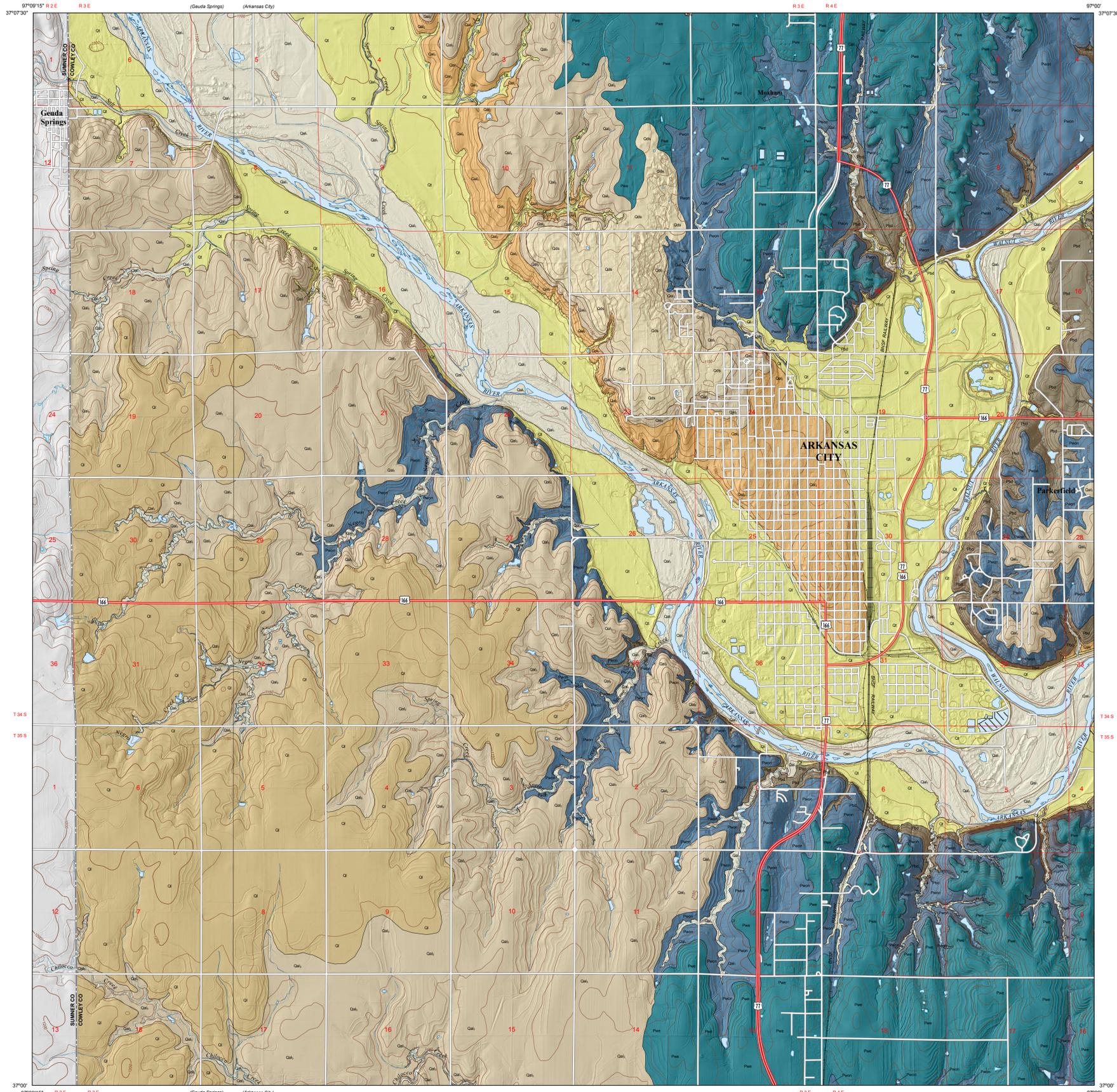


# PRELIMINARY SURFICIAL GEOLOGY OF THE ARKANSAS CITY QUADRANGLE AND THE COWLEY COUNTY PORTION OF THE GEUDA SPRINGS QUADRANGLE, KANSAS

