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

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

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

Daniel I. Carey, Randall L. Paylor, and Bethany L. Overfield

Acknowledgments

Geology adapted from Duncan (2006), Duncan and Stidham (2006), Murphy and Stidham (2006), Yang and Stidham 2006a, b), Zhang (2006a-d), and Zhang and Stidham (2006a-e). Sinkhole data from Paylor and others (2004). Thanks to Kim and Kent Anness, Kentucky Division of Geographic Information, for base map data.

What Are the Factors That Cause Landslides?

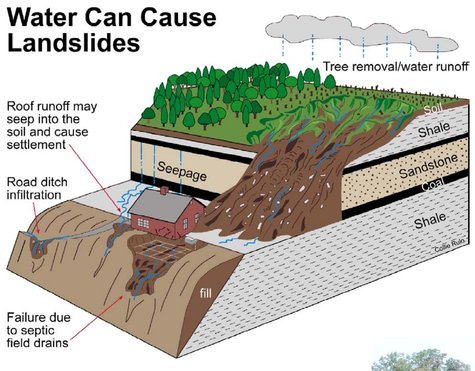
Many factors contribute to landslides. The most common in eastern Kentucky are listed below:

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)



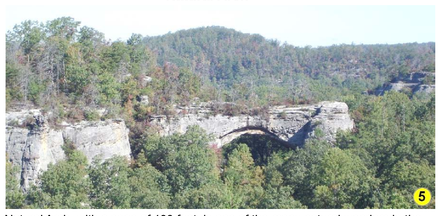
Roadway Support

Drainage management and roadway support are mandatory in steep slope areas that are common in McCreary County, particularly if shale units are encountered. Photo by Randy Paylor, Kentucky Geological Survey.

Retaining Walls

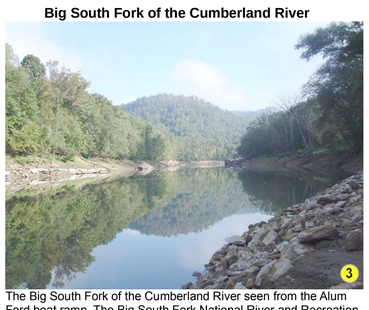
Retaining walls are often needed for slope stability for construction in steeply sloping areas. Photo by Dan Carey, Kentucky Geological Survey.

Natural Arch



Natural Arch, with a span of 100 feet, is one of the many natural wonders in the county that attract tourists. Photo by Bethany Overfield, Kentucky Geological Survey.

Big South Fork of the Cumberland River



The Big South Fork of the Cumberland River seen from the Alum Ford boat ramp. The Big South Fork National River and Recreation Area, part of which extends into southern McCreary County, encompasses 125,000 acres of the Cumberland Plateau, Big South Fork National River and Recreation Area and protects the free-flowing Big South Fork of the Cumberland River and its tributaries. The area boasts miles of scenic gorges and sandstone bluffs, is rich with natural and historic features and has been developed to provide visitors with a wide range of outdoor recreational activities. Photo by Bethany Overfield Kentucky Geological Survey.

Sandstone: Unit 5

Poorly cemented sandstone (unit 5) laid down by an ancient river is seen in this roadcut along U.S. 27 near Whitley City. Close-up on right shows weathering features. Photos by Bethany Overfield, Kentucky Geological Survey.

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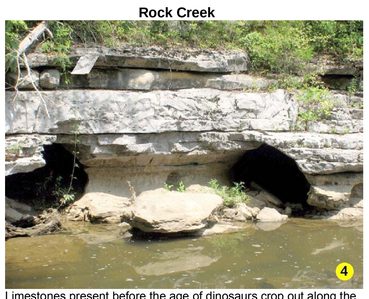
McCreary County Courthouse at Whitley City

McCreary County, an area of 428 square miles in the Eastern Kentucky Coal Field, was established in 1912 as the final county in Kentucky. The population in 2005 was 17,152. The highest elevation, 2,165 feet, is on a knob on Ryans Creek Mountain about 1.5 miles southeast of Hollyhill. The lowest point, 723 feet, is the normal pool of Lake Cumberland. The county lies within the Daniel Boone National Forest and includes the Big South Fork National River and Recreation Area. Photo by Bethany Overfield, Kentucky Geological Survey.

