DEPARTMENT OF NATURAL RESOURCES
STATE OF ILLINOIS
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief
Champaign, Illinois

For further information about this map contact:
Coal Section
Illinois State Geological Survey
615 East Peabody Drive
Champaign, IL 61820
(217) 244-2414

Availability of the Springfield Coal for Mining in Illinois

Map Summary of Illinois Minerals 118

Colin G. Treworgy, Christopher P. Korose, Cheri A. Chenoweth, and Daniel L. North

2000

Introduction

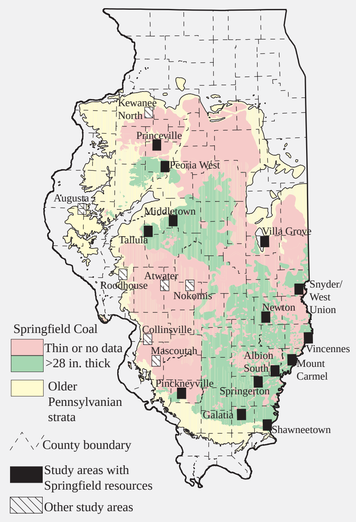
The 63 billion tons of Springfield Coal remaining in Illinois are the second largest coal resource in the state. They represent 97% of the 65 billion tons of original resources of Springfield Coal, the other 2 billion tons having been mined or lost in mining during the more than 100 years of mining Illinois coal. The degree to which this remaining resource is utilized in the future depends on the availability of deposits that can be mined at a cost that is competitive with other coals and alternative fuels.

This is a map summary of Illinois State Geological Survey publication *Illinois Minerals 118*. This map sheet identifies those resources that have the most favorable geologic and land use characteristics for mining, shows the probable trend of future mining of these resources, and alerts mining companies to geologic conditions that have a potentially negative impact on mining costs.

Geology and Minability

The Springfield Coal can be traced throughout the Illinois Basin. The coal crops out along the margins of the basin, but in much of the central and eastern part of the state, this outcrop is buried by tens to hundreds of feet of glacial and alluvial deposits. The coal dips toward the center of the basin in southeastern Illinois where it reaches a maximum depth of just over 1,300 feet. More than 13,000 square miles of Springfield Coal resources have been mapped in Illinois. Surface minable resources are at least 18 inches thick and less than 150 feet deep, and underground minable resources are at least 28 inches thick. The resources occur mostly in two regions: southeastern and central Illinois. The thickest resources (up to 10 feet thick) in southeastern Illinois commonly occur along and within several miles of the Galatia Channel, a river system that was contemporaneous with the ancient peat swamp in which the coal formed (Hopkins 1968, Hopkins et al. 1977). In addition to apparently influencing the coal thickness, the Galatia Channel affected the sulfur content and mining conditions of the coal. In central Illinois, the thickest deposits (up to 7 feet thick) are north and east of the city of Springfield.

This map is based on a series of studies that examined the availability of coal in Illinois for future mining. These studies assessed the availability of coal in 21 7.5-minute quadrangles that were representative of mining conditions found in various parts of the state. Factors that restrict availability of coal were identified through interviews with more than 40 mining engineers, geologists, and other mining specialists representing 17 mining companies, consulting firms, and government agencies active in the Illinois mining industry. The major geologic and land use factors that were found to limit surface and underground mining of the Springfield Coal are listed in the tables to the right and depicted in this statewide assessment of the availability of the Springfield Coal. The factors that are considered to restrict mining are divided into two categories: land use and technological. Other conditions that are unfavorable for mining, but don't necessarily limit it are listed in a third category: potential restrictions. The land use factors consist of various land uses that are in some cases specifically protected from mining, but in most cases are simply uneconomical to mine. The technological factors consist of geologic conditions that are likely to raise mining costs to uneconomical levels. A few of these factors are illustrated. A complete explanation of all factors is given in *Illinois Minerals 118*.



