PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY, UNIVERSITY OF KENTUCKY
KENTUCKY GEOLOGICAL SURVEY
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SYSTEM	SERIES	GROUP	FORMATION	SECTION	THICKNESS, IN FEET	LITHOLOGY	TOPOGRAPHY AND GEOLOGIC SETTING	HYDROLOGY
QUATERNARY	Pleistocene and Recent		Alluvium		0–78′+	Clayey gray silt and clayey brown, gray, or red sand with lenses of chert gravel. Near outcrop of the Fort Payne Formation, the alluvium contains white chert pebbles derived from the Fort Payne.	Thickest deposits in Blood River and Wildcat Creek near Kentucky Lake. Up to 15 feet in small tributaries.	Water perched above cemented material or clay furnishes small supplies for domestic uses to large-diameter wells. The occurrence of perched water in the alluvium of the tributaries of the major streams is unpredictable. Wells in Blood River and some areas of Wildcat Creek should yield a perennial supply of water.
QUATERNARY	Pleistocene		Loess		0–12′	Tan to gray unstratified silt.	Windblown deposits on tops of ridges and uplands. Thickest on lower slopes near streams.	Not an aquifer. When saturated, transmits water to underlying units.
QUATERNARY / TERTIARY	Pleistocene / Pliocene(?)		Gravel and sand [1]		0–75′+	Subangular to well-rounded red to brown pebbles, cobbles, and boulders and very fine to very coarse red to brown sand.	Underlies loess in uplands and terrace slopes. Thickest deposits are in the upland along the west edge of the quadrangle.	Water perched either above the Porters Creek Clay near Lawrence Branch or above clays in the McNairy Formation near New Providence. Seep springs are found at the contact of the Porters Creek. Most wells are not in use. Some wells yield up to 500 gallons per day, but they are inadequate during droughts. One water sample has a nitrate content of 82 ppm (parts per million). Water containing more than 45 ppm of nitrate may cause methemoglobinemia ("blue baby" disease) in infants, sometimes fatal, and should not be used in infants' formulas.
TERTIARY	Paleocene	Midway	Porters Creek Clay		0–30′	Slightly micaceous gray clay; a thin glauconitic zone at the base.	Occurs only in the extreme southwesten part of the quadrangle between Lawrence Branch and McCullough Fork.	Not significant as an aquifer.
CRETACEOUS	Upper Cretaceous		McNairy Formation [2]		0–300′±	Very fine to very coarse, clayey, micaceous sand with locally abundant heavy minerals and plastic, white to black lignitic clay with thin seams of micaceous fine-grained sand. Subrounded white chert pebbles in sand matrix are commonly present near base of formation.	Present beneath deposits of Pliocene(?) gravel; crops out along hillsides in the dissected area.	Yields a plentiful supply of water to small-diameter drilled wells and most large-diameter dug or bored wells. Properly constructed drilled wells should yield as much as 500 gallons per minute in the western part of availability area 5. Shallow water-bearing zones are perched above clay or clayey sand and some wells tapping these zones may yield as much as 5 gpm. The occurrence of the perched zones is unpredictable. Water is generaly soft, but may contain more than 0.3 ppm of iron. Iron in excess of this amount may cause staining of porcelain and textiles. One water sample from a dug well has a nitrate content of 71 ppm.
CRETACEOUS	Upper Cretaceous		Tuscaloosa Formation		?	White rounded chert pebbles and cobbles in tripolitic matrix.	Not known in outcrop, but may be present in the subsurface as remnants in depressions in Paleozoic rocks.	Not significant as an aquifer.
MISSISSIPPIAN	Lower Mississippian		Fort Payne Formation		0–150′	All rocks below the Cretaceous are of Paleozoic age and are the "bed-rock" of drillers. Rubble composed of angular weathered blocks of chert in a matrix of tripolitic material. Grades downward into black to dark-gray limestone and black, brown, or grayish-green shale at base.	The Paleozoic rocks, broken by faults, are consolidated marine deposits mostly concealed by the Cretaceous sediments. The Fort Payne Formation is exposed along Kentucky Lake.	Probably will yield large quantities of water from the gravel-like chert rubble, and from crevices in the limestone. Some crevices near Kentucky Lake may be hydrologically connected with the lake. The quality of water is suitable for most uses, but iron is present in excess of 0.3 ppm. The water from the chert rubble is soft and low in dissolved solids, while that from limestone is usually harder and higher in dissolved solids. Hydrogen sulfide may be present in minor amounts.
DEVONIAN			Chattanooga Shale		0–110′	Black micaceous, carbonaceous fissile shale. Where shale is beneath the Cretaceous sediments, it may be highly weathered and resemble the clay of the Cretaceous.	Present at depth throughout the area. In the western part of the quadrangle, the shale was eroded before the Cretaceous sediments were deposited. Overlain either by the Cretaceous sediments or the Fort Payne Formation.	Yields little or no water. Formation confines water in the underlying rocks and retards the downward movement of water in the overlying Fort Payne Formation.
DEVONIAN			Devonian rocks (undifferentiated)		1000′±	White to brown cherty limestone and chert. Limestone may be finely to coarsely crystalline, and may contain silty or siliceous zones. Thin to thick beds of chert are common.	Present at depth throughout the quadrangle. Overlain by the Cretaceous deposits along the west edge of the area. Underlies the Chattanooga Shale throughout the remaining area.	Wells in other quadrangle tapping rocks below the Chattanooga Shale furnish sufficient water for domestic use. The water may be hard and contain an objectionable amount of iron. Hydrogen sulfide may be present in minor amounts. Salt water is reported in a 1,059-foot oil-test hole near Blood River from 600 feet below the Chattanooga Shale.

