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

T. Jeffrey Adams Don Molden Multiple Services Inc.

Bart Davidson University of Kentucky, bdavidson@uky.edu

Daniel I. Carey University of Kentucky, daniel.carey@uky.edu

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**Kentucky Geological Survey** 

sinkhole draining to cave

cave with

stream

tributary passage 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.

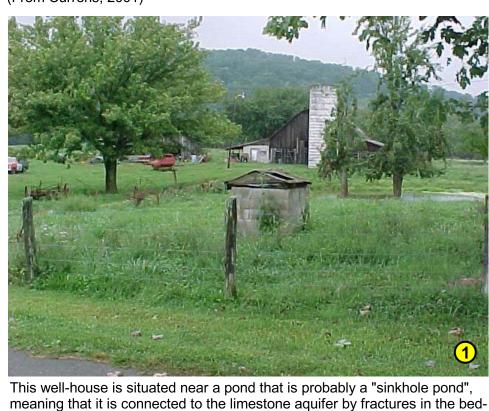
Keep cattle and other livestock out of sinkholes and sinking streams. There are other methods of providing water to livestock.

See to it that sinkholes near or in crop fields are bordered with trees, shrubs, or grass buffer

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

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 waterquality plan (KRS224.71) for your land use. (From Currens, 2001)



rock, but is currently plugged with soil. Cattle feedlots or pastures near this well or pond can cause increased nitrate concentrations in groundwater. Photograph by Bart Davidson, Kentucky Geological Survey.

## **Residential Construction**

imestone 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 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

the structure. This occurs where inadequate 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

ow-lying areas. Adapted from AIPG (1993).

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 snowmelt seeps through soil cover into fractured and

Sinkholes are depressions on the land surface into which water drains underground. hundreds of feet in diameter. Springs occur when water emerges from underground to become surface water. Caves are solution-enlarged fractures or conduits large



contamination by garbage dumping and accidental spills. They are also hazards by litter. Caves like this one are very susceptible to contamination from storm

soluble bedrock (usually limestone, dolomite, or gypsum).

Usually circular and often funnel-shaped, they range in size from a few feet to enough for a person to enter.



to public safety. Photograph by Bart Davidson, Kentucky Geological Survey.

# This sinkhole near the new courthouse in Monticello has been neglected. Sinkholes can be a source of contamination to local aquifers, and should also be carefully considered before building in the area. Photo by Bart Davidson, Kentucky Geological Survey.

Land-Use Planning:

T. Jeffrey Adams
Don Molden Multiple Services Inc.

**Bart Davidson and Daniel I. Carey** 

**Kentucky Geological Survey** 

Acknowledgments

For Planning Use Only

local area, visit our Land-Use Planning Internet Mapping Web Site at

kgsmap.uky.edu/website/kyluplan/viewer.htm.

A National Historic Site, Mill Springs is the location of one

of the first important battles of the Civil War in 1862. It is

gristmill, constructed in 1839. The mill is still in operation,

and is considered one of the largest in the world. Photo

Radon gas, although not widely distributed in Kentucky in amounts above

the Environmental Protection Agency's maximum recommended limit of 4

picocuries per liter, can be a local problem. Unit 6 on the map may contain

high levels of uranium or radium, parent materials for radon gas. This unit

the limestone weathers away the phosphates containing uranium become

concentrated in the soil and ultimately can give rise to high levels of radon.

keep in mind that the health threat results from relatively high levels of

exposure over long periods, and the remedy may simply be additional

.000 times average

100 times average

100 times average

10 times average

Average indoor level

EPA recommends action be taken if indoor levels exceed 4 picocuries per liter

(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

result from a study of a large population meeting the listed criteria (from the U.S.

per liter. Note that this chart is only one estimate; it is not based upon any scientific

outdoor level

outdoor level

ventilation of the home.

