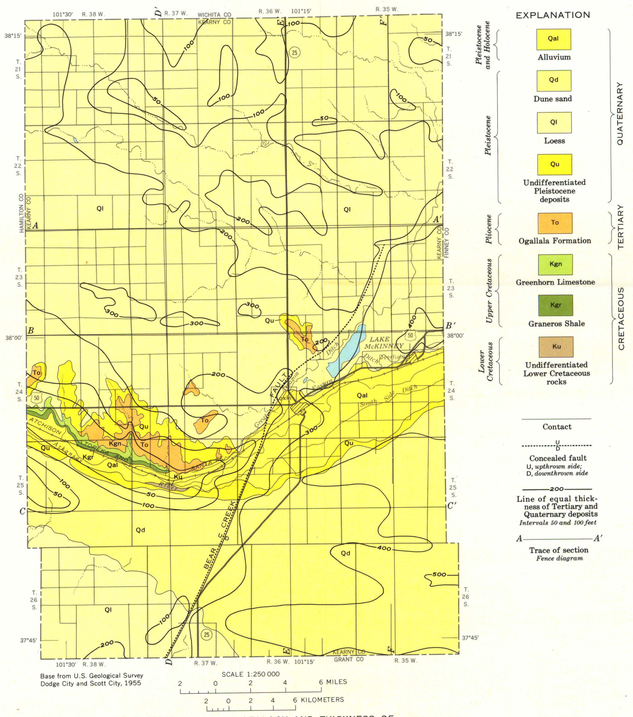
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

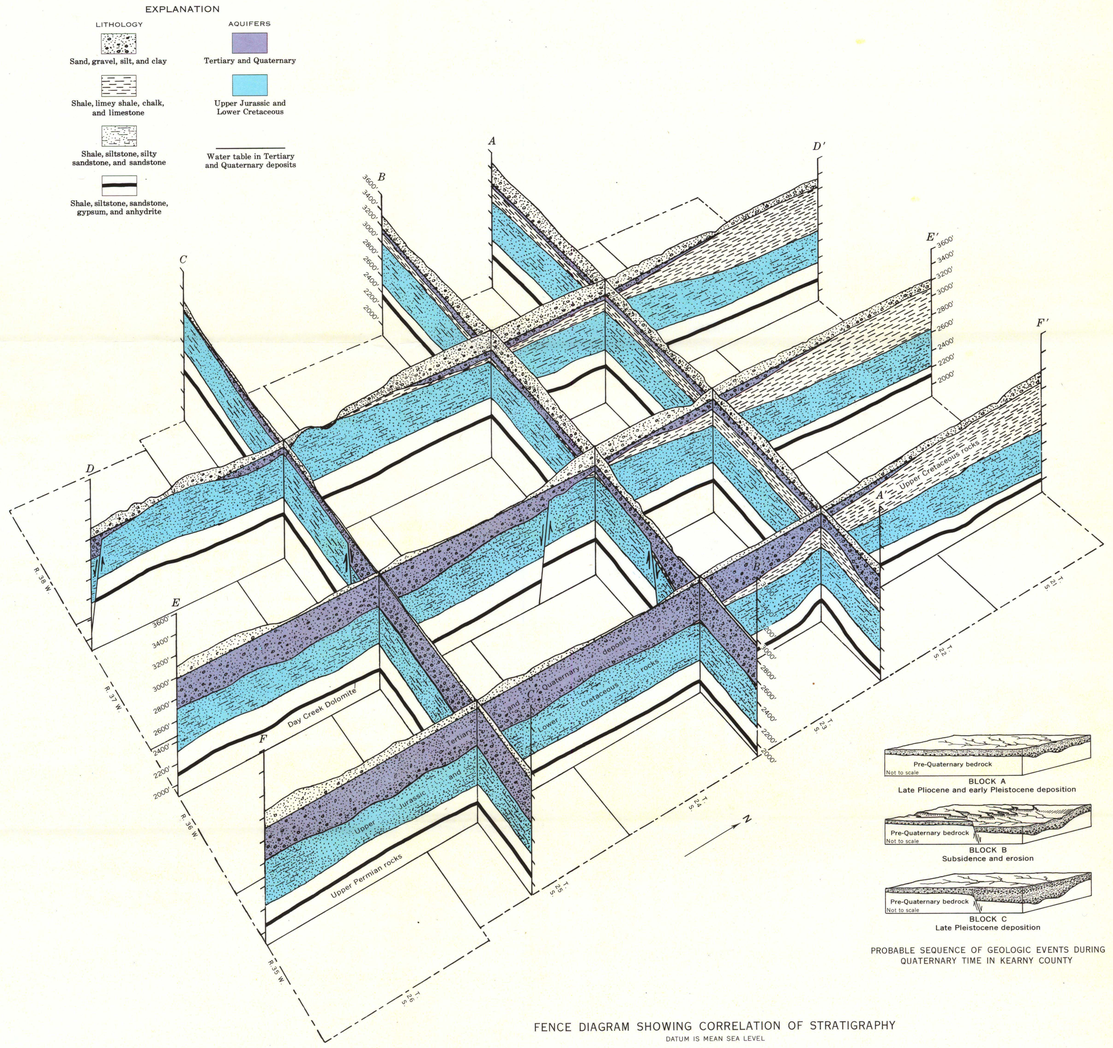
PREPARED IN COOPERATION WITH THE
STATE GEOLOGICAL SURVEY OF KANSAS
KANSAS STATE DEPARTMENT OF HEALTH
KANSAS STATE BOARD OF AGRICULTURE

