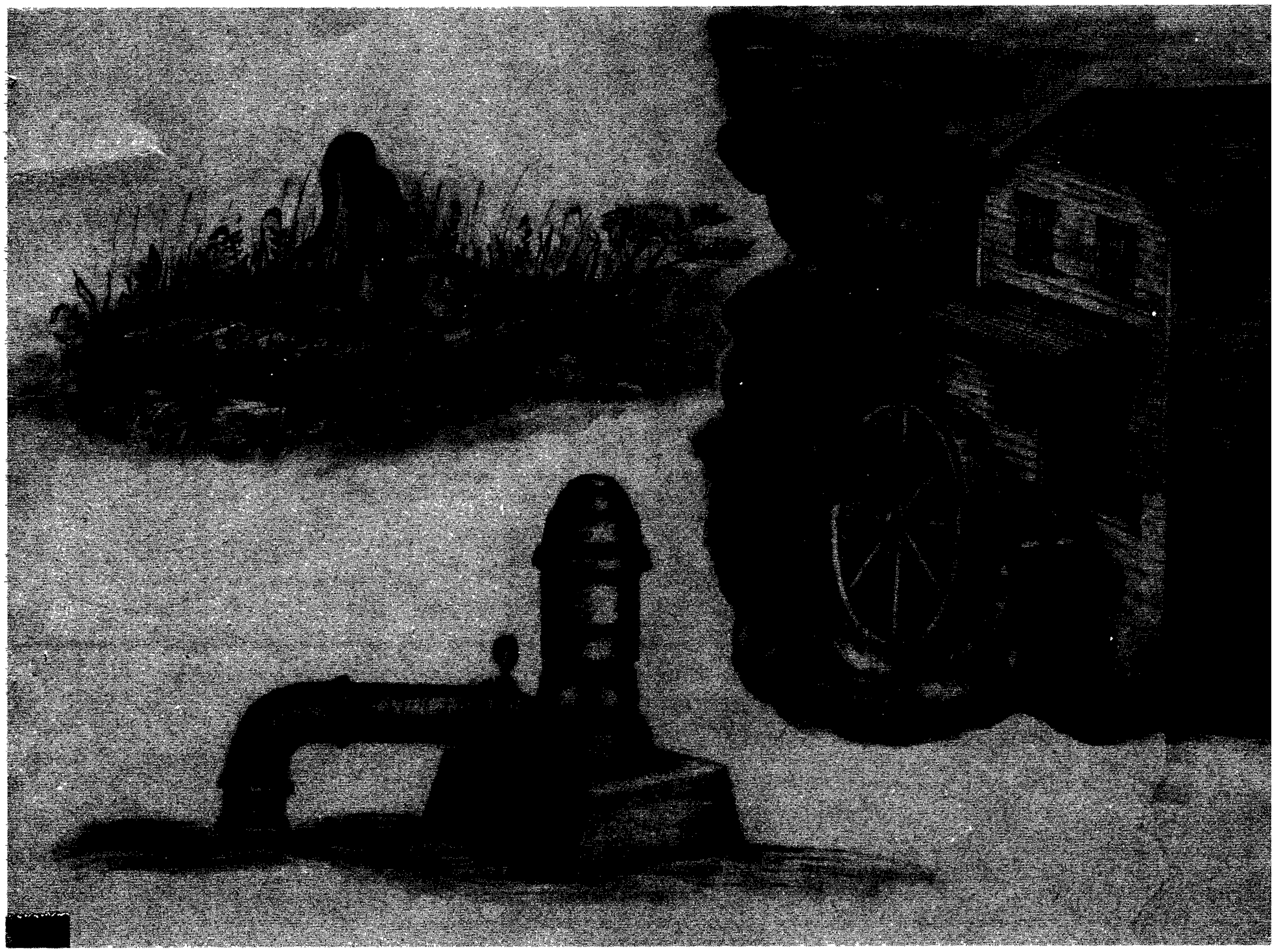
WATER-RESOURCES INVESTIGATIONS REPORT 83-4012

DELINEATION AND DESCRIPTION OF THE REGIONAL AQUIFERS OF TENNESSEE--
THE KNOX AQUIFER IN CENTRAL AND WEST TENNESSEE



Prepared by
U.S. GEOLOGICAL SURVEY
in cooperation with the
U.S. ENVIRONMENTAL PROTECTION AGENCY

DELINEATION AND DESCRIPTION OF THE REGIONAL AQUIFERS OF TENNESSEE--THE KNOX AQUIFER IN CENTRAL AND WEST TENNESSEE

By J. V. Brahana and Michael W. Bradley

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 83-4012

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Nashville, Tennessee
1985

UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, Secretary

GEOLOGICAL SURVEY

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Factors for Converting Inch-Pound Units to
International System of Units (SI)

For the convenience of readers who may want to use International System of Units (SI), the data may be converted by using the following factors:

Multiply	By	To obtain
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
feet per mile (ft/mi)	0.1894	meters per kilometer (m/km)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
gallons per minute (gal/min)	0.004	cubic meters per minute (m^3/min)

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level. NGVD of 1929 is referred to as sea level in this report.

DELINEATION AND DESCRIPTION OF THE REGIONAL AQUIFERS OF TENNESSEE--THE KNOX AQUIFER IN CENTRAL AND WEST TENNESSEE

J. V. Brahana and Michael W. Bradley

ABSTRACT

The Knox aquifer is composed of the Cambrian and Ordovician carbonate rocks of the Knox Group. This aquifer occurs throughout Tennessee, west of the Valley and Ridge province. The Knox crops out in the Sequatchie Valley and in the Wells Creeks cryptoexplosive structure on the northwestern Highland Rim. Ground water in the upper Knox occurs primarily in solution openings. The aquifer may be recharged through fractures and faults in the overlying limestones of the Central Basin aquifer system. The underlying shale of the Conasauga Group acts as a lower confining layer.

Throughout parts of the Central Basin province, the Knox aquifer is an important source of water for rural domestic supplies. In these areas, ground water from the Knox generally has less than 1,000 milligrams per liter dissolved solids. Outside of the Central Basin, the dissolved solids concentrations increased. They may approach brine concentrations beneath the Cumberland Plateau.

INTRODUCTION

The Safe Drinking Water Act (Public Law 93-523) includes provisions for the protection of underground sources of drinking water. Part C of the Act authorizes the Environmental Protection Agency (EPA) to establish regulations to assure that underground injection of contaminants will not endanger existing or potential sources of drinking water. As developed by EPA, the regulations require that all underground sources of drinking water with less than 10,000 milligrams per liter (mg/L) dissolved solids which do not contain hydrocarbon, mineral, or geothermal resources be designated for protection whether or not they are currently being used as a source of drinking water.

The geologic formations of Tennessee have been combined into eight major regional aquifers. Aquifers are delineated on a regional basis and are characterized by a unique set of hydrologic conditions and water quality.

The purpose of this report is to describe the Knox aquifer in central and west Tennessee and to delineate zones within the aquifer that are actual or potential sources of drinking water. For this report, the Knox aquifer is defined as the upper 500 feet of the Knox Group. The hydrology of the Knox Group below this upper 500 feet is unknown.

This report on the Knox aquifer provides generalized information on (1) the areal and stratigraphic occurrence, (2) the occurrence and movement of ground water, (3) dissolved solids concentration of the ground water, (4) area of use and potential use, (5) the areas of known ground-water contamination, and (6) the known locations of current and potential hydrocarbon, mineral, and geothermal resources in the stratigraphic section that includes all of the Knox Group.

Formation names and physiography used in this report are those of the Tennessee Division of Geology (Miller, 1974) and do not necessarily follow the usage of the U.S. Geological Survey. Tennessee nomenclature was chosen because it is anticipated that various state agencies will play major roles in applying the regulations.

Information on the Knox aquifer was obtained from existing published and unpublished data from the following sources:

U.S. Geological Survey
Tennessee Division of Geology
Tennessee Division of Water Quality Control
Tennessee Division of Water Resources

GEOLOGY

The Knox Group is composed of a thick sequence of limestone and dolomite of Cambrian and Ordovician age (table 1) and is present in the subsurface in the western two-thirds of the State (fig. 1). The Knox Group in the Valley and Ridge of East Tennessee is not discussed in this report because it is complexly folded and faulted and hydrologically distinct from the Knox in the remainder of the State.

