DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
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PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
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HYDROLOGIC INVESTIGATIONS
ATLAS HA-93

System	Series	Group	Formation	Thickness, in feet	Lithology	Topography and geologic setting	Hydrology
QUATERNARY	Pleistocene and Recent		Alluvium	0–80'	Clay or silt near the surface, grading downward into clayey sand containing gravel. Well-sorted gravel beds are not known to be present, but could occur as discontinuous elongate deposits in the valley of Clarks River.	Present in the larger stream valleys and their tributaries. May be as thick as 80 feet in the valley of Clarks River at the northern boundary of the quadrangle; 5 to 15 feet thick in small tributaries.	Water bearing in most of the quadrangle. Will furnish a water supply for domestic use in the valley of Clarks River and the lower reach of Rockhouse Creek. Will not furnish an adequate supply for domestic use to most wells in the smaller valleys. The water levels fluctuate greatly and wells may become dry in the summer. Water in the alluvium is reported to be polluted by septic tank and privy effluent at Dexter and possibly at Almo. The quality of the water in the alluvium varies widely because of differences in the stream watersheds and man's urbanization of areas adjacent to the streams.
	Pleistocene		Loess	0–10'	Tan to gray unstratified silt or clay.	Covers all upland areas and the gently sloping sides of stream valleys.	Not an aquifer. When saturated by rainfall transmits water to lower aquifers.
	Pleistocene		Gravel and sand[1]	0–65'	Chert gravel, generally containing sand or clay material. Gravelly sand and sand beds are common in the lower part of the formation in the western part of the quadrangle.	Underlies the loess in upland areas and overlies Tertiary and Cretaceous rocks in the quadrangle. Thickest in a northwest-trending buried channel in the central part of the quadrangle from about well 19 to well 6.	Supplies sufficient water for domestic use in availability area 1 (fig. 1) in the southwestern part of the quadrangle, where it is thick. The Pliocene(?) gravel is the most used aquifer in the quadrangle, but yields are not large and generally are not sufficient for more than domestic, stock, or light commercial uses. The water is generally of good quality, slightly acidic, soft, and its iron content usually is less than 0.3 ppm (part per million). Some wells in the upland areas have been reported to be dry in the summer. Some wells are polluted. Two wells sampled contained more than 45 ppm of nitrate. Water containing more than about 45 ppm of nitrate may cause a type of methemoglobinemia in infants (blue baby disease), sometimes fatal, and should not be used in infants' formulas.
TERTIARY	Pliocene(?)						
TERTIARY	Eocene, Lutetian (estimated)		Sand and clay	0–20'±	White to red clay and sand, generally clayey; cemented zones common.	Underlies Pliocene(?) gravel and overlies the Porters Creek Clay in the southwestern quarter of the quadrangle. The deposit is thin and may be discontinuous in places. Poorly exposed in the upper reaches of West and East Fork Rockhouse Creek near Spring Creek Church and Coles Camp Ground Church, and along U.S. Highway 641 for about 3 miles north of the southern boundary of the quadrangle.	Probably water bearing, but tapped by few wells in this quadrangle. The clay content in the extreme western part of the quadrangle may perch some water.
TERTIARY	Paleocene	Midway	Porters Creek Clay	0–140'	Light- to dark-gray or black, slightly to very micaceous clay. Fine- to medium-grained micaceous sand beds; sometimes glauconitic, present at places in the upper part. About 20 feet of glauconitic sand or clay and black clay at the base.	Underlies Eocene sediments in the southwestern quarter of the quadrangle and Pliocene(?) gravel in much of the remainder of the area. Exposed in creek beds and road cuts east of Clarks River and underlies the alluvial terraces in parts of the quadrangle. Underlies part of Clarks River south of Almo and is poorly exposed for about 3 miles on the east side of Clarks River north of the southern boundary of the quadrangle.	Generally not an aquifer, although the sand beds in the upper and lower parts may yield water to a few wells. The clay perches water in the overlying Pliocene(?) gravel and is the upper barrier to movement of water in the underlying McNairy Formation.
CRETACEOUS	Upper Cretaceous		McNairy Formation[2]	250–300'	Fine- to medium-grained commonly micaceous sand. In the upper part of the formation, the sand generally is interlaminated with dark-gray to black, commonly lignitic clay. Thicker sand beds generally are in the lower part of the formation.	Underlies the Porters Creek Clay west of Clarks River and for about 3 miles from Almo to the southern boundary of the quadrangle east of Clarks River. Exposed in creek beds and road cuts east of Clarks River.	Supplies adequate water for domestic and commercial uses. Most domestic wells penetrate the upper part of the formation. Some wells east of Clarks River obtain water perched above clay beds within the formation. Deeper wells throughout the quadrangle could yield large amounts of water for industrial or public supply. Wells furnished near the contact with the Porters Creek Clay usually yield water with a high iron content. In general, the iron content of water from the McNairy Formation is low. The water is generally slightly acidic, moderately hard, and commonly contains more iron than 0.3 ppm. An iron content of more than 0.3 ppm imparts a disagreeable taste to water and may cause staining of clothing and utensils.
CRETACEOUS	Upper Cretaceous		Tuscaloosa Formation	0–50'	Rounded chert gravel in a micaceous sand or clay matrix.	Not exposed. Present discontinuously farther east below the McNairy Formation and above the Paleozoic rocks. May be absent or thin in this quadrangle.	Water bearing, but generally not a good aquifer because of the poor sorting and high clay content.
DEVONIAN			Devonian rocks (undifferentiated)	200–1000'±	Chert and limestone, commonly weathered near the top, grading downward into massive chert and limestone beds. The Devonian-Silurian contact is about 350 feet below sea level along the southwest corner of the quadrangle.	Not exposed. Present beneath the McNairy or Tuscaloosa Formations throughout the quadrangle. Thins along the line of generalized geologic section (fig. 3) from about 1000 feet in the northeast to about 200 feet in the southwest, mainly owing to erosion.	Not penetrated by wells in this quadrangle, but the Paleozoic bedrock yields water to wells in other areas of the Jackson Purchase, where large yields of good-quality water are obtained from the weathered zone at the top of the Paleozoic rocks or from openings deeper in the Paleozoic limestone.