Rock Creek

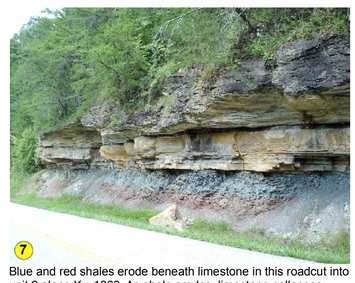


Limestones present before the age of dinosaurs crop out along the aptly named Rock Creek. Photo by Randy Paylor, Kentucky Geological Survey.

Sandstone, Shale: Unit 6

Roadcut along U.S. 27 north of Wiborg shows sandstones over shales in unit 6. Erosion of underlying shale can lead to rock falls. Photo by Bethany Overfield, Kentucky Geological Survey.

Shale and Limestone: Unit 2



Blue and red shales erode beneath limestone in this roadcut into unit 2 along Ky. 1363. As shale erodes, limestone collapses. Photo by Bethany Overfield, Kentucky Geological Survey.

Land-Use Hazards

Flooding along major streams and flash flooding along smaller streams is a significant hazard in McCreary County.

Landslides resulting from construction on steep slopes are also a major cause of damages. Technical assistance from engineers or geologists familiar with the area should be obtained to determine site-specific conditions.

Surface and underground mining has occurred extensively throughout the county. Before undertaking construction in any area, evaluate the site for possible impacts from nearby or underground mined areas.

Sinkholes and karst features in units 3 and 4 may present local problems.

Acid Mine Drainage

Acid mine drainage from an abandoned underground coal mine is exposed to limestone at this facility, reducing the acidity before it flows downstream. Photos by Randy Paylor, Kentucky Geological Survey.

The Old Swimming Hole

Maintenance of clean water is essential for public water systems, groundwater, aquatic wildlife, and recreation. Photo by Dan Carey, Kentucky Geological Survey.

Groundwater

Most wells drilled in the valley bottoms and hillsides are adequate for a domestic supply. About half the wells drilled on hilltops and ridges are adequate for domestic needs. Deep wells penetrating more than 500 feet of sandstone may yield enough water for small utilities or industrial supplies. Water obtained from most wells is soft or moderately hard and contains noticeable amounts of iron. Salty water may be found in wells drilled 100 feet below the level of the principal valley bottoms. In the limestone valleys of western McCreary County, springs are occasionally found with flows as large as 100 gallons per minute. Throughout the county, however, most springs yield less than 5 gallons per minute. For more information on groundwater in the county, see Carey and Stickney (2004)

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.

EXPLANATION

- School

Water wells
- Domestic
- Monitoring
- Public
- Spring
- Gas well
- Oil and gas well
- Enhanced recovery oil well
- County line
- Watershed boundary
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Source-water protection area, zone 1
- Surface, auger, or undetermined mining
- Underground mining
- Mapped sinkhole

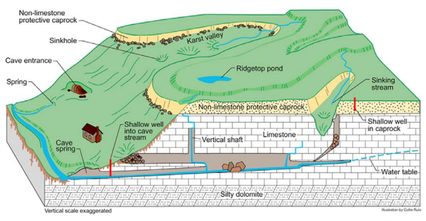
Boundaries of Public Lands
- Lake Cumberland Wildlife Management Area
- Natural Arch Scenic Area
- Beaver Creek Wilderness and Wildlife Management Area
- Big South Fork National River and Recreation Area
- Cumberland Falls State Park and Nature Preserve

4 Photo location

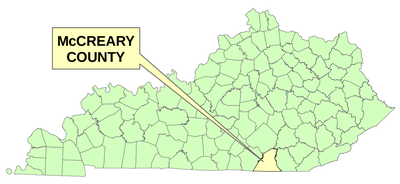
100-foot contour interval

7.5-Minute Quadrangle Index

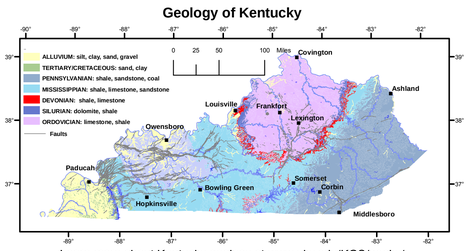
Karst



Limestone units 3 and 4 are in the easternmost Pennyroyal karst region. Proper disposal of waste in this area will help prevent groundwater pollution.