West of the Valley and Ridge, the Knox crops out at two locations, the Wells Creek structure in the northwestern Highland Rim, and in the Sequatchie Valley of the Cumberland Plateau. In central Tennessee the depth to the top of the Knox ranges from 330 feet near Murfreesboro, Rutherford County, to deeper than several thousand feet in areas outside of the Central Basin. The Knox Group is overlain by the Pierce Limestone, Murfreesboro Limestone, and the Pond Spring Formation, a silty, glauconitic dolomite that contains shale beds with disseminated pyrite. The Pond Spring Formation was deposited on the erosional surface on the top of the Knox and has a variable thickness over very short distances, indicating that it conforms to highs and lows on the Knox surface (Newcome and Smith, 1962). The Pond Spring is more than 180 feet thick in Stewart County, but regionally thins toward the east and pinches out in the eastern Central Basin. These three formations, the Pierce, Murfreesboro, and Pond Spring, are characterized by low permeability at depths greater than 300 feet below land surface. The Knox Group directly overlies the Conasauga Group, a thick sequence of shale, siltstone, and limestone.

Structurally, the rocks of the Knox Group are relatively undeformed. Dips are gentle throughout the area, averaging less than one degree. Locally, dips of more than three degrees may be calculated. The Nashville Dome is the dominant structural feature. It is a low dome whose crest is in southern Rutherford County. Minor folding of the rocks occurs locally that is generally attributed to dissolution of the carbonates.

During the upwarping and doming, the rocks at the crest of the dome were stretched, resulting in the formation of systematic joints, parallel sets of almost vertical fractures along which no relative displacement has occurred. These joints serve as the primary avenues of vertical ground-water movement through the rocks which otherwise have low vertical permeability. Faults occur in some areas beneath the Cumberland Plateau and in parts of the southern and northwestern Highland Rim. In these areas, the faults may influence the hydrology.

The configuration of the top and the bottom of the Knox aquifer is shown in figures 2 and 3, respectively. Cross sections have been constructed based on geophysical logs of deep wells. The cross sections are presented as figures 4 through 10. These figures include the generalized structural and stratigraphic relationship of the Knox with other aquifers and the dissolved solids concentrations of water in the Knox.

The geology of the Knox Group and contiguous formations has been described in several published reports, including: Piper (1932); Theis (1936); Bentall and Collins (1945); Wilson (1949); Newcome (1954); Newcome (1958); Smith (1959); Newcome and Smith (1962); Wilson and Stearns (1968); Fischer and Hoagland (1970); Manning and Statler (1975); and Fischer (1977).

HYDROLOGY

Nearly all the ground water in the Knox aquifer in the Central Basin occurs in thin (1-foot thick) zones containing networks of small tubular voids (Newcome and Smith, 1962). These zones are interspersed throughout the aquifer but are concentrated in the upper 200 feet of the Knox Group. They represent zones of secondary porosity and permeability in rocks that otherwise have very low porosity and permeability.

The upper part of the Knox Group is a deep aquifer which possesses a dynamic flow system and a remarkable history of yielding water to more than 99 percent of the wells that penetrate it, many at depths of several thousand feet. The present flow system occurs in a paleo-aquifer that was developed when the Knox Group was subareally exposed and subjected to extensive dissolution (Fischer, 1977). The zones of secondary porosity and permeability developed at that time later served as major avenues for the movement of ore-bearing solutions (Fischer and Hoagland, 1970).

The rocks below the zone of active flow are saturated, but the ground water at that depth may be effectively separated from the zone of active flow above. Ground-water flow velocities at that depth are extremely low. Ground water from the lower part of the Knox is highly mineralized.

Water in the Knox aquifer is under confined conditions, and rises above the zone in which it occurs where penetrated by wells. A conceptual model of ground-water occurrence in the recharge area of these rocks in the Central Basin is shown in figure 11. The present concept of ground-water flow in the Knox aquifer is not well defined, and is based on water levels (Newcome and Smith, 1962), water quality, drillers' records, and geologic data. This concept is limited to the top 500 feet, which represents only about 10 to 20 percent of the Knox Group. Data from the remainder of the Knox is sparse and isolated and does not define a comprehensible model.

Water levels and water quality from the Knox Group in the Central Basin indicate the water in the aquifer is responding to regional recharge and discharge. Although the Knox does not crop out in the Basin, there may be vertical leakage through the Ordovician rocks and into the Knox aquifer. The low vertical permeability of the overlying Ordovician rocks has been modified by vertical joints, fractures, and quite possibly, by the large number of holes drilled into the Knox for zinc exploration in the late 1940's (Luke Ewing and Terry Brashears, Tennessee Division Water Resources, oral commun., 1981). All specific data on these holes in terms of numbers, location, or plugging operations, are confidential. If these drill holes are open, they represent a very important source of recharge into or leakage out of the Knox aquifer.

Rocks overlying the Knox Group in western Rutherford, Williamson, Maury, Marshall, and northern Giles Counties are thin and the Knox is shallow. Water level fluctuations in the Knox aquifer responds like a water-table aquifer. Recharge and discharge areas correspond with topographic highs and lows (fig. 12). Newcome and Smith (1962) and Fischer (1977) show that the potentiometric surface defined by water levels slopes gently west. The gradient indicates that a hydrologic sink or discharge boundary must exist to the west, probably at the Tennessee River (fig. 12). In the subsurface of the northern Cumberland Plateau, ground-water conditions are also thought to be relatively static. Additional data are needed, however, because flow directions in this aquifer outside of the Central Basin are poorly documented.

Aspects of the hydrology of the Knox aquifer have been described in the following publications: Piper (1932); Theis (1936); Newcome and Smith (1962); Fischer and Hoagland (1970); and Fischer (1977).

WATER QUALITY

The water of the Knox aquifer is suitable for drinking water use (generally less than 1,000 mg/L dissolved solids) in the Central Basin. Based on analyses from Newcome and Smith (1962) and later unpublished analyses, the freshest water in the aquifer (less than 1,000 mg/L dissolved solids) is in western Rutherford, Williamson, Maury, Marshall, and northern Giles Counties. Because the aquifer is so thick, and vertically variable, a wide range of water-quality conditions exists. Many wells in the Knox aquifer yield water that is not suitable for drinking water supplies. Areal distribution of dissolved solids concentrations in water from this aquifer are shown in figure 13, and the variation by depth is shown in table 2.

Dissolved solids concentrations of water from the Knox aquifer are more consistent regionally than in the overlying Central Basin aquifer system. Yet, even within this thick, massive unit, discrepancies exist. Most of the analyses are of water from the upper 300 feet of the Knox aquifer. In this zone, the following summary of water quality applies (Newcome and Smith, 1962):

1. Wells near the center of the Central Basin (Williamson, Maury, Marshall, northern Giles, and western Rutherford Counties) yield water with lower dissolved solids (generally from 500 mg/L to 2,500 mg/L dissolved solids) than do wells near the margin (from 1,000 to 6,500 mg/L dissolved solids).

2. Fluoride concentration is high (greater than 2 mg/L).

3. Where dissolved solids are greater than 1,000 mg/L, water type is generally sodium chloride or sodium sulfate. Where dissolved solids are less than 600 mg/L, water type is generally calcium bicarbonate.

4. In the northern and northeastern parts of the Central Basin and in the eastern Highland Rim, the water may contain methane, hydrogen sulfide, and a high concentration of chloride.

5. Based on few data, there is an apparent water-quality boundary at the Tennessee River. West of the river, the few analyses indicate ground water with dissolved solids concentrations of more than 5,000 mg/L. East of the river, ground water commonly contains less than 1,500 mg/L dissolved solids.

In addition to the lateral variation of water quality, there is a distinct vertical zonation in this thick carbonate sequence. Analyses of water from different depths in the same well indicate a general increase in dissolved solids with increasing depth. There are notable exceptions in the few deep analyses that exist. These data, which were collected as drill stem tests and swab tests, are not consistent, however, and may contain sampling errors. Much additional work remains to be done in defining the water quality of this aquifer.

