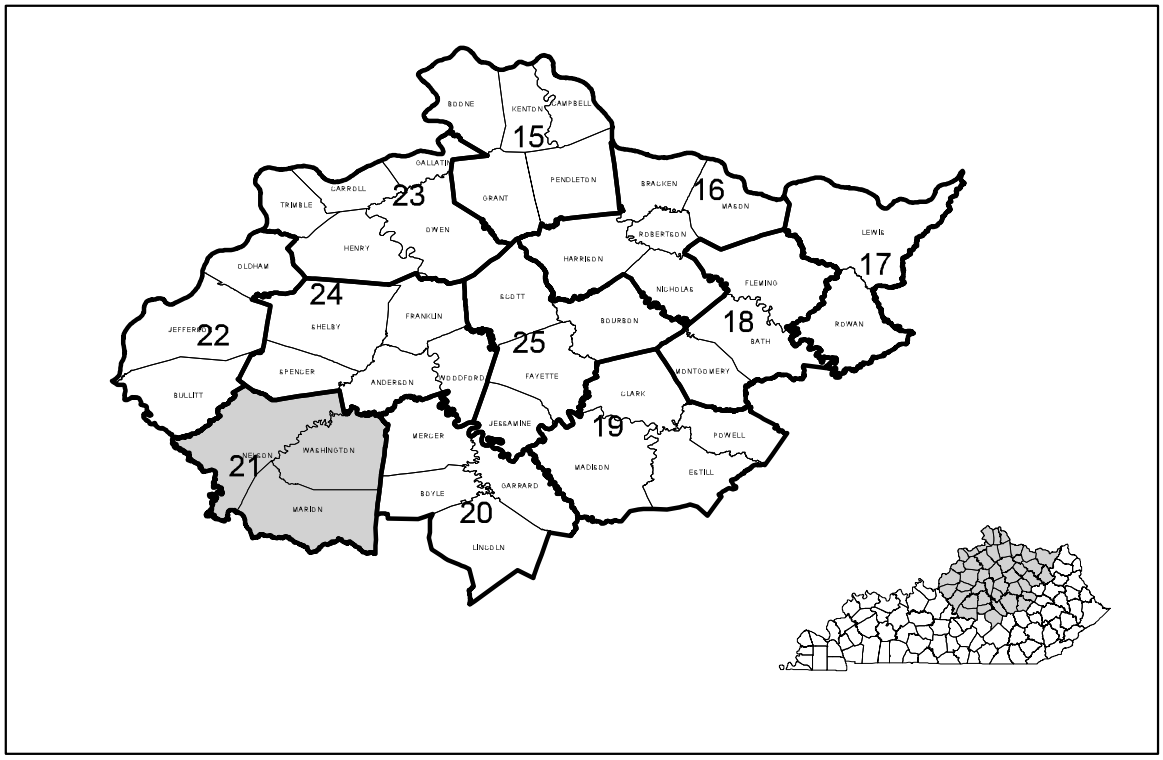
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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

AVAILABILITY OF GROUND WATER IN MARION, NELSON, AND WASHINGTON COUNTIES, KENTUCKY

By
F.R. Hall and W.N. Palmquist, Jr.,

HYDROLOGIC INVESTIGATIONS
ATLAS HA-21



INDEX MAP OF THE BLUE GRASS REGION, KENTUCKY, SHOWING COUNTY GROUPS AND AREA OF THIS ATLAS

This is 1 of 11 atlases (HA-15 to HA-25) showing geology and availability of ground water in the Blue Grass region, Kentucky U.S. Geological Survey Water-Supply Paper 1533 contains a text description and illustrations providing further information on the occurrence and quality of ground water in the Blue Grass region.

