BEDROCK GEOLOGY OF RADDLE QUADRANGLE
JACKSON COUNTY, ILLINOIS

Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
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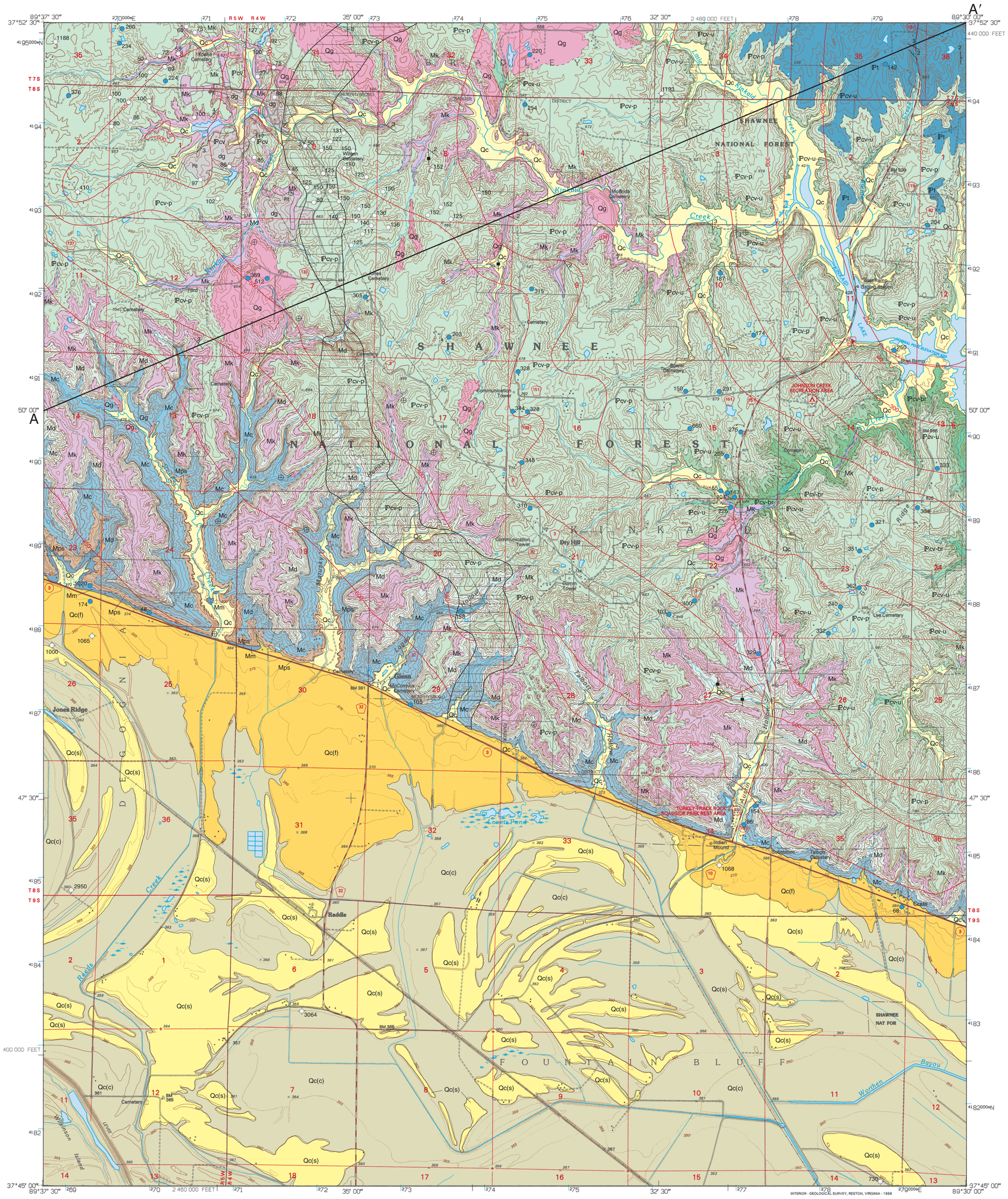
2005

