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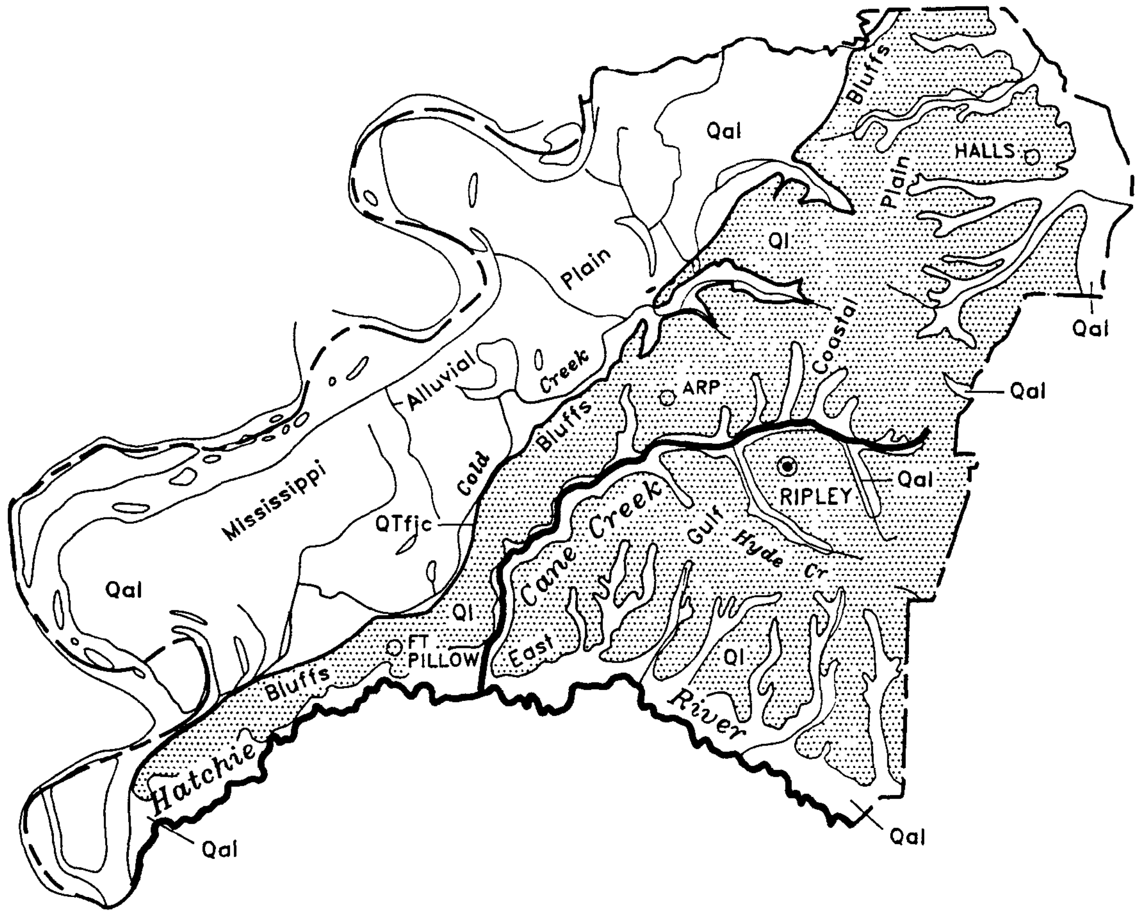
SURFICIAL GEOLOGY OF THE CANE CREEK BASIN, LAUDERDALE COUNTY, TENNESSEE



Prepared by the
U.S. GEOLOGICAL SURVEY

in cooperation with the
U.S. DEPARTMENT OF AGRICULTURE,
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By Joan H. Miller

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Nashville, Tennessee
1991

U.S. DEPARTMENT OF THE INTERIOR
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Multiply	*By*	*To obtain*
inch (in.)	25.40	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer

Temperature in degrees Celsius (^oC) may be converted to degrees Fahrenheit (^oF) as follows:

$$^oF = 1.8 * {}^oC + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

SURFICIAL GEOLOGY OF THE CANE CREEK BASIN, LAUDERDALE COUNTY, TENNESSEE

By Joan H. Miller

ABSTRACT

The surficial geology of the Cane Creek basin, in Lauderdale County, West Tennessee, was studied from 1985-88. Peoria Loess is the parent material from which soils in the Cane Creek drainage basin were derived. In general, a brown silt grades into a gray silt from 5 to 17 feet below ground surface. This color change probably represents depth to water table prior to the channelization of Cane Creek. Only at river mile 11.9 does rock outcrop near the main channel.

Lower reaches of major tributaries have surficial geology similar to the main channel. In upper reaches of Hyde Creek and Fain Spring Creek, the sequence from the surface is sand and gravels, red-brown sandstone, sand and clay layers, and then, an orange sand layer.

Coarse-grained deposits are found most often along the northern boundary of the basin and only occasionally in areas to the west and south of the main channel. Depth to sand or gravel ranges from about 0 to 158 feet in the uplands, and generally deeper than 40 feet near the main channel.

INTRODUCTION

The channel within Cane Creek was significantly modified (straightened and dredged) during 1970 and 1971. The modifications were designed to provide flood control and drainage to areas adjacent to the channel. The length of the channel from the old U.S. Highway 51 crossing to the mouth at the Hatchie River was shortened from 29 to 16.5 miles. The slope of the channel was increased from 0.00058 to 0.00096 foot per foot with the average cross-sectional area increased by about 15 percent.

The modifications in Cane Creek triggered erosion and scour processes within the channel (U.S. Department of Agriculture, Soil Conservation Service, written commun., 1975). The reduction in channel length and increased slope resulted in higher flow velocities. Bank failures and channel-bed erosion resulted in the failure of one bridge and damage to the supports of several others.

