

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

Daniel I. Carey  
Sandstone



**Bell County Courthouse at Pineville**  
Bell County, 361 square miles in the Eastern Kentucky Coal Field, was formed in 1867. Mountainous topography is predominant and communities are located in stream valleys. The unique exception is the area of Middlesboro, which was created by the impact of an object from outer space sometime within the past 300 million years. The resulting crater is roughly 3 miles in diameter. The highest elevation, 3,500 feet, is near White Rock lookout tower northeast of Cumberland Gap. The lowest elevation 975 feet, is where the Cumberland River leaves the county in the northwest. The 2006 population of 29,621 was 1.5 percent smaller than that of 2000. The deer population may be increasing (below). Photos by Dan Carey, Kentucky Geological Survey.



Erosion-resistant sandstone (unit 9) forms hogbacks on Pine Mountain and affords opportunities for sunbathing (below). Photos by Dan Carey, Kentucky Geological Survey.

## Water Resources



The Cumberland River and its tributaries provide scenic beauty, fishing, and level land for agriculture and communities. They also cause flood damage to unprotected development below the flood line. Photo by Dan Carey, Kentucky Geological Survey.

## Kudzu



Kudzu, named after the area of its origin in Japan, grows to impressive displays throughout southeastern Kentucky. It can grow 12 inches in a day, or 80 feet in a season. The nonwoody parts are edible. Photo by Dan Carey, Kentucky Geological Survey.



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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 general, why 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, 889.257.5500. For more information, visit the KGS Community Development Planning Web site at [kgweb.uky.edu/download/igplanning.htm](http://kgweb.uky.edu/download/igplanning.htm).

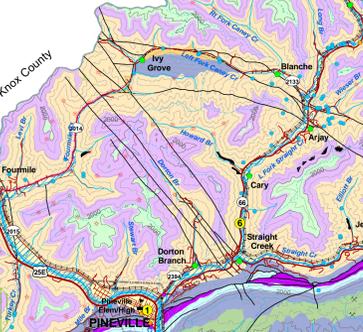
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The view of Pineville from Chained Rock shows the rugged hills and wide stream valleys typical of the county. The floodwall to the right of U.S. 25E that protects the city from Cumberland River floodwaters also symbolizes the threat of flooding to development in stream valleys throughout the county. Photo by Dan Carey, Kentucky Geological Survey.

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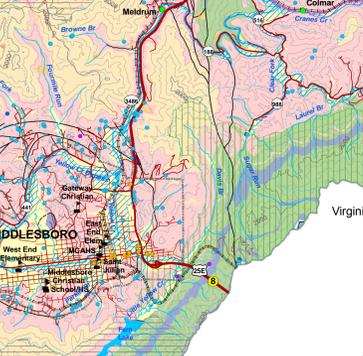


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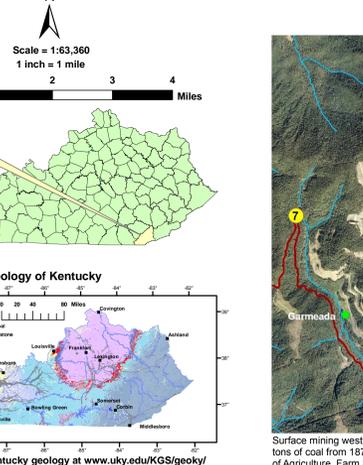
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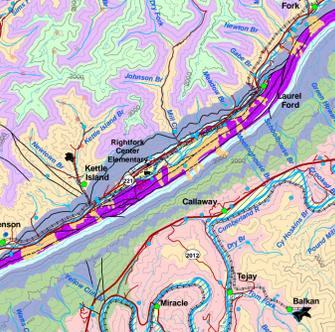
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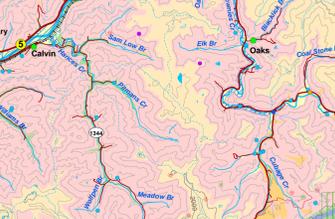
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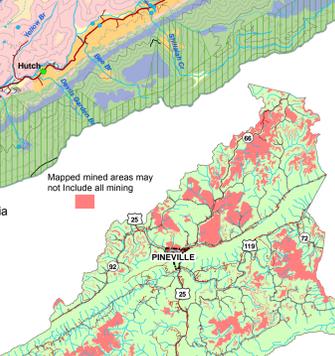


