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

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

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MAP AND CHART 146
Series XII, 2006

Acknowledgments

Geology adapted from Lambert and Sparks (2005), Murphy (2005a-c), Murphy and Petersen (2005), Nelson and Petersen (2005), Zhang (2005), Ashcraft and Petersen (2006) Petersen (2006a, b), Plauché (2006), Plauché and Petersen (2006a-c), Toth (2006), and Toth and Petersen (2006a, b). Mapped sinkholes from Paylor and others (2004).

Karst Geology

Karst areas in Lewis County are indicated by sinkholes. 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.

EXPLANATION

- School

Water wells
- Domestic
- Monitoring
- Public
- Industrial

- Spring
- Gas well
- Oil and gas well
- Sinkhole
- Wet area
- Rock outcrop
- Mine or quarry

- County line
- Railroad
- Watershed boundary

- Landslide deposits
- Mapped sinkhole
- Wildlife management area
- Sand and gravel pit
- Public lands
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Incorporated city boundaries
- Designated flood zone* (FEMA, 2006)

100-foot contour interval

4 Photo location

AA HIGHWAY

*Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

Ohio River

The Ohio River alluvium provides land for agriculture. The river also provides transportation for industry and water for the community. Photo by Dan Carey, Kentucky Geological Survey.

Lewis County Courthouse at Vanceburg

Lewis County, named after the explorer Meriwether Lewis, with an area of 484 square miles, was formed in the Outer Bluegrass and Eastern Kentucky Coal Field regions in 1807. The 2005 county population, 13,510, was 4.1 percent smaller than the population in 2000. The topography of the county is hilly to mountainous. The lowest elevation, 485 feet, is the normal pool of the Ohio River on the western boundary. The highest elevation, 1,400 feet, is a knob near the Lewis-Fleming County line, about 2.5 miles south of Petersville. Photo by Dan Carey, Kentucky Geological Survey.

Sandstone–Unit 6

Sandstones formed 300 million years ago can be seen in this road-cut on Ky. 10 near Garrison. Photo by Dan Carey, Kentucky Geological Survey.

Mineral Resources

The River Sand and Gravel LLC began operations in 2000. Photo by Dan Carey, Kentucky Geological Survey.

Clay Shale–Unit 7

Clay shales (unit 7) are favorable for pond construction, but create unstable slopes unless protected. They also provide soils for agriculture, but drainage may be required (below). Photos by Dan Carey, 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 supersede 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.

Slope Failure

Mass movements or landslides of surficial materials are by far the most frequent and most costly geologic hazards in the northern Kentucky area. Northern Kentucky has the greatest monetary loss per capita caused by landslides in the country. Over 30 years ago, geologic mappers noted 52 landslides in Lewis County. Landslides in the period since then are not shown on the map. The failure of the slope may be rapid, but more commonly is a slow, almost imperceptible movement, called creep, of a few inches per year. Whether rapid or slow, the end results and damage are similar and costly: broken plumbing, cracked walls and foundations, cracked streets and sidewalks, and commonly total loss of the structures.

Virtually all units containing shale are subject to landslides, but particularly units 4 and 5.

Clay shales of units 4, 5, and 7 become plastic when wet and present particularly difficult problems for excavations and foundations. An engineering geologist or a geotechnical engineer should be consulted when clay shales are present.

Gravity is the main driving force, but water nearly always plays a critical role by adding weight and lubricating the particles in the weathered shale. Cutting into or overloading a slope with structures and fill can also be major contributing factors.

Precautions include taking care of all surface-water runoff by making certain that all runoff from roofs, gutters, patios, sidewalks, and driveways is carried well away from and not toward the house; diverting drainage from areas sloping toward the house; cutting into natural slopes as little as possible and avoiding the use of fill; and trying to place the foundation of the structure on undisturbed bedrock.

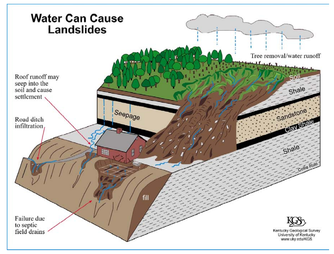
When in doubt, consult an engineering geologist or a geotechnical engineer. Relict landslides can also be easily reactivated. Look for unusual bulges or cracks in the slope, tilted or curved trees, springs coming out onto the hillside, and tilted and cracked sidewalks, streets, and retaining walls.