The scour and erosion processes that resulted in the failures are not well understood. The investigation of these processes will be valuable to plan future dredging strategies or design remedial actions for channels already dredged. In 1985, the U.S. Geological Survey (USGS), in cooperation with the U.S. Department of Agriculture, Soil Conservation Service, began a 3-year study of the post-modification erosion processes in Cane Creek. The study was a multi-disciplinary effort designed to document the history of geomorphic and hydraulic changes in the channel.

One of the elements in the study was a description of the surficial geology of the basin. A knowledge of the surficial geology is necessary to understand the geomorphic processes operating within the Cane Creek basin. The loess deposits in the basin and throughout West Tennessee play a key role in the geomorphic processes that were affected by the channel modifications. Previous investigations in the area (Parks, 1981; Parks and others, 1985) did not include detailed geologic maps or a detailed description of the surficial geology.

Purpose and Scope

This report summarizes the result of the study of surficial geology in the Cane Creek basin. The purposes of the report are to:

1. Describe the occurrence, thickness, and composition of the loess deposits in the basin.

2. Describe the parent soils in the basin.

3. Summarize the surficial geology of the basin with emphasis on the main channel.

The study area included the entire Cane Creek basin as shown in figure 1. Soil descriptions and maps were used to show distributions of the different soil series and other surficial deposits, especially those found within and adjacent to channels.

Approach

Data used for determination of the surficial geology of the Cane Creek drainage basin were collected through field reconnaissance, literature review, and drillers' lithologic logs. Mapping of the drainage basin was accomplished by locating headwalls and tributaries on USGS 7.5-minute topographic maps. Sites generally were chosen to avoid disturbed or cultivated land, but some sites in open pasture were used to determine what types of materials were being transported in ephemeral tributaries. At each site, the area was traversed and observations were made regarding slopes, surficial material, sand or gravel exposed in the channels, and material deposited on and below the channel bed.

DESCRIPTION OF LOESS DEPOSITS

Three episodes of loess deposition are thought to have occurred which correspond to three episodes of glaciation: the Loveland, the Farmdale, and the Peoria (Leighton and Willman, 1950). The oldest of these deposits, the Loveland Loess, lies directly above the Gulf Coastal Plain deposits. Thick profiles appear to be deeply weathered, as indicated by clay contents as high as 34 percent (Wascher and others, 1948) and the presence of only the most weather-resistant minerals. Average thickness of the Loveland Loess is 5 feet, but occurs as thick as 15 feet locally. A typical profile consists of a light brown, compact silt loam overlying a silty clay loam of yellow to brown color with reddish mottling. A noncalcareous silt loam ranging from yellow brown to brown yellow is sometimes found at the base of the formation (Wascher and others, 1948; Leighton and Willman, 1950).

After the Farmdale episode of glaciation, additional loess was blown into place from the west. The Farmdale Loess is a noncalcareous silt with very little clay. Locally, thicknesses may exceed 15 to 20 feet (Leighton and Willman, 1950; Wascher and others, 1948). A zone of reddish-brown, silty or clayey material occurs at the top of this layer. Colors range from pinkish gray where the soil has not been leached to a chocolate brown where it has been oxidized.

The youngest of the glacially derived loesses, the Peoria, is consistently present throughout the eastern Mississippi Valley, and at the bluffs this loess exceeds 15 feet in thickness (Leighton and Willman, 1950; Wascher and others, 1948). The Peoria Loess is a yellow-brown color in well-drained profiles, and gray if drainage is poor. The present day Cane Creek soils were formed from this deposit. Below these loess-derived soils, the Peoria Loess is a noncalcareous silt loam and varies in thickness from several inches to several feet. Below this layer, is nonleached calcareous silt, containing lime concretions and fossils in many locations.

SOILS OF THE CANE CREEK DRAINAGE BASIN

The Peoria Loess is the parent material from which all of the soils in the Cane Creek drainage basin were derived. The fine-grained texture of the parent material has produced a predominantly dark-brown silt loam. Characteristics of the soils in the Cane Creek study area are summarized in table 1. This information was gathered from Soil Conservation Service Soil Interpretations Record sheets, soil surveys of several West Tennessee counties, and unpublished information and maps from the recently (1990) completed soil survey of Lauderdale County (U.S. Department of Agriculture, Soil Conservation Service, written commun., 1990)

Associations of certain soils represent separate topographic regions within the drainage basin. The Memphis-Loring association covers most of the upland areas with a deep, well-drained silt loam on 0 to 40 percent slopes. Clay content decreases with increasing depth. A fragipan (a thin, brittle layer with low permeability) is present in the Loring soil, but is absent in the Memphis soil. The Grenada-Center-Routon association occurs in the uplands and stream terraces in moderately well-drained areas, but does not occur

