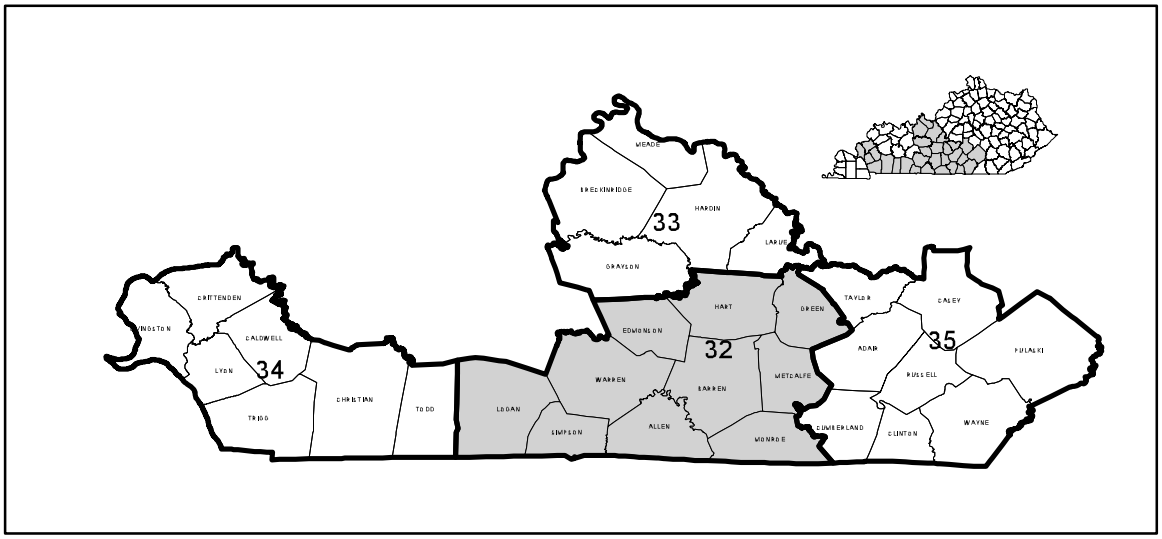
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF KENTUCKY
AND THE KENTUCKY GEOLOGICAL SURVEY
UNIVERSITY OF KENTUCKY

AVAILABILITY OF GROUND WATER IN ALLEN, BARREN, EDMONSON, GREEN, HART, LOGAN, METCALFE, MONROE, SIMPSON, AND WARREN COUNTIES, KENTUCKY

By
R.F. Brown and T.W. Lambert

HYDROLOGIC INVESTIGATIONS
ATLAS HA-32



INDEX MAP OF THE MISSISSIPPIAN PLATEAU REGION, KENTUCKY, SHOWING COUNTY GROUPS AND AREA OF THIS ATLAS

This is 1 of 4 atlases (HA-32 to HA-35) showing geology and availability of ground water in the Mississippian Plateau region, Kentucky U.S. Geological Survey Water-Supply Paper 1603 contains a text description and illustrations providing further information on the occurrence and quality of ground water in the Mississippian Plateau region.

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AND THE KENTUCKY GEOLOGICAL SURVEY, UNIVERSITY OF KENTUCKY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-32 (SHEET 1 OF 3)

EXPLANATION

- Qal — Alluvium
- P — Pennsylvanian rocks
- Mc — Chester rocks
- Mm — Meramec rocks
- Mo — Osage rocks

MISSISSIPPIAN — CARBONIFEROUS

- D — Devonian rocks
- S — Silurian rocks
- O — Ordovician rocks

Contact

Fault

Dashed where approximately located; dotted where concealed

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1962

ADAPTED FROM THE FOLLOWING GEOLOGIC MAPS

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Butts, Charles, 1919, Geologic map of Barren County, Kentucky: Kentucky Geol. Survey, ser. 5, v. 1. Scale, 1:112,000.

