2005

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

E. Glynn Beck
University of Kentucky, ebeck@uky.edu

David A. Williams
University of Kentucky, williams@uky.edu

Daniel I. Carey
University of Kentucky, daniel.carey@uky.edu

https://doi.org/10.13023/kgs.mc108.12
MAP AND CHART 108
Series XII, 2005

Kentucky Geological Survey
James C. Cobb, State Geologist and Director
UNIVERSITY OF KENTUCKY

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

E. Glynn Beck, David A. Williams, and Daniel I.Carey

Acknowledgments

Geology adapted from Crawford (2003), Johnson (2003a-c), Johnson and Thompson (2003), Lambert (2003), Mullins (2002, 2003), Mullins and Thompson (2003), Nelson (2003a-b), Thompson (2003a-b), and Toth (2002a-b, 2003a-b). Mapped sinkhole data from Paylor and others (2004). Karst diagram from Currens (2001). Special thanks to Chris Milam, Logan County Agriculture and Natural Resources agent; Lee Robey, Robey Dairy; and Kevin Belt, Hanson Building Materials America, for their help. Thanks to Richard Smath, Kentucky Geological Survey, for information on tar-sands.

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, Henderson Office, 1401 Corporate Court, Henderson, KY 42420, phone 270.827.3414 or 270.827.3404. 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.

Geologic Hazards

The most prominent geologic hazard for Logan County is the karst development on the terrain underlain by thick limestone, units 5 and 6. Sinkholes shown in red are the surface expression of solution cavities such as caves and flow channels. Karst can be particularly hazardous if not treated properly during urban development. Significant damage can occur if sinkholes open beneath a structure, and flooding can worsen if subsurface channels through sinkholes and caves are plugged or impaired. Groundwater supplies may be polluted if waste is improperly dumped into sinkholes, which ultimately affects surface water.

None of the faults in Logan County are considered to be active; however, the proximity of active seismic zones such as the New Madrid, Wabash, or East Tennessee does call for precautions to be taken for earthquake damage mitigation.

Flooding may be a problem in Logan County, especially along major streams. Urban development often exacerbates flooding, and therefore potential flooding should always be considered in urban development plans. Areas of steep-walled drainage such as that formed in terrain underlain by units 2, 3, 4, and 7 are conducive to flash flooding, especially in developed areas. Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

Steep slopes are present, especially along streams in areas underlain by units 2, 3, 4, and 7, in the northern part of Logan County. Steep slopes can develop soil creep and landslides if not properly treated during development. Proper engineering techniques should be followed when developing on hillsides, and care should be taken not to affect property above and below a development site on a hillside.

Foundations and Excavations

Because of thin soil cover in certain areas of the county, rock excavation is required during road and other types of construction. Photo by Glynn Beck, Kentucky Geological Survey.

Industry

The Logan Aluminum Plant employs approximately 1,000 people, and is the largest manufacturing plant in Logan County. Photo by Glynn Beck, Kentucky Geological Survey.

Mineral Resources

Limestone is an abundant rock in Logan County. The Hanson Aggregate Quarry produces approximately 400,000 tons of crushed stone per year. Photo by Glynn Beck, Kentucky Geological Survey.

Ecoregions

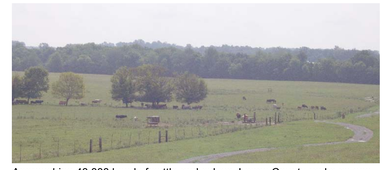
Logan County lies within two ecoregions. The northern part of the county is located in the Crawford–Mammoth Cave Uplands ecoregion and the southern part of the county is located in the Western Pennyroyal Karst Plain ecoregion (Woods, 2002). Both regions are dominated by karst features such as sinkholes and sinking streams. Photo by Glynn Beck, Kentucky Geological Survey.

Tar-Sands in Western Kentucky

Investigations by the Kentucky Geological Survey have confirmed that major tar-sand resources are present in western Kentucky (Noger, 1999). In-place resources are calculated to be in excess of 3 billion barrels. The principal formations that contain tar-sand deposits (also referred to as asphaltic sandstones, heavy-oil deposits, or bitumen-impregnated sandstones) are the Kyrock, Bee Springs, Tar Springs, Hardinsburg, and Big Clifty Sandstones. Some of these may occur in Logan, Warren, Butler, Edmonson, Hart, Grayson, Breckinridge, and Hardin counties. In Logan County, tar-sands may be present in unit 7. Photo by Randy Bruner.

For more information information on tar-sands, go to kgsweb.uky.edu/PubsSearching/PubsSimpleSearch.asp, keyword= tar sands.

Agriculture



Approaching 40,000 head of cattle and calves, Logan County ranks as one of the leaders in western Kentucky beef production. Photo by Glynn Beck, Kentucky Geological Survey.