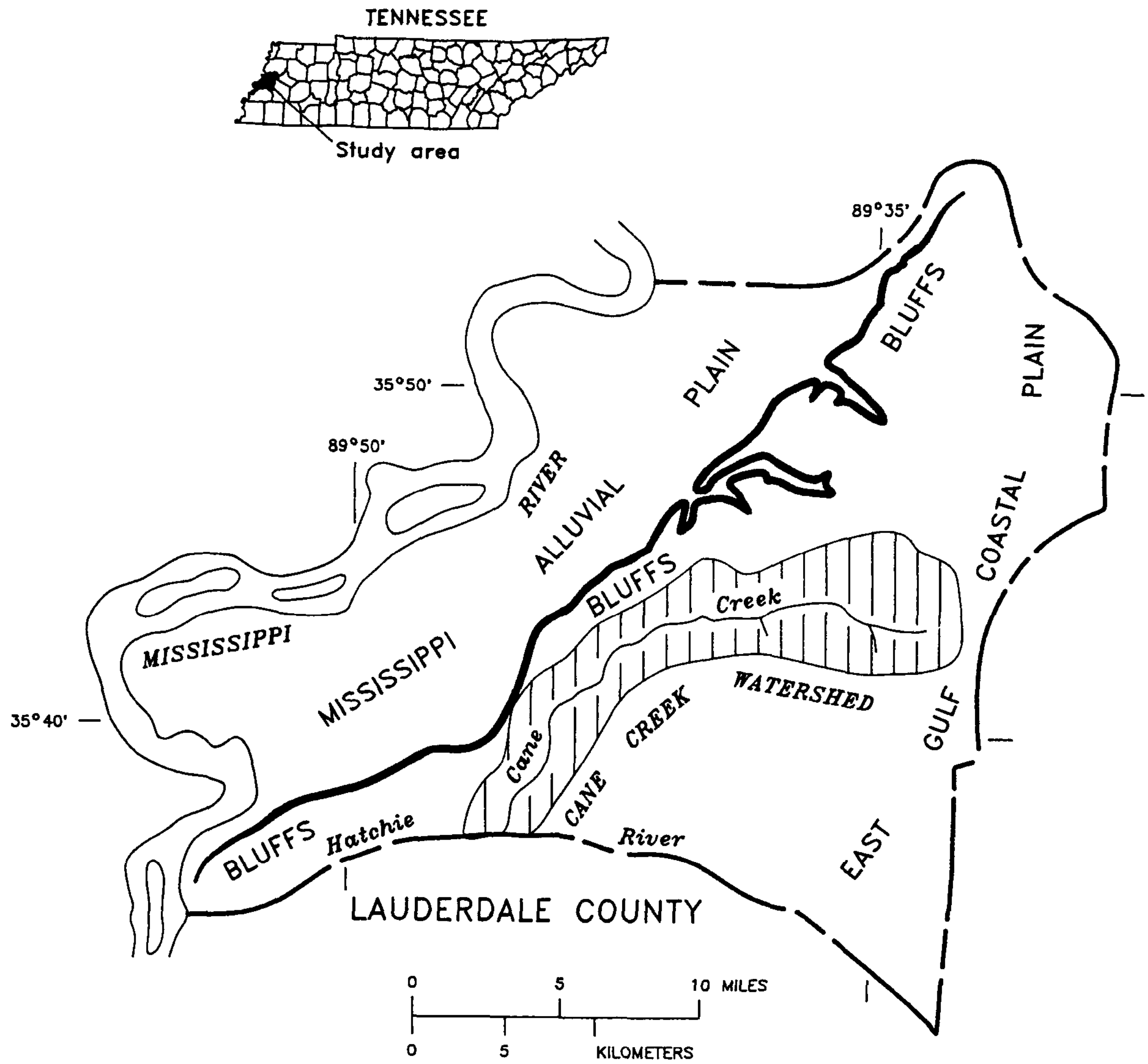


Figure 1.--Location and general features of the Cane Creek basin.

Table 1.--*Soil characteristics in Cane Creek*

[GR, gray; BR, brown; YEL, yellow; DK, dark; LT, light]

Soil name	Color/texture	Thickness, in inches	Percent clay	Percent slope	Flooding, occurrence/ duration/ months	Permeability, in inches per hour	Drainage
Adler	GR BR silt loam	0 - 7	10 - 35	0 - 2	Rare-common	0.6 - 2	Moderate
	YEL BR silt loam mottled GR	7 - 60	5 - 18		Very brief-long		to
					JAN - APR		good.
Amagon	DK GR BR silt loam	0 - 7	15 - 24	0 - 3	None-common	.6 - 2	Poor
	LT BR GR silt loam mottled GR	7 - 16	18 - 30		Very brief-brief	.6 - 2	
	LT BR GR and GR silt loam	16 - 46	20 - 35		DEC - APR	.6 - 2	
	DK GR BR loam	46 - 60	20 - 35			.06 - 0.6	
Askew	BR sandy loam	0 - 11	10 - 25	0 - 3	None	.6 - 2	
	YEL BR mottled silty clay loam	11 - 23	20 - 35			.6 - 2	
	GR BR mottled silty clay loam	23 - 32	10 - 25			.6 - 2	
	YEL BR mottled sandy loam	32 - 72	5 - 15			> 6	
Calloway	DK GR BR silt loam	0 - 24	10 - 30	0 - 5	None-rare	.6 - 2	Poor
	YEL BR mottled GR and						
	BR - fragipan	24 - 44				.06 - .2	
	YEL BR silt loam	30 - 60	10 - 32			.06 - .2	
Center	DK GR BR silt loam	0 - 8	12 - 24	0 - 3	None-common	.6 - 2	Poor
	YEL BR/LT BR GR silt loam	8 - 44	18 - 32		Very brief	.2 - .6	
	YEL BR/GR BR mottled silt loam	44 - 72	15 - 25		DEC - MAR	.2 - .6	
Convent	DK GR BR silt loam	0 - 14	0 - 18	0 - 3	None-common	.6 - 2	Poor
	GR BR silty sandy loam	14 - 50	0 - 18		Brief-long	.6 - 2	
Dekoven	DK GR silt loam	0 - 22	18 - 35	0 - 3	Common	.6 - 2	Very
	DK GR mottled silty clay loam	22 - 60	18 - 35		Brief		poor.
					DEC - MAY		
Dubbs	DK GR BR silty clay loam	0 - 5	5 - 35	0 - 3	None	.6 - 2	Good
	YEL BR silty clay loam	5 - 23	20 - 35			.6 - 2	
	YEL BR loam	23 - 50	10 - 25			2 - 6	
Grenada	DK GR BR silt loam	0 - 5	12 - 16	0 - 8	None	0.6 - 2	Moderate
	BR silt loam	5 - 21	18 - 30			.6 - 2	to
	LT GR silt loam	21 - 24	12 - 16			.6 - 2	good.
	YEL BR silt loam - fragipan	24 - 60	15 - 32			.06 - 0.02	
Loring	BR silt loam	0 - 28	8 - 35	0 - 12	None	.6 - 2	Moderate
	BR mottled silt loam	28 - 50	12 - 25			.06 - .02	to
							good.
Memphis	DK GR BR silt loam	0 - 9	8 - 22	0 - 40	None	.6 - 2	Good
	DK BR silty clay loam	9 - 23	20 - 35			.6 - 2	
	DK BR silty loam	23 - 77	12 - 25			.6 - 2	
Morganfield	DK BR silt loam	0 - 8		0 - 2	None-common	.6 - 2	Good
	DK BR mottled silt loam	8 - 50			Brief	.6 - 2	
					JAN - APR		
Oaklimeter	BR silt loam and fine sandy loam	0 - 11	10 - 16	0 - 2	Rare-common	.6 - 2	Good
	GR and BR mottled silt loam	11 - 20	7 - 18		Brief-v.long	.6 - 2	
	GR silt loam	20 - 60	7 - 30		NOV - APR	.6 - 2	
Routon	DK and LT GR BR silt loam	0 - 18	15 - 25	0 - 3	None-occasional	.6 - 2	Poor
	LT BR GR and BR silt loam	18 - 54	20 - 35		Very brief	.06 - .2	
	YEL BR mottled silt loam	54 - 72	18 - 27		DEC - MAR		