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Base maps are county highway maps and adjacent county groups may not match

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SCALE 1:250 000

4 0 4 8 12 MILES

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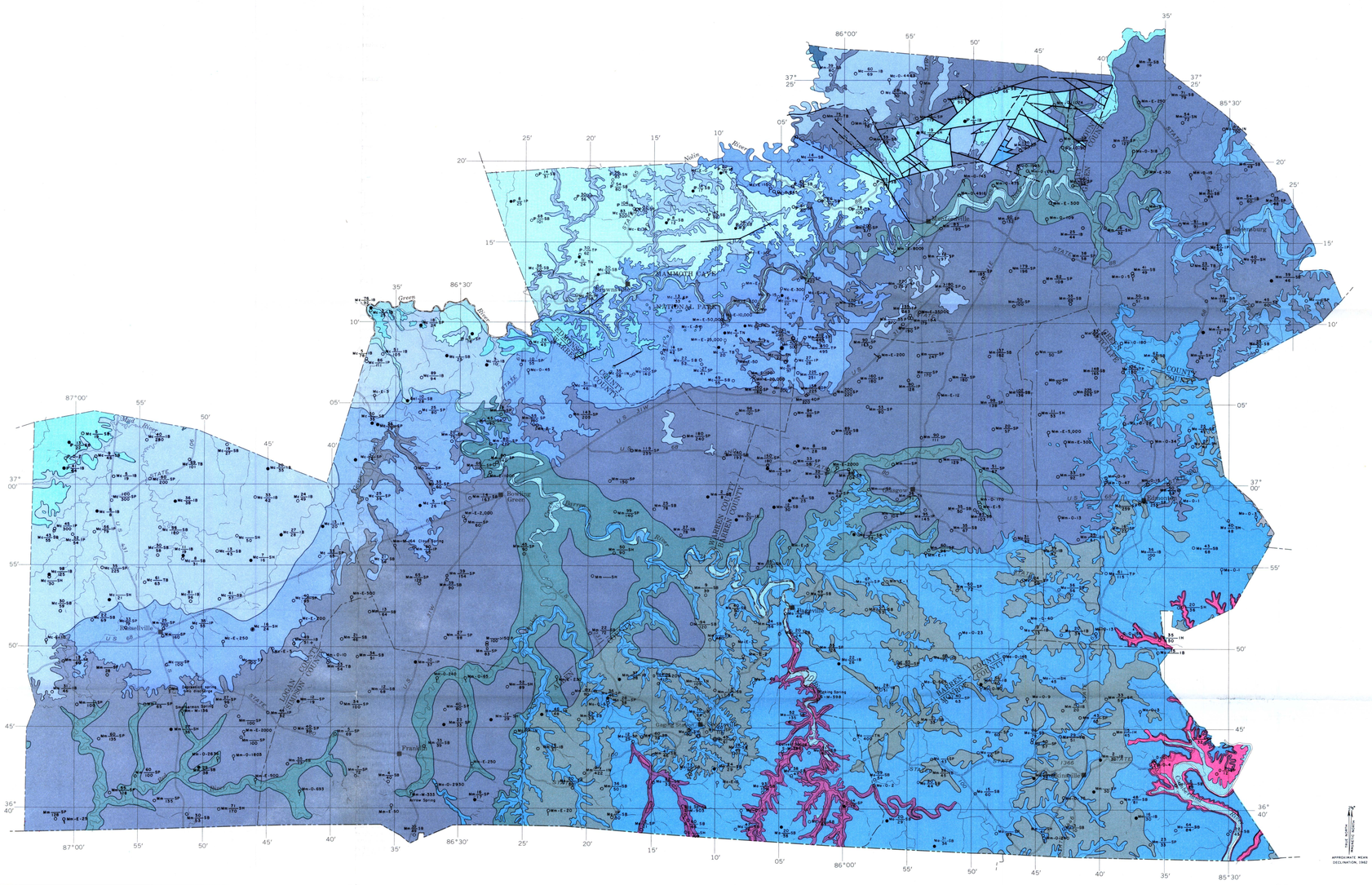