Illinois Preliminary Geologic Map
IPGM Raddle-BG



EXPLANATION

	dg	disturbed ground	
Quaternary	Qc(f)	Cahokia Formation (fan facies)	Holocene and Pleistocene
	Qc(s)	(sandy facies)	
	Qc(c)	(clayey facies)	
	Unconformity		
	Qg	Glasford Formation	
	Unconformity		
	Pt	Tradewater Formation	Desmoinsian and Atokan ?
	Unconformity		
Pennsylvanian	Pcv-p	Caseyville Formation Pounds Sandstone	Morrowan
	Pcv-u	unnamed shale	
	Pcv-br	Battery Rock Sandstone	
	Unconformity		
	Mk	Kinkaid Ls	Chesterian
	Md	Degonia Ss	
Mississippian	Mc	Clore Fm	
	Mps	Palestine Fm	
	Mm	Menard Ls	

Symbols

- 20 — Strike and dip of bedding; number indicates degree of dip
- Horizontal bedding
- Vertical joints

Drill Holes
from which subsurface data was obtained. Numbers indicate total depth of boring in feet

- 260 — Water well
- 100 — Limestone boring
- 410 — Dry oil test

Note: Numbers indicate total depth of boring in feet

Line Symbols
dashed where inferred, dotted where concealed

- Contact
- 440 — Structure contours on the base of the Kinkaid Limestone, contour interval 50 feet
- Basal Pennsylvanian paleovalley
- A—A′ — Line of cross section

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Compiled from imagery dated 1965. Revised from imagery dated 1993. PLSS and survey control current as of 1968. Contours and elevations current as of 1965. Partial field check by U.S. Forest Service 1994. Map edited 1996.

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 16

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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 20 FEET
SUPPLEMENTARY CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Released by the authority of the State of Illinois: 2005

Geology based on field work by J. Devera, 2004–2005.

Digital cartography by M. Jones, Illinois State Geological Survey.

This Illinois Preliminary Geologic Map (IPGM) is a lightly edited product, subject to less scientific and cartographic review than our Illinois Geological Quadrangle (IGQ) series. It will not necessarily correspond to the format of IGQ series maps, or to those of other IPGM series maps. Whether or when this map will be upgraded depends on the resources and priorities of the ISGS.

The Illinois State Geological Survey, the Illinois Department of Natural Resources, and the State of Illinois make no guarantee, expressed or implied, regarding the correctness of the interpretations presented in this document and accept no liability for the consequences of decisions made by others on the basis of the information presented here. The geologic interpretations are based on data that may vary with respect to accuracy of geographic location, the type and quantity of data available at each location, and the scientific and technical qualifications of the data sources. Maps or cross sections in this document are not meant to be enlarged.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

1905-2005 ISGS Illinois State Geological Survey

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4		5
6	7	8

ADJOINING QUADRANGLES
1 Welge
2 Willisville
3 Ava
4 Rockwood
5 Oraville
6 Crosstown
7 Altenburg
8 Gorham

APPROXIMATE MEAN DECLINATION, 2005

ROAD CLASSIFICATION

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

Introduction

The Raddle Quadrangle is located between Carbondale and Chester, in Jackson County, Illinois. About one-third of the quadrangle occurs on the Mississippi River bottoms. The other two-thirds are composed of river bluffs and uplands. The southern third of the quadrangle is comprised of Holocene and Pleistocene gravel, sand, silt and clay deposits which make-up the Mississippi River flood plain. Relief on the flood plain is due to alluvial fans that originate from the mouths of the large south flowing drainages: Austin, Logan and Matusky Hollows, and Reeds Creek. The northern two-thirds of the quadrangle can be divided into two geomorphologic areas: the first, drains water to the south, the second, a higher plateau, drains water to the east along Kinkaid and Little Kinkaid Creeks.

The oldest formation exposed in the quadrangle is the Mississippian Menard Limestone (Upper Chesterian). It can be seen at the base of the bluff along State Highway 3 on the western side of the quadrangle. All of the upper Chesterian units have a regional strike of west-northwest and dip of 2 to 3 degrees north-northeast. Erosion of the Mississippian rocks is greater to the north of the Raddle Quadrangle in the Willisville and Ava Quadrangles (Nelson in preparation and Denny in preparation). The youngest bedrock formation is the lower-middle Pennsylvanian, Tradewater (Atokan and Desmoinsian), which is dominated by siliciclastics. It occurs in the northeastern corner of the map and is locally disconformable with the Caseyville Formation (Morrowan) below.