Location of quadrangles studied for available coal

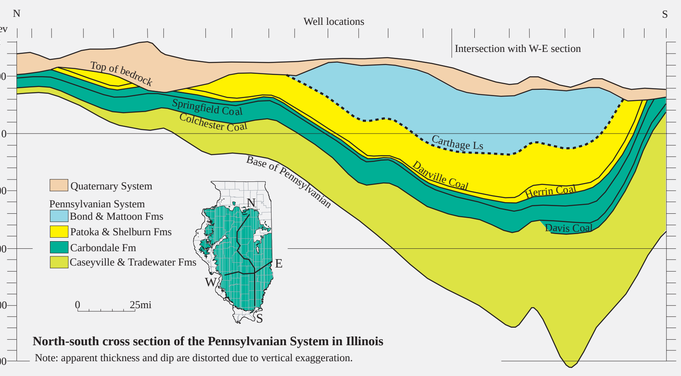
Criteria used to define resources available for underground mining

Technological restrictions	
Minimum seam thickness	42 in.
Minimum bedrock cover	75 ft
Minimum ratio of bedrock to unconsolidated overburden	1:1
Minimum interburden between minable seams	40 ft
Minimum size of mining block (clean coal)	40 million tons
Faults - width of zone of no mining on each side of fault	
Cottage Grove Fault System	
Master fault	500 to 1000 ft
Subsidiary faults	100 ft
Rend Lake Fault Zone	200 ft
Centralia Fault Zone	300 ft
Wabash Valley Fault System	800 ft
Galatia Channel	no mining within 0.5 mi
Land use restrictions (width of unminable coal around feature)	
Surface and underground mines:	200 ft
Towns	0 ft*
Public lands	100 ft
Interstate highways	100 ft
Major airports	100 ft
Dams	100 ft
Closely spaced oil wells (>7 wells per 40 acres)	**
Potential restrictions	
Closely spaced oil wells	4-7 wells per 40 acres
Bedrock cover	75-100 ft
Dykersburg Shale	Transition zone at edge of deposit
Potential land use conflicts	Areas where land use patterns are incompatible with mining.

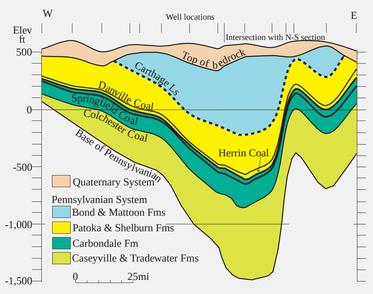
*Actual setback depends on depth, coal thickness, and mining method. Because the municipal boundaries used are commonly larger than the actual developed area, we did not use any buffer around towns. Resources underlying towns are unminable.
**Actual setback is dependent on site-specific factors including depth of coal and age and operational status of the oil well. We have delineated the approximate areas that will be restricted from mining.

Criteria used to define resources available for surface mining

Technological restrictions	
Minimum seam thickness	18 in.
Maximum depth	200 ft
Maximum unconsolidated overburden	60 ft
Stripping ratio (cubic yards of overburden/ton of raw coal; volumes and weights not adjusted for swell factors or cleaning losses)	
Maximum	25:1
Maximum average	20:1
Minimum size of mine reserve (clean coal)	
Cumulative tonnage needed to support a mine and preparation plant	10 million tons
Individual block size (thousands of tons)	
Less than 50 ft of overburden	150
More than 50 ft of overburden	500
Land use restrictions (width of unminable coal around feature)	
Underground mines	200 ft
Towns	0.5 mi
Public lands	100 ft
Railroads	100 ft
Federal & state highways	100 ft
Major airports	100 ft
Pipelines	100 ft
Potential restrictions	
Potential land use conflicts	All otherwise available surface minable coal in areas where land use is incompatible with mining.



North-south cross section of the Pennsylvanian System in Illinois
Note: apparent thickness and dip are distorted due to vertical exaggeration.