Base maps are county highway maps and adjacent county groups may not match

WATER-BEARING FORMATION

Qal	Quaternary alluvium	
P	Pennsylvanian age	MISSISSIPPIAN CARBONIFEROUS
Mc	Chester age	
Mm	Meramec age	
Mo	Osage age	
D	Devonian age	
S	Silurian age	
O	Ordovician age	

Contact

Fault
Dashed where approximately located; dotted where concealed

Water in Recent and Pleistocene alluvium

Some water is obtained from fine sand, silt, and clay, but most wells drilled in these materials are inadequate for a domestic supply with bucket or bailer. Coarse sand and gravel may be encountered in the alluvium where rocks of Pennsylvanian age are close to streams. Wells penetrating these deposits yield as much as about 50 gpm (gallons per minute).
Most dug wells yield less than 100 gpd (gallons per day) and are inadequate for a domestic supply with bucket or bailer.

Water in rocks of Pennsylvanian age

Nearly all drilled wells in the upland are inadequate for power pumps (less than 500 gpd). About half the wells in the upland do not yield enough water for a domestic supply with bailer or bucket (less than 100 gpd). Drilled wells in lowland areas bordering streams generally yield enough water for a domestic supply with bailer or bucket, and a few yield enough for power pumps (more than 500 gpd).
Dug wells in lowland areas bordering streams yield enough water for a domestic supply with bailer or bucket (more than 500 gpd) if adequate storage is provided for peak needs. Very few dug wells are adequate for a domestic supply with power pump.

Water in rocks of Pennsylvanian age

Less than half the drilled wells in this area yield enough water for a domestic supply with power pump (more than 500 gpd), but most are adequate for a domestic supply with bailer or bucket (more than 100 gpd).
Dug wells in lowland areas bordering streams yield enough water for a domestic supply with bailer or bucket (more than 100 gpd) if adequate storage is provided for peak needs. Very few dug wells are adequate for a domestic supply with power pump.

Water in Mississippian rocks of Chester age

Most drilled wells are adequate for a domestic supply with power pump (more than 500 gpd). Adequate wells are as deep as 500 feet. Yields of as much as 50 gpm are obtained from wells that penetrate large solution channels in the limestone of the Girkin formation. Nearly all wells are adequate for a domestic supply with bailer or bucket (more than 100 gpd).
Most dug wells in which water level is close to perennial stream level are adequate for bailer or bucket more than 100 gpd), and many are adequate for a domestic supply with power pump (more than 500 gpd). Dug wells in the Big Clifty sandstone, on the Mammoth Cave Plateau, are generally adequate for a domestic supply with bailer or bucket (more than 100 gpd) and yield enough water for a domestic supply with power pump (more than 500 gpd) where the saturated thickness is large.

APPROXIMATE MEAN DECLINATION, 1962

EXPLANATION

A spring horizon is present at the shale-limestone contact of the Hardinsburg sandstone and the Glen Dean limestone, and a second conspicuous horizon occurs at the base of the Big Clifty sandstone. Flows are as much as 100 gpm. Seepage springs occur at other horizons, but most are seasonal.
A few large springs occur near the Chester-Meramec contact. The lower Chester limestone is lithologically similar to the Meramec, and solution openings are well formed in places. Flows are as much as 1,000 gpm.

Water in Mississippian rocks of Chester age

More than half the drilled wells are inadequate for a domestic supply with bucket or bailer (less than 100 gpd). A few wells yield enough for a domestic supply with power pump (more than 500 gpd) from depths of 150 feet or more. Most shallow drilled wells are inadequate for a domestic supply (less than 100 gpd).
Most dug wells are inadequate for a domestic supply (less than 100 gpd). An adequate domestic supply with bucket or bailer may be obtained in some places close to streams if water bodies in sandstone formations are intercepted. Most wells in the Leitchfield formation are inadequate for domestic use (less than 100 gpd).
A minor spring horizon is present at the base of the Big Clifty sandstone and at the contact of the Hardinsburg sandstone and the Glen Dean limestone. Flows are as much as 50 gpm. Seepage springs occur at other horizons but most are seasonal.

