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

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

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MAP AND CHART 90
Series XII, 2005

Groundwater

In the Salt River Valley bottoms, and in the bottoms of the larger tributaries, most drilled wells less than 100 feet deep will produce enough water for a domestic supply. Wells located in the rest of the larger valleys, and in the uplands of central Bullitt County, will produce enough water for a domestic supply except during dry weather. In the remaining upland areas in Bullitt County (approximately half of the county), most drilled wells will not produce enough water for a dependable domestic supply. Wells along drainage lines in this area may produce enough water for a domestic supply, 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 (2001).

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. 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. Illustration by Paul Howell, U.S. Department of Agriculture–Natural Resource Conservation Service.

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.

A distillery near the entrance of Bernheim Forest uses water from an impounded reservoir to make Kentucky bourbon. Photo by Stephen Greb, Kentucky Geological Survey.

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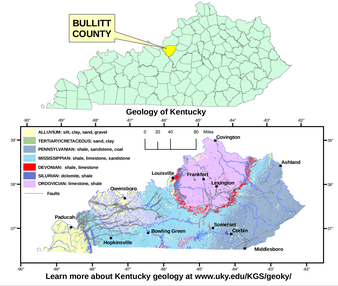
Additional Information Resources

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

ces.ca.uky.edu/bullitt/—University of Kentucky Cooperative Extension Service
www.kineticonet.net/kyrcd/kh.html—Kentucky Resource Conservation and Development
www.kpda.org/Home/Default.asp—KIPDA Area Development District
www.thinkkentucky.com/edis/cmntyclw013/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21029.html—Kentucky Atlas and Gazetteer.
quickfacts.census.gov/qfd/states/21/21029.html—U. S. Census data.
www.bullittcounty.org/—General county information.
http://kgsweb.uky.edu/download/misc/landuse/mainkyuplan.htm—More county information.
www.kdfwr.state.ky.us—Kentucky Department of Fish and Wildlife.



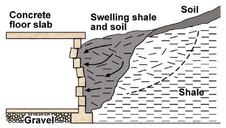
Learn more about Kentucky geology at www.uky.edu/KGS/geoky/

Swelling Shales and Soils

A problem of potential concern in Bullitt County is swelling of some of the clay minerals in shales in units 5, 6, and 7. This 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 laterally 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 can even damage upper floors and interior partitions. This phenomenon has been responsible for extensive damage to schools, homes, and businesses in Kentucky.

We strongly suggest that anyone planning construction on these shales seek professional advice from a geologist or engineer familiar with the problem.

Swelling Shale and Foundation Damage

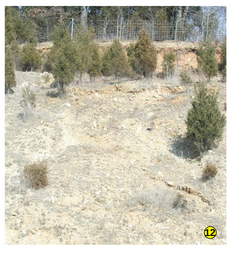


Some shales, and the soils derived from them, swell when exposed to water or air. These swelling shales and soils can have severe impacts on building foundations and other structures (e.g., bridges, dams, roads). Photograph by John Kiefer, Kentucky Geological Survey.

Slope Stability

Steep-sided hills with deeply incised drainages are common in the county. The shales and siltstones from which the hills are formed are susceptible to slumping and sliding, especially where clay shales of unit 5 occur in slopes. Clay shales can become plastic when wet and may yield or slump if construction or roads built on them are not adequately drained. Builders should avoid cutting into the toe (base) of hills or past slides. Bent trees on slopes and water seeps at the base of slopes may indicate past or potential movement.

Steep-sided drainages and washouts are common in the hills of northeastern Bullitt County. Residential development is mostly restricted to the tops of hills and the floodplains between hills in this area because of the steep slopes. Slumps and slides are possible on shaly, steep-sided hills or excavations into shale and siltstone bedrock (like this Interstate interchange below). Photos by Stephen Greb, Kentucky Geological Survey.



Radon

Radon gas, although not widely distributed in Kentucky in amounts above the U.S. Environmental Protection Agency's maximum recommended limit of 4 picocuries per liter, can be a local problem. The black shales in units 5, 6, and 7 may have high levels of radon. Homes in these areas should be tested for radon, but the homeowner should keep in mind that the health threat results from relatively high levels of exposure over long periods of time, and the remedy may simply be additional ventilation of the home.

