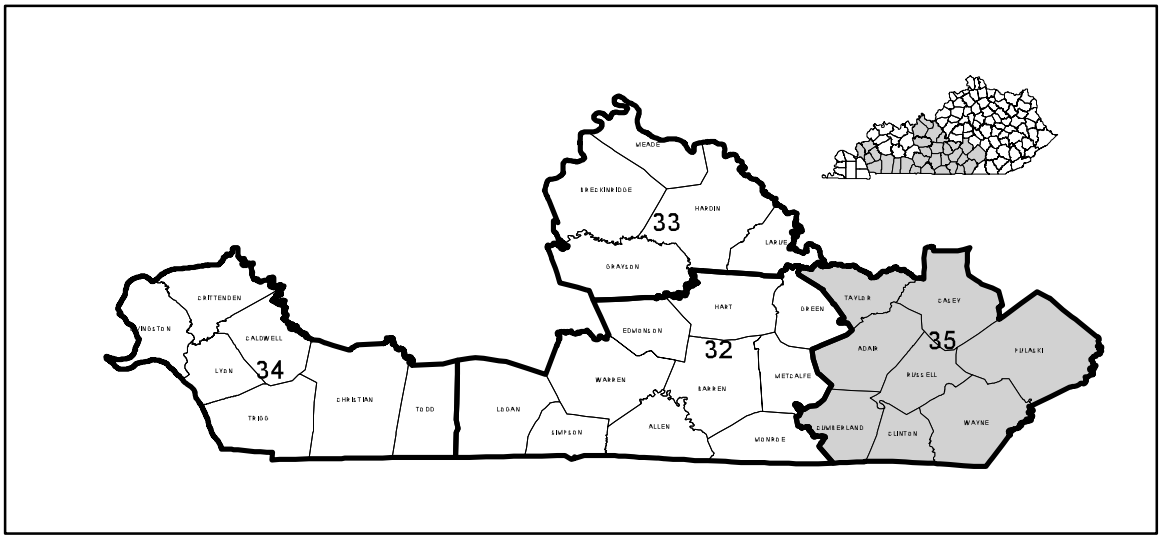
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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

AVAILABILITY OF GROUND WATER IN ADAIR, CASEY, CLINTON, CUMBERLAND, PULASKI, RUSSELL, TAYLOR, AND WAYNE COUNTIES, KENTUCKY

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

HYDROLOGIC INVESTIGATIONS
ATLAS HA-35



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 DEPARTMENT OF ECONOMIC DEVELOPMENT

HYDROLOGIC INVESTIGATIONS
ATLAS HA-35 (SHEET 1 OF 3)

ADAPTED FROM THE FOLLOWING GEOLOGIC MAPS

Dunn, P. H., Shideler, W. H., and Wesley, G. R., 1931, Map of areal and structural geology of Cumberland County, Kentucky: Kentucky Geol. Survey, ser. 6. Scale, 1:62,500.
Jillson, W. R., 1929, Geologic map of Kentucky: Kentucky Geol. Survey, ser. 6. Scale, 1:500,000.
Loughridge, R. H., 1890, Geologic map of Clinton County, Kentucky: Kentucky Geol. Survey, ser. 6. Scale, 1:125,000.
Mayfield, S. M., and Withers, F. S., 1929, Map of areal and structural geology of Pulaski County, Kentucky: Kentucky Geol. Survey, ser. 6. Scale, 1:62,500.
Miller, Raymond, and Crabb, D. H., 1931, Map of areal and structural geology of Clinton County, Kentucky: Kentucky Geol. Survey, ser. 6. Scale, 1:62,500.
Thomas, G. R., Settle, H. W., and Wood, E. B., 1950, Reconnaissance of oil and gas and structural geologic map of Clinton County, Kentucky: Kentucky Geol. Survey, ser. 9. Scale, 1:62,500.

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1963

EXPLANATION

- Qal — Quaternary alluvium
- IP — Pennsylvanian rocks
- Mc — Chester rocks
- Mm — Meramec rocks
- Mo — Osage rocks