The following reports were used to compile information of water quality: Piper (1932); Theis (1936); and Newcome and Smith (1962). In addition, a significant amount of unpublished data compiled by Ollie Smith, Jr., during his tenure with the Tennessee Division of Water Resources and other unpublished records of that agency was most helpful.

DRINKING WATER USE

The Knox aquifer is deep, low yielding, but a dependenable source of drinking water where its quality is suitable. Areas of suitable quality are generally limited to the Central Basin, western Highland Rim, and Sequatchie Valley. No public supplies are known to currently use water from this aquifer west of the Valley and Ridge.

The areas of use and potential use are shown in figure 14. The area of potential use of the Knox aquifer is defined as the area that is not currently used where the water has less than 10,000 mg/L dissolved solids.

CONTAMINATION

Contamination is documented at three sites in the Knox Group (fig. 14 and table 3). The sites are associated with deep, waste injection wells into the lower part of the Knox Group and deeper rock units. One of the deep injection sites is in Humphreys County, and two are in Maury County about four miles apart near Mt. Pleasant. From results of present sampling and monitoring, it appears that the injected wastes have invaded permeable zones in the lower part of the Knox Group.

HYDROCARBON, MINERAL, AND GEOTHERMAL RESOURCES

At the present time, the Knox Group is mined for zinc in Smith County (fig. 15). In the southeastern part of the Highland Rim, the Knox is reported to contain hydrocarbons. Its potential for hydrocarbons has not been extensively investigated beneath the Cumberland Plateau.

SUMMARY

The Knox aquifer is present throughout most of the State in the subsurface from the eastern edge of the Cumberland Plateau through West Tennessee. Except for the Sequatchie Valley, no significant outcrops of this aquifer occur west of the Valley and Ridge province and the area of occurrence was delineated primarily on drilling records. Except for parts of the Sequatchie Valley, the Knox aquifer is under confined conditions throughout its area of occurrence. The upper confining layer includes the Pierce Limestone, Murfreesboro Limestone, and Pond Spring Formation. Near land surface, these formations can be locally significant aquifers. In some areas, these formations may allow ground-water movement into or out of the Knox.

Low permeability zones within the Knox Group probably serve as confining layers between the Knox aquifer and the lower Knox Group. The lower Knox is known from geophysical logs at New Johnsonville and Mt. Pleasant to have greater porosity than the middle Knox. The degree of confinement between upper and lower parts of the Knox Group is unknown. The Conasauga Group is the lower confining layer for the entire Knox Group.

The Knox Group in the Valley and Ridge province of East Tennessee is not discussed in this report. Because of the highly complex faulting and folding of the Valley and Ridge, the Knox Group in East Tennessee is hydrologically distinct from the relatively flat-lying and undeformed Knox aquifer in central and western Tennessee.

The use of the Knox aquifer as a source of domestic drinking water is limited primarily to the Central Basin and the western Highland Rim. No public supplies use the source at present.

The aquifer is composed of Cambrian and Ordovician dolomites and dolomitic limestones. It is hydraulically interconnected with the overlying limestone of the Central Basin aquifer system locally in the Central Basin and western valley of the Tennessee River, but is hydraulically separated from the Central Basin aquifer system on a regional scale.

Ground-water occurrence in the Knox aquifer is limited to permeable zones that are separated by carbonates which function as leaky confining layers. These zones of permeability have been described from core samples. Unlike the bedding plane and vertical joint porosity and permeability of the overlying Devonian-Ordovician limestones aquifer, porosity and permeability in the Knox is in the form of a network of small tubular interconnected voids that are areally extensive. Well yields from the aquifer are small and generally do not exceed 10 gallons per minute (gal/min), but only rarely do wells penetrating the upper 150 feet of the Knox fail to provide an adequate supply for domestic use (Newcome and Smith, 1962).

In the Central Basin and western Highland Rim where ground water in the aquifer is part of a dynamic flow system, dissolved solids concentrations range from several hundred to more than 1,000 mg/L. Below this upper zone, permeability in the Knox aquifer is much lower and analyses of ground water with more than 3,000 mg/L dissolved solids have been documented. The depth of freshwater cannot be defined because data are sparse. Isolated analyses indicate that at some locations the Knox contains water with less than 10,000 mg/L dissolved solids at depths greater than 3,000 feet.

Table 1.--Geohydrology of the formation comprising the Knox aquifer

[Sources: Newcome (1958), Hardeman (1966), Miller (1974)]

SYSTEMS	SERIES	STRATIGRAPHIC UNIT	GEOLOGIC DESCRIPTION	HYDROLOGIC SIGNIFICANCE: OCCURRENCE IN TENNESSEE	HYDROLOGIC SIGNIFICANCE: HYDROLOGIC CLASSIFICATION AND CHARACTER	HYDROLOGIC SIGNIFICANCE: YIELD
ORDOVICIAN	Middle	Pierce Limestone	Limestone, shaly, thin bedded. Total thickness is about 25 feet.	Areally extensive. Present from beneath Cumberland Plateau to west of the Tennessee River.	Relatively insoluble. Shale impedes the downward movement of water.	Yields little or no water to wells. Highly mineralized water.
ORDOVICIAN	Middle	Murfreesboro Limestone	Limestone, massive, dense, dark blue to bluish-gray, cherty. Total thickness about 425 feet.	Areally extensive. Present from beneath Cumberland Plateau to west of the Tennessee River.	Solution openings occur in the outcrop area. Low permeability at depth.	Where it occurs at depth, commonly doesn't yield water to wells. Yields may be in excess of 100 gallons per minute in outcrop area.
ORDOVICIAN	Middle	Pond Spring Formation (Tennessee usage)	Limestone, silty dolomite and dolomitic limestone. Some shales and local conglomeritic zones. Thickness from 0 to 150 feet. This formation is equivalent to the Wells Creek Formation.	Limited to Sequatchie Valley, western Central Basin and Highland Rim pinches out to east.	Confining layer with generally low porosity and permeability. solutional features developed locally.	Does not generally yield water to wells.
ORDOVICIAN / CAMBRIAN	Lower / Upper	Knox Group	Dolomite, gray and brown, fine-grained to granular, siliceous and dense white limestone. Chert abundant near axis of Nashville Dome. Thickness ranges from less than 2,500 to more than 5,000 feet. Includes Mascot Dolomite, Kingsport Formation, Longview Dolomite, Chepultepec Dolomite, and Copper Ridge Dolomite.	Areally extensive, from Valley and Ridge to west of Tennessee River.	Water occurs in thin zones of small tubular voids. Permeable zones separated by thick impermeable sequences of fine-grained carbonates.	Yields consistently 1 to 10 gallons per minute with few wells exceeding 50 gallons per minute. Only rarely does a Knox well fail to provide an adequate domestic supply.
CAMBRIAN	Upper / Middle	Conasauga Group	Shale, thick-bedded, bluish-gray, siltstone and limestone. Thickness about 2,000 feet.	Areally extensive, from Valley and Ridge to Mississippi River.	Ground water in the Conasauga is restricted to small fractures. Impermeable.	Yields from this formation are not known from west of the Valley and Ridge, but are thought to be low.