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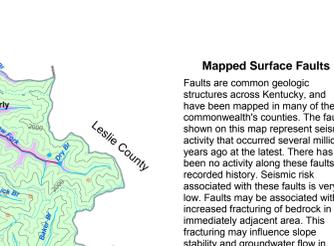
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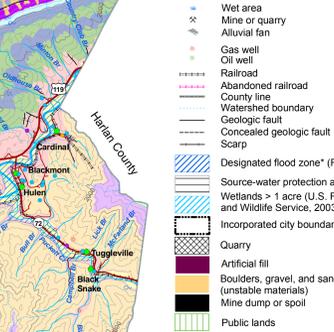
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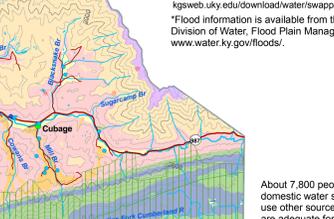
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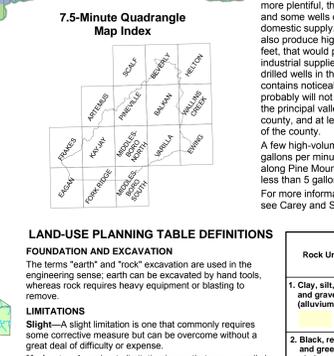


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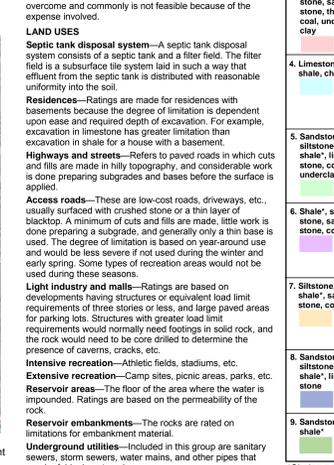
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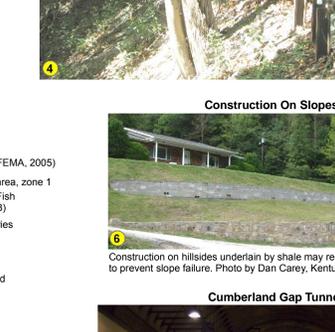
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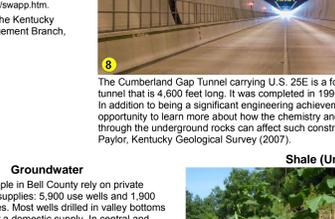
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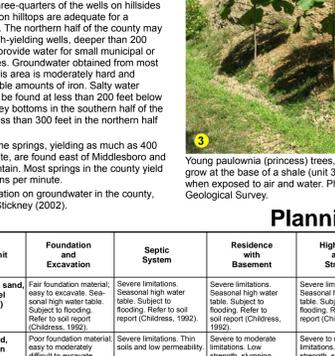


