



2006

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

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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.

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.

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
- Photo location

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

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/web/site/iplan/viewer.htm.

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Daniel I. Carey and Richard E. Sergeant

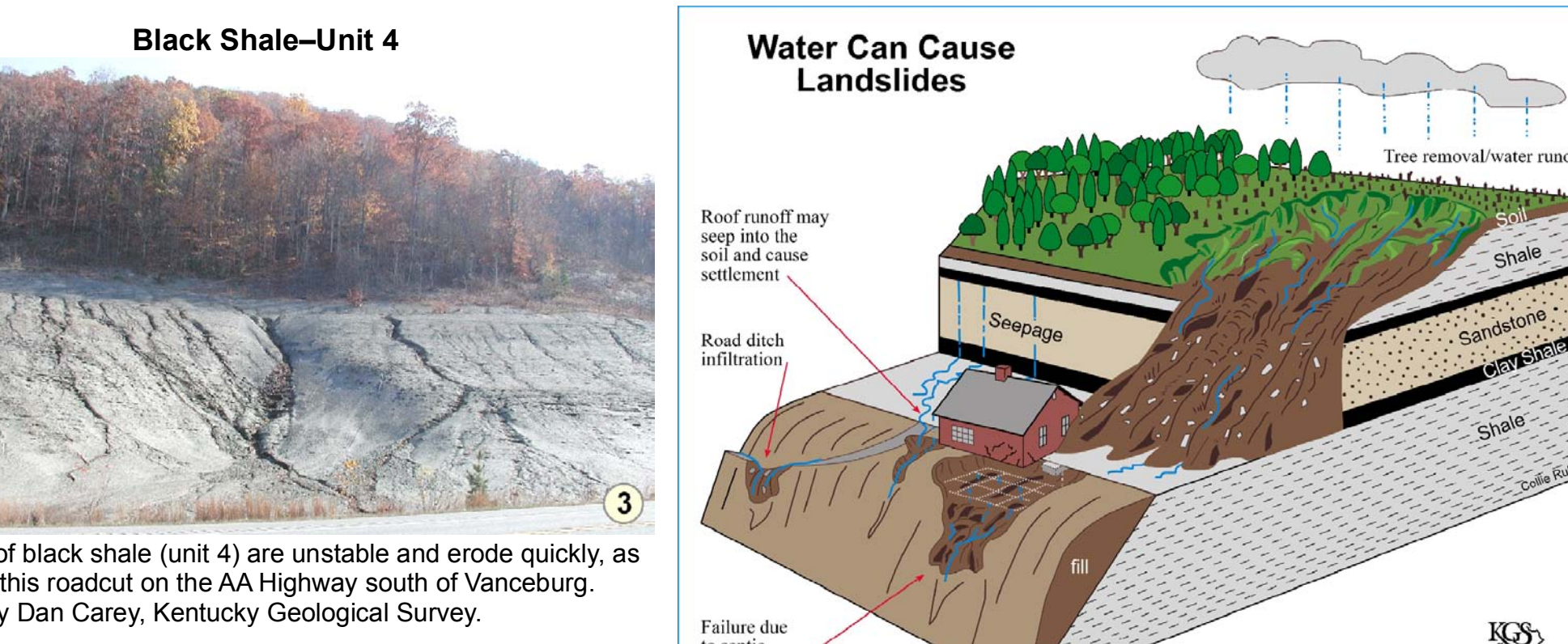
Acknowledgments
Geology adapted from Lambert and Sparks (2005), Murphy (2005a-c), Murphy and Petersen (2005), Nelson and Petersen (2005), Zhang (2005), Ashcraft and Petersen (2006), Petersen (2006a, b), Plauché (2006), Plauché and Petersen (2006a-c), Tott (2006), and Tott and Petersen (2006a, b). Mapped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

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.

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 a major contributing factor. 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).

Water Can Cause Landslides

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.

