

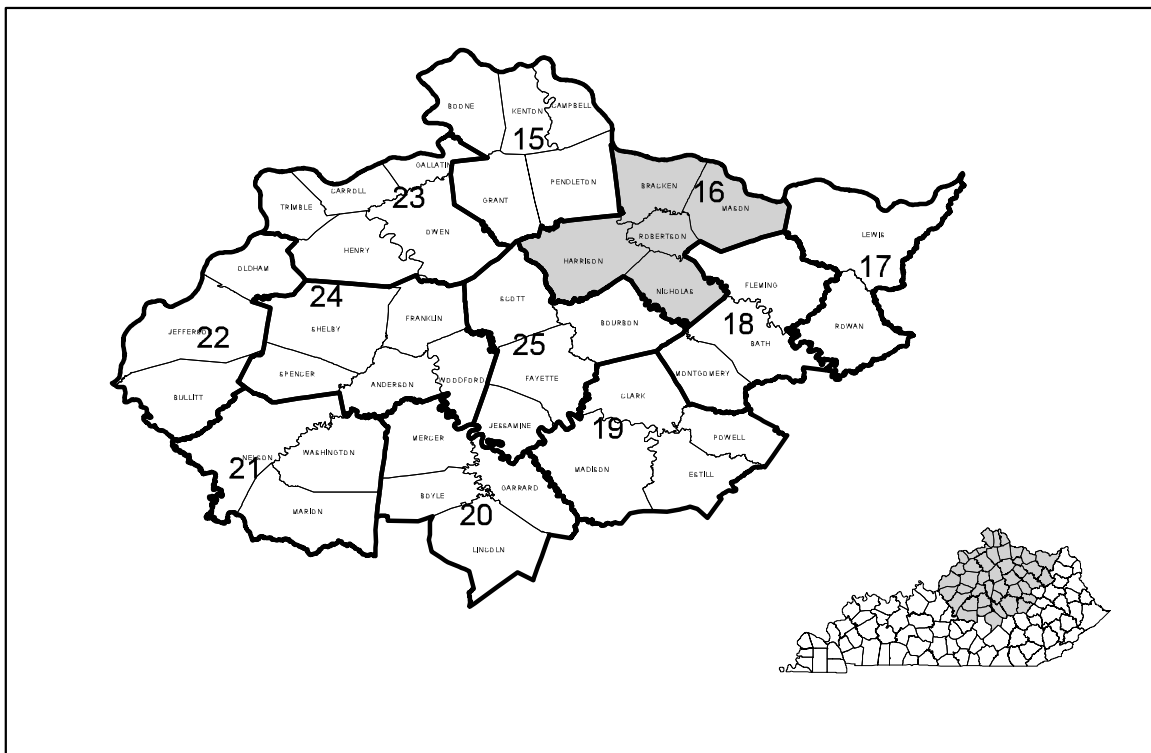
DEPARTMENT OF THE INTERIOR  
UNITED STATES GEOLOGICAL SURVEY

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

AVAILABILITY OF GROUND WATER IN BRACKEN, HARRISON,  
MASON, NICHOLAS, AND ROBERTSON COUNTIES, KENTUCKY

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

HYDROLOGIC INVESTIGATIONS  
ATLAS HA-16



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