HYDROLOGIC INVESTIGATIONS
ATLAS HA-416 (SHEET 1 OF 2)

GEOLOGY AND STRATIGRAPHY

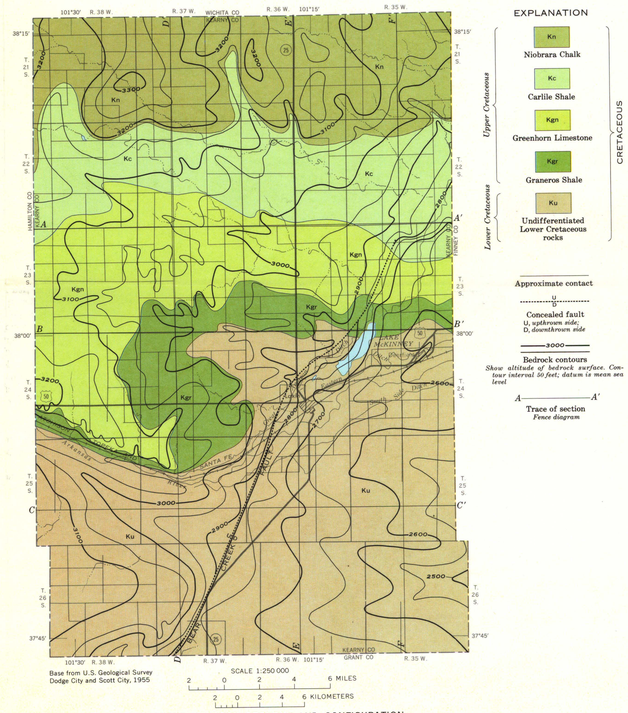


MAP SHOWING SURFICIAL GEOLOGY AND THICKNESS OF TERTIARY AND QUATERNARY DEPOSITS



PROBABLE SEQUENCE OF GEOLOGIC EVENTS DURING QUATERNARY TIME IN KEARNY COUNTY

FENCE DIAGRAM SHOWING CORRELATION OF STRATIGRAPHY
DATUM IS MEAN SEA LEVEL



MAP SHOWING BEDROCK GEOLOGY AND CONFIGURATION OF THE BEDROCK SURFACE

GEOLOGY AND STRATIGRAPHY

SURFICIAL GEOLOGY AND THICKNESS OF TERTIARY AND QUATERNARY DEPOSITS

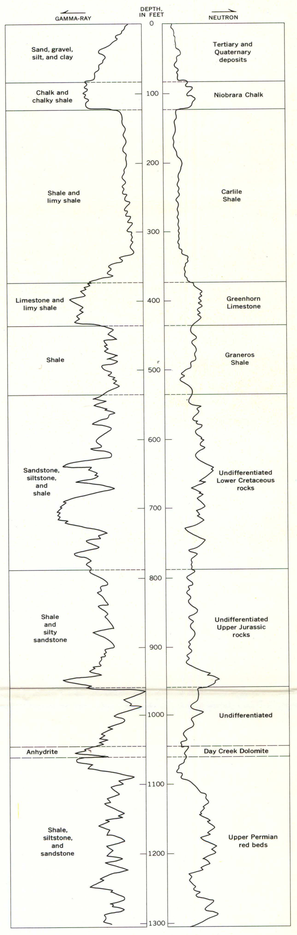
Tertiary and Quaternary deposits underlie most of Kearny County and range in thickness from a few feet to about 500 feet. Cretaceous rocks underlie these younger deposits in most of the county and crop out along the Arkansas River valley in the western part (see surficial geologic map and fence diagram). The Ogallala Formation (Pliocene) and undifferentiated Pleistocene deposits, which consist of intertonguing beds containing variable mixtures of gravel, sand, silt, and clay, also crop out along the river valley. The thick sequence of alternating fine-grained and coarse-grained sediments in the lower part of these deposits east of the Bear Creek fault is considered to be of Pliocene to early Pleistocene age. The predominantly coarse-grained sediments in the upper part that are continuous across the fault are considered to be of late Pleistocene age. Loess deposits mantle much of the upland, and the soil formed on the loess is ideally suited for farming. The dune sand forms a broad belt of hummocky ridges south of the river valley and is used chiefly for rangeland. Alluvium containing sand, gravel, and cobbles of late Pleistocene age overlain by clay, silt, and sand of Holocene age occurs along the flood plain of the Arkansas River and underlies it to a depth of about 60 feet.

STRATIGRAPHY

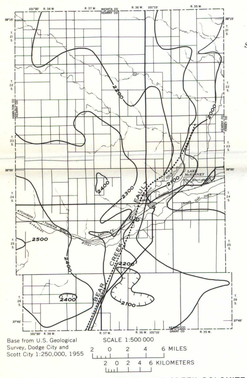