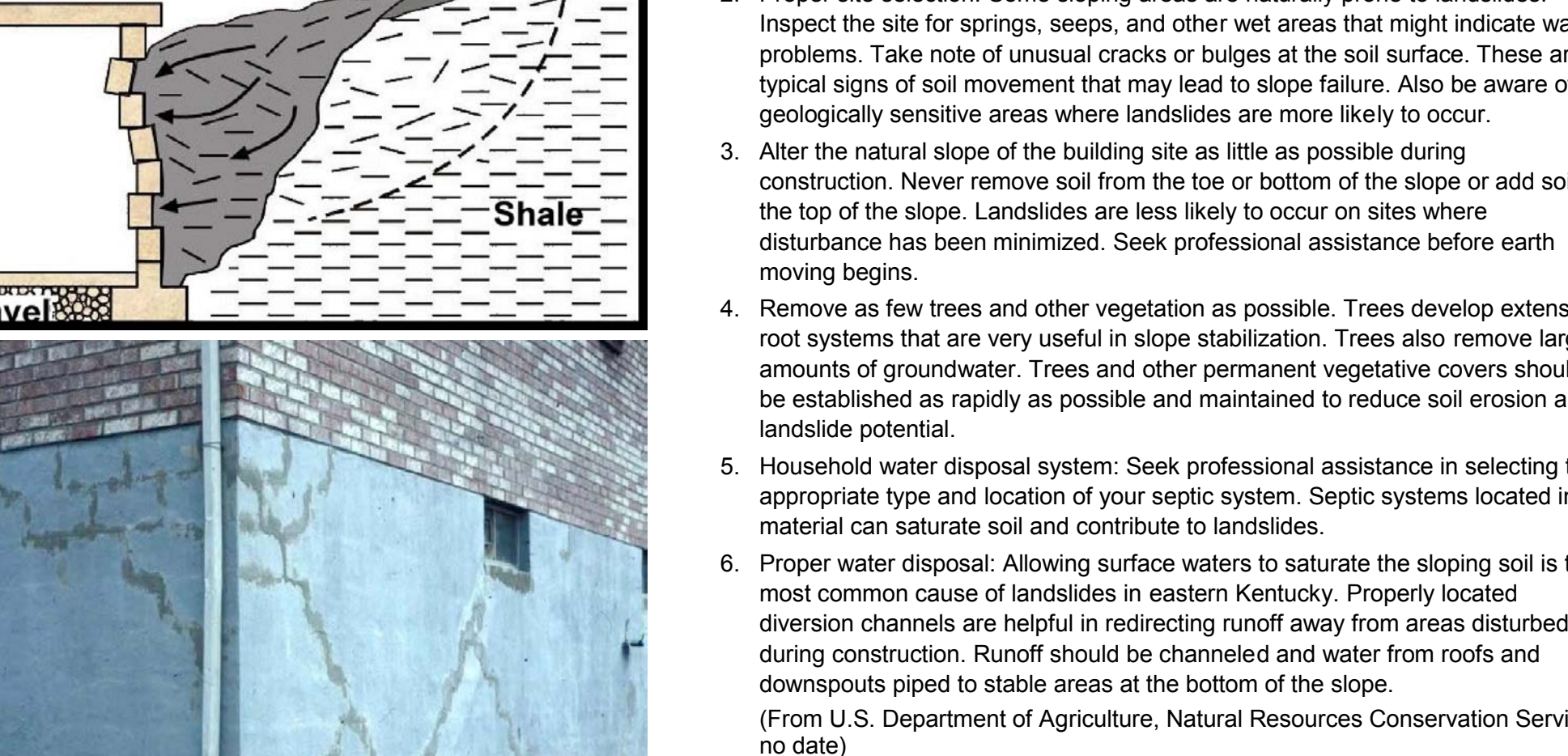
Swelling and Shrinking Shales
A problem of some concern in this area is the swelling of some of the clays and shales. Expanding shale can cause backfill to swell and concrete to crack and crumble. It can heave the foundation, the slab, and interior partitions resting on it, and damage upper floors and 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.

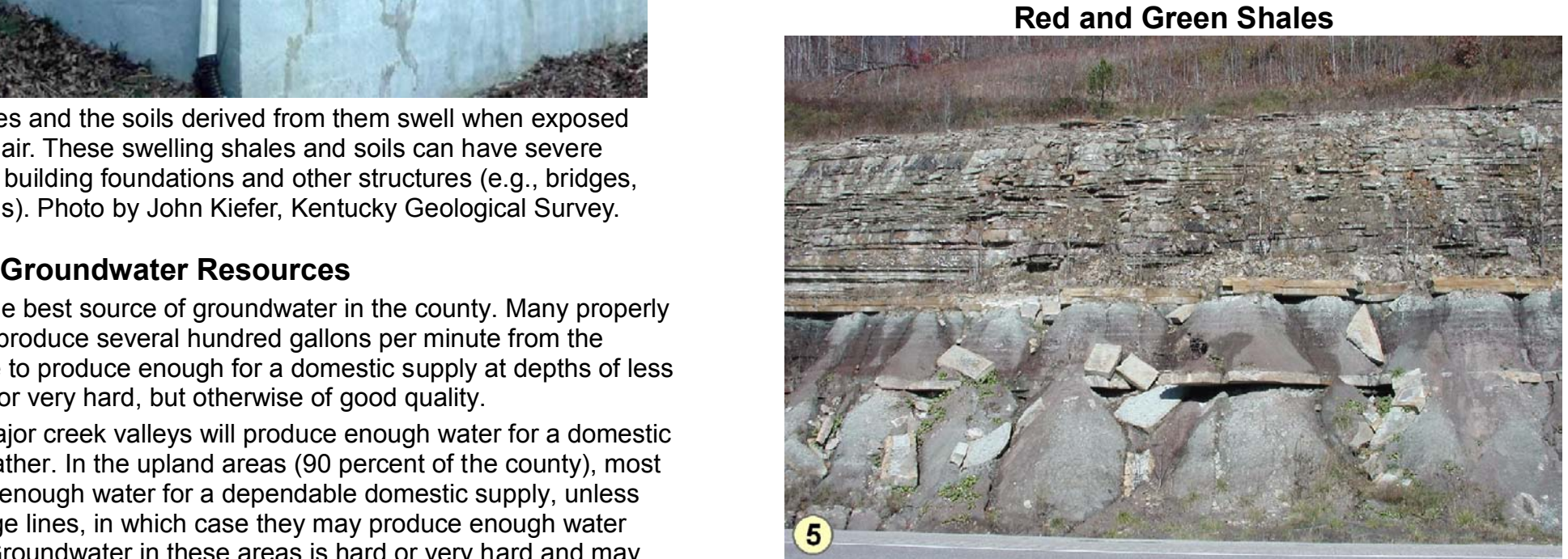
What Are the Factors That Cause Landslides?
Many factors contribute to landslides. The most common in eastern Kentucky are listed below:

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 causes ponding or runoff are sources of water that often contribute to landslides.
3. Changing the natural slope of a 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. Property located in the floodplain should be elevated. 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)

Swelling Shale and Foundation Damage

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.

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.

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 (80 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. 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