With more than 900 milk cows, the Robey Dairy is the largest dairy in Kentucky. Photo by Glynn Beck, Kentucky Geological Survey.

Agriculture is a major part of the Logan County economy. According to the 2002-2003 Kentucky Agricultural Statistics Service, 112,200 acres (32 percent) of the 355,827 acres available were planted in corn and soybeans. Photo by Glynn Beck, Kentucky Geological Survey.

Logan County is ranked as the number one producer of dark air-cured tobacco (dark green tobacco above) in Kentucky. Approximately 1,000 acres were harvested in 2003 in the county. Photo by Glynn Beck, Kentucky Geological Survey.

Groundwater

In the southern half of Logan County, more than three-quarters of the drilled wells in the uplands are adequate for a domestic supply. Yields as high as 50 gallons per minute have been reported from wells penetrating large solution channels. In the low-lying areas of the Red River and its main tributaries, most wells are inadequate for domestic use, unless the well intercepts a major solution opening in the limestone; in that case, the yield could be very large.

Groundwater in the northern half of the county is not as prevalent as in the southern half of the county. Only a few wells in the northern half of the county yield enough water for a domestic supply.

Springs with flows ranging from a few gallons per minute to 2,636 gallons per minute are found in the county. Minimum flow generally occurs in early fall; maximum flows in late winter. For more information on groundwater in the county, see Carey and Stickney (2004).

Additional Planning Resources

Listed below are Web sites for several agencies and organizations that may be of assistance with landuse planning issues in Logan County:

www.visitlogancounty.com/— Logan County Tourist and Convention Commission
www.loganchamber.com—Logan County Chamber of Commerce
ces.ca.uky.edu/logan/—University of Kentucky Cooperative Extension Service
www.bradd.org/—Barren River Area Development District
www.thinkkentucky.com/edis/cmnty/cw021/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21141.html—Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21141.html—U.S. Census data
kgsweb.uky.edu/download/kgsplanning.htm—Planning information from the Kentucky Geological Survey

References Cited

Carey, D.I., and Stickney, J.F., 2004, Groundwater resources of Logan County, Kentucky: Kentucky Geological Survey, ser. 12, County Report 71, www.uky.edu/KGS/water/library/gwatlas/Logan/Logan.htm.

Crawford, M.M., 2003, Spatial database of the Rosewood quadrangle, western Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-1445. Adapted from Kehn, T.M., 1978, Geologic map of the Rosewood quadrangle, western Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1445, scale 1:24,000.

Currens, J.C., 2001, Protecting Kentucky's karst aquifers from nonpoint-source pollution: Kentucky Geological Survey, ser. 12, Map and Chart 27, 1 sheet.

Dye, J.W., Barton, A.J., and Froedge, R.D., 1975, Soil survey of Logan County, Kentucky: U.S. Department of Agriculture, Soil Conservation Service, 78 p.

Johnson, T.L., 2003a, Spatial database of the Auburn quadrangle, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-415. Adapted from Rainey, H.C., III, 1965, Geology of the Auburn quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-415, scale 1:24,000.

Johnson, T.L., 2003b, Spatial database of the Dennis quadrangle, Logan County, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-450. Adapted from Rainey, H.C., III, 1965, Geologic map of the Dennis quadrangle, Logan County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-450, scale 1:24,000.

Johnson, T.L., 2003c, Spatial database of the Russellville quadrangle, Logan County, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-714. Adapted from Miller, R.C., 1968, Geologic map of the Russellville quadrangle, Logan County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-714, scale 1:24,000.

Johnson, T.L., and Thompson, M.F., 2003, Spatial database of the Homer quadrangle, Logan County, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-549. Adapted from Gildersleeve, B., 1966, Geologic map of the Homer quadrangle, Logan County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-549, scale 1:24,000.

Lambert, J.R., 2003, Spatial database of the Allensville quadrangle, Kentucky-Tennessee: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-502. Adapted from Klemic, H., 1966, Geologic map of the Allensville quadrangle, Kentucky-Tennessee: U.S. Geological Survey Geologic Quadrangle Map GQ-502, scale 1:24,000.

Mullins, J.E., 2002, Spatial database of the Sugar Grove quadrangle, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-225. Adapted from Miller, T.P., 1963, Geology of the Sugar Grove quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-225, scale 1:24,000.

Mullins, J.E., 2003, Spatial database of the South Union quadrangle, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-275. Adapted from Klemic, H., 1963, Geology of the South Union quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-275, scale 1:24,000.

Mullins, C.E., and Thompson, M.F., 2003, Spatial database of the Lewisburg quadrangle, Logan County, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-830. Adapted from Rainey, H.C., III, and Miller, R.C., 1969, Geologic map of the Lewisburg quadrangle, Logan County, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-830, scale 1:24,000.

