PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
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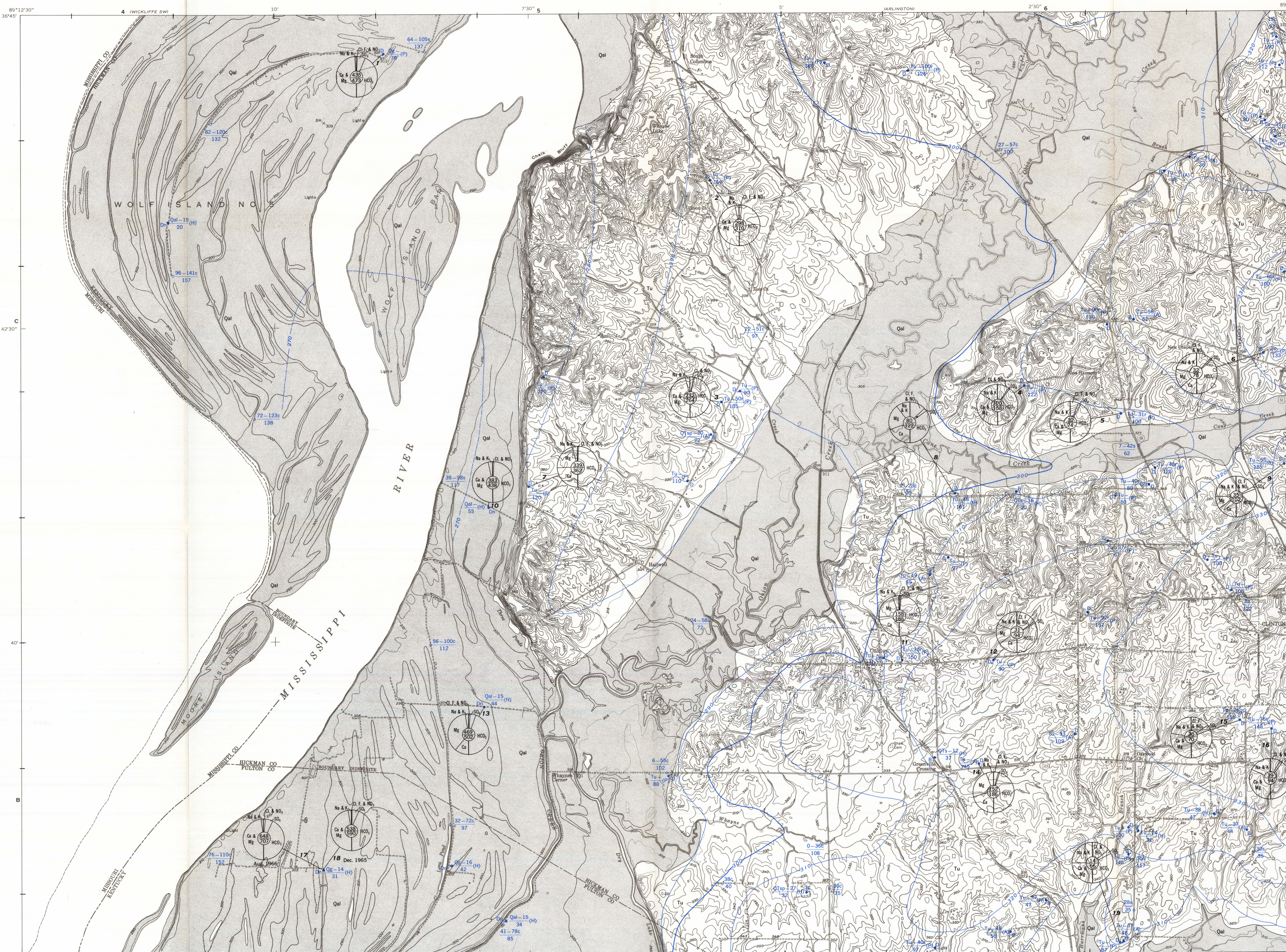
GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS

SYSTEM	SERIES	GROUP	FORMATION	SECTION	THICKNESS, IN FEET	LITHOLOGY	TOPOGRAPHY AND GEOLOGIC SETTING	HYDROLOGY
QUATERNARY	Pleistocene and Recent		Alluvial sand, silt, and clay		0-60 (0-141+)	Light-brown to brownish-gray silty very fine-grained sand, medium-gray to medium-brown silty clay, and medium-gray clayey silt; locally, layers of medium-brown fine- to medium-grained sand.	Flood-plain deposits in the valleys of the Mississippi River and Obion Creek. The maximum thickness in the valley of the Mississippi River is about 60 feet; in Obion Creek it is about 35 feet.	In the Mississippi River valley, several driven wells tap this formation. The layers of sand are so scattered that in most places, a well must penetrate the underlying coarse alluvium.
QUATERNARY	Pleistocene		Alluvial sand and gravel		0-96+	Medium-gray to grayish brown lignitic coarse-grained sand, pebbly sand, and fine-grained gravel.	Underlies the alluvial sand and clay throughout Area 1. This unit is at the land surface near the Mississippi River, a third of a mile south of this map. The maximum thickness in the valley of the Mississippi River is about 100 feet; in Obion Creek it is about 30 feet. The thickness is variable, even in short distances, because of erosion of underlying units, which created an irregular surface on which the alluvium was deposited.	In the Mississippi River valley, several driven wells tap the upper few feet of this formation. Drilled wells penetrating the full thickness of the formation may yield as much as 1000 gpm (gallons per minute) for irrigation. The water is very hard and generally contains between 425 and 525 ppm (parts per million) of dissolved solids. The iron content exceeds 0.3 ppm; more than 0.3 ppm of iron stains fabrics and fixtures and gives water a bitter taste. Along Obion Creek, wells may yield as much as several hundred gallons per minute. The stream channels of Obion Creek, Brush Creek, Cane Creek, and of Whayne Branch downstream from the 310-foot water-level contour, intersect the water table and the streams flow throughout the year.
QUATERNARY	Pleistocene		Loess		0-35+	Yellow-brown to medium-gray silty clay or clayey silt.	Windblown deposits covering all the upland, draping down slopes as colluvium, and merging with alluvium along edges of gently sloping valleys.	Above the zone of saturation. When saturated by rainfall, transmits some water to underlying aquifers.
	Pliocene(?)		Sand, silt, and gravel[1]		0-22+	Yellow-brown to red-brown sandy silt or silty sand and scattered pebbles. Commonly in matrix of sandy clay. Locally, silty clay.	Continental deposits overlying Eocene strata in uplands. Drapes down slopes as colluvium, commonly mixed with loess.	Usually above the zone of saturation. West of Oakton, water may be perched above clay of Eocene age.
TERTIARY	Eocene, undifferentiated		Sand, silt, and clay		250-350 (800-1000)	Blackish-brown to gray-brown clay; white, pink, or light-gray sandy clay; gray to pink silty clay; and yellow to cream clayey very fine- to fine-grained sand. Some layers of yellow, white, or light-brown very fine- to medium-grained sand.	Coastal-plain sediments underlying either continental deposits of Pliocene(?) and Pleistocene ages or alluvium of Pleistocene age in the entire map. Upper unit crops out along the Mississippi River bluffs and the tributary valleys.	Yields of all wells in the main zone of saturation are adequate for domestic use. In Area 2, wells may be completed in this unit between about 260 and 200 feet altitude. In Area 1, wells may be completed in this unit from about 225 feet altitude in the valley of Obion Creek to about 100 feet along the western edge of the map. The water is soft to very hard and generally contains 70 to 375 ppm of dissolved solids; the pH is between 6.0 and 7.0. Both the pH and the concentration of ions dissolved in the water increase toward the Mississippi River.
TERTIARY	Eocene, undifferentiated		Sand, silt, and clay		100-150	Brown, yellow, or white very fine- to fine-grained sand and silt and some medium- to coarse-grained sand near base.		No wells withdraw water from this unit or the underlying strata. Based on data from adjacent areas, wells, about 250 to 500 feet deep, completed in the basal sand of this unit may yield more than 500 gpm.
TERTIARY	Eocene, undifferentiated		Sand, silt, and clay		100±	Brown to white silt and fine- to medium-grained sand and some gray to brown clay.		This unit has a lower permeability than the units above and below; it probably will not yield enough water for industrial or municipal use.
TERTIARY	Eocene, undifferentiated		Sand, silt, and clay		150-250	Brown to white fine- to medium-grained sand and some coarse-grained sand near base.		Industrial and municipal wells may be completed in this unit at depths as shallow as 550 feet in the valley of Obion Creek and as deep as 800 feet near South Columbus; yields may exceed 1400 gpm.
TERTIARY	Eocene, undifferentiated		Sand, silt, and clay		200±	Brown to gray lignitic clay and a basal fine- to medium-grained sand.		The basal sand of this unit may be an adequate aquifer; however, it may never be utilized because of the excellent aquifer overlying it.
TERTIARY	Paleocene	Midway	Porters Creek Clay		300±	Dark-gray clay, locally, micaceous and silty. Upper and basal parts are micaceous glauconitic clayey very fine-grained sand.	Marine sediments underlying Eocene strata in the entire area. Thickness variable owing to pre-Eocene erosion.	Not an aquifer. Retards ground-water movement into the Eocene sediments from the underlying McNairy Formation.
CRETACEOUS	Upper Cretaceous		McNairy Formation[2]		300±	Light- to dark-gray micaceous silty clay interbedded with white, gray, or brown silt or very fine-grained sand.	Deltaic deposits underlying the Porters Creek Clay in the entire quadrangle.	The sand in this formation may yield enough water for domestic use and small towns. Wells will flow in the valleys of the Mississippi River and Obion Creek.

