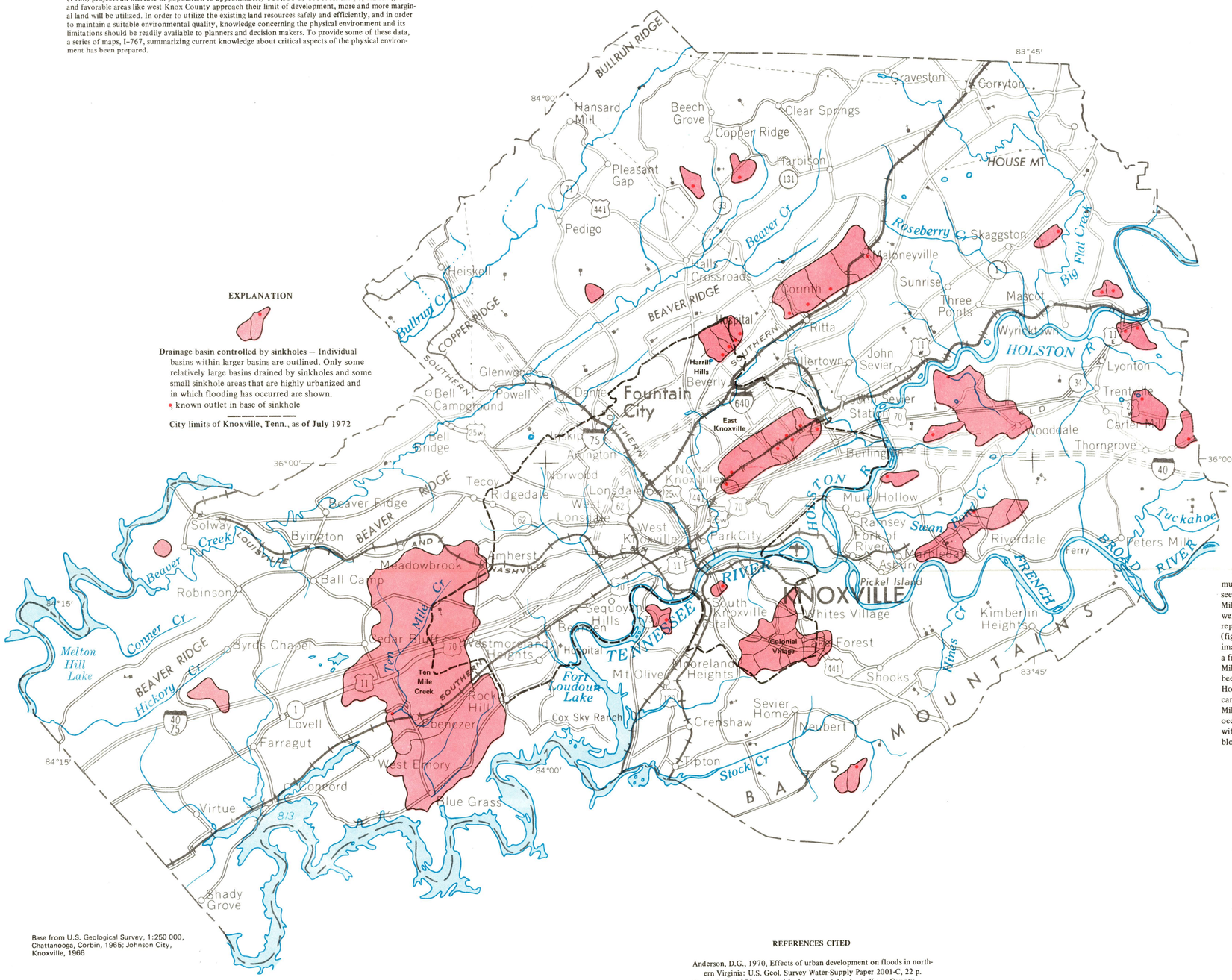
LAND RESOURCE ANALYSIS MAPS OF KNOX COUNTY

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.



EXPLANATION

Drainage basin controlled by sinkholes — Individual basins within larger basins are outlined. Only some relatively large basins drained by sinkholes and some small sinkhole areas that are highly urbanized and in which flooding has occurred are shown.

known outlet in base of sinkhole

City limits of Knoxville, Tenn., as of July 1972

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

SINKHOLES — AREAS OF POSSIBLE FLOODING

Sinkholes are natural depressions that collect and channel surface water into an underground drainage system (Harris, 1973). Although any drainage basin can flood during periods of heavy or prolonged rainfall, the potential for flooding may be greater in a sinkhole-drained basin because the outlet of such a basin may not be large enough to accommodate a sudden surge of water, or the outlet may become plugged by an obstruction. If the natural characteristics of a sinkhole or of a sinkhole drainage basin are changed by urbanization, such a basin can become more susceptible to flooding. This map shows some relatively large basins drained by sinkholes as well as some small basins drained by sinkholes in highly urbanized areas in which flooding has occurred in the past.

