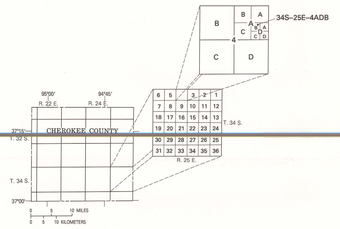
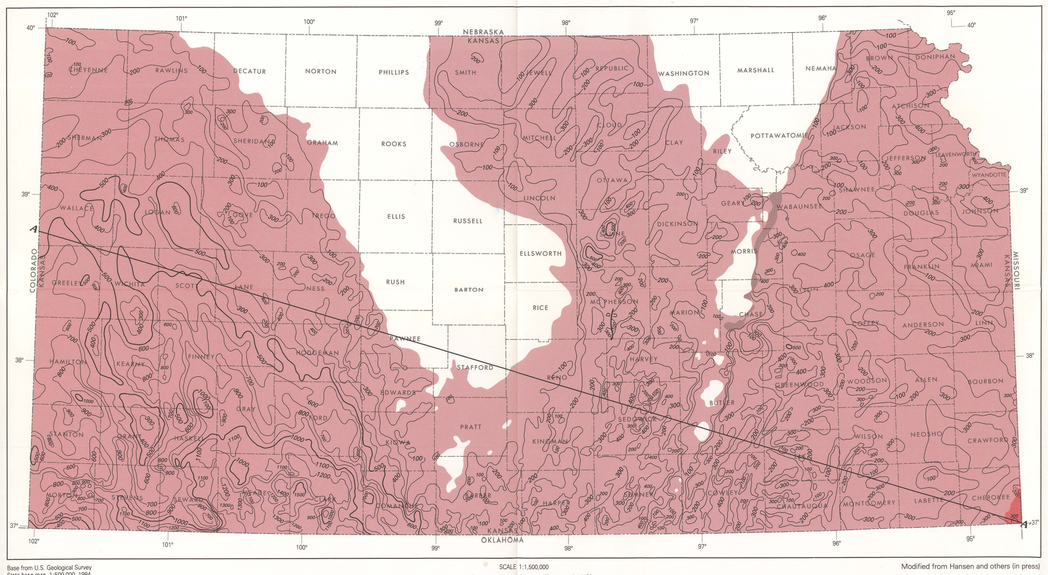
INTRODUCTION

The purpose of the investigation is to provide a description of the principal geohydrologic systems in Upper Cambrian through Lower Cretaceous rocks in Kansas. This investigation was made as part of the Central Midwest Regional Aquifer-System Analysis (CMRASA). The CMRASA is one of several major investigations by the U.S. Geological Survey of regional aquifer systems in the United States. These regional investigations are designed to increase knowledge of the flow regime and hydrologic properties of major aquifer systems and to provide quantitative information for the assessment, development, and management of water supplies. The CMRASA study area includes all or parts of 10 Central Midwestern States (Jorgensen and Signor, 1981), as shown of the envelope cover.

This Hydrologic Investigations Atlas, which consists of a series of chapters, presents a description of the physical framework and geohydrology of principal aquifers and confining systems in Kansas. Chapter H presents the geohydrology of the upper aquifer unit in the Western Interior Plains aquifer system. The physical framework of the aquifer system in relation to other systems is described by maps and sections showing areal extent and the thickness of rocks that compose the unit. The physical framework of the upper aquifer unit is described in detail in chapter D of the atlas (Hansen and others, in press). The hydrology of the system in relation to that of other systems is described in this chapter by maps showing the altitude of fluid levels and the direction of water movement within the unit. The chemical composition of water in the system is described by maps that show the distribution of dissolved-solids concentrations and the differences in water types on the basis of principal chemical constituents. Chapter A of this atlas series (Wolf and others, 1990) describes the relation of principal geohydrologic systems in Kansas and presents a more detailed discussion of the methods and data used to prepare and ensure consistency among the sets of maps.

