



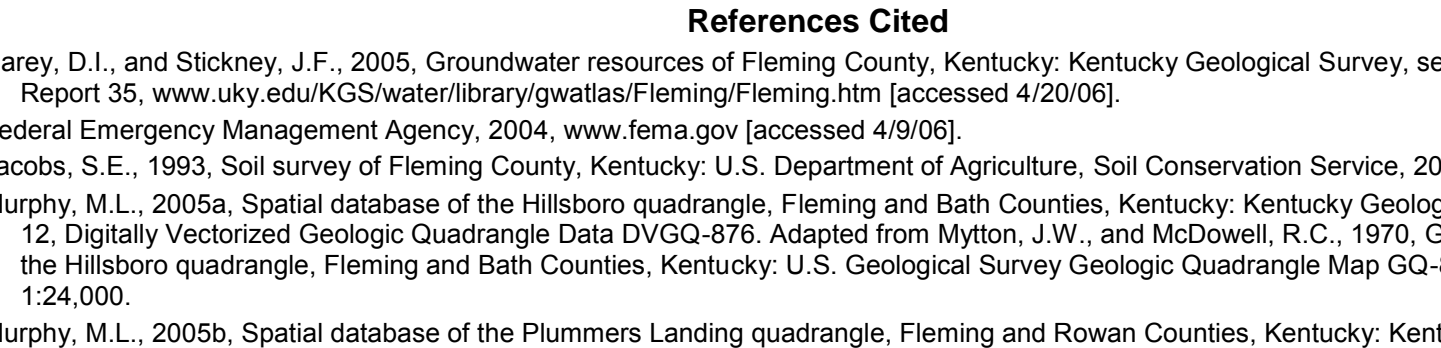
The Grange City covered bridge over Fox Creek is one of several such bridges in the county, survivors from a time of slower pace. Photo by Dan Carey, Kentucky Geological Survey.



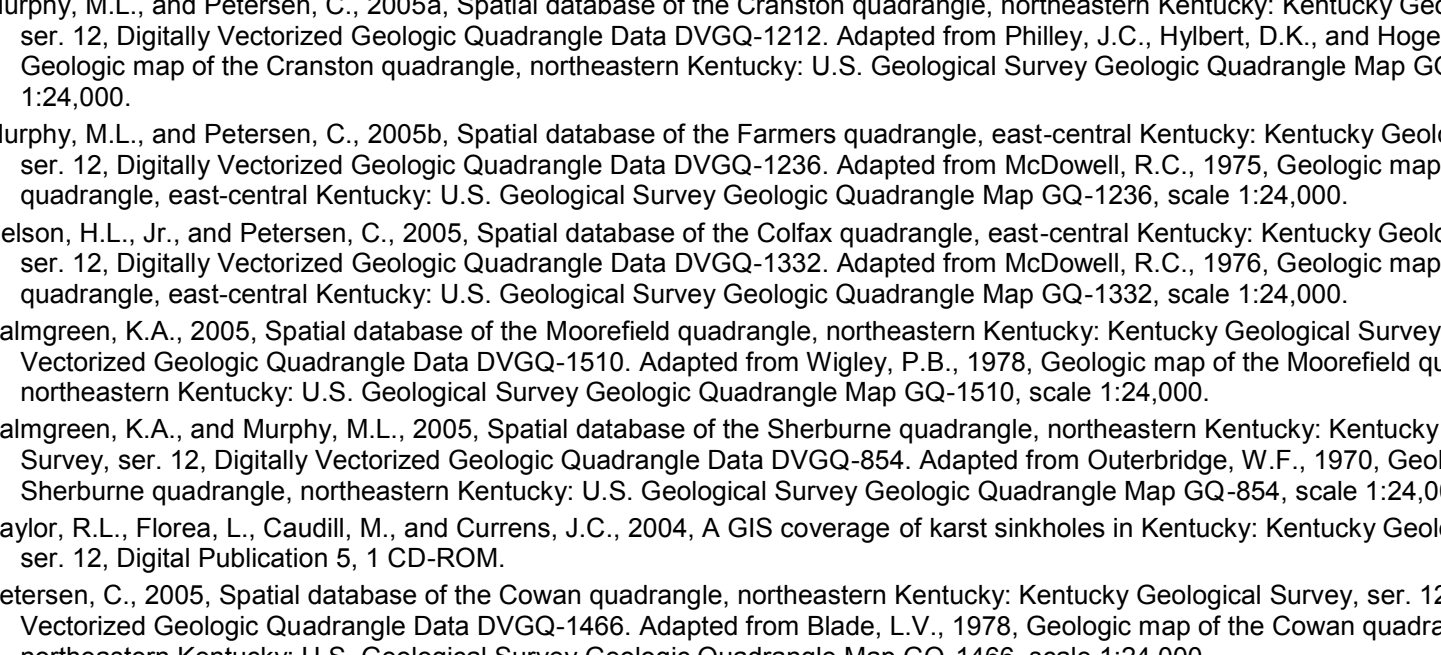
A growing population is spreading across the county. This residential development is north of Flemingsburg off Ky. 11. Photo by Dan Carey, Kentucky Geological Survey.