[1] Age undetermined. Estimated age ranges from Pliocene or older to Pleistocene.

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

EXPLANATION

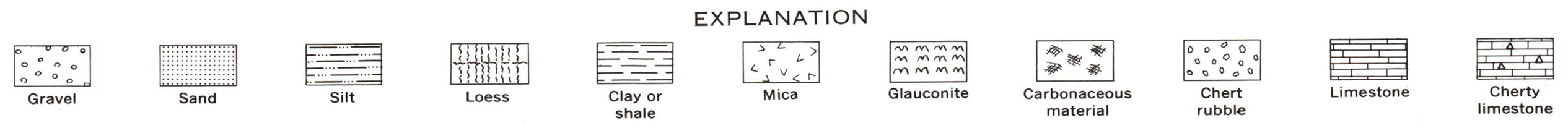
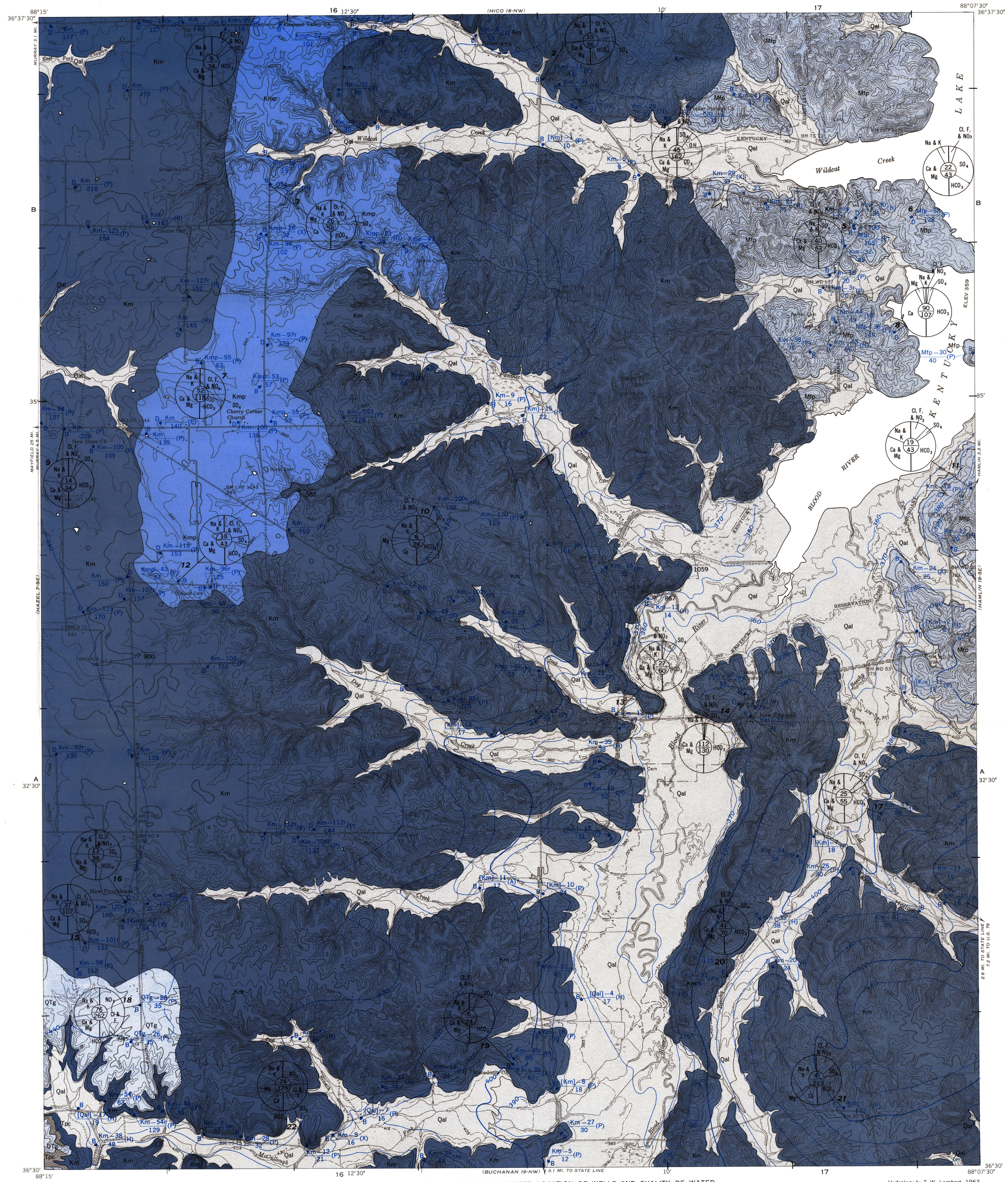