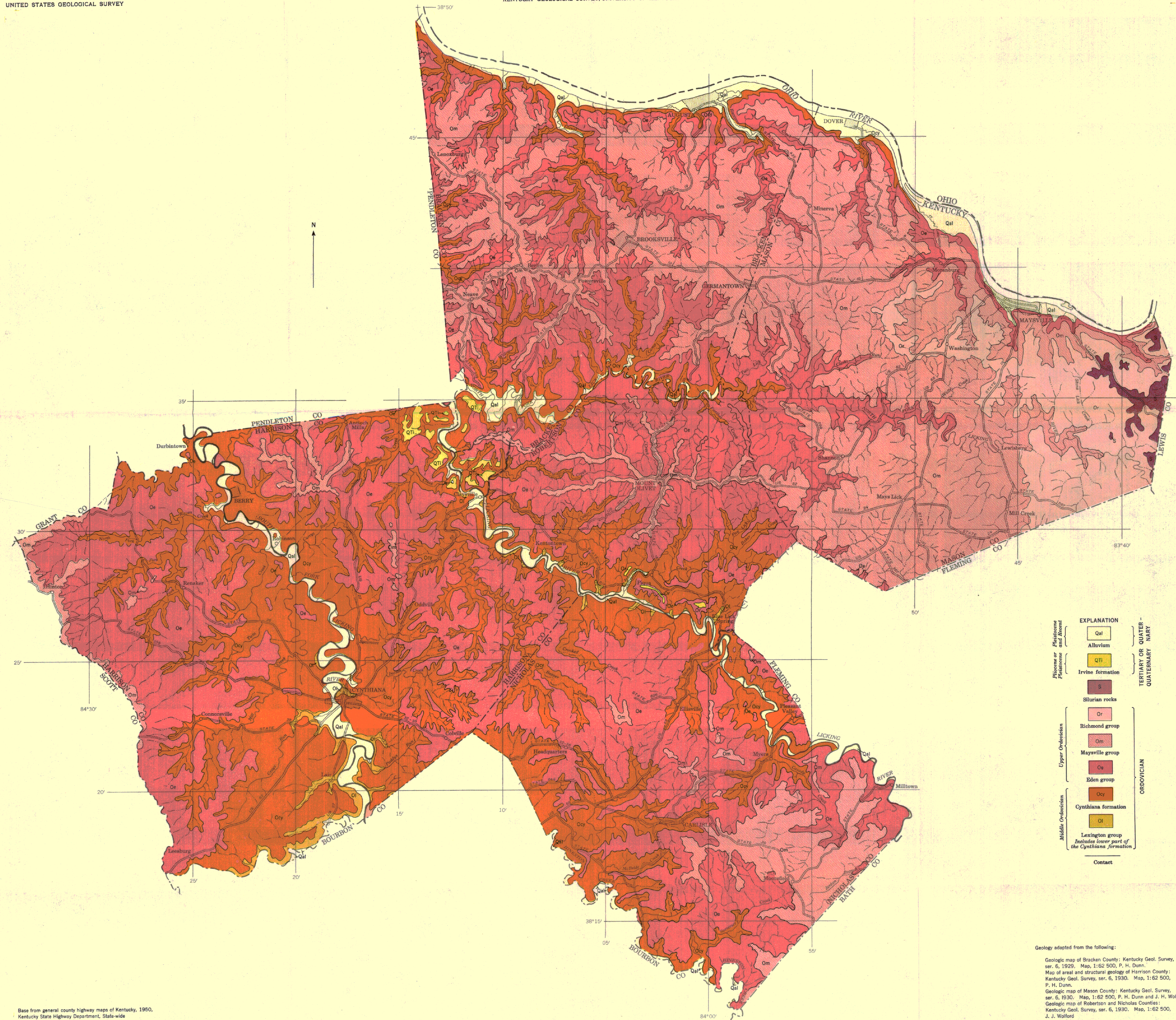
This is 1 of 11 atlases (HA-15 to HA-25) showing geology and availability of ground water in the Blue Grass region, Kentucky U.S. Geological Survey Water-Supply Paper 1533 contains a text description and illustrations providing further information on the occurrence and quality of ground water in the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