[1] Age undetermined; estimated to range from Pliocene or older to Pleistocene
[2] Upper part may be of Clayton age

EXPLANATION

Gravel   Sand   Silt   Loess   Clay   Mica   Glauconite   Lignite



36°37'30"
89°12'30"

Base from 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

SCALE 1:24 000

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

KENTUCKY
QUADRANGLE LOCATION

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 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 wells are adequate for domestic and/or stock use. Drilled wells may yield enough water for irrigation or industrial use. The alluvial gravel is the thickest on Wolf Island No. 5 and near the southwest corner of the map; properly constructed wells may yield as much as 1,000 gpm (gallons per minute)

Tu

AREA 2
Water in Eocene sand

Yields of all wells in the sands of Eocene age are adequate for domestic and/or stock use. Domestic wells may be completed at about 260 feet altitude north of Clinton and about 200 feet near Oakton. Industrial or municipal wells may be completed in either of two deeper sands, at depths varying from 250 to 500 feet and from 550 to 800 feet; yields may exceed 1,400 gpm. The specific capacity of a 600-gpm industrial well in Fulton, about 10 miles southeast of this map, is about 35 gpm per foot of drawdown; that of a 1,750-gpm municipal well in Union City, Tenn., about 15 miles south of this map, is about 28 gpm per foot of drawdown

Area boundary

Test hole

Test hole in upland

8c / 122
- Depth to top of Eocene strata, in feet below land surface
- Lithology of upper Eocene strata; c, clay; s, sand
- Depth of test hole, in feet below land surface

Test hole in valley

6—55c / 102
- Saturated thickness of alluvial gravel, in feet
- Depth to base of gravel, in feet below land surface
- Lithology of upper Eocene strata; c, clay; s, sand
- Depth of test hole, in feet below land surface

Water well

D, *Drilled well, generally 4-inch plastic or smaller steel casing with well screen*
B, *Bored or dug well, generally 8-inch vitrified clay pipe, open at the bottom*
Dn, *Driven well, generally 1½-inch pipe with sand point*

Tu—48 (P) / 161
- Aquifer (see below)
- Water level in well, in feet below land surface; r, if reported
- Yield, in gpm, or adequacy (see below)
- Depth of well, in feet below land surface

AQUIFER SYMBOLS

Qal ---- Alluvial silty sand of Quaternary age
Qg ---- Alluvial gravel of Quaternary age
QTs ---- Sandy silt of Pliocene(?) and Pleistocene ages
QTsp ---- Perched water in sandy silt of Pliocene(?) and Pleistocene ages
Tu ---- Sand of Eocene age

YIELD OR ADEQUACY

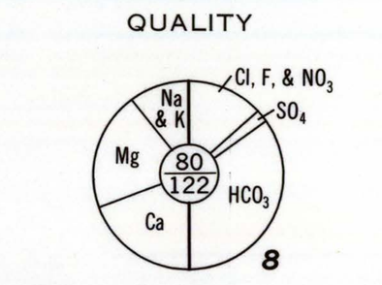
(8) ---- Gallons per minute
(P) ---- Reported adequate for power pump for domestic and/or stock supply
(H) ---- Reported adequate for bailer or hand pump
(A) ---- Abandoned

——300——

Water-level contour

Shows altitude of water level in the upper part of the zone of saturation. Dashed where inferred. The depth to water is the difference between the land surface altitude and the water-level contour. Water levels measured in August 1966. Contour interval 10 feet; datum is mean sea level. Northwest of Obion Creek, contours extrapolated from adjacent area.

