

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

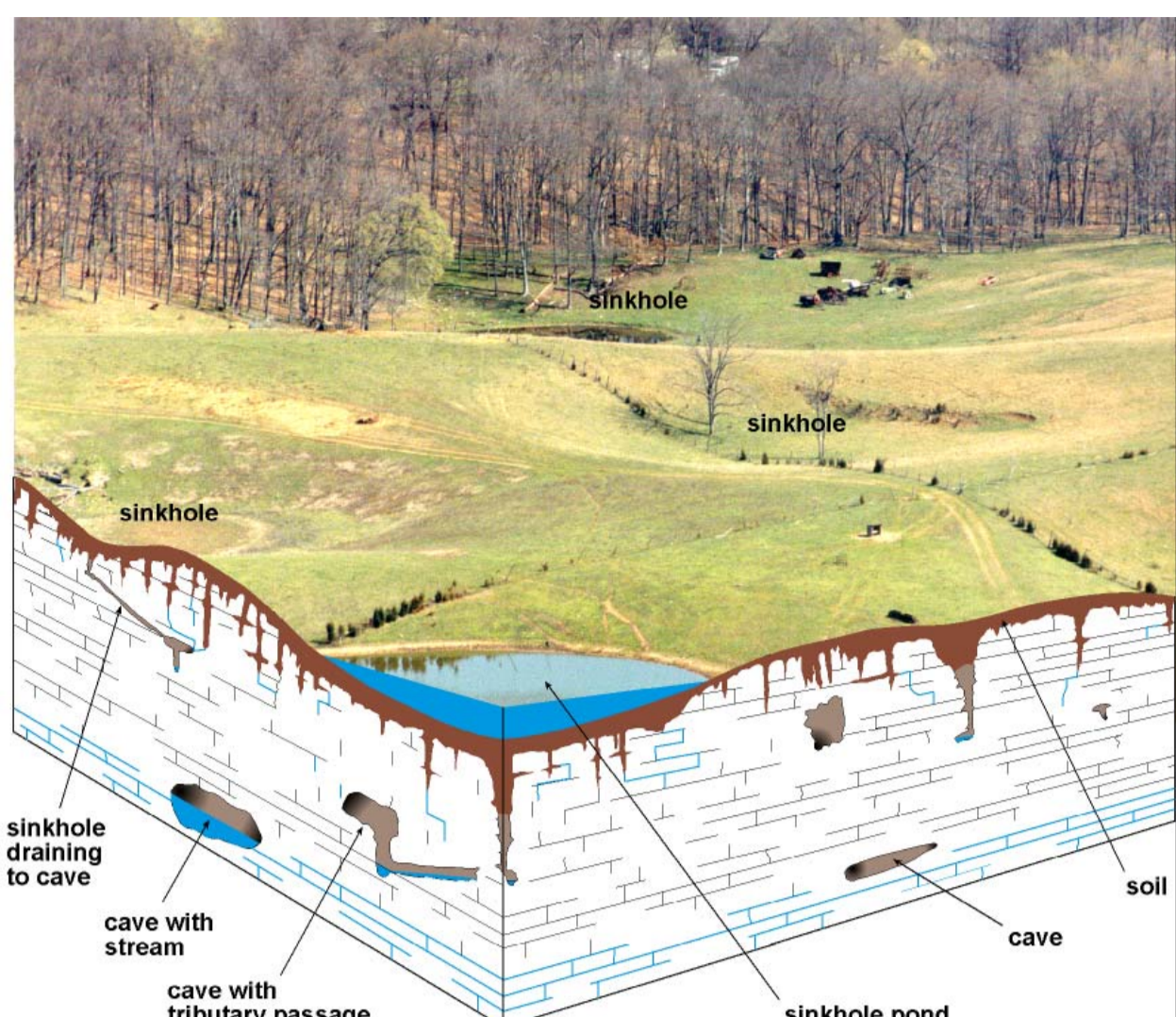
E. Glynn Beck, David A. Williams, and Daniel I. Carey

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 both the soils and the underlying rock. For further assistance, contact the Kentucky Geological Survey, Western Kentucky Office, 1401 Corporate Court, Henderson, KY 42420, phone 270.827.3414 or 270.827.3404. For more information, and to make custom maps of your local area, visit our Land-Use Planning Interim Mapping Web Site at kgsmap.uky.edu/web/site/kytuplanviewer.htm.