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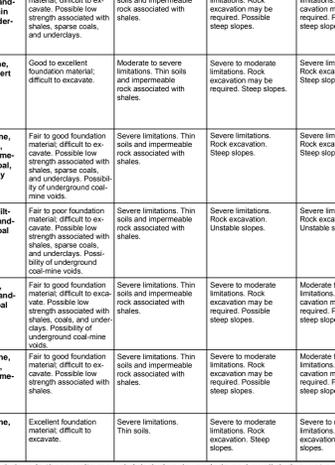
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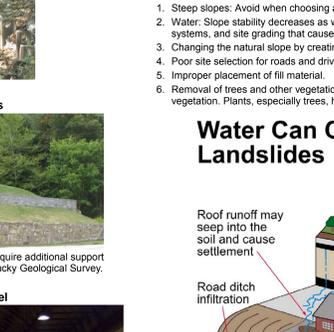
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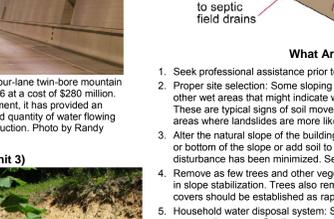
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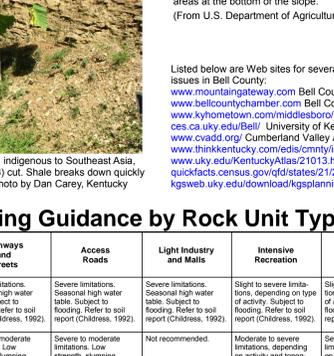


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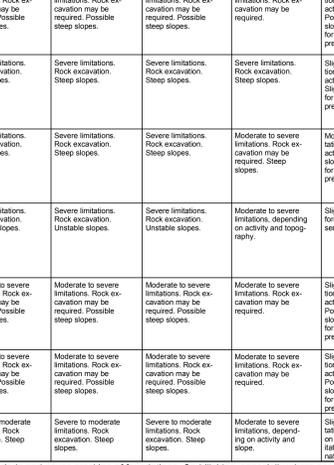
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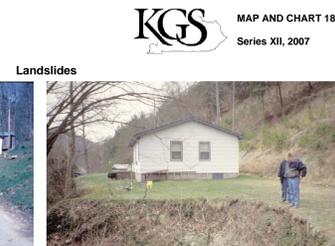
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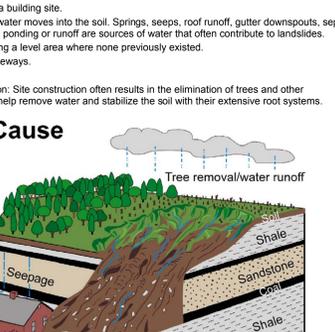
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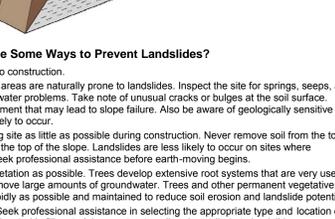
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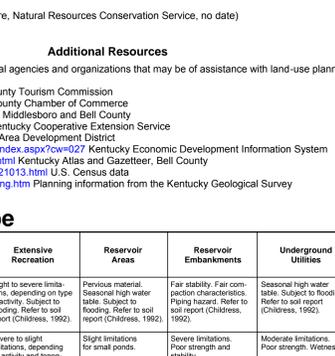