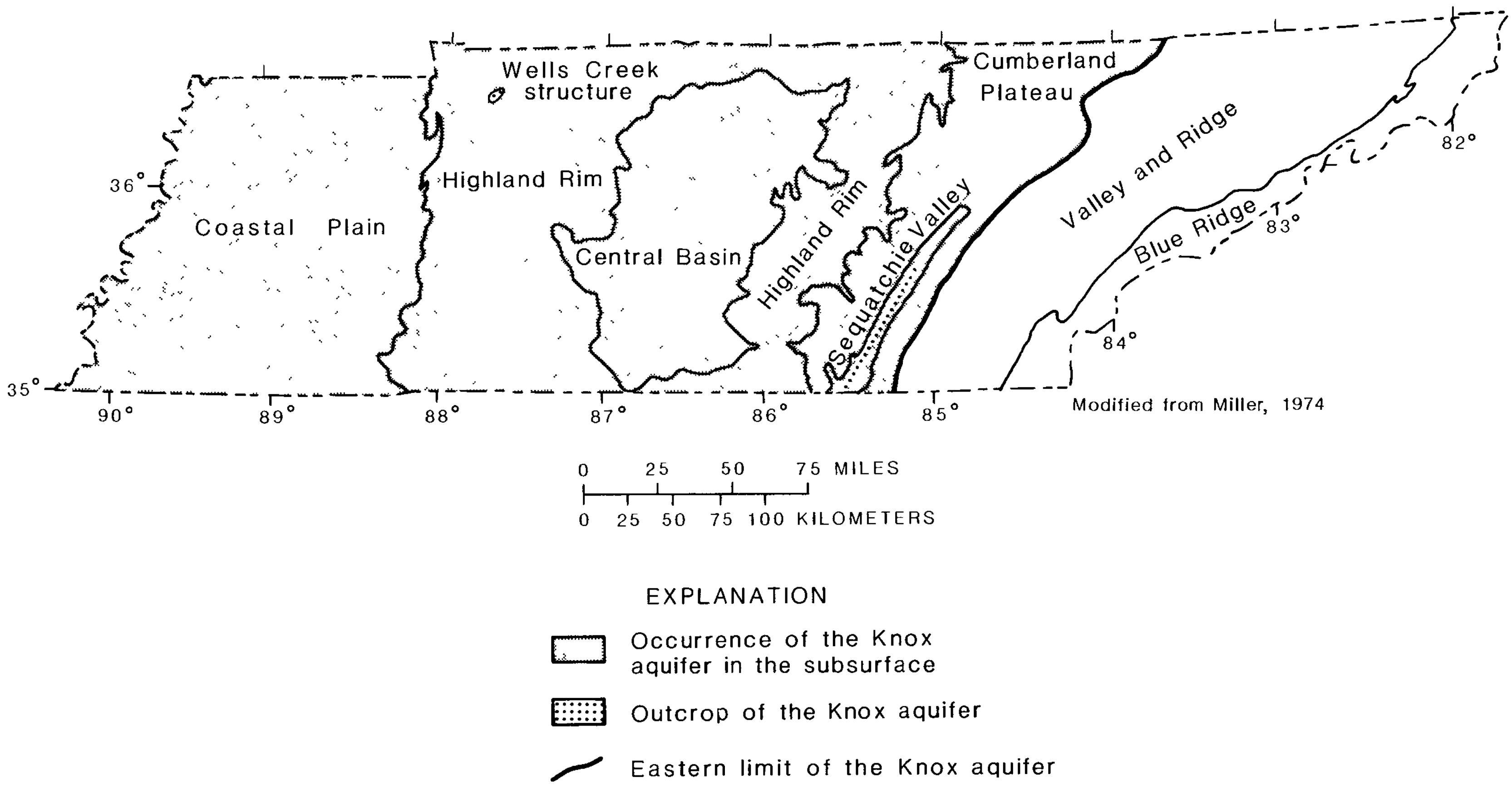
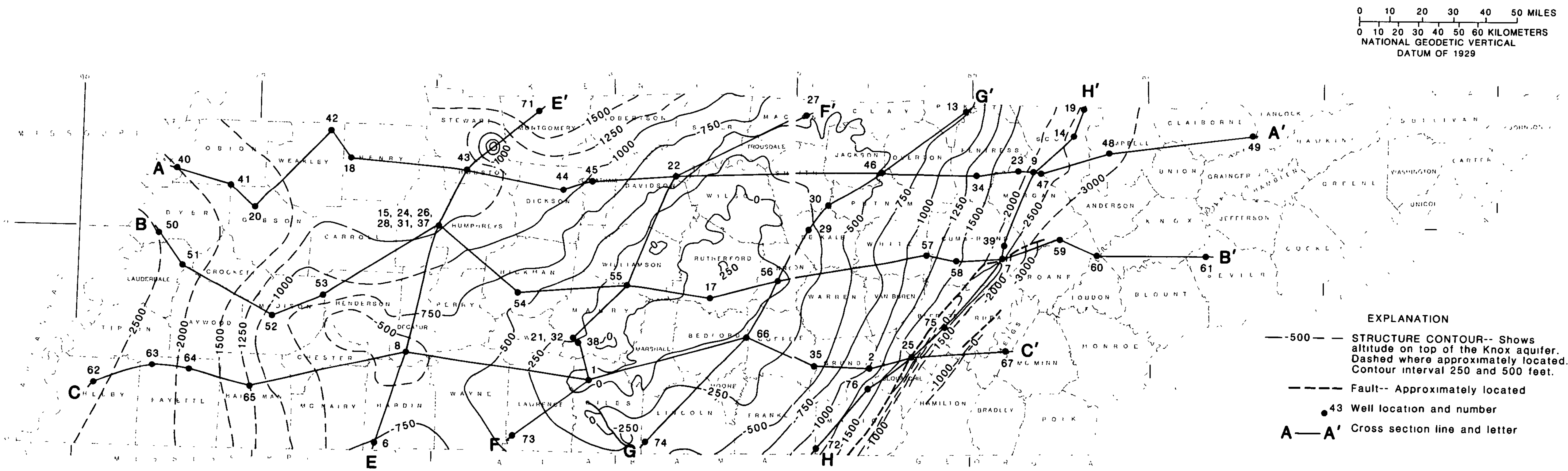


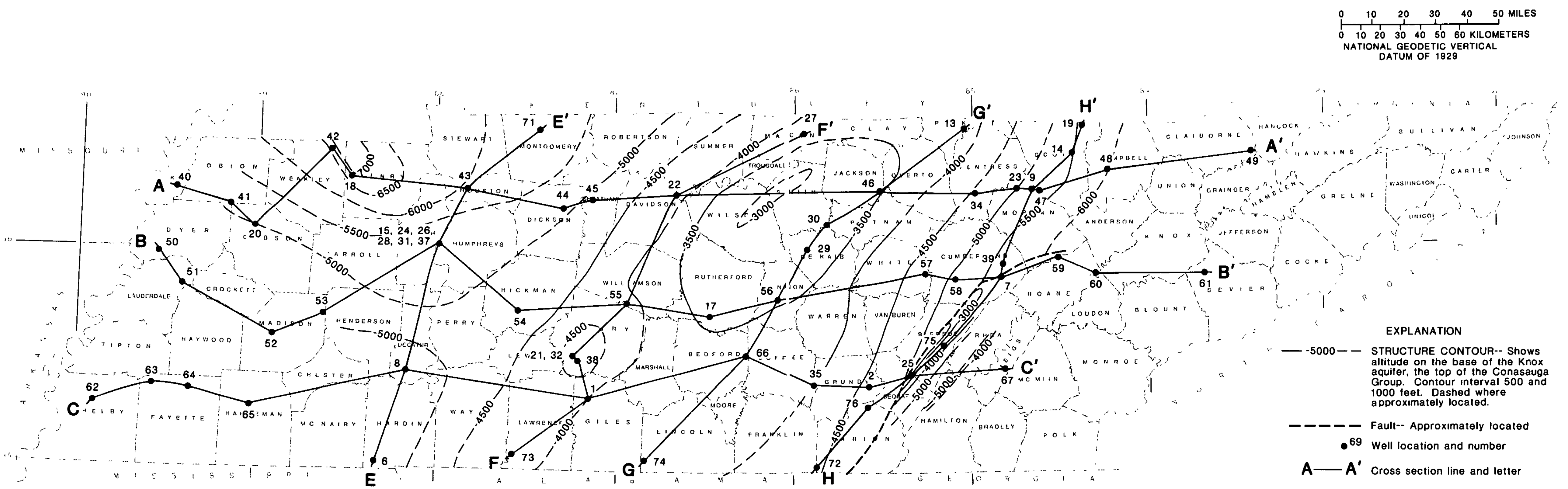
Figure 1.-- Areal occurrence of the Knox aquifer and physiographic provinces in Tennessee.



Base from U.S. Geological Survey State base map, 1:1,000,000, 1973, revised 1973

Modified from Manning and Statler, 1975

Figure 2.-- Structural contours on top of the Knox aquifer.



Base from U.S. Geological Survey
State base map 1:1,000,000,1957
revised 1973

Modified from Manning and Statler, 1975

Figure 3.-- Structural contours on the base of the Knox aquifer.