on the steeper upland slopes. The Adler-Convent-Morganfield association is found on the flood plain adjacent to Cane Creek and its tributaries. This silt loam is moderately to well drained and is occasionally flooded in the winter and spring. The Amagon-Oaklimeter association occurs on the flood plain near the confluence of the Hatchie River and Cane Creek. These soils are generally poorly drained and are frequently flooded.

SURFICIAL GEOLOGY OF THE CANE CREEK DRAINAGE BASIN

Subsurface geologic formations were summarized by Parks and others (1985) (fig. 2, table 2). Interpretation of geophysical logs of test wells in Lauderdale County indicates that several faults intersect the county and displacement has apparently occurred as deep as the Fort Pillow Sand (Wilcox Group) and up to and including the Cockfield Formation (Parks and others, 1985). These inferred faults (fig. 3) may have displaced the unconsolidated sediments of the surficial Jackson Formation and younger Quaternary deposits.

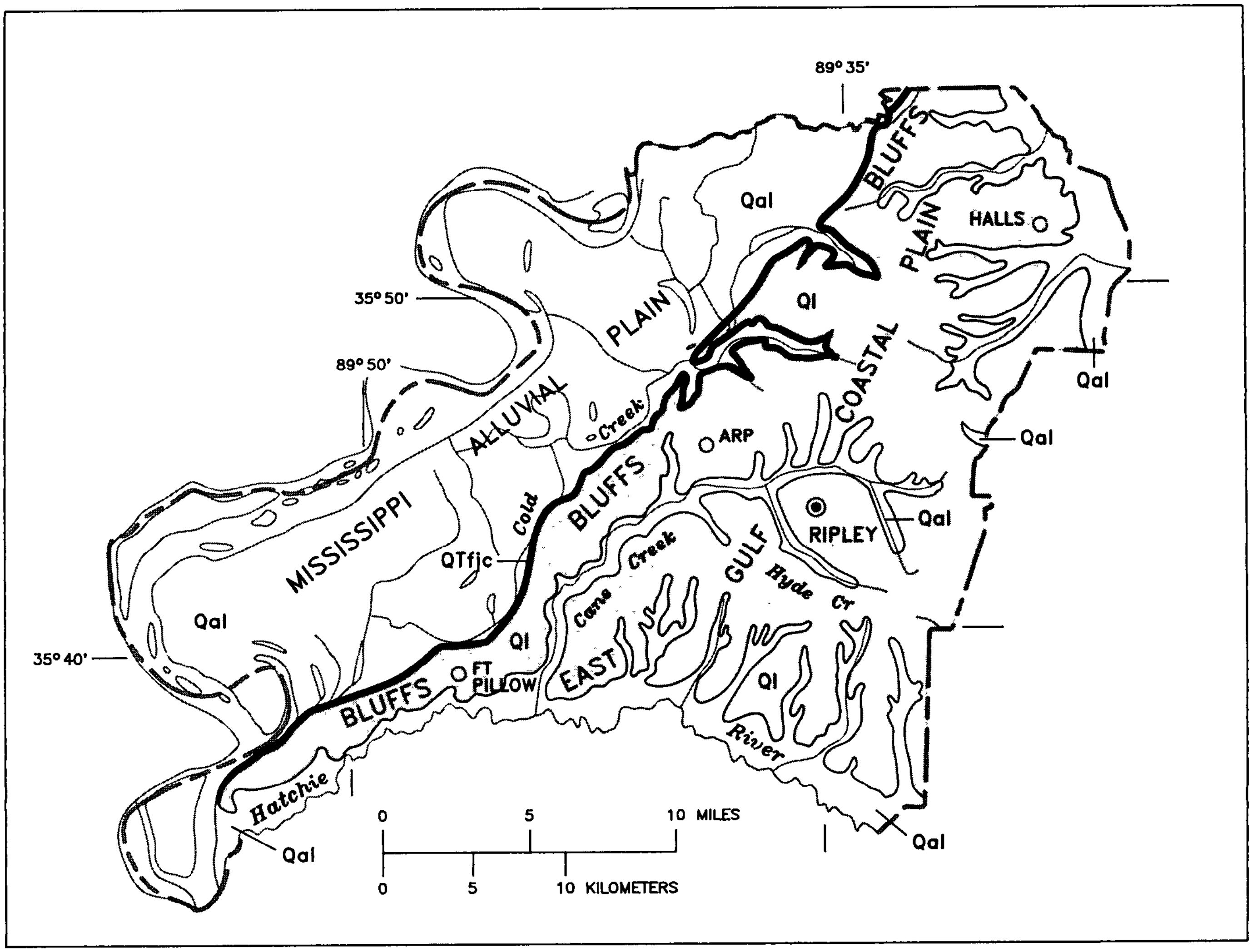
Main Channel of Cane Creek

Along the Cane Creek main channel only minor variation occurs in the type of material exposed on the banks. Typically, a brown silt, found surficially and on the upper banks, gradually grades into a gray silt with increasing depth. Although these materials are referred to as silt, they contain up to 15 percent clay. A color change occurs anywhere from 5 to 17 feet below ground surface and averages about 13 feet. In the color-change zone, the brown silt becomes faintly mottled with gray, and then increasingly mottled until the material is uniformly gray. This color change is thought to represent depth to the water table prior to the channelization of Cane Creek. In a few places, a thin, brown layer is present below the color change. The wide range in depth to the gray layer indicates that the level of the water table (if this in fact determined the position of the color change) was quite variable.