Maps in this chapter are based on available data from selected geophysical and lithologic logs, drill-stem tests, water-level measurements, and water-quality analyses and from published maps of stratigraphically equivalent units. An index to the geohydrologic data compiled for the CMRASA in Kansas is presented in Spinazola and others (1987). Note that most of the data used to construct the maps were collected at different times and, therefore, do not reflect aquifer conditions for any specific time period. The reader should refer to the "Selected References" contained on sheet 2 of this chapter for a listing of the published material used as part of map compilation. Wells in this report are numbered according to a modification of the U.S. Bureau of Land Management's system of land subdivision. In this system, the first set of digits of a well number indicates the township south (S) of the Kansas-Nebraska State line; the second set, the range east (E) or west (W) of the sixth principal meridian; the third set, the section in which the well is situated. The first letter of the third set of digits denotes the quarter section, or 160-acre tract within the section; the second, the quarterquarter section, or 40-acre tract; the third, the quarter-quarter-quarter section, or 10-acre tract. Subdivisions of each section are designated A, B, C, D in a counterclockwise direction beginning in the northeast quadrant. In the following example diagram, well 34S-25E-4ADB is located in the northwest quarter of the southeast quarter of the northeast quarter of section 4, township 34 south, range 25 east.

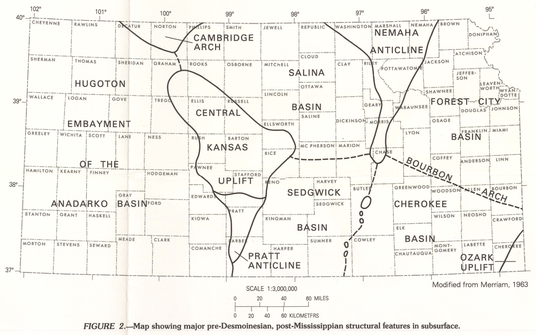




Base from U.S. Geological Survey
State base map, 1:500,000, 1984

Modified from Hansen and others (in press)

FIGURE 1.—Geohydrologic map showing extent and thickness of upper aquifer unit in Western Interior Plains aquifer system.



Modified from Merriam, 1963

FIGURE 2.—Map showing major pre-Desmoinesian, post-Mississippian structural features in subsurface.

TABLE 1. Generalized stratigraphic units and related geohydrologic systems

SYSTEM	Series	Provincial series	Geologic unit	Geohydrologic systems: Subdivisions	Geohydrologic systems: Major systems
QUATERNARY	Holocene		Undifferentiated Quaternary deposits		Alluvial and glacial-drift aquifer system
	Pleistocene				
TERTIARY	Miocene		Ogallala Formation		High Plains aquifer system
CRETACEOUS	Upper		Undifferentiated Upper Cretaceous rocks		Great Plains confining system
	Lower		Dakota Formation	Upper aquifer unit	Great Plains aquifer system
			Kiowa Shale	Confining unit	
			Cheyenne Sandstone	Lower aquifer unit	
JURASSIC	Upper		Morrison Formation	Upper unit	Western Interior Plains confining system
			Undifferentiated Upper Jurassic rocks		
PERMIAN	Upper		Big Basin Formation	Lower unit	
	Lower		Day Creek Dolomite		
			Whitehorse Formation		
			Nippewalla Group: Dog Creek Formation, Blaine Formation, Flowerpot Shale, Cedar Hills Sandstone, Salt Plains Formation, Harper Sandstone		
			Sumner Group: Stone Corral Formation, Ninnescah Shale, Wellington Formation		
			Chase Group		
			Council Grove Group		
			Admire Group		
PENNSYLVANIAN	Upper	Virgilian	Wabaunsee Group		
			Shawnee Group		
			Douglas Group		
		Missourian	Lansing Group		
			Kansas City Group		
		Desmoinesian	Undifferentiated Desmoinesian rocks		
	Middle	Atokan	Undifferentiated Atokan rocks		
	Lower	Morrowan	Undifferentiated Morrowan rocks		
MISSISSIPPIAN	Upper	Chesterian	Undifferentiated Chesterian rocks		
	Lower	Meramecian	Undifferentiated Upper and Lower Mississippian rocks	Upper aquifer unit	Western Interior Plains aquifer system
		Osagean			
		Kinderhooklian			
DEVONIAN			Undifferentiated Lower Mississippian and Upper Devonian rocks	Confining unit	
SILURIAN			Hunton Formation	Upper part of lower aquifer unit	
ORDOVICIAN	Upper		Maquoketa Shale		
	Middle		Viola Limestone		
			Simpson Group		
	Lower		Arbuckle Group	Lower part of lower aquifer unit	
CAMBRIAN	Upper				
PRECAMBRIAN			Igneous, metamorphic, and metasedimentary rocks		Basement confining system

