Generalized Geologic Map for Land-Use Planning: Jackson County, Kentucky

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Karst Geology

The term "karst" refers to a landscape characterized by sinkholes, springs, sinking streams (streams that disappear underground), and underground drainage through solution-enlarged conduits or caves. Karst landscapes form when slightly acidic water from rain and snowmelt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum). Sinkholes are depressions on the land surface into which water drains underground. Usually circular and often funnel-shaped, they range in size from a few feet to hundreds of feet in diameter. Springs occur when water emerges from underground to become surface water. Caves are solution enlarged fractures or conduits large enough for a person to enter.

Cover-Collapse Sinkhole

An excellent example of a cover-collapse sinkhole near U.S. 421 south of Big Hill. When soil covers a void space over a preexisting, buried sinkhole, a "soil arch" is formed, which may be a few inches or feet thick. If the soil arch collapses, a depression is formed on the ground surface over the sinkhole. Homeowners and builders should take every precaution to avoid these features, which may cause significant problems for structures built on top of them. Photo by Bart Davidson, Kentucky Geological Survey.

Limestone Cave

Jackson County is situated in two physiographic regions, the Mississippian Plateau (primarily limestones of units 3 and 4) and the Eastern Kentucky Coal Field (sandstones, shales, siltstones, and coals in units 2 and 5). The limestones in the northern part of the county make up a karst terrain, which includes sinkholes, underground streams, and caves. This small cave is in unit 3 along U.S. 421 between Clover Bottom and Sand Gap. Photo by Bart Davidson, Kentucky Geological Survey.

For Planning Use Only

This map is not intended to be used for selecting individual sites. Its purpose is to inform land-use planners, government officials, and the public in a general way about geologic bedrock conditions that affect the selection of sites for various purposes. The properties of thick soils may supercede those of the underlying bedrock and should be considered on a site-to-site basis. At any site, it is important to understand the characteristics of both the soils and the underlying rock. For further assistance, contact the Kentucky Geological Survey, 859.257.5500. For more information, and to make custom maps of your area, visit the KGS Land-Use Planning Internet Mapping Web Site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

Acknowledgments

Geology adapted from Miller and others (2006), Morris and Lambert (2005), Nelson (2001a, b), Nelson and others (2006a-c), Solis and Stidham (2006), Yang and Stidham (2006a, b), and Zhang and Stidham (2006).

Courthouse at McKee

Jackson County, where the mountains meet the Bluegrass, is an area of 346 square miles established in 1858. The Mill Creek Wildlife Area (13,000 acres) and the Daniel Boone National Forest (56,000 acres) cover about 31 percent of the county. The 2004 population of 13,622 was 0.9 percent larger than in 2000. The elevation ranges from 650 to 1,633 feet. Photo by Ed Hodges, Bowser-Morner Inc.

EXPLANATION

- School
- Gas well
- Oil well
- Sinkhole
- Wet area
- Water wells
  - Domestic
  - Industrial
  - Monitoring
  - Public
  - Spring
- County line
- Watershed boundary
- Water service
- Sewer service
- Mined area
- Incorporated city boundaries
- Mapped sinkhole
- Daniel Boone National Forest
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Source-water protection area, zone 1
- Wildlife Management Area
- Quarry
- 50-foot contour interval
- Photo location

Wastewater Treatment

Wastewater treatment pumping station on Ky. 89 near McKee. Most households in the county rely on on-site wastewater treatment systems. Photo by Ed Hodges, Bowser-Morner Inc.

Source-Water Protection Areas

Source-water protection areas are those in which activities are likely to affect the quality of the drinking-water source. For more information, see kgsweb.uky.edu/download/water/swapp/swapp.htm.

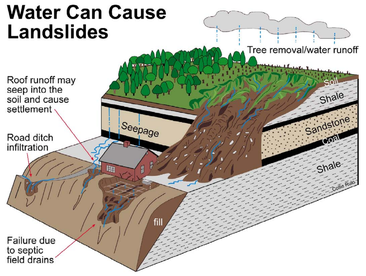
Beulah Lake

Beulah Lake near Tyner on U.S. 421 serves as a reservoir for the Jackson County Water Association, and is also open for recreational use (no wake). The water treatment plant is located to the right of the dam. Future line extensions will provide public water to 100 percent of the county. Photo by Bart Davidson, Kentucky Geological Survey.