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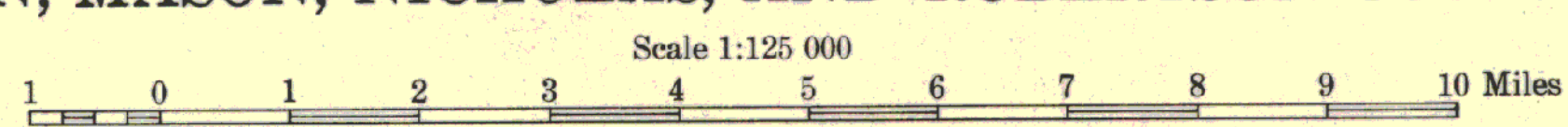


EXPLANATION		TERTIARY OR QUATERNARY - QUATERNARY
Pleistocene or Pleistocene and Recent	Qal	
	Alluvium	
	QTI	
Irvine formation	S	TERTIARY OR QUATERNARY - QUATERNARY
	Silurian rocks	
Upper Ordovician	Or	ORDOVICIAN
	Richmond group	
	Om	
	Maysville group	
	Eden group	
Middle Ordovician	Ocy	ORDOVICIAN
	Cynthiana formation	
	Oi	
	Lexington group <i>Includes lower part of the Cynthiana formation</i>	
	Contact	

Geology adapted from the following:  
 Geologic map of Bracken County: Kentucky Geol. Survey, ser. 6, 1929. Map, 1:62 500, P. H. Dunn.  
 Map of areal and structural geology of Harrison County: Kentucky Geol. Survey, ser. 6, 1930. Map, 1:62 500, P. H. Dunn.  
 Geologic map of Mason County: Kentucky Geol. Survey, ser. 6, 1930. Map, 1:62 500, P. H. Dunn and J. H. Wolford.  
 Geologic map of Robertson and Nicholas Counties: Kentucky Geol. Survey, ser. 6, 1930. Map, 1:62 500, J. J. Wolford.

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

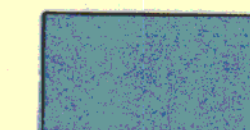
GEOLOGIC MAP OF BRACKEN, HARRISON, MASON, NICHOLAS, AND ROBERTSON COUNTIES, KENTUCKY (COUNTY GROUP 16)



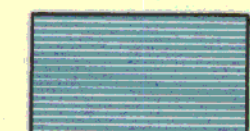
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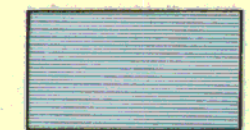
EXPLANATION



**Area 1**  
Many properly constructed drilled wells in this area will produce several hundred gallons per minute from alluvial material unless bedrock is encountered at shallow depths. Maximum reported yield is 800 gpm. Most drilled wells will produce enough water for a domestic supply with a power pump and pressure system (more than 500 gallons a day) at depths of less than 100 feet. Water is hard or very hard but otherwise of good quality