Surficial deposits in the uplands include an Illinoian diamicton called the Glasford Formation that attains a thickness of 80 feet consisting of clay, silt, sand and glacial erratics, as well as local bedrock rip-up clasts. It is found on the ridges and in valleys along a north-south trend. Windblown silt (loess) occurs above the glacial till and locally above bedrock.

General Stratigraphy and Depositional Environments

The Mississippian rock package is composed of upper Chesterian dark, argillaceous lime mudstones, fossil wackestones and to a lesser extent packstone facies that alternate with dark gray shales and tan to white, fine grained, quartz arenites. In ascending order upper Chesterian units include: Menard Limestone, Palestine Sandstone, Clore Formation (includes shales, limestones and sandstones), Degonia Sandstone, and the Kinkaid Limestone. The carbonate rocks range from near-shore shallow shelf to lagoonal (subtidal, tidal to superatidal facies). The sandstones range from fluvial deltaic to tidal estuarine with evidence of tidal flat environments.

A special case of a tidal flat with small-scaled, tidal creeks can be seen in the Degonia Sandstone in the center of the west half of Section 17, T8S, R4W in Matusky Hollow. In the upper part of the formation, thin tidally laminated beds contain U-shaped troughs that are filled with calcite cement. The troughs weather differentially and are about two feet wide. Tidal couplets show alternating thick and thin laminae indicative of a semi-diurnal tidal system. Other cycles include neap and spring pinching and swelling. This is a classic exposure in the upper part of the Degonia that represents a "fossil" environment of tidal creeks on a sand flat.

Basal Pennsylvanian rocks range from late Morrowan to Desmoinsian. These rocks are dominated by sandstones, siltstones and shales. The basal Caseyville Formation is composed of relatively pure, quartz-rich, coarse sandstones and quartz pebble conglomerates with gray to dark gray shales. The overlying Tradewater Formation is unconformable with the Caseyville Formation. The Tradewater is composed of plant-bearing shales, laminated siltstones and "dirty" or clay-rich sublitharenites. Clay within the quartz sandstone is gray to white and may in some cases be altered feldspars. Mica is also common in the Tradewater Formation. The basal part of the Tradewater has eroded into and reworked sediments from the upper part of the Caseyville Formation. Large, rounded quartz pebbles occur in the lower Tradewater of the Raddle and surrounding quadrangles.

The depositional sequences of the Caseyville are composed of fluvial to estuarine cycles with a series of at least two terrestrial to marine sequences, locally. A local change in base-level occurred at the end of Caseyville deposition (an angular unconformity) with deposition of the overlying Tradewater Formation.

A large-scale regional unconformity occurs between the Mississippian and Pennsylvanian rocks called the sub-Absaroka unconformity. This can be observed in the southeast corner of Section 7, T8S, R4W, where the Kinkaid Limestone is locally removed and the Caseyville directly overlies the Degonia Sandstone. A well-developed paleovalley runs north-south and has up to 100 feet of relief in the Raddle Quadrangle. A second paleovalley is suspected (not shown on map). It runs north-south along the eastern edge of the quadrangle. This second valley was found by a few water wells in Sections 23, 24 and 25 in T8S, R4W, showing only a few feet of Kinkaid Limestone.

Surficial Geology

The Glasford Formation (Illinoian) occurs in many areas within the quadrangle. The formation was mapped only in areas where the Glasford is greater than fifty feet thick. It is thickest in the northern portion of the quadrangle. An area within an active quarry in Section 36, T7S, R5W, yielded a fifty-foot thick, buried, blind valley of Pleistocene material within the Kinkaid Limestone. Straight linear ridges of diamicton (colluvial Glasford) can be seen in Sections 5 and 8, T8S, R4W, which are the result of undercut erosion in the drainages and subsequent slumping. This can be observed in Section 22, T8S, R4W, where a series of slumps are present in the glacial till section.