COMPARATIVE RISK CHART for RADON LEVELS

Radon Level pCi/L	Estimated Fatal Lung Cancers/1000	Comparable Exposure Levels	Comparable Risk Estimate
200	440 - 770	1,000 times average outdoor level	More than 60 times non-smoker risk
100	270 - 630	100 times average outdoor level	4-car pack/day smoker or 20,000 chest X-rays/yr
40	120 - 390	100 times average outdoor level	Two-pack/day smoker
20	60 - 210		
10	30 - 120	10 times average indoor level	One pack/day smoker
4	13 - 50	4-10 times average outdoor level	Five times non-smoker risk
2	7 - 30		
1	3 - 13	Average indoor level	Non-smoker risk of fatal lung cancer
0.2	1 - 3	Average outdoor level	20 chest X-rays/yr

EPA recommends action be taken if indoor levels exceed 4 pCi/L, which is 10 times the average outdoor level. Some EPA representatives believe the action level should be lowered to 2 picocuries per liter; other scientists dissent and claim the risks estimated in this chart are already much too high for low levels of radon. The action level in European countries is set at 10 picocuries per liter. Note that this chart is only one estimate; it is not based upon any scientific result from a study of a large population meeting the listed criteria. (from the U.S. Environmental Protection Agency)

Economic Resources

Shale is quarried in the northern part of the county to make a lightweight aggregate for use in construction materials. The shale is the latest in a long history of natural resources that have been excavated in the county, including salt and pig iron (in the1800's), limestone for aggregate, siltstone for dimension stone, and clay shales for bricks and tiles. Photos by Stephen Greb, Kentucky Geological Survey.

Commercial parks and development are common in the flat land in the northern part of the county and along the Interstate. Likewise, there has been considerable suburban residential growth in these areas because of the county's proximity to Louisville. New developments require water, sewers, storm drainage, sewers, power lines, roads, and other infrastructure. Adequate sewage disposal is an important consideration in this county, because much of the bedrock and alluvium is unsuited for septic tanks or seepage fields of conventional disposal. Photo by Bart Davidson, Kentucky Geological Survey.

Erosion Control

During construction, erosion-control fences such as these may be needed to prevent silt from entering local streams. Photo by Bart Davidson, Kentucky Geological Survey.

Riprap drainage control and erosion protection. Photo by Stephen Greb, Kentucky Geological Survey.

An abandoned limestone quarry near Mount Washington now serves as a pond used for fishing and recreation. Photo by Bart Davidson, Kentucky Geological Survey.

Fort Knox

Part of Fort Knox encompasses the southwest quarter of the county. Since Fort Knox is an active military reservation, access is limited and land use is strictly regulated by the U.S. Army. Access to the Fort Knox Wildlife Management Area for hunting and fishing is coordinated through the Directorate of Base Operations Support to ensure safety. For more information call (502) 624-7311 or visit the website at www.knox.army.mil/

Development

Commercial parks and development are common in the flat land in the northern part of the county and along the Interstate. Likewise, there has been considerable suburban residential growth in these areas because of the county's proximity to Louisville. New developments require water, sewers, storm drainage, sewers, power lines, roads, and other infrastructure. Adequate sewage disposal is an important consideration in this county, because much of the bedrock and alluvium is unsuited for septic tanks or seepage fields of conventional disposal. Photo by Bart Davidson, Kentucky Geological Survey.

Scale 1:63,360
1 inch equals 1 mile
0 0.5 1 2 3 4 Miles

For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call:

Public Information Center
859.257.3896 or
877.778.7827 (toll free)

View the KGS World Wide Web site at:
www.uky.edu/kgs

Acknowledgments

Geology adapted from Bhattarai (2005a-c), Nelson (2001, 2002a-c), Nelson and Sparks (2002a-b), and Zhang (2002a-c). Thanks to Paul Howell, U.S. Department of Agriculture–Natural Resources Conservation Service, for pond construction illustrations. Sinkhole data from Paylor and others (2004). Thanks to Jim Currens, Kentucky Geological Survey, for karst illustrations.

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 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 local area, visit our Land-Use Planning Internet Mapping Web Site at kgsmap.uky.edu/website/kyluplan/viewer.htm.