The gray silt layer has several distinctive features. Consistency of the gray silt varies from very sticky, almost liquid, to very tough and hard, at which point the material fractures and cracks. Organic material such as sticks, leaves, stumps, and logs have been exposed by bed degradation. At some sites, cobble-sized lumps made of tiny balls of clay or silt are imbedded within the hard gray layer. These erode, break apart, and are deposited on the bed or as channel bars along the channel. Tubes, usually about 3 inches in diameter, have been found extending down into the gray layer and often have a hard oxidized rind. These may represent areas once filled by tree roots (Snowden and Priddy, 1968). Bands of brown staining, possibly oxidation induced, alternate with gray bands and surround areas of brittle, oxidized concretions. A maroon or orange platy silt-clay layer sometimes occurs directly above the gray layer in a thin band of approximately 0.1 foot and may represent the boundary between the Loveland and Farmdale episodes of loess deposition.

At river miles (RM) 6.2, 10.3, 11.3, and 14.8 on the main channel (fig. 4), test holes were drilled which exceeded 40 feet; this depth is generally lower than the channel bottom. At RM 14.8 the depth reached was 49 feet where a liquid, gray material, gritty with sand and containing mollusk shells measuring less than an eighth of an inch in length was encountered. The maximum depth of the hole at RM 11.3 was 45 feet and revealed gray silt at depth. The maximum depth of the hole at RM 10.3 was 46 feet and revealed only a very tough, gray silt at depth with no sand present. At RM 6.2, fine sand was logged from 36 to 45 feet below ground surface. Sand and gravel lenses occur throughout the Cane Creek basin and West Tennessee.

Two types of rock crop out at RM 11.9 (fig. 4): (1) a poorly cemented, oxidized sandstone, is located in the creek adjacent to a steep hill on the south side of the creek; and (2) a fine-grained siliceous rock is located at the base of the hill approximately 100 feet upstream of the sandstone. The sandstone is present as large boulders on the left bank of the creek and on the north side of the hill. Empty shells or rinds which once surrounded concretions occur in the fine-grained siliceous rock. The siliceous rocks are smooth on the surface and are shaped like elongate concretions found in loess deposits in Mississippi. The concretions found in Mississippi apparently formed in deep loess deposits in cavities left by decaying plant roots. These cavities eventually filled with carbonate

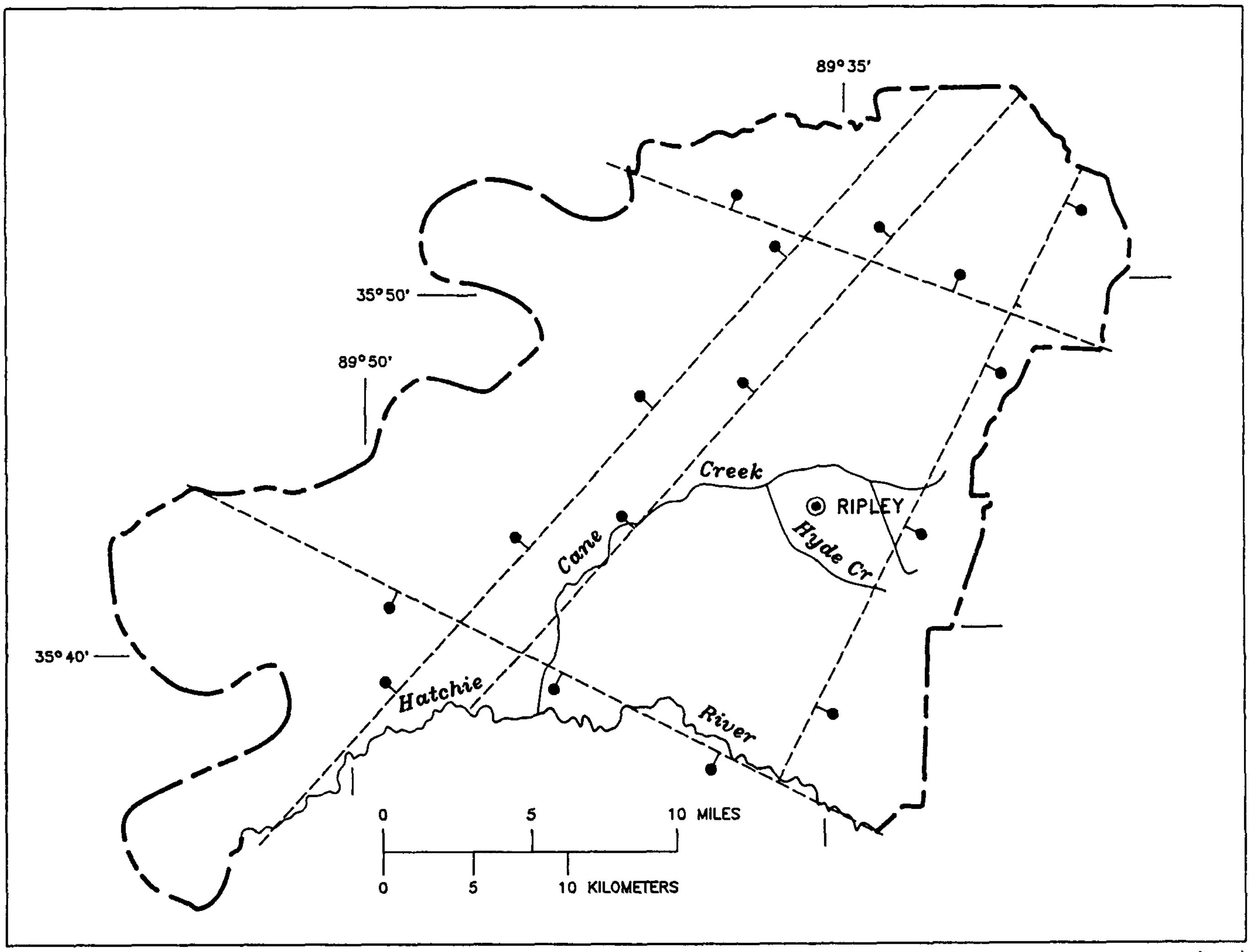


Modified from W.S. Parks (1981)