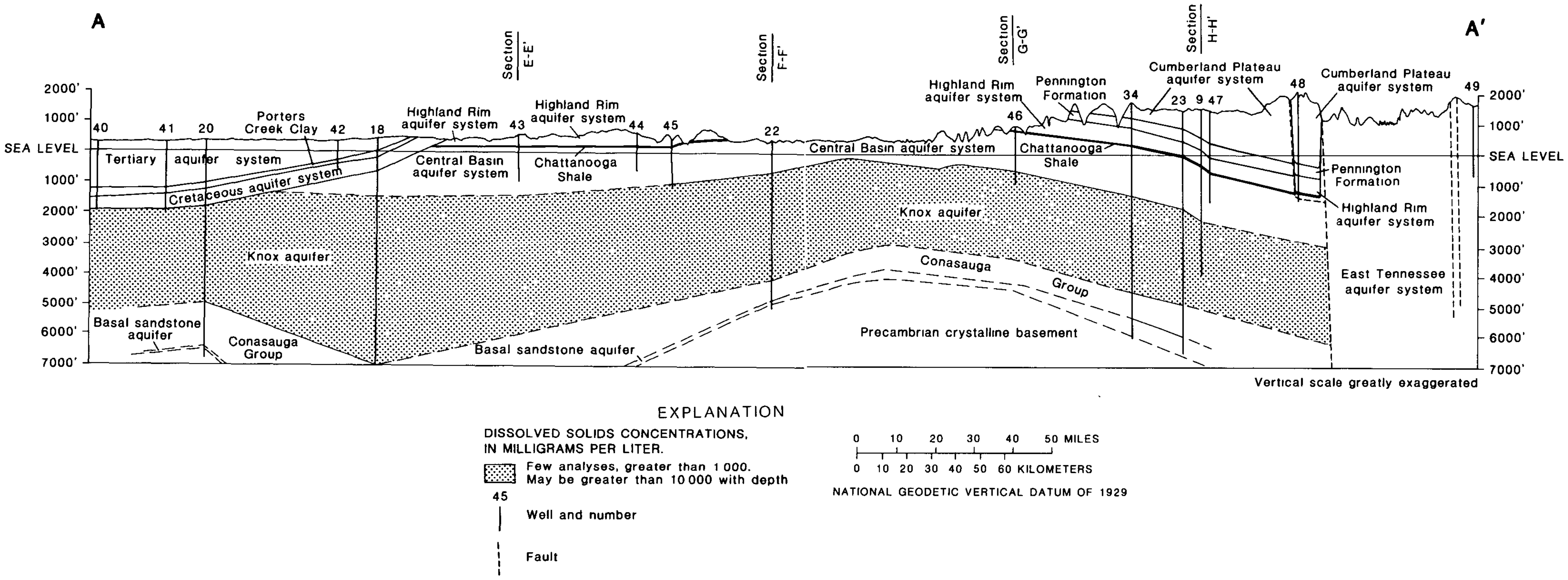


Figure 4.-- Geohydrologic section showing water quality in the Knox aquifer along line A-A'.

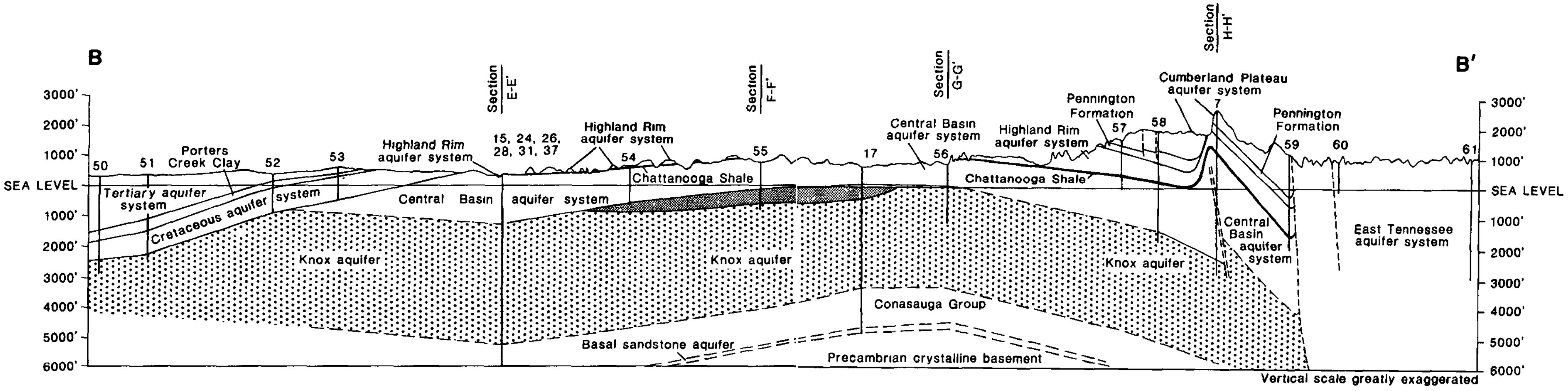


Figure 5.-- Geohydrologic section showing water quality in the Knox aquifer along line B-B'.

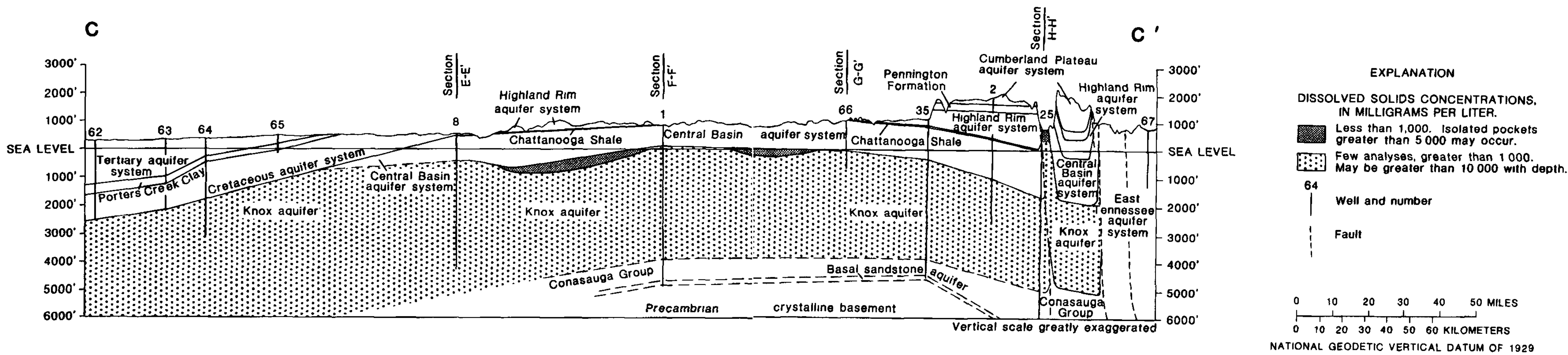


Figure 6.-- Geohydrologic section showing water quality in the Knox aquifer along line C-C'.

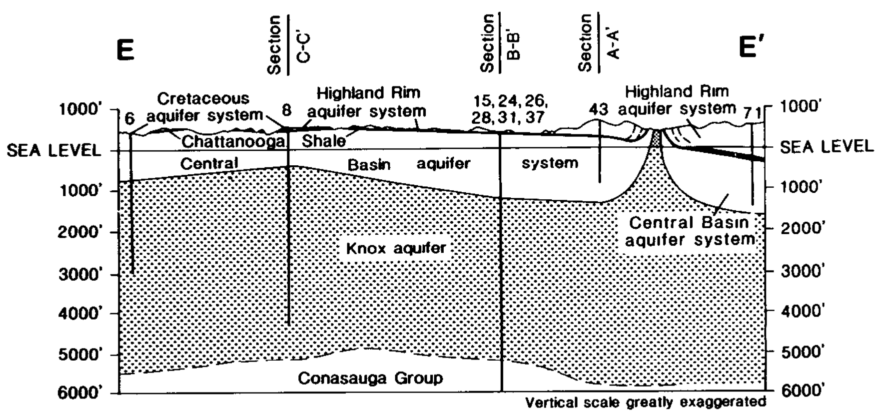


Figure 7.-- Geohydrologic section showing water quality in the Knox aquifer along line E-E'.