Karst Geology

The term "karst" refers to a landscape characterized by sinkholes, springs, sinking streams (streams that disappear underground), and underground drainage through solution-enlarged conduits or caves. Karst landscapes form when slightly acidic water from rain and snow-melt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum). Sinkholes are depressions on the land surface where water drains underground. Usually circular and often funnel-shaped, they range in size from a few feet to hundreds of feet in diameter. Springs occur when water emerges from underground to become surface water. Caves are solution-enlarged fractures or conduits large enough for a person to enter.

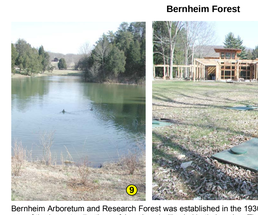
Residential construction off Ky. 44 near Bleemel Road illustrates limestone bedrock that must often be excavated for foundations, basements, and septic fields. Photo by Bart Davidson, Kentucky Geological Survey.

Caissons (concrete columns) must be constructed to support the weight of industrial buildings in areas with caves and sinkholes (karst geology). Photo by Bart Davidson, Kentucky Geological Survey.

EXPLANATION

- School
- Water wells
  - Domestic
  - Monitoring
  - Public
  - Spring
  - Gas well
- Urban service boundary
- Wetlands > 1 acre (U.S. Fish & Wildlife Service, 2003)
- Watershed boundaries
- Sinkholes
- Artificial fill
- Concealed fault
- Ft. Knox boundary
- 40-foot contour interval
- (4) Photograph location

Bernheim Forest



Bernheim Arboretum and Research Forest was established in the 1930's in south-central Bullitt County. It has one of the largest collections of American hollies in North America. There are many miles of hiking trails and numerous public programs. The new visitors center is constructed with a septic system that uses peat filters (green squares) to purify wastes. Photos by Stephen Greb, Kentucky Geological Survey.

PLANNING GUIDANCE 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 and without 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 presence of cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

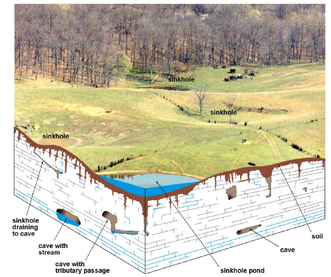
Extensive recreation—Camp sites, picnic areas, parks, etc.

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.

Environmental Protection



Never use sinkholes as dumps. All waste, but especially pesticides, paints, household chemicals, automobile batteries, and used motor oil, should be taken to an appropriate recycling center or landfill.

Make sure runoff from parking lots, streets, and other urban areas is routed through a detention basin and sediment trap to filter it before it flows into a sinkhole.

Make sure your home septic system is working properly and that it's not discharging sewage into a crevice or sinkhole.

Keep cattle and other livestock out of sinkholes and sinking streams. There are other methods of providing water to livestock.

See to it that sinkholes near or in crop fields are bordered with trees, shrubs, or grass buffer strips. This will filter runoff flowing into sinkholes and also keep tilled areas away from sinkholes.

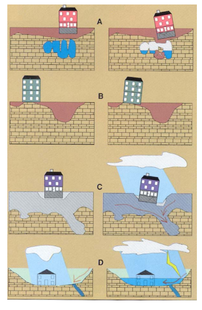
Construct waste-holding lagoons in karst areas carefully, to prevent the bottom of the lagoon from collapsing, which would result in a catastrophic emptying of waste into the groundwater.

If required, develop a groundwater protection plan (410KAR5:037) or an agricultural water-quality plan (KRS224.71) for your land use.

(From Currens, 2001)

Cover-collapse sinkholes (outlined in red) in eastern Bullitt County are typical in areas of karst geology, which feature caves, underground streams, sinkholes, and springs. Many sinkholes such as these have not been mapped. The construction implications of these features must be addressed for any type of development. Photo by Bart Davidson, Kentucky Geological Survey.

Residential Construction



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).