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 partial analyses it is computed from specific conductance and is only approximate. Each segment in the circle is proportional to the ions dissolved in the water; percentages are computed from equivalents per million of the ions. Calcium and magnesium are shown together as one segment in partial analyses.

No sample contained more than 45 ppm of nitrate. Water with more than 45 ppm of nitrate may cause methemoglobinemia ("blue baby" disease), sometimes fatal, in infants and should not be used in their formulas

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION KENTUCKY

Ground water for domestic, irrigation, and industrial use is abundant in the Oakton quadrangle and the Kentucky part of the Wolf Island quadrangle. This atlas, one of a series for the entire Jackson Purchase region, describes the ground-water resources of western Hickman County and northern Fulton County.

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 and test holes. Chemical quality is shown by circular diagrams.

The principal aquifers are the sands of Eocene age and the alluvial gravel of Pleistocene age. Sand of Eocene age underlies the entire area; alluvial gravel of Quaternary age underlies alluvial silt and sand of Pleistocene and Recent age throughout Area 1.

Throughout the valley of the Mississippi River the saturated thickness of the alluvial gravel ranges from 32 to 96 feet. In the tributary valleys of Area 1 the saturated thickness ranges from 6 to 27 feet. Yields may exceed 1,000 gpm (gallons per minute) near Missouri where the saturated gravel is thickest.

In Area 2 the sands of Eocene age are the principal aquifers. Data from a test hole near Columbus, north of this map, and other records suggest that the Eocene strata are from 800 to 1,000 feet thick and dip southwestward about 30 feet per mile.

Five water-bearing units in the Eocene are recognizable. In stratigraphically descending order they are: sporadic sand layers within a predominantly clay section, a sand unit which may yield large quantities of water, a section of sand with some clay layers, a moderately thick sand which may yield more than 1,400 gpm, and a basal sand.

Wells may be completed in the sands within the upper clay unit at about 260 feet altitude north of Clinton, about 200 feet near Oakton, and about 100 feet along the western edge of this map. Most of the sands in the clay section are probably discontinuous; therefore, some wells must be drilled deeper than others nearby in order to penetrate a water-yielding sand bed.

Wells may tap the sand of the second unit from about 100 feet altitude at the northeast corner of the map to about 150 feet below sea level in the southwest corner. Wells may yield more than 500 gpm; the municipal well at Clinton yields 600 gpm.

Few data are available for the lowest three units: the sand with clay layers, the moderately thick sand, and the basal sand. The sand of the fourth unit may yield more than 1,400 gpm; municipal wells at nearby Fulton, Ky. and Union City, Tenn. yield 1,200 and 1,700 gpm, from this unit.

The water level in the upper part of the saturated zone slopes westward from about 330 feet altitude near Clinton to about 270 feet at the Mississippi River.

The Porters Creek Clay of Paleocene age, which underlies the Eocene strata, although not an aquifer, is hydrologically significant because it retards ground-water movement into the Eocene beds from the underlying Cretaceous sediments. The clay is about 300 feet thick; its upper surface probably slopes south-southwestward and is about 650 feet below sea level in the central part of the map.

The McNairy Formation of Cretaceous age, below the Porters Creek Clay, is about 300 feet thick and overlies the limestone and chert bedrock of Paleozoic age. The water level in the McNairy slopes northwestward from about 350 feet altitude at the southeast corner of the map to about 335 feet at the northwest corner.

The water in the Quaternary alluvium is very hard and generally contains 425 to 525 ppm (parts per million) of dissolved solids; the pH is between 7.2 and 7.9. The iron and manganese contents are so high that they may need to be removed to make the water satisfactory for many uses.