Structural Geology

The Mississippian rocks appear to be rotated up toward the northwest along a hinge line that occurs east and southeast of the Raddle Quadrangle. This hinge line is called the Bodenschatz Lick Fault. It trends north-south but then curves to the southwest in the Oraville Quadrangle (Williams 2003). The Pennsylvanian rocks (mainly Caseyville) thicken to the east across the study area yielding a wedge-shaped package of rocks (Sonnefeld 1981). The Caseyville Formation on laps the earlier Mississippian rocks with the Battery Rock Member above the Mississippian rocks on the eastern side of the quadrangle. In the central portion of the quadrangle, a shale in the middle part of the Caseyville overlies Mississippian rocks and the western portion only the upper member (Pounds Sandstone) of the Caseyville occurs above the Mississippian rocks.

Structure contours using the base of the Kinkaid Limestone were drawn based on water wells, oil and gas tests and limestone test holes. The surface indicates a west northwest strike and a dip-slope surface to the northeast. In the northwest corner of the map the structure contours show a fifty to sixty foot area of closure. The surface is disrupted along a narrow north-south paleovalley where the surface was eroded during post Mississippian time.

No major faults were mapped on the Raddle Quadrangle. However, minor strike-slip faults are suspected in the northwestern corner of the map within the old limestone quarry in the eastern central part of Section 1, T8S, R5W. Large float blocks were found in the old quarry that had horizontal slickensides on the side of the blocks normal to the bedding planes. Small adjustment transform faults are suspected to trend northwest as seen in the high-wall of the old quarry.

Economic Geology

Industrial Minerals
Limestone is currently being mined in the northwestern corner of the study area. There are two benches of the Kinkaid Limestone present, the basal Negli Creek Member and the middle Cave Hill Member. The Negli Creek is a dark micritic limestone that shows conchoidal fracture and also contains dark gray chert nodules. The Cave Hill Member is composed of argillaceous limestones and fossil wackestones. Both members are used as road material and rip-rap. The current quarry has 40 to 50 feet of usable limestone.
Another potential area for the Kinkaid Limestone is in the east half of Section 22, T8S, R4W. Here the limestone ranges from 70 to 80 feet thick and occurs just below the loess and is well exposed in the ravines in the area.

Oil and Gas
Ten oil and gas wells were drilled in the Raddle Quadrangle. They ranged in depth from 730 to 3,064 feet. All wells were dry and abandoned. Only one well, the Rodewald #1 had two shows of oil, one in the Yankeetown (Benoist) at 1,065 feet below the surface and the other in the Aux Vases at 1,105 feet below the surface. "Dead oil" or tar was found in the Kimmswick Limestone at 2,773 feet below the surface in the Trumbell #1 well.

The most interesting area for oil and gas potential in the quadrangle is in Section 1, T8S, R5W. Here the basal Kinkaid surface has 50 to 60 feet of closure. The area of closure is elongate northeast-southwest and parallels the Campbell Hill Anticline.

Groundwater
The most commonly drilled formation for water in the northeastern third of the quadrangle is the Degonia Sandstone. It is a clean, fine grained, white, quartz arenite with high-quality water that is recharged in the central portion of the map. In the uplands toward the central part of the map the Palestine Sandstone also contains groundwater. The Palestine is also a quartz arenite that contains high-quality water.

In the bottom land or Mississippi River alluvium, water wells are completed in shallow sand and gravel deposits.

Acknowledgments

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The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