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2018

Funded in part by the  
USGS National Cooperative  
Geologic Mapping Program



**GEOLOGIC UNITS**

**CENOZOIC**

**Quaternary System**

**Pleistocene-Holocene**

**Qal<sub>1</sub>** — Undifferentiated floodplain alluvium — Relatively recent alluvial deposits associated with the Arkansas River and numerous smaller streams and tributaries. Most channel systems, especially those with potential flow, experienced entrenchment during the latter part of the Holocene, likely 1,200–1,000 years ago, with the Arkansas River and its two main tributaries actively undergoing floodplain redevelopment. Floodplain alluvium consists of silt, sand, and gravel, with only minute amounts of clay, exhibited primarily as slack water deposits. The alluvial deposits are relatively thin, probably not exceeding 20 ft (~6 m) in thickness.

**Qal<sub>2</sub>** — Alluvial terrace deposits — Terrace deposits occur along the Arkansas River and smaller streams and tributaries. The Arkansas River valley in Cowley County has a well-exposed broad terrace, primarily on the east side of the channel and is traceable into upstream counties, where it has been radiocarbon and luminescence dated to a maximum age of 35,000 years ago, with younger ages from the late Holocene being derived in relatively close proximity to the modern channel. Terrace deposits of the Arkansas River consist primarily of silt, sand, and gravel and are exposed in multiple cut-bank exposures along the east side. Terrace deposits of the Walnut River, Grouse Creek, and their tributaries are fine-grained (clay, silt, fine sand) as a result of originating in the Permian and Pennsylvanian shales. The thickest deposits of up to 70 ft (21 m) occur in the Arkansas River valley, but thicknesses range down to only a few feet in tributaries.

**Qal<sub>3</sub>** — Upland alluvium — Mid-level upland alluvium is extensive and approximately parallel to and east of the modern Arkansas River bottomland at 60–70 ft (18–21 m) above the modern channel. Unit thickness averages ~10 ft (3 m), but varies significantly due to surface erosion. The alluvium varies in color but is mostly reddish gray to reddish brown and consists of silt, sand, and cherty gravel, with very little clay, and an arkosic composition, reflecting its Rocky Mountain source. There are also local indications of incision of Qal<sub>1</sub>.

**Ql** — Loess — Loess, or wind-deposited silt and fine sand, mantles much of the upland area in western Cowley County. Exposures of the loess are limited, but drill data indicate a maximum thickness of about 25 ft (8 m) with thinning along its edges. Though not dated in this county, loess in other parts of Kansas range from late Pleistocene in age (~30,000–14,000 years ago) to Illinoian in age (~130,000 years ago).

**Qds** — Dune sand — Aeolian sand deposits are few within the county but they do occur on the floodplain (Qal<sub>1</sub>) and low terrace (Ql) of the Arkansas River. Dune sand is sourced from the active channel, probably during low-water periods of strong or gusty winds. Dunes are generally less than 8 ft (2.4 m) in height and vegetated, and the age of dune formation or most recent activation is most certainly within the last few hundred years (Halfen et al., 2012).

**MESOZOIC**

**Permian System**

**Leonardian Series**

**Pwe** — **Wellington Formation** — The Wellington Formation is the only formation of the Permian Sumner Group exposed in Cowley County. The Wellington Formation is about 80 ft (24 m) thick but is upwards of 650 ft (198 m) thick elsewhere in Kansas. It is composed primarily of gray to greenish-gray shales with some thin-bedded and argillaceous limestone, dolomite, siltstone, gypsum, and anhydrite. Members of the Wellington include, in ascending order, the Hollenberg Limestone Member, Carlton Limestone Member, Hutchinson Salt Member, and Milan Limestone Member as well as two unnamed members (Sawin et al., 2008). The Wellington weathers easily and tends to form gentle slopes rather than vertical outcrops. With a lack of exposures revealing the contact between the uppermost Milan Limestone Member and the overlying distinctive reddish-gray Niangua Shale, it is difficult to ascertain stratigraphic situation within the Wellington. The Wellington is locally overlain by loess, but the two have similar soil profiles and topography, making them difficult to distinguish.