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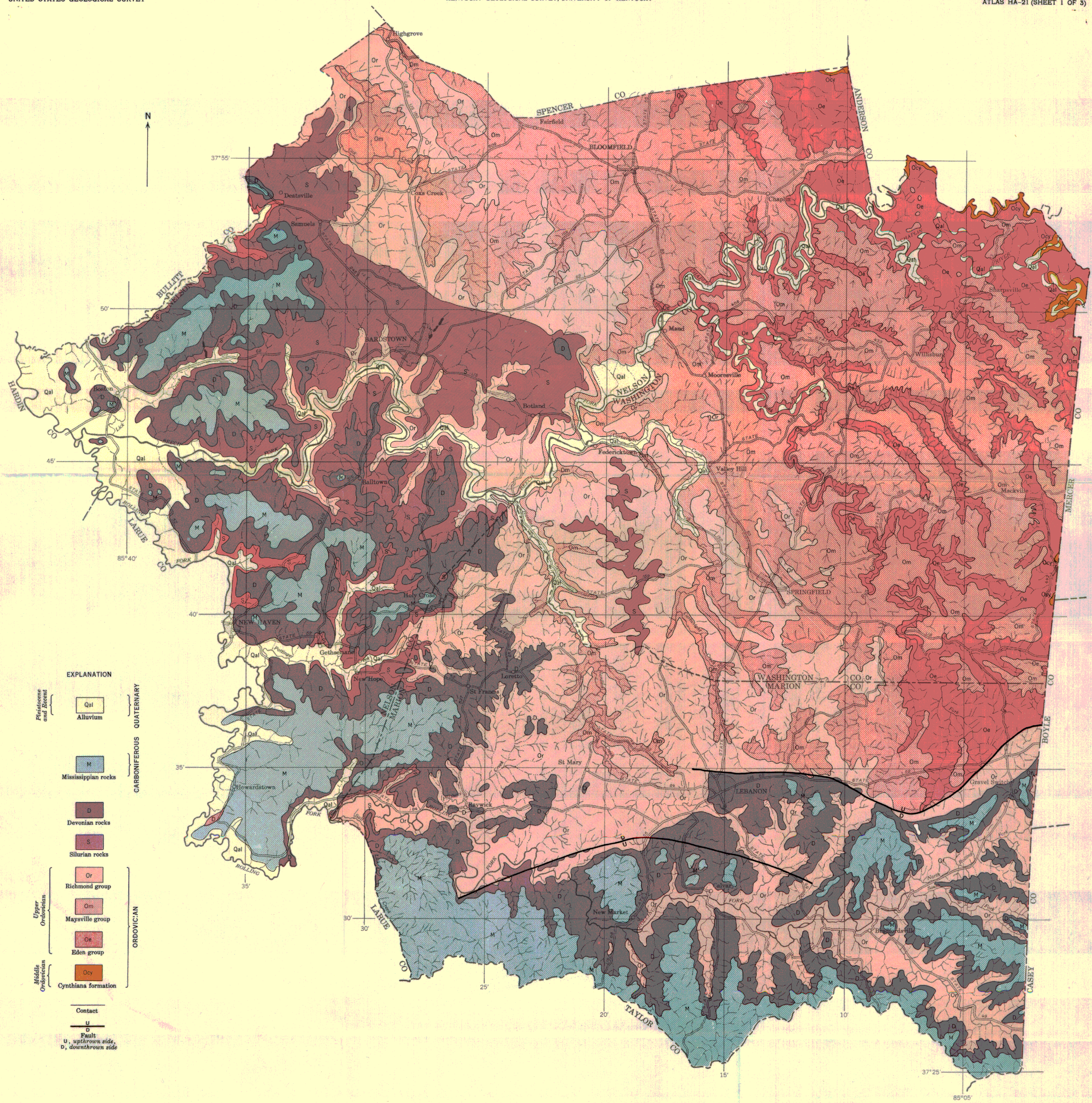
HYDROLOGIC INVESTIGATIONS
ATLAS HA-21 (SHEET 1 OF 3)



Base from general county highway maps of Kentucky, 1950, Kentucky State Highway Department, State-wide Planning Survey

Geology adapted from the following:

Geologic map of Marion County: Kentucky Geol. Survey, ser. 6, 1930. Map, 1:62 500, Raymond Miller and G. H. Briggs.
Geologic map of Nelson County: Kentucky Geol. Survey, ser. 6, 1929. Map, 1:62 500, W. H. Shideler, G. H. Briggs, and Raymond Miller.
Geologic map of Washington County: Kentucky Geol. Survey, ser. 6, 1930. Map, 1:62 500, P. H. Dunn, J. J. Wolford, and F. S. Withers

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GEOLOGIC MAP OF MARION, NELSON, AND WASHINGTON COUNTIES, KENTUCKY (COUNTY GROUP 21)

Scale 1:125 000

1 0 1 2 3 4 5 6 7 8 9 10 Miles

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ATLAS HA-21 (SHEET 2 OF 3)

EXPLANATION

Area 2

Most drilled wells in this area will produce enough water for a domestic supply with a power pump and and pressure system (more than 500 gallons a day) at depths of less than 100 feet. Some wells produce several gallons per minute from alluvium or thick limestone along large streams. Water is hard or very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet

