SEPTIC-TANK FILTER FIELDS

Septic-tank systems are a common method for individual sewage disposal in suburban Knox County, but the natural conditions suitable for successful operation of these systems are not uniform throughout the county. Consequently, each individual site must be carefully considered to establish its feasibility for septic-tank installation. Proper operation of a septic system is primarily dependent on the ability of the soil to absorb and filter the liquid sewage flowing from the septic tank and on the rate at which water moves through a soil (percolation rate). Other important physical factors include depth to ground water, drainage characteristics, depth to bedrock, slope of the ground, the distance from bodies of water, and flood hazard. The most favorable percolation rate may not compensate for one or more other unfavorable environmental factors. Thus, before septic-tank systems are approved for installation, the total environment has to be assessed. The accompanying map classifies land in Knox County according to its natural physical capabilities to support the installation of septic-tank fields. Although the map indicates to planners the general suitability of a large area, sufficient data are not shown to predict the absolute suitability of a single small building site. Onsite evaluation of individual building sites is recommended.

Factors limiting the usefulness of septic-tank filter systems as suggested in U.S. Public Health Service (1969) and Bender (1961) are:

PERCOLATION RATE is based on the length of time required for 1 inch of water to move or percolate into saturated soil from a hole dug to the depth of the proposed septic-tank trench. Soils with percolation rates slower than 1 inch in 60 minutes are not suitable for any type of septic-tank system. The rate at which water moves through a soil is greatly influenced by its physical characteristics. Soils with a high sand and silt content have available connected pore space through which water can percolate freely. In contrast, soils with high clay content retard free percolation of water because they lack interconnected pore space. Unfortunately, most of the soils in Knox County have a high clay content and without proper planning are not well suited for septic-tank fields.

GROUND-WATER LEVEL is the level below the earth's surface that is naturally saturated with water. Ground-water level throughout much of the county is deeper than 10 feet. In those areas where the level is at or near the surface, however, the soil is saturated with water and will not permit additional water from other sources, such as septic-tank fields, to be absorbed. In a septic-tank field the ground-water level should be at least 4 feet below the base of the field trenches.

SOIL DRAINAGE ON SHALE. Soils in areas of low relief developed from the weathering of shale are commonly poorly drained. Although ground-water level may be well below the soil in the shale bedrock, pore space available in shale soils is so limited that percolation of water downward is slow. During wet periods, septic-tank fields in shale soils commonly fail to function because all available pore space has been filled. Even during dry periods, if the volume of septic tank effluent is large enough to exceed the absorption rate, effluent may rise to the surface and result in a definite health hazard.

DEPTH TO BEDROCK should be at least four feet below the depth of the septic-tank field trenches to insure the proper amount of soil for adequate absorption and filtration. Depth to bedrock is inadequate in about 42 percent of the county, where soil materials are developed over shale and limestone bedrock, and average less than five feet thick. Because shale soils as well as the shale bedrock transmit water slowly, effluent discharged from a septic tank may build up to the point that it may flow out on the ground or it may flow laterally along the contact between soil and shale bedrock, discharging directly into streams. Shallow depth to bedrock is equally important in areas underlain by limestone, because present-day weathering has removed large amounts of limestone underground, producing an interconnected cavity system. Effluent added to a thin limestone soil may quickly percolate downward, into this cavity system without proper filtration or purification, resulting in ground-water pollution.