**Pwon** — **Winfield Limestone, Odell Shale, and Nolans Limestone** — In ascending order, these are the upper three formations of the Permian Chase Group cropping out in Cowley County. The Winfield Limestone ranges up to 30 ft (~9 m) in thickness and is composed of massive beds of light-blue to gray limestone with thin shale partings. The Winfield weathers white to light gray and forms steep outcrops. Though composed of three members elsewhere, only the uppermost Crosswell Limestone Member is recognized in Cowley County and the upper contact with the Odell Shale is nearly always covered. The Odell Shale is approximately 40 ft (~12 m) thick and is composed of calcareous shale that is predominantly gray with dark blue-gray streaks. The Odell commonly underlies vegetation-covered slopes between the scarp-forming Winfield Limestone and the Herington Limestone Member of the Nolans Limestone. The Nolans Limestone is the uppermost formation of the Chase Group and has a total thickness in Cowley County of approximately 40 ft (~12 m). In ascending order, the formation is composed of the Kinder Limestone Member, Paddock Shale Member, and Herington Limestone Member. The Kinder Limestone Member, commonly less than 10 ft (~3 m) thick, consists of two limestone beds separated by a 1 ft (~0.3 m) yellow-brown shale. The Paddock Shale Member is an ~10 ft (~3 m) bed of gray calcareous shale. The Herington Limestone Member averages 15 ft (4.5 m) in thickness and is a yellowish, dolomitic limestone. In northern Cowley County, the upper portion of the Herington is granular in texture, and the lower is blocky and ledge forming, marking the boundary with the overlying Wellington Formation. The Herington is more massive to the south with abundant chert nodules in the upper part and calcite geodes in the lower.

**Pbd** — **Barneston Limestone and Doyle Shale** — In ascending order, these are the lower two formations of the Permian Chase Group cropping out in Cowley County. The Barneston Limestone is about 80 ft (24 m) thick, thinning to the south in Cowley County, and buff to gray in color, with blue-gray chert occurring in the lower Florence Limestone Member. Echinoid and other fossils occur throughout, with fusulinids near the base. The overlying Okoto Shale Member is generally absent in southeastern Kansas. The upper Fort Riley Limestone Member gradually transitions to the overlying Doyle Shale. The Doyle Shale is about 90 ft (27 m) at its thickest, and is composed of, in ascending order, the Holmesville Shale Member, Towanda Limestone Member, and the Gage Shale Member. The Holmesville Shale Member is an ~30 ft (9 m) feature, greenish gray to red, unfossiliferous shale. The Towanda Limestone Member, averaging ~10 ft (~3 m) in thickness, is a resistant gray to yellow, brecciated limestone that often forms a bench between the lower Barneston and overlying Winfield formations. The Gage Shale Member is a red, green, and brown calcareous shale ~45 ft (~14 m) thick and characterized by a concretion zone. It forms steep slopes between the overlying Winfield Limestone.

**CITED REFERENCES**

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Sawin, R. S., Franseen, E. K., West, R. R., Ludvigson, G. A., and Watney, W. L., 2008. Clarification and changes in Permian stratigraphic nomenclature in Kansas. *Current Research in Earth Sciences: Kansas Geological Survey, Bulletin 254*, part 2. <http://www.kgs.ku.edu/Current/2008/Sawin/index.html>.

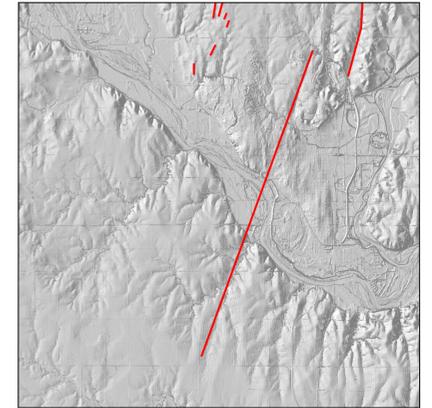
**ADDITIONAL SOURCES**

Bass, N. W., 1929. The geology of Cowley County, Kansas: Kansas Geological Survey, Bulletin 12, 203 p.