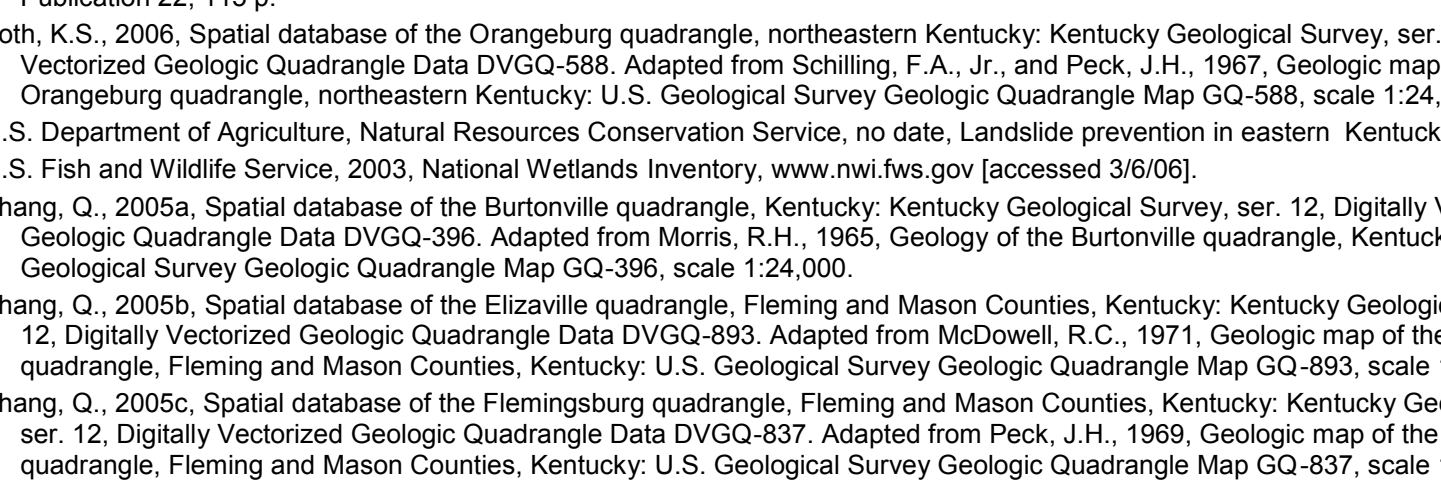
This reservoir is a source of water for the Flemingsburg Utility System. A local resident reports that it also provides habitat for bluegill, crappie, small-mouth bass, and catfish. About 80 percent of Fleming County residents are served by public water and 30 percent are on public sewer. Photo by Dan Carey, Kentucky Geological Survey.



