SCALE 1:100 000

universal transverse Mercator projection, zone 16: 1927 North American datum

TOPOGRAPHIC CONTOUR INTERVAL 10 METERS

Limestone

89° 88° 87° 86° 85° 84° 83°

DRIPPING SPRINGS ESCARPMENT

Ste. Genevieve Limestone

St. Louis Limestone

Salem and Warsaw Limestones

Beech Creek Limestone and

Cypress Formation

Bethel Sandstone

Locations of the 30 x 60 minute quadrangles covering Kentucky. The

location of the Bowling Green quadrangle is highlighted in blue.

This version of the geology of the Kentucky portion of the Member of the Jeffersonville Limestone, Clear Creek Formation, Bowling Green 30 x 60 minute quadrangle was digitally compiled Decatur Limestone, Brownsport Group, Dixon and Lego from U.S. Geological Survey 7.5-minute geologic quadrangle Members of the Louisville Limestone, Laurel Dolomite, and maps (GQ's), as cited in the references. The GQ's are products Brassfield Dolomite (Schwalb and others, 1972). Many wells of a cooperative mapping project between the U.S. Geological still operating throughout the quadrangle have low production Survey and the Kentucky Geological Survey from 1960 to 1978. levels, after initial high production rates. The major producing The stratigraphy of the Mississippian rocks has been described horizons in the different parts of the Bowling Green quadrangle

Rock asphalt, also known as tar sand, crops out in the Homer

.5-minute guadrangle in the northwestern part of the Bowling

Green 30 x 60 minute quadrangle. Two units contain lenticular

rom youngest to oldest, the Hardinsburg Sandstone and Big

Clifty Sandstone Member of the Golconda Formation. A "tar

spring" flows from the base of the Hardinsburg Sandstone, and

tar sand deposits are believed to occur in the Hardinsburg

Sandstone in the Homer 7.5-minute quadrangle (Noger, 1999)

Big Clifty Sandstone Member of the Golconda Formation in

e Lewisburg, Homer, and South Union 7.5-minute quadrangles.

he heavy oil resources were estimated in 1984 by the Interstate

Oil Compact Commission (Noger, 1999) (Table 1). In the past,

some of this rock asphalt has been used for paving roads; in

**Table 1.** Tar sand resource estimates (million barrels) for the

Bowling Green quadrangle. From Noger (1999).

Gravel deposits occur in the southwestern, central, and

found in river beds and have been used in the past for secondary

roads. The Hardinsburg Sandstone in the Lewisburg 7.5-minute

quadrangle and the Big Clifty Sandstone Member of the

Golconda Formation in the Auburn 7.5-minute quadrangle have

The Hardinsburg Sandstone has also been quarried for use

Deposit or Formation Measured High-End Yields Conditions

5 gal/min

Geologic hazards related to karst are common in the Bowling

Green quadrangle because of the numerous caves and solution

ppenings in the soluble limestone bedrock (Currens, 2002).

he most common hazards are collapse sinkholes and sinkhole

looding. Cover-collapse sinkholes and surface subsidence are

frequent in the Girkin Formation, Ste. Genevieve Limestone.

St. Louis Limestone, and the Salem and Warsaw Limestones

in this quadrangle, and occur in the soil or other loose material

by cave roof failure is known to occur in this region, but is rare.

Sinkhole flooding occurs when there is more precipitation than

carrying water are blocked with trash or rock fall. Since many

sinkholes are too broad to view all at once, it may not be

obvious that a site is in a flood-prone closed depression.

Consulting topographic maps and inspecting the area carefully

for previous water damage may identify sinkhole flooding

potential. To protect from flooding and collapse hazards,

The permanent pool elevation of Barren River Lake is 160

Vectorized Geologic Quadrangle Data DVGQ-420. Adapted from Moore, S.L., 1965, Geology of the Hickory Flat quadrangle

Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologi Quadrangle Data DVGQ-251. Adapted from Haynes, D.D., 1963

Survey Geologic Quadrangle Map GQ-251, scale 1:24,000.

Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorize Geologic Quadrangle Data DVGQ-275. Adapted from Klemic, H

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quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-235, scale 1:24,000.

Kentucky-Tennessee: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-281. Adapted from Shawe, F.R., 1963, Geology of the Franklin quadrangle, Kentucky-

Tennessee: U.S. Geological Survey Geologic Quadrangle Map GQ-281, scale 1:24,000. Thompson, M.F., 2003c, Spatial database of the Meador quadrangle

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Shawe, F.R., and Rainey, H.C., III, 1965, Geologic map of the Prices Mill quadrangle, Kentucky-Tennessee: U.S. Geological

Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-309. Adapted from Rainey, H.C., III, 1964, Geology of the Rockfield quadrangle, Kentucky:

.S. Geological Survey Geologic Quadrangle Map GQ-309, scale

Survey Geologic Quadrangle Map GQ-449, scale 1:24,000.

hompson, M.F., 2003f, Spatial database of the Rockfield quadrangle

'hompson, M.F., 2003g, Spatial database of the Woodburn quadrangle, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-280. Adapted from Shawe, F.R.,

Toth, K.S., 2003a, Spatial database of the Adairville quadrangle

Toth, K.S., 2003b, Spatial database of the Dot quadrangle, Kentucky

Map GQ-569, scale 1:24,000.

1963, Geology of the Woodburn quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-280, scale 1:24,000.

Kentucky-Tennessee: Kentucky Geological Survey, ser. 12, Digitally

Vectorized Geologic Quadrangle Data DVGQ-569. Adapted from Shawe, F.R., 1966, Geologic map of the Adairville quadrangle, Kentucky-Tennessee: U.S. Geological Survey Geologic Quadrangle

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3, Geology of the South Union quadrangle, Kentucky: U. Geological Survey Geologic Quadrangle Map GQ-275, scale 1:24.000.

Mullins, J.E., 2003d, Spatial database of the Lucas quadrangle, Kentuck

engineering evaluations should be conducted when excavating

for structures or when building near sinkholes.

Map GQ-420, scale 1:24,000.

Fort Payne Formation

10->2,000 gal/min; 50 gal/min | Springs/large solution openi

30 gal/min; 5 gal/min Springs/solution openings Salty or mineralized with depth at stream levels

as dimension stone and rough architectural stone.

southeastern parts of the Bowling Green quadrangle. They are

Speculated Measured Total

the future it could be a source for oil (Noger, 1999).

deposits of rock asphalt, which have some heavy oil. They are

by Rice and others (1980) and Sable and Dever (1990). The are: .5-minute quadrangles that make up the Bowling Green 30 North-central: St. Louis Limestone, Salem and Warsaw x 60 minute quadrangle are shown in Figure 1. The data files resulting from the digitization of the GQ's are part of a Northeast: Fort Payne Formation and Corniferous South-central: Corniferous Southeast: Corniferous. The Knob Lick sandstone, which crops out at the base of the Devonian black shale and is mapped with the black shale in

comprehensive relational and spatial data set being developed by the Kentucky Geological Survey. The data files will be available on the KGS Web site in the near future (Anderson and others, 1999). Users will have at their disposal a spatial database from which to select any map or particular map the Holland 7.5-minute quadrangle, is a potential source of themes to create custom maps and add supplemental oil, hydrocarbons. It pinches out in outcrops in the quadrangles to mineral, coal, or water information. This powerful database of the north and west. The Knob Lick sandstone has been a geologic information can be used in a geographic information productive horizon in Metcalfe and Monroe Counties to the system (GIS) for analysis or manipulation of the data. east in the Tompkinsville 30 x 60 minute quadrangle (Wilson and Sutton, 1973). The 7.5-minute geologic quadrangle maps were digitally