EXPLANATION

(open box)	Qal--Alluvial deposits	QUATERNARY
(open box)	Ql--Loess deposits	QUATERNARY
(black box)	QTfjc--Fluvial deposits, Jackson and Cockfield Formations, undivided	QUARTERNARY AND TERTIARY

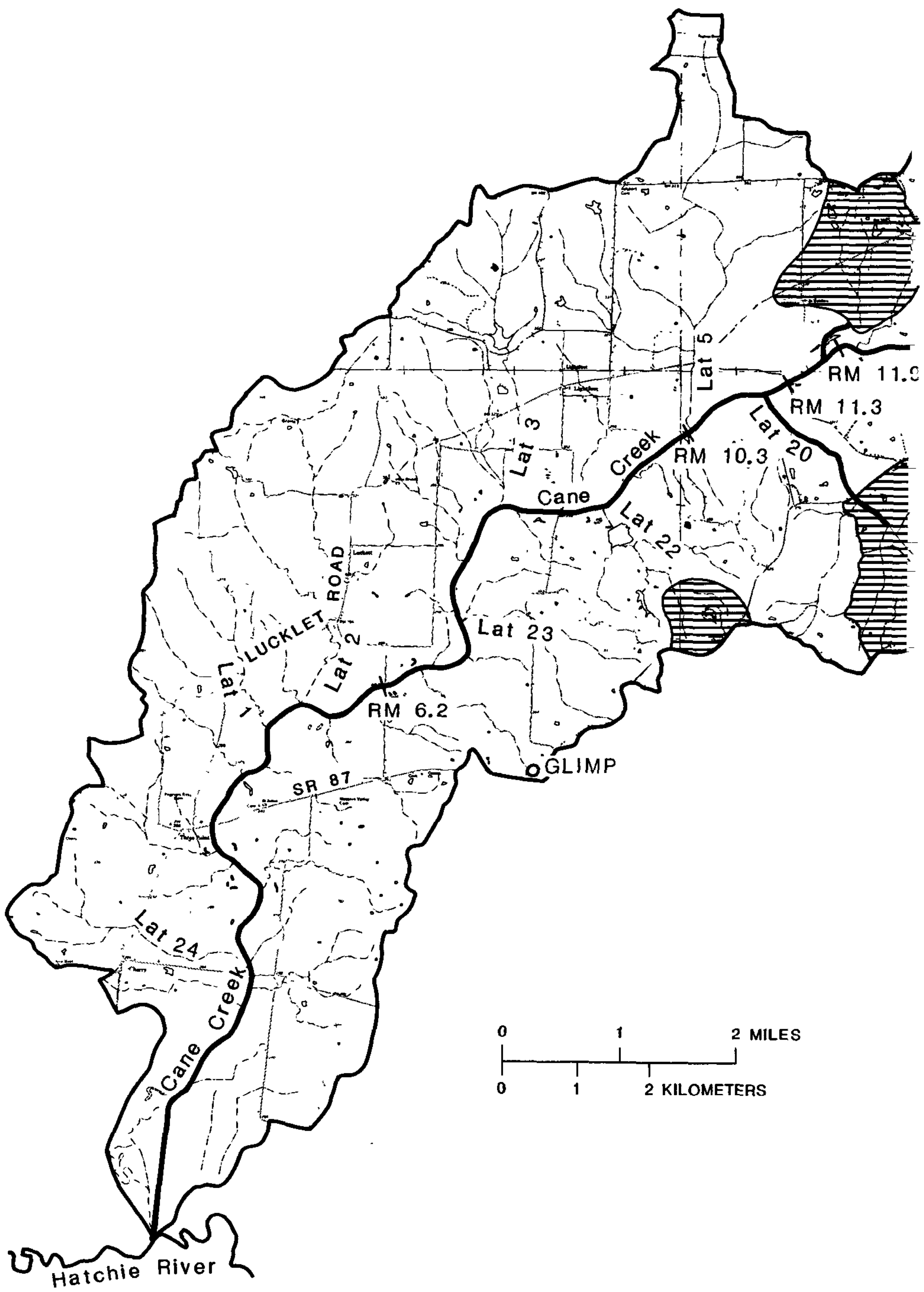
Figure 2.--Generalized surficial geology and geomorphological features of Lauderdale County, Tennessee.