An interpretation of the structure, erosion, and lithologic changes in the subsurface is necessary to evaluate the potential ground-water resources of the area. One of the more useful tools in the correlation of geologic units is a gamma-ray and neutron log, available for many oil and gas test holes. By comparing data obtained from the study of rock outcrops or drill cuttings to responses on radioactivity logs, it is possible to interpret the lithology and thicknesses of geologic units. The log does not show the water-yielding capability, but does indicate the character of the formation, from which the water-yielding capability may be inferred.

The generalized gamma-ray and neutron log shown illustrates some typical responses to geologic formations underlying Kearny County. The sharp contrast in the response to the Tertiary and Quaternary deposits and the response to the Cretaceous rocks is the result of dissimilar lithology. In the Upper Cretaceous rocks, a sharp contrast in responses distinguishes the shale from the limestone and chalk. Correlation of individual lithologic units in the Upper Jurassic and Lower Cretaceous rocks is extremely difficult because the sandstone, sandy shale, and shale beds are thin and discontinuous. Consequently, only a few thick shale or sandstone beds are traceable for many miles.

The Permian red beds, which are not a source of potable ground water in the county, represent the maximum depth for water-well drilling. The contact between the silty shale in the Upper Permian rocks and the sandstone or sandy shale in the Upper Jurassic rocks generally is shown by a distinct change on the log. One of the most distinctive and persistent marker beds in the geologic section is the Day Creek Dolomite of Permian age. This bed consists of anhydrite that is uniform in thickness (15 to 20 feet) and lithology in much of southwest Kansas. Altitudes of the top of the Day Creek provide the most accurate information on bedrock structure and substantiate the location of the Bear Creek fault (see structure-contour map).