FACTORS AFFECTING RUNOFF

The frequency and magnitude of floods are directly influenced by runoff rates. In rural areas, soil with vegetative cover absorbs rainfall and retards runoff; flooding occurs only during heavy or prolonged rainfall. However, housing or industrial development in a basin prevents infiltration and increases runoff by covering part of the land surface with roadways and other impermeable structures. As development proceeds, the runoff rate increases and the lapse between the start of a storm and the maximum runoff rate decreases (fig. 1). When development is near the maximum, the runoff rate may increase to the point that even during moderate amounts of rain, large volumes of water are rapidly concentrated and directed into a drainage system. If no provision has been made to accommodate the sudden increase in water volume, frequent flooding will result. To use a sinkhole drainage basin safely and wisely, detailed studies should be undertaken, 1) to determine what effect urbanization would have on frequency and magnitude of floods in the basin, and 2) to identify areas subject to flooding, particularly those areas below the lowest point on the rim of a sinkhole. Construction below the lowest point on the rim of a sinkhole should be carefully considered and provision should be made to maintain the outlet permanently because of the possibility of blockage. Furthermore, excavation within the drainage basin could increase the sediment load of the stream, thereby increasing the possibility of silting up and restricting or plugging the outlet.

The majority of sinkhole-drained basins shown on the map are in rural areas; however, some basins like the one at Harrill Hills in Fountain City, the basins along the Southern Railway in east Knoxville, and the basins at Colonial Village in south Knoxville are within the Knoxville city limits and are examples of sinkhole-drained basins in urbanized areas. Some of the sinkhole basins in these areas are now subject to periodic flooding.

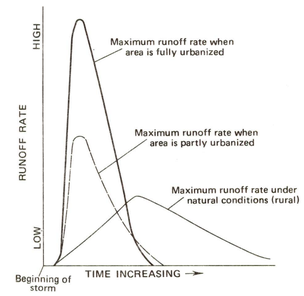
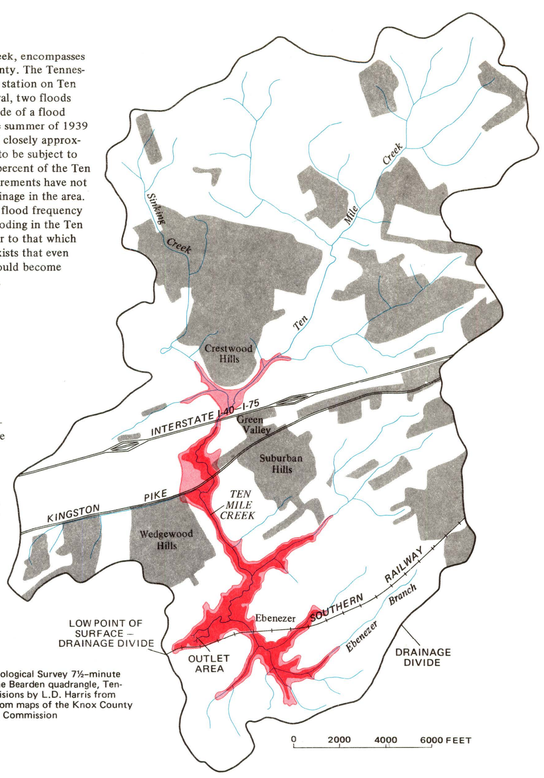


FIGURE 1 — As a drainage basin is transformed from a rural to an urban area, the runoff rate from storms gradually changes. In a rural area, the runoff rate increases gradually and the maximum runoff rate is relatively low. As the area becomes more urbanized, the runoff rate increases more rapidly. When the area is fully urbanized, the maximum runoff rate is highest and is reached most rapidly after the beginning of a storm. Hydrographs not to scale; modified from Anderson (1970).

TEN MILE CREEK BASIN

The largest basin drained by a sinkhole, Ten Mile Creek, encompasses much of the most rapidly developing area of Knox County. The Tennessee Valley Authority (1958) maintained a stream gauge station on Ten Mile Creek from 1941 to 1945. During that short interval, two floods were recorded. However, these were not of the magnitude of a flood reported by a local resident to have occurred during the summer of 1939 (fig. 2). The area reported inundated by the 1939 flood closely approximates the area estimated from regional considerations to be subject to a fifty-year flood (Kellberg, 1972). Approximately 25 percent of the Ten Mile Creek basin is presently urbanized. Detailed measurements have not been made of the effect of this development on the drainage in the area. However, as more land area is developed, an increase in flood frequency can be expected because of increased runoff. Severe flooding in the Ten Mile Creek basin could result from a major storm similar to that which occurred during the summer of 1939. The possibility exists that even without a major storm, the outlet for Ten Mile Creek could become blocked and the area shown in reds on figure 2 flooded.



EXPLANATION

Area reported flooded by a summer storm in 1939 — Limits of flooding reconstructed from all available information

Area that could be flooded if sinkhole outlet of Ten Mile Creek were plugged — This is the area below the lowest point on the surface-drainage divide. Includes area flooded by 1939 storm

Urbanized areas

Flood boundary

Base from the U.S. Geological Survey 7½-minute topographic map of the Bearden quadrangle, Tennessee, 1966, with revisions by L.D. Harris from field inspection and from maps of the Knox County Metropolitan Planning Commission

FIGURE 2 — The Ten Mile Creek drainage basin (15.8 square miles).

REFERENCES CITED

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BASINS DRAINED BY SINKHOLES IN KNOX COUNTY, TENNESSEE

By
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1973

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