Area 3

Most drilled wells in this area will produce enough water for a domestic supply with a hand pump (100 to 500 gallons a day) at depths of less than 100 feet. Some wells will produce more than 500 gallons a day except during dry weather. Water is hard or very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 feet

Area 4

Most drilled wells in this area will not produce enough water for a dependable domestic supply (100 gallons a day). Wells along drainage lines may produce enough water for a domestic supply except during dry weather. Water is hard and may contain salt or hydrogen sulfide at depths greater than 100 feet

EXPLANATION

Well

Spring

No objectionable quantities of salt or hydrogen sulfide in water

Sulfurous water[1]
Contains hydrogen sulfide in noticeable amounts

Salty water
Contains sodium chloride in amounts readily detected by tasting

Salty and sulfurous[1] water
Contains both sodium chloride and hydrogen sulfide in readily detectable amounts

Om–H / 50 — Well; S–3 — Spring

Aquifer

- S Silurian rocks
- Or Richmond group (Ordovician)
- Om Maysville group (Ordovician)
- Oe Eden group (Ordovician)
- Ocy Cynthiana formation (Ordovician)

Yield

- 3 Figure above line indicates yield, in gallons per minute, where known
- P Reported adequate for power-pump installation
- H Reported adequate for hand-pump installation
- N No pump, or reported inadequate supply

Depth

50 Figure below line indicates depth of well, in feet

[1] Much of the sulfurous (hydrogen sulfide-bearing) water is satisfactory for domestic use, as the hydrogen sulfide escapes as a gas upon exposure of the water to the air