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Planning Guidance by Rock Unit Type

Rock Unit	Foundation and Excavation	Septic System	Residence Basement	Highways and Breeds	Access Roads	Light Industry and Malls	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities	
1. Clay, silt, sand, and gravel (alluvium)	Severe limitations. Foundation material easy to excavate. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs, 1993).	Severe limitations. Refer to water table. Subject to flooding. Refer to soil report (Jacobs, 1993).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs, 1993).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs, 1993).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs, 1993).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Jacobs, 1993).	Slight to severe limitations, depending on topography. Subject to flooding. Refer to soil report (Jacobs, 1993).	Slight to severe limitations, depending on topography. Subject to flooding. Refer to soil report (Jacobs, 1993).	Severe limitations. Fair to good stability. Refer to soil report (Jacobs, 1993).	Fair stability. Fair to good stability. Refer to soil report (Jacobs, 1993).	Slight limitations. In general, except for seasonal high water table. Subject to flooding. Refer to soil report (Jacobs, 1993).	
2. Clay, silt, sand, and gravel (terrace deposits)	Fair foundation. Severe to moderate limitations to excavate.	Moderate to slight limitations. Severe to moderate limitations on top of cover.	Moderate to slight limitations. Severe to moderate limitations on top of cover.	Slight limitations. Severe to moderate limitations on top of cover.	Slight limitations. Severe to moderate limitations on top of cover.	Slight limitations. Severe to moderate limitations on top of cover.	Moderate to slight limitations, depending on activity and topography. Severe to moderate limitations on wooded slopes.	Moderate to slight limitations, depending on activity and topography. Severe to moderate limitations on wooded slopes.	Not recommended. Severe to moderate limitations on small ponds.	Severe to slight and stable steep slopes.	Slight limitations.	
3. Limestone, shale*	Good to excellent foundation material, difficult to excavate.	Moderate to severe limitations. Inexpensive to excavate. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Moderate to severe limitations. Inexpensive to excavate. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Moderate to severe limitations. Inexpensive to excavate. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Moderate to slight limitations. Reservoir may sink where rocks are fractured. Sinks possible.	Moderate to slight limitations. Reservoir may sink where rocks are fractured. Sinks possible.	Moderate to severe limitations. Rock excavation likely.	Moderate to severe limitations. Rock excavation likely.
4. Limestone	Good to excellent foundation material, difficult to excavate.	Moderate to severe limitations. Inexpensive to excavate. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Moderate to severe limitations. Inexpensive to excavate. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Moderate to severe limitations. Inexpensive to excavate. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Moderate to slight limitations. Reservoir may sink where rocks are fractured. Sinks possible.	Moderate to slight limitations. Reservoir may sink where rocks are fractured. Sinks possible.	Moderate to severe limitations. Rock excavation likely.	
5. Black shale*	Poor foundation. Severe to moderate limitations to excavate. Low strength and stability. May contain debris.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Moderate to severe limitations, depending on activity. Slight limitations for nature preserve.	Moderate to severe limitations, depending on activity. Slight limitations for nature preserve.	Slight limitations for small ponds.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wet, recess.	
6. Shale*, limestone	Fair to good foundation material. Severe to moderate limitations. Slumps when wet. Avoid steep slopes.	Slight to severe limitations, depending on topography. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to severe limitations, depending on topography. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to severe limitations, depending on topography. Severe to moderate limitations on steep slopes. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Slight to moderate limitations, depending on topography. Local drainage problems. Sinks possible, especially on shale. Sinks possible. Drainage required.	Moderate to slight limitations. Reservoir may sink where rocks are fractured. Sinks possible.	Moderate to slight limitations. Reservoir may sink where rocks are fractured. Sinks possible.	Moderate to severe limitations. Rock excavation likely.	
7. Shale*	Poor foundation. Low permeability. Moderately difficult to excavate. Low strength and stability. May contain debris.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Severe limitations. Low permeability. Severe to moderate limitations on steep slopes.	Slight to severe limitations, depending on activity. Slight limitations for nature preserve.	Slight to severe limitations, depending on activity. Slight limitations for nature preserve.	Slight limitations for small ponds.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wet, recess.	
8. Sandstone, siltstone, shale	Good to excellent foundation material, difficult to excavate.	Severe limitations. This soil.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations, depending on activity and topography. Slight limitations for nature preserve.	Moderate to severe limitations, depending on activity and topography. Slight limitations for nature preserve.	Not applicable.	Not applicable.	Severe limitations. Rock excavation.	

