

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

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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, 858 237 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/kytuplan/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. 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 transitional landslide.

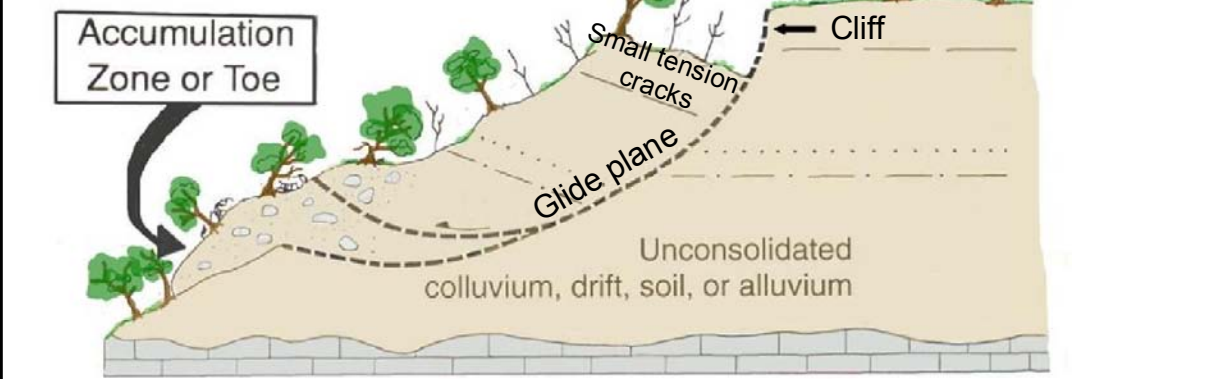
Gravity is the main driving force, and water nearly always plays a critical role by adding weight and lubricating the particles in the colluvium. Cutting into or overloading a slope with structures and fill can also be major contributing factors.

Precautions include taking care of all surface water runoff by making certain that all runoff from 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. Old relic 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.

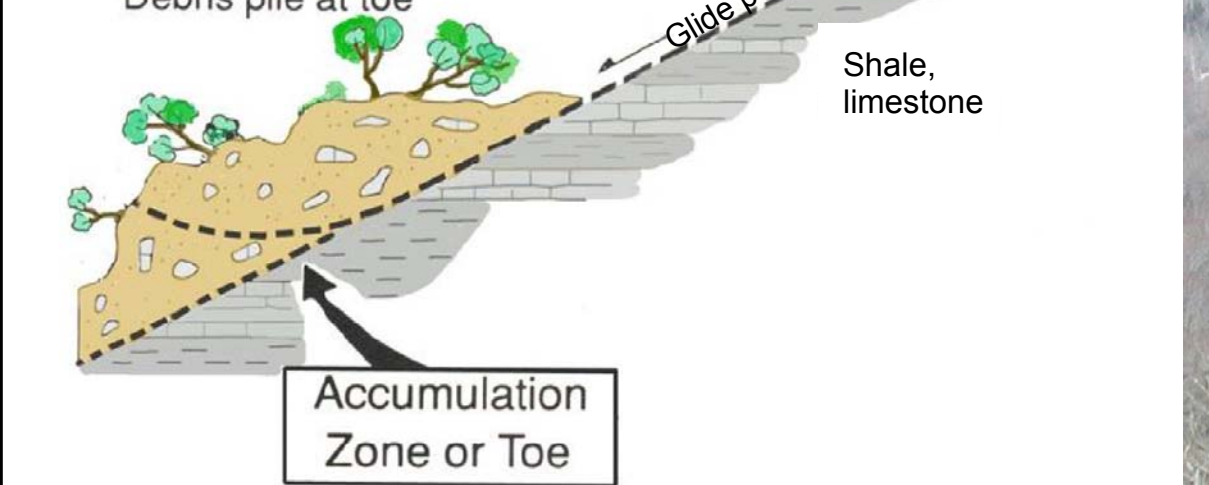
For more information, see Potter (1996).

ROTATIONAL SLIDE
Movement is likely to be slow, but can be accelerated by an increased load or an excessive increase of water.



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 scars or cliffs as material moves downslope and small bulges in the bottom become larger ones. After Potter (1996).

TRANSLATIONAL SLIDE
Colluvium can be less than 6 feet thick. An additional load may sit for years before conditions are right and the ground slides quickly. Debris pile at toe.



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).

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.