MISSISSIPPIAN; CARBONIFEROUS

- D — Devonian rocks
- O — Ordovician rocks

Contact

Fault
Dashed where approximately located; dotted where concealed

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

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.— 10417

GEOLOGIC MAP OF ADAIR, CASEY, CLINTON, CUMBERLAND, PULASKI, RUSSELL TAYLOR, AND WAYNE COUNTIES, KENTUCKY

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SCALE 1:250 000

4 0 4 8 12 MILES
4 0 4 8 12 KILOMETERS

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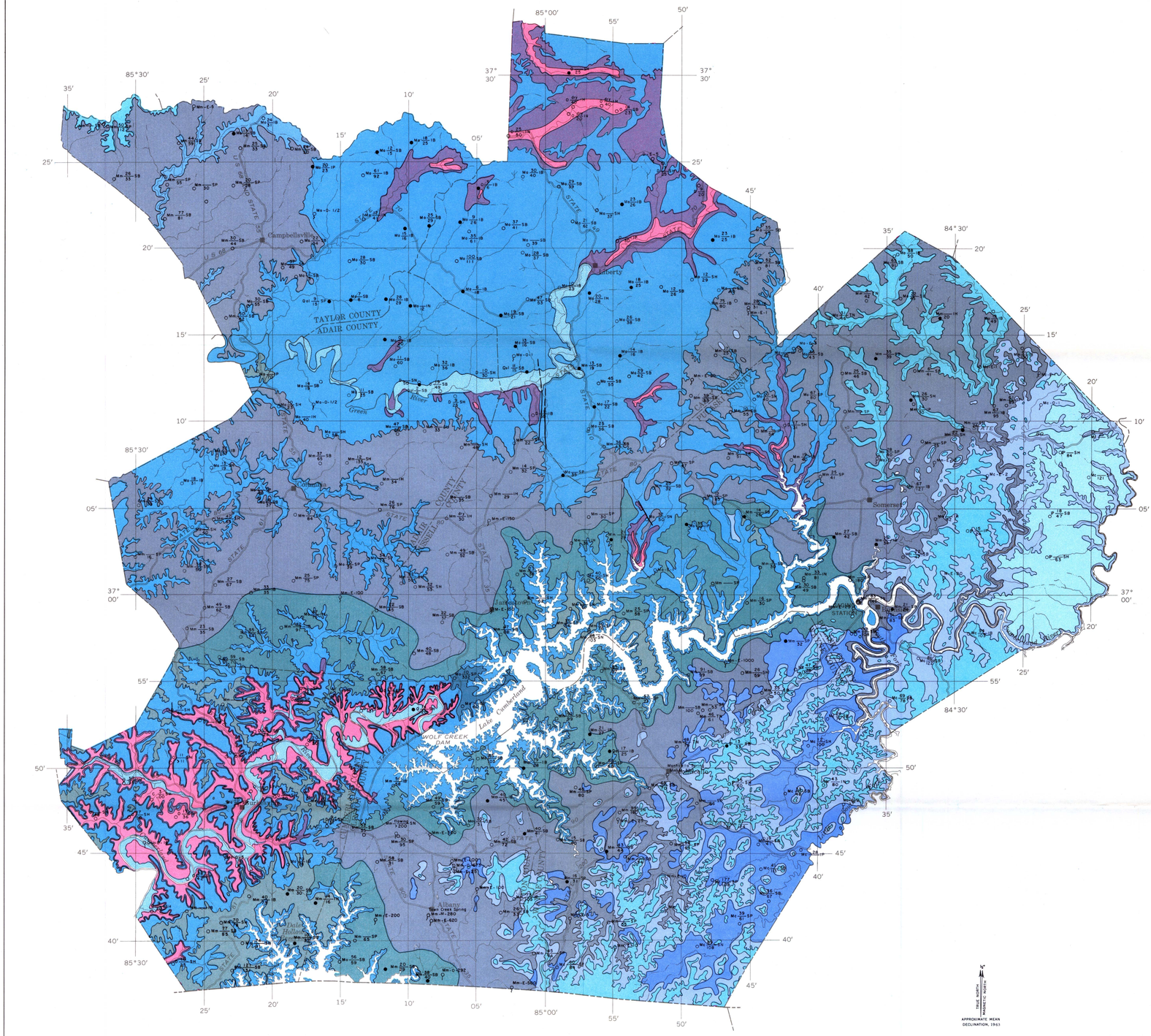

EXPLANATION

WATER-BEARING FORMATION

- Qal — Quaternary alluvium
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Contact

Fault

Dashed where approximately located; dotted where concealed

Water in Recent and Pleistocene alluvium

Most drilled wells yield less than 100 gpd (gallons per day) and are inadequate for a domestic supply with bucket or bailer. Water is obtained from fine sand, silt, and clay in most places.
Most dug wells are inadequate for a domestic supply with bucket or bailer (less than 100 gpd).