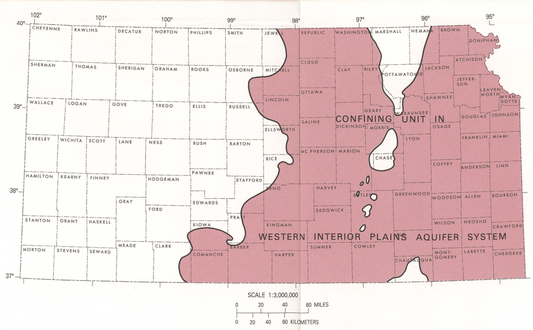


FIGURE 3.—Geologic map showing extent of confining unit in Western Interior Plains aquifer system.

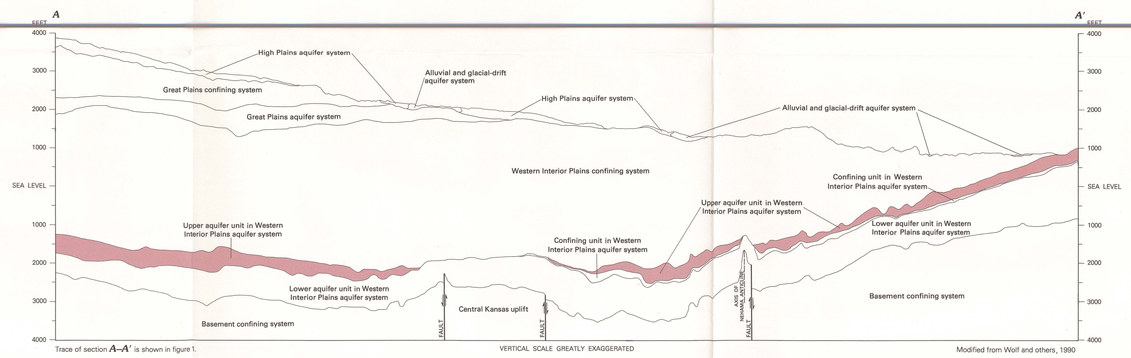


FIGURE 4.—Geohydrologic section showing relation of upper aquifer unit in Western Interior Plains aquifer system to other geohydrologic systems.

DESCRIPTION OF PHYSICAL CHARACTERISTICS

The Western Interior Plains aquifer system is included within the rocks of Late Cambrian to Late Mississippian age in Kansas. In the extreme southeastern corner of the State, the system also has been included with adjacent States as part of a CMRASA subregional analysis for the Ozark Plateaus aquifer system. For ease of mapping and convenience of discussion, only the terminology for the Western Interior Plains aquifer system is used in this report.

Two aquifer units and an intervening confining unit are identified within the Western Interior Plains aquifer system. The upper aquifer unit of the aquifer system comprises of permeable limestone, cherty limestone, and dolomite of Mississippian age. This upper unit includes carbonate rocks from the uppermost part of the Kinderhookian through the Meramecian Provincial Series, as shown in table 1. It is equivalent, in part, to the Springfield Plateau aquifer of the subregional Ozark Plateaus aquifer system (Imes, 1990). Rocks in the upper aquifer unit of the Western Interior Plains aquifer system underlie most of Kansas (fig. 1). They are exposed in the extreme southeastern corner of the State and are absent in areas where they have been eroded from the Central Kansas Uplift and the Nemaha Anticline (fig. 2). Thickness of the upper aquifer unit is greatest in the basin areas, reaching a maximum of about 1,500 feet in the Hugoton Embayment.