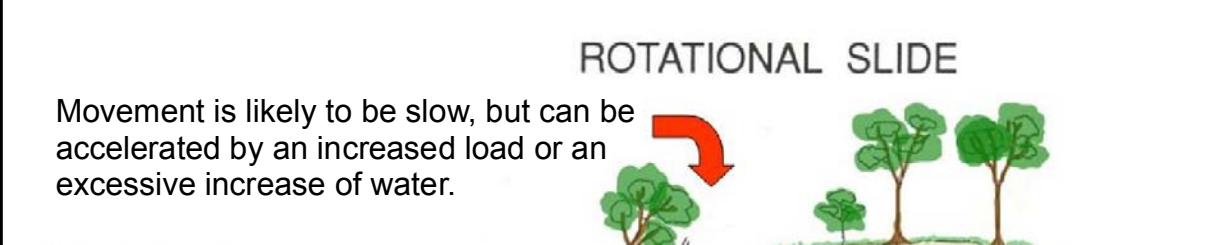
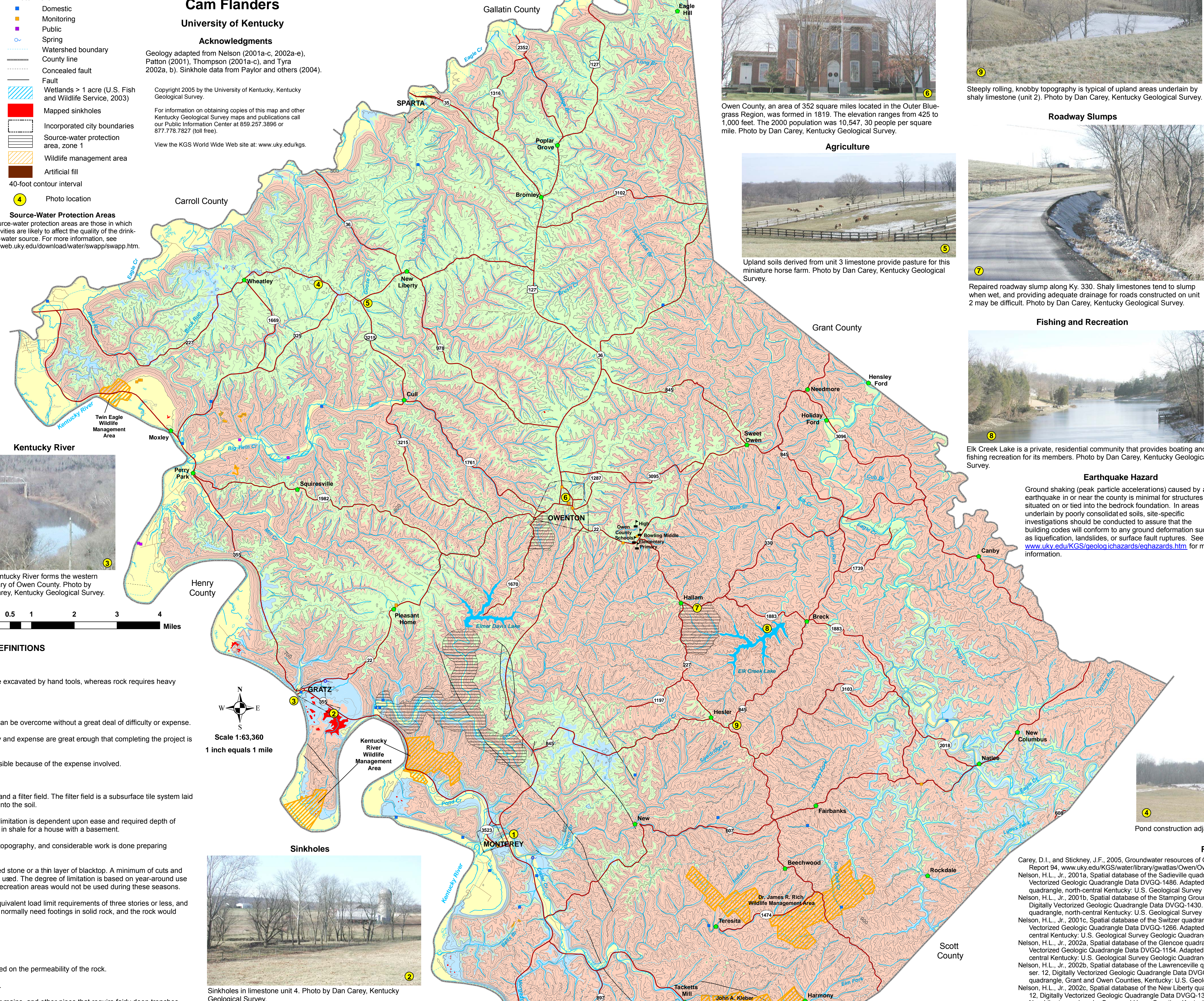
Light industry and malls—Ratings are based on developments having structures or equivalent load limit requirements of three stories or less, and large paved areas for parking lots. Structures with greater load limit requirements would normally need footings in solid rock, and the rock would need to be 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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Planning Guidance by Rock Unit Type

