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

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Daniel I. Carey, Steven E. Webb, Bart Davidson

### Acknowledgments

Geology adapted from Crawford (2003), Johnson (2003), Martin (2003), Mullins (2003a, b), Mullins and Murphy (2003), Sparks (2003a-f), Toth (2003), Toth and Sparks (2003), Petersen (2004), Morris and others (2005a, b). Thanks to Paul Howell, U.S. Department of Agriculture, Natural Resources Conservation Service, for photos. Thanks to Meg Smith, Kentucky Geological Survey, for editorial improvements. Thanks to Kim and Kant Annes, Kentucky Division of Geographic Information, for base-map data.

### Natural Beauty

Harlan County is blessed with natural beauty, whether the sandstone formations like Log Rock in Kingdom Come State Park (above) or butterflies in the sunshine along the ridgetops (below). Photos by Dan Carey, Kentucky Geological Survey.

### Cumberland River at Loyal

The Cumberland River and its tributaries define the settlement patterns in the county. Flooding has been a historical problem. Cutoffs such as this one in Loyal, although preventing flooding, leave isolated meanders (below) that may create unanticipated secondary impacts. Photos by Dan Carey, Kentucky Geological Survey.

### Blanton Forest and Camp Blanton

This 3,090-acre Blanton Forest State Nature Preserve is the largest old-growth forest in Kentucky. The 10-acre Camp Blanton (left) has five cabins, a large dining hall and kitchen, restrooms and showers, and recreational opportunities including canoeing, swimming, a firing range, and hiking trails. Photo by Dan Carey, Kentucky Geological Survey.

### Groundwater

About 16,800 people in Harlan County rely on private domestic water supplies: 14,000 use wells and 2,800 use other sources. Most wells drilled in valley bottoms are adequate for a domestic supply. About three-quarters of the wells drilled on hillsides and one-third of the wells drilled on hillsides are adequate for a domestic supply. Wells drilled 200 feet or more below the level of the principal valley bottoms may yield enough water for small municipal or industrial supplies. Few wells in this county drilled to less than 200 feet below the level of the principal valley bottoms will yield salty water, except in the small corner of the county north of Pine Mountain, where salty water can be found in the range of 200 feet below the principal valley bottoms. Wells drilled in the Pine Mountain area that reach limestone may yield as much as several hundred gallons per minute. Groundwater obtained from most drilled wells in this area is soft but contains noticeable amounts of iron, except north of Pine Mountain, where the water is moderately hard. Some of the most productive springs in eastern Kentucky are found along Pine Mountain in Harlan County. Limestone springs can yield more than 50 gallons per minute but generally yield less than 10 gallons per minute. For more information on groundwater in the county, see Carey and Siskney (2005).

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### Additional Resources

- Listed below are Web sites for several agencies and organizations that may be of assistance with land-use planning issues in Harlan County.
- [www.harlandcounty.com](http://www.harlandcounty.com) Harlan County
- [www.kyhotmetown.com/harlan/](http://www.kyhotmetown.com/harlan/) Harlan and Harlan County
- [www.harlancountykycamber.com](http://www.harlancountykycamber.com) Harlan County Chamber of Commerce
- [www.harlandcountytourism.com](http://www.harlandcountytourism.com) Harlan County Tourism Commission
- [www.harlancountykyc.com](http://www.harlancountykyc.com) Kentucky Mountain Trails of Harlan County
- [www.thinkkentucky.com/eds/cmmv/index.asp?ow=075](http://www.thinkkentucky.com/eds/cmmv/index.asp?ow=075) Kentucky Economic Development Information System
- [www.uky.edu/KentuckyAtlas/21095.html](http://www.uky.edu/KentuckyAtlas/21095.html) Kentucky Atlas and Gazetteer, Harlan County
- [quickfacts.census.gov/qof/states/21/21095.html](http://quickfacts.census.gov/qof/states/21/21095.html) U.S. Census data
- [www.ky.gov/education/development/planning.htm](http://www.ky.gov/education/development/planning.htm) Planning information from the Kentucky Geological Survey
- [www.cwdsd.org/](http://www.cwdsd.org/) Cumberland Valley Area Development District Extension Service
- [www.thinkkentucky.com/eds/cmmv/index.asp?ow=075](http://www.thinkkentucky.com/eds/cmmv/index.asp?ow=075) Kentucky Economic Development Information System
- [www.uky.edu/KentuckyAtlas/21095.html](http://www.uky.edu/KentuckyAtlas/21095.html) Kentucky Atlas and Gazetteer, Harlan County
- [quickfacts.census.gov/qof/states/21/21095.html](http://quickfacts.census.gov/qof/states/21/21095.html) U.S. Census data
- [www.ky.gov/education/development/planning.htm](http://www.ky.gov/education/development/planning.htm) Planning information from the Kentucky Geological Survey
- [www.cwdsd.org/](http://www.cwdsd.org/) Cumberland Valley Area Development District Extension Service

