Kentucky Geological Survey
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UNIVERSITY OF KENTUCKY, LEXINGTON

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

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MAP AND CHART 158
Series XII, 2007

Washington County Courthouse at Springfield

Washington County, an area of 301 square miles in the Outer Bluegrass Region, was formed in 1792 as the 10th Kentucky county and named after President George Washington. The courthouse, the oldest still in use in Kentucky, was completed in 1816 and contains the marriage certificate of Abraham Lincoln's parents. The terrain of the county ranges from rugged (unit 4) to rolling. The highest elevation, 1,020 feet, is on a ridge south of U.S. 150 near the southeastern corner of the county. The lowest elevation, 475 feet, is at the confluence of Brush Fork and Hardins Creek. The 2005 population of 11,491 was 5.3 percent greater than that of 2000. Photo by Dan Carey, Kentucky Geological Survey.

Limestone and Shale Terrain–Unit 3

Agriculture

Rural Living

Limestone (unit 3) provides rich soils for agriculture (above), attractive sites for rural residential construction (above right), habitat for wildlife (below left), and industrial sites (below right). Thoughtful planning can minimize conflicting interests and accomodate the needs of all. Photos by Dan Carey, Kentucky Geological Survey.

Wildlife Habitat

Industry

Mineral Resources

Limestone from the Gilbert Member of the Ashlock Formation (unit 3) in the Springfield Quarry excavated for use as construction aggregate and agricultural lime. Photo by Dan Carey, Kentucky Geological Survey.

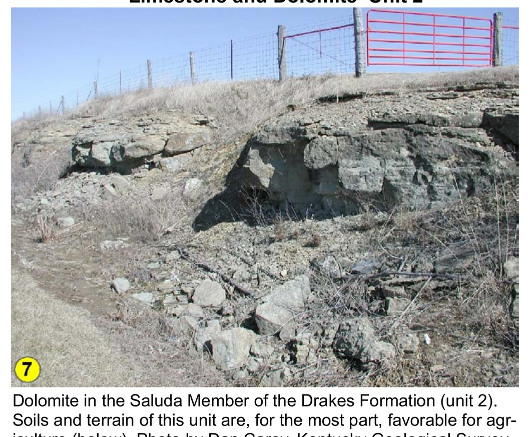
Limestone and Shale–Unit 3

Thin, interbedded layers of limestone and shale (unit 3) are exposed (above) in this roadcut on Ky. 555 in north Springfield. The limestone and shale in the lower member of the Grant Lake Limestone (below), also included in unit 3, has thicker limestone layers with slightly different characteristics. These variations illustrate that excavation requirements may vary from site to site within the same rock unit. Photos by Dan Carey, Kentucky Geological Survey.