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

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

Daniel I. Carey
Kentucky Geological Survey

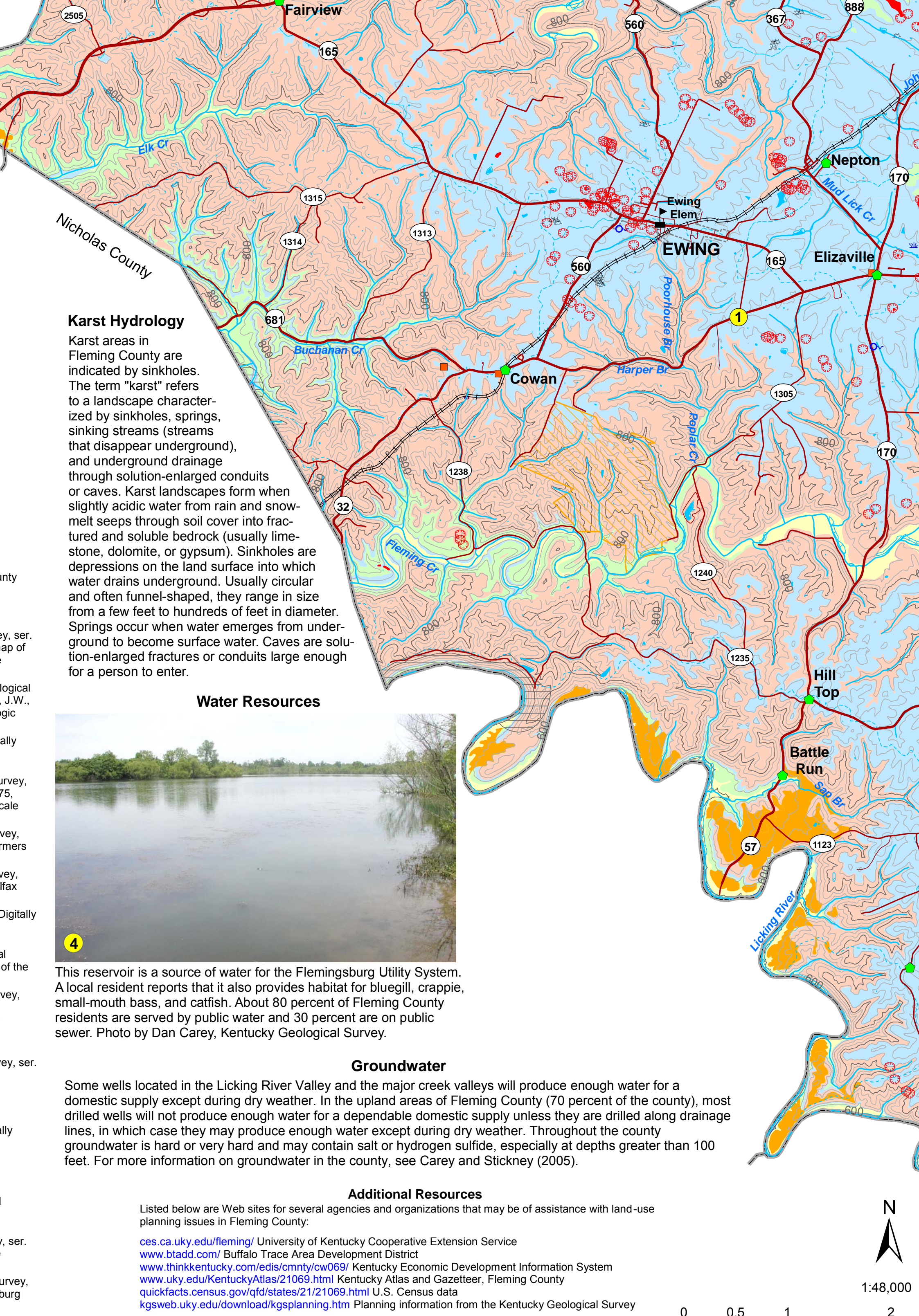
Joseph Buckles
University of Kentucky

Acknowledgments

Geology adapted from Murphy (2005a-c), Murphy and Petersen (2005a, b), Nelson and Petersen (2005), Palmgren (2006), Palmgren and Murphy (2005), Petersen (2005, 2008), Toth (2008), and Zhang (2005a-c). Mapped sinkholes from Paylor and others (2004).

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/kytplanviewer.htm.



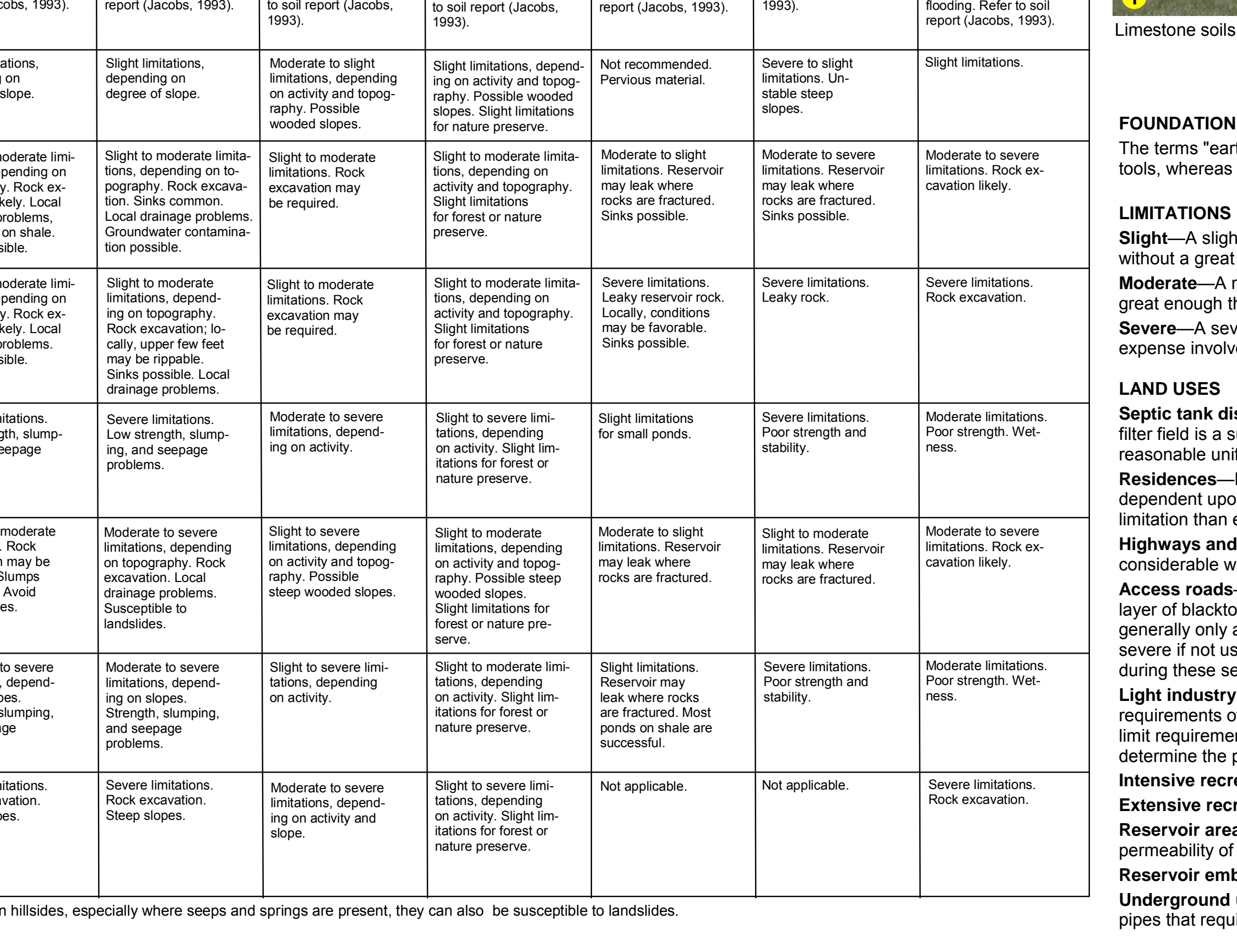
Limestone terrain (unit 4) provides for a rich agriculture. Photo by Dan Carey, Kentucky Geological Survey.

