Kentucky Geological Survey
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MAP AND CHART 112
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Generalized Geologic Map for Land-Use Planning: Crittenden County, Kentucky

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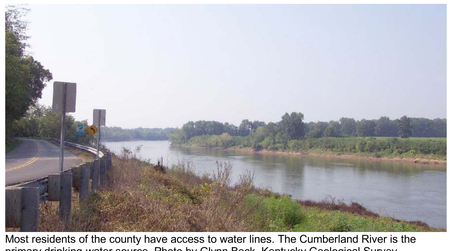
For Planning Use Only

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

Water Supply

Lake George is the source of drinking water for the city of Marion's 3,500 residents. Photo by Glynn Beck, Kentucky Geological Survey.

Drinking Water



Most residents of the county have access to water lines. The Cumberland River is the primary drinking-water source. Photo by Glynn Beck, Kentucky Geological Survey.

Groundwater

On the northern edge of Crittenden County, wells in the alluvium of the Ohio River Valley yield several hundred gallons per minute; compound horizontal wells have a potential yield as high as 5,000 gallons per minute.

In the westernmost three-quarters of the county, most 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 or fault zones. In the low-lying areas of Claylick and Livingston Creeks and the tributaries to the Ohio River, 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. Groundwater in the sandstone- and shale-rich easternmost quarter of the county is not as prevalent as in the rest of the county, which is predominantly limestone. Most wells in the eastern part of the county are inadequate for a domestic supply; however, some wells in sandstone formations yield enough water for a domestic supply when located in areas bordering streams.

Springs with flows ranging from a few gallons per minute to 1,400 gallons per minute are found in the county. Minimum flows generally occur in early fall, maximum flows in late winter. For more information on groundwater in the county, see Carey and Stickney (2005).

Acknowledgments

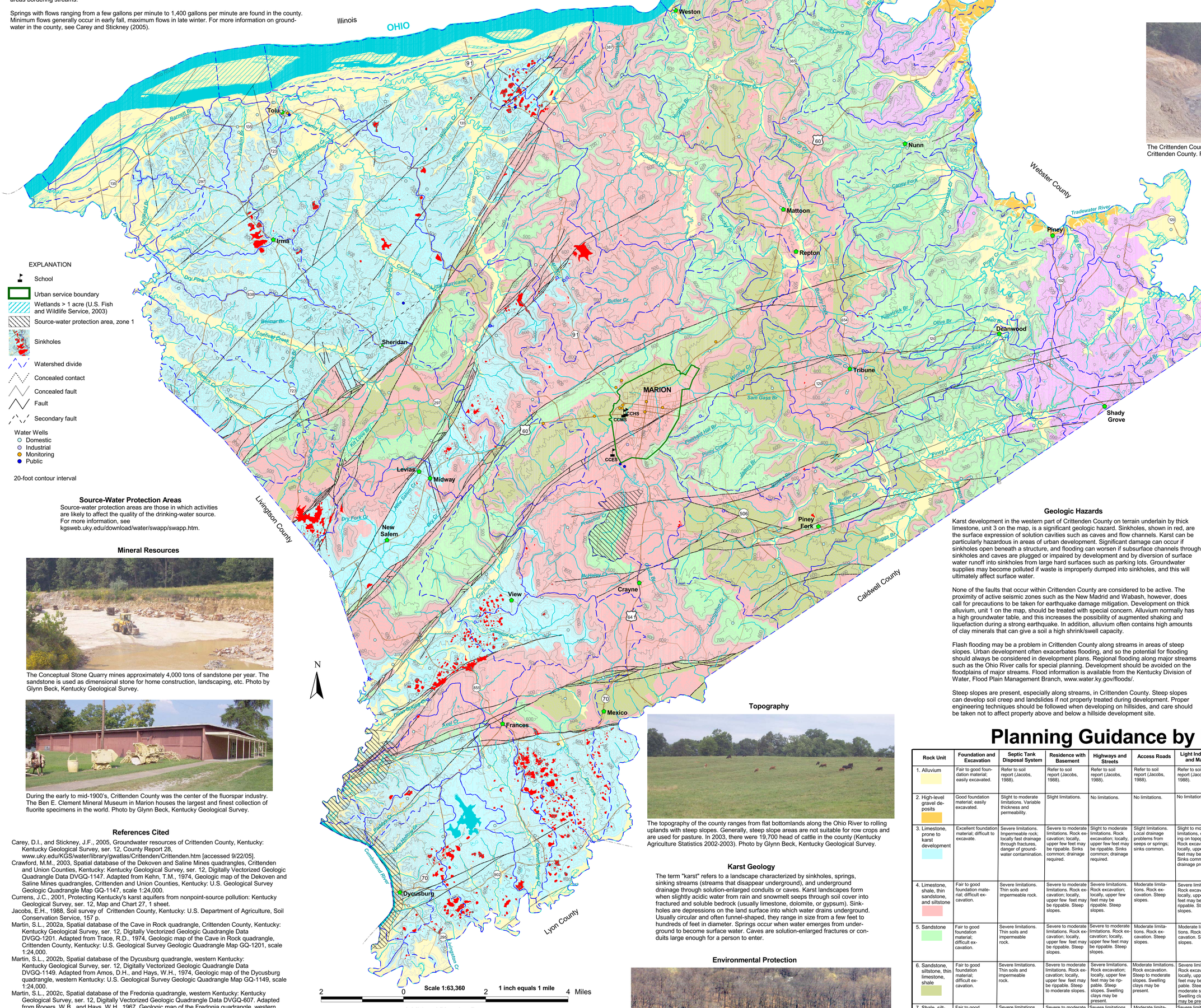
Geology adapted from Crawford (2003), Martin (2002a-h), Mullins (2003a-b), Smith (2003), Solis and Hettinger (2000), and Tyra (2003). Mapped sinkhole data from Paylor and others (2004). Karst diagram from Currens (2001). Thanks to Corey Payne, Crittenden County Agriculture and Natural Resources agent; Danny Clayton, Crittenden County Coal Company; and Donnie Taylor, Conceptual Stone, for photo assistance.