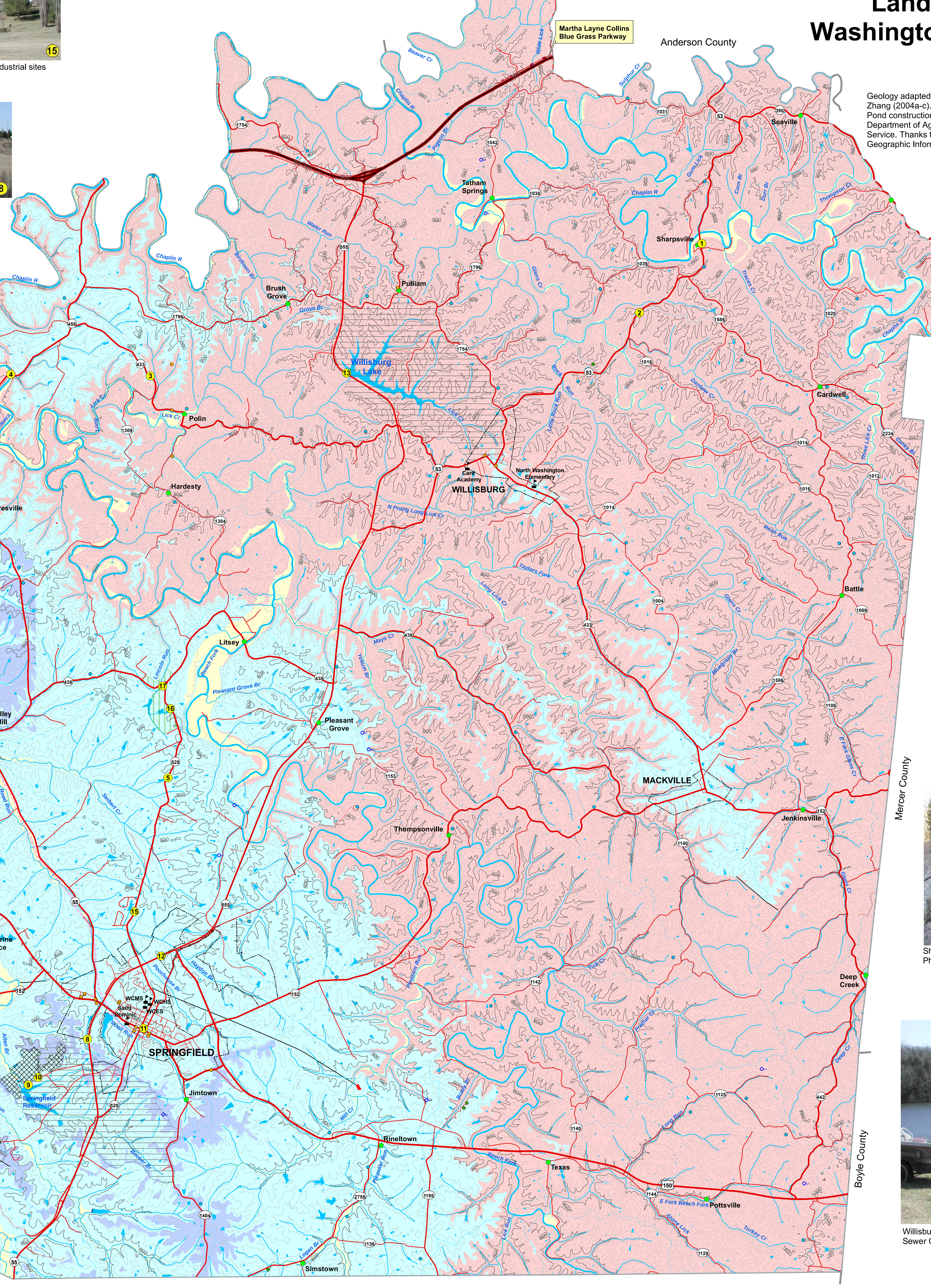
Springfield Quarry and Springfield Reservoir

Springfield Quarry and Springfield Reservoir seen from the air. Aerial photo (2004) by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program.

Limestone and Dolomite–Unit 2



Dolomite in the Saluda Member of the Drakes Formation (unit 2). Soils and terrain of this unit are, for the most part, favorable for agriculture (below). Photo by Dan Carey, Kentucky Geological Survey.



Swelling and Shrinking Shales

A problem of some concern in southwestern Washington County is the swelling of some of the clay minerals in shale units 5 and 6. The process is exacerbated when the shale contains the mineral pyrite (fool's gold). Pyrite is a common mineral and can be found distributed throughout the black shale, although it is not always present and may be discontinuous both vertically and horizontally. In the presence of moisture and oxygen, pyrite oxidizes and produces sulfuric acid. The acid reacts with calcium carbonates found in water, the rock itself, crushed limestone, and concrete. This chemical reaction produces sulfate and can form the mineral gypsum, whose crystallization can cause layers of shale to expand and burst, 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.

Radon

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 units 2 and 3 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 additional ventilation of the home.

Radon Risk If You've Never Smoked (U.S. Environmental Protection Agency, 2005)

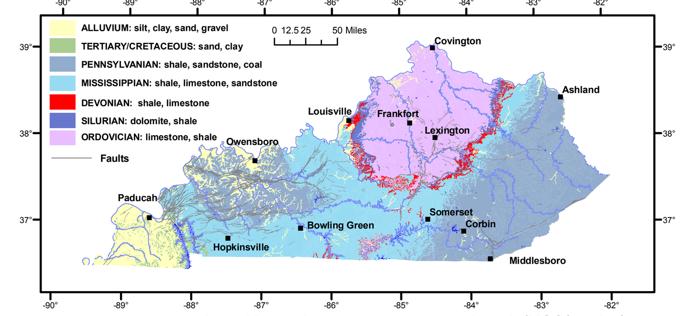
Radon Level	If 1,000 people who never smoked were exposed to this level over a lifetime*...	The risk of cancer from radon exposure compares to**...	WHAT TO DO:
20 pCi/L	About 36 people could get lung cancer	35 times the risk of drowning	Fix your home
10 pCi/L	About 18 people could get lung cancer	20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

Note: If you are a former smoker, your risk may be higher.
* Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003).
** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.