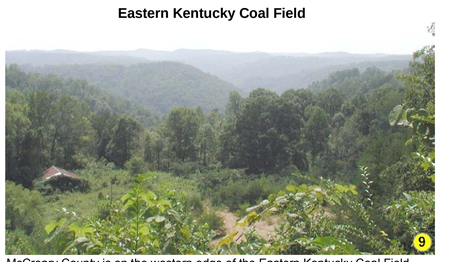


Geology of Kentucky



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

Eastern Kentucky Coal Field



McCreary County is on the western edge of the Eastern Kentucky Coal Field. Topography such as this, underlain by units 5, 6, and 7, is typical of the region. Photo by Randy Paylor, 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. Alluvium—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 (Byrne and others, 1970).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Byrne and others, 1970).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Byrne and others, 1970).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Byrne and others, 1970).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Byrne and others, 1970).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Byrne and others, 1970).	Slight to severe limitations, depending on type of activity and topography. Subject to flooding. Refer to soil report (Byrne and others, 1970).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Byrne and others, 1970).	Fair stability. Fair compaction characteristics. Piping hazard. Refer to soil report (Byrne and others, 1970).	Slight limitations, in general, except for seasonal high water table. Subject to flooding. Refer to soil report (Byrne and others, 1970).
2. Shale, sandstone, limestone, siltstone	Fair to good foundation material; difficult to excavate. Possible expansion of shales.	Severe limitations; thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Possible steep slopes. Possible expansion of shales.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Possible steep slopes. Possible expansion of shales.	Moderate limitations. Rock excavation; possible steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Possible steep slopes. Possible expansion of shales.	Severe limitations. Possible steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Possible steep slopes.	Moderate limitations. Highly variable amount of rock and earth excavation.
3. Limestone, shale, siltstone	Fair to good foundation material; difficult to excavate. Possible expansive shales.	Severe limitations; thin soils and impermeable rock. Fast drainage through fractures to water table; possible groundwater contamination.	Moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes along major drainages. Possible expansion of shales.	Moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes along major drainages. Possible expansion of shales.	Slight limitations. Rock excavation. Steep slopes along major drainages.	Slight limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes along major drainages. Possible expansion of shales.	Moderate limitations. Steep to moderate slopes.	Slight limitations.	Slight to moderate limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Slight limitations. Reservoir may leak where rocks are fractured.	Moderate limitations. Possibility of thin soils and rock excavation.
4. Limestone, dolomite, shale	Fair to very good foundation material; difficult to excavate.	Severe limitations; thin soils and Impermeable rock. Locally fast drainage through fractures to water table; possible groundwater contamination.	Severe limitations. Rock excavation may be required. Steep slopes along major drainages.	Moderate limitations. Rock excavation. Local drainage problems. Sinks possible.	Moderate limitations. Rock excavation. Local drainage problems. Sinks possible.	Slight to severe limitations, depending on topography. Rock excavation possible. Sinks common. Local drainage problems. Groundwater contamination possible.	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.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe limitations. Possible rock excavation.
5. Sandstone, conglomerate, and minor shale	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 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, siltstone, sandstone, coal	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, coals, and underclays. Possibility of underground coal-mine voids.	Severe limitations; thin soils and impermeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Possible radon occurrence.	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. Possible steep slopes.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes. Slight limitations for nature preserve.	Slight limitations. Reservoir may leak where rocks, including coal, are jointed or fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Thin soils. Possible rock excavation.
7. Sandstone, siltstone, shale, underclay, coal	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, coals, and underclays. Possibility of underground coal-mine voids.	Severe limitations; thin soils and impermeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required.	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.	Severe to moderate limitations. Rock excavation may be required.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes. Slight limitations for nature preserve.	Slight limitations. Reservoir may leak where rocks, including coal, are jointed or fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Thin soils. Possible rock excavation.

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Additional Resources

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

ces.ca.uky.edu/Mccreary/ University of Kentucky Cooperative Extension Service
www.lcadd.org/ Lake Cumberland Area Development District
www.thinkkentucky.com/edis/cmnty/cw108/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21147.html Kentucky Atlas and Gazetteer, McCreary County
quickfacts.census.gov/qfd/states/21/21147.html U.S. census data
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey

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.

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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.