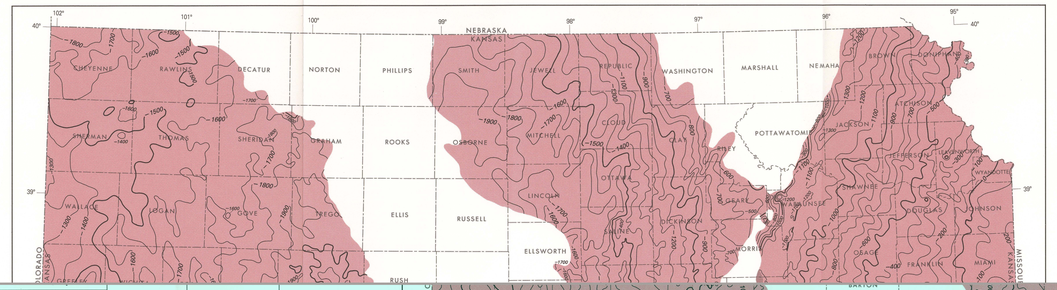
The upper aquifer unit is underlain throughout most of the eastern one-half of Kansas by the predominately shale sequences of Late Devonian through Early Kinderhookian age, which is known as the confining unit of the Western Interior Plains aquifer system (fig. 3). Where present, these rocks separate the upper and lower aquifer units of the Western Interior Plains aquifer system. The confining unit is equivalent, in part, to the Ozark confining unit in the subregional Ozark Plateaus aquifer system analysis (Imes, 1990). In western Kansas, where the confining unit is absent, the upper aquifer unit lies directly above the lower aquifer unit of the Western Interior Plains aquifer system, and the two units function as one aquifer.

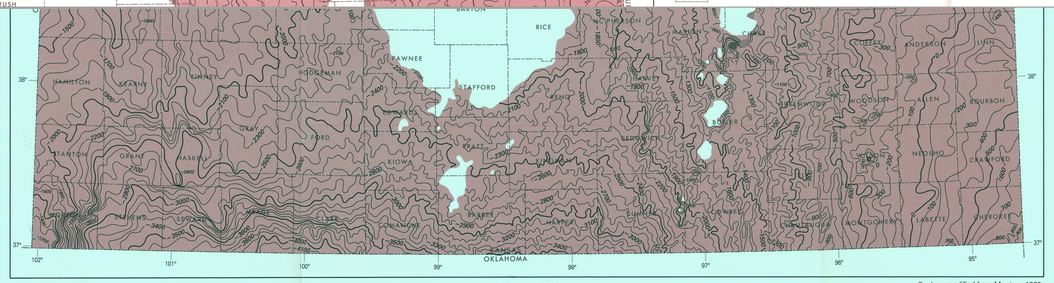
The lower aquifer unit in the Western Interior Plains aquifer system consists of a thick series of limestone, dolomite, shale, and sandstone of Late Cambrian through Early Devonian age. This geohydrologic unit occurs throughout the State except for areas of the Central Kansas Uplift and the Nemaha Anticline. The lower aquifer unit is described in Chapters F and I of this series.

The Western Interior Plains aquifer system is overlain by a thick, predominantly shale sequence of Late Mississippian through Jurassic age, which is known as the Western Interior Plains confining system. This confining system is present throughout Kansas, except for a small area in the southeastern corner. The Western Interior Plains aquifer system is underlain by igneous, metamorphic, and metasedimentary rocks of Precambrian age, which is known as the basement confining unit.

The stratigraphic relation of the Western Interior Plains aquifer system to overlying and underlying geohydrologic systems is illustrated in figure 4.

Altitude and configuration of the top of the upper aquifer unit in the Western Interior Plains aquifer system are shown in figure 5. Altitude of the top ranges from a maximum of about 900 feet above sea level at the outcrop area in southeastern Kansas to a minimum of about 4,100 feet below sea level in Clark and Meade Counties, southwestern Kansas.





Base from U.S. Geological Survey
State base map, 1:500,000, 1984

Geology modified from Merriam, 1960

FIGURE 5.—Geohydrologic map showing altitude and configuration of top of upper aquifer unit.

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer
gallon per minute (gal/min)	0.06309	liter per second
cubic foot per day per square foot times foot of aquifer thickness [(ft³/d)/ft²] ft	0.09290	cubic meter per day per square meter times meter of aquifer thickness

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum 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 Sea Level Datum of 1929.

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GEOHYDROLOGIC SYSTEMS IN KANSAS—GEOHYDROLOGY OF THE UPPER AQUIFER UNIT IN THE WESTERN INTERIOR PLAINS AQUIFER SYSTEM

By
J.F. Kenny, C.V. Hansen, and R.J. Wolf

1993