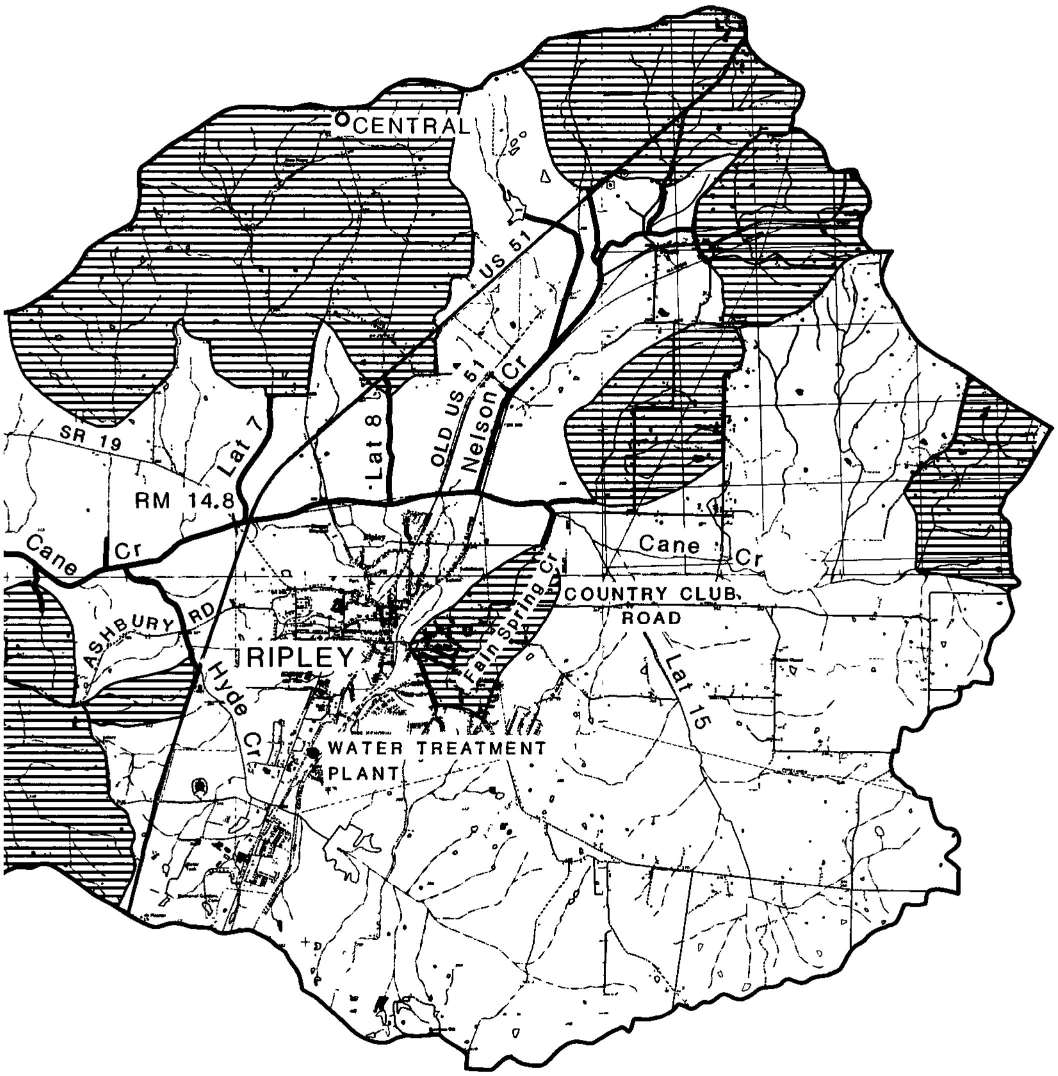
W.S. Parks, J.K. Carmichael, and D.D. Graham (1985)

INFERRED FAULT, BALL AND BAR ON DOWNTHROWN SIDE

Figure 3.--Inferred faults crossing Lauderdale County, Tennessee.



RM 11.9
RM 11.3
Lat 5
Lat 20
Lat 3
Cane Creek
RM 10.3
Lat 22
LUCKLET ROAD
Lat 2
Lat 23
Lat 1
RM 6.2
GLIMP
SR 87
Lat 24
Cane Creek
Hatchie River
0 1 2 MILES
0 1 2 KILOMETERS



EXPLANATION

SOURCE AREA OF SAND AND GRAVEL

SAND AND GRAVEL FOUND IN CREEK BED

Lat 24 LATERAL AND NUMBER

RM 14.8 RIVER MILE

Figure 4.--Source locations of coarse-grained materials in the Cane Creek basin, Lauderdale County, Tennessee.

Table 2.--*Lithology and hydrologic significance of Lauderdale County*

System	Series	Group	Stratigraphic unit*	Thickness (feet)	Lithology and hydrologic significance**
Quaternary	Holocene and Pleistocene		Alluvial deposit (alluvial)	0-200	Sand, gravel, silt, and clay. Underlies the Mississippi Alluvial Plain and flood plains of other streams. Thickest beneath the Alluvial Plain; probably no more than 50 ft elsewhere. Supplies water to domestic and farm wells in the Alluvial Plain where this aquifer has potential for large capacity wells to provide a source of irrigation.
	Pleistocene		Loess	0-80	Silt, silty clay, and minor sand. Forms principal formation at the surface in the Coastal Plain. Thickest on bluffs that border Mississippi Alluvial Plain. Not an aquifer; tends to retard downward movement of water recharging the water-table aquifers
Quaternary and Tertiary(?)	Pleistocene and Pliocene(?)		Fluvial deposits (terrace deposits)	0-100	Sand, gravel, and minor clay. Generally underlies the loess in the Coastal Plain, but locally may be absent. Thickness highly variable because of erosional surfaces at top and base. Locally supplies water to domestic, farm, and municipal wells where of sufficient thickness and contains enough water.
Tertiary	Eocene	?	Jackson Formation and Cockfield Formation of Claiborne Group	0-400	Sand, silt, clay, and lignite. Because of similar lithology, the Jackson and Cockfield cannot be subdivided based on available information. Preserved section probably mostly Cockfield, but at places uppe part includes the Jackson. Principal aquifer in the Coastal Plain supplying water for domestic, farm, commercial, industrial, and municipal use.
		Claiborne	Cook Mountain Formation	30-200	Clay, silt, sand, and lignite. Identified in Fort Pillow test well; not enough information available to identify elsewhere. Believed to consist generally of clay and silt, but locally may consist largely of sand. Forms upper confining bed for the Memphis Sand where chiefly clay and silty.
			Memphis Sand ("500-foot" sand)	650-700	Sand, silt, and clay. Consists of a thick body of san with lenses of clay and silt at various stratigraphic horizons. Thickest in southern part of county. Used for public, municipal, commercial, and industrial supplies where shallower aquifers do not yield enough water for installation of large capacity wells.
		Wilcox	Flour Island Formation	150-200	Silt, clay, and sand. Not an aquifer; serves as lower confining bed for the Memphis Sand and upper confining bed for Fort Pillow Sand.
			Fort Pillow Sand ("1400-foot" sand)	150-300	Sand, and minor clay. Relatively deep aquifer not presently used in the county because of the availability of water at shallower depths. May have potential for supplying water of better quality than available from shallower aquifers, but specific information on ground-water quality not available.
	? Paleocene		Old Breastworks Formation	0-300	Silt, clay, sand, and lignite. Not an aquifer. Thickest in southern part of County; may be absent in northern part. Serves as the lower confining bed for the Fort Pillow Sand. Underlain by the Porters Creek clay of the Midway Group.

