DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
WILLIAM T. PECORA, DIRECTOR

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
WALLACE W. HAGAN, DIRECTOR AND STATE GEOLOGIST

HYDROLOGIC INVESTIGATIONS
ATLAS HA-180

GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS

System	Series	Group	Formation	Section	Thickness in feet	Lithology	Topography and geologic setting	Hydrology
Quaternary	Pleistocene and Recent		Alluvium		0–70	Light to medium gray, grayish brown, or yellowish brown silty clay or clayey silt with a few layers of yellowish to medium gray silty fine-grained sand. In the valley of Bayou du Chien, and locally elsewhere, gravel and coarse sand, as much as 25 feet thick, at base.	Flood-plain deposits in the valleys of the larger streams and their tributaries. Maximum known thickness, 70 feet, is in the valley of Bayou du Chien. The maximum known thickness in the valley of Mud Creek is 64 feet. Thin, or absent, in smaller stream valleys.	Only one well is known to tap the alluvium. In the tributary valleys, the alluvium is above the main zone of saturation; in the southwestern third of the quadrangle, water may be perched above clay of Eocene age. In the larger valleys, wells may yield enough water for domestic use. Yields will be small where the gravel is thin or absent; larger yields are available from the sand in the underlying Eocene strata. The stream channels of Bayou du Chien and Little Bayou du Chien, and of Mud Creek downstream from the 310-foot water-level contour, intersect the water table and the streams flow throughout the year.
					0–25			
	Pleistocene		Loess		0–37	Yellowish brown, gray-brown, and medium gray silty clay and clayey silt.	Windblown deposits covering all upland area. Drapes down slopes as colluvial deposits; merges with alluvium on gentle slopes.	Above the main zone of saturation. When saturated by precipitation, it may transmit some water to underlying aquifers.
	Pliocene(?)		Silt, sand and gravel		0–34	Yellowish brown, reddish brown, or medium gray sandy silt with some silty sand; occasionally, scattered pebbles. North of Bayou du Chien, in most of the area between Bayou du Chien and Little Bayou du Chien, and locally elsewhere, sandy to clayey gravel at base; as much as 18 feet thick along the north edge of map.	Continental deposits overlying Eocene strata in uplands. South of Bayou du Chien and Little Bayou du Chien, usually less than 10 feet thick; often absent near Mud Creek. Drapes down slopes as thin colluvial deposits, commonly mixed with loess.	Usually above the main zone of saturation. In the southwestern third of the quadrangle, water is perched above clay of Eocene age. The perched water probably will not provide an adequate domestic supply; the sandy silt has rather low permeability and little saturated thickness. Also, several wells are reported to go dry in late summer. Based on nearby areas, the perched water may contain slightly less than 45 ppm of nitrate.
					0–18			
Tertiary	Eocene, undifferentiated		Sand, silt and clay		175–300	Medium-gray to white clay, some brown or olive-green clay, some white, yellow, or red fine- to medium-grained sand, and interbedded clay, silt, and fine sand.	Coastal-plain sediments underlying either continental deposits of Pliocene(?) and Pleistocene age or alluvium of Pleistocene age in the entire quadrangle. Upper unit crops out along the tributary valleys.	Yields of all wells in the main zone of saturation are adequate for domestic use. Wells completed in this unit are generally between 85 and 150 feet deep, northeast of Mud Creek. Southwest of Mud Creek, depths are generally between 125 and 225 feet. Yields may exceed 100 gpm. The water generally is moderately hard, acidic, and has less than 0.3 ppm of iron.
					100–150	Brown to white very fine- to fine-grained sand and silt with some medium- to coarse-grained sand near base.		No wells withdraw water from this unit or the underlying strata. Wells, about 400 to 500 feet deep, completed in the basal sand of this unit may yield more than 500 gpm.
					200–300	Gray to brown clay with some brown to white silt and fine- to medium-grained sand.		This unit has low permeability and probably will not yield an adequate supply to wells.
					200–300	Brown to white fine- to medium-grained sand with some coarse-grained sand near base.		Industrial and municipal wells may be completed in this unit at depths as shallow as 500 feet in the bottoms of Bayou du Chien and Little Bayou du Chien to as deep as 850 feet in the southwest corner of the quadrangle; yields may exceed 1,400 gpm.
					200–400	Brown to gray lignitic clay with a basal fine- to medium-grained sand.		The basal sand of this unit may be an adequate aquifer; however, it probably will never be tapped because of the excellent aquifer overlying it.
	Paleocene	McNairy	Porters Creek Clay		300±	Dark-gray clay, often micaceous and silty. Upper and basal parts are micaceous glauconitic clayey very fine-grained sand.	Marine sediments underlying Eocene strata in the entire quadrangle. Thickness variable owing to pre-Eocene erosion. Overlies the McNairy Formation of Cretaceous age.	Not an aquifer. Retards ground-water movement between the Eocene sediments and the underlying formations.