Water in rocks of Pennsylvanian age

Nearly all drilled wells are inadequate for power pumps (less than 500 gpd). Most wells do not yield enough water for a domestic supply with bailer or bucket (less than 100 gpd).
Dug wells are inadequate for a domestic supply with bailer or bucket (less than 100 gpd) except in areas bordering streams where a few wells are adequate if storage is provided for peak needs.

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). Drilled wells in lowland areas bordering streams generally yield enough water 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 (more than 500 gpd).

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 much as 300 feet in depth. Yields of more than 5 gpm (gallons per minute) are obtained from wells that penetrate large solution channels in the limestones of early Chester age. 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 is adequate for bailer or bucket (more than 100 gpd), and a few are adequate for a domestic supply with power pump (more than 500 gpd).

Water in Mississippian rocks of Chester age

About half the drilled wells are adequate for a domestic supply with bucket or bailer (more than 100 gpd). Very few wells yield enough for a domestic supply with power pump (more than 500 gpd). Nearly all wells in the upper part of the Chester in the Pennington shale 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 (more than 100 gpd) may be obtained in some places close to streams if perched water bodies are intercepted. Nearly all wells in the Pennington shale are inadequate for a domestic supply (less than 100 gpd).
Small springs discharge from perched water bodies at numerous horizons in the limestones of early Chester age. Flows range up to about 5 gpm. The springs are generally inadequate for domestic use.

Water in Mississippian rocks of Meramec age

About 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 encounter large solution channels yield more than 5 gpm, and some yield more than 50 gpm.
Dug wells are inadequate for a domestic supply except where water levels are close to perennial stream levels.
Springs are present in a few areas where there are minor surface streams. Low flows are as much as 500 gpm. Many of these discharge on top of relatively impermeable shale and silt layers and go dry during extended dry periods in late summer and fall.

Water in Mississippian rocks of Meramec age

Springs with low flows ranging from less than 10 gpm to about 1,500 gpm occur in the lower part of the Meramec. Most of the springs are perched high above perennial stream levels. One major horizon is close to normal pool stage of Lake Cumberland; another is about 50 feet above pool stage. The springs have great variability and many go dry during extended dry periods in late summer and fall. A few drilled wells in this area that intercept springs may yield as much as the flow of the springs, 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 where perched water bodies are intercepted. Many of these perched water bodies go dry during extended dry periods in late summer and fall, but a few are extensive and support a perennial water body.

Water in Mississippian rocks of Meramec age

More than half the drilled wells in this area are inadequate for a domestic supply (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 at several horizons. Flows generally do not exceed several gallons a minute and most go dry during extended dry periods in late summer and fall.

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 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 are 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 encounter perched water bodies of small areal extent in limestone at a shale contact. In about half the wells, water from these perched water bodies migrates below any openings in the wells during rainless periods. These wells are then dry until rainfall recreates a perched water body. In Casey County and northeastern Taylor County, the Osage is dissected into "knobs," or small steep hills. The perched water bodies are small in this area and many wells go dry. None of the wells inventoried in this area were adequate for a domestic supply with power pump, and more than half were inadequate for a domestic supply with bailer or bucket (less than 100 gpd).
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 and joints in limestone and siltstone 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-Devonian age

Most drilled wells are inadequate for domestic use with bailer or bucket (less than 100 gpd). In eastern Casey County some wells may yield as much as ½ gpm. Where limestone is penetrated, a few wells are adequate for domestic use with bucket or bailer (more than 100 gpd) in lowlands 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 Ordovician age

Yields enough water for a domestic supply with a power pump (more than 500 gpd) to drilled wells in lowland areas near the Cumberland River. 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 ● Dug well

