Bedrock Topography of Waterloo Quadrangle
Monroe County, Illinois

Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
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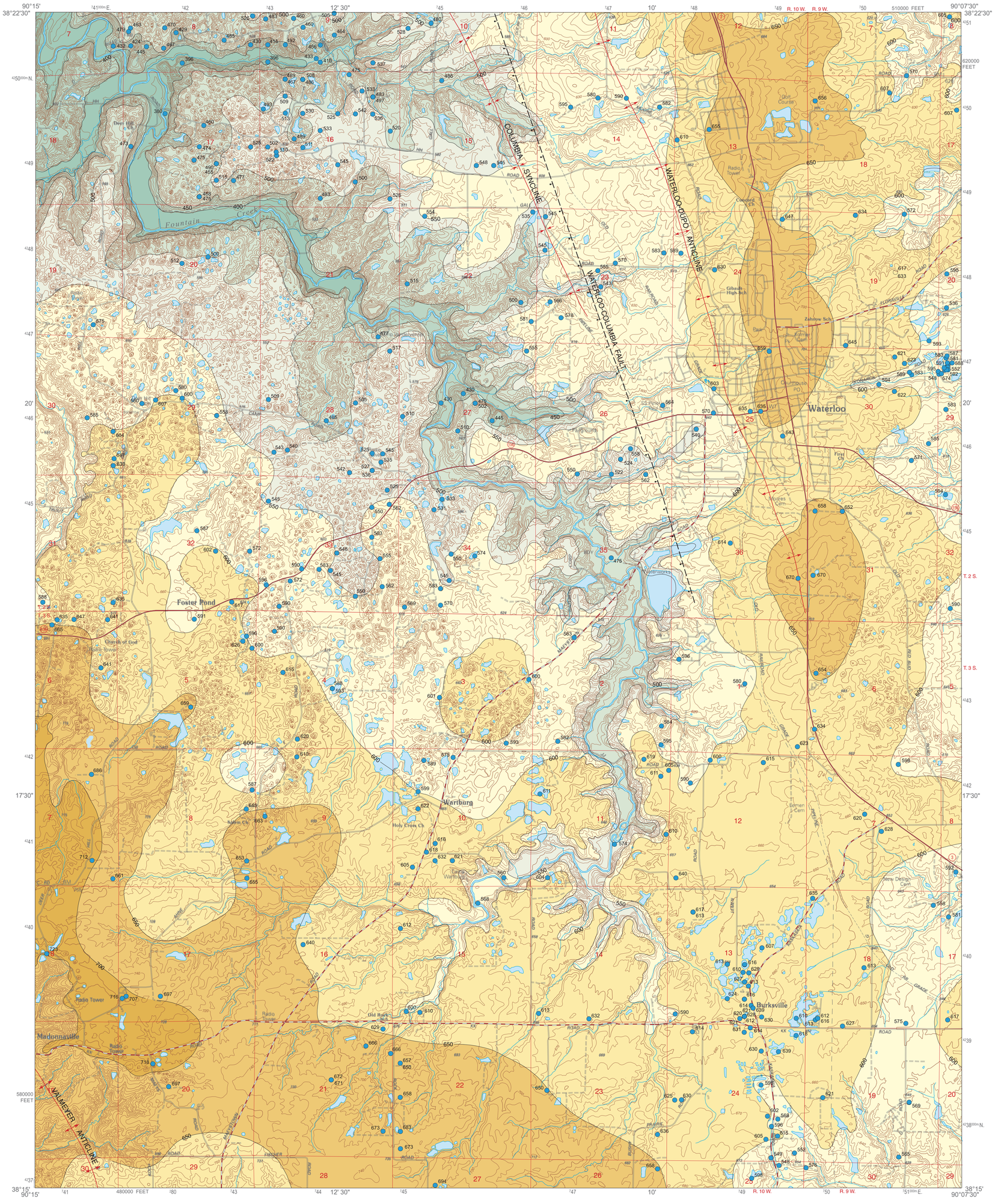
2008

Illinois Geologic Quadrangle Map
IGQ Waterloo-BT



Introduction

The bedrock topography of the Waterloo Quadrangle is part of a series of maps by the Illinois State Geological Survey (ISGS) that interpret (at a scale of 1:24,000) the geology within 7.5-minute quadrangles in the Metro East Illinois area of Greater St. Louis. Data collection and interpretation were funded by the ISGS.

The Waterloo Quadrangle is an area presently experiencing rapid population growth and urban and suburban development of primarily rural and agricultural land. Because of increasing environmental concerns with karst and associated groundwater contamination issues, it is important to document the bedrock topography for urban planning, land use planning, and water resource management.