Radon Ventilation

Ventilation system removes radon from the basement area of this home on unit 5. Photo by Dan Carey, Kentucky Geological Survey.

Geology of Kentucky



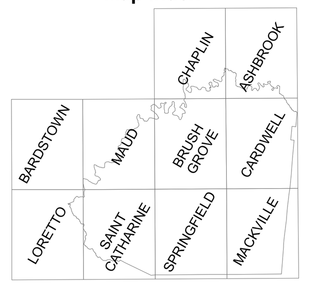
Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

N
1:48,000
1 inch = 3/4 mile
0 0.5 1 2 3 4 Miles

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/website/kyluplan/viewer.htm.

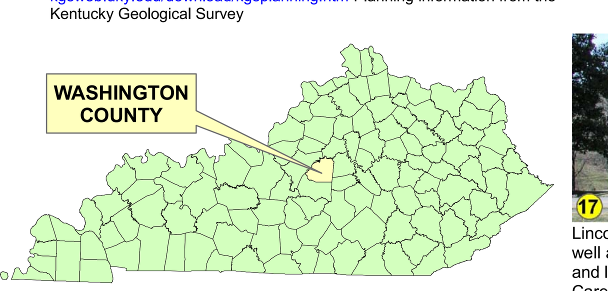
7.5-Minute Quadrangle Map Index



Additional Resources

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

www.kyhometown.com/Springfield/ Springfield and Washington County
www.springfieldky.org/ Springfield
ces.ca.uky.edu/Washington/ University of Kentucky Cooperative Extension Service
www.ltadd.org/ Lincoln Trail Area Development District
www.thinkkentucky.com/edis/cmnty/cw/cw099/ Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21229.html Kentucky Atlas and Gazetteer, Washington County
quickfacts.census.gov/qfd/states/21/21229.html U.S. Census data
kgsweb.uky.edu/download/kgsplanning.htm Planning information from the Kentucky Geological Survey



History

The Beech Fork Bridge, built in 1865, is 102 feet long, the longest covered bridge in Kentucky. Photo by Dan Carey, Kentucky Geological Survey.

Lincoln Homestead State Park

Lincoln Homestead State Park features the original home of Lincoln's mother, as well as replicas of the 1782 cabin and blacksmith shop where his father grew up and learned his trade. The park includes an 18-hole golf course. Photo by Dan Carey, Kentucky Geological Survey.

Acknowledgments

Geology adapted from Crawford (2004a, b), Nelson (2004a-e), and Zhang (2004a-c). Sinkhole data from Paylor and others (2004). Pond construction illustration courtesy of Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service. Thanks to Kim and Kent Anness, Kentucky Division of Geographic Information, for digital base-map data.

EXPLANATION

- School
- Water wells: Domestic; Agricultural; Monitoring
- Spring
- Incorporated city boundary
- Lincoln Homestead State Park
- Source-water protection area, zone 1
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Watershed boundaries
- Quarry
- Mapped sinkhole
- Artificial fill
- Concealed fault
- Fault

40-foot contour interval

Photo location

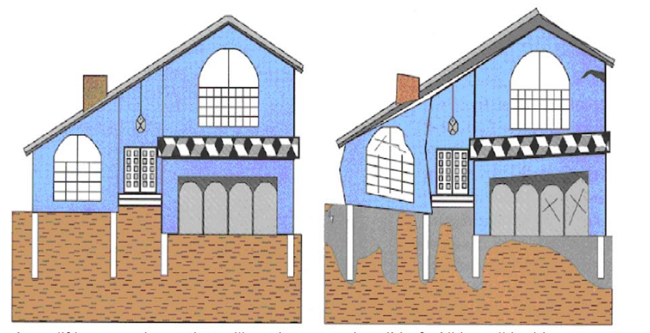
Source-Water Protection Areas

In source-water protection areas, activities are likely to affect the quality of the drinking-water source. For more information, see kgsweb.uky.edu/download/water/swapp/swapp.htm.