FIGURE 2.—GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF THE GEOLOGIC FORMATIONS



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

TRUE NORTH
MAGNETIC NORTH
4½°
APPROXIMATE MEAN DECLINATION, 1964

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

SCALE 1:24 000

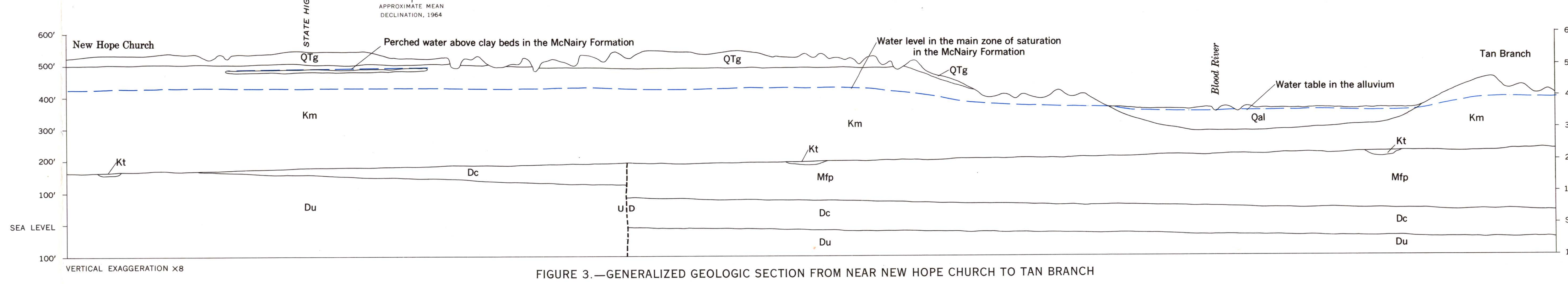
1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

KENTUCKY
QUADRANGLE LOCATION

Hydrology by T. W. Lambert, 1963



VERTICAL EXAGGERATION X8

FIGURE 3.—GENERALIZED GEOLOGIC SECTION FROM NEAR NEW HOPE CHURCH TO TAN BRANCH

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 geologic and water-bearing properties are described in the generalized columnar section, figure 2

Qal

AREA 1
Water in Quaternary alluvium

The known wells in the alluvium are in the tributaries of Blood River and Wildcat Creek. Most of the wells obtain water perched above alluvial or Cretaceous clays at depths generally less than 20 feet. Most wells in the perched water bodies will yield up to 500 gallons per day. Many wells in this area penetrate through the alluvium into the underlying McNairy Formation and yield more than 500 gallons per day

QTg

AREA 2
Water in the Pliocene(?) gravel

The main area of water-bearing Pliocene (?) gravel is southwest of New Providence. Most wells in this area have a maximum depth of about 35 feet and can be pumped dry, but generally will yield between 100 and 500 gallons per day. During droughts the wells that are perched above clay in the McNairy Formation may not furnish sufficient water for domestic use. Between Lawrence Branch and McCullough Fork, the water-bearing Pliocene (?) gravel is perched above the Porters Creek Clay and numerous small springs are found at the contact. If sufficient water is not found in the gravel above the Porters Creek, wells must penetrate the Porters Creek into the underlying McNairy Formation. One well, north of Cherry Corner, is perched above cemented sand in the McNairy Formation. The quality of water in the gravel generally is good, but the sample of water collected has a nitrate content higher than the local average

