EXPLANATION

ls — Limestone

d — Dolomite

css — Calcareous sandstone with subordinate shale

cst — Calcareous siltstone with subordinate shale and limestone

sh — Shale with subordinate limestone and siltstone

ss — Sandstone with subordinate shale

GLOSSARY

LIMESTONE – A rock composed chiefly of calcium carbonate ($CaCO_3$)

DOLOMITE – A rock composed chiefly of calcium magnesium carbonate [$CaMg(CO_3)_2$]

CALCAREOUS – A rock containing some calcium carbonate

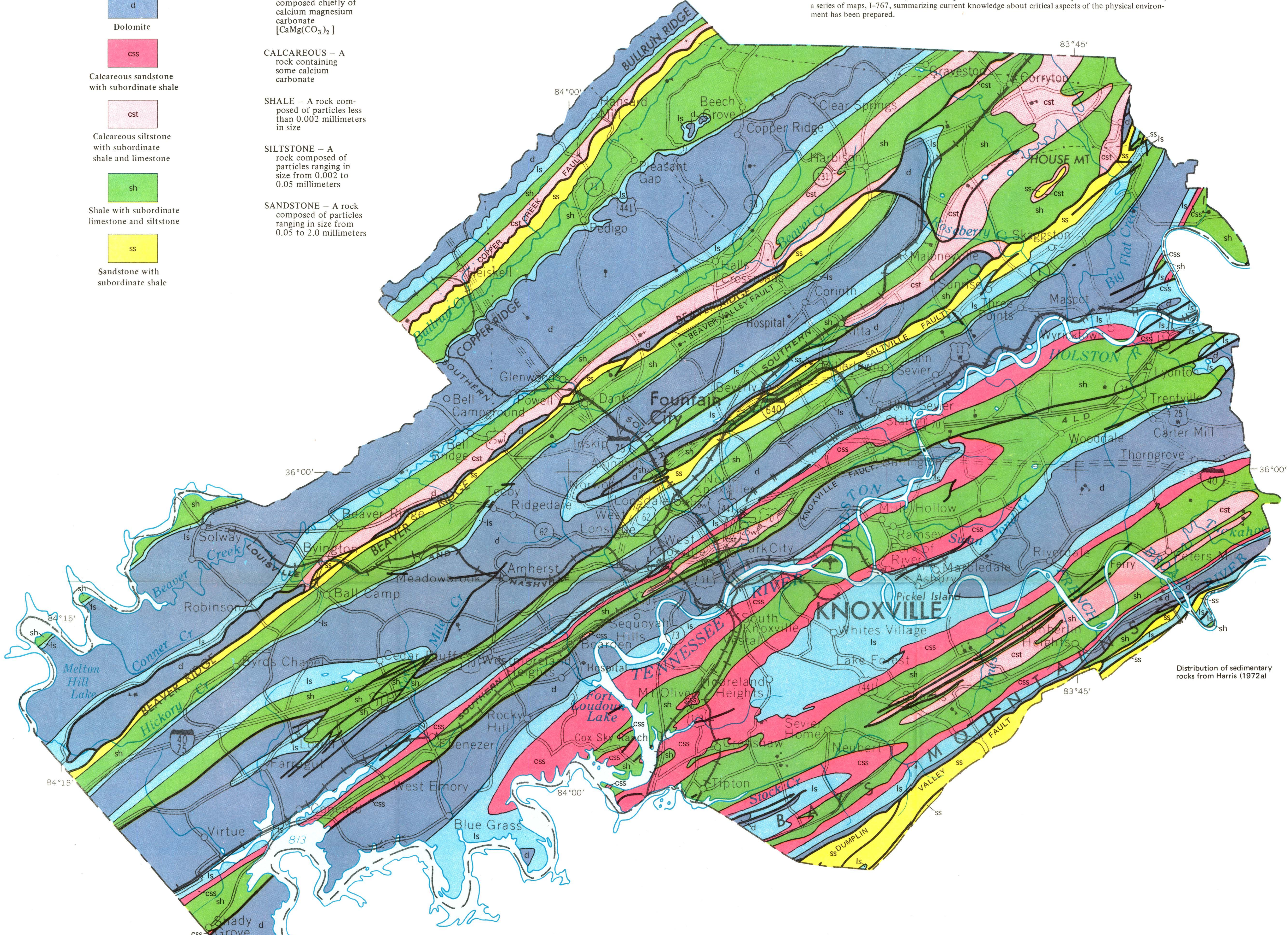
SHALE – A rock composed of particles less than 0.002 millimeters in size

SILTSTONE – A rock composed of particles ranging in size from 0.002 to 0.05 millimeters

SANDSTONE – A rock composed of particles ranging in size from 0.05 to 2.0 millimeters

LAND RESOURCE ANALYSIS MAPS OF KNOX COUNTY

Knox County has a 1972 population in excess of 270,000. The Metropolitan Planning Commission (1968) projects an increase in population to approximately 360,000 by 1990. As the population grows and favorable areas like west Knox County approach their limit of development, more and more marginal land will be utilized. In order to utilize the existing land resources safely and efficiently, and in order to maintain a suitable environmental quality, knowledge concerning the physical environment and its limitations should be readily available to planners and decision makers. To provide some of these data, a series of maps, I–767, summarizing current knowledge about critical aspects of the physical environment has been prepared.