[1]Age undetermined. Estimates of age range from Pliocene or older to Pleistocene

[2]May contain beds of Clayton age at the top

EXPLANATION

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

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

Base by Tennessee Valley Authority and U.S. Geological Survey, 1955

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 R. W. Davis, 1962

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1964

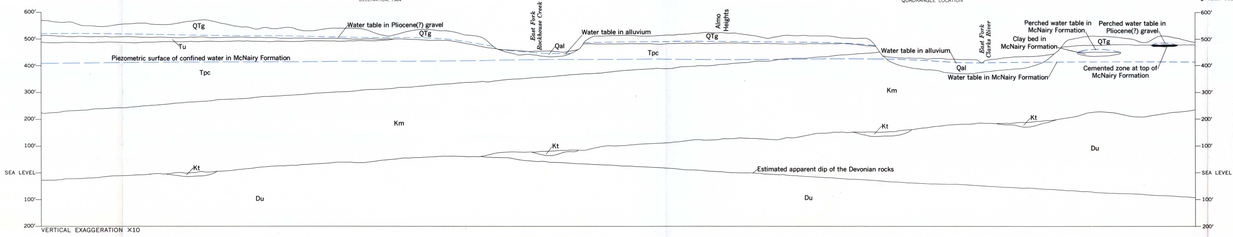
SCALE 1:24 000

1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION



SECTION EXPLANATION

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

FIGURE 3.—GENERALIZED GEOLOGIC SECTION ALONG A NORTHEAST-TRENDING LINE FROM 1½ MILES NORTH OF PENNY TO 1 MILE SOUTH OF BROOKS CHAPEL SCHOOL

EXPLANATION

The water-availability areas on this map show the occurrence and availability of ground water in the shallowest aquifer that may 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