GENERALIZED GAMMA-RAY AND NEUTRON LOG



STRUCTURE-CONTOUR MAP OF DAY CREEK DOLOMITE

Table 1.—*Generalized columnar section and water-yielding characteristics*

Note.—The classification and nomenclature of the stratigraphic units used in this report are those of the U.S. Geological Survey and differ somewhat from those of the State Geological Survey of Kansas.

System	Series	Stratigraphic unit	Thickness, feet	Physical character	Water supply
Quaternary	Holocene and Pleistocene	Alluvium	0–60±	Silt, clay, and sand of Holocene age overlying sand, gravel, and cobbles of late Pleistocene age in the Arkansas River valley	Yields from single wells range from 500 to 2,400 gpm (gallons per minute), and yields from battery wells range from 500 to 4,500 gpm.
	Pleistocene	Dune sand	0–75±	Fine to medium quartzose sand and lesser amounts of coarse sand, silt, and clay formed into mounds and ridges by the wind. Located along the south side of the Arkansas River and covers about 20 percent of the county.	Lies above the water table and does not yield water to wells.
		Loess	0–20±	Windblown silt mantles about 65 percent of the county.	
		Undifferentiated rocks	0–300±	Sand, gravel, silt, clay, and caliche underlies most of the county; overlies the Ogallala Formation when both formations are present.	The sand and gravel of the undifferentiated Pleistocene deposits and the Ogallala Formation are the principal water-yielding deposits in the county. Yields to irrigation wells range from 400 to 2,400 gpm.
Tertiary	Pliocene	Ogallala Formation	0–300±	Poorly sorted sand, gravel, silt, and caliche; unconsolidated to tightly cemented by calcium carbonate.	
Cretaceous	Upper Cretaceous	Niobrara Formation	0–50	Tan-white to light-gray massive chalky limestone; contains dark-gray to brownish-gray shale. Only lower member is found in county.	Not known to yield water to wells. Solution cavities underlying sand and gravel aquifer may yield irrigation supplies.
		Carlile Shale	0–260	Dark blue-gray slightly calcareous to non-calcareous shale in upper part. Lower part consists of very calcareous dark-gray shale interbedded with thin gray limestone beds.	Not known to yield water to wells in Kearny County.
		Greenhorn Limestone	0–60	Dark-gray calcareous shale and light-gray thin-bedded limestone, usually yellow on weathered surface; contains layers of bentonite.	
		Graneros Shale	0–130	Dark-gray calcareous shale interbedded with black non-calcareous shale; contains thin beds of bentonite. Also contains thin-bedded gray limestone and fine-grained silty sandstone layers.	
	Lower Cretaceous	Undifferentiated rocks	210–380	Upper unit (Dakota Formation)—brown to gray fine- to medium-grained sandstone, interbedded with gray sandy shale and varicolored shale. Middle unit (Kiowa Shale)—dark-gray to black shale interbedded with tan and gray sandstone. Basal unit (Cheyenne Sandstone)—gray and brown fine- to medium-grained sandstone, interbedded with dark-gray shale.	Yields 30 to 300 gpm to wells from sandstone aquifers.
Jurassic	Upper Jurassic	Undifferentiated rocks	130–230	Shale, gray, noncalcareous; interbedded with gray-green and blue-green calcareous shale. Contains fine-grained silty sandstone, and thin limestone beds.	A potential aquifer, untested in Kearny County. May yield 30 to 300 gpm.
Permian	Upper Permian	Undifferentiated rocks	350–500	Red shale, sandstone, sandy shale, and anhydrite. Day Creek Dolomite (50 to 250 feet below top of Permian rocks) serves as a marker bed for the subsurface structure.	Yields no potable water to wells.

GEOLOGY AND CONFIGURATION OF THE BEDROCK SURFACE

The configuration of the surface on the underlying Cretaceous rocks indicates an east- to southeast-trending drainage system that has been altered by faulting (see bedrock geologic map). Several well-defined channels on the upthrown side of the fault are in sharp contrast with bedrock ridges on the downthrown side, suggesting two separate erosion cycles. The probable sequence of alteration indicated by the structure of the bedrock surface and the lithology of the overlying alluvial deposits is shown by blocks A, B, and C. The fault extends north from Grant County to sec.4, T.23 S., R.35 W. From there, a steeply dipping monocline extends eastward into Finney County. The maximum displacement along the fault is about 250 feet. This fault, informally called "Syracuse fault" and "Syracuse flexure" by H. T. U. Smith (1940), is here named the Bear Creek fault.