For more information, see Potter (1996) and U.S. Department of Agriculture (no date).

Black Shale–Unit 4

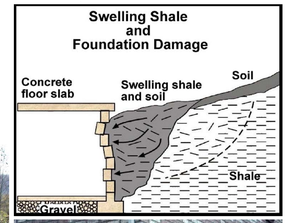
Slopes of black shale (unit 4) are unstable and erode quickly, as seen at this roadcut on the AA Highway south of Vanceburg. Photo by Dan Carey, Kentucky Geological Survey.

Water Can Cause Landslides



Swelling and Shrinking Shales

A problem of some concern in this area is the swelling of some of the clays and shales. Expanding shale can cause backfill to swell and concrete to crack and crumble. It can heave the foundation, the slab, and interior partitions resting on it, and damage upper floors and interior partitions. This phenomenon has been responsible for extensive damage to schools, homes, and businesses in Kentucky. During times of drought, these same shales may shrink, causing foundations to drop. Anyone planning construction on these shales should seek professional advice from a geologist or engineer familiar with the problem.



Some shales and the soils derived from them swell when exposed to water or air. These swelling shales and soils can have severe impacts on building foundations and other structures (e.g., bridges, dams, roads). Photo by John Kiefer, Kentucky Geological Survey.

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 existed.
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)

Alluvial Valleys

Alluvial valleys (unit 1) cut by streams in eastern Lewis County provide land for living and farming. Photo by Dan Carey, Kentucky Geological Survey.

Grassy Fork

Sandstones (unit 5) along Grassy Fork. Lewis County is blessed with many beautiful streams. Photo by Dan Carey, Kentucky Geological Survey.

Groundwater Resources

The Ohio River alluvium is the best source of groundwater in the county. Many properly constructed drilled wells will produce several hundred gallons per minute from the alluvium; most wells are able to produce enough for a domestic supply at depths of less than 100 feet. Water is hard or very hard, but otherwise of good quality.

Some wells located in the major creek valleys will produce enough water for a domestic supply except during dry weather. In the upland areas (90 percent of the county), most drilled wells will not produce enough water for a dependable domestic supply, unless they are drilled along drainage lines, in which case they may produce enough water except during dry weather. Groundwater in these areas is hard or very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet.

For more information on groundwater in the county, see Carey and Stickney (2005).

Red and Green Shales

Red and green shales lie at the base of the sandstone (unit 6) along the AA Highway east of Vanceburg. These shales, similar to unit 5, weather easily and may become plastic when wet. Photo by Dan Carey, Kentucky Geological Survey.