The quality of water in the Eocene strata is satisfactory for most uses. Approximately east of Greenville Crossing, the water is soft and generally contains 70 to 100 ppm of dissolved solids; the pH is between 6.0 and 6.2. Between Greenville Crossing and Obion Creek, the water is moderately hard or hard and generally contains 150 to 200 ppm of dissolved solids; the pH is generally between 6.4 and 6.8. Northwest of Obion Creek, the water is very hard and contains 250 to 375 ppm of dissolved solids; the pH is about 7.0. The water in the Eocene strata generally contains less than 0.3 ppm of iron. However, most of the wells with steel casings yield water that contains more than 0.3 ppm 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 13 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 usually alleviates the problem of high iron content due to corrosion of well casings.

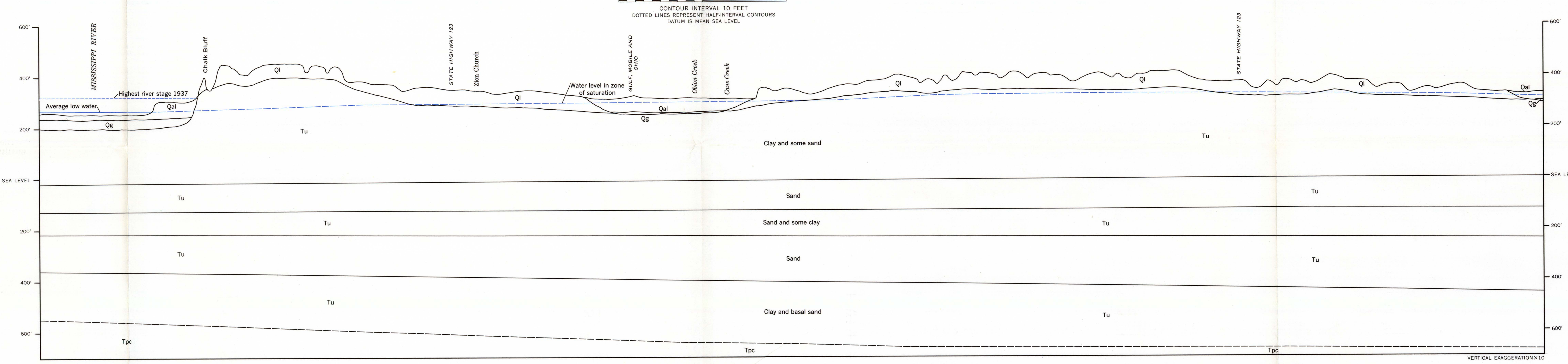
In adjacent areas, the water in the deeper Eocene aquifers is acidic, soft, and has less than 90 ppm of dissolved solids. The water in the lowest Eocene unit is soft and has about 175 ppm of dissolved solids.

The water in the McNairy Formation is soft and contains about 300 ppm of dissolved solids; the iron content is about 1.5 ppm. The McNairy may yield enough water for domestic use or a small municipal supply to drilled wells, which will flow in the valleys of the Mississippi River and Obion Creek. No wells in this area tap formations deeper than the Eocene Strata.

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	14	0.00	0.14	0.32	0.94	0.04	0.06	0.25	0.42	0.61
pH	7.3	—	7.0	6.4	—	6.1	7.2	6.4	6.2	7.2

Analysis number	11	12	13	14	15	16	17	18	19
Iron content	0.48	—	14	0.00	0.05	0.09	0.67	—	0.10
pH	7.0	6.2	7.9	6.8	6.1	6.2	7.5	7.1	6.0



GENERALIZED GEOLOGIC SECTION THROUGH CHALK BLUFF, ZION CHURCH, AND THE SOUTHEAST CORNER OF MAP

EXPLANATION

Qal ---- Alluvial silty sand of Quaternary age
Qg ---- Alluvial gravel of Quaternary age
Ql ---- Loess (includes gravelly deposits of Pliocene(?) and Pleistocene ages)
Tu ---- Sand and clay of Eocene age, undifferentiated
Tpc ---- Porters Creek Clay of Paleocene age

AVAILABILITY OF GROUND WATER IN THE OAKTON QUADRANGLE AND PART OF THE WOLF ISLAND QUADRANGLE IN JACKSON PURCHASE REGION, KENTUCKY

By
Arnold J. Hansen, Jr.
1968

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