The Waterloo Quadrangle lies within the southwestern Illinois sinkhole plain, which is within the Salem Plateau Section (Leighton et al. 1948). The karst topography that dominates the study area is the result of the soluble nature of the underlying bedrock. Mississippian-age carbonate bedrock, particularly St. Louis and Ste. Genevieve Limestones, contain solution-enlarged secondary fractures, and the area is characterized by cover-collapse sinkholes, caves, and large springs.

Map Use

This map is useful for delineating the locations of buried bedrock valleys and for defining flow patterns and recharge and discharge pathways of these aquifers. The map is essential for accurate assessment of the volume and distribution of economically significant shallow deposits of limestone and other construction stone. It is a useful predictive guide for drilling operations, construction and engineering projects, and geophysical surveys and as a base map from which geological units and bedrock structures can be delineated. This bedrock surface is the lower limiting surface that must be integrated into three-dimensional models of the overlying Quaternary sediments. Finally, this bedrock surface is the lower limiting surface that must be integrated into three-dimensional models of the overlying Quaternary sediments.

Mapping Methods

Bedrock topography was compiled using data from 335 well logs from the ISGS wells and borings database. Well locations were verified using plat books. Bedrock exposures were used to identify bedrock surface elevations; such exposures were usually associated with the bottom of sinkholes, cave entrances, springs, bluffs along major stream valleys, and stream bottoms. The data were plotted and contoured by hand; the resultant map was scanned into raster format and digitized using ESRI ArcMap software. Bedrock elevations were subtracted from standard 30-m digital elevation model data to be sure that the bedrock surface did not extend above the land surface. Because of the low data density, contour lines were not modified in the vicinity of sinkholes.

Bedrock Topography, Geology, and Hydrogeology

The Waterloo Quadrangle is on the western margin of the Illinois Basin, and the bedrock dips gently to the east. Much of Monroe County and parts of St. Claire County to the north and Randolph County to the south are referred to as the sinkhole plain because of the area's high density of sinkholes. Approximately 10,000 sinkholes (with densities as high as 230 per square mile), numerous large springs, and the largest caves in the state are found in the Salem Plateau Section (Panno and Weibel 1996, Weibel and Panno 1997, Panno et al. 2004). Glacial drift thickness in this area is relatively thin and typically ranges from 0 to 30 feet (Herzog et al. 1994). Bedrock is covered by a layer of windblown loess that overlies Illinoian glacial deposits and pre-Illinois Episode residuum. This material, especially loess, is easily eroded and forms numerous cover-collapse sinkholes (sinkholes formed in sediment overlying creviced bedrock) and steep-sided gullies. Sinkholes have formed in about 30 feet of loess and glacial sediments over crevices in the bedrock surface that are 6 or more inches wide (Panno et al. 2008). As noted earlier, the quadrangle lies within the sinkhole plain of southwestern Illinois (Panno et al. 1997, Weibel and Panno 1997). The karst topography that characterizes the region is the result of the soluble nature of the underlying bedrock (particularly the St. Louis and Ste. Genevieve Limestones) and the moderate amount of annual precipitation (40 inches per year) of the area. Sinkholes have formed in about 30 feet of loess and glacial sediments over crevices in the bedrock surface that are 6 or more inches wide (Panno et al. 2008). Bedrock exposures in the quadrangle are most often associated with sinkholes, cave entrances, large springs, and along the bluffs overlooking Fountain Creek and streambeds. Most sinkholes, caves, and large springs occur in the Mississippian-age St. Louis and Ste. Genevieve Limestones; these fairly soluble rocks are responsible for widespread karst terrain in southwestern Illinois (Weibel and Panno 1997), Kentucky, and Indiana.

The structural features of the Waterloo Quadrangle are dominated by two subparallel elongate ridges associated with the Waterloo-Dupo Anticline in the northeastern portion of the map and the Valmeyer Anticline in the southeastern portion of the quadrangle (Nelson 1995; unpublished mapping by F.B. Denny). The bedrock topography of the quadrangle is generally reflected in the surface topography and is controlled by bedrock lithology and structures. The bedrock topographic ridge in the northeastern quarter of the quadrangle, identified by contour lines greater than 650 feet above mean sea level, is a result of the Waterloo-Dupo Anticline located slightly to the west. The ridge apparently formed as a result of differential erosion of carbonate rocks on the flanks of the anticline. Highway 3 runs in a northwestern trend along the ridge, and where the ridge gently flattens, the highway curves to the southeast. Those constructing the highway apparently followed the ridge in order to avoid sinkhole areas.