[1] Age undetermined; estimated to range from Pliocene or older to Pleistocene

Gravel · Sand · Silt · Loess · Clay · Mica · Glauconite · Lignite

AVAILABILITY OF GROUND WATER IN THE CAYCE QUADRANGLE, JACKSON PURCHASE REGION, KENTUCKY-TENNESSEE

Ground water for domestic, agricultural, and industrial use is abundant in the Cayce quadrangle. This atlas, one of a series describing the ground water of the entire Jackson Purchase region in western Kentucky, presents a nontechnical description of the ground water in this quadrangle between Fulton and Hickman, Kentucky.

The availability map shows the occurrence and quality of ground water in the shallowest aquifer that may yield an adequate domestic water supply. Ground-water availability at any site is shown by the map pattern and the data for nearby wells. Chemical quality is shown by circular diagrams.

The principal aquifers are the sands of Eocene age. Sparse data suggest that the Eocene strata are from 900 to 1,400 feet thick and dip southwestward about 30 feet per mile. Four water-yielding sand strata are recognizable - an upper sand, two deeper sands, and a basal sand. Wells may be completed in the upper sand varying from about 250 feet altitude along the north and east edges of the quadrangle to about 140 feet altitude near the southwest corner; yields to individual wells may exceed 100 gpm (gallons per minute). Properly constructed wells in the third of the four Eocene aquifers may yield more than 1,400 gpm. Municipal wells at nearby Fulton, Ky., and Union City, Tenn., yield 1,200 gpm and 1,700 gpm, respectively. Many of the sands in the Eocene strata are lenticular. Therefore, some wells must be drilled deeper than others nearby in order to obtain a similar yield.

The water level in the main zone of saturation slopes northwestward from about 330 feet altitude in the southeast corner of the quadrangle to about 275 feet where Bayou du Chien flows out of the quadrangle. Based on continuous water-level records in the Jackson Purchase, the annual range of water-level fluctuation is about 3 feet in the upland.

The uppermost layer of the Eocene strata throughout the quadrangle is generally clay or clayey silt. Where this clay is above the main zone of saturation, it retards the downward movement of water and perches water in the overlying material. Southwest of Mud Creek, water is perched in silt and silty sand of Pliocene(?) and Pleistocene age, above clay of Eocene age. The yields of bored wells in the perched water may be inadequate for domestic use because the silt layer is thin and relatively impermeable; also, some wells are reported to go dry in late summer.

The Porters Creek Clay of Paleocene age, which underlies the Eocene strata, is not an aquifer; instead, it retards ground-water movement between the Eocene beds and the underlying Cretaceous sediments. The clay is about 300 feet thick; its upper surface probably slopes south-southwestward about 35 feet per mile and is about 900 feet below sea level in the central part of the quadrangle.

The McNairy Formation of Cretaceous age, below the Porters Creek Clay, is about 300 feet thick. The McNairy Formation was deposited on limestone and chert of Paleozoic age. The Paleozoic bedrock surface probably slopes southwestward about 30 feet per mile and is about 1,400 feet below mean sea level near Cayce. However, no wells in this quadrangle, or adjacent areas, tap formations deeper than the Eocene strata. The water below the Porters Creek Clay may be hard and contain excessive iron and dissolved solids.