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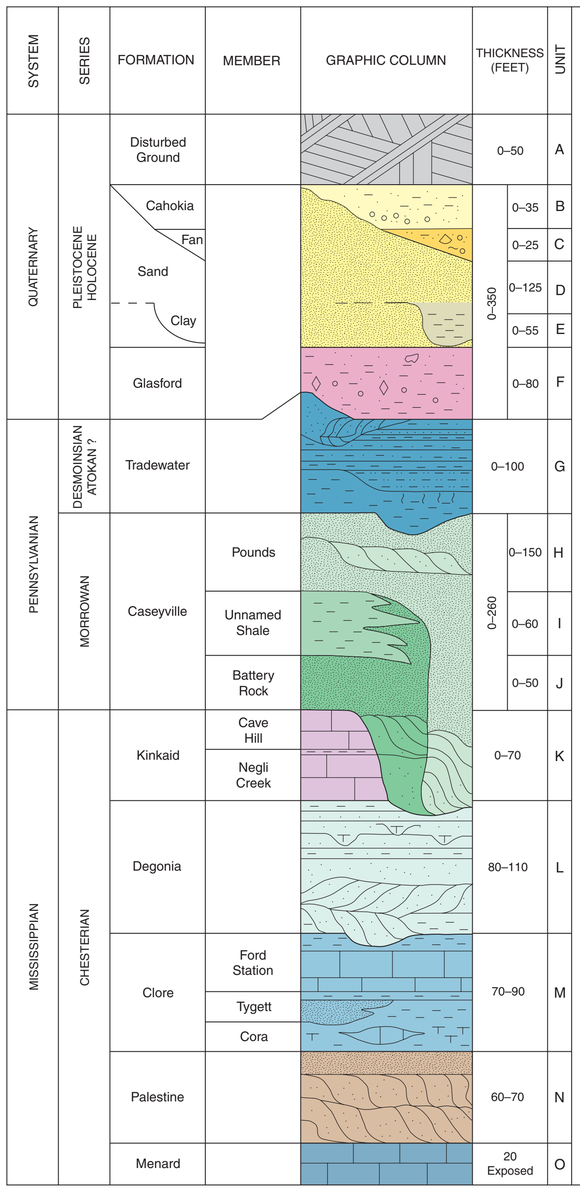

A Disturbed Ground Significant areas of earth material disrupted by human activity; includes areas of construction and fill such as quarries, and levees.

B Cahokia Formation Silt, sand, and gravel (east and north of the Mississippi River bluffs) In ravines the Cahokia is dominantly silt that is tan and contains white to light gray sand bars. The silt and sand are mainly derived from colluvial silt and sand from loess in the upland areas. Sand is also locally derived from Pennsylvanian and Mississippian sandstones that are quartz-rich. The gravel is composed of rounded quartz grains from the basal Pennsylvanian sandstones, angular chert and limestone clasts from the Mississippian limestones and sandstone rock fragments from both indurated Mississippian and Pennsylvanian sandstones. At the mouth of the ravines where they flow onto the Mississippi River bottoms the Cahokia is mapped as a vertical cut-off with the alluvial fans.

C Cahokia fans Clay, silt, sand, and gravel A low, outspread of gently sloping non-lithified material composed of a mixture of clay, silt sand and gravel derived from upland formations carried by streams and issued from the stream onto a broad open plain or valley. The Cahokia fans issue from bedrock valleys onto the Mississippi River flood plain and are broadly conical or scallop-shaped above the 365 foot elevation level.

D Cahokia Sand (sandy-point bar deposits on the Mississippi River flood plain) over Henry Formation (gravel deposits) Sand fine to coarse, typically fines upward. Silts mixed with sand in the upper 3 feet becomes coarser sand between medium to coarse grained down to about 70 to 80 feet where coarse sands and gravels of the Henry Formation are found. Total depth to bedrock and thickness of alluvium ranges from about 90 to 120 feet.

E Cahokia Clay (clayey-backswamp deposits on Mississippi River flood plain) over sandy Cahokia Clay and silty clay; 5 to 50 feet thick, deposited in abandoned meander channels or backswamp areas that originated from the Mississippi River. Clay can also be deposited over sand or Cahokia sand and gravel of the Henry Formation. Typically seen as modern elongate wetland environments in the American Bottoms.

F Glasford Formation Diamicton that occurs above the local bedrock It is composed of a pebbly silt and clay mixture that is gray, and oxidizes to yellow-brown to orange brown. Limestone, shale, and chert clasts are locally derived from bedrock and make-up the pebbles found within the till. Igneous and metamorphic erratics are common in the study area. The diamicton is overlain by loess of Wisconsinan Age which are undifferentiated on the map. Glasford is only mapped where it exceeds 50 feet in thickness, otherwise the first bedrock unit encountered is shown. The diamicton was encountered as bedrock paleovalley fill and observed in uplands and in the modern valleys. The diamicton in some of the modern valleys showed Holocene slumping due to modern stream erosion.