LAND-USE PLANNING TABLE DEFINITIONS

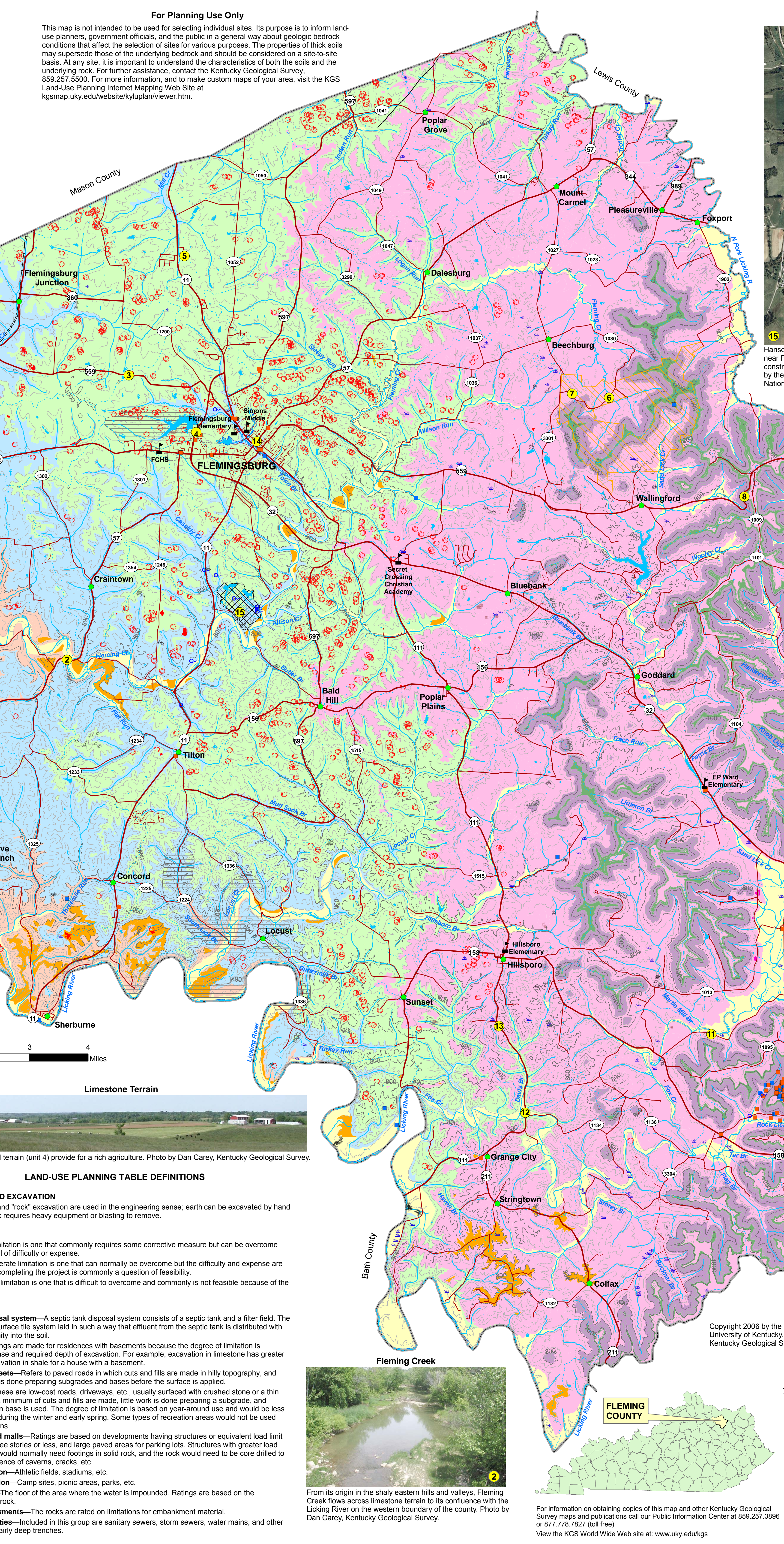
The terms "earth" and "rock" excavation are used in the engineering sense; earth can be excavated by hand tools, whereas rock requires heavy equipment or blasting to remove.