No major gas fields are in the Bowling Green quadrangle compiled using a semi-automated data-capture technique to but some producing gas wells are in the Rockfield, Drake, and convert hard-copy geologic maps into digital format. Compiling Polkville 7.5-minute quadrangles in the north-central part of 7.5-minute maps into a 30 x 60 minute map required the the quadrangle. Gas wells are also scattered throughout central resolution of significant problems, such as (1) correlating and eastern 7.5-minute quadrangles of the Bowling Green 30 geologic formations across quadrangle boundaries, (2) resolving x 60 minute quadrangle. The primary zones of production are

nonuniform structure-contour datums or intervals, and (3) the Warsaw Formation, the Fort Payne Formation, and the resolving discrepancies in formation boundaries and inferred Corniferous zone. Small amounts of gas have been produced contacts. The metadata portion of the digital file provides locally. detailed information about the conversion process. Formation

Limestone for construction aggregate, road metal, crushed codes were assigned using the American Association of stone, building stone, and agricultural products has been mined Petroleum Geologists' standard stratigraphic code (Cohee, in the past from the Caseyville Formation, Leitchfield Formation, 1967), which was modified by the Kentucky Geological Survey

Glen Dean Limestone, Girkin Formation, Ste. Genevieve for state-specific use. Formations and formation boundaries Limestone. St. Louis Limestone, and Warsaw Formation. Active were not mapped the same way on each of the 7.5-minute mining occurs in the Girkin Formation, Ste. Genevieve quadrangle maps, since they were compiled by various authors

Limestone, and Warsaw Formation. Active quarries are in Allen, between 1960 and 1978. Resolution of the differences between Logan, and Simpson Counties (Stone and others, 2001). quadrangles was necessary for efficient topological analysis in a GIS environment. In addition, numerous small members mapped on individual 7.5-minute quadrangle maps are too small to be mapped at a scale of 1:100,000 on a 30 x 60 minute quadrangle map. These problems were resolved by adhering to geologic, cartographic, and GIS standards appropriate for the scale of the map.

This map is a compilation of existing maps, and no additional geologic field work took place. When there were problems in stratigraphic correlation between quadrangles, the best current

Measured and speculated tar sand deposits also occur in the data available were used to resolve these differences. GEOLOGIC SETTING AND STRUCTURAL SETTING The geology of the Bowling Green 30 x 60 minute quadrangle consists of sedimentary rocks of Ordovician through Mississippian age and unconsolidated sediments of Quaternary age. Outcrops of Mississippian rocks in the quadrangle contain deposits of Chesterian, Meramecian, and upper Osagean age (Sable and Dever, 1990). In addition, small outcrops of Devonian, Silurian, and Ordovician rocks occur in the southeastern part of the guadrangle. These sedimentary rocks mainly consist of offshore marine deposits. The dominant rock types for the mapped area are dolomite for the Ordovician strata; dolomite Big Clifty Sandstone and shale for the Silurian strata; shale, limestone, and sandstone for the Devonian strata; and limestone, sandstone, shale, siltstone, and dolomite for the Mississippian strata. Quaternary sediments are mainly unconsolidated, and are composed of clay, silt, sand, and gravel deposits.

Mississippian Plateau The quadrangle is located south and southeast of the Western Kentucky Coal Field. It borders Tennessee, and contains the been quarried in small quantities in the past for use as flagstone. Dripping Springs Escarpment and the Mississippian Plateau (the dominant physiographic feature in the guadrangle) (Rice and others, 1980). This plateau trends in an arcuate pattern

The groundwater resources for the Bowling Green quadrangle around the Western Kentucky Coal Field. It consists of a broad are relatively good (Table 2). At least 80 percent of the people karst plain and an upland area, which are divided by the in the counties of the Bowling Green quadrangle have access Dripping Springs Escarpment. The Big Clifty Sandstone Member to public water. For those not on public water, the groundwater of the Golconda Formation generally caps the Dripping Springs resources can vary from inadequate to excellent. The best Escarpment, which is an east- and south-facing ridge. South yielding wells are generally near perennial stream levels and and east of the Dripping Springs Escarpment is a broad plain penetrate sandstones or large solution openings. Big Spring, with karst development in areas underlain by the St. Louis and in the Petroleum 7.5-minute quadrangle, has minimum measured Ste. Genevieve Limestones. North and west of the Dripping flows of 1.3 million gal/day (Carey and Stickney, 2001, a-e). Springs Escarpment is an upland area with moderate relief,