G Tradewater Formation: Sandstone, Siltstone and Shale Sandstone thin-bedded, reddish brown, well sorted, quartz arenite. More common in the lower part of this unit are laminated siltstones and shales. The siltstones are dark gray, finely graded, rhythmites that yield thick and thin bundles of silt to clay laminae. The shale at the base is dark gray to black and contains well preserved *Neuropteris* sp. fronds in a two to three-foot section. Above the shale is a sideritic siltstone and gray shale. Siderite nodules are rusty red in the siltstone which shows loading on a gray shale below. The basal contact is unconformable with the unit below.

H Caseyville Sandstone: Sandstone, conglomerate and Shale On the eastern half of the quadrangle the Caseyville is separated by a shale unit of variable thickness. The shale pinches out toward the west. The Caseyville also thins to the west as it on laps Chesterian units which were high during deposition. The upper sandstone is a sucrosic, white poorly sorted, quartz arenite that can contain a rounded quartz pebble conglomerate. There are large channel form, cross bedded deposits that cut out or passively fill the Kinkaid Limestone below in the western part of the quadrangle. The shale is gray to dark gray, with poorly preserved carbonized plant remains, platy and laterally unfossiliferous. The basal sandstone is similar to the upper sandstone containing fine to coarse grained quartz sand and rounded quartz pebbles. Both lower and upper sandstones are unconformable with underlying Chesterian rocks from east to west, respectively.

I Kinkaid Limestone: Limestone and Shale Limestone is commonly composed of two benches of lime-mudstone separated by a three-foot thick shale. The limestone is medium to light gray, contains fossil lime-mudstones, wackestones, and packstones. Chert occurs in nodules in the upper bench and is light gray to dark gray, occasionally chocolate-brown and contains white pelmatozoan debris within the nodule. The upper limestone is also shaly and thin bedded and has proetid pygidia, *Archimedes* sp., and other bryozoa, *Spirifer increbesens, Composita* sp., and echinoid spines and plates and rugose corals. The shale is a soft, non-fissile, gray shale that is non-fossiliferous. The basal limestone is a dark gray, medium to thick bedded lime-mudstone that contains wackestones and diagnostic fossils (*Girvanella* sp., *Chaetetes milleporaceous*, and large bellerophontid gastropods). Chert is black and nodular in the lower limestone. The basal contact is conformable.

J Degonia Sandstone: Sandstone, shale and minor amounts of calcareous sandstone This unit is well exposed throughout the study area. It is dominated by a white, fine-grained, well sorted quartz arenite that is channel-form multi-stacked, multi-storied cross bedded in the lower part and laminated with rhythmic bedding in the upper part. Also small channels (two to three foot across) in the upper part of the unit contain calcareous cement which weather different than the non-calcareous part. The channels can be observed protruding out six inches to a foot from the outcrop face. Another feature of this unit is the presence of *Stigmaria* roots. These sandstone casts are common in the float within the alluvium. Shale is seen in the upper and lower portions of the sandstone. In the upper part, it is a gray shale associated wavy bedded, sandstones. In the lower part it is a gray, platy shale that either has a locally abrupt contact with the underlying shaly limestone or is unconformable with sandstone channel at the base.

K Clore Formation: Shale, Limestone and Sandstone This unit is dominated by gray to dark gray shales both fossiliferous and non-fossiliferous. The limestones at the top are dark gray argillaceous lime mudstones that display "hour-glass" weathering. Fossils are dominantly fenestrate bryozoans and spiny productid brachiopods but more occasionally, large blastoids *(Pentremites obesus)* are found in the upper lime mudstones. A thin quartz arenite occurs in the middle of this unit, which is similar to the Degonia Sandstone. The basal part is shale dominated with yellow dolomitic layers and lenticular fossil- wackeystone lenses within the gray soft shale. The basal contact is gradational with the underlying unit.

L Palestine Sandstone: Sandstone and Shale This unit is a tan to yellow-white quartz arenite. Shales occur above and below. In the lower part of the sandstone low-angle cross beds are present; also ripple-laminated sheet sands were observed. The sandstone is fine-grained, well sorted, with thick tabular beds in places. Shales are gray, soft, platy and have a sharp contact with the limestone below.

M Menard Limestone: Limestone and Shale Dominated by lime mudstones, this unit contains a shallow marine fauna. Like the overlying limestones, this unit is dark to medium gray and contains abundant clay. Most beds are separated by dark gray to black, soft shales. Only the upper portion of the formation is exposed in the quadrangle.