Tpc

AREA 3
Water in the Porters Creek Clay

The Porters Creek Clay in the quadrangle is not water bearing. Sufficient water may be obtained in the McNairy Formation at depths in excess of 30 feet

Kmp

AREA 4
Perched water in the McNairy Formation

Perched water in the McNairy Formation occurs between Cherry Corner and the head of Wildcat Creek. The water is perched on top of discontinuous clays in the McNairy Formation, and therefore may not be present throughout this availability area. The wells, 32 to 64 feet deep, yield sufficient water for domestic uses, but several unused wells are inadequate for a hand-drawn bucket supply. One well in this area obtains water that is perched in the Pliocene (?) gravel above cemented sand of the McNairy Formation. The quality of the water perched in the McNairy generally is good and low in dissolved solids. If inadequate water is found in the perched zone, wells may be deepened into the main zone of saturation of the McNairy Formation

Km

AREA 5
Water in the main zone of saturation in the McNairy Formation

The McNairy Formation yields sufficient water for domestic uses to all drilled wells and most large-diameter wells. The drilled wells range from 95 to 226 feet in depth, and properly constructed wells should yield as much as 500 gallons per minute in the western part of this area. A few large-diameter wells in the upland areas tap water at depths of more than 100 feet, but most are less than 50 feet. Many of the large-diameter wells tap widely scattered perched zones in the McNairy. The water generally is of good quality, but iron may be present in objectionable amounts. A well at New Concord elementary school taps the Fort Payne Formation for its water supply. If larger yields are required in the eastern part of area 5, wells may be deepened into the underlying Fort Payne Formation.

Mfp

AREA 6
Water in the McNairy Formation and in the Fort Payne Formation

The McNairy Formation yields sufficient water for domestic uses to about three-fourths of the large-diameter wells in this area. The depths of the large-diameter wells range from 20 to 66 feet. One drilled well, 127 feet deep, in the McNairy Formation was abandoned as a dry hole near Wildcat Creek. To obtain a larger supply, water must be found in the Fort Payne Formation. Three drilled wells, 128, 149, and 165 feet deep, tap the Fort Payne, and two of these wells supply sufficient water to lake-side subdivisions. Water from the Fort Payne and McNairy generally is good, but iron present in objectionable amounts in the Fort Payne may cause staining of porcelain and textiles

Area boundary

○ 75
Test hole
Figure below line is depth of test hole

1059
Oil-test hole
Figure below line is depth of well

● D
Water well

D, *Drilled or jetted well; generally 4-inch steel or plastic casing with a screen on the lower end.*
B, *Bored or dug well; generally 24-inch concrete tile casing open at bottom*

Mfp—58 (P) / 128
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 and sand of Pliocene(?) age
Kmp .... Perched water in the McNairy Formation of Cretaceous age
Km .... McNairy Formation of Cretaceous age
Mfp .... Fort Payne Formation of Mississippian age
[ ] .... Brackets indicate probable aquifers where not definitely known

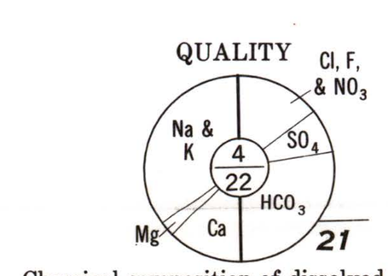
YIELD OR ADEQUACY

(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
(A) .... Well abandoned or destroyed

——400——?
Water-level contour

Shows altitude of water level in the main zone of saturation. Depth to water is difference between altitude of water-level contour and land surface. Contour interval 10 feet; datum is mean sea level; queried where indefinite. Water measurments made in October, 1962

QUALITY



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 180 ppm or more, very hard. Dissolved solids in partial analysis are computed from specific conductances 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 analysis. Nitrate is shown separately if present in amounts greater than 45 ppm. Analysis 4 contains carbonate (CO_3) and hydroxide (OH)

SECTION EXPLANATION

Qal ...... Alluvium of Quaternary age
QTg ...... Gravel and sand of Pliocene(?) age
Km ...... McNairy Formation of Cretaceous age
Kt ...... Tuscaloosa Formation of Cretaceous age
Mfp ...... Fort Payne Formation of Mississippian age
Dc ...... Chattanooga Shale of Devonian age
Du ...... Devonian rocks, undifferentiated

U/D
Inferred fault
U, *upthrown side;* D, *downthrown side*

AVAILABILITY OF GROUND WATER IN THE NEW CONCORD QUADRANGLE, KENTUCKY

Large undeveloped supplies of ground water for domestic and commercial uses are available in the area of the New Concord quadrangle. This atlas, one of a series that includes the entire Jackson Purchase region, presents non-technical data about ground water in the area east of Murray, Kentucky, for the use of well drillers, landowners, and others.