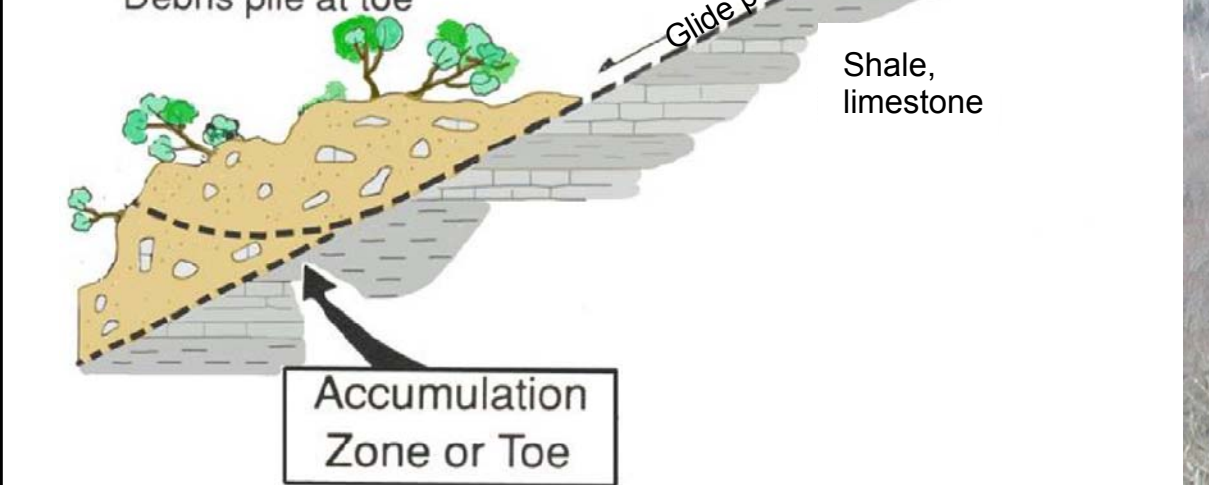
Rock Unit	Karst Potential Rating	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Clay, silt, sand, and gravel (high-level terrace deposits)	None, but on-site 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 (Wesenberger and Richardson, 1972).	Water in alluvium may be in direct contact with basements. Refer to soil report (Wesenberger and Richardson, 1972).	Slight limitations. Refer to soil report (Wesenberger and Richardson, 1972).	Slight to moderate limitations. Refer to soil report (Wesenberger and Richardson, 1972).	Slight to moderate limitations. Refer to soil report (Wesenberger and Richardson, 1972).	Refer to soil report (Wesenberger and Richardson, 1972).	Refer to soil report (Wesenberger and Richardson, 1972).	Refer to soil report (Wesenberger and Richardson, 1972).	Not recommended. Refer to soil report (Wesenberger and Richardson, 1972).	Not recommended. Refer to soil report (Wesenberger and Richardson, 1972).
2. Shale, limestone	Medium to low.	Fair to good foundation material; difficult excavation. Slump 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 may be required. Possible steep slopes. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to severe limitations, depending on topography. Rock excavation may be required. Possible steep slopes. 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. Susceptible to landslides.	Moderate to severe limitations. Possible rock excavation.
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. Possible steep slopes. Sinks common and caves possible.	Moderate limitations. Rock excavation possible. Possible steep slopes. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to severe limitations, depending on topography. Rock excavation may be required. Possible steep slopes. 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. 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.	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. Possible steep slopes.	Severe to moderate limitations. Rock excavation possible. Possible steep slopes. Sinks common and caves possible.	Slight to moderate limitations, depending on topography. Rock excavation may be required. Possible steep slopes. Sinks common. Local drainage problems. Groundwater contamination possible.	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. 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 (low-level terrace deposits)	None, but on-site 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 of dip.	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. Slight limitations for nature preserve.	Previous material. Not recommended.	Severe to slight limitations. Unlikely 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.