Geologic Hazards

The most prominent geologic hazard for Trigg County is the karst development on the terrain underlain by thick limestone, unit 5 on the map. Sinkholes shown in red on the map are the surface expression of solution cavities such as caves and flow channels. Karst can be particularly hazardous if not treated properly during urban development. Significant damage can occur if sinkholes open beneath a structure, and flooding can worsen if subsurface drainage through sinkholes and caves are plugged or impaired. Groundwater supplies may be polluted if waste is improperly dumped into sinkholes, which ultimately affects surface water.



Karst

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 limestones, 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 that are large enough for a person to enter.

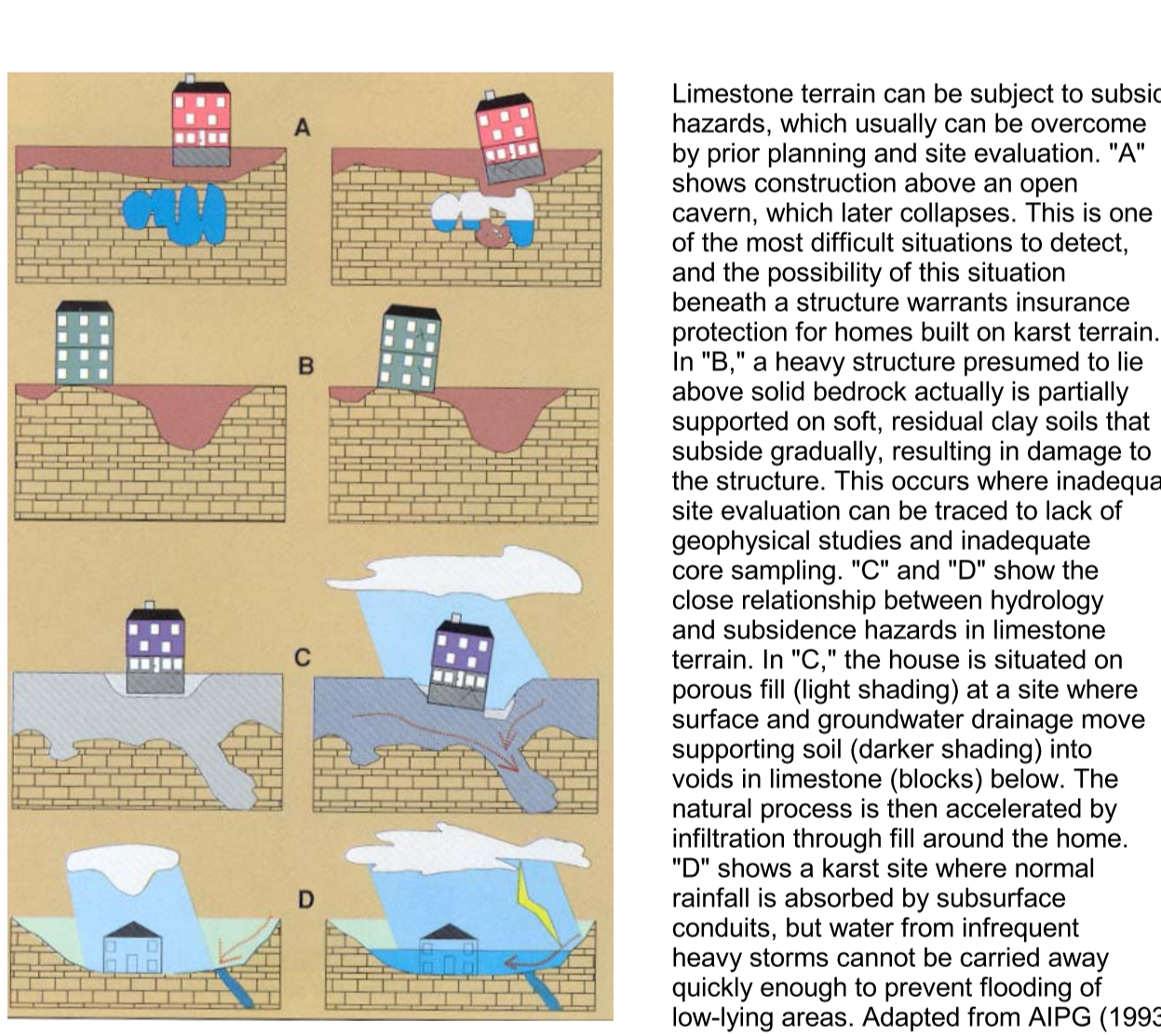
- Never use sinkholes as dumps. All waste, but especially pesticides, paints, household chemicals, automobile batteries, and used motor oil, should be taken to an appropriate recycling center or landfill.
- Make sure runoff from parking lots, streets, and other urban areas is routed through a detention 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 lagoons from collapsing, which would result in a catastrophic emptying of waste into the groundwater.
- If required, develop a groundwater protection plan (410KARS.037) or an agricultural water-quality plan (KRS224.71) for your land use.