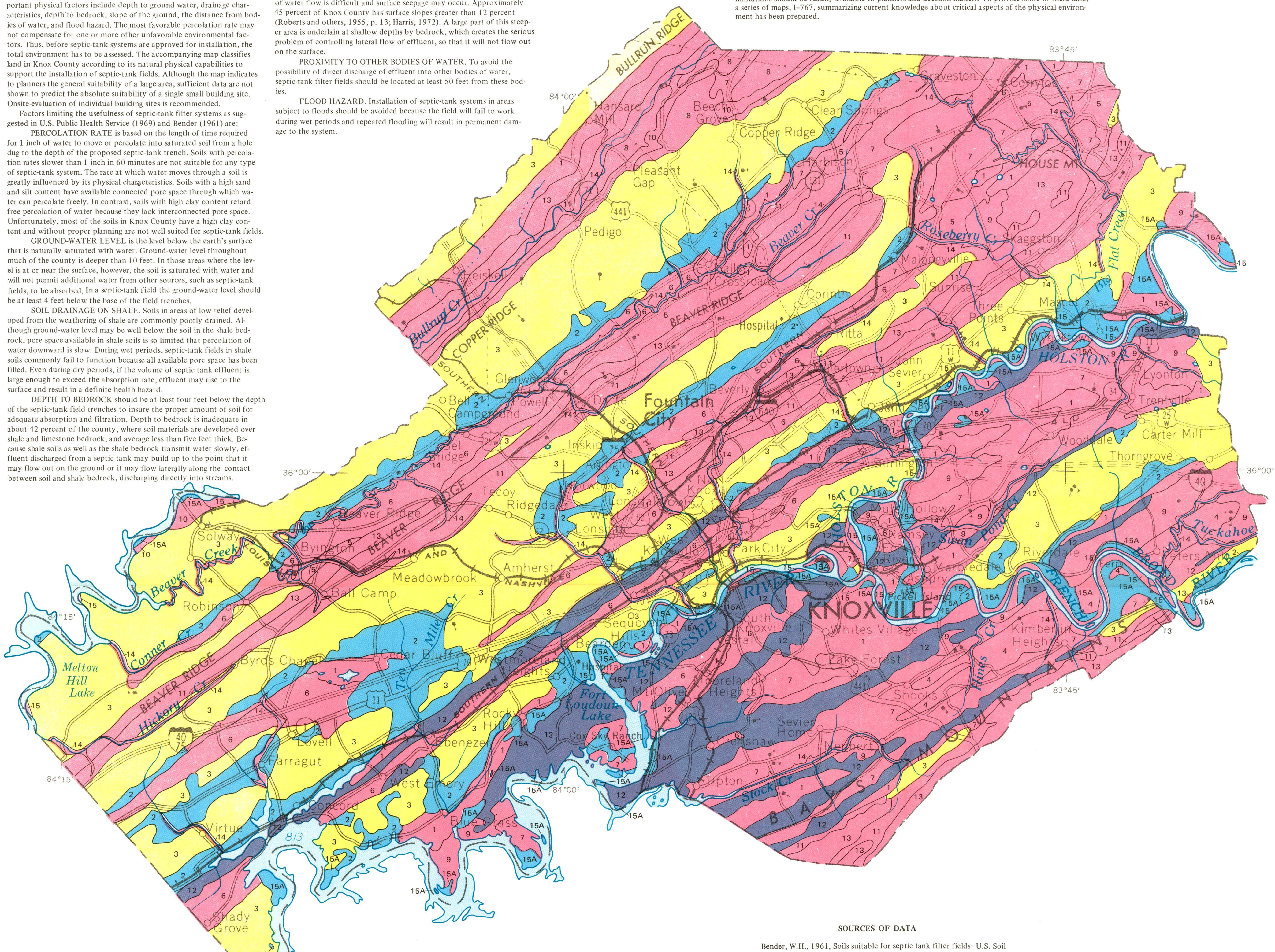
SLOPE OF THE GROUND. Slopes of less than 10 percent are considered to be well suited for installation and maintenance of septic-tank fields, provided other factors are satisfactory. On steeper slopes, control of water flow is difficult and surface seepage may occur. Approximately 45 percent of Knox County has surface slopes greater than 12 percent (Roberts and others, 1955, p. 13; Harris, 1972). A large part of this steeper area is underlain at shallow depths by bedrock, which creates the serious problem of controlling lateral flow of effluent, so that it will not flow out on the surface.