Large-diameter wells in the valleys of Clarks River and the lower reach of Rockhouse Creek yield an adequate supply of water for domestic use at most places. In other parts of area 1 the water levels fluctuate greatly and some wells may become dry in the summer. If the alluvium is dry or yields only small amounts of water, wells may be deepened to obtain water from the McNairy Formation. The depth of the McNairy is greater in the western part of the quadrangle, as shown in figure 3

QTg

AREA 2
Water in Pliocene(?) gravel

Furnishes sufficient water for an adequate domestic supply to large-diameter wells as deep as 70 feet; however, most wells obtaining water from the gravel are from 30 to 50 feet deep. Wells in area 2 adjacent to area 1 may not yield an adequate domestic supply. However, if the saturated gravel is thin or yields only small amounts of water, large-diameter wells may be deepened into the Porters Creek Clay to provide additional storage. Wells deepened into the Eocene sediments beneath the gravel in the west may receive additional water from sand beds. If a large supply of water is required in this area, wells should be drilled to the deeper sands of the McNairy Formation. The depth to the McNairy is greatest in the western part of the quadrangle, as shown in figure 3

Tu

AREA 3
Water in Eocene sand

Large-diameter wells apparently obtain a sufficient supply of water for domestic use from Eocene sand in two small unconnected areas. The Eocene sediments may be water bearing below the Pliocene(?) gravel in the west, but at present the sediments are not known to be tapped by wells in this area. Many of the Eocene deposits in the quadrangle are thin, cemented, or very clayey and generally not an aquifer

Tpc

AREA 4
Water in Porters Creek Clay

The Porters Creek Clay is generally not water bearing, although sand beds near the top and at the base of the formation may yield a small amount of water to some wells. Area 4, in general, is the outcrop area of the Porters Creek Clay. The outcrops are concealed, except in excavations and creek beds, by gravel and clay washed down the hillsides (colluvial deposits). The gravel in the colluvial deposits may yield an adequate supply of water to large-diameter wells if sufficient storage capacity is provided, but generally adequate supplies must be obtained from the sand in the deeper McNairy Formation. The depth to the McNairy is greatest in the western part of the quadrangle, as shown in Figure 3

Kmp

AREA 5
Perched water in the McNairy Formation

Large-diameter wells may yield adequate domestic supplies from water-bearing sands above clays in the McNairy Formation at altitudes above the main zone of saturation. If the water in the perched zone is thin or yields only small amounts of water, wells may be deepened to obtain water from the main zone of saturation in the McNairy. The water table in the main zone of saturation in area 5 is at an altitude of about 430 feet and the depths of wells tapping this zone will range from about 40 to 120 feet. One well in this area obtains water from a perched zone in the Pliocene(?) gravel. The water is perched either by cemented sand or by clay beds at the gravel-McNairy contact

Km

AREA 6
Water in the main zone of saturation in the McNairy Formation

Large-diameter wells, generally deeper than 100 feet, obtain sufficient water for an adequate domestic supply from sands in the main zone of saturation in the McNairy Formation. Small-diameter drilled wells 150 to 300 feet deep, should be capable of furnishing an adequate domestic supply from deeper sands in the McNairy. Properly constructed drilled wells, 300 to 500 feet deep, should be capable of supplying at least 200 gallons per minute from the McNairy Formation.

Some large-diameter wells in area 6 obtain water from perched water zones in the McNairy or from perched water zones in the Pliocene(?) gravel, generally at the gravel-McNairy contact. Locations of perched zones are difficult to predict. Wells tapping them are capable of supplying sufficient water for some domestic uses, but are either marginal or not capable of furnishing an adequate domestic supply as defined in this report

Area boundary

°45 Test hole
Figure below line is depth of hole

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

Spring

Km—80 (P) 87
Aquifer (see below)
Water level in well, in feet below land surface; r if reported
Yield, in gallons per minute, or adequacy (see below)
Depth of well, in feet below land surface

AQUIFER SYMBOLS

Qal.....Alluvium of Quaternary age
QTg.....Gravel of Pliocene(?) age
QTgp.....Perched water in gravel of Pliocene(?) age
Tu.....Sand of Eocene age
Km.....Sand in the McNairy Formation of Cretaceous age
Kmp.....Perched water in the McNairy Formation of Cretaceous age

