DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
THOMAS B. NOLAN, 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-92

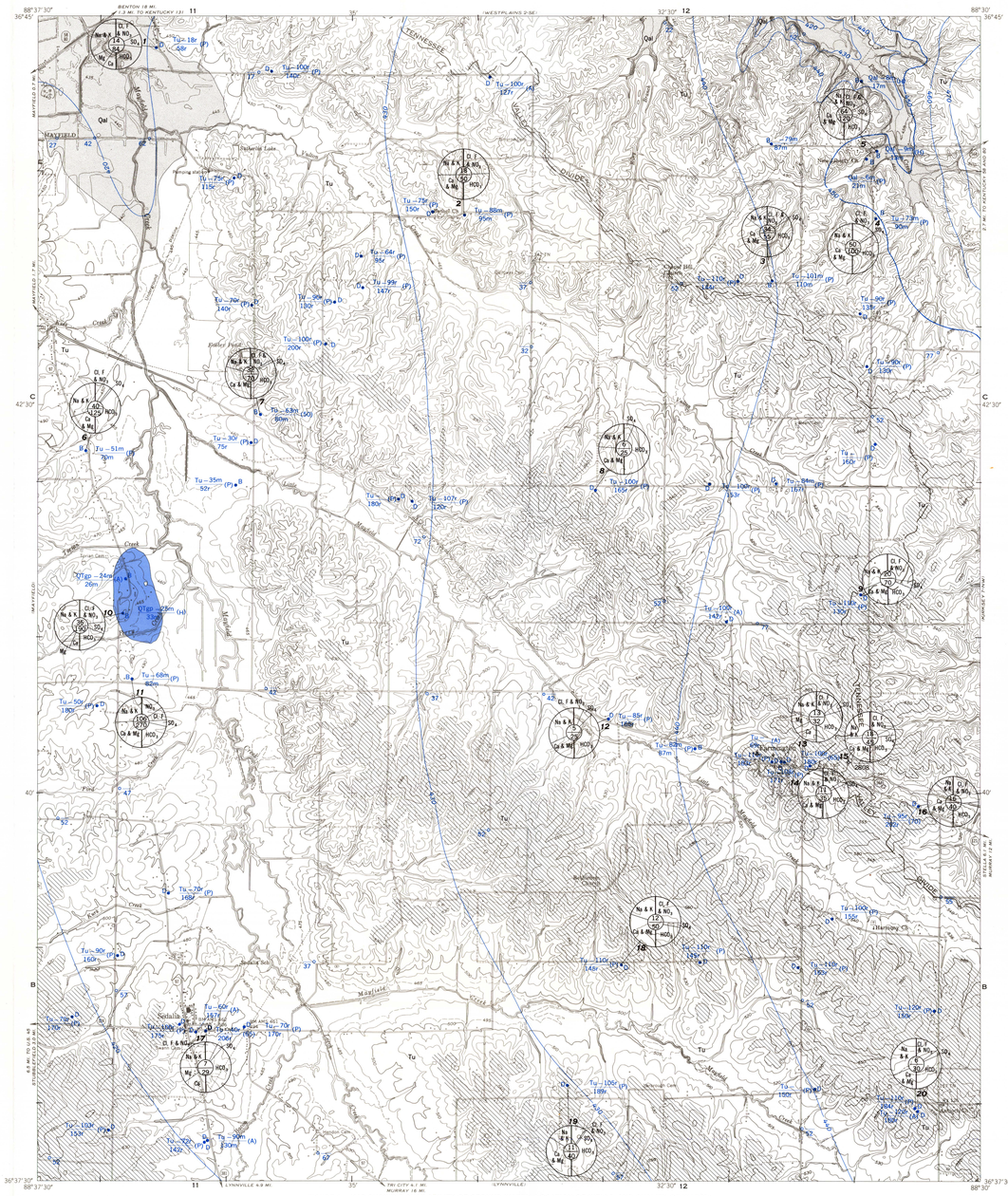
System	Series	Group	Formation	Section	Thickness, in feet	Lithology	Topography and geologic setting	Hydrology
QUATERNARY	Pleistocene and Recent		Alluvium		0-20'	Tan to gray silt, sand, and silty sand with thin beds of clay or very clayey sand in places. Gravelly sand in some areas.	Flood-plain deposits in valleys of regional drainage system. Alluvium in valley of Mayfield Creek is as thick as 20 feet in extreme northwest corner of quadrangle; alluvium is thinner upstream and less than 10 feet thick in most tributary valleys.	Water bearing in availability area 1. Yields adequate domestic supplies of ground water to dug or bored large-diameter wells commonly less than 20 feet deep. Jetted small-diameter wells in areas of alluvium usually are as deep as 60 feet and obtain water from sand of Eocene age beneath the alluvium. One sample of water was moderately hard and contained only a negligible amount of iron.
	Pleistocene		Loess		0-10'	Tan or buff to brown unstratified noncalcareous silt and clay; may be reworked with gravel at base.	Windborne deposits which mantle the uplands and drape down hillsides. Thickest in upland; eroded or removed in places.	Yields little or no water to wells. Probably transmits some water from rainfall to underlying aquifers.
	Pliocene(?)		Gravel, sand, and clay,		0-100'	Red to brown well-rounded to angular iron-stained chert pebbles and cobbles with some quartz pebbles in a medium- to coarse-grained sandy matrix. Sand is quartz or chert and contains some clay. Gravel is poorly consolidated; locally cemented zones in either gravel or sand. Discontinuous clay beds in places.	Stream-laid deposits in the uplands and formerly extensive over the area. At thick as 50 feet; eroded thin or removed in places. Exposed in hillsides, roadcuts, and tributary valleys. Rest unconformably on sediments of Eocene age.	Water bearing in availability area 2 and probably in other areas where the gravel is thick and (or) coarse. Yields only small amounts of water to large-diameter wells; generally not adequate for a power pump and pressure-distribution system. One sample contained soft water with only a minor amount of iron.