Level Fatal Lung

pCi/L Cancers/1000

100 270 - 630 outdoor level

10 30 - 120 indoor level

120 - 380 outdoor level

0.2 1-3 Average outdoor level

Environmental Protection Agency, 1986).

mineral apatite. Uranium is sometimes part of the apatite structure, and when

Homes in these areas should be tested for radon, but the homeowner should

COMPARATIVE RISK CHART for RADON LEVELS

Exposure

Risk

Estimate

r 20,000 chest X-rays/yr

Two-pack/day smoker

One pack/day smoker

ive times non-smoker risk

fatal lung cancer

4 Miles

6 Kilometers

those that penetrate small solution openings within the limestone bedrock.

For more information on the groundwater resources of the county, see Carey

and Stickney (2004).

20 chest X-rays/yr

Non-smoker risk of

More than 60 times

n-smoker risk

Four pack/day smoker

and several other limestones in the state locally contain the phosphate

named after 13 springs that feed a creek which powers the

Survey, for karst illustrations.

A small cave is located in Monticello across from the new courthouse. This cave was apparently used by the public in the past, and included a rock staircase and reflection pool nearby. It is now in a state of disrepair and marred sewers, and are likely to be connected to the local aquifer. Photograph by Bart

# PLANNING 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

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.

Slight—A slight limitation is one that commonly requires some corrective measure but can be overcome without a great deal

Severe—A severe limitation is one that is difficult to overcome and commonly is not feasible because of the expense involved.

FOUNDATION AND EXCAVATION

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

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

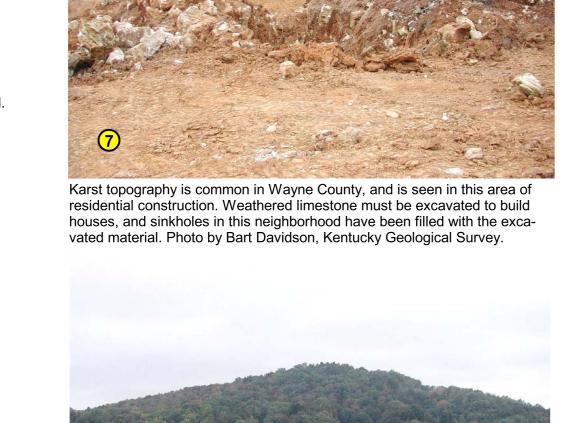
blacktop. A minimum of cuts and fills are made, little work is done preparing a subgrade, and generally only a thin

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 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