### Nature's Playground



In an attempt to diversify its economy, eastern Kentucky is promoting itself as "nature's playground." Harlan County has miles of off-road sport vehicle and hiking trails, campsites, and spectacular ridgetop views. Photos by Dan Carey, Kentucky Geological Survey.



### Cumberland River at Loyal

The Cumberland River and its tributaries define the settlement patterns in the county. Flooding has been a historical problem. Cutoffs such as this one in Loyal, although preventing flooding, leave isolated meanders (below) that may create unanticipated secondary impacts. Photos 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 60 feet in a season. The woody parts are edible. Photo by Dan Carey, Kentucky Geological Survey.

### Sandstone (Unit 9)



The difficulties of sandstone excavation can be imagined when looking at the 300-million-year-old Bee Rock Sandstone Member (unit 9) of the Lee Formation exposed along U.S. 421 near the base of Pine Mountain. Photo by Dan Carey, Kentucky Geological Survey.

### Shale (Unit 7)



Shale (unit 7) weathers quickly and exhibits a characteristic crumbly appearance when exposed, as seen in this photo on Ky. 160. Photo by Dan Carey, Kentucky Geological Survey.

### Construction on Slopes



Construction on slopes underlain by shale require additional support for stability. Photo by Dan Carey, Kentucky Geological Survey.

### Landslides



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

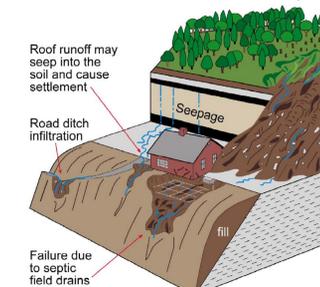
### Landslides

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 overbuilding 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:
  - Sleep slopes: Avoid when choosing a building site.
  - 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.
  - Changing the natural slope by creating a level area where none previously existed.
  - Poor site selection for roads and driveways.
  - Improper placement of fill material.
  - 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