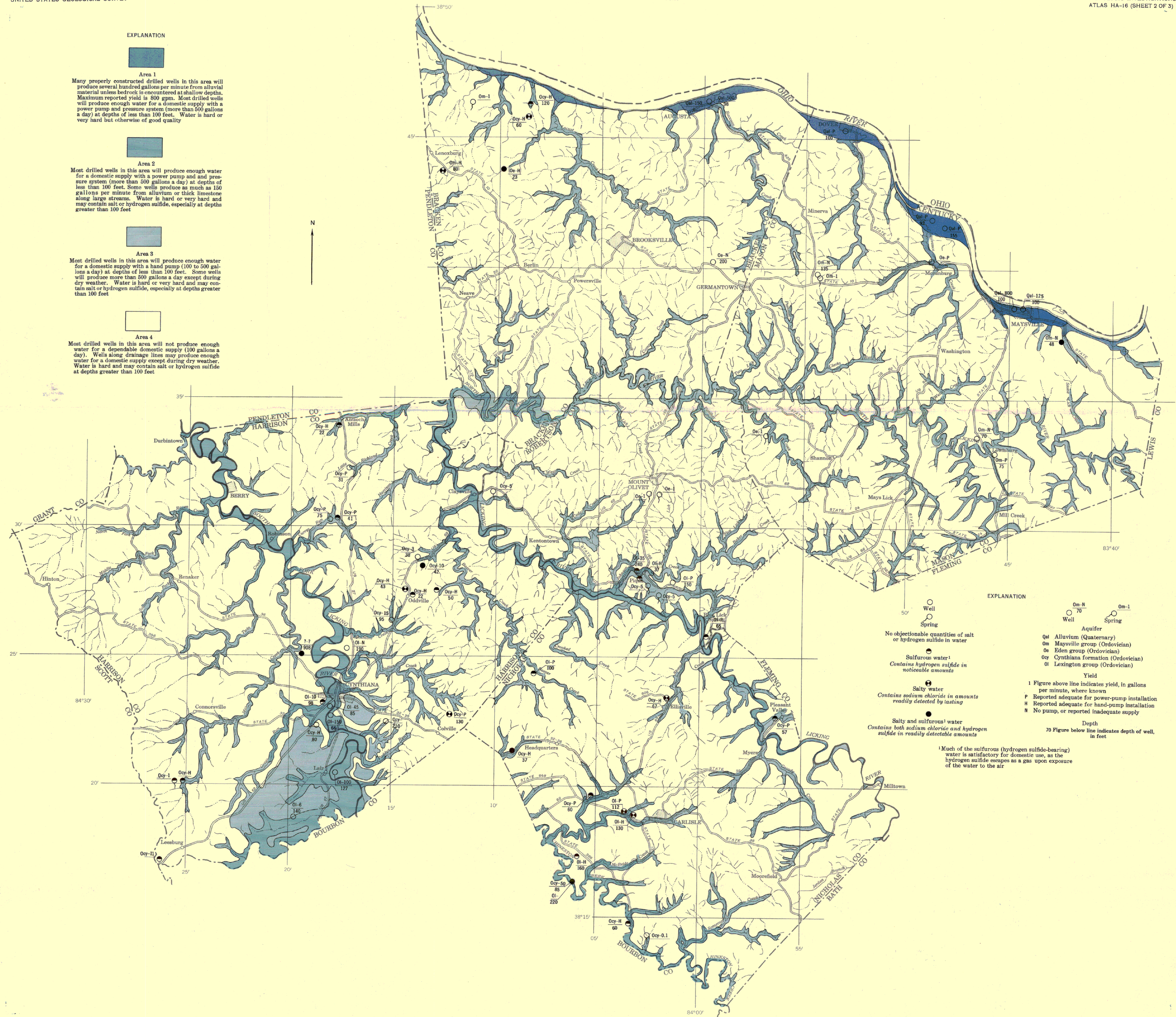
**Area 2**  
Most drilled wells in this area will produce enough water for a domestic supply with a power pump and pressure system (more than 500 gallons a day) at depths of less than 100 feet. Some wells produce as much as 150 gallons per minute from alluvium or thick limestone along large streams. 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<sup>1</sup>  
Contains hydrogen sulfide in noticeable amounts
- Salty water  
Contains sodium chloride in amounts readily detected by tasting
- Salty and sulfurous<sup>1</sup> water  
Contains both sodium chloride and hydrogen sulfide in readily detectable amounts
- Om-N 70 Well
- Om-1 Spring
- Aquifer
- Qal Alluvium (Quaternary)
- Om Maysville group (Ordovician)
- Oe Eden group (Ordovician)
- Ocy Cynthia formation (Ordovician)
- OI Lexington group (Ordovician)
- Yield
- 1 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
- 70 Figure below line indicates depth of well, in feet

<sup>1</sup>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

AVAILABILITY OF GROUND WATER IN BRACKEN, HARRISON, MASON, NICHOLAS, AND ROBERTSON COUNTIES, KENTUCKY (COUNTY GROUP 16)