East-west cross section of the Pennsylvanian System in Illinois
Note: thickness and dip are distorted due to vertical exaggeration.

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Treworgy, C.G., E.I. Prussen, M.A. Justice, C.A. Chenoweth, M.H. Bargh, R.J. Jacobson, and H.H. Damberger, 1997, Illinois Coal Reserve Assessment and Database Development: Final Report, Illinois State Geological Survey Open File Series 1997-4, 105 p.

See also the list of reports on available coal resources.

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Treworgy, C. G., 1999, Coal Resources Map and Availability of Coal for Mining, Villa Grove Quadrangle, Douglas County, IL: Illinois State Geological Survey IGQ Villa Grove-CR.

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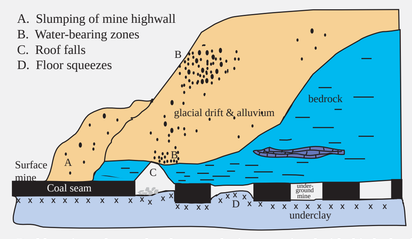
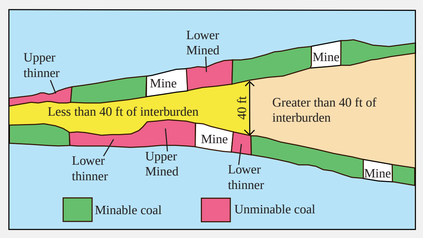
Report on the Availability of the Springfield Coal

Treworgy, C.G., C.P. Korose, C.A. Chenoweth, and D.L. North, 1999, Availability of the Springfield Coal for Mining in Illinois: Illinois State Geological Survey, Illinois Minerals 118, 43 p.



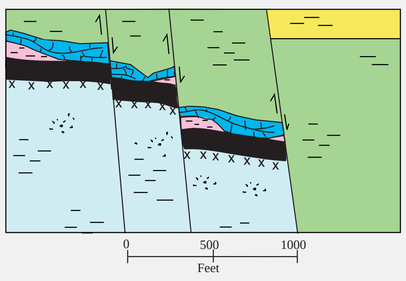
Problems in surface and underground mines associated with thin bedrock cover overlain by thick unconsolidated sediments

Slumping of the highwall and excess inflows of water may be encountered in surface mines with more than about 60 feet of unconsolidated overburden. Roof falls, floor squeezes, and water inflows may be experienced in underground mines with less than 100 feet of bedrock cover or a bedrock to unconsolidated overburden ratio of less than 1:1.



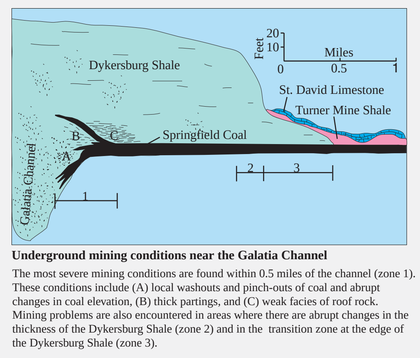
Effect of interburden thickness on underground mining

In areas where the interburden between two seams is less than 40 feet thick, only one of the two seams can be mined. The thinner of the two seams is considered unminable.



Cross section illustrating multiple, parallel faults displacing a coal seam

Many fault zones consist of multiple parallel faults with varying amounts of displacement. Although mines can mine through the zones, most companies find it uneconomical to mine past the first or second displacement encountered.