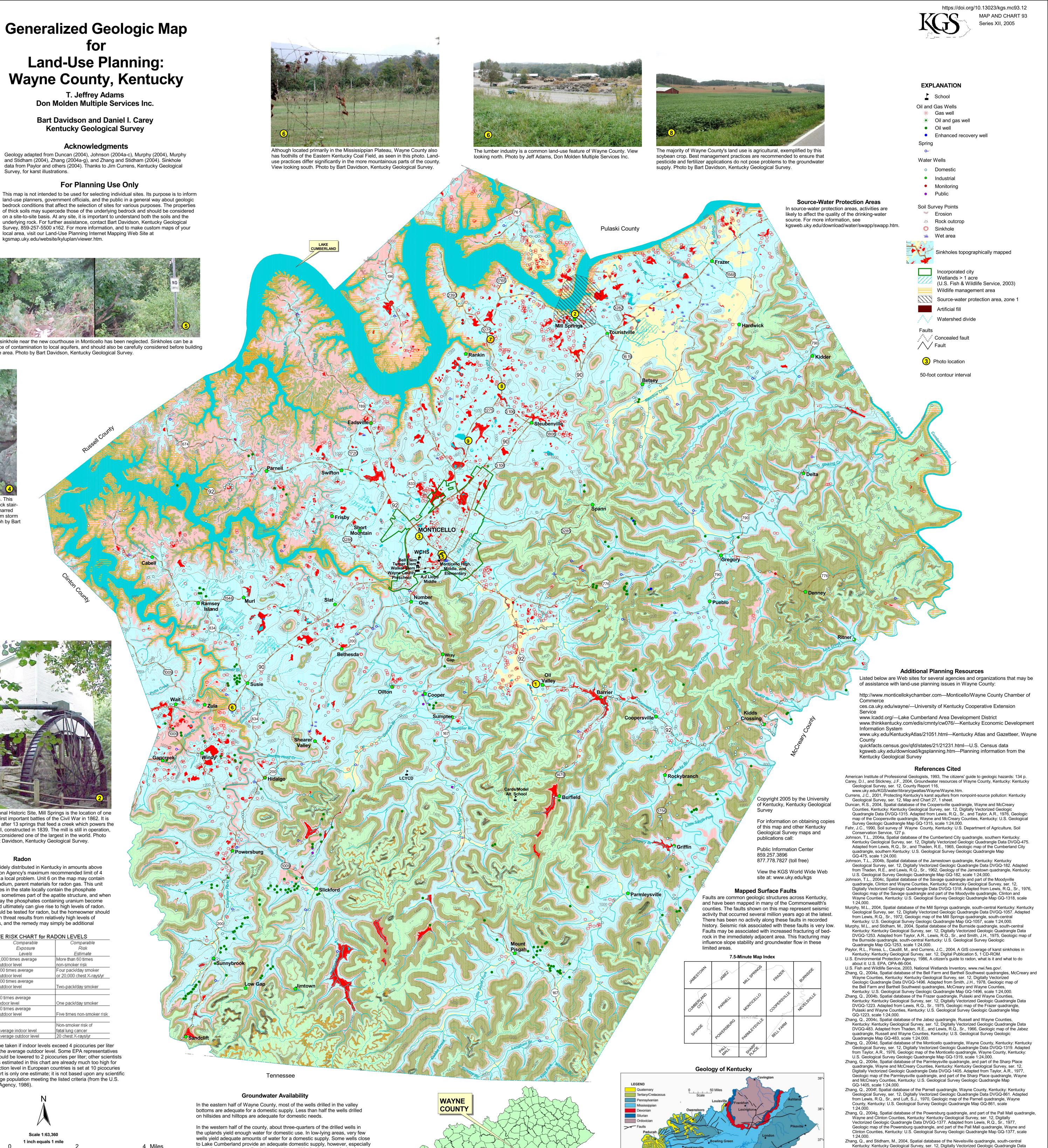


This pond was a sinkhole on dry land in the early 1970's, but filled with water in a few days after the sinkhole became plugged with clayey soil. Photo by

Bart Davidson, Kentucky Geological Survey.

