Surficial Geologic Map of Lee County, Iowa

Stephanie Tassier-Surine, Ryan Clark, Phil Kerr, and Alyssa Bancroft
Iowa Geological Survey, IIHR-Hydroscience & Engineering, University of Iowa, Iowa City, Iowa

Iowa Geological Survey

Open File Map: **OFM-22-2**
Keith Schilling, State Geologist
Published August, 2022

Introduction

Lee County is located on the Southern Iowa Drift Plain landform region. The thickness of Quaternary materials varies widely across the county generally ranging from 0 to 23 m (0-75 ft) but may be up to 122 m (400 ft) in the eastern part of the mapping area. The region is dominated by loess-mantled till plains in the uplands, and coarse- to fine-grained alluvial deposits within tributary streams. Thick sequences of sand and gravel are found in the Des Moines and Mississippi river valleys and are mantled with finer-grained deposits. Several Wisconsin-age terrace deposits are located along the Mississippi River and its tributaries. Terrace positions in the Mississippi River valley include the Savanna and the younger Kingston, both of which are Middle Wisconsin glaciofluvial deposits related to the development of the Upper Mississippi River. Additional terraces, mapped in Sugar Creek near Fort Madison, are elevated above those in the Mississippi River valley and represent slackwater deposits that predate the Savanna and Kingston terraces. These are interpreted to correlate with the St. Charles Group.

Glacial till is only exposed in drainages and steep sideslopes. Stratigraphically, the landscape is mantled with 2 to 5 m (7-15 ft) of Peoria Formation loess overlying paleosol formed in glacial till. In the eastern half of the county, the Peoria Formation overlies the Illinoian till plain. This glacier did not advance very far into Iowa and the terminal moraine extends roughly north-south through Lee County. The Illinoian till generally has a thickness ranging from 3 to 10 m (10-33 ft) although it reaches a maximum thickness of 15 m (50 ft) near the terminal moraine. The Illinoian till overlies Pre-Illinoian deposits with an intervening Yarmouth Paleosol. To the west of the moraine, loess overlies a well-developed Yarmouth-Sangamon paleosol formed in Pre-Illinoian till. Bedrock exposures are found along the Mississippi River and its tributaries, primarily Sugar Creek in the central portion of the county. Mississippian and Pennsylvanian units dominate the bedrock surface. An accompanying map of the bedrock geology of Lee County has been published concurrently with this map (Open File Map OFM-22-1; Clark et al., 2022).

All data from previous STATEMAP quadrangle surficial map projects in Lee County were incorporated into this final surficial map of Lee County. Data collected for this mapping project included 27 drill cores and 176 passive seismic data points, as well as investigation of 44 exposures, six abandoned quarries, and five active. Additional subsurface information was derived from the analysis of more than 1,600 water well records, over 100 of which have cutting samples that were described as part of this mapping project. Additional information about the surficial mapping units and stratigraphy may be found in the Summary Map Report of Lee County, Iowa.

Description of Map Units

CENOZOIC

QUATERNARY SYSTEM

HUDSON EPISODE

Qal - Alluvium (DeForest Formation-Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hill slopes, and in closed depressions. May overlie Pre-Illinoian or Illinoian formation glacial till, Peoria Formation loess, or Noah Creek Formation sand and gravel. This unit may include local fan deposits in smaller drainages. Associated with low-relief modern floodplain, closed depressions, modern drainageways, or toeslope positions on the landscape. Seasonal high water table and potential for frequent flooding. The depth to bedrock may be less than 8 m (26 ft) along tributaries of the Des Moines and Mississippi rivers.

Qalb - Alluvium Shallow to Bedrock (DeForest Formation-Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hillslopes and in closed depressions. May overlie Noah Creek Formation sand and gravel or Mississippian or Pennsylvanian bedrock. Bedrock surface is within 5 m (16 ft) of the land surface. Associated with low-relief modern floodplain, closed depressions, modern drainageways, or toeslope positions on the landscape. Seasonal high water table and potential for frequent flooding.

Qallt - Low Terrace (DeForest Formation-Camp Creek and Roberts Creek members) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous, stratified silty clay loam, loam, or clay loam, associated with the modern channel belts of the Des Moines and Mississippi river valleys and their tributaries. Overlies Noah Creek or Henry formation sand and gravel. Occupies the lowest position on the floodplain (i.e., modern channel belts). Includes islands and landforms within the Mississippi River channel. Seasonal high water table and frequent flooding potential.