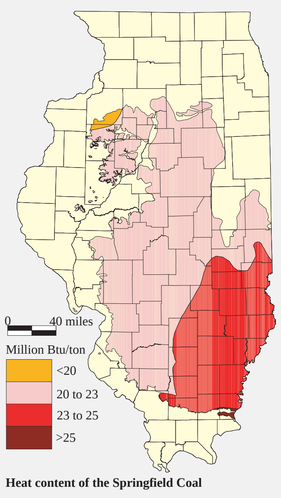


Underground mining conditions near the Galatia Channel

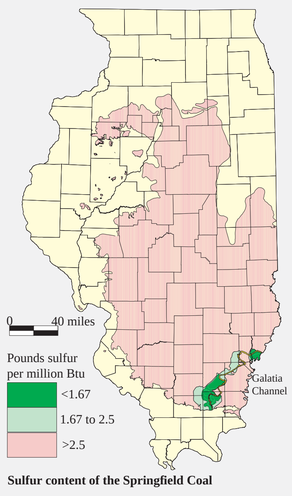
The most severe mining conditions are found within 0.5 miles of the channel (zone 1). These conditions include (A) local washouts and pinch-outs of coal and abrupt changes in coal elevation, (B) thick partings, and (C) weak facies of roof rock. Mining problems are also encountered in areas where there are abrupt changes in the thickness of the Dykersburg Shale (zone 2) and in the transition zone at the edge of the Dykersburg Shale (zone 3).

Quality

The Springfield Coal is a high volatile bituminous coal that ranges from rank A in the southeastern corner of the state to rank C in the northwestern two-thirds of the state. Heat content ranges over the same area from more than 25 million Btu per ton to less than 20 million Btu per ton, which is equivalent to more than 12,500 Btu per pound to less than 10,000 Btu per pound (as-received basis, ar). Ash is commonly in the range of 9 to 12% (ar); slightly lower ash content is reported in the southeastern part of the state. The sulfur content of the coal is commonly more than 2.5 pounds per million Btu, which is equivalent to 3 to 5% (dry basis), except for areas in southeastern Illinois associated with the Galatia Channel. In these areas, the sulfur content of the coal is as low as less than 1 pound of sulfur per million Btu (about 1% sulfur). Chlorine content of the coal is loosely correlated to depth and increases from less than 0.1% (dry basis) at shallow depths along the margins of the basin to greater than 0.6% in the central part of the basin (Chou 1991).