The quality of water in the main zone of saturation is satisfactory for most uses. In the eastern two-thirds of the map the water from shallow wells generally is soft or moderately hard and contains 80 to 120 ppm (parts per million) of dissolved solids. The water has a pH generally between 6,3 and 6,5. The temperature ranges from 59° to 62°F. In the western third of the map the water from deeper wells generally is moderately hard or hard and contains 150 to 275 ppm of dissolved solids. The water has a pH generally between 6,6 and 6,9.

The water generally contains less than 0,3 ppm of iron. However, a few of the wells with 2½-inch or smaller steel casings and sucker-rod pumps yield water that contains large amounts of iron. Most of this iron is derived from the corrosion of the well casing and pump apparatus by the acidic ground water. To obtain representative samples of the iron content of the ground water, 6 of the 16 samples were collected from wells with 4-inch plastic casings; in all six, the iron content was less than 0,3 ppm. Apparently, plastic casing can in most cases alleviate the problem of high iron content due to corrosion of well casings. However, in some areas, as in the Clinton quadrangle (see index map), the ground water contains more than 0,3 ppm of iron regardless of the casing used; probably, even here though, the iron content is lowest in water from wells with plastic casing.

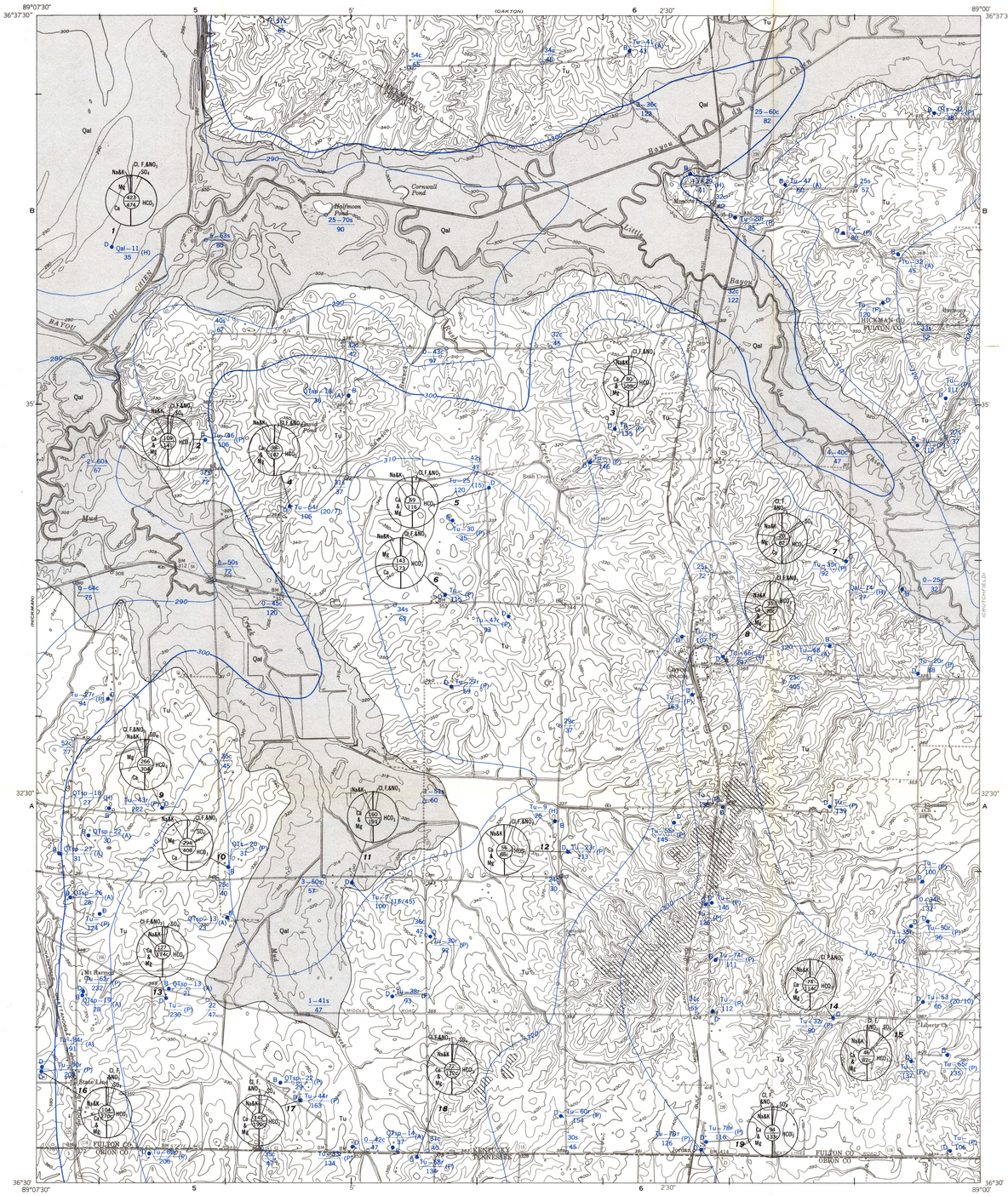
In adjacent quadrangles, the water in the deeper Eocene sands generally is soft and has less than 90 ppm of dissolved solids. The water is acidic.