Bayne, C. K., 1960. Geology and ground-water resources of Harper County, Kansas: Kansas Geological Survey, Bulletin 143, 183 p.

Bayne, C. K., 1962. Geology and ground-water resources of Cowley County, Kansas: Kansas Geological Survey, Bulletin 158, 219 p.

Walters, K. L., 1961. Geology and ground-water resources of Sumner County, Kansas: Kansas Geological Survey, Bulletin 151, 198 p.



Elevation contours are presented for general reference. Used in the U.S. Geological Survey's current US Topo 1:24,000-scale topographic map series, they were generated from hydrographically improved 1/3 arc-second National Elevation Dataset (NED) data and smoothed during processing for use at 1:24,000 scale. In some places, the contours may be more generalized than the base data used for compilation of geologic outcrop patterns. Outcrop patterns on the map will typically reflect topographic variation more accurately than the associated contour lines. Repeated fluctuation of an outcrop line across a contour line should be interpreted as an indication that the mapped rock unit is maintaining a relatively constant elevation along a generalized contour.

1-meter LiDAR hillshades and 1-meter U.S. Department of Agriculture – Farm Services Agency (USDA-FSA) National Agriculture Imagery Program (NAIP) digital imagery were used as references in the digital mapping. USGS 7.5-minute 1:24,000-scale topographic maps, USDA Natural Resources Conservation Service (NRCS) soil surveys, and other geologic maps and bulletins were used to supplement the mapping. Roads and highways are shown on the base map as represented by data from the U.S. Census Bureau, U.S. Department of Agriculture – Farm Services Agency (USDA-FSA) National Agriculture Imagery Program (NAIP) imagery also was used to check road locations.

Shaded relief is based on 1-meter hydroflattened bare-earth DEMs from the State of Kansas LiDAR Database. The DEM images, in ERDAS IMAGINE format, were mosaicked into a single output DEM, downsampled to 2-meter resolution, and reprojected to decimal degrees. The output DEM was then converted to a hillshade, a multidirectional shaded-relief image using angles of illumination from 0°, 225°, 270°, and 315° azimuths, each 45° above the horizon, with a 4x vertical exaggeration.

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program, award number G17AC00261 (FY2017).

This map was produced using the ArcGIS system developed by Esri (Environmental Systems Research Institute, Inc.). This map is a preliminary product and has had less scientific and cartographic review than the Kansas Geological Survey's M-series geologic maps. KGS does not guarantee this map to be free from errors or inaccuracies and disclaims any responsibility or liability for interpretations made from the map or decisions based thereon.

**SUGGESTED REFERENCE TO THE MAP**

Johnson, W. C., Schlagel, N. A., and Dunham, J. W., 2018. Preliminary surficial geology of the Arkansas City quadrangle and the Cowley County portion of the Geuda Springs quadrangle, Kansas: Kansas Geological Survey, Open-File Report 2018-3, scale 1:24,000, unpublished.

**SCALE 1:24 000**

0 0.5 1 2  
KILOMETERS

0 500 1000 1500 2000  
METERS

0 0.5 1  
MILES

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000  
FEET

UNIVERSAL TRANSVERSE MERCATOR PROJECTION, ZONE 14  
NORTH AMERICAN DATUM OF 1983

**EXPLANATION**

**Boundaries and Locations**

- County boundary
- Township/range line
- Section line
- U.S. highway
- Local road
- Railroad

**Hydrology**

- Perennial stream
- Intermittent stream
- Water body
- Water body – manmade shoreline

**Topography**

- Elevation contour (50-foot interval)
- Elevation contour (10-foot interval)
- Depression contour (50-foot interval)
- Depression contour (10-foot interval)

**Geologic Unit Boundaries**

- Observed contact

APPROXIMATE MEAN DECLINATION, 2018

**QUADRANGLE LOCATION**

**ADJOINING 7.5' QUADRANGLES**

Admville	Hackey	Warfield
Geuda Springs	Arkansas City	Silverdale
Prebham	Newkirk	Kaw City SW