Irrigation

In order to maintain optimum production during drought conditions, Ohio River water is used for pivot irrigation of row crops in the valley. Photo by Glynn Beck, Kentucky Geological Survey.

Coal Mining

The Crittenden County Coal Company Tex No. 1 Mine is the only active coal mine in Crittenden County. Photo by Glynn Beck, Kentucky Geological Survey.



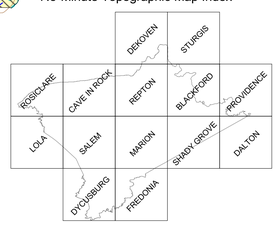
EXPLANATION

- School
- Urban service boundary
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Source-water protection area, zone 1
- Sinkholes
- Watershed divide
- Concealed contact
- Concealed fault
- Fault
- Secondary fault

Water Wells
- Domestic
- Industrial
- Monitoring
- Public

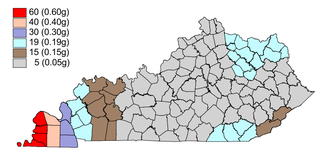
20-foot contour interval

7.5-Minute Topographic Map Index



Earthquake Hazard Information

Peak ground acceleration at the top of rock that will probably occur in the next 500 years in Kentucky



Although we do not know when and where the next major earthquake will occur, we do know that an earthquake will cause damage. Damage severity depends on many factors, such as earthquake magnitude, the 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 pertaining to earthquake hazards visit the Kentucky Geological Survey Web site at www.uky.edu/KGS/geologichazards/geologichazards.html.

Source-Water Protection Areas

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

Mineral Resources

The Conceptual Stone Quarry mines approximately 4,000 tons of sandstone per year. The sandstone is used as dimensional stone for home construction, landscaping, etc. Photo by Glynn Beck, Kentucky Geological Survey.

During the early to mid-1900's, Crittenden County was the center of the fluorspar industry. The Ben E. Clement Mineral Museum in Marion houses the largest and finest collection of fluorite specimens in the world. Photo by Glynn Beck, Kentucky Geological Survey.

Geologic Hazards

Karst development in the western part of Crittenden County on terrain underlain by thick limestone, unit 3 on the map, is a significant geologic hazard. Sinkholes, shown in red, are the surface expression of solution cavities such as caves and flow channels. Karst can be particularly hazardous in areas of urban development. Significant damage can occur if sinkholes open beneath a structure, and flooding can worsen if subsurface channels through sinkholes and caves are plugged or impaired by development and by diversion of surface water runoff into sinkholes from large hard surfaces such as parking lots. Groundwater supplies may become polluted if waste is improperly dumped into sinkholes, and this will ultimately affect surface water.

None of the faults that occur within Crittenden County are considered to be active. The proximity of active seismic zones such as the New Madrid and Wabash, however, does call for precautions to be taken for earthquake damage mitigation. Development on thick alluvium, unit 1 on the map, should be treated with special concern. Alluvium normally has a high groundwater table, and this increases the possibility of augmented shaking and liquefaction during a strong earthquake. In addition, alluvium often contains high amounts of clay minerals that can give a soil a high shrink/swell capacity.

Flash flooding may be a problem in Crittenden County along streams in areas of steep slopes. Urban development often exacerbates flooding, and so the potential for flooding should always be considered in development plans. Regional flooding along major streams such as the Ohio River calls for special planning. Development should be avoided on the floodplains of major streams. Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, www.water.ky.gov/floods/.