(From Currens, 2001)

None of the faults in Trigg County are considered to be active; however, the proximity of active seismic zones, such as the New Madrid, Wabash, or East Tennessee, calls for precautions to be taken for earthquake damage mitigation.

Flooding may be a problem in Trigg County, especially, along major streams. Urban development often exacerbates flooding, and therefore potential flooding should always be considered in urban development plans. Areas of steep walled drainage, such as that formed in terrain underlain by unit 6, are conducive to flash flooding, especially in developed areas. Areas underlain by alluvium (unit 1) are generally subject to flooding. Also, alluvium contains abundant clay minerals, which may result in significant shrink/swell conditions.

Steep slopes are present, especially along streams, in areas underlain by unit 6 in the western part of Trigg County. Steep slopes can develop soil creep and landslides if not properly treated during development. Proper engineering techniques should be followed when developing on hillsides, and care should be taken not to affect property above and below a development site on a hillside.



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 AIFG (1993).

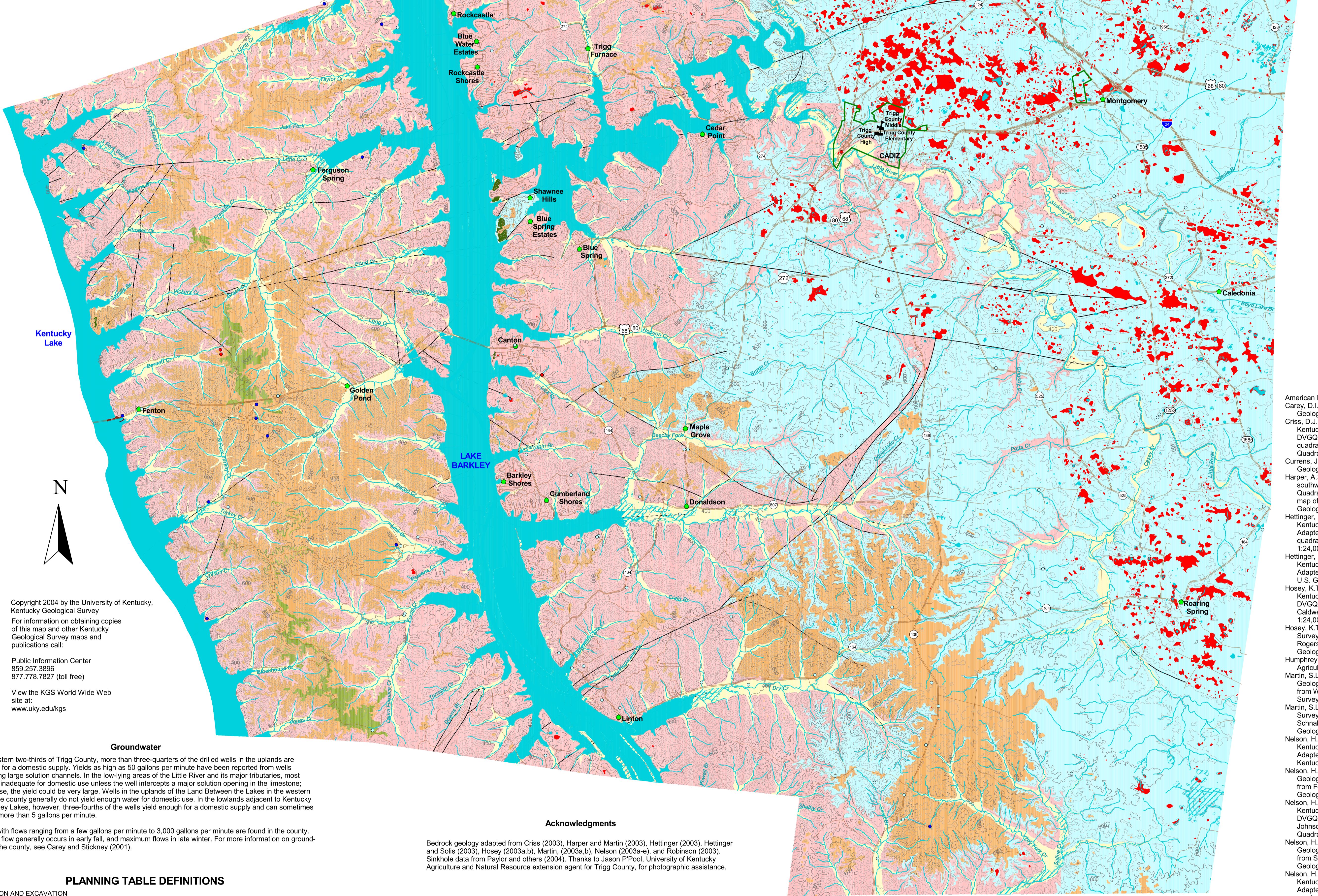
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Public Information Center
659.257.3986
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View the KGS World Wide Web site at www.uky.edu/kgs