Landslides

Hillside construction can cause earth movements if not properly planned. Photos by Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service.

Water Can Cause Landslides



What Are the Factors that Cause Landslides?

Many factors contribute to landslides. The most common in eastern Kentucky are listed below:

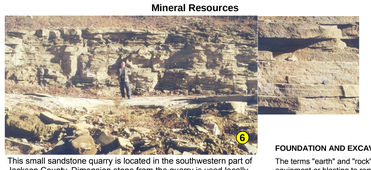
1. Steep slopes: Avoid when choosing a building site.
2. Water: Slope stability decreases as water moves into the soil. Springs, seeps, roof runoff, gutter downspouts, septic systems, and site grading that cause ponding or runoff are sources of water that often contribute to landslides.
3. Changing the natural slope by creating a level area where none previously exists.
4. Poor site selection for roads and driveways.
5. Improper placement of fill material.
6. Removal of trees and other vegetation: Site construction often results in the elimination of trees and other vegetation. Plants, especially trees, help remove water and stabilize the soil with their extensive root systems.

What Are Some Ways to Prevent Landslides?

1. Seek professional assistance prior to construction.
2. Proper site selection: Some sloping areas are naturally prone to landslides. Inspect the site for springs, seeps, and other wet areas that might indicate water problems. Take note of unusual cracks or bulges at the soil surface. These are typical signs of soil movement that may lead to slope failure. Also be aware of geologically sensitive areas where landslides are more likely to occur.
3. Alter the natural slope of the building site as little as possible during construction. Never remove soil from the toe or bottom of the slope or add soil to the top of the slope. Landslides are less likely to occur on sites where disturbance has been minimized. Seek professional assistance before earth moving begins.
4. Remove as few trees and other vegetation as possible. Trees develop extensive root systems that are very useful in slope stabilization. Trees also remove large amounts of groundwater. Trees and other permanent vegetative covers should be established as rapidly as possible and maintained to reduce soil erosion and landslide potential.
5. Household water disposal system: Seek professional assistance in selecting the appropriate type and location of your septic system. Septic systems located in fill material can saturate soil and contribute to landslides.
6. Proper water disposal: Allowing surface waters to saturate the sloping soil is the most common cause of landslides in eastern Kentucky. Properly located diversion channels are helpful in redirecting runoff away from areas disturbed during construction. Runoff should be channeled and water from roofs and downspouts piped to stable areas at the bottom of the slope.

(From U.S. Department of Agriculture, Natural Resources Conservation Service, no date)

Mineral Resources



This small sandstone quarry is located in the southwestern part of Jackson County. Dimension stone from the quarry is used locally for building materials. Photos by Ed Hodges, Bowser-Morner Inc.

LAND-USE PLANNING TABLE DEFINITIONS

FOUNDATION AND EXCAVATION

The terms "earth" and "rock" excavation are used in the engineering sense; earth can be excavated by hand tools, whereas rock requires heavy equipment or blasting to remove.

LIMITATIONS

Slight—A slight limitation is one that commonly requires some corrective measure but can be overcome without a great deal of difficulty or expense.

Moderate—A moderate limitation is one that can normally be overcome but the difficulty and expense are great enough that completing the project is commonly a question of feasibility.

Severe—A severe limitation is one that is difficult to overcome and commonly is not feasible because of the expense involved.

LAND USES

Septic tank disposal system—A septic tank disposal system consists of a septic tank and a filter field. The filter field is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the soil.

Residences—Ratings are made for residences with basements because the degree of limitation is dependent upon ease and required depth of excavation. For example, excavation in limestone has greater limitation than excavation in shale for a house with a basement.

Highways and streets—Refers to paved roads in which cuts and fills are made in hilly topography, and considerable work is done preparing subgrades and bases before the surface is applied.