TERTIARY	Eocene (undifferentiated)		Sand and clay		300-400'	White to light-gray fine- to medium-grained subrounded to rounded quartz sand with discontinuous beds of light- to olive-gray to pink clay. Sand is well sorted and coarse grained in places and oxidized to shades of red in upper 20 feet. Cross bedding is locally conspicuous but bedding is smooth and massive. Ironstone layers and partly or nonsilicified beds of sand are present. Beds of lignite are common in some zones.	Continental deposits exposed beneath Pliocene(?) gravel in a few roadcuts and deeper valley walls. Thickness ranges from about 300 feet in western part of quadrangle to slightly more than 400 feet in western part. Clay lenses are more abundant in the subsurface between Mayfield Creek and Little Mayfield Creek in the central and south-central parts of the quadrangle.	Water bearing beneath the entire quadrangle. Yields an abundant supply of ground water to both large-diameter bored wells and small-diameter drilled wells. The water table is within 100 feet of the land surface in much of the quadrangle, and the zone of saturation is probably as thick as 300 feet in the deepest valleys in the upland drainage areas. Enough water is available for either municipal or industrial supplies. The water is commonly soft and generally slightly acidic. Objectionable amounts of iron may be present in some places. Greater concentrations of iron, if present, may cause the water to be unsuitable for, or be the objectionable limit, may stain the laundry and plumbing fixtures. Nitrate in excess of 45 parts per million was present in one sample; more than this amount of nitrate is considered harmful in water fed to infants.
	Paleocene	Midway	Porters Creek Clay		250'±	Dark-gray to black massive slightly micaceous to very micaceous clay. Contains thin and discontinuous beds of fine-grained micaceous sand in places. Glauconite in a few places. Weathers to light-gray moderate prismatic fissile are present where formation is exposed in other quadrangles. Dark-gray to greenish-gray very glauconitic and micaceous clay or fine-grained sand at base.	Marine deposits concealed beneath sediments of Eocene age. Separated from the underlying McNairy Formation by a thin glauconitic zone, which may be more than 20 feet thick in places.	Not significant as an aquifer. Sand beds may yield some water to wells. The thick clay retards descending water in sand of Eocene age and confines water in the underlying McNairy Formation of Cretaceous age.