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

Site Drainage



An uplifting experience that will not be appreciated! Left: All is well in this newly built home until water from percolation, drains, lawn sprinklers, leaking sewers, or water mains soaks swelling soil beneath the foundation.
Right: With time, expanding soils exert several tons per square foot of pressure on the foundation and shallow pilings. Without remedial measures, the house will actually become deformed, and shatter masonry and windows. Remedies vary from mere maintenance that keeps drainage away from the house to expensive reconstruction of foundations. Prior site planning that takes geology into account is always preferable to dealing with problems after a structure is built. From AIPG (1993).

Slope Failure

Mass movements or landslides of surficial materials are costly geologic hazards in Kentucky. 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 units containing shale on slopes are subject to landslides.

Shales will break down and weather rapidly when exposed to air and water. Many 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.

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

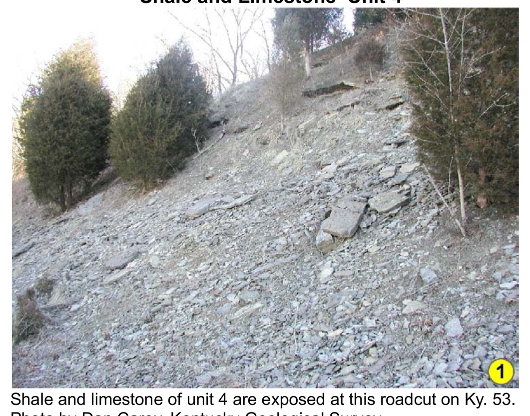
Precautions include taking care of all surface-water runoff by making certain that all runoff from roofs, gutters, patios, sidewalks, and driveways is carried well away from and not toward the house; diverting drainage from areas sloping toward the house; cutting into natural slopes as little as possible 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.

Shale and Limestone–Unit 4

As the shale content in the underlying rock increases, the terrain becomes more rugged. The hills of unit 4 support small beef operations. Small ponds are common. Cedar trees quickly reclaim a cleared hillside (below). Photos by Dan Carey, Kentucky Geological Survey.

Shale and Limestone–Unit 4



Shale and limestone of unit 4 are exposed at this roadcut on Ky. 53. Photo by Dan Carey, Kentucky Geological Survey.

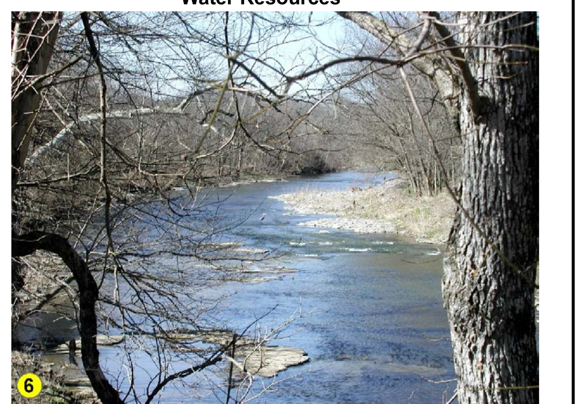
Springfield Reservoir

The Springfield Reservoir is one of several sources of water for the public water system. Photo by Dan Carey, Kentucky Geological Survey.

Willisburg Lake

Willisburg Lake offers 160 acres of boating and fishing—bass, crappie, bluegill, and catfish. It is also a source of water for the Springfield Water and Sewer Commission. Photo by Dan Carey, Kentucky Geological Survey.

Water Resources



Washington County is blessed with an abundance of water. Cartwright Creek is one of many large streams in the county. Maintaining water quality is important for the human population and the fish and fowl that rely on the streams. Photo by Dan Carey, Kentucky Geological Survey.

Groundwater

About 4,800 people in Washington County rely on private domestic water supplies: 1,200 use wells, and 3,600 use other sources. Groundwater resources in Washington County are limited. Wells located in the larger valley bottoms throughout the county will produce enough water for a domestic supply, except during dry weather. In the upland areas of Washington County (85 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).