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.

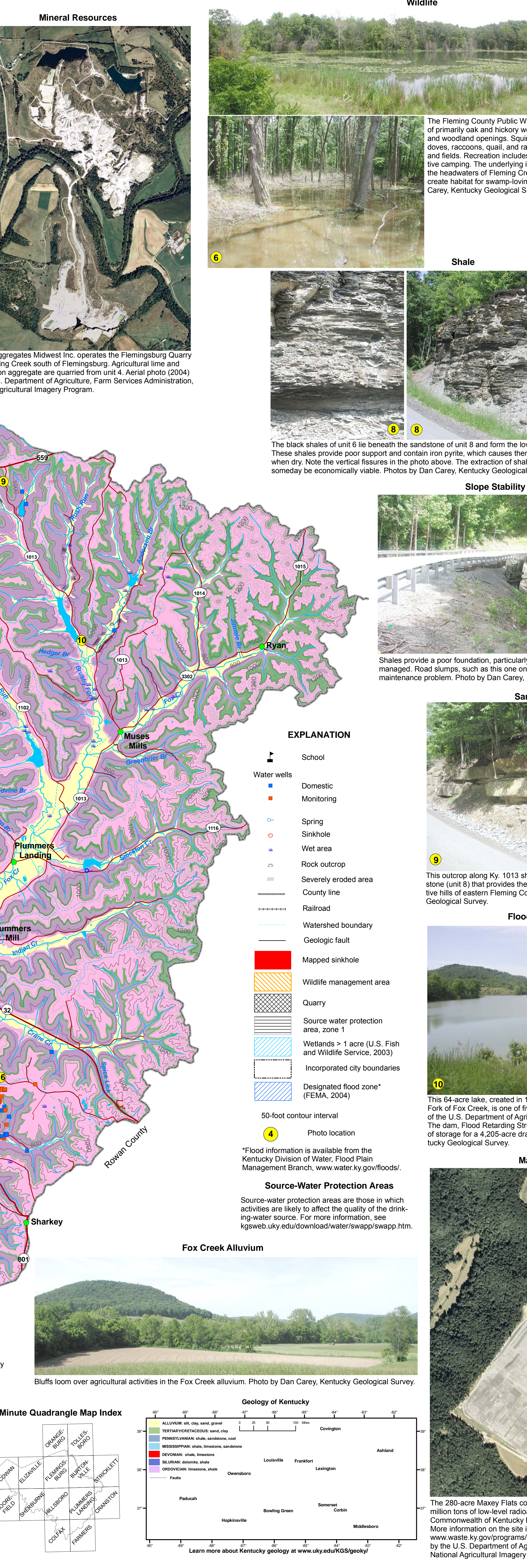
LAND USES
Septic tank disposal system—A septic tank disposal system consists of a septic tank and a filter field. The filter field is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the soil.
Residences—Ratings are made for residences with basements because the degree of limitation is dependent upon base and required depth of excavation. For example, excavation in limestone has greater limitation in 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 in 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.