PROXIMITY TO OTHER BODIES OF WATER. To avoid the possibility of direct discharge of effluent into other bodies of water, septic-tank filter fields should be located at least 50 feet from these bodies.

FLOOD HAZARD. Installation of septic-tank systems in areas subject to floods should be avoided because the field will fail to work during wet periods and repeated flooding will result in permanent damage to the system.

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.



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

E X P L A N A T I O N

Numbered map units are soil associations from U.S. Geological Survey (1972)

Areas within which factors affecting septic-tank feasibility are generally poor

Soil association	Percolation rate, in minutes	Ground-water level, in feet	Soil drainage	Flood hazard	Thickness of soil, in feet	Percent of soil association with: 0–12 percent ground slope	Greater than 12 percent ground slope
Stony land-Talbott (1)	Greater than 75	+10		Low	0 to +6	39	61
Bland-Camp (4)					0–4	36	64
Sequoia-Bland-Leadvale (5)						81	19
Sequoia-Leadvale (6)			Poor during wet periods			100	
Sequoia-Litz-Dandridge (7)							100
Armuchee-Leadvale (8)							100
Dandridge-Litz-Leadvale (9)							100
Montevallo (10)						25	75
Jefferson-Montevallo (11)						100	
Muskingum-Lehew-Jefferson (13)	Less than 45						100
Staser-Hamblen and Lindside-Melvin (14)	Less than 45 to less than 75	0–3 during wet periods	Poor during wet periods	Frequent	+6	100	
Huntington (15)	Less than 45			Infrequent		100	

Areas within which factors affecting septic-tank feasibility are generally poor to fair

Soil association	Percolation rate, in minutes	Thickness of soil, in feet	Percent of soil association with: 0–12 percent ground slope	Greater than 12 percent ground slope
Tellico-Neubert (12)	45–75	0 to +6	30	70

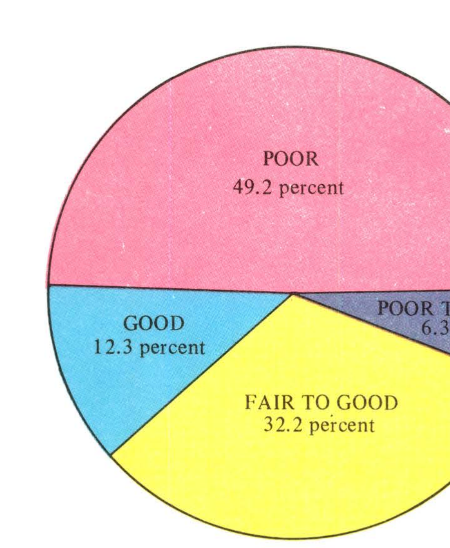
Areas within which factors affecting septic-tank feasibility are generally fair to good

Soil association	Percolation rate, in minutes	Thickness of soil, in feet	Percent of soil association with: 0–12 percent ground slope	Greater than 12 percent ground slope
Fullerton-Bolton-Clarksville (3)	45–75	+6	47	53

Areas within which factors affecting septic-tank feasibility are generally good

Soil association	Percolation rate, in minutes	Thickness of soil, in feet	Percent of soil association with: 0–12 percent ground slope	Greater than 12 percent ground slope
Decatur-Dewey-Emory (2)	Less than 45	+6	87	13
Cumberland (15A)		+6	82	18

CONTACT – Boundary between different soil associations



PERCENT DISTRIBUTION OF RELATIVE FEASIBILITY CATEGORIES FOR SEPTIC-TANK FILTER FIELDS IN KNOX COUNTY, TENN.

SOURCES OF DATA

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CATEGORIES OF RELATIVE FEASIBILITY FOR SEPTIC-TANK FILTER FIELDS IN KNOX COUNTY, TENNESSEE

By
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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