Pond Construction

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 3 units horizontal to 1 unit vertical. Ponds with dam heights exceeding 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.

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	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.	Severe limitations. Failed septic systems can contaminate groundwater. Refer to soil report (Craddock, 1986).	Severe limitations. Water in alluvium may be in direct contact with basements. Refer to soil report (Craddock, 1986).	Moderate to severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Craddock, 1986).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Craddock, 1986).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Craddock, 1986).	Subject to flooding. Poor drainage. Refer to soil report (Craddock, 1986).	Subject to flooding. Refer to soil report (Craddock, 1986).	Pervious material. Seasonal high water table. Subject to flooding. Refer to soil report (Craddock, 1986).	Fair stability. Fair compaction characteristics. Piping hazard. Refer to soil report (Craddock, 1986).	Moderate to severe limitations. Wetness, flooding. Refer to soil report (Craddock, 1986).
2. Limestone, dolomite	Excellent foundation material; difficult to excavate.	Moderate to severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks to water table, with possible contamination.	Severe limitations. Rock excavation.	Severe limitations. Rock excavation.	Severe to moderate limitations. Rock excavation.	Slight to moderate limitations, depending on topography. Rock excavation. Sinks possible. Local drainage problems.	Slight to moderate limitations, depending on activity and topography.	Slight to moderate limitations, depending on activity and topography.	Moderate limitations. Reservoir may leak where rocks are fractured.	Moderate limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Rock excavation.
3. Limestone and shale	Fair to good foundation material; moderately difficult to difficult to excavate.	Severe limitations. Impermeable rock. Locally fast drainage through fractures to water table, with possible contamination.	Severe limitations. Rock excavation.	Moderate to severe limitations. Rock excavation; locally, upper few feet may be rippable.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Local drainage problems.	Slight to moderate limitations. Rock excavation may be required.	Slight to moderate limitations, depending on activity and topography.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured.	Moderate to severe limitations. Possible rock excavation.
4. Shale** and limestone	Good to excellent foundation material; moderately difficult to difficult to excavate.	Severe limitations. Low permeability.	Slight to moderate limitations. Earth and rock excavation. Poor drainage.	Slight to moderate limitations. Rock excavation. Local seeps; subgrade requires drainage.	Slight limitations. Local seeps.	Slight limitations. Rock generally rippable in shallow cuts. Local seeps.	Slight to moderate limitations. Rock excavation may be required.	Slight to moderate limitations, depending on activity and topography.	Slight limitations. Locally, impermeable rock is underlain by fissured limestone.	Slight limitations.	Moderate limitations. Highly variable amount of rock and earth excavation.
5. Shale*	Fair to poor foundation material; easy to moderately difficult to excavate. Possible expansion of shales. Plastic clay is particularly poor foundation.	Severe limitations. Low permeability.	Severe limitations. Low strength, slumping, and seepage problems. Possible shrinking and swelling of shales.	Moderate to severe limitations, depending on slopes. Strength, slumping, and seepage problems.	Moderate to severe limitations, depending on slopes. Strength, slumping, and seepage problems.	Moderate to severe limitations, depending on slopes. Strength, slumping, and seepage problems.	Severe to slight limitations, depending on activity and topography. Strength, slumping, and seepage problems.	Moderate to slight limitations, depending on activity and topography.	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, wetness.
6. Shale* and dolomite	See unit 2 for dolomite, unit 5 for shale.	See unit 2 for dolomite, unit 5 for shale.	See unit 2 for dolomite, unit 5 for shale.	See unit 2 for dolomite, unit 5 for shale.	See unit 2 for dolomite, unit 5 for shale.	See unit 2 for dolomite, unit 5 for shale.	Severe to moderate limitations, depending on activity and topography.	Severe to slight limitations, depending on activity and topography. Slight limitations for forest preserve.	Moderate limitations. Reservoir may leak where rocks are fractured.	Moderate limitations. Reservoir may leak where rocks are fractured.	See unit 2 for dolomite, unit 5 for shale.

* See discussions of swelling shales and soils and **slope stability.

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