◎ Drilled observation well

Mm-22-60 5P
- 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

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

○— 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

3000	Gallons of flow per minute

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

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SYSTEM	SERIES	FORMATION OR GROUP	THICKNESS (IN FEET)	SECTION	LITHOLOGY	TOPOGRAPHY	WATER-BEARING CHARACTER
QUATERNARY	Pleistocene and Recent	Alluvium	0–50		Silt, clay, and some gravel and sand in major stream valleys. Silt, clay, and some sand in tributary valleys.	Terraces and flood plains of Green River, Cumberland River, and tributaries.	Yields less than 100 gpd (gallons per day) to most wells, inadequate for a domestic supply with bucket or bailer. A few wells in Cumberland and Green River valleys yield enough for a domestic supply with a bucket or bailer (more than 100 gpd).
PENNSYLVANIAN		Lee	0–500±		Sandstone, yellowish-brown, medium-grained, massive. Yellowish-brown medium-grained conglomerate and sandstone contain quartzite pebbles; conglomerate is lenticular. Shale and coal found in places.	Forms dissected ridges and caps mountains in Clinton, Wayne, and Pulaski Counties; forms major escarpment of marginal area of eastern mountains. Underlies dissected upland in Pulaski County. Channel-fills mantle rocks of Meramec age in Taylor and Adair Counties.	Yields enough water for a domestic supply with a power pump (more than 500 gpd) to wells in lowland areas bordering streams. In broad upland areas, deep wells that penetrate fractures produce enough for a domestic supply with a power pump and some may yield as much as 5 gpm (gallons per minute). Wells in small upland areas generally are inadequate (produce less than 100 gpd).
CARBONIFEROUS / MISSISSIPPIAN	Chester	Pennington shale	0–250±		Shale, red and green, clayey, and minor amounts of limestone and sandstone. In places removed by pre-Pennsylvanian erosion. Thickness varies greatly owing to the pre-Pennsylvanian erosion.	Forms moderate to steep slopes in mountain margin area where capped by massive sandstone of Lee formation.	Yields little or no water to wells.
		Glen Dean limestone	15–25		Limestone, dark- to bluish-gray, fine- to medium-grained; shaly beds near top; very fossiliferous in places.	Forms steep hillsides or underlies dissected uplands in marginal area of mountains of Pulaski, Wayne, and Clinton Counties.	Yields enough water for bucket or bailer (more than 100 gpd) to wells in lowland areas bordering streams. Where the overlying Pennington shale has been removed by erosion from extensive areas of the Glen Dean, large solution openings are present which yield more than 5 gpm to wells in lowland areas bordering streams. Minor spring horizon at base yields as much as 5 gpm.
		Hardinsburg sandstone	10		Clay shale, green to dark-gray, soft. Conspicuous marker. Known by drillers as the "Pencil Cave".	Forms moderate to steep slopes and discontinuous benches.	Yields little or no water to wells.
		Haney limestone[1]	15		Limestone, gray, fine- to medium-grained, medium crystalline, oolitic in places; beds ½ to 2 feet in thickness, contrasting to massive limestone below.		
		Beech Creek and Reelsville limestones[1]	35		Limestone, light-gray to white, fine- to medium-grained, oolitic to coarsely crinoidal, massive. Cobbly or conglomeratic limestone at base.	Forms steep hillsides or underlies dissected upland in marginal area of mountains of Pulaski, Wayne, and Clinton Counties.	Yield enough water for a domestic supply with a power pump (more than 500 gpd) from solution openings. Some wells produce more than 5 gpm from large solution openings. Near outcrop areas, particularly near major escarpments, yields generally are inadequate during dry periods.
		Beaver Bend and Paoli limestones[1]	60		Limestone, light-gray, fine-grained, dense. Oolitic in places.	Form foot of mountains along base of escarpment of eastern mountains. Underlie broad rolling karst areas and dissected uplands of Pulaski and Wayne Counties.	
	Meramec	Ste. Genevieve limestone	80		Limestone; breccia present usually at top of formation. Limestone, light-gray to white, oolitic, fine-grained in places, crossbedded; minor amount of chert.	Forms steep bluffs along Lake Cumberland. Underlies dissected karst areas in uplands. Forms steep slopes on hills in Casey County.	Yields more than 50 gpm to wells from large solution openings in karst area of Clinton, Wayne, and Pulaski Counties. Most wells yield enough water for a domestic supply with a bailer or bucket. Springs having low flows ranging from less than 10 gpm to more than 200 gpm occur at or near stream level or near the contact with the underlying St. Louis limestone.
