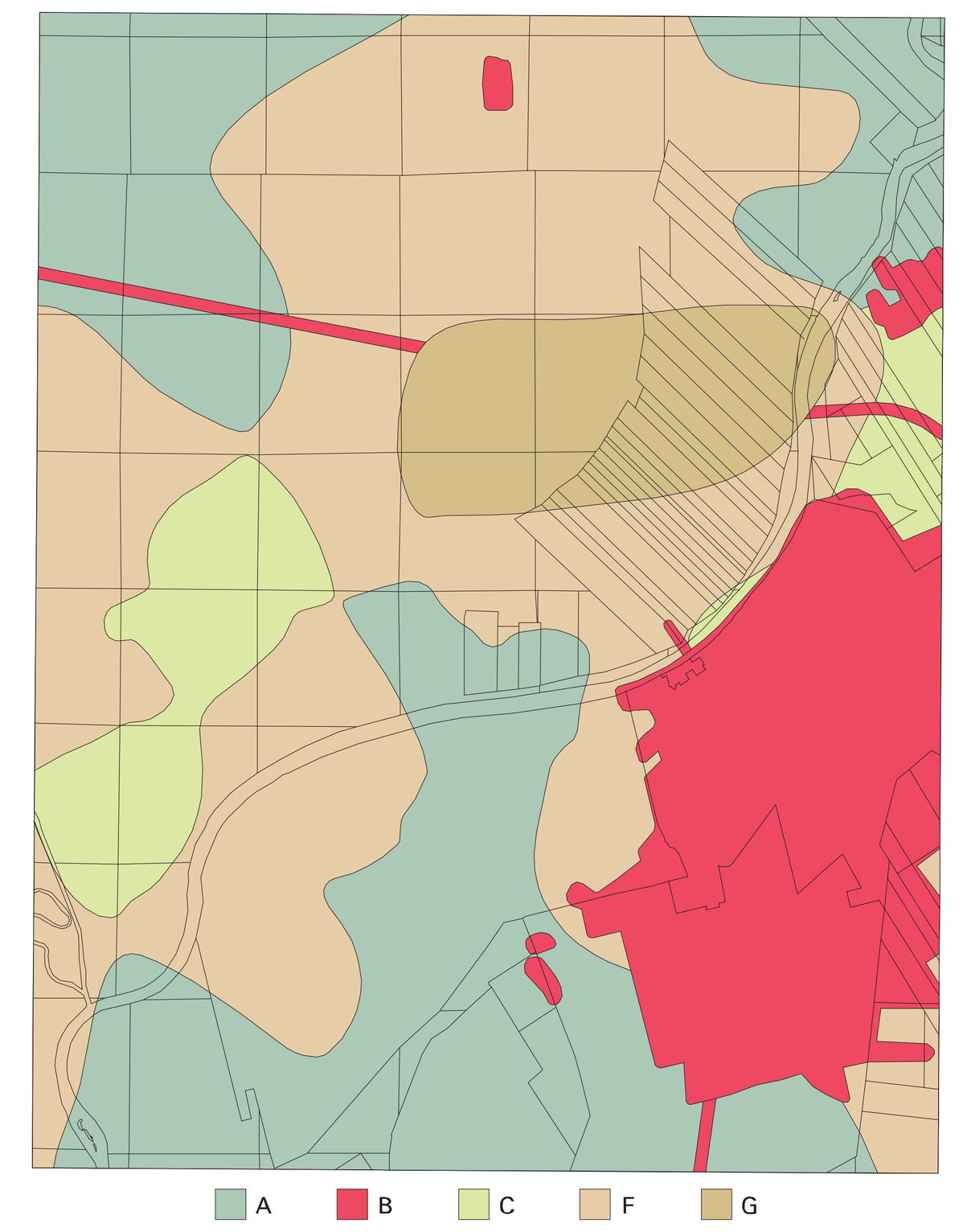

Figure 5b. Availability of the Springfield Coal

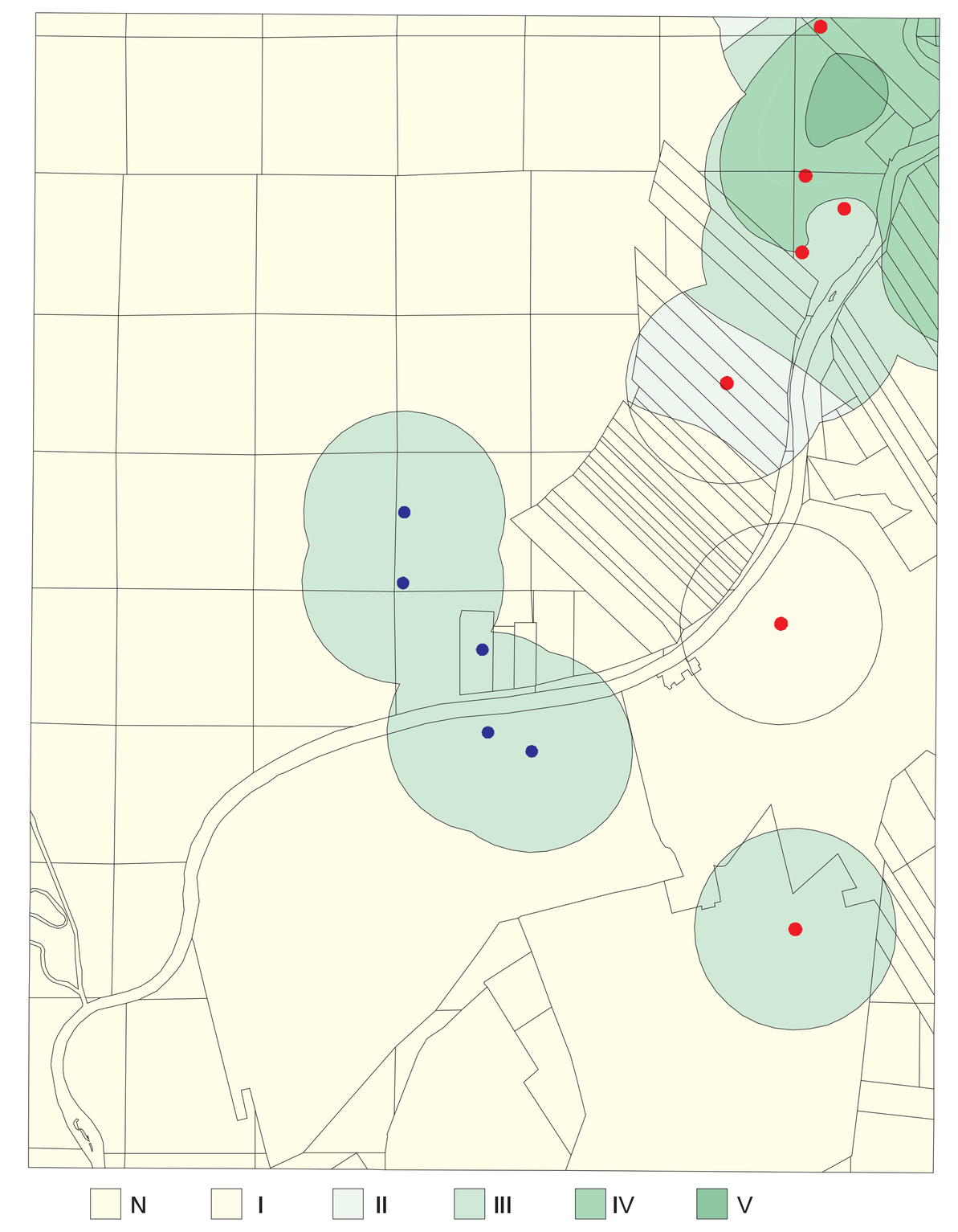

Figure 6. Thickness of the Survant Coal

Explanation of Coal Thickness (feet)	Explanation of Coal Availability
N - No Data	A - Available For Underground Mining
I - Less Than 2.5	B - Land Use Restriction
II - 2.5 to 3.5	C - Block Size Too Small
III - 3.5 to 4.5	D - Mined Out
IV - 4.5 to 5.5	E - Adverse Mining Conditions
V - Greater Than 5.5	F - Coal Less Than 3.5 Feet Thick
	G - Coal Less Than 2.5 Feet Thick
	H - Interval Between Seams Less Than 40 Feet