Groundwater

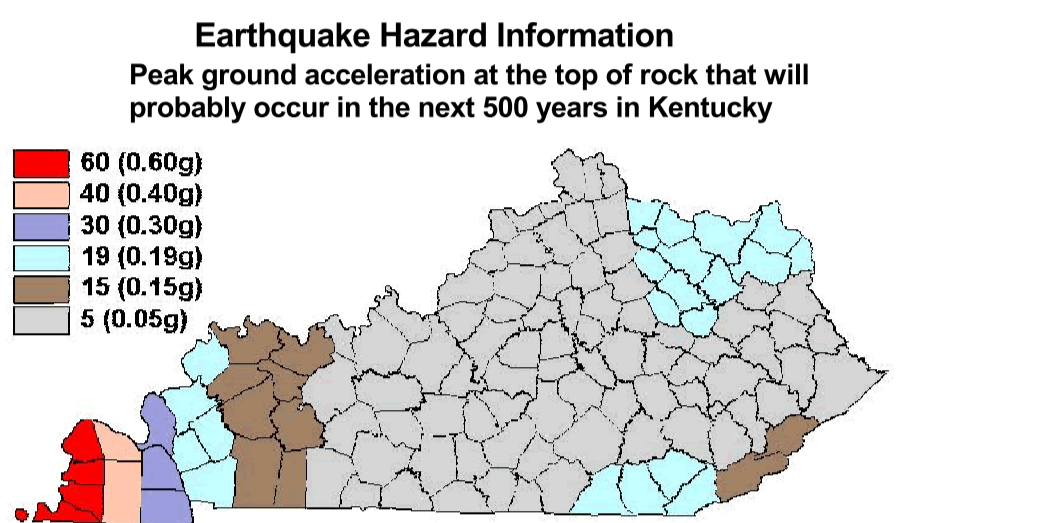
In the eastern two-thirds of Trigg County, more than three-quarters of the drilled wells in the uplands are adequate for a domestic supply. Yields as high as 50 gallons per minute have been reported from wells penetrating large solution channels. In the low-lying areas of the Little River and its major tributaries, most wells are inadequate for domestic use unless the well intercepts a major solution opening in the limestone; in that case, the yield could be very large. Wells in the uplands of the Land Between the Lakes in the western third of the county generally do not yield enough water for domestic use. In the lowlands adjacent to Kentucky and Barkley Lakes, however, three-fourths of the wells yield enough for a domestic supply and can sometimes produce more than 5 gallons per minute.