The water-availability map (fig. 1) is a graphic representation of the occurrence and quality of water in the shallowest aquifer that may yield water in adequate amounts for domestic use. The availability of ground water at a particular site may be determined by study of the availability pattern and the data on nearby wells, which show the source of the shallowest ground water at this site. Chemical constituents of the water from nearby wells are shown by circular diagrams; pH and iron content are listed at the end of the text.

The most extensive body of ground water in this quadrangle is in the sand of the McNairy Formation. The McNairy is at or near the surface throughout most of the quadrangle. The formation dips westward and is about 300 feet thick along the western edge of the area. The altitude of the surface of the main zone of saturation or water table slopes eastward from about 440 feet at New Providence to about 360 feet near Kentucky Lake. Properly constructed drilled wells in the McNairy Formation in the western half of the area may yield large amounts of water. All wells currently in use are for domestic supplies. City wells in Murray, 2 miles west of this area, yield about 1,100 gpm (gallons per minute).

Discontinuous clay or sandy clay beds above the main zone of saturation retard the downward movement of water and form water bodies on top of the clay. These water bodies are known as perched water and usually will furnish sufficient water for domestic use. Many perched zones are small, but one major perched zone in the western part of the quadrangle is tapped by wells which probably will yield as much as 5 gpm. A test hole south of Wildcat Creek indicated that there may be several perched zones at this site.

A second important ground-water body is in the Fort Payne Formation of Mississippian age. A chert rubble, which was formed over much of the surface of the limestone by pre-Cretaceous weathering, is generally an excellent aquifer and hydrologically resembles a gravel. Drilled wells in the Fort Payne Formation yield sufficient water to two lakeside subdivisions and a local elementary school. Wells that are completed in the limestone may range in yield from a few gallons per minute to a few hundred gallons per minute. Some wells in the chert rubble might yield as much as 100 gpm.

In adjacent quadrangles, rocks older than the Chattanooga Shale of Devonian age yield sufficient water for domestic purposes. Wells drilled into these rocks in the valley of Blood River may flow or have a water level near the land surface.

Small supplies of ground water are obtained also from the alluvium and from the Pliocene(?) gravel. Yields of these wells are small and may be affected by droughts.

The quality of water from the McNairy Formation is excellent for most uses, although slightly acidic. Most samples contain less than 0.3 ppm (parts per million) of iron, the maximum amount recommended by the Public Health Service for drinking water on interstate carriers. The concentration of dissolved solids is generally less than 100 ppm. Nitrate appreciably higher than the local average may suggest pollution. The water from two wells has a high nitrate content.

The hardness of the water from the Fort Payne Formation ranges from soft to hard. Generally the water from the chert rubble is soft and low in dissolved solids, while that from the limestone is usually harder and higher in dissolved solids. Water from the limestone may contain hydrogen sulfide in minor amounts.

No water wells are drilled below the Chattanooga Shale in the New Concord quadrangle, but wells in nearby quadrangles obtain water of good quality from the pre-Chattanooga rocks. One oil-test hole encountered salt water 600 feet below the Chattanooga.

Analysis 4 shows that a new large-diameter well cased with concrete tile may have an excessively high pH and hydroxide alkalinity.

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 alkalinity; values lower than 7.0 indicate acidity. Corrosiveness of water generally increases with decreasing pH.

Analysis number	1	2	3	4	5	6	7	8	9	10	11
Iron content	0.24	0.06	0.02	0.17	0.24	0.70	0.15	0.80	0.58	0.09	0.08
pH	5.8	5.9	6.1	10.7	—	5.9	6.6	7.2	6.2	5.7	5.9

Analysis number	12	13	14	15	16	17	18	19	20	21	22
Iron content	0.13	0.01	0.39	0.18	1.3	0.40	0.02	0.02	0.03	0.04	0.26
pH	6.8	—	—	5.8	—	6.2	6.6	5.6	6.6	5.7	5.9

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AVAILABILITY OF GROUND WATER IN THE NEW CONCORD QUADRANGLE, KENTUCKY

By
T. W. Lambert

1964

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