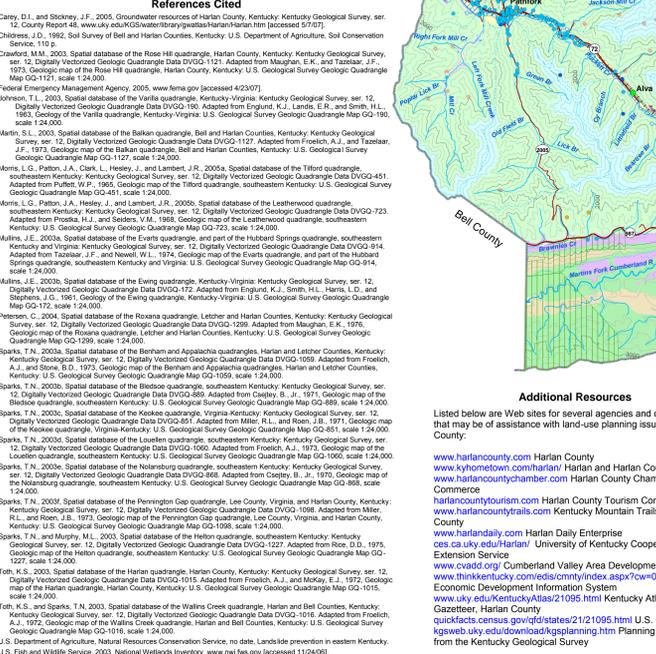


### What Are Some Ways to Prevent Landslides?

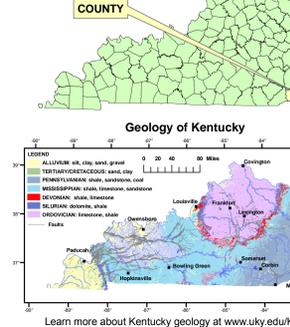
- Seek professional assistance prior to construction.
- Proper site selection: Some sloping areas are naturally prone to landslides. Inspect the site for springs, seeps, and other wet areas that might indicate water problems. Take note of unusual cracks or bulges at the soil surface. These are typical signs of soil movement that may lead to slope failure. Also be aware of geologically sensitive areas where landslides are more likely to occur.
- Alter the natural slope of the building site as little as possible during construction. Never remove soil from the toe or bottom of the slope or add soil to the top of the slope. Landslides are less likely to occur on sites where disturbance has been minimized. Seek professional assistance before earth-moving begins.
- Remove as few trees and other vegetation as possible. Trees develop extensive root systems that are very useful in slope stabilization. Trees also remove large amounts of groundwater. Trees and other permanent vegetative covers should be established as rapidly as possible and maintained to reduce soil erosion and landslide potential.
- Household water disposal system: Seek professional assistance in selecting the appropriate type and location of your septic system. Septic systems located in fill material can saturate soil and contribute to landslides.
- Proper water disposal: Allowing surface waters to saturate the sloping soil is the most common cause of landslides in eastern Kentucky. Properly located diversion channels are helpful in redirecting runoff away from areas disturbed during construction. Runoff should be channeled and water from roofs and downspouts piped to stable areas at the bottom of the slope. (From U.S. Department of Agriculture, Natural Resources Conservation Service, no date)

### For Planning Use Only

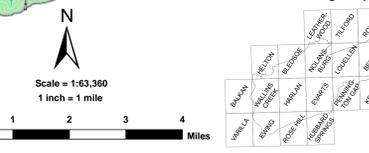
This map is not intended to be used for selecting individual sites. Its purpose is to inform land-use planners, government officials, and the public in a general way about geologic bedrock conditions that affect the selection of sites for various purposes. The properties of thick soils may supersede 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, 859.257.5500. For more information, visit the KGS Community Development Planning Web site at [kgsweb.uky.edu/download/kgsplanning.htm](http://kgsweb.uky.edu/download/kgsplanning.htm)



### Harlan County



### 7.5-Minute Quadrangle Map Index



### Alluvial Valleys (Unit 1)

Alluvial valleys (unit 1) provide level land for development, agriculture, and transportation if drainage and flooding problems are addressed. Photo by Dan Carey, Kentucky Geological Survey.