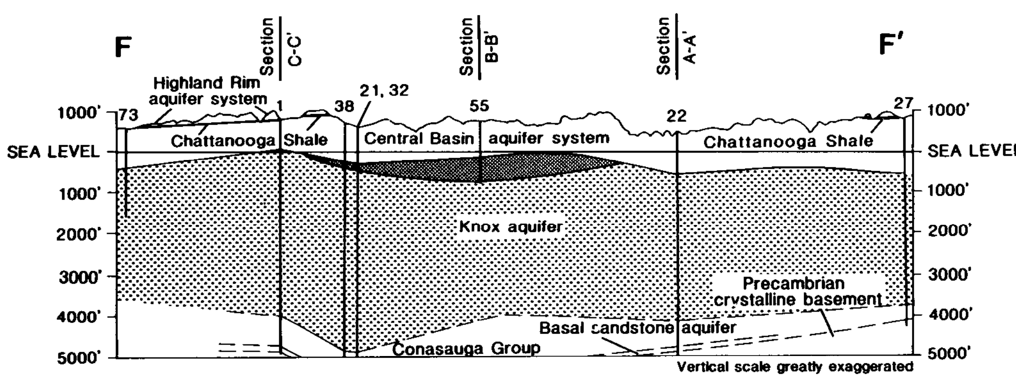


Figure 8.-- Geohydrologic section showing water quality in the Knox aquifer along line F-F'.

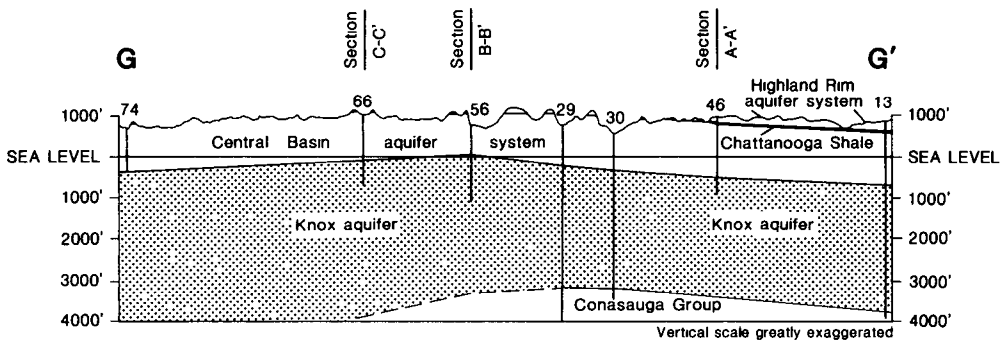


Figure 9.-- Geohydrologic section showing water quality in the Knox aquifer along line G-G'.

EXPLANATION

DISSOLVED SOLIDS CONCENTRATIONS, IN MILLIGRAMS PER LITER

Less than 1 000. Isolated pockets greater than 5 000 may occur.

Few analyses, greater than 1 000. May be greater than 10 000 with depth.

43 — Well and number

Fault

0 10 20 30 40 50 MILES

0 10 20 30 40 50 60 KILOMETERS

NATIONAL GEODETIC VERTICAL DATUM OF 1929

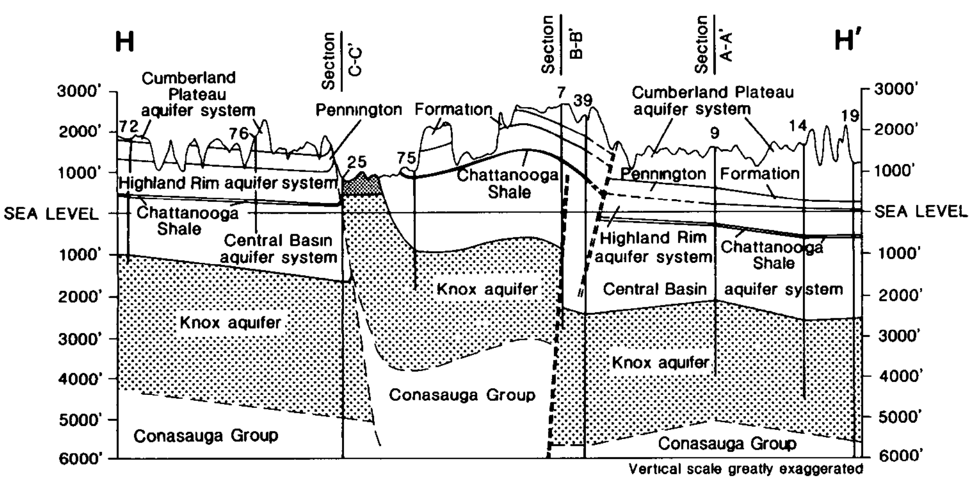


Figure 10.-- Geohydrologic section showing water quality in the Knox aquifer along line H-H'.

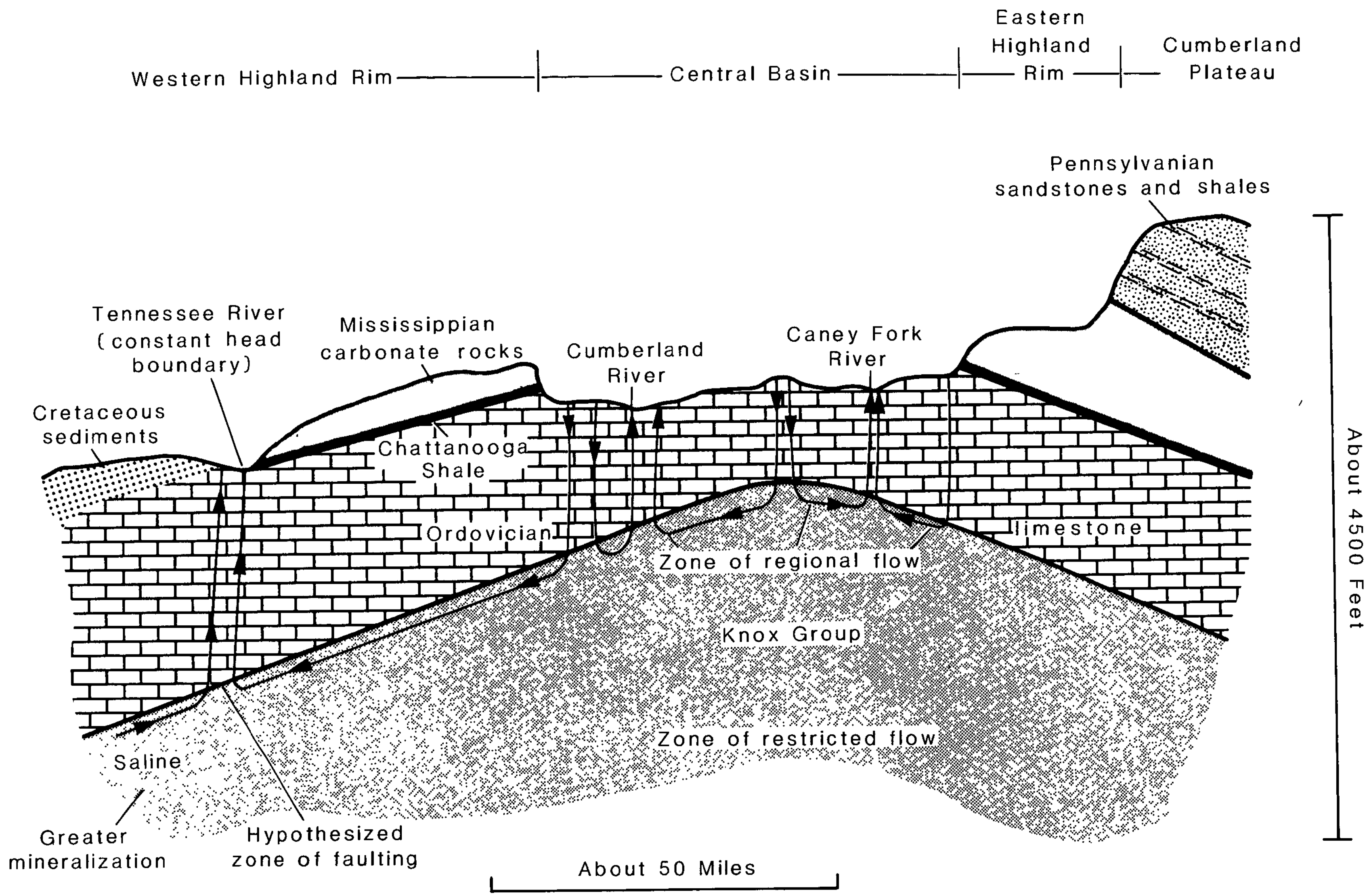


Figure 11.-- Conceptual model of flow in the Knox aquifer.