Nelson, H.L., Jr., 2003a, Spatial database of the Olmstead quadrangle, Todd and Logan Counties, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-553. Adapted from Ulrich, G.E., 1966, Geologic map of the Olmstead quadrangle, Todd and Logan Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-553, scale 1:24,000.

Nelson, H.L., Jr., 2003b, Spatial database of the Sharon Grove quadrangle, Todd and Logan Counties, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-482. Adapted from Ulrich, G.E., 1966, Geologic map of the Sharon Grove quadrangle, Todd and Logan Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-482, scale 1:24,000.

Noger, M.C., 1999, Tar-sand resources of western Kentucky: Kentucky Geological Survey, ser. 11, Reprint 45, 27 p.

Paylor, R.L., Florea, L., Caudill, M., and Currens, J.C., 2004, A GIS coverage of karst sinkholes in Kentucky: Kentucky Geological Survey, ser. 12, Digital Publication 5, 1 CD-ROM.

Thompson, M.F., 2003a, Spatial database of the Prices Mill quadrangle, Kentucky-Tennessee: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-449. Adapted from Shawe, F.R., and Rainey, H.C., III, 1965, Geologic map of the Prices Mill quadrangle, Kentucky-Tennessee: U.S. Geological Survey Geologic Quadrangle Map GQ-449, scale 1:24,000.

Thompson, M.F., 2003b, Spatial database of the Rockfield quadrangle, 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: U.S. Geological Survey Geologic Quadrangle Map GQ-309, scale 1:24,000.

Toth, K.S., 2002a, Spatial database of the Dunmor quadrangle, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-290. Adapted from Miller, T.P., 1964, Geology of the Dunmor quadrangle, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-290, scale 1:24,000.

Toth, K.S., 2002b, Spatial database of the Quality quadrangle, Butler and Logan Counties, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-673. Adapted from Gildersleeve, B., 1968, Geologic map of the Quality quadrangle, Butler and Logan Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-673, scale 1:24,000.

Toth, K.S., 2003a, Spatial database of the Adairville quadrangle, 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 Map GQ-569, scale 1:24,000.

Toth, K.S., 2003b, Spatial database of the Dot quadrangle, Kentucky-Tennessee: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-568. Adapted from Shawe, F.R., 1966, Geologic map of the Dot quadrangle, Kentucky-Tennessee: U.S. Geological Survey Geologic Quadrangle Map GQ-568, scale 1:24,000.

U.S. Fish and Wildlife Service, 2003, National Wetlands Inventory, www.nwi.fws.gov/.

Woods, A.J., Omernik, J.M., Martin, W.H., Pond, G.J., Andrews, W.M., Call, S.M., Comstock, J.A., and Taylor, D.D., 2002, Ecoregions of Kentucky (color poster with map, descriptive text, summary tables, and photographs): U.S. Geological Survey, scale 1:1,000,000.

EXPLANATION

- School
- Urban service boundary
- Wetlands > 1 acre, (U.S. Fish and Wildlife Service, 2003)
- Source-water protection area, zone 1
- Artificial fill
- Sinkholes
- Concealed faults
- Faults

Water Wells
- Domestic
- Industrial/commercial
- Monitoring
- Public

Oil and Gas Wells
- Gas well
- Oil and gas well
- Oil well
- Class II injection well

50-foot contour interval

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.

For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call:

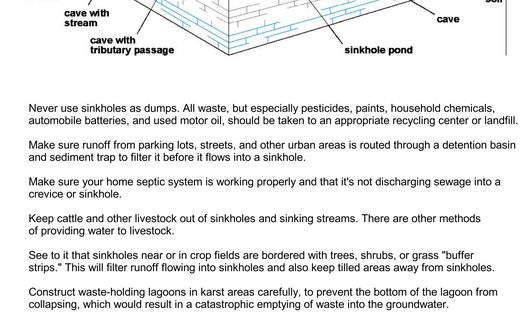
Public Information Center
859.257.3896
877.778.7827 (toll free)

View the KGS World Wide Web site at:
www.uky.edu/kgs

Karst Geology

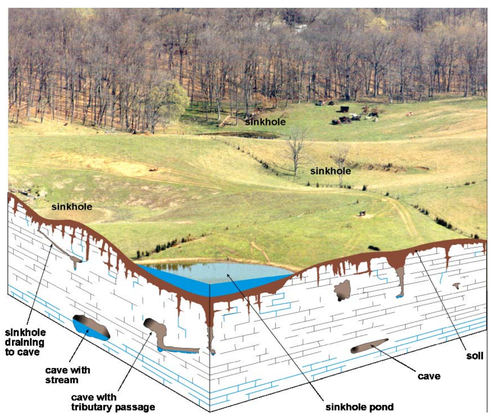
The term "karst" refers to a landscape characterized by sinkholes, springs, sinking streams (streams that disappear underground), and underground drainage through solution-enlarged conduits or caves. Karst landscapes form when slightly acidic water from rain and snowmelt seeps through soil cover into 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.

