Kentucky Geological Survey
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UNIVERSITY OF KENTUCKY, LEXINGTON

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

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Kentucky Geological Survey

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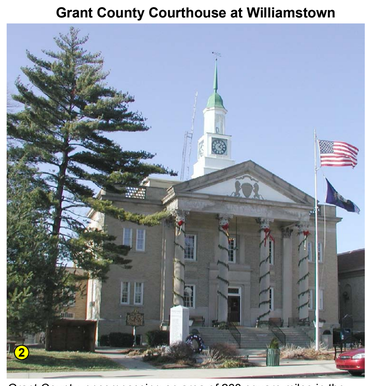
University of Kentucky

MAP AND CHART 123

Series XII, 2006

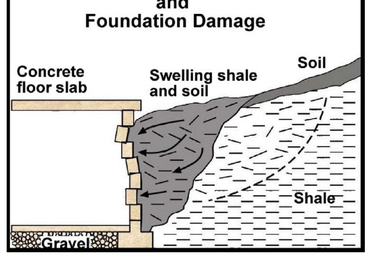
Grant County Courthouse at Williamstown



Grant County, encompassing an area of 260 square miles in the Outer Bluegrass Region, was established in 1820. Highway, air, and rail transportation are readily accessible. Lakes and rolling hills provide for a variety of recreational activities. From 1990 to 2004, the population increased 54 percent, to 24,300 residents. Photo by Dan Carey, Kentucky Geological Survey.

Swelling and Shrinking Shales

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.



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.

Eagle Creek

Looking downstream at Eagle Creek from the Ky. 1132 bridge south of Folsom. With a drainage area of 519 square miles, Eagle Creek is the largest creek in Kentucky. Photo by Dan Carey, Kentucky Geological Survey.

Eagle Creek Alluvial Valley

Wide alluvial valley along Eagle Creek in western Grant County. Photo by Dan Carey, Kentucky Geological Survey.

Residential Development

Residential development near Crittenden. Photo by Dan Carey, Kentucky Geological Survey.

Williamstown Lake

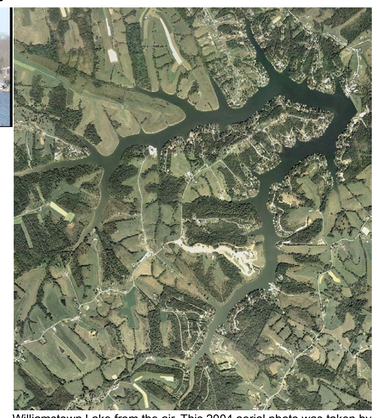
The 330-acre Williamstown Lake serves as a water-supply reservoir, and provides fishing and boating recreation for residents and vacationers. Photo by Dan Carey, Kentucky Geological Survey.

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 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/website/kyluplan/viewer.htm.

Acknowledgments

Geology adapted from Duncan (2002), Duncan and Thompson (2002), Nelson (2001, 2002a-f), Patton (2001), Thompson (2002), Tyra (2002), and Zhang (2002). Sinkholes from Paylor and others (2004).



Williamstown Lake from the air. This 2004 aerial photo was taken by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

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
  - Spring
- Watershed boundary
- Railroad
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Incorporated city boundaries
- Source-water protection area, zone 1
- Wildlife management area
- Artificial fill
- 40-foot contour interval
- 4 Photo location

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. 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 of the mass movements in northern Kentucky occur in colluvium—the weathered soil and rock materials that crumble from the bedrock as it weathers. The lower slopes of unit 2 are commonly thickly mantled with colluvium.

Shales of unit 2 and adjacent unit 3 will break down and weather rapidly when exposed to air and water. These shaly units tend to swell considerably when exposed to water. For this reason, plumbing trenches under walls and foundations should be prevented from accumulating water. Units 2 and 3 may share a translational landslide.

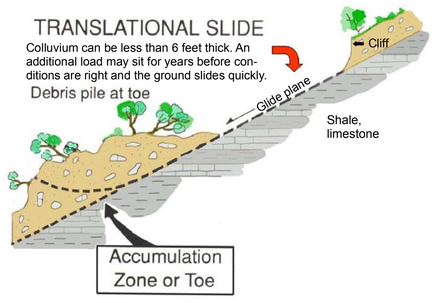
Gravity is the main driving force, but water nearly always plays a critical role by adding weight and lubricating the particles in the colluvium. Cutting into or overloading a slope with structures and fill can also be major contributing factors.

Precautions include taking care of all surface-water runoff by making certain that all runoff from roof, 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. Old 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).

Rotational landslides occur in both the thicker colluvium of unit 2 and in glacial deposits. The head or top area has tension cracks or small cliffs; the toe or bottom has transverse ridges or bulges. A principal glide plane connects the top to the bottom. Small tension cracks in the top become large scarps or cliffs as material moves downslope and small bulges in the bottom become larger ones. After Potter (1996).