Access roads—These are low-cost roads, driveways, etc., usually surfaced with crushed stone or a thin layer of blacktop. A minimum of cuts and fills are made, little work is done preparing a subgrade, and generally only a thin base is used. The degree of limitation is based on year-around use and would be less severe if not used during the winter and early spring. Some types of recreation areas would not be used during these seasons.

Light industry and malls—Ratings are based on developments having structures or equivalent load limit requirements of three stories or less, and large paved areas for parking lots. Structures with greater load limit requirements would normally need footings in solid rock, and the rock would need to be core drilled to determine the presence of caverns, cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

Extensive recreation—Camp sites, picnic areas, parks, etc.

Reservoir areas—The floor of the area where the water is impounded. Ratings are based on the permeability of the rock.

Reservoir embankments—The rocks are rated on limitations for embankment material.

Underground utilities—Included in this group are sanitary sewers, storm sewers, water mains, and other pipes that require fairly deep trenches.

7.5-Minute Quadrangle Map Index

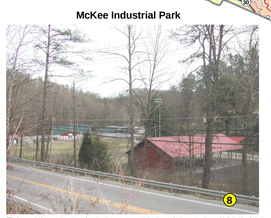
Rural Residential Development

There are a number of new rural residential areas in the county such as this one (with underground utilities) near Clover Bottom off U.S. 421 on the hilly terrain of unit 2. Photo by Ed Hodges, Bowser-Morner Inc.

Alluvial Floodplains

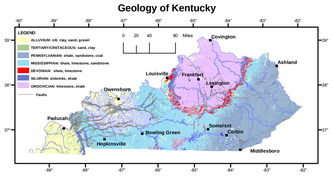
This floodplain of Pond Creek is located at the intersection of Ky. 30 and Ky. 3443 near Tyner. A power substation can be seen in the distance. Floodplains such as this are suitable for land-uses that will not be severely threatened by high water, such as recreational areas. Photo by Ed Hodges, Bowser-Morner Inc.

McKee Industrial Park



This public park also includes a small industrial complex. With limited open spaces, such combined land-uses areas make the best use of available land. Photo by Bart Davidson, Kentucky Geological Survey.

Geology of Kentucky



Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

Groundwater

In northern and western Jackson County, most wells in the valley bottoms are located in limestone formations and are adequate for domestic use. In the central and eastern parts of the county, most drilled wells in the valley bottoms are set in sandstone and usually produce enough water for domestic use. Most wells on hillsides produce enough water for domestic use, and about half the wells drilled on hilltops and ridges are adequate for domestic use. In far eastern Jackson County, water becomes scarcer, and only some wells in the valleys and a few wells on the ridges are able to produce enough water for domestic use. Most well water in Jackson County is moderately hard and contains noticeable amounts of iron. Some wells in the Station Camp Creek Valley produce very hard water that may contain hydrogen sulfide in objectionable quantities. Salt water can also be found at depths of 100 feet and greater below the principal valley bottoms in eastern, northern, and western Jackson County. A few springs supply enough water for domestic use. Most springs yield less than 5 gallons per minute, except in the northern and western parts of the county, where limestone springs producing up to 100 gallons per minute can be found. For more information on groundwater in the county, see Carey and Stickney (2005).