Springs with flows ranging from a few gallons per minute to 3,000 gallons per minute are found in the county. Minimum flow generally occurs in early fall, and maximum flows in late winter. For more information on groundwater in the county, see Carey and Stickley (2001).

- ### EXPLANATION
- School
 - Urban service boundary
 - Wetlands > 1 acre (U.S. Fish & Wildlife Service, 2003)
 - Water
 - Artificial fill
 - Sinkholes
 - Concealed faults
 - Faults
 - Water Wells
 - Domestic
 - Industrial
 - Monitoring
 - Public
 - 40-foot contour interval



The population of Trigg County grew 21.6 percent between 1990 and 2000, according to the U.S. Census Bureau. Because of this growth, home construction is a growing land use throughout the county. Photograph by Glynn Beck, Kentucky Geological Survey.



Although we do not know when and where the next major earthquake will occur, we do know that an earthquake will cause damage. Severity depends on many factors, such as earthquake magnitude, distance from the epicenter, and local geology. Information on earthquake effects is obtained by monitoring earthquakes and performing research. Such information is vital for earthquake hazard mitigation and risk reduction.

The most important information for seismic-hazard mitigation and risk reduction is ground-motion hazard. One way of predicting ground-motion hazard is by determining the peak ground acceleration (PGA) that may occur in a particular timeframe. The map above shows the PGA at the top of bedrock that will likely occur within the next 500 years in Kentucky (Street and others, 1996). It shows, as expected, that PGA would be greatest in far western Kentucky near the New Madrid Seismic Zone. Ground-motion hazard maps for the central United States and other areas are available from the U.S. Geological Survey. These maps are used to set general policies on mitigating damage. For example, maps produced by the USGS in 1996 were used to determine seismic design in building codes. For additional information about earthquake hazards, visit the Kentucky Geological Survey Web site at www.uky.edu/kgs/geologic/hazards/geologic/hazards.html.

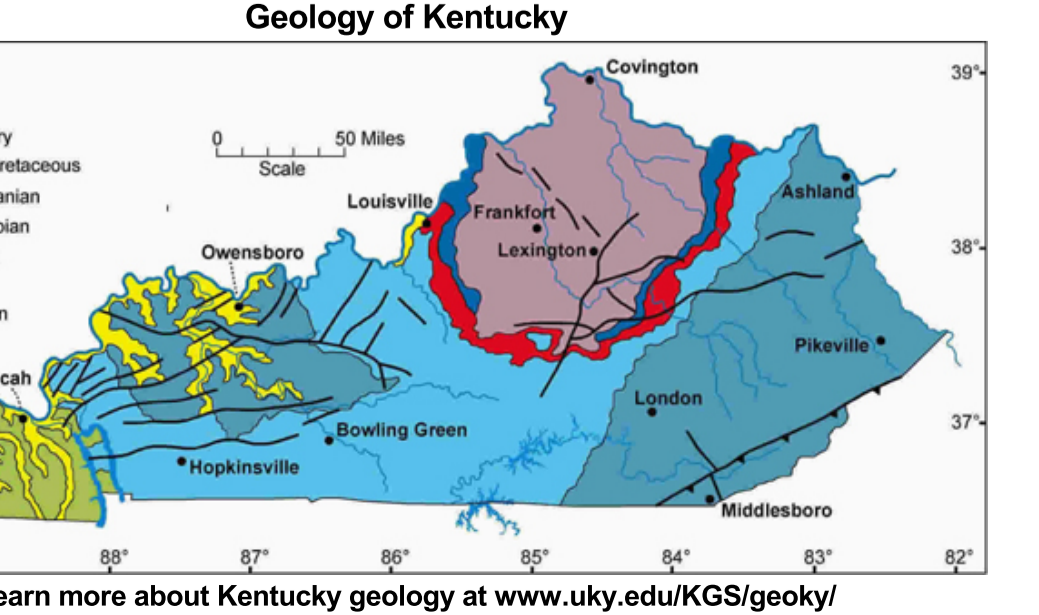
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Additional Planning Resources

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

- www.barkleylake.com/—Trigg County Chamber of Commerce
- www.uky.edu/trigg/—University of Kentucky Cooperative Extension Service
- www.paeadd.org/—Pennylane Area Development District
- www.thinkkentucky.com/ky/w029/—Kentucky Economic Development Information System
- www.uky.edu/KentuckyAtlas/21221.html—Kentucky Atlas and Gazetteer
- quickfacts.census.gov/qd/states/21/21221.html—U.S. Census data
- web.uky.edu/doi/land/kgsplanning.htm—Planning information from the Kentucky Geological Survey



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

PLANNING TABLE DEFINITIONS

The terms "karst" 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 natural 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 subgrade 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 cut 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 caverns, cracks, etc.