CRETACEOUS	Upper Cretaceous		McNairy Formation[1]		300'	Brown, buff, gray, or white fine- to medium-grained micaceous silty and carbonaceous sand, interbedded with dark-gray to black massive, in some places sandy, micaceous and carbonaceous clay. Lignite beds are common.	Deltaic deposits underlying Porters Creek Clay. Present in entire quadrangle. Rest on an eroded Paleozoic rock surface except where separated by the Tuscaloosa Formation.	Water bearing in entire quadrangle at depths ranging from about 650 feet in eastern part to more than 850 feet in western part. Probably will yield an abundant supply of ground water. Not tapped in this area because overlying, shallower Eocene sand contains large quantities of excellent water. Water is slightly acidic and may be; the formation should rise in wells to an altitude of about 390 feet above sea level. Its quality probably is suitable for many uses. The water, which may be hard and contain objectionable amounts of iron, is probably less acidic than water at shallower depths.
			Tuscaloosa Formation		?	White well-rounded waterworn chert pebbles and cobbles in a poorly sorted sandy and tripolitic matrix.	Stream-laid deposits which fill channels and depressions in eroded Paleozoic rock surface. The formation is known to north and east of the area and may be present in this area. Thickness is unknown but in adjacent areas it exceeds 60 feet.	Probably will yield an adequate supply of ground water for many uses. Not known to be present in this area. Tripolite in matrix could cause clogging of well screens. Water may be hard and contain objectionable concentrations of iron.
SILURIAN AND DEVONIAN	Lower and Middle Silurian	Lower Devonian and	Devonian and Silurian rocks (undifferentiated)		350'	All rocks below the Cretaceous are of Paleozoic age and are the "bedrock" of well drillers. Gray, brown, and maroon dense to crystalline limestone and dolomite containing dark-gray or brown interbedded chert. Siliceous or sandy in zones. Glauconitic at base of Silurian System. Underlain by shale, sandstone and dolomite of Ordovician age.	Consolidated marine sediments underlying Cretaceous rocks in the Mayfield Creek quadrangle. Dip gently westward on truncated subcrop of northeastward-dipping Paleozoic rocks. Devonian rock, about 50 feet thick, underlies Cretaceous deposits in eastern part of quadrangle; Silurian rock in contact with Cretaceous deposits in western part. Ordovician rock recorded at depth of 1310 feet in deep oil-test well near Farmington.	Water bearing at depths below 350 feet in western part of quadrangle and below 1530 feet in eastern part. Probably contains water in solution caverns and crevices in limestone or dolomite. Little is known of ground-water conditions in Paleozoic rock in this area. The quality of water probably is suitable for many uses. The water may be hard, high in dissolved solids, and may contain objectionable concentrations of iron.