The quality of the perched water depends upon local factors and may vary throughout the quadrangle.

The following table lists the iron content, in parts per million, and the hydrogen-ion concentration, as pH, of the water analyses shown by circular diagrams on the availability map. A pH of 7,0 indicates neutrality. Values higher than 7,0 denote alkalinity; lower values indicate acidity. Below 7,0 corrosiveness generally increases as pH decreases.

Analysis number	1	2	3	4	5	6	7	8	9	10
Iron content	1.1	0.10	0.10	0.04	0.13	2.8	0.09	0.06	1.7	0.00
pH	7.7	6.9	6.5	6.5	6.4	—	6.2	6.3	8.0	7.0

Analysis number	11	12	13	14	15	16	17	18	19
Iron content	0.04	0.08	8.5	0.24	0.06	8.7	0.09	1.2	0.18
pH	6.9	6.4	6.8	6.4	6.4	6.6	6.9	6.6	6.5



Base by U.S. Geological Survey, 1951

The Carter Coordinate System letters and numbers used to designate five-minute divisions of latitude and longitude are shown along the margins; tick marks indicate one-minute divisions

Hydrology by Arnold J. Hansen, Jr., 1966

MAP SHOWING AVAILABILITY OF GROUND WATER, LOCATION OF WELLS, AND QUALITY OF WATER

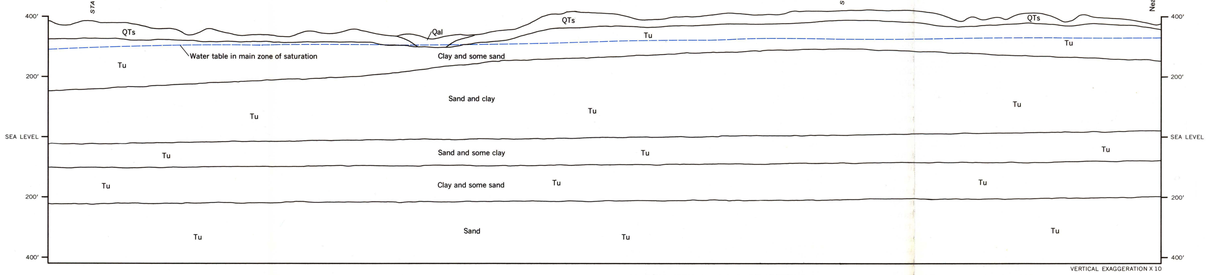
APPROXIMATE MEAN DECLINATION, 1967

SCALE 1:24 000

1 MILE · ½ · 0 · 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT HALF INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION



GENERALIZED GEOLOGIC SECTION FROM STATE HIGHWAY 125 TO NEAR LIBERTY CHURCH BETWEEN STATE HIGHWAYS 116 (STATE LINE ROAD) AND 166 (MIDDLE ROAD)