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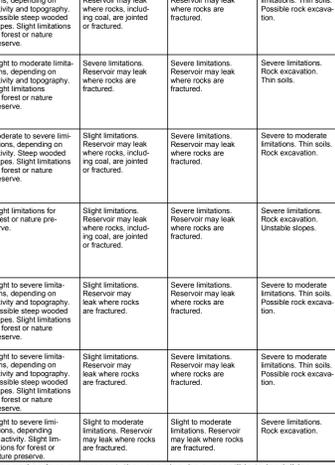
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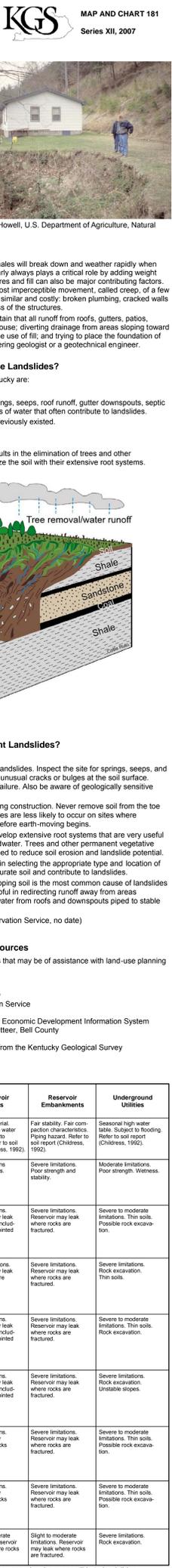
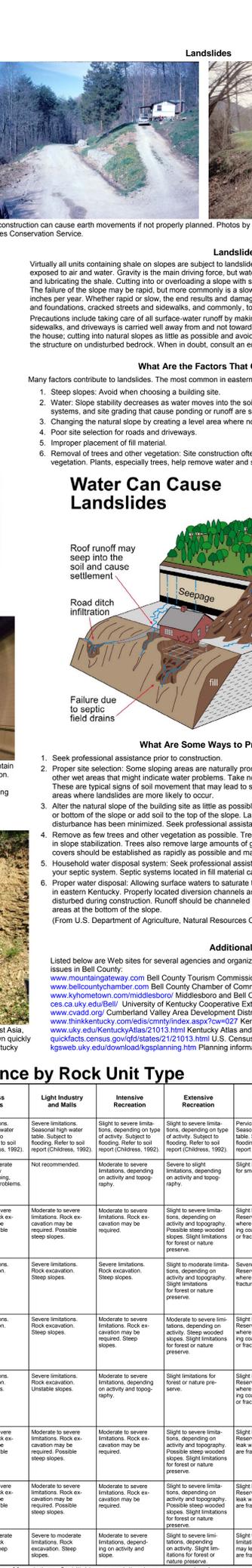