Qali-ht - Intermediate-High Terrace (DeForest Formation-Gunder Member) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous, silty clay loam to loam alluvium or colluvium. Overlies Noah Creek or Henry formation sand and gravel. May be mantled with 1 to 2 m (3-7 ft) stringers of eolian sand along westernmost Sugar Creek. Occupies terrace and valley margin positions 1 to 2 m (3-7 ft) above the modern floodplain. Two terrace levels are present in some areas. In the Mississippi River valley it may be buried by or interfinger with the alluvial fan (Qaf) unit. Seasonal high water table and low to moderate flooding potential.

Qe - Sand Dunes and Sand Sheets (Peoria Formation-sand facies) Generally less than 3 m (10 ft) of yellowish brown, massive, calcareous loamy sand to fine sand. It occurs as sand stringers and small dunes overlying Holocene or Wisconsin alluvial deposits.

Qaf - Alluvial Fan (DeForest Formation-Corrington Member) Variable thickness of 2 to 5 m (7-16 ft) of dark brown to yellowish brown, noncalcareous, silt loam to loam with interbedded lenses of fine sand and silts. A pebble lag is commonly found at or near the fan surface. Overlies thick sand and gravel of the Henry Formation along the Des Moines and Mississippi river valleys as steep angled fans at the base of low order drainages and colluvial slopes. In these settings, the fan unit may exceed 6 m (20 ft) in thickness. May bury Wisconsin terrace units or interfinger with Holocene units.

WISCONSIN EPISODE

Qhm - Outwash Sand and Pebbly Sand (Henry Formation-Muscatine Member) Yellowish brown to gray, moderately to well sorted, massive to well stratified, coarse to fine feldspathic quartz sand and pebbly sand with gravel zones at depth. May be mantled with up to 2 m (7 ft) of eolian sand. Comprises the Kingston Terrace complex in the Mississippi River valley. Lies 3 to 6 m (10-20 ft) above the modern floodplain.

Qhs - Outwash Sand and Pebbly Sand (Henry Formation-Sabula Member) Yellowish brown to gray, moderately to well sorted, massive to well stratified, coarse to fine feldspathic quartz sand and pebbly sand with gravel zones at depth. May be mantled with up to 5 m (16 ft) of eolian sand. Comprises the Savanna Terrace complex in the Mississippi River valley. Lies 6 to 12 m (20-40 ft) above the modern floodplain and may contain more than one terrace level.

Qsl - Slackwater Deposits ("St. Charles Group") Massive to stratified dense reddish brown to gray silty clay to clay loam mantled with up to 5 m (16 ft) of Peoria Formation loess. Occurs as slackwater deposits in tributaries to the Mississippi River. Low-relief landforms expressed as broad, long, narrow longitudinal terraces or cuspate-shaped point terraces that may be more than 18 m (60 ft) above the modern valley. Unit is benched on a gray, calcareous, massive, dense clay loam diamicton of the Glasford, Alburnett, or Wolf Creek formations or bedrock. Interpreted to be correlative with the St. Charles Group deposits. No flooding potential.

Qpt - Loess Mantled Terrace (Peoria Formation-silt and/or sand facies) 2 to 7 m (7-23 ft) of yellowish brown to gray, massive, jointed, calcareous or noncalcareous, silt loam and intercalated fine to medium, well sorted sand. May grade downward to poorly to moderately well sorted, moderately to well stratified, coarse to fine feldspathic quartz sand, loam, or silt loam alluvium (Late Phase High Terrace) or may overlie a Farmdale Geosol developed in Pisgah Silt. In turn, the Pisgah Silt overlies a well-expressed Sangamon Geosol developed in poorly to moderately well sorted, moderately to well stratified, coarse to fine sand, loam, or silt loam alluvium (Early Phase High Terrace). May be benched directly on bedrock in the Sugar Creek valley near Fort Madison.

Qps - Loess (Peoria Formation-silt facies) Generally 2 to 5 m (7-15 ft) of yellowish to grayish brown, massive, jointed calcareous or noncalcareous silt loam to silty clay loam. May overlie a grayish brown to olive gray silty clay loam to silty clay (Pisgah Formation – eroded Farmdale Geosol) which is less than 1.5 m (5 ft) thick. The Pisgah Formation is in the same stratigraphic position as the Roxanna Silt which is mapped in Illinois. The Farmdale Geosol may be welded to an older Sangamon Geosol developed in loamy glacial till of the Wolf Creek or Alburnett formations. This mapping unit encompasses upland divides, ridgetops, and convex sideslopes. Well to somewhat poorly drained landscape.