The broad valley of Fountain Creek transects the quadrangle from northwest to southeast. Tributaries drain the highs on the crests of the ridges into Fountain Creek. Bedrock lithology in the Waterloo Quadrangle is made up predominantly of St. Louis and Ste. Genevieve Limestones; these areas are characterized by karst terrain. Bedrock along the crest of the Waterloo Anticline is eroded to the Keokuk and Burlington Limestones, Warsaw Shale, and Salem Limestone. Just to the west of the anticline, Pennsylvanian rocks and the Aux Vases and Renault Limestone constitute the bedrock surface. Aux Vases Sandstone and Renault Limestone are found along the very eastern edge of the quadrangle as well (unpublished mapping by F.B. Denny). Karst features are typically not observed in these latter areas.

The region west of the Waterloo-Dupo Anticline is transected by Fountain Creek. Bedrock topography within the structural low along Fountain Creek descends to lower than 400 feet above mean sea level. The creek and its tributaries occupy the central portion of the quadrangle and are bounded by the ridge of the Waterloo-Dupo Anticline to the north and the Valmeyer Anticline to the southwest. The Columbia Syncline structure parallels the Waterloo-Dupo Anticline structure on its western limb, and this topographic low may be related to the development of the Fountain Creek drainage system. Early workers (Lamar 1922, Weller and Weller 1939) suggested that the steep dip of the western limb of the Waterloo-Dupo Anticline is actually a fault, as did J.A. Devera (unpublished mapping) and F.B. Denny (unpublished mapping). Flat-lying Pennsylvanian rocks form the uppermost bedrock within the Columbia Syncline. Pennsylvanian rocks rest in angular unconformity on the steeply dipping, older Mississippian age rocks of the syncline, and Pennsylvanian age rocks are absent on the crest of the Waterloo-Dupo Anticline (Nelson 1995). The Valmeyer Anticline to the southwest is generally defined by a bedrock ridge where the bedrock topography is greater than 650 feet above mean sea level.

References

Herzog, B.L., B.J. Stiff, C.A. Chenoweth, K.L. Warner, J.B. Sieverling, and C. Avery, 1994, Buried bedrock surface of Illinois: Illinois State Geological Survey, Illinois Map 5, 1:500,000.

Lamar, J.E., 1922, Notes on the Waterloo Anticline: Transactions of the Illinois State Academy of Science, v. 15, p. 398–404.

Leighton, M.M., G.E. Ekblaw, and C.L. Horberg, 1948, Physiographic divisions of Illinois: Journal of Geology, v. 56, p. 16–33.

Nelson, J.W., 1995, Structural features in Illinois: Illinois State Geological Survey, Bulletin 100, 144 p.

Panno, S.V., J.C. Angel, D.O. Nelson, C.P. Weibel, and J.A. Devera, 2008, Sinkhole density of Waterloo Quadrangle, Monroe County, Illinois. Illinois State Geological Survey: Illinois Geologic Quadrangle Map, IGQ Waterloo-SD, 1:24,000, report, 6 p.

Panno, S.V., S.E. Greenberg, C.P. Weibel, and P.K. Gillespie, 2004, Guide to the Illinois Caverns State Natural Area: Illinois State Geological Survey, GeoScience Education Series 19, 106 p.

Panno, S.V., and C.P. Weibel, 1996, Karst regions of Illinois: Illinois State Geological Survey, Open File Series 1997-2, 42 p.

Panno, S.V., C.P. Weibel, and W. Li, 1997, Karst regions of Illinois: Illinois State Geological Survey, Open File Series 1997-2, 42 p.

Weibel, C.P., and S.V. Panno, 1997, Karst terrains and carbonate bedrock of Illinois: Illinois State Geological Survey, Illinois Map 8, 1:500,000.

Weller, S., and J.M. Weller, 1939, Preliminary geological maps of the pre-Pennsylvanian formation in part of southwestern Illinois: Illinois State Geological Survey, Report of Investigations 59, 15 p.

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography compiled by photograpmmetric methods from aerial photographs taken 1986. Planimetry derived from imagery taken 1998. PLSS current as of 1989.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, west zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 15

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SCALE 1:24,000

1 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

BASE MAP CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Released by the authority of the State of Illinois: 2008

Based on field work and data compilation by S. Panno, B. Denny, and J. Angel, 2007.

Digital cartography by J. Domier, S. Geegan, and S. Radil, Illinois State Geological Survey.

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4		5
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ADJOINING QUADRANGLES
1 Oakville
2 Columbia
3 Millstadt
4 Valmeyer
5 Paderborn
6 Selma
7 Renault
8 Ames

½° MAGNETIC NORTH TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2008

ROAD CLASSIFICATION

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
State Route

Bedrock Elevation
(feet above mean sea level)

750 700 650 600 550 500 450 400 350

Data Type

615 Water-well boring, bedrock elevation in feet above mean sea level
Normal fault: bar and ball on downthrown side, inferred
Syncline
Anticline

Note: Well and boring records are on file at the ISGS Geological Records Unit and are available from the ISGS Web Site.