### Kentucky Geological Survey James C. Cobb, State Geologist and Director UNIVERSITY OF KENTUCKY, LEXINGTON

# Montgomery County Courthouse at Mount Sterling



grass and Knobs Regions, was formed in 1797. The 2005 population of 24,092 was 6.8 percent greater than the 2000 population. The highest elevation, 1,447 feet, is on Westbrook Mountain near the county line about 4.5 miles south of Camargo. The lowest elevation, 707 feet is the point were Copperas Creek leaves the county at the Montgomery Clark-Powell boundary. Photo by Dan Carey, Kentucky Geological Survey.

## Mapped Surface Faults

Faults are common geologic structures across Kentucky, and have been mapped in many of the commonwealth's counties. The faults shown on this map represent seismic activity that occurred several million years ago at the latest. There has been no activity along these faults in recorded history. Seismic risk associated with these faults is very low. Faults may be associated with increased fracturing of bedrock in the immediately adjacent area. This fracturing may influence slope stability and groundwater flow in these limited areas.

**Mineral Resources** 





Listed below are Web sites for several agencies and organizations that may be of assistance with land-use

www.mtsterlingchamber.com Mount Sterling-Montgomery County Chamber of Commerce www.montgomery.k12.ky.us Montgomery County Public ces.ca.uky.edu/Montgomery/ University of Kentucky Cooperative Extension Service www.gwadd.org/ Gateway Area Development District www.thinkkentucky.com/edis/cmnty/cw/cw052/ Kentucky Economic Development Information System www.uky.edu/KentuckyAtlas/21173.html Kentucky Atlas and Gazetteer, Clark County <u>uickfacts.census.gov/qfd/states/21/21173.html</u> U.S. Census kgsweb.uky.edu/download/kgsplanning.htm Planning



This abandoned quarry in the Grant Lake Limestone (unit 4) east of Stoops near Ky. 537 produced commer-

cial grade limestone. Photo by Dan Carey, Kentucky Geological Survey.

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Rock Unit	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 (alluvium)	Fair foundation material; easy to excavate. Seasonal high water table. Subject to flood- ing. Refer to soil report (Froedge, 1986).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Froedge, 1986).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Froedge, 1986).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Froedge, 1986).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Froedge, 1986).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Froedge, 1986).	Refer to soil report (Froedge, 1986).	Refer to soil report (Froedge, 1986).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Froedge, 1986).	Fair stability. Fair com- paction characteristics. Piping hazard. Refer to soil report (Froedge, 1986).	Slight limitations, in general, except for seasonal high water table. Subject to flooding. Refer to soil report (Froedge, 1986).
2. Siltstone, shale, and limestone	Siltstone, fair to good foundation material; difficult to excavate. Shale, fair to poor; easy to moderately difficult to excavate.	Severe limitations. Low permeability.	Severe limitations. Rock excavation. Shales: se- vere limitations. Low strength, slumping, and seepage problems.	Moderate to severe limitations. Rock ex- cavation possible. Local drainage prob- lems on shale.	Slight to moderate limita- tions. Rock excavation likely. Local drainage problems on shale.	Slight to moderate limita- tions. Rock excavation. Local drainage problems.	Moderate to slight limitations, depending on activity and topog- raphy.	Moderate to slight limitations, depending on activity and topog- raphy.	Moderate to slight limitations. Reservoir may leak where rocks are fractured.	Moderate to slight limitations. Reservoir may leak where rocks are fractured.	Slight limitations.
3. Limestone, shale*	Good to excellent foundation material; difficult to excavate.	Moderate to severe limitations. Imperme- able rock. Locally fast drainage through frac- tures and sinks. Dan- ger of groundwater contamination.	Severe to moderate limitations. Rock excavation may be required.	Moderate to severe limitations. Rock ex- cavation possible. Local drainage prob- lems, especially on shale. Sinks possible. Avoid steep slopes.	Slight to moderate limi- tations, depending on topography. Rock ex- cavation likely. Local drainage problems, especially on shale. Sinks possible.	Slight to moderate limita- tions, depending on to- pography. Rock excava- tion. Sinks common. Local drainage problems. Groundwater contamina- tion possible.	Slight to moderate limitations. Rock excavation may be required.	Slight to moderate limita- tions, depending on activity and topography. 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. Rock ex- cavation likely.
4. Limestone/ dolomite	Good to excellent foundation material; difficult to excavate.	Moderate to severe limitations. Imperme- able rock. Locally fast drainage through frac- tures and sinks. Dan- ger of groundwater contamination.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Drainage required.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks possible. Drainage required.	Slight to moderate limi- tations, depending on topography. Rock ex- cavation likely. Local drainage problems. Sinks possible.	Slight to moderate limitations, depend- ing on topography. Rock excavation; lo- cally, upper few feet may be rippable. Sinks possible. Local drainage problems.	Slight to moderate limitations. Rock excavation may be required.	Slight to moderate limita- tions, depending on activity and topography. Slight limitations for forest or nature preserve.	Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations. Leaky rock.	Severe limitations. Rock excavation.
5. Black shale*	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clavs.	Severe limitations. Thin soils and low permeability.	Severe limitations. Low strength, slump- ing, and seepage problems.	Severe limitations. Low strength, slump- ing, and seepage problems.	Severe limitations. Low strength, slump- ing, and seepage problems.	Severe limitations. Low strength, slump- ing, and seepage problems.	Moderate to severe limitations, depend- ing on activity.	Slight to severe limi- tations, depending on activity. Slight lim- itations for forest or nature preserve.	Slight limitations for small ponds.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wet- ness.
6. Shale* and limestone/ dolomite	Fair to good foun- dation material; difficult excavation. Slumps when wet. Avoid steep slopes.	Slight to severe limita- tions, depending on amount of soil cover and depth to imper- meable rock.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes. Possible shrinking and swelling shales.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes.	Severe to moderate limitations. Rock excavation may be required. Slumps when wet. Avoid steep slopes.	Moderate to severe limitations, depending on topography. Rock excavation. Local drainage problems. Susceptible to landslides.	Slight to severe limitations, depending on activity and topog- raphy. Possible steep wooded slopes.	Slight to moderate limitations, depending on activity and topog- raphy. Possible steep wooded slopes. Slight limitations for forest or nature pre- serve.	Moderate to slight limitations. Reservoir may leak where rocks are fractured.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Rock ex- cavation likely.
7. Shale*	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Low permeability.	Severe limitations. Low strength, slump- ing, and seepage problems.	Moderate to severe limitations, depend- ing on slopes. Strength, slumping, and seepage problems.	Moderate to severe limitations, depend- ing on slopes. Strength, slumping, and seepage problems.	Moderate to severe limitations, depend- ing on slopes. Strength, slumping, and seepage problems.	Slight to severe limi- tations, depending on activity.	Slight to moderate limi- tations, depending on activity. Slight lim- itations for forest or nature preserve.	Slight limitations. Reservoir may leak where rocks are fractured. Most ponds on shale are successful.	Severe limitations. Poor strength and stability.	Moderate limitations. Poor strength. Wet- ness.
8. Shale, siltstone, sandstone	Good to excellent foundation material; difficult to excavate.	Severe limitations. Thin soils.	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, depend- ing on activity and slope.	Slight to severe limi- tations, depending on activity. Slight lim- itations for forest or nature preserve.	Not applicable.	Not applicable.	Severe limitations. Rock excavation.