* Stratigraphic nomenclature and usage modified from Moore and Brown (1969).
** (From Parks, Carmichael, and Graham 1985)

leached from the carbonate-rich deposits above (Snowden and Priddy, 1968). Testing with hydrochloric acid showed that the Cane Creek concretions are not carbonate. The concretions are assumed to be a silicate precipitate or an infilling of silt deposited later.

Lowland Tributary Channels

Major tributaries of Cane Creek such as Hyde Creek and the numbered laterals (fig. 4) have lithologies similar to the main channel. Brown silt is present on the surface and grades down into the mottled gray and then uniformly gray silt. In only two tributaries, Hyde Creek and Fain Spring Creek, is any material other than silt exposed on the banks or bed.

Hyde Creek between Highway 51 and Ashbury Road contains an exposure of black to orange crust, 0.5 inch thick, which occurs at the present (1986) bed level. Gray silt occurs above, and blue-gray silt below the crusty layer. On the underside of this crusty layer is a very thin layer of medium-grained, brown-red sandstone which may simply represent a period when no loess was being deposited, and sand was being deposited from an upstream source.

Along Fain Spring Creek above Country Club Road (fig. 4), the channel is very sinuous. Sand and gravels are exposed in the banks and deposited on the bed and as channel bars along inside bends for a distance of about 1,000 feet. Upstream of this location, layers of brown and gray loess are exposed.

Upland Areas

The stratigraphy of the uplands differs from that of the main channel and major tributaries because of frequent, local exposure of sand, gravel, and sandstone. Topographically, these areas are highly dissected with relatively steep slopes. Stratigraphically, these deposits are similar to those found at RM 11.9 of the main channel. Brown loess is found surficially and is successively underlain by sand and gravel, red-brown sandstone, sand and clay layers, and an orange sand layer. The coarse-grained deposits are found most often along the northern boundary of the basin and occasionally in areas to the west and south of the main channel. Typically, the materials range from medium-grained sands to poorly sorted gravel deposits intermixed with sand and clay; gravel sizes range from 0.25 to 3.0 inches.

Logs of wells drilled on the basin divide at the town of Central (fig. 4) show that either sandy clay or gravel occurs between 30 and 35 feet at three wells, and that sandy clay is present at ground surface in one well. At the water treatment plant in Ripley, depth to sandy clay, coarse-grained sand, or gravel varies from 0 to 30 feet. Logs of wells located along the eastern divide indicate depth to sand or gravel ranges from 3 to 19 feet. In and near the town of Glimp along Highway 87, and along Luckett Road which parallels Cane Creek to the north (fig. 4), logs of wells show depths to sand or gravel were between 60 and 158 feet.

Source Areas for Coarse Bed Material

Major source areas of coarse-grained material (sand and gravels) are shown in figure 4. The heavy-lined tributaries and main channel (fig. 4) indicate sand or gravel deposited on the bed. The heavy lines are extended only to the point where the tributaries start branching and have not been channelized. In two of the sub-basins, the sand and gravel being exposed do not appear in noticeable amounts farther downstream, possibly because the coarse sediment gets trapped in sediment ponds. In some areas small amounts of sand are exposed, but these did not appear downstream and, therefore, were not considered to be major sources of coarse sediment.

Directly downstream of bridges crossing Cane Creek, greater amounts of sand and gravel were noted than on the upstream sides. Sand and gravel may be extracted from deep scour holes that develop downstream from contracted bridge openings.

SUMMARY

The Peoria Loess is the parent material from which all of the soils in the Cane Creek drainage basin were derived. The Memphis-Loring soil association covers most of the upland areas on slopes ranging from 0 to 40 percent. The

Grenada-Center-Routon association occurs in the uplands and stream terraces in moderately well-drained areas, but does not occur on the steep upland slopes. The Adler-Convent-Morganfield association is found on the flood plain adjacent to Cane Creek and its tributaries. The Amagon-Oaklimeter association occurs on the flood plain near the confluence of the Hatchie River and Cane Creek.

The surficial geology of the Cane Creek main channel generally is uniform. Typically, a brown silt grades into a gray silt at depth. Color change occurs anywhere from 5 to 17 feet below ground surface and probably represents depth to the water table prior to the channelization of Cane Creek. Sand and gravel lenses that occur throughout West Tennessee also occur in the Cane Creek basin. Rock outcrop occurs only near the main channel at river mile 11.9. Sandstone is present as boulders in and near the channel bank, and a siliceous rock outcrops on a hillside adjacent to the channel.

Lower basins of the major tributaries have surficial geology similar to the valleys of the main channel. In upper reaches of Hyde Creek and Fain Spring Creek, sand and gravel are locally exposed and supply enough material to form in-channel bars for short distances downstream.

The surficial geology of the uplands differs from the lowland areas in that a brown loess is successively underlain by sand and gravel, red-brown sandstone, sand and clay layers, and an orange sand layer. The coarser grained deposits are found most often along the northern boundary of the basin and occasionally in areas to the west and south of the main channel. Logs of wells indicate depth to sand or gravel ranges from 0 to 158 feet. Coarse bed material may be extracted from deep scour holes that develop downstream from contracted bridge openings.

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