[1] Age undetermined. Estimates of age range from Pliocene or older to Pleistocene
[2] May contain beds of Clayton age in upper part

EXPLANATION

Gravel, Sand, Clay or shale, Silt, Loess, Mica, Glauconite, Carbonaceous material, Limestone, Dolomite, Crystalline limestone, Cherty limestone, Cherty dolomite

FIGURE 2.—GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS



Base by Tennessee Valley Authority and 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

FIGURE 1.—MAP SHOWING AVAILABILITY OF GROUND WATER, LOCATION OF WELLS, AND QUALITY OF WATER

Hydrology by J. H. Morgan, 1962

SCALE 1:24 000
1 ½ 0 1 MILE
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1964
KENTUCKY
QUADRANGLE LOCATION

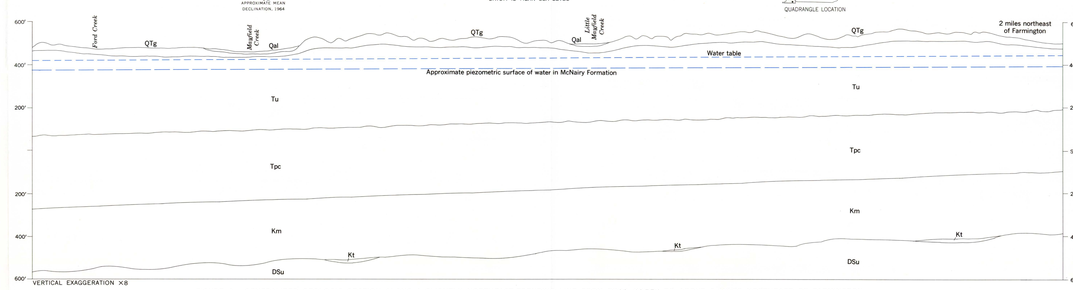


FIGURE 3.—GENERALIZED GEOLOGIC SECTION ALONG A SLIGHTLY NORTHEAST-TRENDING LINE FROM FORD CREEK TO ABOUT 2 MILES NORTHEAST OF FARMINGTON

EXPLANATION

Qal ..... Alluvium of Quaternary age
QTg ..... Gravel and sand of Pliocene(?) age
Tu ..... Eocene formations, undifferentiated
Tpc ..... Porters Creek Clay of Paleocene age
Km ..... McNairy Formation of Cretaceous age
Kt ..... Tuscaloosa Formation of Cretaceous age
DSu ..... Devonian and Silurian rocks, undifferentiated

EXPLANATION

The water-availability areas on this map show the occurrence and availability of ground water in the shallowest aquifer that can yield adequate amounts of water for domestic use in each area. As considered in this report, an adequate domestic supply will deliver approximately 500 gallons per day from a well equipped with a power pump and pressure-distribution system. The shallowest aquifer is underlain by deeper aquifers whose water-bearing properties are described in the generalized columnar section, figure 2.

Qal

AREA 1
Water in Quaternary alluvium

The alluvium is water bearing at depths commonly less than 10 feet in Panther Creek and 20 feet in Mayfield Creek in area 1, where the stream valleys have been eroded sufficiently deep to intersect the water table. The zone of saturation, probably more than 300 feet thick, is continuous into underlying saturated sand of the Eocene Series. Shallow-diameter dug or bored wells are usually adequate in water-bearing alluvium. Small-diameter drilled or jetted wells are used through the alluvium and obtain water through well screens placed in the underlying sand. Enough water is available in the alluvium for a domestic supply; the underlying Eocene sand probably contains sufficient amounts for a large supply. The alluvium outside of area 1 may be water bearing where small bodies of water are perched above discontinuous beds of clay. These small bodies of perched water commonly are present only in rainy seasons and, although some of them may persist through dry seasons, they probably will not yield enough water for a domestic supply as defined in this report. To obtain an adequate supply of water, wells should penetrate through these perched-water bodies and enter the main zone of saturation beneath the alluvium

QTgp

AREA 2
Perched water in Pliocene (?) gravel

A small body of water in Pliocene(?) gravel is perched above a bed of clay in area 2 at a depth of about 35 feet. The extent of the clay bed is unknown and the boundaries of area 2 are only approximately located. The yield of this body of water is reported inadequate for a power pump and pressure-distribution system but is adequate for a hand pump or bailer. The body of water is reported to be present even in the driest years. Similar bodies of perched water were located in two test holes but are not shown on the map because their yields are apparently inadequate for a domestic supply. Other bodies of perched water may be present but have not been located. However, for a dependable and adequate supply of water, wells should penetrate the zone of perched water and tap the underlying main zone of saturation

Tu

AREA 3
Water in Eocene sand

Diagonal ruling shows areas where the water level in wells is more than 100 feet below the land surface.