EXPLANATION

Each availability area on this map shows the occurrence and availability of ground water in the shallowest aquifer that may yield enough water for domestic use. This report considers that an adequate aquifer will yield at least 500 gallons per day to a well equipped with a power pump and pressure-distribution system. The shallowest aquifer is underlain by other aquifers which are described in the generalized columnar section

Qal

AREA 1
Water in Quaternary alluvium
Yields from bored wells may be adequate for domestic use. Yields will be small where the gravel is thin or absent. Wells can be drilled deeper into the sand in the underlying Eocene strata to obtain larger yields

Tu

AREA 2
Water in Eocene sand
Diagonal ruling indicates where the static water level in wells is deeper than 100 feet
Yields of wells in the main zone of saturation are adequate for domestic use. Most domestic wells tap an upper sand and are between 85 and 150 feet deep, except southwest of Mud Creek, where most depths are between 125 and 225 feet. Industrial wells may be completed in either of two deeper sands, at depths varying from 400 to 500 feet and from 500 to 850 feet; yields may exceed 1,500 gpm. The specific capacity of a 600-gpm industrial well in Fulton, about seven miles east of this map, is about 35 gpm per foot of drawdown. Most specific capacities of domestic 4-inch wells in this and adjacent quadrangles are reported to be between 0.5 and 2.5 gpm per foot of drawdown

Area boundary

Test hole

Test hole in upland
54c — Depth to top of Eocene strata, in feet below land surface
65 — Lithology of upper Eocene strata; c clay, s sand
Depth of test hole, in feet below land surface

Test hole in valley
0–45c — Saturated thickness of alluvial gravel and sand, in feet
97 — Depth to base of alluvium, in feet below land surface
Lithology of upper Eocene strata; c clay, s sand
Depth of test hole, in feet below land surface

D — Water well
D, *Drilled or jetted well, generally 4-inch plastic or smaller steel casing with well screen*
B, *Bored or dug well, generally 8-inch vitrified clay pipe or 24-inch brick, open at the bottom*

Tu–54c — Aquifer (see below)
106 — Water level in well, in feet below land surface; r, if reported
(20/7) — Specific capacity, in gallons per minute per foot of drawdown; yield, in gpm; or adequacy (see below)
Depth of well, in feet below land surface

AQUIFER SYMBOLS

Qal — Alluvium of Quaternary age
QTsp — Perched water in silt of Pliocene(?) and Pleistocene age
QTs — Silt of Pliocene(?) and Pleistocene age
Tu — Sand of Eocene age

YIELD OR ADEQUACY

(20/10) — Gallons per minute/Drawdown, in feet
(15) — Gallons per minute
(P) — Well reported adequate for power pump for domestic and/or stock supply
(H) — Well reported adequate for bailer or hand pump
(A) — Well abandoned or destroyed

300 — Water-level contour
Shows altitude of water level in the main zone of saturation. The depth to water is the difference between the land-surface altitude and the water-level contour. Water levels measured in October 1965. Contour interval 10 feet; datum is mean sea level. Contours interpreted from predominantly reported data

QUALITY

Chemical composition of dissolved solids
Figure between circular diagram and well symbol is analysis number in table at end of text. Figure above line at center of circle is carbonate hardness (calcium magnesium hardness, as $CaCO_3$) in parts per million. The U.S. Geological Survey classifies hardness as follows: 0–60 ppm, soft; 61–120 ppm, moderately hard; 121–180 ppm, hard; and 181 ppm or more, very hard. Figure below line is dissolved solids in parts per million; in some partial analyses, c indicates it is computed from specific conductance and is only approximate. Each segment in the circle is proportional to the ion dissolved in the water; percentages are computed from equivalents per million of the anions and cations. Calcium and magnesium are shown together as one segment in partial analyses

EXPLANATION

Qal — Alluvium of Quaternary age
QTs — Silt of Pliocene(?) and Pleistocene age (includes Loess)
Tu — Sand and clay of Eocene age, undifferentiated

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