# 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. Alluvium, landslide, and terrace deposits	Fair to good foundation material; easily excavated. Refer to soil report (Fehr, 1990).	Slight limitations. Easy to excavate. Refer to soil report (Fehr, 1990).	Moderate to severe limitations. Check area to determine if flood prone. Basements can be wet. Refer to soil report (Fehr, 1990).	Slight to moderate limitations. Refer to soil report (Fehr, 1990).	Slight to moderate limitations. Refer to soil report (Fehr, 1990).	Slight limitations. Refer to soil report (Fehr, 1990).	Check to see if area is flood prone. If not, slight limitations based on type of structures. Refer to soil report (Fehr, 1990).	Check to see if area is flood prone. If not, slight limitations based on type of structures. Refer to soil report (Fehr, 1990).	Severe limitations. Leaky reservoir material. Refer to soil report (Fehr, 1990).	Severe limitations. Leaky reservoir material. Refer to soil report (Fehr, 1990).	High groundwater table possible. Moderate to severe limitations. Refer to soil report (Fehr, 1990).
2. Shale, silt- stone, sand- stone, and coal	Fair to good foundation material; difficult to excavate. Possible expansive shales.	Severe limitations. Impermeable rock. Thin soils.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes. Possible expansion of shales.	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.	Severe limitations. Steep slopes.	Moderate limitations. Highly variable amount of rock and earth excavation.
3. Shale, sand- stone, lime- stone, and siltstone	Fair to good foundation material; difficult to excavate. Possible expansive shales.	Severe limitations. Impermeable rock. Thin soils.	Severe to moder- ate limitations. Rock excavation; locally, upper few feet may be rip-	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.	Severe limitations. Steep slopes.	Moderate limitations. Highly variable amount of rock and earth excavation.
4. Sandstone, conglomerate, and minor shale	Fair to good foundation material; difficult to excavate.	Severe limitations. Impermeable rock. Thin soils.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rip- pable. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable Steep slopes.	Moderate limitations. Rock excavation; steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe limitations. Steep slopes.	Slight to moderate limitations.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Steep slopes.	Moderate limitations. Highly variable amount of rock and earth excavation.
5. Limestone, shale, and siltstone	Fair to good foundation material; difficult to excavate. Possible expan- sive shales.	Severe limitations. Thin soils and impermeable rock. Fast drainage through fractures to water table; possible groundwater contamination.	1	Moderate limitations. Rock excavation; locally, upper few feet may be rip- pable. Steep slopes along major drain- ages. Possible ex- pansion of shales.	Slight limitations. Rock excavation. Steep slopes along major drain- ages.	Slight limitations. Rock excavation; locally, upper few feet may be rip- pable. Steep slopes along major drain- ages. Possible ex- pansion of shales.	Moderate limitations. Steep to moderate slopes.	Slight limitations.	Slight to moderate limitations. Reser- voir may leak where rocks are fractured. Sinks possible.	Slight limitations. Reservoir may leak where rocks are fractured.	Moderate limitations. Possibility of thin soils and rock excavation.
6. Limestone, dolomite, and shale	Fair to very good foundation material; difficult to excavate.	Severe limitations. Thin soils and impermeable rock. Fast drainage through fractures to water table; possible groundwater contamination.		Moderate limitations. Rock excavation; local drainage problems. Sinks common.	Moderate limitations. Rock excavation; local drainage problems. Sinks common.	Severe to slight limitations, depending on topography. Rock excavation. Local drainage problems. Sinks common. Groundwater contamination possible.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Moderate to severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Moderate to severe limitations. Reser- voir may leak where rocks are fractured. Sinks possible.	Severe limitations. Possible rock excavation.
7. Dolomite and lime- stone/silt- stone	Very good foundation material; difficult to excavate.	Severe limitations. Thin soils and impermeable rock. Fast drainage through fractures to water table; possible groundwater contamination.		Severe limitations. Rock excavation. Possible steep slopes.	Severe to moderate limitations. Rock excavation. Possible steep slopes and narrow ravines.	Moderate to slight limitations, depend- ing on topography. Rock excavation; local drainage prob- lems. Sinks common	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Slight to moderate limitations. Reser- voir may leak where rocks are fractured. Sinks possible.	Slight to moderate limitations. Reser- voir may leak where rocks are fractured. Sinks possible.	Severe limitations. Possible rock excavation.
8. Shale and dolomite	Fair to good foundation material; difficult excavation. Possible expan- sion of shales.	Severe limitations. Thin soils and impermeable rock. Fast drainage through fractures to water table; possible groundwater contamination.	ate limitations. Rock excavation; locally, upper few feet may be rippable. Steep		Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes. Possible expansion of shales.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Slight to moderate limitations. Reser- voir may leak where rocks are fractured.	Slight to moderate limitations. Reser- voir may leak where rocks are fractured.	Severe to moderate limitations. Possible rock excavation.
9. Siltstone, dolomite, and chert	Fair to good foundation material; difficult to excavate.	Severe limitations. Thin soils and impermeable rock. Fast drainage through fractures to water table; possible groundwater		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. Possible steep slopes.	Severe to moderate limitations. Rock excavation may be required.	Severe to slight limitations, depending on activity and topography. Possible steep wooded slopes.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Reservoir may leak where rocks are fractured. Sinks possible.	Severe to moderate limitations. Possible rock excavation.



DVGQ-1326. Adapted from Smith, J.H., 1976, Geologic map of the Nevelsville quadrangle, south-central Kentucky: U.S. Geological Survey Geologic Quadrangle Map GQ-1326, scale

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