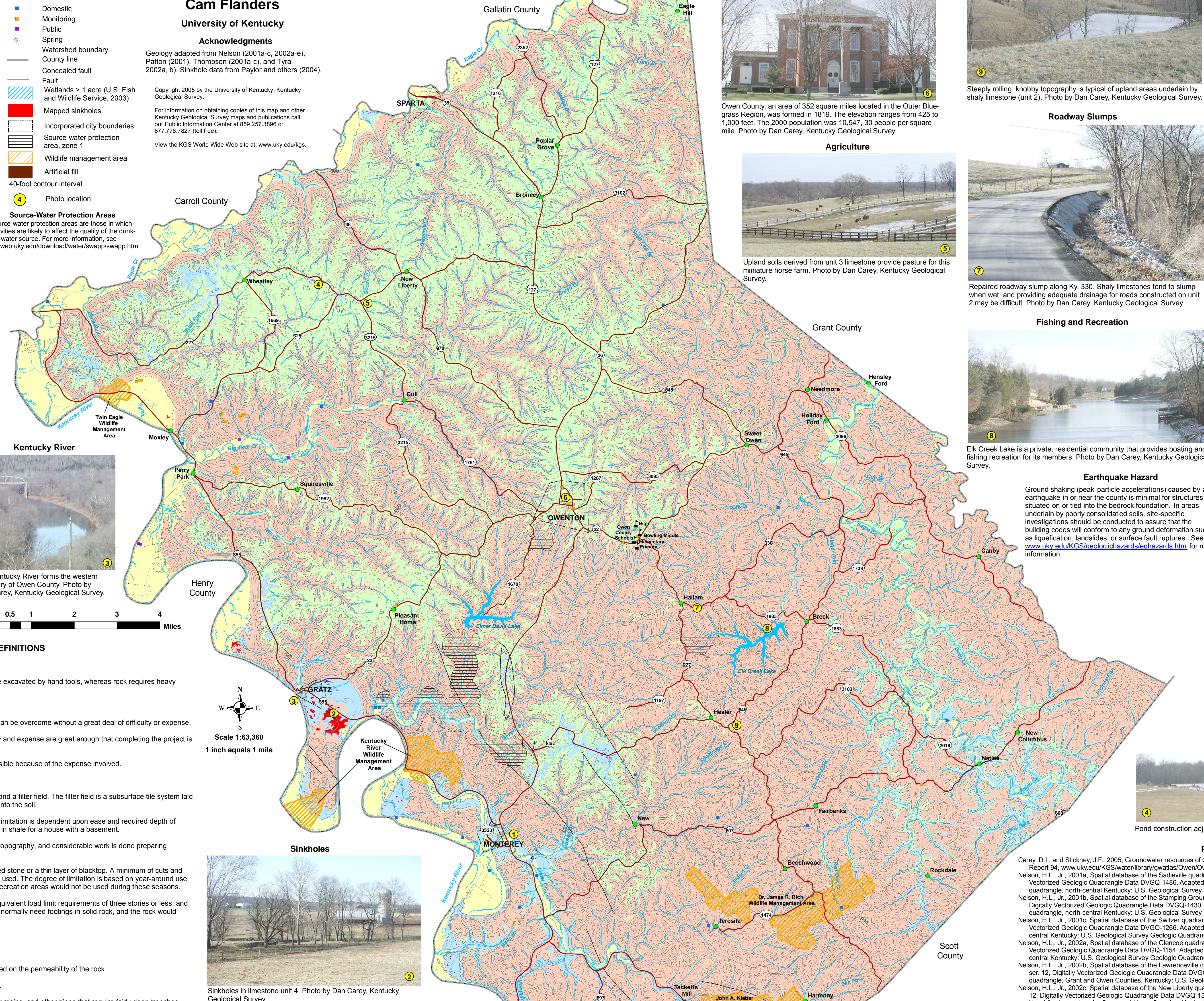


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The Kentucky River forms the western boundary of Owen County. Photo by Dan Carey, Kentucky Geological Survey.

Sinkholes
Sinkholes in limestone unit 4. Photo by Dan Carey, Kentucky Geological Survey.

Owen County Courthouse
Owen County, an area of 352 square miles located in the Outer Blue-grass Region, was formed in 1819. The elevation ranges from 425 to 1,000 feet. The 2000 population was 10,347, 30 people per square mile. Photo by Dan Carey, Kentucky Geological Survey.

Agriculture
Upland soils derived from unit 3 limestone provide pasture for this miniature horse farm. Photo by Dan Carey, Kentucky Geological Survey.