Qps-gla - Loess (Peoria Formation-silt facies) Generally 2 to 5 m (7-15 ft) of yellowish to grayish brown, massive, jointed, calcareous or noncalcareous silt loam to silty clay loam. May overlie a grayish brown to olive gray silty clay loam to silty clay (Pisgah Formation – eroded Farmdale Geosol) which is less than 1.5 m (5 ft) thick. The Pisgah Formation is in the same stratigraphic position as the Roxanna Silt which is mapped in Illinois. The Farmdale Geosol may be welded to an older Sangamon Geosol developed in loamy glacial till of the Glasford Formation. This mapping unit encompasses upland divides, ridgetops, and convex sideslopes. Well to somewhat poorly drained landscape.

ILLINOIS EPISODE

Qgla - Till (Glasford Formation) Generally 3 to 10 m (10-33 ft) of very dense, massive, fractured, loamy glacial till of the Illinoian Glasford Formation with or without a thin loess mantle (Peoria Formation – less than 2 m) and intervening clayey Farmdale/Sangamon Geosol. The maximum thickness reaches 15 m (50 ft) near the terminal moraine. Overlies the Yarmouth Paleosol formed in Pre-Illinoian till. This mapping unit encompasses narrowly dissected interfluves and side slopes, as well as side valley slopes. Drainage is variable from well drained to poorly drained.

PRE-ILLINOIS EPISODE

Qwa3 - Till (Wolf Creek or Alburnett formations) Generally 10 to 18 m (33-60 ft) of very dense, massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations with or without a thin loess mantle (Peoria Formation – less than 2 m) and intervening clayey Farmdale/Sangamon Geosol. May exceed 60 m (197 ft) in bedrock channels. This mapping unit encompasses narrowly dissected interfluves and side slopes, and side valley slopes. Drainage is variable from well drained to poorly drained.

OTHER MAPPING UNITS

Qbr - Loamy Sediments Shallow to Dolostone, Limestone, Shale, and Sandstone (DeForest, Noah Creek, Peoria, Glasford, Wolf Creek, and Alburnett formations) Generally 1 to 2 m (3-7 ft) of yellowish brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy, and silty sediments that overlie the Pennsylvanian or Mississippian bedrock surface. All areas of bedrock outcrop or shallow to bedrock soils are shown in red on the map, regardless of the bedrock mapping unit. Bedrock units are shown on the cross-section and may be identified on the bedrock map of Lee County (OFM-22-1).

Qpq - Pits and Quarries Sand and gravel pits and rock quarries. Extent mapped as shown on the county soil survey and as identified on aerial imagery and LiDAR hillshade.

Qf –Fill Areas of cut and fill associated with major land disturbances including highways, railroads, and other land development. Deposits may be similar in character to those of adjacent map units but may also have significant mantles of fill or deep cuts that expose underlying units.

Correlation of Map units

General Lithology	Shallow Bedrock	Tributary Valleys	Major Valleys	Illinoian Till Plain	Pre-Illinoian Till Plain	Episode	Series	Stage
Alluvium	Qalb	Qallt	Qallt	Qal	Qal	Hudson	Holocene	Quaternary
		Qali-ht	Qali-ht					
			Qaf					
Eolian	Qbr		Qe					
		Qpt		Qps-gla	Qps	Wisconsin	Pleistocene	
Outwash			Qhm					
			Qhs					
Slackwater Deposits		Qsl						
Glacial Till		Qgla				Illinoian		
		Qwa3				Pre-Illinoian		
Bedrock		Pcl*				Pennsylvanian		
		Mpsl*				Mississippian		
		Mws*						
		Mkeo*						
		Mb*						
		Mk*						
		Der*				Devonian		
		Dss*						
		Dgc*						

*Units only shown on the Cross-Section

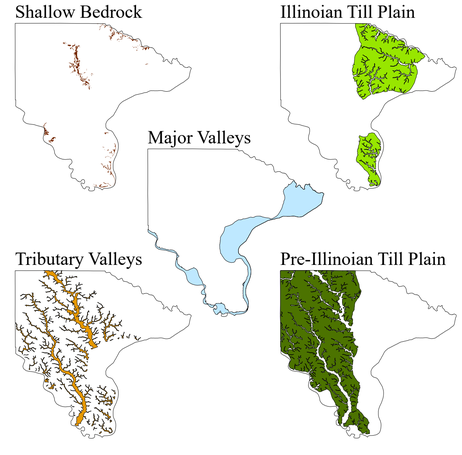


Figure 2. Locations of the major landscape groups in the correlation chart.