Table 2.--Dissolved solids concentrations from selected wells in the Knox aquifer

[Date source:
1. Newcome and Smith (1962)
2. Unpublished records - Tennessee Division of Water Resources
3. Unpublished records - Tennessee Division of Geology
4. Unpublished records - Tennessee Division of Water Quality Control
5. Unpublished records - U.S. Geological Survey
6. Newcome (1958)
7. Fischer and Hoagland (1970)

C, estimate based on calculation from concentration of major constituents; A, estimate based on average of more than one chemical analysis; L, estimate based on interpretation from geophysical log analysis]

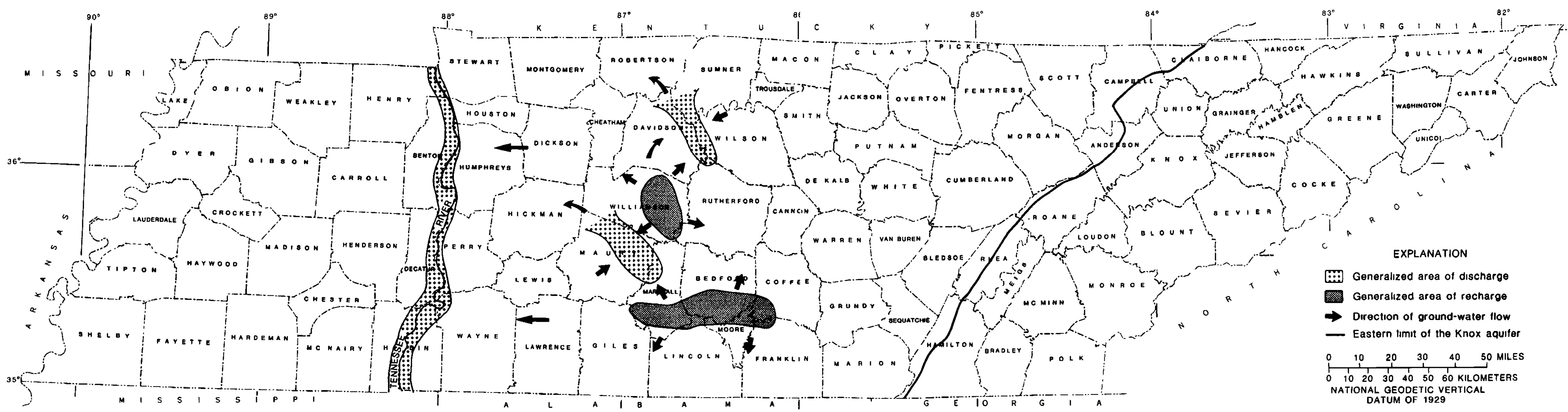
County	Location	Well depth (feet)	Dissolved solids (milligrams per liter)	Data source
Bedford	Farmington 3 mi E	746	610	1
	Shelbyville 0.5 mi N	858	602	1
	Wheel	817	428	1
	Unionville 1.75 mi NW	694	2,450 C	1
Benton	Eva	1,441	5,500 A	2
Cannon	Woodbury 8.5 mi SW	1,005	1,100 C	1
Davidson	Nashville 6 mi N	1,095	4,080	5
	Forest Hills	1,110	1,003	1
	Nashville	1,149	2,064	1
	Nashville 1.5 mi N	1,241	2,563	1
	Old Hickory 3 mi SW	1,057	6,552	1
	Brentwood 2.5 mi W	1,300	524	1
	Bellevue 3 mi W	1,600	570 C	1
	Madison	1,095	3,248	1
	LaVergne 1.5 mi NW	937	576	1,6
	Nashville	859	2,350	1,6
DeKalb	Alexandria	1,385	1,100 +C	1
Dickson	White Bluff 1 mi NE	1,551	1,450 C	1
Giles	Good Spring	705	1,416	5
	Lynnville	1,084	1,257	1
	Ardmore 3 mi NW	957	468	1
	Pulaski 3.5 mi W	874	270	1
	Pulaski	931	720	1
	Campbellsville	1,000	1,159	1

Table 2.--Dissolved solids concentrations from selected wells in the Knox aquifer--Continued

County	Location	Well depth (feet)	Dissolved solids (milligrams per liter)	Data source
Humphreys	New Johnsonville	1,980-2,196	1,250	2,3,4
	New Johnsonville	3,730-4,020	2,115	2,3,4
	New Johnsonville	4,657-6,735	4,283	2,3,4
Jackson	Gainesboro 9 mi W	1,465	4,524	1,6
	Gainesboro 6 mi ESE	1,034	14,898	1
Lincoln	Ardmore 3 mi NE	1,050	16,170	1
Marshall	Cornersville	940	3,002	5
	Lewisburg 4.75 mi WNW	830	1,060	1,6
	Verona 3 mi NE	595	960 C	1
	Lewisburg	835	750 C	1
	Holtland 1 mi NW	788	270 C	1
	Petersburg 0.5 mi NW	905	292	1
	Caney Spring 2 mi NE	788	507	1
Maury	Columbia 4.5 mi SW	922	685	1
	Mt. Pleasant 3 mi NE	1,037	480 C	1
	Spring Hill 0.5 mi SE	970	302	1
	Culleoko 3.5 mi E	800	1,619	1
	Berlin 4.25 mi NW	545	627	1
	Jameson 1.5 mi SW	1,047	1,550 C	1
	Columbia 4 mi NE	990	990 C	1
	Waco 5 mi NNE	1,044	900 C	1
	Mt. Pleasant 1.5 mi SE	1,168-1,329	550	2,3,4
	Mt. Pleasant 1.5 mi SW	4,580-4,720	4,340	2,3,4
Perry	Beardstown 1.5 mi SW	1,625	860 C	1
	Linden	1,320	2,762	1
Pickett	Byrdstown 4.5 mi NE	2,101	20,383	1
Rutherford	Lascassas 1 mi NE	584	2314	1
	Smyrna 3.5 mi NE	632	2,220	1,6
	Smyrna 2 mi SE	513	432	1
	Murfreesboro 2 mi NW	461	270	1
	Double Springs 0.5 mi SE	852	1,185	1
	Concord 1.75 mi W	760	518	1
	Pinnacle Hill 2.25 mi NE	493	300	1

Table 2.--Dissolved solids concentrations from selected wells in the Knox aquifer--Continued

County	Location	Well depth (feet)	Dissolved solids (milligrams per liter)	Data source
Smith	Elmwood 1 mi W	4	4,450 C,A	7
Sumner	Bethpage	1,415	18,768	1
	Saundersville 2 mi N	1,133	6,577	1,6
Trousdale	Hartsville 5 mi SW	1,300	2,530	1
Wayne	Clifton 3 mi NE	1,125	804	1
	Waynesboro 6 mi SE	3,003	1,551	1
Wilson	Lebanon 2 mi E	2,003	1,175 C	1
	Green Hill 1 mi W	1,004	1,632	1
Williamson	Bingham 3 mi N	1,020	1,440	1,6
	Brentwood 1.5 mi S	1,002	556	1
	Ewingville 1 mi NE	912	1,330	1
	Franklin 1.4 mi W	1,338	1,968	1
	Kirkland	916	700	1
	Nolensville 2 mi SE	1,135	1,428	1
	Thompson Sta. 3 mi NE	906	545	1,6
	Franklin 1.75 mi E	950	526	1,6



Base from U.S. Geological Survey State base map, 1:1,000,000, 1957, revised 1973

Hydrology modified from Newcome and Smith, 1962

Figure 12.-- Discharge and recharge areas of the Knox aquifer.