Water in Mississippian rocks of Meramec age

More than three-fourths of the drilled wells in this area yield enough water for a domestic supply with a power pump (more than 500 gpd). Very few wells are inadequate for domestic use (less than 100 gpd). Wells that penetrate large solution channels in limestone yield more than 5 gpm, and some yield more than 50 gpm.
Dug wells are inadequate for a domestic supply (less than 100 gpd) except where water levels are close to perennial streams levels.
Springs are present where there are minor surface streams. Flows are as much as 500 gpm. Many of the springs are of the depression type and yield more than 100 gpm when pumped.

Water in Mississippian rocks of Meramec age

Springs with low flows ranging from less than 10 gpm to about 1,500 gpm occur at or near stream level. Maximum flows range from less than 100 gpm to more than 100,000 gpm. Minimum flows generally occur in early fall, maximum flows in late winter. A few drilled wells in this area that intercept major solution openings in limestone yield as much as the flow of the springs from these openings, but most wells are inadequate for domestic use (less than 100 gpd).
Dug wells are inadequate for a domestic supply (less than 100 gpd) except in lowland areas bordering streams.

Water in Mississippian rocks of Meramec age

More than half the drilled wells in this area are inadequate for a domestic supply with a bailer and bucket (less than 100 gpd). Very few wells yield enough water for a domestic supply with power pump (more than 500 gpd).
Nearly all dug wells are inadequate for a domestic supply (less than 100 gpd).
Small springs and wet-weather seeps occur near the base of the Warsaw limestone. Flows are as much as 100 gpm, but most are less than 2 gpm.

Water in Mississippian rocks of Osage age

Most drilled wells are adequate for a domestic supply with bailer or bucket (more than 100 gpd). A few wells in lowland areas bordering streams will yield enough for a domestic supply with power pump (more than 500 gpd). Most wells obtain water from fractures and small solution openings in limestone. Where large quantities of shale or siltstone are penetrated, yields will be lower.
Most dug wells in lowland areas bordering streams are adequate for a domestic supply with bailer or bucket (more than 100 gpd).

Water in Mississippian rocks of Osage age

Yields of about half the drilled wells are adequate for a domestic supply with bailer or bucket (more than 100 gpd). A few wells in lowland areas bordering streams yield enough for a domestic supply with power pump (more than 500 gpd). Most wells penetrate perched water bodies of small areal extent in limestone at a shale contact. In some wells water from these perched water bodies migrates below any openings in the wells during rainless periods. These wells are then dry until rainfall reestablishes a perched water body.

Most dug wells obtain water from the contact of mantle and bedrock or from shallow perched water bodies in the bedrock. These wells usually go dry during extended dry periods in late summer and fall.
There are numerous small springs and seeps that discharge from the Osage. Most discharge from small solution openings in limestone and are supported by shale layers. Flows are as much as 20 gpm, but most have minimum flows of less than 1 gpm.

Water in rocks of Mississippian and Devonian age

Nearly all drilled wells in the Chattanooga shale are inadequate for domestic use with bailer or bucket (less than 100 gpd). Where limestone is penetrated, wells may be adequate for domestic use with bucket or bailer (more than 100 gpd) in lowland areas bordering streams.
Nearly all dug wells are inadequate for domestic use with bailer or bucket (less than 100 gpd).
Seepage springs are present along much of the area in which the Chattanooga shale crops out. Flows are generally less than 1 gpm, and most dry up during late summer and fall.

Water in rocks of Silurian age

Drilled wells in lowland areas bordering streams yield enough water for a domestic supply with power pump from large solution channels (more than 500 gpd). Where solution channels are not penetrated at shallow depth, wells will yield sulfurous or saline water. Upland wells that tap water in the Silurian rocks under the Chattanooga shale generally yield brines.
Yields of dug wells are similar to those of drilled wells, but generally are less dependable because of the small saturated thickness.
A major spring horizon is present along Barren River and its tributaries in southern Barren and Allen Counties, where Silurian rocks crop out near stream level. Flows may exceed 20,000 gpm. Variability of flow of most of the springs is relatively slight.