From its origin in the shaly eastern hills and valleys, Fleming Creek flows across limestone terrain to its confluence with the Licking River on the western boundary of the county. Photo by Dan Carey, Kentucky Geological Survey.



From its origin in the shaly eastern hills and valleys, Fleming Creek flows across limestone terrain to its confluence with the Licking River on the western boundary of the county. Photo by Dan Carey, Kentucky Geological Survey.



For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call our Public Information Center at 859.257.5896 or 877.776.7827 (toll free). Visit the KGS World Wide Web site at www.uky.edu/kgs

Wildlife

The Fleming County Public Wildlife Area is 2,070 acres of primarily oak and hickory woods with some croplands and woodland openings. Squirrels, deer, grouse, doves, raccoons, quail, and rabbits live in the woodlands and fields. Recreation includes fishing, hiking, and primitive camping. The underlying impermeable shales here in the headwaters of Fleming Creek impede drainage and create habitat for swamp-loving creatures. Photos by Dan Carey, Kentucky Geological Survey.

Shale

The black shales of unit 6 lie beneath the sandstone of unit 8 and form the lower slopes of the Eastern Hills. These shales provide poor support and contain iron pyrite, which causes them to swell when wet and shrink when dry. Note the vertical fissures in the photo above. The extraction of shale oil from this formation may someday be economically viable. Photo by Dan Carey, Kentucky Geological Survey.

Slope Stability

Shales provide a poor foundation, particularly when drainage is not properly managed. Road slumps, such as this one on Ky. 559, can be an ongoing maintenance problem. Photo by Dan Carey, Kentucky Geological Survey.

Sandstone

This outcrop along Ky. 1013 shows the 300-million-year-old sandstone (unit 8) that provides the erosion-resistant core for the distinctive hills of eastern Fleming County. Photo by Dan Carey, Kentucky Geological Survey.

Flood Protection

This 64-acre lake, created in 1988 by a 45-foot dam on the Brushy Fork of Fox Creek, is one of five such lakes in the basin that are part of the U.S. Department of Agriculture Fox Creek Watershed Project. The dam, Flood Retarding Structure No. 2, provides 1,433 acre-feet of storage for a 4,205-acre drainage area. Photo by Dan Carey, Kentucky Geological Survey.

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.

Fox Creek Alluvium

Bluffs loom over agricultural activities in the Fox Creek alluvium. 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 basins to swell and concrete to crack and crumble. It can heave the foundation, the slabs, 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.

Swelling Shale Foundation Damage

Concrete floor slab, Swelling shale and soil, Soil, Shale, Gravel.

Water Cause Landslides

Roof runoff may seep into the soil beneath the sidewalk. Road ditch infiltration. Failure due to soil erosion.

What Are the Factors That Cause Landslides?

Many factors contribute to landslides. The most common 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. Poor site preparation: Poor site preparation by creating a level area where none previously existed.
4. Poor site preparation for roads and driveways.
5. Improper placement of fill material.
6. Removal of trees and other vegetation: Site structure 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 top 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: Allow surface waters to saturate the soil as little as possible. Perhaps the most common cause of landslides. 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)

Geology of Kentucky

7.5-Minute Quadrangle Map Index

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