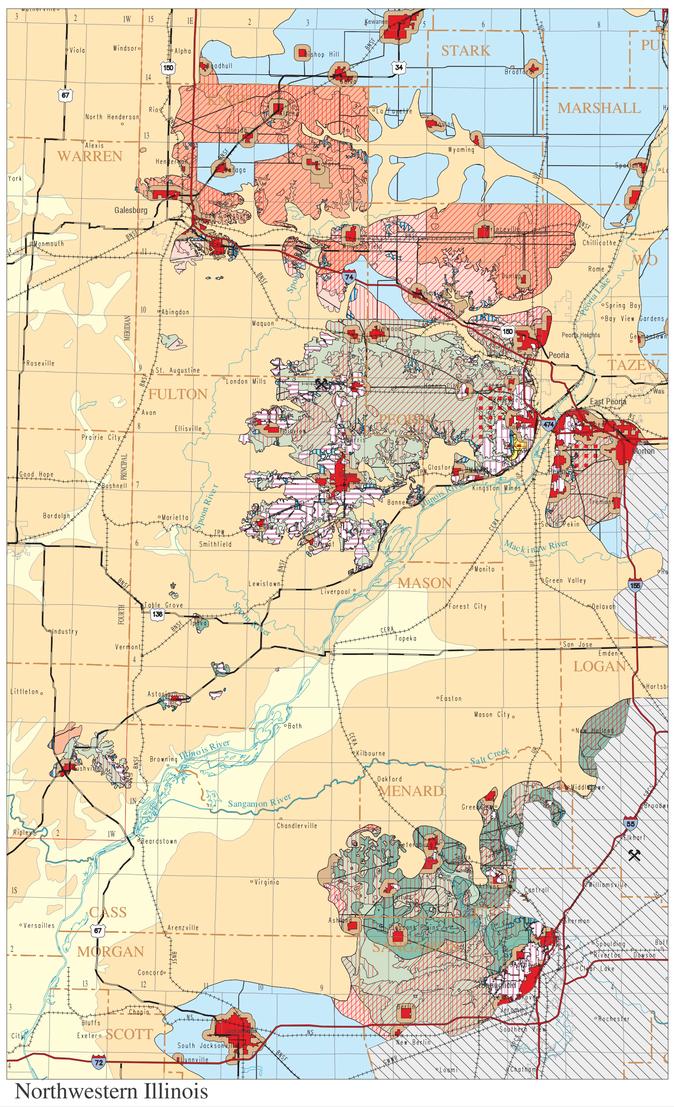
Heat content of the Springfield Coal



Sulfur content of the Springfield Coal

Surface Mining

The areas of available surface minable coal are limited in tonnage and areal extent. Towns, high stripping ratios, and thick unconsolidated overburden restrict mining of significant quantities of resources. Future surface mining operations will be smaller in size and production relative to past operations and will use mobile equipment that can be easily moved to another site.

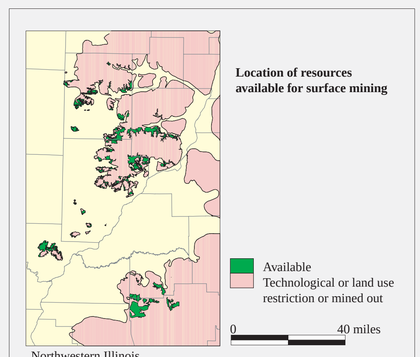


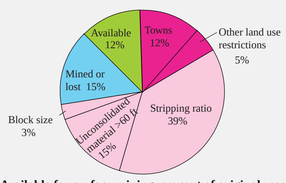
Northwestern Illinois

Map locations

Resources available for surface mining, millions of tons and percent of original resources

Original	**7,804**
Mined (percent of original)	**1,148 (15)**
Remaining (percent of original)	**6,655 (85)**
Available	**920 (12)**
Available w/ potential restrictions	**15 (<1)**
Potential land use conflict	15 (<1)
Land use restrictions	**1,247 (16)**
Towns	909 (12)
Roads	65 (1)
Pipelines	62 (1)
Public lands	39 (<1)
Railroads	39 (<1)
Underground mines	131 (2)
Airports	2 (<1)
Major dams	<1 (<1)
Technological restrictions	**4,472 (57)**
Stripping ratio	3,064 (39)
Thick unconsolidated material	1,195 (15)
Block too small	214 (3)





Available for surface mining, percent of original resources

Factors influencing the availability of coal for surface mining

COAL THICKNESS
- Greater than 66 inches
- 42 to 66 inches
- 28 to 42 inches
- Less than 28 inches
- Insufficient data
- Sandstone channel