Water in rocks of Ordovician age

Drilled wells in lowland areas near the Cumberland River yield enough water for a domestic supply with a power pump (more than 500 gpd). In tributary valleys, most wells are dry.
Dug wells are generally inadequate for a domestic supply with a bucket or bailer (less than 100 gpd).
Yields from fault zones generally are greater than shown by the availability pattern; however, some wells yield much less than is shown by the pattern.

- Drilled well
- Drilled observation well
- Dug well
- Dug observation well

Mm 25 / 59 — 60 P
- Depth to water below land surface, in feet
- Type of lift
- Yield of well
- Depth of well below land surface, in feet
- Water-bearing formation

TYPE OF LIFT

B	Bailer or bucket
H	Hand force pump
P	Power pump
N	No pump, bucket, or bailer

YIELD

60	Gallons per minute, where known
S	Satisfactory supply for domestic use
I	Inadequate supply for domestic use
T	Yield not determined
SB SH	Minimum yield of well reported 100 gallons per day
SP	Minimum yield of well reported 500 gallons per day
IB IBH IP	Will not yield a minimum supply with type of lift installed

- Spring

Mm-E-3000
- Formation
- Yield
- Method used to determine yield figure

METHOD USED TO DETERMINE YIELD

E	Estimated on basis of one observation
M	Measured with pygmy meter or flume more than one time. Minimum measured flow shown.
O	Measured with pygmy meter or flume one time. Observed measured flow shown