Sinkhole Protection



Sinkholes are natural drainage points for groundwater and should never be used as trash dumps. This sinkhole on the Milam Farm in Logan County has been protected . Photo by Glynn Beck, Kentucky Geological Survey.

Environmental Protection



Never use sinkholes as dumps. All waste, but especially pesticides, paints, household chemicals, automobile batteries, and used motor oil, should be taken to an appropriate recycling center or landfill.

Make sure runoff from parking lots, streets, and other urban areas is routed through a detention basin and sediment trap to filter it before it flows into a sinkhole.

Make sure your home septic system is working properly and that it's not discharging sewage into a crevice or sinkhole.

Keep cattle and other livestock out of sinkholes and sinking streams. There are other methods of providing water to livestock.

See to it that sinkholes near or in crop fields are bordered with trees, shrubs, or grass "buffer strips." This will filter runoff flowing into sinkholes and also keep tilled areas away from sinkholes.

Construct waste-holding lagoons in karst areas carefully, to prevent the bottom of the lagoon from collapsing, which would result in a catastrophic emptying of waste into the groundwater.

If required, develop a groundwater protection plan (410KAR5:037) or an agricultural water-quality plan (KRS224.71) for your land use.

(From Currens, 2001)

7.5-Minute Topographic Map Index

Planning Guidance by Rock Unit Type

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 and without 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 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.

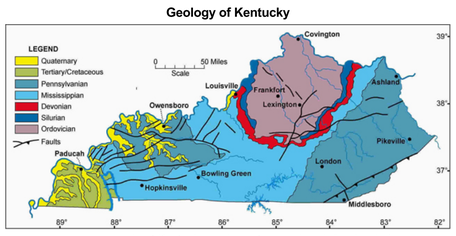
Reservoir embankments—The rocks are rated on limitations for embankment material.

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

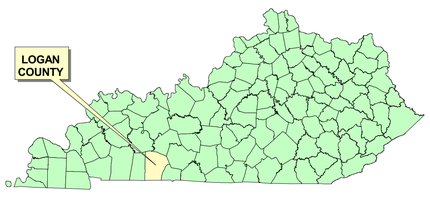
Rock Unit	Foundation and Excavation	Septic Tank Disposal System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Alluvium	Fair to good foundation material. Easily excavated.	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).	Refer to soil report (Dye and others, 1975).
2. Shale, siltstone, sandstone, limestone, coal, underclay	Fair to good foundation material; difficult excavation.*	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.* **	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.* **	Moderate limitations. Rock excavation. Steep slopes.*	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.* **	Severe limitations. Steep slopes.*	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.**	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation.
3. Sandstone	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Steep slopes.	Slight to moderate limitations.	Moderate limitations. Permeable rock.	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation. Steep slopes.
4. Sandstone, siltstone, thin limestone, shale	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.*	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.*	Moderate limitations. Rock excavation. Steep slopes. Swelling clays may be present.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.* Swelling clays may be present.	Severe limitations. Steep slopes.*	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation.
5. Limestone, shale: karst development possible	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Slight to severe limitations. Steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation.
6. Limestone, prone to karst development	Excellent foundation material; difficult excavation.	Severe limitations. Impermeable rock; locally fast drainage through fractures, danger of groundwater contamination.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Drainage required.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Drainage required.	Slight limitations. Local drainage problems from seeps or springs; sinks possible.	Slight to moderate limitations, depending on topography. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Local drainage problems.	Slight to severe limitations. Steep slopes.	Slight to moderate limitations.	Severe limitations. Leaky reservoir rock; locally, conditions may be favorable. Sinks possible.	Severe limitations.	Severe limitations. Rock excavation.
7. Sandstone, siltstone, shale	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.*	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.*	Moderate limitations. Rock excavation. Steep slopes.*	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.*	Severe limitations. Steep slopes.*	Slight to moderate limitations.	Slight limitations. Reservoir might leak where rocks are fractured.	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation.

* Generally forms steep slopes along drainages, but in upland areas usually forms rolling terrain.
** Coal beds and underclays should not be used for foundations or reservoir embankments because of the presence of expanding pyrite in coal and underclays and the weakness of underclay when it becomes wet.

Geology of Kentucky



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



Scale 1:63,360

1 inch equals 1 mile

1 0 1 3 4 Miles

N