The Eocene sand is the shallowest water-bearing formation in area 3. The upper part of the main zone of saturation is less than 100 feet below land surface except in areas shown by diagonal ruling, where the water table is at slightly greater depth. The actual depth to water is shown by the water-level data relating to specific wells on the map. Small-diameter drilled wells, generally more than 100 feet deep, are commonly constructed in areas where dry loose sand above the water table tends to collapse while excavating large-diameter wells. Because small diameter wells are usually finished in coarse sand for proper functioning of well screens, the depths to coarse sand can be considered analogous to the depths of the wells. Large-diameter dug or bored wells usually are less than 100 feet deep and are terminated only a few feet below the water table in almost any size sand. The main zone of saturation extends downward to the Porters Creek Clay (fig. 2) and is as thick as 300 feet in some places. Properly constructed wells in the main zone of saturation should furnish enough water for either a municipal or an industrial supply

Area boundary

2808
Oil-test well
Figure below line is depth of well

62
Test hole
Figure below line is depth of test hole

D
Water well
D, *Drilled or jetted well, generally steel or plastic casing with well screen on lower end.*
B, *Bored or dug well, generally 24-inch concrete tile casing open at the bottom*

Tu -120 150 (70)
- Aquifer (see below)
- Water level in well, in feet below land surface; *r* if reported, *m* if measured
- Yield, in gallons per minute, or adequacy (see below)
- Depth of well, in feet below land surface; *r* if reported, *m* if measured

AQUIFER SYMBOLS

Qal ..... Alluvium of Quaternary age
QTgp ..... Perched water in gravel and sand of Pliocene(?) age
Tu ..... Sand of Eocene age, undifferentiated

YIELD OR ADEQUACY

(60) ..... Gallons per minute where known
(P) ..... Well reported adequate for power pump for domestic and/or stock supply
(H) ..... Well reported adequate for hand pump or bailer
(A) ..... Abandoned

450
Water level contour
Shows altitude of the water level in the main zone of saturation. Contour interval 10 feet; datum is mean sea level. Where impermeable sediments occur in the upper part of the zone of saturation, the water level is confined locally and will rise to the altitude of the contour in wells that penetrate the underlying saturated zone. The depth to water is the difference, in feet, between the altitude of the water-level contour and the land surface. Water-level measurements made in August 1962.

QUALITY

Cl, F & NO_3 / Na & K / SO_4 / Mg / Ca / HCO_3 — 13

Chemical composition of dissolved solids
Figure between circular diagram and well symbol refers to analysis number in table at end of text. Figure above line at center of circular diagram is carbonate hardness (calcium magnesium hardness, as $CaCO_3$) in parts per million (ppm); figure below line is dissolved solids in parts per million. Hardness of water is classified by the U.S. Geological Survey as follows: 0-60 ppm, soft; 61-120 ppm, moderately hard; 121-180 ppm, hard; and 181 ppm or more, very hard. Dissolved solids in partial analysis are computed from specific conductance and are proportional to the mineral component in the dissolved solids in the water. Percentages are computed from equivalents per million of the anions and cations. Calcium and magnesium are shown as one segment in partial analyses. Nitrate shown separately if present in amounts greater than 45 ppm

AVAILABILITY OF GROUND WATER IN THE FARMINGTON QUADRANGLE, KENTUCKY

A plentiful supply of ground water for domestic needs is available in the Jackson Purchase region in western Kentucky. The increasing demand for water in our expanding economy has required that special consideration be given to the water resources. To encourage wise development and conservation of this resource, investigations planned and being carried on by the U.S. Geological Survey in cooperation with the Kentucky Geological Survey are to expand the present scientific knowledge of ground-water conditions and availability. This report, one of a series that includes the entire Jackson Purchase region, provides detailed information on the availability of ground water in the Farmington quadrangle.