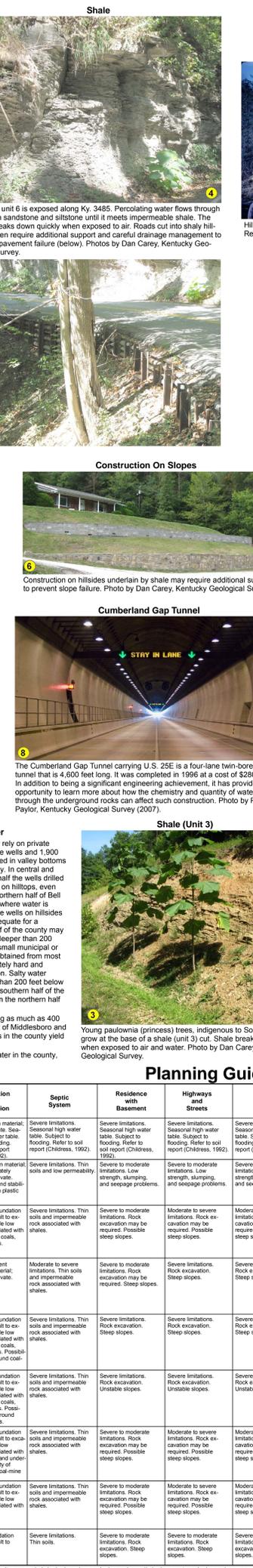
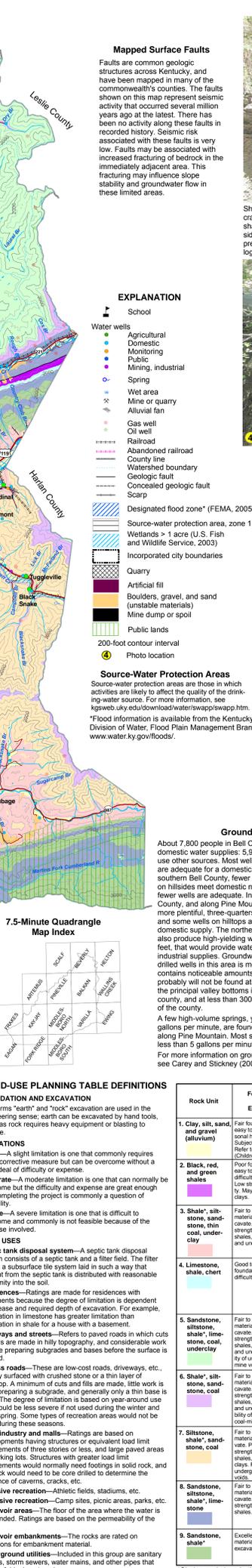
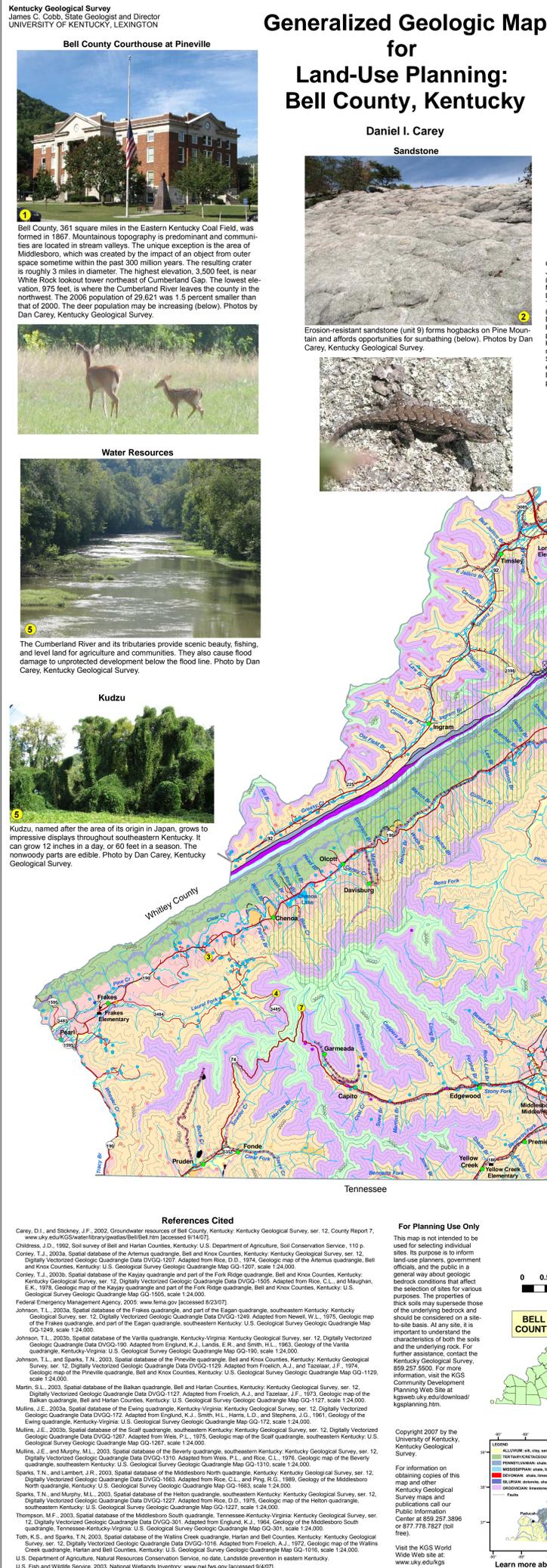
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**EXPLANATION**