Scale of figs 1, 3 to 7: .75 inches = 1 mile

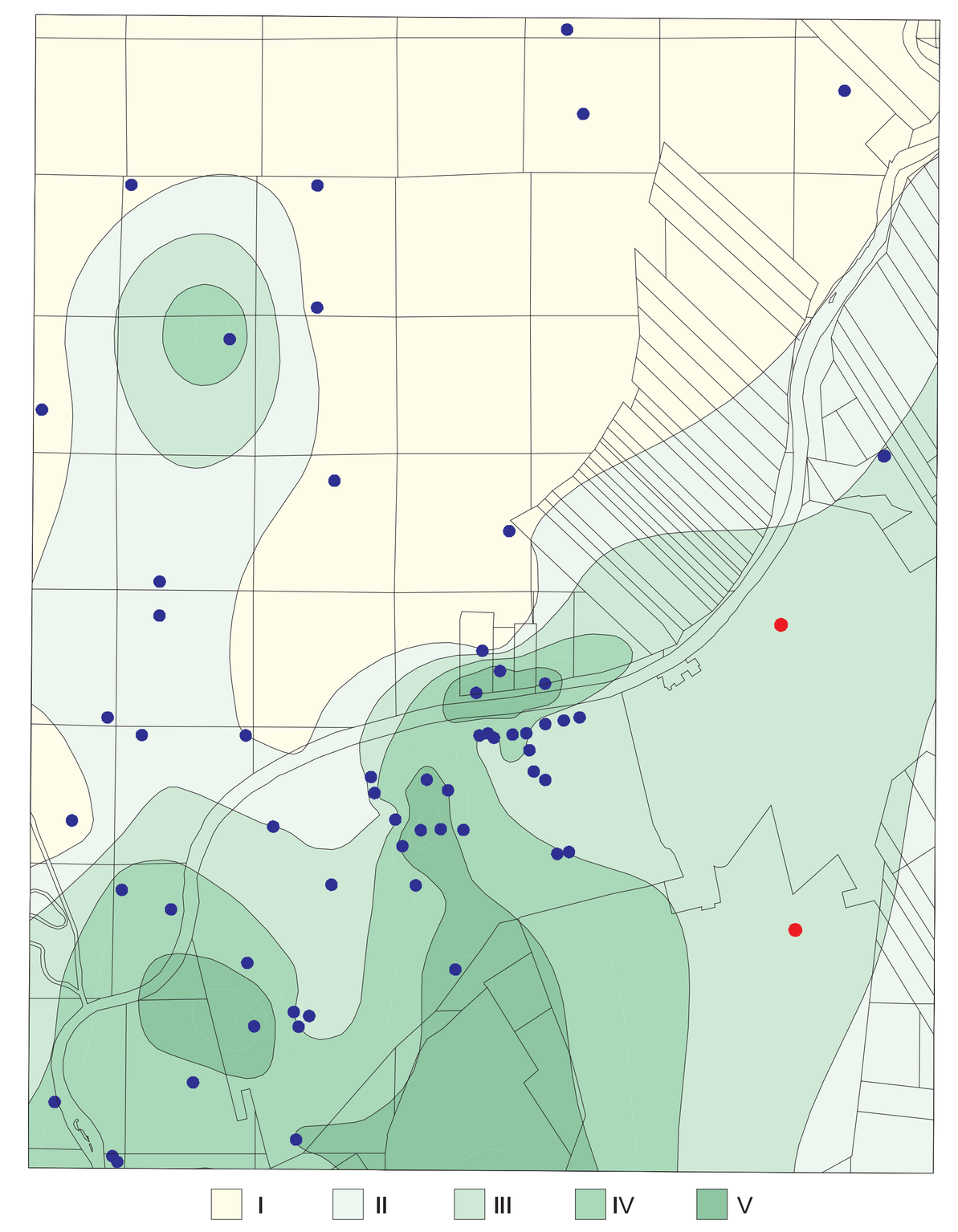

Figure 7a. Thickness