### LAND-USE PLANNING TABLE DEFINITIONS

Rock Unit	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Mills	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Clay, silt, sand, and gravel (alluvium)	Fair foundation material; easy to excavate. Low strength and stability. May contain plastic clay.	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Slight to severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Slight to severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Previous material. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Fair stability. Fair construction characteristics. Piling hazard. Refer to soil report (Childress, 1992).	Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).
2. Black, red, and green shales	Poor foundation material; difficult to excavate. Low strength and stability. May contain plastic clay.	Severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Not recommended.	Moderate to severe limitations. Low strength, slumping, and seepage problems.	Severe to slight limitations. Depending on activity and topography.	Slight limitations for small ponds.	Severe limitations for stability.	Moderate limitations. Floor strength. Wetness.
3. Shale, siltstone, sandstone, thin coal, underclay	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay.	Severe limitations. This soil and its permeable rock associated with shales.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight limitations where rocks, including coal, are present or fractured.	Severe limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
4. Limestone, shale, chert	Good to excellent foundation material; difficult to excavate.	Moderate to severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Slight to moderate limitations. Depending on activity and topography. Steep slopes.	Severe limitations where rocks are fractured.	Severe limitations where rocks are fractured.	Severe limitations. Rock excavation. This soil.
5. Sandstone, siltstone, shale, limestone, coal, underclay	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight limitations where rocks, including coal, are present or fractured.	Severe limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
6. Shale, siltstone, sandstone, shale	Fair to poor foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight limitations where rocks are fractured.	Severe limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
7. Siltstone, shale, sandstone, thin coal	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight to severe limitations. Depending on activity and topography. Steep slopes.	Slight limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
8. Sandstone, siltstone, shale, limestone	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight to severe limitations. Depending on activity. Steep slopes.	Slight to moderate limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
9. Sandstone, siltstone, shale, minor coal	Excellent foundation material; difficult to excavate.	Severe limitations. This soil.	Severe to moderate limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Slight to moderate limitations. Reservoir may leak where rocks are fractured.	Slight to moderate limitations where rocks are fractured.	Severe limitations. Rock excavation. This soil.

### Planning Guidance by Rock Unit Type

Rock Unit	Foundation and Excavation	Septic System	Residence with Basement	Highways and Streets	Access Roads	Light Industry and Mills	Intensive Recreation	Extensive Recreation	Reservoir Areas	Reservoir Embankments	Underground Utilities
1. Clay, silt, sand, and gravel (alluvium)	Fair foundation material; easy to excavate. Low strength and stability. May contain plastic clay.	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Slight to severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Slight to severe limitations. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Previous material. Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).	Fair stability. Fair construction characteristics. Piling hazard. Refer to soil report (Childress, 1992).	Seasonal high water table. Subject to flooding. Refer to soil report (Childress, 1992).
2. Black, red, and green shales	Poor foundation material; difficult to excavate. Low strength and stability. May contain plastic clay.	Severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Severe to moderate limitations. Low strength, slumping, and seepage problems.	Not recommended.	Moderate to severe limitations. Low strength, slumping, and seepage problems.	Severe to slight limitations. Depending on activity and topography.	Slight limitations for small ponds.	Severe limitations for stability.	Moderate limitations. Floor strength. Wetness.
3. Shale, siltstone, sandstone, thin coal, underclay	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay.	Severe limitations. This soil and its permeable rock associated with shales.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight limitations where rocks, including coal, are present or fractured.	Severe limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
4. Limestone, shale, chert	Good to excellent foundation material; difficult to excavate.	Moderate to severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Slight to moderate limitations. Depending on activity and topography. Steep slopes.	Severe limitations where rocks are fractured.	Severe limitations where rocks are fractured.	Severe limitations. Rock excavation. This soil.
5. Sandstone, siltstone, shale, limestone, coal, underclay	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight limitations where rocks, including coal, are present or fractured.	Severe limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
6. Shale, siltstone, sandstone, shale	Fair to poor foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight limitations where rocks are fractured.	Severe limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
7. Siltstone, shale, sandstone, thin coal	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight to severe limitations. Depending on activity and topography. Steep slopes.	Slight limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
8. Sandstone, siltstone, shale, limestone	Fair to good foundation material; difficult to excavate. Possible low strength associated with shales, sparse coals, and underclay. Possibility of underground coal-mine voids.	Severe limitations. This soil and its permeable rock associated with shales.	Severe to moderate limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Moderate to severe limitations. Rock excavation may be required. Possible steep slopes.	Slight to severe limitations. Depending on activity. Steep slopes.	Slight to moderate limitations where rocks are fractured.	Severe to moderate limitations. This soil. Possible rock excavation.
9. Sandstone, siltstone, shale, minor coal	Excellent foundation material; difficult to excavate.	Severe limitations. This soil.	Severe to moderate limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to severe limitations. Rock excavation. Steep slopes.	Moderate to				