Steep slopes are present, especially along streams, in Crittenden 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 hillside development site.

Topography

The topography of the county ranges from flat bottomlands along the Ohio River to rolling uplands with steep slopes. Generally, steep slope areas are not suitable for row crops and are used for pasture. In 2003, there were 19,700 head of cattle in the county (Kentucky Agriculture Statistics 2002-2003). Photo by Glynn Beck, Kentucky Geological Survey.

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 snowmelt seeps through soil cover into fractured and soluble bedrock (usually limestone, dolomite, or gypsum). Sinkholes are depressions on the land surface into which 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.

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.

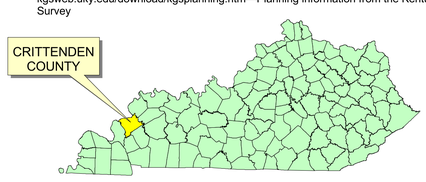
If required, develop a groundwater protection plan (410KAR5:037) or an agricultural water-quality plan (KRS224.71) for your land use.

(From Currens, 2001)

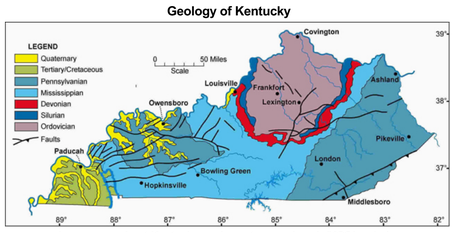
Additional Planning Resources

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

ces.ca.uky.edu/crittenden/—University of Kentucky Cooperative Extension Service
www.peadd.org/—Pennyrile Area Development District
www.thinkkentucky.com/edis/cmnty/cw014/—Kentucky Economic Development Information System
www.uky.edu/KentuckyAtlas/21055.html—Kentucky Atlas and Gazetteer
quickfacts.census.gov/qfd/states/21/21055.html—U.S. Census data
kgsweb.uky.edu/download/kgsplanning.htm—Planning information from the Kentucky Geological Survey



Geology of Kentucky



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

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.

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 (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).	Refer to soil report (Jacobs, 1988).
2. High-level gravel deposits	Good foundation material; easily excavated.	Slight to moderate limitations. Variable thickness and permeability.	Slight limitations.	No limitations.	No limitations.	No limitations.	No limitations.	No limitations.	Not applicable.	Not applicable.	Slight limitations.
3. Limestone, prone to karst development	Excellent foundation material; difficult to excavate.	Severe limitations. Impermeable rock; locally fast drainage through fractures, danger of groundwater contamination.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks common; drainage required.	Slight to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Sinks common; drainage required.	Slight limitations. Local drainage problems from seeps or springs; sinks common.	Slight to moderate limitations, depending on topography. Rock excavation; locally, upper few feet may be rippable. Sinks common; local drainage problems.	Slight to severe limitations. Steep slopes.	Slight to moderate limitations. Steep slopes.	Severe limitations. Local drainage problems; reservoir rock; locally, conditions may be favorable. Sinks common.	Severe limitations. Local drainage problems; reservoir rock; locally, conditions may be favorable. Sinks common.	Severe limitations. Rock excavation.
4. Limestone, shale, thin sandstone, and siltstone	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. 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 depending on topography.	Slight limitations. Reservoir may leak where rocks are fractured.	Severe limitations. Leaky rock.	Moderate limitations. Highly variable amount of soil and rock excavation.
5. Sandstone	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Moderate limitations. Rock excavation. Steep slopes.	Severe limitations. Steep slopes.	Slight to moderate limitations, depending on topography.	Moderate limitations. Permeable rock.	Severe limitations. Leaky rock.	Moderate limitations. Highly variable amount of earth and rock excavation.
6. Sandstone, siltstone, thin limestone, shale	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. Steep to moderate slopes.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep slopes. Swelling clays may be present.	Moderate limitations. Rock excavation. Steep to moderate slopes. Swelling clays may be present.	Severe limitations. Rock excavation; locally, upper few feet may be rippable. Steep to moderate slopes. Swelling clays may be present.	Severe to moderate limitations. Steep to moderate slopes.	Slight to moderate limitations, depending on topography.	Severe limitations. Leaky rock.	Slight limitations. Reservoir might leak where rocks are fractured.	Moderate limitations. Highly variable amount of earth and rock excavation.
7. Shale, siltstone, sandstone, limestone, coal, underclay	Fair to good foundation material; difficult excavation.	Severe limitations. Thin soils and impermeable rock.	Severe to moderate limitations. Rock excavation; locally, upper few feet may be rippable. 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, depending on topography.	Severe limitations. Leaky rock.	Slight limitations. Reservoir might leak where rocks are fractured.	Moderate limitations. Highly variable amount of earth and rock excavation.

PLANNING GUIDANCE 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 depends on 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, riveways, 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 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.

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