YIELD

5000 Gallons of flow per minute

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4 0 4 8 12 MILES

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SYSTEM	SERIES	FORMATION OR GROUP	THICKNESS (IN FEET)	SECTION	LITHOLOGY	TOPOGRAPHY	WATER-BEARING CHARACTER
QUATERNARY	Pleistocene and Recent	Alluvium	0–120		Silt, clay, gravel, and sand in major stream valleys. Silt, clay, and some sand in tributary valleys.	Forms terraces and flood plains along Green River and tributaries.	Most wells furnish less than 100 gpd (gallons per day), not enough for a bucket or bailer. Coarse sand and gravel may occur in the alluvium where rocks of Pennsylvanian age are close to streams. Wells penetrating these deposits will produce as much as about 50 gpm (gallons per minute).
PENNSYLVANIAN		Caseyville sandstone	0–100		Sandstone, brownish-yellow, fine- to medium-grained; contains sandy shale and coal. Massive basal conglomerate locally present.	Forms dissected uplands and ridgetops near Green River. Occupies channels in Pennsylvanian rocks.	Yields enough water (more than 500 gpd) to wells in lowland areas bordering streams for a domestic supply with a power pump. Wells in upland generally are inadequate (yield less than 100 gpd).
	Chester	Leitchfield[1] / Buffalo Wallow	0–125		Shale, gray or bluish-gray, red and green in places, finely laminated. Includes some thin limestone and sandstone beds. Thickness differs due to pre-Pennsylvanian erosion.	Underlies gently rolling uplands. Forms fairly steep slopes adjacent to stream valleys. Sandstone lenses form small benches in Edmonson and Hart Counties.	Yields almost no water to wells.
		Tar Springs sandstone			Sandstone, brown, massive, shaly in places.	Forms small benches on hillsides.	
		Glen Dean limestone	50–70		Limestone, light- to medium-gray, finely to coarsely crystalline; chert in lower part of the formation; crinoidal to coarsely oolitic in places. Contains medium-gray beds toward the base.	Underlies gently rolling uplands. Forms steep slopes above benches of the underlying sandstone.	Sandstone formations yield enough water for a domestic supply with bucket or bailer (more than 100 gpd) in lowland areas bordering streams and in broad upland areas where there is a substantial saturated thickness in perched water bodies. Deep wells that penetrate the sandstone formations near perennial stream level may produce enough for a domestic supply with a power pump (more than 500 gpd). Close to outcrop areas, particularly near major escarpments, yields from perched water bodies generally are low and not dependable. Minor spring horizons occur on discontinuous layers of shale near the base of the sandstones. The most conspicuous springs are those that discharge from the base of the Big Clifty sandstone. These are the "dripping springs" of the Dripping Springs escarpment. Many of these springs go dry during the late fall and summer, and very few are adequate for a domestic supply with a power pump. Limestone formations yield small to adequate supplies from solution openings. In lowland areas bordering streams, some wells produce enough for a domestic supply with a power pump (more than 500 gpd). Most wells in upland areas are inadequate for a domestic supply with bailer or bucket (less than 100 gpd). Deep wells that penetrate large solution openings in limestone produce more than 5 gpm, but most deep wells are inadequate for a domestic supply with bailer or bucket (less than 100 gpd). Close to outcrop areas, particularly near major escarpments, yields from perched water bodies generally are inadequate during dry periods. Many springs occur at the base of the limestones where they crop out on escarpments and hillsides. Adjacent to large upland areas flows are as much as 1,000 gpm and low flows more than 5 gpm from some springs.
		Hardinsburg sandstone	40±		Sandstone, yellowish-brown, medium-grained, thin-bedded, generally massive; shale near the top of the formation.	Underlies level uplands. Forms small discontinuous benches on hillsides.	
		Haney limestone[2]	40±		Limestone, light-gray, fine to coarsely crystalline; contains a basal shale unit and, in places, shale at the top of the formation.	Underlies gently rolling to flat uplands. Forms bluffs near heads of valleys.	
		Big Clifty sandstone[2]	60–75		Sandstone, yellowish-brown, medium-grained, massive, crossbedded.	Forms a major escarpment, (Dripping Springs escarpment) several hundred feet high. Underlies gently rolling upland.	
		Girken[3]	100–140		Limestone, white to light-gray, sublithographic to coarsely crystalline and oolitic, massive; contains thin shale beds. Where oolite is present, the limestone may be crossbedded.	Forms the lower part of the Dripping Springs escarpment. Contains numerous large sinks into which the overlying sandstone has collapsed. Lower part of formation underlies rolling karst areas near base of escarpment.	
MISSISSIPPIAN	Meramec	Ste. Genevieve limestone	150–200		Limestone, white to bluish-gray, fine to coarsely crystalline, oolitic near the base; contains dark bluish-gray to black chert.	Underlies rolling karst areas. Forms steep bluffs near Green River. Most of the caverns of Mammoth Cave are developed in this formation.	Yields more than 50 gpm to wells from large solution openings in karst areas. Most wells penetrate solution openings, but in areas high above perennial streams, these solution openings are dry in late summer and fall and many wells are inadequate. Contains major caverns of Mammoth Cave area which have large connected subsurface streams. Springs having low flows ranging from less than 10 to about 1,500 gpm occur at or near stream level. Smaller springs discharge from perched water bodies in upland area, but many go dry during late summer and fall.