The occurrence of the shallowest aquifer that may yield an adequate ground-water supply for domestic use is shown on a water-availability map (fig. 1). The main zone of saturation--that part of the rock material that is completely saturated with water--is continuous beneath the entire quadrangle and is as thick as 300 feet in some places. This zone is in sand of Eocene age in most places, but in a few places the upper surface of the zone intersects the alluvium in stream valleys.

As an example of the usefulness of the map, near Foster Pond in the northwest corner of the quadrangle, the conditions in availability area 3 (see explanation of map) are shown. The water table (the upper surface of the main zone of saturation) is less than 100 feet below the land surface, ground water is obtained by both small- and large-diameter wells, and the water-bearing sediments yield enough water for a municipal or industrial supply. The probably minimum depth of a well at any chosen site is the difference between the altitude of the land surface and the water table at that site. Near Foster Pond the difference is about 75 feet, which is the estimated depth to water and the minimum depth of a dependable well.

In a few places, discontinuous beds of clay above the water table retard descending water above them. These local occurrences of ground water, here called "perched water," are usually inadequate for even a domestic supply, although the amount of water available may be sufficient for many uses in the home or on the farm.

The shallowest water-bearing formation (aquifer) is believed to yield a sufficient supply for domestic purposes, but should an additional source of water be required, deeper formations can be tapped (see fig. 2). The McNairy Formation, an excellent aquifer in Marshall and Calloway Counties, underlies the entire quadrangle. It has never been tapped in this quadrangle because the shallower Eocene aquifer offers abundant water of good to excellent quality. The water in the McNairy Formation, confined by the overlying Porters Creek Clay, will rise in wells to an altitude of about 390 feet above sea level. The Tuscaloosa Formation may not be present in this quadrangle but is water bearing in other quadrangles where the gravel in the formation has been located. The Paleozoic rocks underlying the Farmington quadrangle are an excellent source of ground water elsewhere in the Jackson Purchase region where they are at lesser depths. Near the Ohio River in southern Illinois the Paleozoic rocks supply water to several homes, small businesses, and to a few large industries. The McNairy, Tuscaloosa, and Paleozoic aquifers are capable of furnishing large quantities of water to wells in the quadrangle.

The quality of water in the main zone of saturation is satisfactory for most uses. The water is generally very soft but locally may be moderately hard; in 13 of 18 samples, the hardness of the water is less than 20 ppm (parts per million). The concentration of dissolved solids rarely exceeds 50 ppm. The water is slightly acidic and may be considered corrosive for some uses. The nitrate (NO_3) content may be more than 45 ppm in some places. The temperature of the ground water ranges from about 58° to about 64°F. In the deeper McNairy Formation the water may be less acidic and may contain objectionable amounts of iron.

The following table shows the iron content in parts per million and the hydrogen-ion concentration, expressed as pH, of the water analyses shown by circular diagrams on figure 1. A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increasing alkalinity; values lower than 7.0 indicate increasing acidity. Corrosiveness of water generally increases with decreasing pH.

Analysis number	1	2	3	4	5	6	7	8	9	10
Iron content	.11	.12	.07	.44	.10	.05	.52	.06	.09	.13
pH	6.4	6.3	7.2	6.7	7.1	6.9	6.4	5.9	6.0	6.2

Analysis number	11	12	13	14	15	16	17	18	19	20
Iron content	1.90	.05	10.02	.11	.10	.35	.17	.12	.20	.06
pH	7.1	5.9	5.5	6.9	6.0	—	6.2	6.0	6.4	5.9

[1] Total iron in sediment and solution

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1964—W64038

AVAILABILITY OF GROUND WATER IN THE FARMINGTON QUADRANGLE, KENTUCKY

By
J. H. Morgan

1964

HYDROLOGIC INVESTIGATIONS
ATLAS HA-92

For sale by U.S. Geological Survey, price 50 cents