of the Seelyville Coal

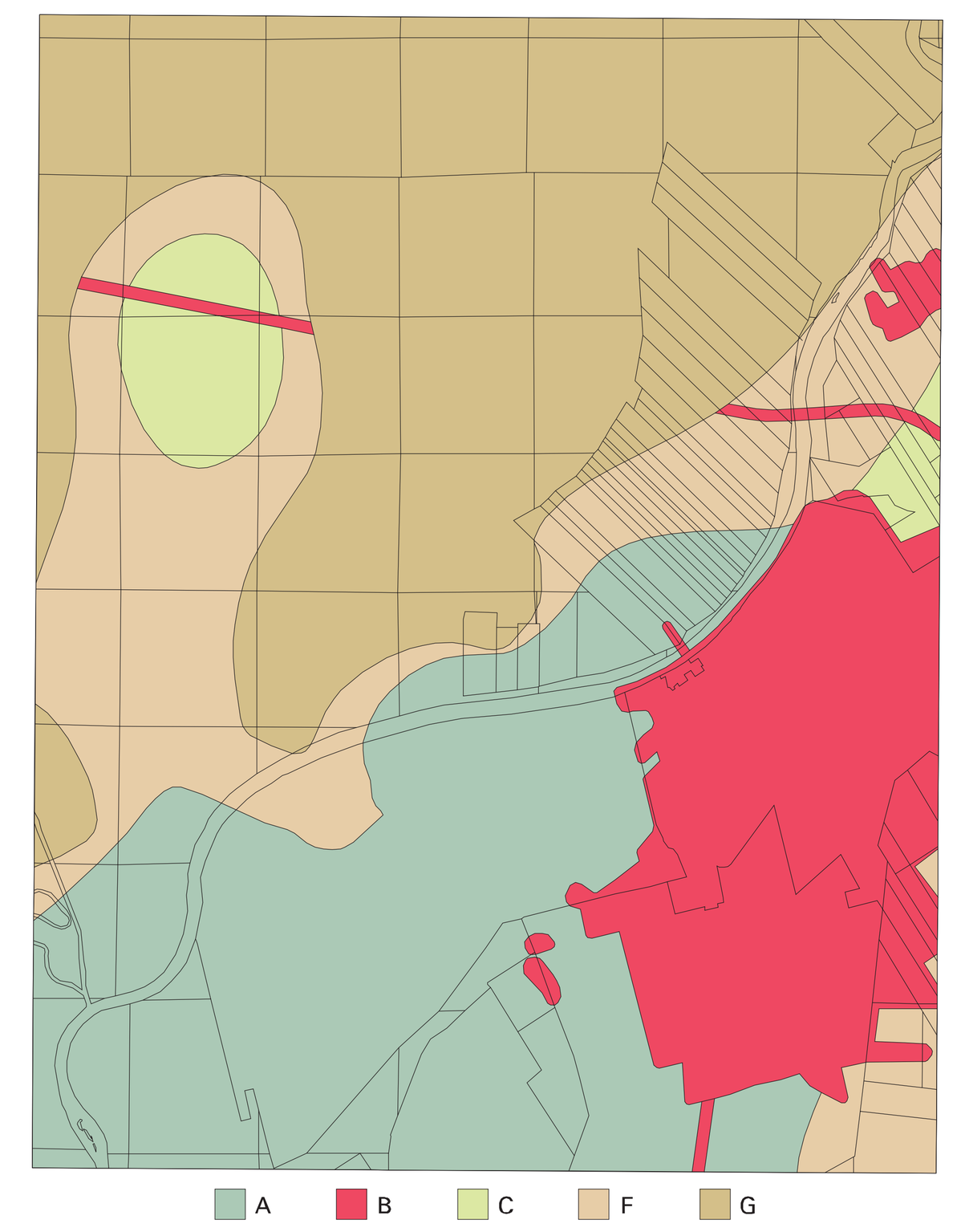

Figure 7b. Availability of the Seelyville Coal