Lower Cretaceous rocks are in contact with the overlying alluvial deposits in the southern part of the county, and Upper Cretaceous rocks subcrop in normal stratigraphic sequence as the altitude of the bedrock surface rises northward. The dip of the Cretaceous formations is northeastward.

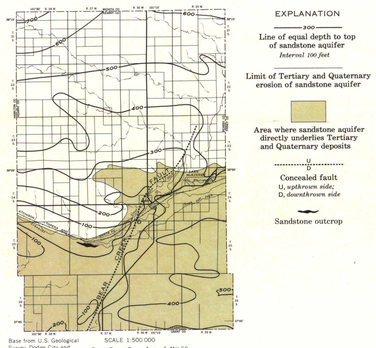
SANDSTONE AQUIFER

The sandstone aquifer is defined here to include all the Upper Jurassic and Lower Cretaceous rocks in Kearny County. The Upper Jurassic rocks consist of a fine-grained silty sandstone unit overlain by a variegated shale and dark-gray sandy shale unit. The Lower Cretaceous rocks consist of the Cheyenne Sandstone (a fine- to medium-grained sandstone interbedded with shale), the Kiowa Shale (predominantly shale interbedded with thin sandstone layers), and the Dakota Formation (a fine- to medium-grained sandstone interbedded with sandy shale and shale). The lithology of these formations differs within short distances and individual units are difficult to trace in the subsurface. Thus, the entire section is mapped as a unit and is defined as an aquifer although only part of this unit has the capacity to yield water to wells.

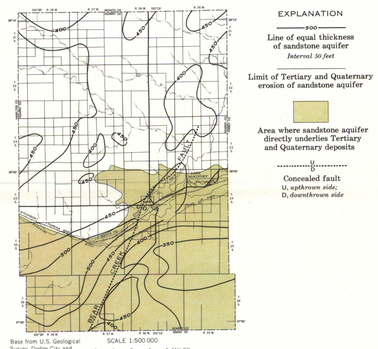
In the southern part of the county, the eroded surface of the sandstone aquifer underlies the Tertiary and Quaternary deposits and crops out in a small area in the Arkansas River valley. In the northern part of the county, the aquifer underlies the Upper Cretaceous shales and limestones. The map of the depth to the top of the sandstone aquifer shows that the depth ranges from 0 to about 500 feet in the southern part of the county owing to the effects of erosion, faulting, and deposition of Tertiary and Quaternary sediments. The depth to the top of the aquifer increases northward from the outcrop to a maximum of about 700 feet.

The map of the thickness of the sandstone aquifer shows that the thickness ranges from about 350 to 500 feet. In the northern part of the county, the thickness is relatively uniform. In the southern part, the thickness differs because some of the upper beds have been removed by post-Cretaceous erosion.

Because the aquifer includes numerous beds of shale and sandy shale and because the sandstone beds commonly are silty or tightly cemented, the yield of ground water to wells may be sufficient only for domestic or stock supplies. In some counties to the south and east, ground water in sufficient quantities for irrigation is obtained from loosely cemented sandstone beds. The few deep tests in Kearny County do not show similar conditions of cementation. It is possible, however, that enough water might be obtained locally to provide irrigation supplies or to provide supplemental supplies to irrigation wells pumping from the overlying Tertiary and Quaternary deposits.



MAP SHOWING DEPTH TO TOP OF SANDSTONE AQUIFER



MAP SHOWING THICKNESS OF SANDSTONE AQUIFER

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GROUND WATER IN KEARNY COUNTY, SOUTHWESTERN KANSAS

By
E. D. Gutentag, D. H. Lobmeyer, and H. E. McGovern

1972

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