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Scale 1:125 000

1 0 1 2 3 4 5 6 7 8 9 10 Miles

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HYDROLOGIC INVESTIGATIONS
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SYSTEM	SERIES	GROUP	FORMATION	THICKNESS, IN FEET	SECTION	LITHOLOGY	TOPOGRAPHY	HYDROLOGY
QUATERNARY	PLEISTOCENE AND RECENT		ALLUVIUM	0-80±		Clay, silt, sand and some gravel. Maximum thickness of nearly 80 feet on Rolling Fork a few miles downstream from Nelson County line.	Extensive flood plains with small terraces along Rolling Fork, and narrow flood plains and small terraces along Beech Fork and larger tributaries.	Yields 100 to more than 500 gpd (gallons per day) from thick deposits along Rolling Fork. Too thin and fine grained to yield much water along Beech Fork and the large tributaries. Water is hard and may have a high iron content.
MISSISSIPPIAN	UPPER MISSISSIPPIAN	BORDEN[1]	SALEM LIMESTONE	35±		Thick-bedded to massive granular limestone, locally crossbedded, argillaceous or sandy, and interbedded calcareous shale.	Tops of some knobs and the Mississippian escarpment (Muldraugh Hill) in southern Marion and southwestern Nelson Counties.	Yield 100 to 500 gpd to drilled wells on broad ridges or on upland; yield water to springs at heads of ravines and on face of escarpment. Water from wells is hard but otherwise of good quality.
			WARSAW LIMESTONE	20±		Thin-bedded, thick-bedded, or irregularly bedded granular limestone, locally crinoidal or shaly, and some interbedded shale.		
			MULDRAUGH FORMATION[2]	75-95		Calcareous siltstone and fine-grained pure, siliceous, or argillaceous, locally crinoidal, limestone with chert beds and lenses and scattered shale partings. Small geodes in the siliceous limestone.	Dissected upper slopes and tops of some knobs and ridges. Limestone forms ledges and small cliffs.	Yields 100 to 500 gpd to wells in valley bottoms; may yield more than 500 gpd where thick siltstone beds occur at and below stream level; yields almost no water to wells on hills; yields water to small springs in limestone and siltstone beds. Water from the shale is soft; from the siltstone, hard; and from the limestone, very hard. At shallow depths below stream level, water may contain salt, hydrogen sulfide, or iron. Silty shale and siltstone are favorable for dug wells, common in this area. Most dug wells produce less than 500 gpd, and many yield very little or go dry in late summer and early fall.
			FLOYDS KNOB FORMATION[1]	1-2		Siliceous and crinoidal limestone with a glauconitic parting or with glauconitic grains scattered throughout.	No characteristic topographic expression.	
			BRODHEAD FORMATION[2]	135-200		Drab-gray silty shale, shaly massive siltstone, and fine-grained sandstone. Siliceous crinoidal limestone with chert beds and lenses occurs at places near the top. Small geodes and calcium carbonate concretions throughout.	Main part of the Mississippian escarpment, ridges, and knobs. Shale forms steep slopes, and the more resistant beds form ledges on slopes and in ravines.	
			NEW PROVIDENCE FORMATION[1]	70-175		Soft bluish-gray or drab argillaceous shale with phosphatic nodules at the base and noncarbonate beds and concretions throughout. Shale appears massive and breaks with conchoidal fracture. Fine-grained sandstone beds, a few inches to 4 feet thick, separated by sandy shale partings occur about 25 to 40 feet above the base in western and southwestern Nelson County. Grades into underlying Ohio shale in many places.	Dissected lower slopes and broad flat valleys in the knobs region of southern and southwestern Nelson County and southern Marion County; some steep slopes and bluffs along streams.	
DEVONIAN	UPPER DEVONIAN		OHIO OR NEW ALBANY SHALE	65±-100±		Black highly fissile shale with green shale layers locally. Shale contains grains of quartz, pyrite, and other minerals, and organic material. Thin sandstone or calcareous layers are more numerous toward the base. Pyrite may be present at contact with underlying limestone.	Broad, flat valleys with steep hillsides; steep, dissected bluffs along streams.	Yields 100 to 500 gpd to drilled wells in broad valleys and on uplands; yields water to dug wells almost any place in the black shale; yields water to small springs. Water is in fractures that extend less than 50 feet below land surface. Water is hard and may contain salt or hydrogen sulfide.
	MIDDLE DEVONIAN		SELLERSBURG LIMESTONE	4-16		Massive dolomite and crinoidal crystalline limestone and much chert.	Prominent outcrops beneath black shale.	Yields almost no water to wells; yields hard water to small springs.
SILURIAN			LOUISVILLE LIMESTONE	0-45		Massive gray fine-grained limestone.	Prominent outcrops.	Yields water to small springs. Water is hard.
			WALDRON SHALE	0-10		Coarse nonfissile greenish-gray calcareous and magnesian shale; occurs only in southwestern Nelson County, where it pinches out.	Erodes easily, undermining the overlying Louisville.	Yields almost no water. Water is hard.
			LAUREL DOLOMITE	0-40		Bluish to light-gray fine-grained massive dolomitic limestone; not present in Washington County and may be absent in Marion County.	Tops of ridges and extensive flat upland surface in Nelson County; ledges on steep hillsides and in bluffs along streams.	Yields 100 to 500 gpd to drilled wells in valley bottoms, on broad ridges, and along streams on upland; yields water to many springs. Water is hard.
			OSGOOD FORMATION	0-30±		Green or bluish-gray fissile to lumpy calcareous and magnesian shale with a few thin beds of fine-grained limestone; may be absent in Marion County.	Steep, dissected hillsides; erodes easily, undermining the Laurel.	Yields almost no water, impedes recharge to the Saluda, and holds up water in the Laurel. Limestone yields water to small springs. Water is hard.
			BRASSFIELD LIMESTONE	0-10±		Pink to yellow medium-crystalline to coarsely crystalline dolomitic limestone; may be absent in Marion and Washington Counties.	Ledges.	Yields water to small springs. Water is hard.