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.





Learn more about Kentucky geology at www.uky.edu/KGS/geoky/



Some wells located in the major creek valleys will produce enough water for a domestic supply, except during dry weather. In 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. 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 (2004).





### Groundwater



**MAP AND CHART 149** Series XII. 2007

### 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



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.

Limestone terrain can be subject to subsidence hazards, which usually can be overcome by prior planning and site evaluation. "A" shows construction above an open cavern, which later collapses. This is one of the most difficult situations to detect, and the possibility of this situation beneath a structure warrants insurance protection for homes built on karst terrain. In "B," a heavy structure presumed to lie above solid bedrock actually is partially supported on soft, residual clay soils that subside gradually, resulting in damage to the structure. This occurs where inadequate site evaluation can be traced to lack of geophysical studies and inadequate core sampling. "C" and "D" show the close relationship between hydrology and subsidence hazards in limestone terrain. In "C," the house is situated on porous fill (light shading) at a site where surface- and groundwater drainage move supporting soil (darker shading) into voids in limestone (blocks) below. The natural process is then accelerated by infiltration through fill around the home. "D" shows a karst site where normal rainfall is absorbed by subsurface conduits, but water from infrequent heavy storms cannot be carried away quickly enough to prevent flooding of low-lying areas. Adapted from AIPG (1993).

Radon gas can be a local problem, in some areas exceeding the U.S. Environmental Protection Agency's maximum recommended limit of 4 picocuries per liter. The shales of unit 5 and limestones of unit 4 in particular may contain high levels of uranium or radium, parent materials for radon gas. Homes in these areas should be tested for radon, but the homeowner should keep in mind that the threat to health results from relatively high levels of exposure over long periods, and the remedy may simply be

adon evel	If 1,000 people who never smoked were exposed to this level over a lifetime*	The risk of cancer from radon exposure compares to**	WHAT TO DO: Fix your home	
0 pCi/L	About 36 people could get lung cancer	35 times the risk of drowning		
0 pCi/L	About 18 people could get lung cancer	20 times the risk of dying in a home fire	Fix your home	
pCi/L	About 15 people could get lung cancer	4 times the risk of dying in a fall	Fix your home	
pCi/L	About 7 people could get lung cancer	The risk of dying in a car crash	Fix your home	
pCi/L	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing between 2 and 4 pCi/L	
.3 pCi/L	About 2 people could get lung cancer (Average indoor radon level		(Reducing radon	
.4 pCi/L		(Average outdoor radon level)	2 pCi/L is difficult.)	

Itetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R \*\* Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001

# Pond Construction

Anti-Leakage Strategy Deny water access to permeable materials and/or alter materials to an impermeable condition Top of Dam

tructured Clay So 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.

Dams should be constructed of compacted clayey soils at slopes flatter than three units horizontal to one 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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