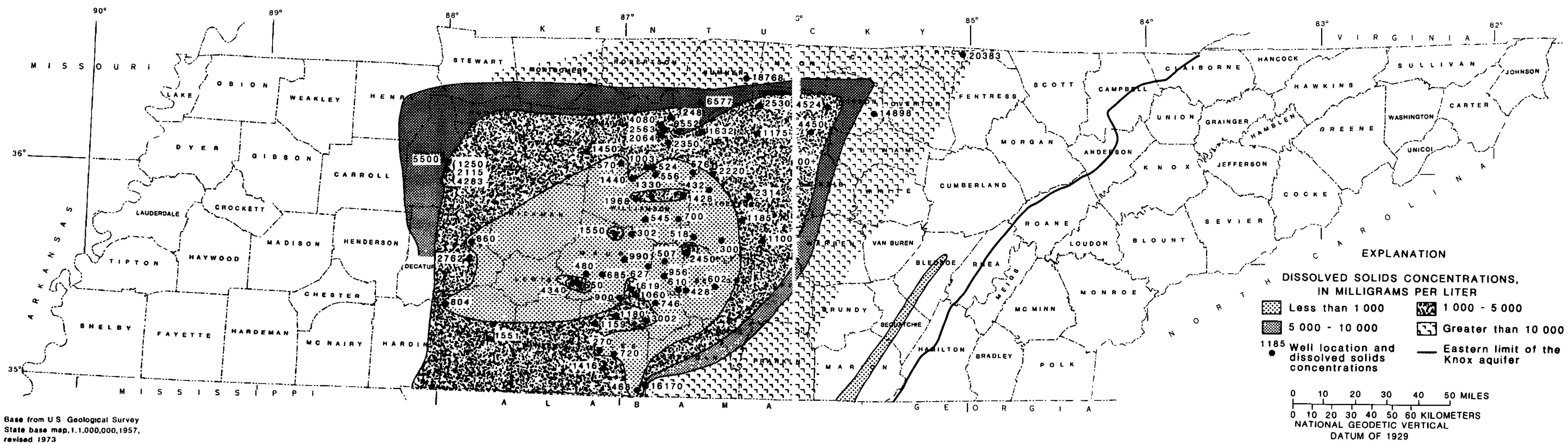
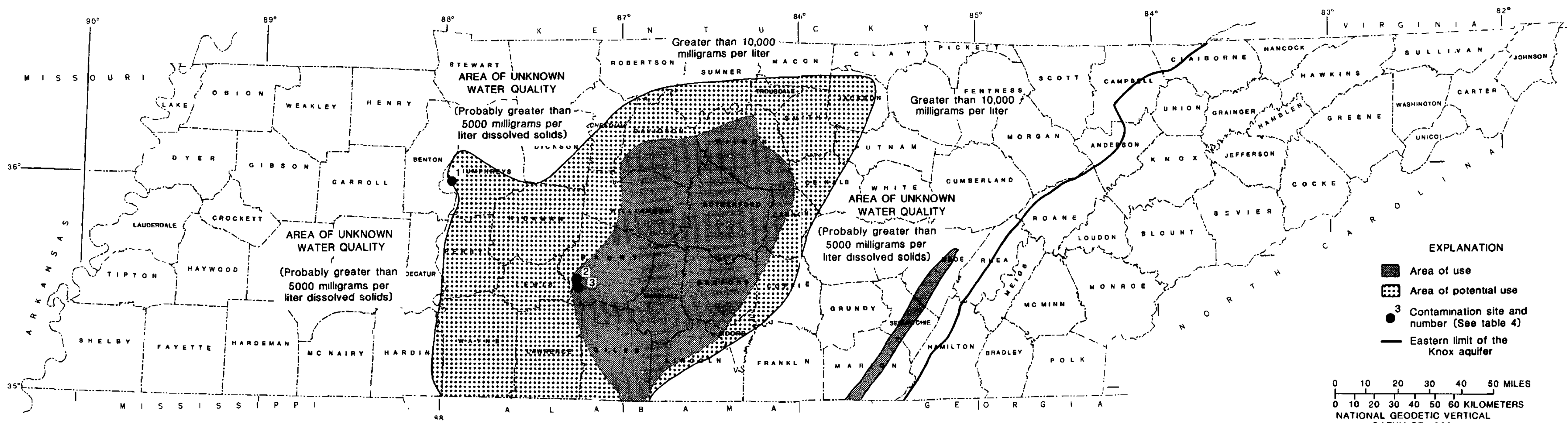


Figure 13.-- Concentration of dissolved solids in the upper Knox aquifer.



Base from U S Geological Survey State base map, 1 1,000,000, 1957, revised 1973

Figure 14.-- Areas of use and potential use of the upper Knox aquifer for drinking water supplies and contaminant sites in the lower Knox aquifer

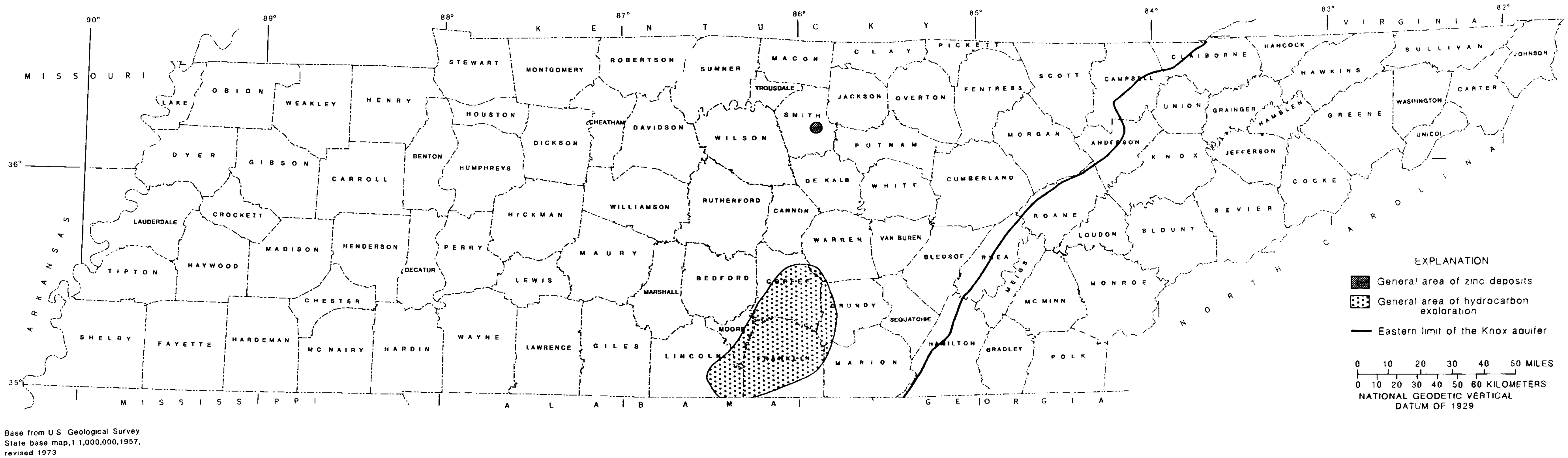


Figure 15.-- Hydrocarbons and mineral resources of the Knox Group

Table 3.--Description of contamination sites in the Knox Group

[Data from the Tennessee Division of Geology and Tennessee Division of Public Health]

Site identification number	Location	Type of contamination	Stratigraphic interval contamination	Remarks
1	New Johnsonville, Humphreys County.	Industrial wastes Deep-well injection	Injection into the Copper Ridge Dolomite in the lower part of the Knox Group, the Conasauga Group, and underlying unnamed basal Cambrian sandstone.	Before injection of iron chloride, water quality analyses indicated low dissolved solids, less than 1,000 mg/L to a depth greater than 5,000 feet. After injection dissolved solids increased to 99,000 mg/L in one of six wells. Contamination of the Knox unknown.
2	Mount Pleasant, Maury County.	Industrial wastes Deep well injection	Injection into the Copper Ridge Dolomite in the lower part of the Knox Group, the Conasauga Group, and underlying unnamed basal Cambrian sandstone.	Injected wastes consist primarily of sodium chloride. Extent of contamination to aquifer unknown.
3	Mount Pleasant, Maury County.	Industrial wastes Deep well injection	Injection into the Copper Ridge Dolomite in the lower part of the Knox Group, the Conasauga Group, and underlying unnamed basal Cambrian sandstone.	Injected wastes consist primarily of sodium chloride. Extent of contamination unknown.

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