Distribution of sedimentary rocks from Harris (1972a)

Base from U.S. Geological Survey, 1:250 000, Chattanooga, Corbin, 1965; Johnson City, Knoxville, 1966

SCALE 1:125 000

5 4 3 2 1 0 5 MILES

5 4 3 2 1 0 5 10 KILOMETERS

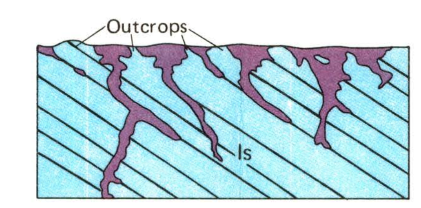
FACTORS AFFECTING THICKNESS OF OVERBURDEN

Engineers use the term soil to refer to all unconsolidated material including weathered rock that can be easily removed by common excavation methods down to hard bedrock. This differs from the definition of soil by the soil scientist who restricts the term soil to that part of the unconsolidated material that supports plant growth above weathered or hard rock (Harris, 1972c). Consequently, thickness of soil means one thing to an engineer and another to the soil scientist. This difference is of small consequence where there is a sharp contact between unconsolidated material and bedrock, but the distinction is greater where there is a transition zone of weathered rock between soil and hard bedrock. In this report, the term overburden is substituted for soil as used by by the engineer, and it includes all unconsolidated material and weathered rock down to hard bedrock.

The thickness of the overburden is a function of the climate, the resistance of minerals in the bedrock to weathering, the abundance of fractures or cracks in the rock, the attitude of bedding (Harris, 1972b), the volume of insoluble material (residue) remaining after weathering, and the rate of erosion. Although the factors controlling the thickness of overburden are interrelated, not all factors are operative to the same degree in one particular area. Because of this lack of uniformity, the thickness of overburden, even for a single rock type, is variable throughout Knox County. Closely spaced water wells in the county have shown that thickness variations in overburden are very great. Despite this limitation, some generalization concerning expectable engineering conditions in overburden developed over particular rock types can be made. All sedimentary rocks in Knox County are consolidated, and they are not porous enough to allow water, a major agent of weathering, to move freely through the pore spaces. Instead, water moves along natural partings between the rock layers (bedding) and breaks (joints) that cut through the layers. Water charged with weak organic acids moves along these natural accessways and dissolves the most soluble minerals (mainly the carbonate minerals calcite and dolomite), thereby enlarging the original openings to form interconnected channelways to great depths. The depth of weathering is nearly proportional to the amount of carbonate minerals originally present in the bedrock. Drill records of approximately 300 wells indicate that rocks with few or no carbonate minerals (such as shale with subordinate limestone and siltstone, sandstone, and shale) may weather to depths of as much as 25 feet; rocks which contain as much as 45 percent carbonate as cement (such as calcareous sandstone with subordinate shale, calcareous siltstone with subordinate limestone and shale) may locally weather to depths in excess of 25 feet; and rocks containing more than 85 percent carbonate minerals (such as limestone and dolomite) may weather to depths in excess of 100 feet. Other generalizations for each rock type in Knox County is given in the explanation. These may aid the engineer in planning the degree of on-site investigation necessary to determine depth to bedrock.

SECTIONS SHOWING GENERALIZED CONFIGURATION OF BEDROCK AND OVERBURDEN

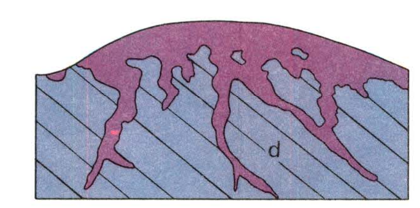
OVERBURDEN



Limestone

Numerous discontinuous outcrops, but the depth to bedrock may be more than 100 feet.
Contact between overburden and bedrock is very irregular. Isolated pinnacles of limestone commonly project to the surface from the main bedrock zone.
In the subsurface, bedrock may contain numerous solution cavities that are partly to completely filled with mud.
Thickness of overburden, based on water-well data:

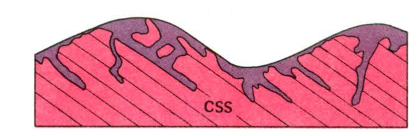
Thickness, in feet	Percent of wells
0–10	39
10–20	18
20–30	16
30–100	25
+100	2



Dolomite

Outcrops rare, limited to steep slopes and stream valleys where erosion has removed overburden.
Contact between overburden and bedrock is very irregular. Isolated pinnacles of dolomite commonly project upward from the main bedrock zone.
In the subsurface, bedrock may contain numerous solution cavities that are partly to completely filled with mud.
Thickness of overburden, based on water-well data:

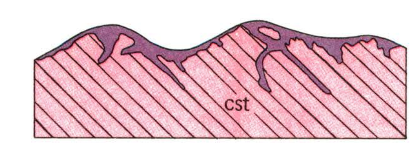
Thickness, in feet	Percent of wells
0–10	5
10–20	16
20–30	8
30–100	62
+100	9



Calcareous sandstone with subordinate shale

More than 50 percent of the outcrop area forms slopes greater than 25 percent. Bedrock is shallow on these steep slopes.
Contact between overburden and bedrock is irregular. Isolated bedrock pinnacles may project to the surface.
Thickness of overburden, based on water-well data:

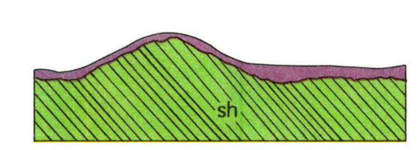
Thickness, in feet	Percent of wells
0–10	36
10–20	22
20–30	7
30–80	35



Calcareous siltstone with subordinate shale and limestone

About 40 percent of the outcrop area of this unit forms slopes greater than 25 percent. Bedrock is shallow on these steep slopes.
Contact between overburden and bedrock is irregular. Isolated bedrock pinnacles may project to the surface.
Thickness of overburden, based on water-well data:

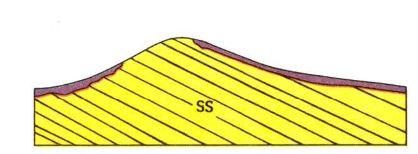
Thickness, in feet	Percent of wells
0–10	50
10–20	7
20–30	19
30–70	24



Shale with subordinate limestone and siltstone

Limited soil development; numerous outcrops of weathered shale. Locally may contain layers of limestone more than 20 feet thick.
Contact between overburden and fresh bedrock is irregular and gradational. Weathered shale may be as much as 20 feet thick.
Weathered shale makes up more than 90 percent of the overburden; fresh bedrock contains numerous thin beds of limestone.
Thickness of overburden, based on water-well data:

Thickness, in feet	Percent of wells
0–10	34
10–20	37
20–30	16
30–45	13



Sandstone with subordinate shale

Approximately 80 percent of the outcrop area of the unit forms slopes greater than 25 percent.
Limited data suggest that the thickness of overburden is less than 5 feet and that the contact between overburden and bedrock is gradational.

CONTACT – A boundary between different rock units

FAULT – A break in the rocks along which movement has occurred

SOURCES OF DATA

Harris. L.D., 1972a, Distribution of sedimentary rocks in Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 C.
——— 1972b, Structure map of Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 D.
——— 1972c, Physical characteristics of soil in Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 I.
——— 1973a, Basins drained by sinkholes in Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 G.
——— 1973b, Areas with abundant sinkholes in Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 F.
Harris, L.D., and Kellberg, J.M., 1972, Engineering characteristics of overburden in Knox County, Tennessee: U.S. Geol. Survey Misc. Geol. Inv. Map I–767 K.
Metropolitan Planning Commission, 1968, General plan 1990, Knoxville, Knox County, Tennessee: Knoxville, Tenn., Metropolitan Planning Commission, 1 sheet, scale 1 inch = approx. 1 mile.
Moneymaker, R.H., 1972, written communication, U.S. Dept. Agriculture, Soil Conservation Service
Roberts, Wallace, Nichols, B.C., Odom, J.N., Gallatin, M.H., Odom, L.E., and Beesley, T.E., 1955, Soil survey of Knox County, Tennessee: U.S. Soil Conserv. Service, Soil Survey Series 1948, no. 10, 241 p.

[1] Tennessee Valley Authority, Knoxville, Tenn.

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1973—G73049

OVERBURDEN RELATED TO TYPE OF BEDROCK AND ENGINEERING CHARACTERISTICS OF THE BEDROCK, KNOX COUNTY, TENNESSEE

By
Leonard D. Harris and John M. Kellberg[1]
1972

Blackline copies of this map are available at cost on transparent scale-stable material from the U.S. Geological Survey, Washington, D.C. 20242

For sale by U.S. Geological Survey, price 75 cents per set