Roadway Slumps
Repaired roadway slump along Ky. 330. Shaly limestones tend to slump when wet, and providing adequate drainage for roads constructed on unit 2 may be difficult. Photo by Dan Carey, Kentucky Geological Survey.

Fishing and Recreation
Elk Creek Lake is a private, residential community that provides boating and fishing recreation for its members. Photo by Dan Carey, Kentucky Geological Survey.

Earthquake Hazard
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.

Pond Construction
Dams should be constructed of compacted clayey soils at slopes flatter than 3 units horizontal to 1 unit vertical. Ponds with dam heights exceed-ing 25 feet, or pond volumes exceeding 50 acre-feet, require permits. Contact the Kentucky Division of Water, 14 Reilly Rd., Frankfort, KY 40601, telephone: 502.564.3410. Illustration by Paul Howell, U.S. Department of Agriculture—Natural Resources Conservation Service.

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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 Owen County:
ces.ca.uky.edu/owen/ University of Kentucky Cooperative Extension Service
www.kydnr.net/kyrcvof/egale.htm Eagle Resource Conservation and Development Council Inc.
www.thinkkentucky.com/eda/cmy/cw032 Detailed county statistics
www.uky.edu/kentucky/Atlas21187.htm Kentucky Atlas and Gazetteer, Owen County
quickfacts.census.gov/qd/states/21/21187.htm U.S. census data
owencounty.ky.gov/ County government site
kgsweb.uky.edu/download/kgsplanning.htm Kentucky Geological Survey planning information site

Anti-Leakage Strategy
Deny water access to permeable materials and/or alter materials to an impermeable condition.
Top of Dam
Structured Clay Soil
Limestone Bedrock with Plumbing
Perm - Imperm Boundary

Successful pond construction must prevent water from seeping through structured soils into limestone solution channels below. A compacted clay liner or artificial liner may prevent pond failure. Getting the basin filled with water as soon as possible after construction prevents drying and cracking, and possible leakage, of the clayey soil liner. Ponds constructed in dry weather are more apt to leak than ponds constructed in wet weather. A geotechnical engineer or geologist should be consulted regarding the requirements of a specific site. Other leakage prevention measures include synthetic liners, bentonite, and asphaltic emulsions. The U.S. Department of Agriculture—Natural Resources Conservation Service can provide guidance on the application of these liners to new construction, and for treatment of existing leaking ponds.

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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 Owen County:
ces.ca.uky.edu/owen/ University of Kentucky Cooperative Extension Service
www.kydnr.net/kyrcvof/egale.htm Eagle Resource Conservation and Development Council Inc.
www.thinkkentucky.com/eda/cmy/cw032 Detailed county statistics
www.uky.edu/kentucky/Atlas21187.htm Kentucky Atlas and Gazetteer, Owen County
quickfacts.census.gov/qd/states/21/21187.htm U.S. census data
owencounty.ky.gov/ County government site
kgsweb.uky.edu/download/kgsplanning.htm Kentucky Geological Survey planning information site

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Nelson, H.L., Jr., 2002b. Spatial database of the Lawrenceville quadrangle, Grant and Owen Counties, Kentucky. Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVQG-1204. Adapted from Swadley, W.C., 1975. Geologic map of the Lawrenceville quadrangle, Grant and Owen Counties, Kentucky. U.S. Geological Survey Geologic Quadrangle Map GQ-1204, scale 1:24,000.
Nelson, H.L., Jr., 2002c. Spatial database of the New Liberty quadrangle, Owen and Henry Counties, Kentucky. Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVQG-1200. Adapted from Swadley, W.C., 1976. Geologic map of the New Liberty quadrangle, Owen and Henry Counties, Kentucky. U.S. Geological Survey Geologic Quadrangle Map GQ-1200, scale 1:24,000.
Nelson, H.L., Jr., 2002d. Spatial database of the Owenon quadrangle, Owen and Grant Counties, Kentucky. Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVQG-1237. Adapted from Swadley, W.C., 1975. Geologic map of the Owenon quadrangle, Owen and Grant Counties, Kentucky. U.S. Geological Survey Geologic Quadrangle Map GQ-1237, scale 1:24,000.
Nelson, H.L., Jr., 2002e. Spatial database of the Sanders quadrangle, north-central Kentucky. Kentucky Geological Survey, ser. 12, Digitally Vectorized Geologic Quadrangle Data DVQG-1095. Adapted from Swadley, W.C., 1973. Geologic map of the Sanders quadrangle, north-central Kentucky. U.S. Geological Survey Geologic Quadrangle Map GQ-1095, scale 1:24,000.
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