Table 2. Groundwater resources of the Bowling Green quadrangle. underlain by Upper Mississippian (Chesterian) deposits of limestone, sandstone, and shale (Sable and Dever, 1990). Thick sand or gravel deposits The east—west-trending fault system, in the northwestern Thin alluvium part of the quadrangle, is believed to be a surface fault system | Caseyville Formation sandstones | Go gal/min | Salty or mineralized with depth | related to the southern subsurface boundary faults of the Rough | Golconda Formation | 5-250 gal/min; >500 gal/day | Springs/wells at stream levels along its northern boundary (Drahovzal, 1994). The east–westtrending fault system was mapped in the Lewisburg, Russellville, Homer, South Union, and Rockfield 7.5-minute quadrangles of the Bowling Green 30 x 60 minute quadrangle.

**ECONOMIC AND ENGINEERING GEOLOGY** Oil, gas, limestone, rock asphalt, and gravel are the principal mineral resources in the Bowling Green quadrangle (McGrain and Sutton, 1973). The two deepest oil or gas wells were drilled in the Polkville 7.5-minute quadrangle in Warren County. Both reached the Cambrian Copper Ridge Dolomite, which is in the lower part of the Knox Group. The deepest is the T.R. Pittman No. 1 Davenport Texas Gas, drilled in 1968. The total depth was 1,225 m (4,018 ft), and it was reported dry and abandoned. The second deepest is the T.R. Pittman No. 1 Hunt well, drilled in 1970. Its total depth was 1,207 m (3,959 ft), and it was also reported dry and abandoned. The larger named oil fields, and the 7.5-minute quadrangles the underlying conduits and caves can handle, or when conduits

in which they occur, are, from north to south: Rockfield: South Union quadrangle Rockfield, Bowling Green: Rockfield and Bowling Green South guadrangles Meador, Finney: Meador quadrangle

Finney, Red Cross: Lucas quadrangle Meador, Gainesville, Scottsville: Scottsville quadrangle Rodemer: Adolphus quadrangle

 Scottsville, Rodemer: Petroleum quadrangle Exploration has occurred in all 24 of the 7.5-minute m (525 ft). During seasonal periods of high precipitation, quadrangles within the Bowling Green 30 x 60 minute elevation ranges from 160 m (525 ft) to 168 m (552 ft); however, quadrangle. Drillers often refer to a major production zone in the pool may rise to a maximum of 180 m (590 ft) for floodthe north-central, south-central, northeastern, and southeastern control purposes (U.S. Army Corps of Engineers, 2002). Barren regions of the quadrangle as the "Corniferous." The producing River Lake is in the Lucas and Austin 7.5-minute quadrangles. norizons in the Corniferous include the Dutch Creek Sandstone

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Station and Int

Figure 2. Structure contours in the Bowling Green 30 x 60 minute quadrangle ndex gives names of each mapped horizon. The horizon boundaries are show on the geologic map as thin red dashed lines. Contour interval is 20 feet with index contours at every 100 feet.

0 (sea level)

Louisville Limestone.

Waldron Shale, and

Laurel Dolomite

Figure 1. Locations of the 24 quadrangles used in the digital compilation of the Bowling Green  $30 \times 60$  minute map. Index shows names of the individual 7.5-

minute quadrangle maps and their USGS geologic quadrangle map (GQ) numbers.

Salem and Warsaw

Limestones

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vertical exaggeration 12x

0 (sea level)

NOTE: cross section is diagrammatic

Menard Limestone

Formation

Vienna Limestone Sandstone

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