YIELD OR ADEQUACY

(5).....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 bucket
(N).....Well reported not adequate
(X).....No yield data available

500 Water level contour
Shows altitude of the water level in gravel of Pliocene(?) age. Contour interval 10 feet; datum is mean sea level. Water-level measurements made in August 1962

QUALITY

Cl, F & NO_3; Na & K; SO_4; Mg; 11; 28; Ca; HCO_3; 25

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; 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 only approximate values. Areas of the segments of each circle 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 DEXTER QUADRANGLE, KENTUCKY

Sufficient supplies of ground water for both domestic and commercial uses are available in the area of the Dexter quadrangle. This atlas presents nontechnical information about ground water in an area just north of Murray, Kentucky, for use by well drillers, landowners, and others.

The most extensive body of ground water in the area is in the sands of the McNairy Formation. The McNairy is at or near the land surface east of Clarks River. The formation dips westward and its top is as much as 350 feet below land surface near Penny. A second large body of ground water is in the Pliocene(?) gravel where it overlies the nearly impermeable Porters Creek Clay. This body of water, mostly west of Clarks River, is the most used aquifer in the quadrangle. Some shallow water is obtained from other deposits, as shown by the water-availability map (fig.1). This map presents information on the occurrence of the shallowest ground water that may yield an adequate supply for domestic use.

The availability of ground water at a particular location may be determined by the area pattern on the map at this location. The map explanation and columnar section briefly describe the water-yielding qualities of the formation. Chemical analyses of water from nearby wells are represented on the map by circular diagrams. The approximate depth to water in areas 2 and 3 can be calculated by subtracting the altitude of the water level (as shown by the water-level contours) from the altitude of the land surface. In the other availability areas, depths of nearby wells indicate the approximate depth necessary for a well in the shallowest aquifer. In area 6, the altitude of the surface of the main zone of saturation (the water table) slopes generally northward from about 440 feet in the south to about 410 feet in the north; however, perched water zones may be present at higher altitudes than the main zone of saturation.

The aquifers in the Dexter quadrangle area are capable of providing ground water for commercial and public supplies as well as for the expanding domestic needs. One well presently produces 320 gpm (gallons per minute) from the McNairy Formation. This formation is capable of producing at least 100 gpm throughout the quadrangle. A public-supply well at Murray, about a mile south of the Dexter quadrangle, yields 1,145 gpm from sands in the McNairy Formation.

Increasing urbanization in the southern part of the quadrangle near Murray and along U.S. Highway 641 may cause pollution of the shallow aquifers, and many home owners may need to drill wells to the deeper McNairy Formation to obtain safe water. Safe water may be supplied more economically to this area of urban growth by public water districts obtaining water from deep wells in the McNairy or by extension of the present water system of the town of Murray than by individual wells.

The chemical quality of ground water in the quadrangle is generally good. Analyses show that most of the water from the Pliocene(?) gravel is from 59° to 61°F., is slightly acidic, is soft, and has an iron content generally less than 0.3 part per million. Water from the McNairy Formation is about 60° to 62°F., is generally slightly acidic, is moderately hard, and commonly contains more iron than 0.3 part per million.

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	0.15	0.01	3.4	0.28	0.12	0.06	10	0.08	0.06	0.04
pH	5.6	—	6.4	5.2	6.3	5.9	6.1	5.9	6.6	5.6

Analysis number	11	12	13	14	15	16	17	18	19	20
Iron content	2.2	0.78	0.34	0.10	0.13	0.17	0.17	0.12	8.3	15
pH	7.0	6.2	5.9	5.8	6.3	6.2	7.1	6.1	7.8	6.1

Analysis number	21	22	23	24	25
Iron content	0.55	0.08	0.21	0.08	0.23
pH	6.9	5.9	6.5	6.8	6.3

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AVAILABILITY OF GROUND WATER IN THE DEXTER QUADRANGLE, KENTUCKY

By
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1964

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