

A problem of considerable concern in this area is the swelling of some of the clay minerals in shale units 2 and 3. 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.

The diagram shows a cross-section of the ground. At the top is a horizontal line representing the ground surface, labeled 'Soil'. Below this is a layer of 'Shale' represented by horizontal dashed lines. A portion of the shale layer is shaded grey and labeled 'Swelling shale and soil'. Arrows point upwards from this shaded area, indicating the direction of swelling. Below the shale is a layer of 'Gravel' represented by small circles. Above the gravel is a 'Concrete floor slab' represented by a thick horizontal line. The swelling shale is shown pushing upwards against the gravel and the concrete slab.



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.

Steep, rolling, mammillary topography is characteristic of areas underlain by shaly limestone (unit 2). Photo by Dan Carey, Kentucky Geological Survey.

Ground shaking (peak particle accelerations) caused by an earthquake in or near the county is minimal for structures situated on or tied into the bedrock foundation. In areas underlain by poorly consolidated soils, site-specific investigations should be conducted to assure that the building codes will conform to any ground deformation such as liquefaction, landslides, or surface fault ruptures. See www.uky.edu/KGS/geologic/hazards/eqhazards.htm for more information.

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

ces.ca.uky.edu/harrison/ University of Kentucky Cooperative Extension Service
www.kinctoneet.net/kvrcvd/ukr/ Licking River Valley Resource Conservation and Development Council Inc.
www.bgaad.org/ Bluegrass Area Development District
www.kentucky.com/content/contentPages.jsp?id=690489 Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21097.htm Kentucky Atlas and Gazetteer, Harrison County
quickfacts.census.gov/qsd/states/21/21037.html U.S. census data
www.kentucky.gov/download/ka2planing.htm Planning information from the Kentucky Geological Survey

Geology adapted from Nelson (2001a-f, 2002a, b), Sparks (2001), Thompson (2001), and Zhang (2002a, b).

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/webseite/kyulpan/viewer.htm.

 School
 Water wells
 Domestic
 Monitoring
 Spring
 Watershed boundary
 Railroad
 Geologic fault
 County line
 Mapped sinkhole
 Designated flood zone* (FEMA, 2005)
 Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
 Incorporated city boundaries
 Source-water protection area, zone 1
 Artificial fill
 40-foot contour interval
 Photo location

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

A map of Harrison County, West Virginia, is shown. An inset map to the right shows the surrounding counties: Mason, Boone, Raleigh, and Lee. The county is highlighted in yellow on the main map and in the inset map.



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For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call our Public Information Center at 859.257.3896 or 877.778.7827 (toll free)

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

Several rural residential developments are under way near Cynthiana. Serenity Place, a planned unit development of 33 1- to 5-acre lots, lies northeast of the city off of U.S. 62. Photo by Dan Carey, Kentucky Geological Survey.

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.

Limestone (unit 4) soils provide for an agricultural economy. Photo by Dan Carey, Kentucky Geological Survey.

Rock Unit	Karst Potential Rating	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Retail	Intensive Recreation	Extensive Roads	Reservoir Area	Reservoir Embankment	Underground Utilities
1. Clay, silt, sand, and gravel (high-level karst investigation reveals where less than 25 feet thick over soluble rock)	None, but on-site karst investigation recommended where less than 25 feet thick over soluble rock	Fair foundation material; easy to excavate.	Severe limitations. Failed septic systems can contaminate groundwater. Refer to soil report (Odor and others, 1968).	Water in alluvium may be in direct contact with basements. Refer to soil report (Odor and others, 1968).	Slight limitations. Refer to soil report (Odor and others, 1968).	Slight to moderate limitations. Refer to soil report (Odor and others, 1968).	Slight to moderate limitations. Avoid construction in flood plain (Odor and others, 1968).	Refer to soil report (Odor and others, 1968).	Refer to soil report (Odor and others, 1968).	Refer to soil report (Odor and others, 1968).	Not recommended. Refer to soil report (Odor and others, 1968).	Not recommended. Refer to soil report (Odor and others, 1968).
2. Shale*, lime-stone	Medium to low.	Fair to good foundation material; easy to excavate. Avoid steep slopes.	Slight to severe limitations. Rock excavation may be required to depth to impermeable rock. Avoid steep slopes.	Severe to moderate limitations. Rock excavation may be required to meet wet. Avoid steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate limitations. Rock excavation likely. Local drainage on shale. Shinks common.	Slight to severe limitations. Depending on topography. Rock excavation possible. Shinks common. Groundwater contamination possible.	Slight to moderate limitations. Depending on activity and topography. Possible steep wooded slopes.	Slight limitations. Depending on activity and topography. Possible steep wooded slopes. No limitations for nature or forest preserve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Possible rock excavation. Susceptible to landslides.
3. Limestone, shale	High to medium.	Good to excellent foundation material; difficult to excavate.	Slight to severe limitations. Depending on amount of soil cover and depth to impermeable rock.	Severe to moderate limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage possible. Shinks common and caves possible.	Moderate limitations. Rock excavation possible. Possible steep slopes. Shinks common. Local drainage problems. Groundwater contamination possible.	Slight to severe limitations. Depending on topography. Rock excavation likely. Shinks common. Local drainage problems. Groundwater contamination possible.	Slight to moderate limitations. Depending on activity and topography. Rock excavation may be required.	Slight limitations. Depending on activity and topography. Rock excavation may be required. No limitations for nature or forest preserve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Possible rock excavation.
4. Limestone	High.	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 rivels.	Slight to moderate limitations. Depending on topography. Rock excavation possible. Shinks common. Local drainage problems.	Moderate to slight limitations. Depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations. Depending on activity and topography. Possible steep wooded slopes. No limitations for nature preserve.	Slight to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Slight to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Possible rock excavation.
5. Clay, silt, sand, and gravel (high-level karst investigation reveals where less than 25 feet thick over soluble rock)	None, but on-site karst investigation recommended where less than 25 feet thick over soluble rock	Fair foundation material; easy to excavate.	Severe to slight limitations. Depending on amount of soil cover.	Moderate to slight limitations. Depending on slope.	Slight limitations.	Slight limitations. Depending on degree of slope.	Slight limitations. Depending on degree of slope.	Moderate to slight limitations. Depending on activity and topography. Possible steep wooded slopes.	Slight limitations. Depending on activity and topography. Possible steep wooded slopes. No limitations for nature preserve.	Not recommended. Previous material.	Severe to slight limitations. Unstable steep slopes.	Slight limitations.

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