Scale 1:125 000  
0 1 2 3 4 5 6 7 8 9 10 Miles

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SYSTEM	SERIES	GROUP	FORMATION	THICKNESS, IN FEET	SECTION	LITHOLOGY	TOPOGRAPHY	HYDROLOGY
QUATERNARY	PLEISTOCENE AND RECENT		ALLUVIUM	100		Silt, clay, and some sand in upper part and lenses and layers of silt, sand, and gravel in lower part of Ohio River valley; some deposits more than 100 feet thick. Sandy silt and clay and some fine gravel in Licking River valley. Thin and fine grained in tributary valleys.	Valley flats, terraces, and flood plains. Long, narrow, discontinuous terraces in the narrow Ohio River valley; broad terraces along the relatively wide Licking River valley. Too thin in tributary valleys to have distinctive topography.	Yields moderate to large quantities of water to drilled wells in the Ohio River valley, according to its thickness and texture; commonly yields 200 gpm (gallons per minute), and as much as 800 gpm from gravel-packed wells; yields more than 500 gpd (gallons per day) in valleys of the Licking and South Fork Licking Rivers, and as much as 150 gpm in places. Too thin and fine grained in small streams to yield large amounts of water. Water is hard and may contain salt or hydrogen sulfide.
			IRVINE(?) FORMATION	35		Fluvial deposits of clay, sand, and small amounts of gravel in old stream channels at an intermediate level along Licking and North Fork Licking River valleys.	Tops of low hills near the Licking and North Fork Licking Rivers.	Yields small amounts of water to wells and springs.
TERTIARY OR QUATERNARY	PLEISTOCENE	RICHMOND	BRASSFIELD LIMESTONE	10		Gray to pink medium-crystalline to coarsely crystalline dolomitic limestone.	Discontinuous ledges near hilltops.	Yields water to small springs.
			ELKHORN AND WHITEWATER FORMATIONS UNDIFFERENTIATED	50		Shale and interlayered thin beds of limestone; alternating limestone and shale in some places.		
			LIBERTY FORMATION	30		Dolomitic limestone and many interlayered thin beds of calcareous shale.		
			WAYNESVILLE LIMESTONE	40		Alternating argillaceous limestone and calcareous shale.	Gently to moderately rolling upland except along large streams where there is much dissection; consequent steep slopes littered with thin limestone slabs. In places thick limestone beds crop out as ledges on slopes and steep bluffs along larger streams, and also may underlie broad, flat valleys in upland.	Yields more than 500 gpd to drilled wells in valley bottoms of large streams; yields almost no water to drilled wells on hillsides and narrow ridgetops; yields small amounts to dug wells on ridgetops; yields 100 to 500 gpd to wells in thick limestone beds along streams in upland; yields water to small springs. Water is hard and in valley bottoms may contain salt or hydrogen sulfide. In alternating limestone and shale, such as in most of the Richmond and Maysville groups, amount of water available to wells and springs depends upon amount of shale. Shale beds have small, poorly connected openings, and flow of ground water is very slow; result is very little solution of underlying limestone beds. Only along streams, where ground water has ready access to thick limestone beds, are wells likely to be successful.
			ARNHEIM FORMATION	75		Fossiliferous rubby limestone, dolomitic claystone, and interbedded argillaceous limestone.		
			MC MILLAN FORMATION	100		Thin- to medium-bedded, locally rubby, argillaceous limestone interbedded with lumpy blue-gray calcareous shale. Shale predominates in some places, but generally there is more limestone than shale. The lower part (Bellevue limestone member) consists of thin crystalline limestone, locally crossbedded or rubby, and a little interbedded shale.		