MINED AREAS
- Mined area: Surface
- Mined area: Underground
- Active mine

SURFACE FEATURES
- Stream or small river
- Large river, lake

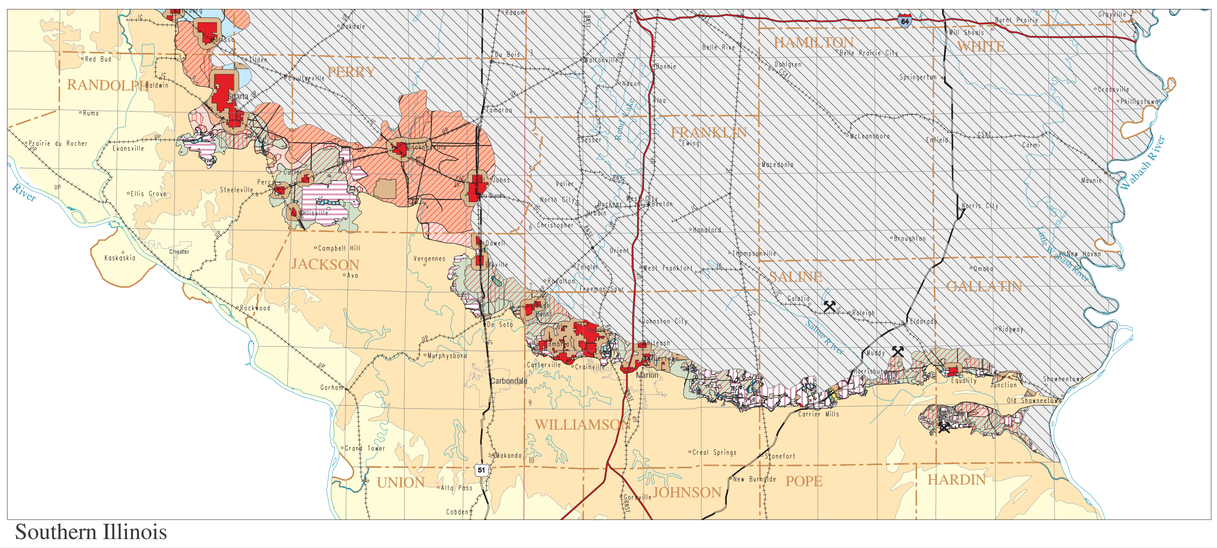
OTHER GEOLOGIC FACTORS
- Rocks of Pennsylvanian System eroded
- Extent of rocks of Pennsylvanian System

POTENTIAL RESTRICTIONS
- Potential land use conflict

LAND USE RESTRICTIONS
- Town restrictive to mining
- Land use restriction (see table above)
- U.S. Highway
- Interstate
- Railroad
- Pipeline

TECHNOLOGICAL RESTRICTIONS
- Coal depth greater than 200 feet
- Average stripping ratio greater than 25
- Unconsolidated overburden thickness greater than 60 feet
- Mining block too small

Scale 1:500,000
0 40 miles
0 40 kilometers



Southern Illinois

Resources

Approximately 41% of the original Springfield resources (27 billion tons) are available for mining. Available means that the surface land use and geologic conditions related to mining of the deposit (e.g. thickness, depth, in-place tonnage, stability of bedrock overburden) are comparable to those for other coals currently mined in the state. Of these resources, 23 billion tons are 42 to 66 inches thick, and 4 billion tons are greater than 66 inches thick. An additional 2.6 billion tons of the Springfield resources are available but have geologic or land use conditions that may make them less favorable for mining. Technological factors (geologic conditions and engineering parameters such as size of reserve block) restrict mining of 47% of the resources, and land use (e.g., towns, highways) restricts mining of 5% of the resources.

Most of the Springfield Coal resources have greater than 2.5 pounds of sulfur per million Btu and are only suited for the high-sulfur coal market. Only 1.4 billion tons of the remaining Springfield resources have a sulfur content of 0.6 to 1.7 pounds of sulfur per million Btu. However, the majority of these medium to low sulfur resources (1 billion tons) are classified as available or available with potential restrictions. Technological factors, such as geologic conditions associated with faults and channels, are the primary restrictions on mining these lower sulfur deposits.

Only about 8 billion tons of the original Springfield resources are less than 200 feet deep and potentially minable by surface methods. Of these resources, 15% have already been mined and 12% (just under 1 billion tons) are available for surface mining. Land use, primarily towns, restricts 16% of the resources. Technological factors, primarily stripping ratio and thick unconsolidated material, restrict 57% of the resources.

Most of the available Springfield resources will have to be mined by underground methods. Of the original resources that are at least 75 feet deep, 41% are available for underground mining. An additional 4% are available but with potential restrictions that make the resources less desirable. These potential restrictions are the presence of closely spaced oil wells, less stable roof strata, or close proximity to developing urban areas. The major technological factors that restrict mining are thin interburden between the Springfield Coal and an overlying seam, unfavorable thicknesses of bedrock and unconsolidated overburden, and coal less than 42 inches thick. Land use restricts underground mining of 5% of the resources, and 3% have already been mined or lost in mining.