		St. Louis limestone	100		Limestone, dark-gray to black, fine-grained, dense, medium- to thick-bedded, cherty. Top 10 feet marked by black chert nodules and stringers containing coral: *Lithostrotion*. Argillaceous and oolitic in places. Medium- to dark-gray massive geodiferous siltstone. In places only siltstone is present.	Forms steep bluffs along Lake Cumberland. Underlies rolling karst areas in uplands; dissected close to Lake Cumberland and tributaries. Siltstone and shale layers form discontinuous minor benches on hillsides.	Yields more than 50 gpm to wells from large solution openings in karst areas. Most wells penetrate some solution openings but where openings are small, yields are inadequate for domestic use with a power pump. A major spring horizon occurs near the top of the formation in the karst areas. Many seepage springs occur throughout the formation; low flows range from less than 10 gpm to more than 500 gpm. The lower part of the formation is composed of siltstone and argillaceous limestone. Yields from these sedimentary rocks are low and generally are not adequate for a domestic supply with bailer or bucket.
		Spergen limestone[2]	50		Limestone, gray, granular to oolitic, shaly, argillaceous, and siltstone beds in places. Light-brown medium-grained sandstone. Dark-gray to black gritty calcareous shale fossiliferous in places; grades into geodiferous limestone.	Underlie moderately to highly dissected rolling uplands. Form steep bluffs along Lake Cumberland. In some areas numerous small sinkholes occur in the Warsaw.	Yield enough water for a domestic supply with a power pump where the formations are dominantly limestone. Yields are low where siltstone or argillaceous limestone is penetrated. Minor spring horizon occurs at the contact of the limestone with the underlying siltstone or argillaceous limestone. Another spring horizon occurs near the contact of the Warsaw and Fort Payne. Low flows generally are less than 5 gpm.
		Warsaw limestone	0–100		Limestone, light- to dark-gray, granular, crinoidal, massive, crossbedded crosslaminated, argillaceous in places. Medium- to dark-gray brittle, geodiferous siltstone. In places only siltstone present. Light-brown medium-grained flaggy sandstone; occurs at top of formation in Wayne County.		
	Osage	Borden group[4] — Muldraugh[3] (Fort Payne chert)	60–95		Limestone, gray, siliceous; calcareous siltstone in places. Yellowish-brown argillaceous chert; contains impure limestone, small geodes.	Underlie moderately to highly dissected rolling uplands. Form "knobs". Form major escarpment in Taylor County and in Casey County where it is modified by faults. Form steep bluffs along rivers.	Yield enough water for domestic supply with bailer or bucket (more than 100 gpd). Wells in lowland areas close to streams produce enough water for a domestic supply with a power pump. Most wells obtain water from perched or semiperched water bodies supported by discontinuous shale layers, and many are dry during late summer and fall. Minor spring horizons occur throughout the formations. Flows are as much as 30 gpm, but most go dry in late summer or fall. Where the formation consists predominantly of siltstone, most wells are inadequate for domestic use (less than 100 gpd). Where the Fort Payne chert crops out in lowland areas close to streams, the limestone and chert facies supply enough water for a domestic supply with a power pump.
		Floyds Knob[4] (Fort Payne chert)	5		Limestone, siliceous, crinoidal, glauconitic zones. Calcareous siltstone in places.		
		Brodhead[3] (Fort Payne chert)	135–140		Siltstone, gray, and impure siliceous limestone grading into siltstone. Gray fossiliferous patches of siltstone and shale; grade into shale. Gray to drab silty shale; abundant worm marks.		
		New Providence shale[4]	100–150±		Shale, green- to steel-gray, clayey, crinoidal, stringers of limestone. Thick massive boulders of dense fine-grained bluish-gray limestone in Wayne County. Variable facies occur.	Forms moderate to steep slopes near base of eastern mountain margin escarpment and "knobs".	Yields little or no water to wells.
DEVONIAN		Chattanooga shale	20–40		Shale, black, fissile.	Forms steep slopes near base of eastern mountain margin escarpment and "knobs". Underlies small round hills near base of escarpment.	Yields little or no water to wells. Small springs are present at numerous horizons, but most go dry during late summer and fall. A few wells in eastern Casey County have produced as much as ½ gpm.
		Sellersburg limestone	50		Limestone, gray, dolomitic, crinoidal, fossiliferous, and large amounts of light- to bluish-gray chert. Conglomeratic locally.	Forms gentle slopes on hillsides under capping Chattanooga shale in southern Casey County.	Yields enough water for a domestic supply with a power pump to wells in lowland areas close to streams in northern Casey County. Yields enough for a domestic supply with a bucket or bailer from other areas.
ORDOVICIAN	Maysville	McMillan	25–90		Limestone, gray, fine-grained, dense, hard, argillaceous. Gray fossiliferous shale.	Form bluffs and dissected valley sides adjacent to Cumberland River area. Exposed in faulted areas in Casey County.	Yield enough water for a domestic supply with a power pump to wells in lowland areas near the Cumberland River. In tributary valleys most wells are dry. Deep wells generally yield sulfurous water or brines.
		Fairview	100–150		Limestone, thin-bedded, and shale.		

See list of references in Water-Supply Paper 1603.
1 As used by McFarlan, Swann, Walker, and Nosow (1955).
2 As used by Stockdale (1939)=Salem limestone of Cummings (1901)=Somerset shale member of Warsaw limestone.
3 Of Stockdale (1939).
4 As used by Stockdale (1939).

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