			FAIRVIEW FORMATION	140		Thin alternating beds of gray rubby limestone and lumpy blue-gray calcareous shale. More limestone than shale in most places, but locally may be more than one-half shale.	Gently to moderately rolling upland except along major streams, where there is much dissection; consequent steep slopes. Thick limestone beds crop out as ledges on slopes and steep bluffs along larger streams; sinkholes may be present locally where thicker limestone beds underlie broad, flat valleys in upland. The Maysville group forms broad ridges between steep-sided valleys cut into shale of the underlying Eden group.	Yields 100 to 500 gpd to drilled wells in valley bottoms of large streams, but almost no water to drilled wells on hillsides and narrow ridgetops; yields some water to dug wells on ridgetops; yields 100 to 500 gpd to wells in thick limestone beds along streams in upland. These thick limestone beds yield water to several springs; the rest of the Maysville group yields water to small springs. Water is hard and in valley bottoms may contain salt or hydrogen sulfide. Small amounts of water may be obtained from the semiperched water body in rocks of the Maysville group where they cap ridges between valleys cut into shale of the Eden group. Dug wells on ridges produce more water than drilled wells; however, many go dry in late summer or fall.
			UNNAMED SANDSTONE MEMBER	0-48		Well-cemented calcareous siltstone and fine-grained sandstone interbedded with sandy shale and limestone. Garrard sandstone grades downward into rocks typical of the Eden group, and the unnamed sandstone member grades upward into rocks typical of the Maysville group. Unit thins northward from Nicholas County.	Similar to that of the Maysville group; crops out as prominent ledges in steep slopes and bluffs in many places along large streams.	Yields 100 to 500 gpd to drilled wells in valley bottoms, but almost no water to wells on hillsides or ridgetops; yields little water to springs. The well-cemented siltstone and fine-grained sandstone do not allow free circulation of water. Water is hard.
			GARRARD SANDSTONE	0-48		Well-cemented calcareous siltstone and fine-grained sandstone interbedded with sandy shale and limestone. Garrard sandstone grades downward into rocks typical of the Eden group, and the unnamed sandstone member grades upward into rocks typical of the Maysville group. Unit thins northward from Nicholas County.		
			EDEN			215		Evenly bedded lumpy blue calcareous shale and mudstone and interlayered thin limestone beds. Shale predominates and may form entire section, but thicker limestone beds are present in places, especially in lower part.
MIDDLE ORDOVICIAN	LEXINGTON		CYNTHIANA FORMATION	120-140?		Thin to thick beds of finely to coarsely crystalline limestone; rubby in some exposures. Much interbedded calcareous shale in upper part, limestone predominant in lower part.	Broad valleys along large streams between steep, narrow ridges of the Eden shale belt; low, rolling hills in a belt bordering the Licking River in Harrison County. Limestone has undergone solution and in some areas is characterized by small sinkholes and subsurface drainage.	Yields more than 300 gpd to drilled wells in valley bottoms along large streams; yields small amounts of water to wells on hillsides and hilltops; yields water to small springs and to a few large ones. Water is hard or very hard and may contain hydrogen sulfide or salt, particularly in wells in valley bottoms; both, especially hydrogen sulfide, may be found in wells on hillsides. Beneath broad interstream areas, much solution enlargement of fractures and bedding-plane openings has taken place in the soluble zones beneath tributary streams, and many drilled wells produce 100 to 500 gpd. Little water is available from the Cynthiana where it is covered by younger rocks.
							Lower part of Cynthiana formation has been mapped as part of Lexington group.	
			BENSON LIMESTONE	10		Thin- to thick-bedded fine- to coarse-grained limestone and some thin interbedded shale.	Valley bottoms along the Licking River in Harrison and Robertson Counties.	Yield more than 500 gpd to wells in stream valleys and as much as 150 gpm in places. Water is hard and may contain salt or hydrogen sulfide.
JESSAMINE LIMESTONE	25		Thin- to thick-bedded fine- to coarse-grained limestone and some thin interbedded shale.					

GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF THE ROCK IN BRACKEN, HARRISON, MASON, NICHOLAS, AND ROBERTSON COUNTIES, KENTUCKY (COUNTY GROUP 16)

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