		St. Louis limestone	300±		Limestone, light-gray to black, fine to coarsely crystalline, dolomitic or argillaceous in places; contains abundant black chert nodules and stringers. May contain small geodes.	Underlies rolling karst areas, but has less relief than karst in the area underlain by the Ste. Genevieve limestone. Forms steep bluffs along Barren River.	Yields more than 50 gpm to wells from large solution openings in karst areas. Most wells penetrate solution openings, but in areas high above perennial streams many wells are inadequate. Yields of wells close to major streams are large where solution openings are penetrated, but most wells near major streams are inadequate (less than 100 gpd). Major spring horizon has many springs flowing several hundred to several thousands of gallons a minute.
		Spergen limestone[4]	50±		Limestone, argillaceous, geodiferous; in places contains a basal unit of black, calcareous, fossiliferous shale.	Underlies gently rolling uplands. Form steep bluffs where the limestones overlie rocks of Osage age. Underlie small areas of karst in upper parts.	Yields enough water for a domestic supply with a power pump where solution openings are penetrated close to perennial stream level. Minor spring horizon in upper part.
		Warsaw limestone	50±		Limestone, light- to dark-gray, granular, to fine-grained, massive, crossbedded, cross-laminated; argillaceous in places. Basal part of formation consists of medium- to dark-gray, brittle, geodiferous siltstone. In places only siltstone is present.		Yields enough water for a domestic supply with bailer or bucket (more than 100 gpd) to most wells. Wells that penetrate large solution openings may produce more than 5 gpm. Minor spring horizon near base at contact zone of limestone and underlying siltstone.
	Osage	Fort Payne chert	100–150		Limestone, gray, coarsely crystalline; contains abundant chert. Geodes are common locally. Formation may be shaly or argillaceous in places.	Underlies rolling dissected uplands. Forms steep valley sides in maturely dissected topography. Small valleys are steep and V-shaped. Siltstone and chert form discontinuous ledges on hillsides.	Yields enough water for a domestic supply with bailer or bucket (more than 100 gpd). Wells in lowland areas close to streams may produce more than 5 gpm from solution openings. Most wells obtain water from perched water bodies supported by discontinuous shale layers and many are dry during late summer and fall. Minor spring horizons occur throughout the formation. Flows are as much as 30 gpm, but most are seasonal. Where shale layers are conspicuous, most wells are inadequate for domestic use (less than 100 gpd). Where chert layers are thick and extensive in area, yields of more than 5 gpm may be obtained.
		New Providence shale	0–30		Shale, greenish-gray, and thin crinoidal limestone beds. Geodes are very common in places.	Forms lower part of steep valley sides and resistant base of small streams. Conspicuous in southern Allen County.	Yields little or no water to wells.
DEVONIAN		Chattanooga shale	25–50		Shale, black, fissile.	Forms lower part of steep valley sides and steep slopes of tributary streams. Resistant layers form small discontinuous ledges and minor waterfalls in streams. In places caps the Louisville limestone and forms small rounded hills.	Yields little or no water to wells. Seepage springs are present at numerous horizons, but most go dry during late summer and fall.
		Sellersburg limestone	8–10				
SILURIAN		Louisville limestone	140–180		Limestone, gray, fine-grained, massive.	Forms steep hillsides and ledges near Cumberland River. Underlies broad flat bottoms; small areas of karst are formed in the upper part of the formation.	Major spring horizon in Allen and Barren Counties. Several springs have low flows of several thousands of gallons a minute. Wells in lowland areas bordering streams that encounter large solution channels yield as much as the flow of some springs. Wells away from streams generally yield sulfurous water or brines.
		Waldron shale	5–10		Shale, greenish-gray, coarse-grained, highly calcareous and magnesian.	Forms moderate to steep slopes near Cumberland River.	Yields little or no water to wells.
		Laurel dolomite	25–40		Limestone, light-gray to bluish-gray, fine-grained, dolomitic, thick-bedded.		Yields small quantities of water to wells near Cumberland River.
		Osgood	20±		Limestone, gray, fine-grained, magnesian. Shale, gray or greenish-gray, calcareous and magnesian in places.		Yields small quantities of water to wells near Cumberland River.
		Brassfield limestone	25±		Limestone, gray, medium to coarsely crystalline, dolomitic, sandy in appearance.		Yields little or no water to wells.
ORDOVICIAN		Richmond group	100±		Limestone, gray, fine-grained, silty or shaly.	Form moderate to steep slopes near Cumberland River. Shale and limestone layers form discontinuous ledges along hillsides in some areas.	In lowland areas bordering streams yields enough water for a domestic supply with a power pump (more than 500 gpd) to wells. Elsewhere yields little water to wells. Yields small quantities of water to springs.
		Maysville group	100–200±		Limestone, gray, fine-grained, fossiliferous, thin-bedded; contains interbedded shale.		

See list of references in Water-Supply Paper 1603..

1 As used by J. M. Weller (1927).
2 As used by McFarlan, Swann, Walker, and Nosow (1955).
3 Of Sutton and Weller (1932).
4 As used by Stockdale (1939)=Salem limestone of Cummings (1901)=Somerset shale member of Warsaw limestone.

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