Intensive recreation—Athletic fields, stadiums, etc.

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.

Acknowledgments

Bedrock geology adapted from Criss (2003), Harper and Martin (2003), Hettinger (2003), Hettinger and Sells (2003), Hisey (2003a,b), Martin (2003a,b), Nelson (2003a-e), and Robinson (2003). Thanks to Jason PFPod, University of Kentucky Agriculture and Natural Resource extension agent for Trigg County, for photographic assistance.

Planning Guidance by Rock Unit Type

Rock Unit	Foundation and Excavation	Septic Tank Disposal 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	Fair to good foundation material. Easily excavated.	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).	Refer to soil report (Humphrey, 1981).
2. Gravel	Fair to good foundation material. Variable thickness and permeability.	Slight to moderate limitations. Variable thickness and permeability.	Severe to moderate limitations. Shallow water tables may be present.	No limitations.	No limitations.	No limitations.	No limitations.	No limitations.	Severe limitations. Leaky reservoir material.	Severe limitations. Leaky reservoir material.	Slight to moderate limitations. Variable materials.
3. Sandstone limestone, shale	Fair to good foundation material.	Slight to moderate limitations. Variable materials. Low permeability zones possible.	Slight limitations. Shallow water tables may be present.	No limitations.	No limitations.	No limitations.	No limitations.	No limitations.	Slight to moderate limitations. Permeable materials possible.	Slight to moderate limitations. Permeable materials possible.	No limitations.
4. Sandstone	Fair to good foundation material. Shallow water tables may be present.	Severe limitations. Thin soils.	Severe to moderate limitations. Rock excavation locally, upper few feet may be ripable. Steep slopes.	Moderate to moderate limitations. Rock excavation locally, upper few feet may be ripable. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Steep slopes.	Slight to moderate limitations.	Moderate limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations.	Moderate limitations. Highly variable amount of soil and rock excavation. Steep slopes.
5. Karst limestone	Excellent foundation material. Difficult to excavate.	Severe limitations. Impervious rock. Locally, few feet may be ripable. Danger of groundwater drainage required.	Severe to moderate limitations. Rock excavation locally, upper few feet may be ripable.	Slight to moderate limitations. Rock excavation locally, upper few feet may be ripable. Steep slopes.	Slight limitations. Local drainage problems from seeps or springs; sinks possible.	Slight to moderate limitations, depending on topography. Rock excavation locally, upper few feet may be ripable.	No limitations.	No limitations.	Severe limitations. Leaky reservoir rock. Locally, conditions may be favorable. Sinks possible.	Severe limitations.	Severe limitations. Rock excavation.
6. Limestone	Excellent foundation material. Difficult to excavate.	Severe limitations. Impervious rock.	Severe to moderate limitations. Rock excavation locally, upper few feet may be ripable.	Slight to moderate limitations. Rock excavation locally, upper few feet may be ripable.	Slight limitations.	Slight to moderate limitations, depending on topography. Rock excavation locally, upper few feet may be ripable.	No limitations.	No limitations.	Slight to moderate limitations.	Severe limitations.	Severe limitations. Rock excavation.
7. Sand	Fair to good foundation material. Easy to excavate. Prone to instability during strong earthquakes.	Slight limitations. May have variable thickness and permeable zones.	Slight to moderate limitations. Rock excavation locally, upper few feet may be ripable.	No limitations.	No limitations.	No limitations.	No limitations.	Slight limitations. Loose footing.	Moderate to severe limitations. Leaky reservoir material.	Severe limitations. Poor reservoir embankment material.	No limitations.