			SALUDA LIMESTONE	0-35		Massive bluish-gray fine-grained dolomitic limestone with coral reef near the top; may be absent in Marion County.	Ridgetops and upland surfaces; ledges on steep hillsides and in bluffs along streams.	Yields 100 to 500 gpd to drilled wells in broad valley bottoms and on broad ridges. Yields almost no water to wells where overlain by more than a few feet of the Osgood formation; yields water to small springs. Water is hard.
			LIBERTY FORMATION	0-50		Coarse bluish-gray shale with thin layers of crystalline limestone; coral reef at the base.	Somewhat dissected upland areas; moderately steep slopes where shale predominates, moderately undulating to gently rolling surface where limestone predominates. Slopes are steep to cliffy and dissected along large streams; many are littered with limestone slabs left after shale eroded and washed away. Small sinkholes with some underground drainage are present where thick limestone beds occur along broad upland stream valleys.	Yield 100 to 500 gpd to drilled wells in broad valleys and along streams on upland, but almost no water to drilled wells on hillsides or ridgetops; yield water to small springs. Water is hard and in valley bottoms may contain salt or hydrogen sulfide. Shale prevents circulation of water in thicker limestone beds except where limestone is exposed on flat ridges or valley bottoms.
			WAYNESVILLE LIMESTONE	40-70±		Massive green to gray fine-grained argillaceous limestone with thin beds of green shale.		
			ARNHEIM FORMATION	35-60		Bluish-gray lumpy claystone and thin-bedded shale with much interbedded irregular, knotty, and rubbly limestone.		
ORDOVICIAN	UPPER ORDOVICIAN	MAYSVILLE	MC MILLAN FORMATION	95-100±		Thin- to medium-bedded rubbly argillaceous limestone with much shale; thin, locally crossbedded crystalline rubbly limestone with some shale in lower part (Bellevue limestone member).	Gently to moderately rolling upland away from major streams, moderately dissected where shale is predominant. Dissected and steep along large streams. Thick limestone beds stand out as ledges along steep hillsides and bluffs along streams, and where present on upland underlie broad, flat valleys that may have small sinkholes and some underground drainage. Lower part of the Maysville group caps broad, flat ridges between steep-sided valleys cut into underlying shale of the Eden group.	Yields 100 to 500 gpd to drilled wells in valley bottoms and along streams on upland; yield almost no water to drilled wells on hillsides or ridgetops, although may yield some water to dug wells on ridgetops; yield water to small springs. Water is hard and in valley bottoms may contain salt or hydrogen sulfide. Shale exerts strong control on amount of water available. Near base of the McMillan, there is 25 feet or more of limestone and small amounts of shale (Bellevue limestone member). Where this limestone unit occurs at and below stream level in valley bottoms or along streams on upland, there is opportunity for the solutional enlargement of fractures and bedding-plane openings, and the outcrop area, particularly in Nelson County, is characterized by many small and a few large perennial springs. Some wells drilled into this limestone yield more than 500 gpd. The Garrard sandstone is too well cemented to yield water.
			FAIRVIEW FORMATION	75-100±		Thin to medium-thick beds of gray limestone, rubbly in places, and much interbedded shale.		
			UNNAMED SANDSTONE MEMBER / GARRARD SANDSTONE	100±		Fine-grained calcareous sandstone or siltstone grading into sandy limestone and shale above and below; better developed in Marion County than in Nelson and Washington Counties.		
		EDEN		125±-185		Bluish-gray lumpy calcareous shale with thin evenly bedded argillaceous limestone layers that are more numerous and thicker toward the base. May consist almost entirely of shale in some places.	Rugged, dissected topography of long, narrow, steep-sided ridges and narrow, winding, V-shaped valleys in dendritic drainage pattern. Shale on steep slopes weathers and washes away, leaving limestone slabs. Underlying Cynthiana formation extends into the Eden shale belt in a few broad, flat valleys. Contrast with rolling upland outcrop areas of the Maysville and Richmond groups is striking except along large streams, where change is masked by dissection.	Yields 100 to 500 gpd to drilled wells in broad valley bottoms, but almost no water to drilled wells on hillsides or ridgetops; may yield some water to dug wells on ridgetops; yields water to small springs and seeps. Water is hard, and in valley bottoms may contain salt or hydrogen sulfide. Shale has small, poorly connected openings, and ground-water circulation is slow. On ridgetops the shale impedes downward percolation of water and holds up water in the soil and weathered-rock zone. Dug wells, having large wall areas, are best suited for obtaining this water. On broad ridges capped by the Maysville group, the underlying Eden holds up a semiperched water body in the Maysville, and dug wells produce some water; however, wells often go dry in late summer and fall.
	MIDDLE ORDOVICIAN		CYNTHIANA FORMATION	100±		Thin- to thick-bedded fine- to coarse-grained argillaceous limestone, locally crossbedded, rubbly, or bouldery, with drab or bluish-gray shale. Upper part is more shaly in most places.	Broad, flat valley bottoms between steep valley walls of shale of the Eden group.	Yields 100 to 500 gpd to drilled wells in broad valley bottoms; may yield more than 500 gpd to wells near large streams; yields water to springs. Water is hard and in valley bottoms may contain salt or hydrogen sulfide.

[1] As used by Stockdale (1939). [2] Of Stockdale (1939)

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GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF THE ROCKS IN MARION, NELSON, AND WASHINGTON COUNTIES, KENTUCKY (COUNTY GROUP 21)

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