- School
- Water wells
  - Agricultural
  - Domestic
  - Monitoring
  - Public
  - Mining, industrial
  - Spring
  - Wet area
  - Mine or quarry
  - Aluvial fan
  - Cas well
  - Oil well
- Railroad
- Abandoned railroad
- County line
- Watershed boundary
- Geologic fault
- Concealed geologic fault
- Scarp
- Designated flood zone\* (FEMA, 2005)
- Source-water protection area, zone 1
- Wetlands > 1 acre (U.S. Fish and Wildlife Service, 2003)
- Incorporated city boundaries
- Quarry
- Artificial fill
- Boulders, gravel, and sand (unstable materials)
- Mine dump or spoil
- Public lands
- 200-foot contour interval
- Photo location

**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 [kgweb.uky.edu/download/water/wapp/wapp.htm](http://kgweb.uky.edu/download/water/wapp/wapp.htm).  
\*Flood information is available from the Kentucky Division of Water, Flood Plain Management Branch, [www.water.ky.gov/flood/](http://www.water.ky.gov/flood/).

**Groundwater**  
About 7,800 people in Bell County rely on private domestic water supplies: 5,900 use wells and 1,900 use other sources. Most wells drilled in valley bottoms are adequate for a domestic supply. In central and southern Bell County, fewer than half the wells drilled on hillsides meet domestic needs, on hillsides, even fewer wells are adequate. In the northern half of Bell County, and along Pine Mountain where water is more plentiful, three-quarters of the wells on hillsides and some wells on hillsides are adequate for a domestic supply. The northern half of the county may also produce high-yielding wells, deeper than 200 feet, that would provide water for small municipal or industrial supplies. Groundwater obtained from most drilled wells in this area is moderately hard and contains noticeable amounts of iron. Salty water probably will not be found at less than 200 feet below the principal valley bottoms in the southern half of the county, and at less than 300 feet in the northern half of the county.  
A few high-volume springs, yielding as much as 400 gallons per minute, are found east of Middlesboro and along Pine Mountain. Most springs in the county yield less than 5 gallons per minute.  
For more information on groundwater in the county, see Carey and Stickney (2002).

**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 normally 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 essentially 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 backstop. 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 of 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.

\*Shales and clays in these units may shrink during dry periods and swell during wet periods and cause cracking of foundations. On hillsides, especially where seeps and springs are present, they can also be susceptible to landslides.

**Mapped Surface Faults**  
Faults are common geologic structures across Kentucky, and have been mapped in many of the commonwealth's counties. The faults shown on this map represent seismic activity that occurred several million years ago at the latest. There has been no activity along these faults in recorded history. Seismic risk associated with these faults is very low. Faults may be associated with increased fracturing of bedrock in the immediately adjacent area. This fracturing may influence slope stability and groundwater flow in these limited areas.

**Shale**  
Shale of unit 6 is exposed along Ky. 3485. Percolating water flows through cracks in sandstone and siltstone until it meets impermeable shale. The shale breaks down quickly when exposed to air. Roads cut into shaly hillsides often require additional support and careful drainage management to prevent pavement failure (below). Photos by Dan Carey, Kentucky Geological Survey.

**Construction On Slopes**  
Construction on hillsides underlain by shale may require additional support to prevent slope failure. Photo by Dan Carey, Kentucky Geological Survey.

**Cumberland Gap Tunnel**  
The Cumberland Gap Tunnel carrying U.S. 25E is a four-lane twin-bore mountain tunnel that is 4,500 feet long. It was completed in 1966 at a cost of \$28 million. In addition to being a significant engineering achievement, it has provided an opportunity to learn more about how the chemistry and quantity of water flowing through the underground rocks can affect such construction. Photo by Randy Paylor, Kentucky Geological Survey (2007).

**Landslides**  
Hillside construction can cause earth movements if not properly planned. Photos by Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service.

Virtually all units containing shale on slopes are subject to landslides. Shales will break down and weather rapidly when exposed to air and 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. 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.  
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.

**What Are the Factors That Cause Landslides?**  
Many factors contribute to landslides. The most common in eastern Kentucky are:  
1. Steep slopes: Avoid when choosing a building site.  
2. Water: Slope stability decreases as water moves into the soil. Springs, seeps, roof runoff, gutter downspouts, septic systems, and site grading that cause ponding or runoff are sources of water that often contribute to landslides.  
3. Changing the natural slope of soil by creating a level area where none previously existed.  
4. Poor site selection for roads and driveways.  
5. Improper placement of fill material.  
6. Removal of trees and other vegetation: Site construction often results in the elimination of trees and other vegetation. Plants, especially trees, help remove water and stabilize the soil with their extensive root systems.

**Water Can Cause Landslides**  
Roof runoff may seep into the