Map Symbols

- GeoSam point
- new drill core
- geophysics point
- bedrock outcrop
- quarry
- contact
- contact (uncertain)
- limit of Illinoian Advance
- river/stream
- town boundary
- cross-section

Road Classification

- U.S. Route
- State Route

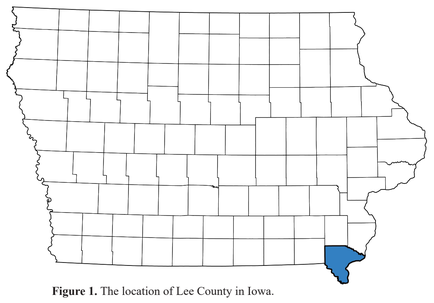


Figure 1. The location of Lee County in Iowa.

Map projection and coordinate system based on WGS 1984 Web Mercator (auxiliary sphere).

The map and cross-section are based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site-specific studies. 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.

Supported in part by the U.S. Geological Survey Cooperative Agreement Number G21AC10680 National Cooperative Geologic Mapping Program (STATEMAP).

UTM GRID AND 2022 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

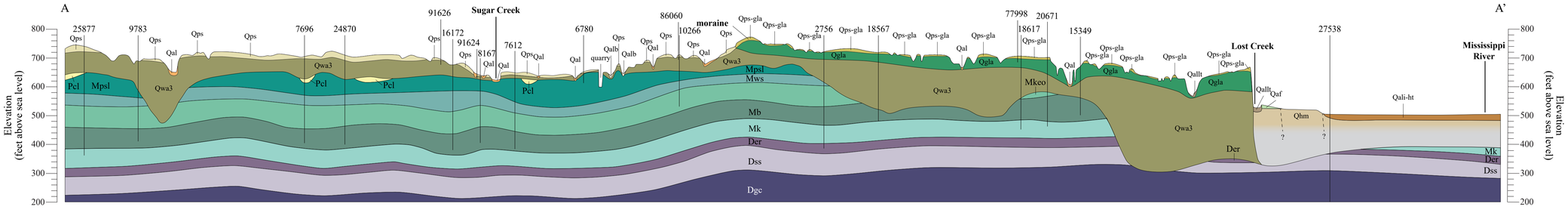
1°4'
19 MILS
0°0'
0 MILS

0 1.25 2.5 5 7.5 10 Miles
0 1.5 3 6 9 12 Kilometers

1:100,000

CONTOUR INTERVAL 50 FEET

Geologic Cross-Section A-A'



Acknowledgements

Special thanks to the landowners who allowed access to their properties: Jim Bair, Pat Beelman, Jerry and Joan Boecker, Dawn Callahan, Kathy Coleman, Gary and Marilyn Crabtree, Mike and Ruth Dresser, Brent Dresser, Doug Fenton, Dennis Gibbs, Dennis Harwood, Alsace Heimold, Danny and Anna Hodges, Greg Hohl, JoAnn Holtkamp, Jim Kannenberg, Clem and Jolisa Krogmeier, Dale McNeeley, Martin Meerotto, Sam and Sue Menke, Tom Morfeld, Carol and Marvin Newton, Phillip Pietz, Teresa Sallen, David Shinstock, Mary Small, Mike Tweedy, Doug Walljasper, James and Paulette Wemke, Dennis McGregor (City Administrator) and Mark Camby from the City of West Point, Nathan Unsworth (Executive Director) of the Lee County Conservation Board, John Byrd (Iowa Department of Natural Resources) of Shimek State Forest, and Cole O'Donnell (City Administrator), Robert Hellenthal (Public Works Director), and John Reiter from the City of Keokuk. Thanks also to Don Smith of Cessford Construction, Co. (Oldcastle Materials) and Chuck Manson (Douds Stone) for allowing us to access quarries in and around the mapping area. Drilling was provided by Matthew Streeter of the Iowa Geological Survey (IGS). University of Iowa (UI) Department of Earth and Environmental Sciences (EES) student Brennan Hill helped with various aspects of data collection and management including producing descriptive logs of water well cutting samples, updating well locations, and geophysical data acquisition. Thanks to Rick Langel (IGS) for managing the IGS geologic sampling database (GeoSam). Special thanks to Kathy Woida (retired) of the Natural Resources Conservation Service and Art Bettis (retired, UI-IES) for assistance with core description and for numerous valuable discussions regarding the geology of southeast Iowa. Administrative support was provided by Suzanne Doershuk, Melissa Eckrich, Teresa Gaffey, Carmen Langel, and Rosemary Tiwari.