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. 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 (Whitaker and Waters, 1986).	Water in alluvium may be in direct contact with basements. Refer to soil report (Whitaker and Waters, 1986).	Slight limitations. Refer to soil report (Whitaker and Waters, 1986).	Slight to moderate limitations. Refer to soil report (Whitaker and Waters, 1986).	Slight to moderate limitations. Avoid construction in flood-plain. Refer to soil report (Whitaker and Waters, 1986).	Refer to soil report (Whitaker and Waters, 1986).	Refer to soil report (Whitaker and Waters, 1986).	Refer to soil report (Whitaker and Waters, 1986).	Not recommended. Refer to soil report (Whitaker and Waters, 1986).	Not recommended. Refer to soil report (Whitaker and Waters, 1986).
2. Limestone	High.	Good to excellent foundation material. Difficult excavation.	Severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Danger of groundwater contamination.	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. Local drainage problems. Stream sinks. 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, depending on activity and topography. Possible steep wooded slopes.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Slight limitations for forest or nature preserve.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
3. Limestone, dolomite, and shale	High.	Fair to good 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 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. Local drainage problems. Sinks common.	Slight to severe limitations, depending on topography. Rock excavation. Sinks common. Local drainage problems. Groundwater contamination possible.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes. Sinks common.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
4. Dolomite	Medium.	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.	Moderate to severe limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Local drainage problems, especially on shale. Sinks common and caves possible.	Severe to moderate limitations. Rock excavation. Possible steep slopes and narrow ravines.	Slight to severe limitations, depending on topography. Rock excavation. Local drainage problems. Groundwater contamination possible.	Moderate to slight limitations, depending on activity and topography. Possible wooded slopes.	Slight to severe limitations, depending on activity and topography. Possible steep wooded slopes.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to slight limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
5. Siltstone, shale*	Low.	Fair to good foundation material. Moderately difficult to excavate.	Moderate to severe limitations. Impermeable rock. Possible thin soils.	Moderate to severe limitations. Rock excavation; locally, upper few feet may be rippable.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes. Possible expansion of shales.*	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes. Possible expansion of shales.*	Severe limitations. Steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir may leak where rocks are fractured.	Moderate limitations.	Moderate limitations. Possible rock excavation.
6. Shale*	Low.	Poor foundation material; easy to moderately difficult to excavate. Low strength and stability. May contain plastic clays.	Severe limitations. Thin soils and low permeability.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Low strength, slumping, and seepage problems.	Severe limitations. Depending on activity.	Moderate to severe limitations. Depending on activity and topography.	Slight limitations for small ponds.	Moderate limitations. Poor strength and stability.	Moderate limitations. Possible rock excavation.
7. Shale and limestone*	Medium.	Fair to good foundation material. Difficult to excavate.	Moderate to severe limitations. Impermeable rock. Locally fast drainage through fractures and sinks. Possible contamination. Groundwater contamination.	Moderate to severe limitations. Rock excavation may be required.	Moderate limitations. Rock excavation possible. Possible drainage and slumping problems on shale. Sinks common and caves possible.*	Moderate limitations. Rock excavation. Possible steep slopes.	Moderate limitations. Rock excavation likely. Local drainage problems. Sinks common.	Slight to severe limitations, depending on topography. Rock excavation possible. Sinks common. Local drainage problems. Possible groundwater contamination.*	Slight to severe limitations, depending on activity and topography. Possible wooded slopes. Sinks common.	Moderate to severe 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.
8. Siltstone, dolomite, and limestone	Medium.	Fair to good foundation material. Difficult to excavate.	Severe limitations. Thin soils and impermeable rock. Fast drainage through fractures and sinks to water table, with possible contamination.	Moderate to severe limitations. Rock excavation may be required.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required.	Severe to moderate limitations. Rock excavation may be required.	Severe to moderate limitations. Rock excavation may be required.	Slight limitations. Reservoir may leak where rocks are fractured.	Slight to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate limitations. Possible rock excavation.
9. Sandstone	None.	Fair to good foundation material. Difficult to excavate.	Severe limitations. Thin soils.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Severe to moderate limitations. Rock excavation. Possible steep slopes.	Severe to moderate limitations. Rock excavation. Possible steep slopes.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible wooded slopes.	Moderate limitations, requires liner material. Permeable rock.	Moderate to severe limitations. Difficult to excavate.	Moderate to severe limitations. Highly variable amount of rock and earth excavation. Steep slopes possible.

* See discussions of swelling shales and soils and slope stability