A transitional landslide is a relatively thin sheet of colluvium that separates from the underlying bedrock and slides catastrophically downslope more or less as a coherent sheet until it abruptly stops and becomes a crumbled, disorganized pile of debris. Such failures are common on steeper slopes of shale-dominated units (units 2, 3) when both colluvium and the weathered, more permeable bedrock below become fully saturated with water. After Potter (1996).

Epperson Landfill

The Epperson landfill contains 1.9 million tons of nonhazardous solid waste and is permitted to accept another 3.9 million tons. A network of environmental protection systems includes a clay and synthetic liner, a leachate collection system, and a gas management system. This 2004 aerial photo was taken by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

Shaly Limestone Terrain

Most upland areas of Grant County are underlain by shaly limestone (unit 2), characterized by rolling, knobby hills that provide pasture for livestock. In northern and eastern areas of the county, unit 3 often lies along ridgetops. Photo by Dan Carey, Kentucky Geological Survey.

Groundwater

Groundwater resources in Grant County are limited. Wells located in the larger valley bottoms 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. Upland wells drilled along drainage lines may produce enough water, except during dry weather. Throughout the county groundwater 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).

Ea;rthquake Hazards

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 liquefication, landslides, or surface fault ruptures. See www.uky.edu/KGS/geologichazards/eqhazards.htm for more information.

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.

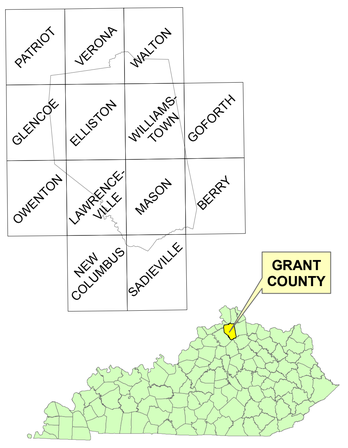
Underground utilities—Included in this group are sanitary sewers, storm sewers, water mains, and other pipes that require fairly deep trenches.

Planning Guidance by Rock Unit Type

Rock Unit	Karst Potential Rating	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	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 (Froedge and Weisenberger, 1980).	Water in alluvium may be in direct contact with basements. Refer to soil report (Froedge and Weisenberger, 1980).	Slight limitations. Refer to soil report (Froedge and Weisenberger, 1980).	Slight to moderate limitations. Refer to soil report (Froedge and Weisenberger, 1980).	Slight to moderate limitations. Avoid construction in flood-plain. Refer to soil report (Froedge and Weisenberger, 1980).	Refer to soil report (Froedge and Weisenberger, 1980).	Refer to soil report (Froedge and Weisenberger, 1980).	Refer to soil report (Froedge and Weisenberger, 1980).	Not recommended. Refer to soil report (Froedge and Weisenberger, 1980).	Not recommended. Refer to soil report (Froedge and Weisenberger, 1980).
2. Shale*, limestone	Medium to low.	Fair to good foundation material. Difficult excavation. Slumps when wet. Avoid steep slopes.	Slight to severe limitations, depending on amount of soil cover and depth to impermeable rock.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate limitations. Rock excavation likely. Local drainage problems, especially on shale. Sinks common.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. 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. Slight limitations for forest or nature 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 problems, especially on shale. Sinks common and caves possible.	Moderate limitations. Rock excavation possible. Possible steep slopes. Slight limitations with suitable topography.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to moderate limitations. Rock excavation may be required.	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.	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 ravines.	Slight to moderate limitations, depending on topography. Rock excavation possible. Sinks common. Local drainage problems.	Moderate to slight limitations, depending on activity and topography. Possible wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes. Slight 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 terrace deposits)	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 wooded slopes.	Slight limitations, depending on activity and topography. Possible wooded slopes. Slight limitations for nature preserve.	Pervious material. Not recommended.	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.

7.5-Minute Topographic 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 Grant County:

ces.ca.uky.edu/grant/ University of Kentucky Cooperative Extension Service
www.kineticnet.net/kyrcd/eagle.html Eagle Resource Conservation and Development Council Inc.
www.nkadd.org/ Northern Kentucky Area Development District
www.thinkkentucky.com/edis/cmnty/cw107/ Detailed county statistics
www.uky.edu/KentuckyAtlas/21081.html Kentucky Atlas and Gazetteer, Grant County
quickfacts.census.gov/qfd/states/21/21081.html U.S. census data
grantcounty.ky.gov/ County government site
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey

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Nelson, H.L., Jr., 2002c, Spatial database of the Mason quadrangle, Grant and Harrison Counties, Kentucky: Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVGQ-1311. Adapted from Luft, S.J., 1976, Geologic map of the Mason quadrangle, Grant and Harrison Counties, Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1311, scale 1:24,000.
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