The available resources are primarily located in the central and southeastern portions of the state and are well suited for high-efficiency longwall mining. The resources are relatively flat-lying with a consistent seam thickness over large areas; relatively free of faults, channels, or other geologic anomalies; located predominantly in rural areas free from oil wells and other surface development; and occur in minable blocks of hundreds of millions of tons. Whether or not the resources are ultimately mined depends on a variety of other factors that have not been assessed, including willingness of local landowners to lease the coal, demand for a particular quality of coal, transportation infrastructure, proximity of the deposit to markets, and cost and availability of competing fuels.

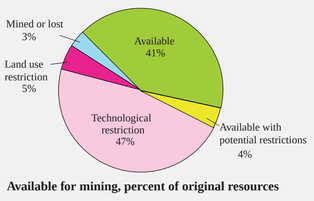
Remaining resources by county and availability by mining method (millions of tons)

	Remaining resources	Total available	Available by mining method: Surface	Underground
Cass	138	<1	<1	-
Christian	1,233	399	-	399
Clark	1,664	989	-	989
Clay	1,996	1,237	-	1,237
Clinton	99	-	-	-
Coles	1,081	411	-	411
Crawford	1,278	160	-	160
Cumberland	1,315	36	-	36
DeWitt	1,496	308	-	308
Douglas	459	-	-	-
Edgar	776	292	-	292
Edwards	1,121	411	-	411
Effingham	2,181	848	-	848
Fayette	2,288	345	-	345
Ford	41	-	-	-
Franklin	2,066	1,211	-	1,211
Fulton	656	250	187	68
Gallatin	1,264	924	8	918
Hamilton	2,426	1,780	-	1,780
Jackson	243	153	30	125
Jasper	2,139	104	-	104
Jefferson	2,879	1,961	-	1,961
Knox	627	125	123	2
Lawrence	1,499	738	-	738
Livingston	214	-	-	-
Logan	2,807	1,575	-	1,575
McLean	3,956	176	-	176
Macon	2,383	1,898	-	1,898
Marion	2,490	1,512	-	1,512
Menard	1,151	268	62	206
Morgan	39	-	-	-
Moultrie	66	42	-	42
Peoria	1,368	407	99	315
Perry	323	107	32	75
Piatt	1,250	292	-	291
Randolph	179	60	60	-
Richland	1,702	1,290	-	1,290
Saline	824	445	4	441
Sangamon	3,078	1,663	225	1,464
Schuyler	105	59	59	-
Shelby	1,958	692	-	692
Tazewell	458	-	-	-
Wabash	1,097	520	-	520
Warren	1	<1	<1	-
Washington	38	10	-	10
Wayne	2,956	1,594	-	1,594
White	2,403	1,196	-	1,196
Williamson	888	498	30	469
Woodford	257	-	-	-
Total	62,953	26,986	920	26,109

Availability of the Springfield Coal for mining, billions of tons

Numbers in parentheses are percent of original resources. Note: surface and underground resources do not add to total because coal 75 to 200 feet deep is included in both categories.

	Total	Mining method: Surface	Underground	Pounds of sulfur/mill. Btu: <1.67	>1.67
Original	65.1	7.8	63.0	1.8	63.3
Mined	2.2 (3)	1.1 (15)	1.8 (3)	0.4 (23)	1.8 (3)
Remaining	63.0 (97)	6.7 (85)	61.2 (97)	1.4 (77)	61.5 (97)
Available	27.0 (41)	0.9 (12)	26.1 (41)	0.8 (46)	26.2 (41)
Available with potential restrictions	2.6 (4)	<0.1 (<1)	2.6 (4)	0.2 (12)	2.4 (4)
Technological restrictions	30.1 (47)	4.5 (57)	29.4 (47)	0.3 (16)	29.9 (47)
Land use restrictions	3.2 (5)	1.2 (16)	3.0 (5)	<0.1 (4)	3.1 (5)



Available for mining, percent of original resources