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 (alluvium)	Fair foundation material; easy to excavate. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).	Fair stability. Fair compaction characteristics. Piping hazard. Refer to soil report (Jacobs and Jones, 2004).	Slight limitations, in general, except for seasonal high water table. Subject to flooding. Refer to soil report (Jacobs and Jones, 2004).
2. Limestone, shale	Fair to good foundation material; moderately difficult to excavate.	Severe limitations. Steep slopes, impermeable rock.	Moderate to severe limitations. Steep slopes. Possible clay shales.	Moderate to severe limitations. Steep slopes. Possible clay shales.	Moderate to severe limitations. Steep slopes. Possible clay shales.	Severe limitations. Steep slopes. Possible clay shales.	Moderate to severe limitations. Steep slopes.	Slight to moderate limitations, depending on slope.	Moderate limitations.	Severe to slight limitations. Unstable steep slopes.	Moderate limitations. Possible clay shales.
3. Limestone	Excellent foundation material; difficult to excavate.	Severe limitations. Locally fast drainage through fractures. Danger of ground-water 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 to moderate 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. Rock excavation may be required.	Slight to moderate limitations, depending on activity and topography. Slight limitations for forest or nature preserve.	Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky rock.	Severe limitations. Rock excavation.
4. Black shale*	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Thin soils and impermeable rock.	Severe limitations. Low strength, slump-ing, and seepage problems.	Severe limitations. Low strength, slump-ing, and seepage problems.	Severe limitations. Low strength, slump-ing, and seepage problems.	Severe limitations. Low strength, slump-ing, and seepage problems.	Moderate to severe limitations, depend-ing on activity.	Slight to severe limi-tations, depending on activity. Slight limi-tations for forest or nature preserve.	Slight limitations for small ponds.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wetness.
5. Shale*	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Thin soils and low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations on slopes. Strength, slump-ing, and seepage prob-lems.	Severe limitations on slopes. Strength, slump-ing, and seepage prob-lems.	Severe limitations on slopes. Strength, slump-ing, and seepage prob-lems.	Moderate to severe limitations, depending on activity.	Slight to severe limita-tions, depending on activity. Slight limitations for forest or nature preserve.	Slight limitations. Reser-voir may leak where rocks are fractured. Most ponds on shale are successful.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wetness.
6. Sandstone	Excellent foundation material; 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 limitations. Rock ex-cavation may be required. Possible steep slopes.	Severe limitations. Rock ex-cavation may be required. Possible steep slopes.	Slight to severe limitations, depending on activity and topog-raphy. Possible steep wooded slopes.	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.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation. Thin soils.
7. Clay shale*	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. Plastic clays.	Severe limitations. Thin soils and low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations on slopes. Strength, slump-ing, and seepage prob-lems.	Severe limitations on slopes. Strength, slump-ing, and seepage prob-lems.	Severe limitations on slopes. Strength, slump-ing, and seepage prob-lems.	Moderate limitations, depending on activity.	Slight to severe limita-tions, depending on activity. Slight limitations for forest or nature preserve.	Slight limitations. Reser-voir may leak where rocks are fractured. Most ponds on shale are successful.	Slight limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wetness.
8. Siltstone	Excellent foundation material; difficult to excavate.	Severe limitations. Thin soils.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock ex-cavation. Steep slopes.	Moderate to severe limitations. Rock ex-cavation may be required. Steep slopes.	Moderate to severe limitations. Rock ex-cavation may be required. Steep slopes.	Moderate to severe limitations. Rock ex-cavation may be required. Steep slopes.	Slight to severe limita-tions, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Thin soils. Rock excavation.
9. Sandstone, shale, silt-stone, sparse coal	Fair to good foundation material; difficult to ex-cavate. Possible low strength associated with shales, coals, and underclays.	Severe limitations. Thin soils and impermeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock ex-cavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock ex-cavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock ex-cavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock ex-cavation may be required.	Slight to severe limita-tions, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Slight limitations. Reservoir may leak where rocks, includ-ing coal, are jointed or fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Severe to moderate limitations. Possible rock excava-tion.

*Shales and clays in these units can shrink during dry periods, and swell during wet periods and cause cracking of foundations. On hillsides, especially where seeps and springs are present, they can also be susceptible to landslides.

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Scale 1:63,360 1 inch equals 1 Miles
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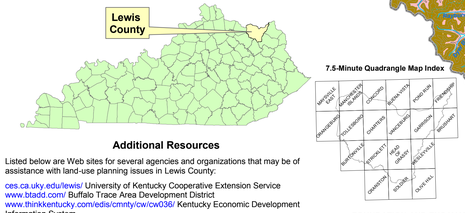
Lewis County

7.5-Minute Quadrangle Map Index

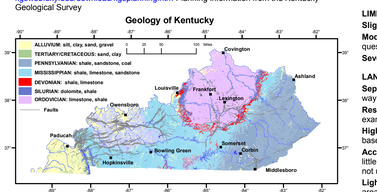


Additional Resources

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

ces.ca.uky.edu/lewis/ University of Kentucky Cooperative Extension Service
www.btadd.com/ Buffalo Trace Area Development District
www.thinkkentucky.com/edis/cmnty/cw/cw036/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21135.html Kentucky Atlas and Gazetteer, Lewis County
quickfacts.census.gov/qfd/states/21/21135.html U.S. census data
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey

Geology of Kentucky



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

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.