Planning Guidance by Rock Unit Type

Rock Unit	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Clay, silt, sand, and gravel	Fair foundation material; easy to excavate. Seasonal high water table. Subject to flooding.	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Hayes, 1989).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Hayes, 1989).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Hayes, 1989).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Hayes, 1989).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Hayes, 1989).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Hayes, 1989).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Hayes, 1989).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Hayes, 1989).	Fair stability. Fair compaction characteristics. Piping hazard. Refer to soil report (Hayes, 1989).	Slight limitations, in general, except for seasonal high water table. Subject to flooding. Refer to soil report (Hayes, 1989).
2. Shale, sandstone, siltstone	Fair to good foundation material; difficult excavation. Possible expansion of shales.	Severe limitations, thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Thin soils. Possible rock excavation.
3. Limestone	Excellent foundation material; difficult to excavate.	Severe to moderate limitations. Impermeable rock. Locally, fast drainage through fractures and sinks to water table. Possible groundwater contamination.	Severe to moderate limitations. Rock excavation may be required. Possible radon occurrence.	Severe to moderate limitations. Rock excavation. Steep slopes.	Severe to moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to severe limitations, depending on activity and topography.	Slight to severe limitations. Reservoir may leak where rocks are jointed or fractured.	Moderate limitations. Reservoir may leak where rocks are jointed or fractured.	Moderate limitations. Rock excavation.
4. Dolomite, limestone, shale	Excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Danger of groundwater contamination.	Severe to moderate limitations. Rock excavation may be required.	Severe limitations. Rock excavation. Possible steep slopes.	Severe to moderate limitations. Possible rock excavation. Possible steep slopes and narrow ravines.	Slight to moderate limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes. Slight limitations for nature preserve.	Slight to moderate limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Slight to moderate limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Rock excavation.
5. Sandstone	Fair to good foundation material; moderately difficult to excavate.	Severe limitations. Thin soils.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Thin soils. Possible rock excavation.
6. Shale	Fair to poor foundation material; easy to moderately difficult to excavate. Possible expansion of shales. Plastic clay presents particularly poor foundation conditions.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to water table. Possible groundwater contamination.	Severe to moderate limitations. Rock excavation may be required. Possible radon occurrence. Plastic clay presents particularly poor foundation conditions.	Moderate limitations. Rock excavation. Local drainage problems. Plastic clay presents particularly poor foundation conditions and will not hold up in high-angle roadcuts.	Moderate limitations. Rock excavation. Local drainage problems. Plastic clay presents particularly poor foundation conditions and will not hold up in high-angle roadcuts.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Possible expansion of shales. Plastic clay presents particularly poor foundation.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes. Slight limitations for nature preserve.	Severe limitations. Reservoir may leak where rocks are fractured. Plastic clay provides excellent sealer, but tends to slump.	Severe to moderate limitations. Reservoir may leak where rocks are fractured. Plastic clay provides excellent sealer.	Moderate to severe limitations. Thin soils. Possible rock excavation.

Additional Resources

Listed below are Web sites for several agencies and organizations that may be of assistance with land-use planning issues in Jackson County:

ces.ca.uky.edu/jackson/ University of Kentucky Cooperative Extension Service
www.cvadd.org/ Cumberland Valley Area Development District
www.thinkkentucky.com/edis/cmnty/cw074/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21109.html Kentucky Atlas and Gazetteer, Jackson County
quickfacts.census.gov/qfd/states/21/21109.html U.S. census data
kgsweb.uky.edu/download/kasplanning.htm Planning information from the Kentucky Geological Survey

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Nelson, H.L., Jr., 2000b, Spatial database of the Bighill quadrangle, east-central Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-900. Adapted from Weir, G.W., Lee, K.Y., and Cassity, P.E., 1971, Geologic map of the Bighill quadrangle, east-central Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-900, scale 1:24,000.

Nelson, H.L., Jr., Patton, J.A., Hesley, J., and Lambert, J.R., 2006a, Spatial database of the Maulden quadrangle, southeastern Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-1140. Adapted from Lee, K.Y., and Jones, C.L., 1974, Geologic map of the Maulden quadrangle, southeastern Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1140, scale 1:24,000.

Nelson, H.L., Jr., Patton, J.A., Hesley, J., and Lambert, J.R., 2006b, Spatial database of the McKee quadrangle, Jackson and Owsley Counties, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-1125. Adapted from Weir, G.W., and Mumma, M.D., 1973, Geologic map of the McKee quadrangle, Jackson and Owsley Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1125, scale 1:24,000.

Nelson, H.L., Jr., Patton, J.A., Hesley, J., and Lambert, J.R., 2006c, Spatial database of the Sturgeon quadrangle, east-central Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-1455. Adapted from Weir, G.W., 1978, Geologic map of the Sturgeon quadrangle, east-central Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1455, scale 1:24,000.

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U.S. Department of Agriculture, Natural Resources Conservation Service, no date, Landslide prevention in eastern Kentucky.

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Scale 1:48,000 1 inch = 3/4 mile

0 0.5 1 2 3 4 Miles

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