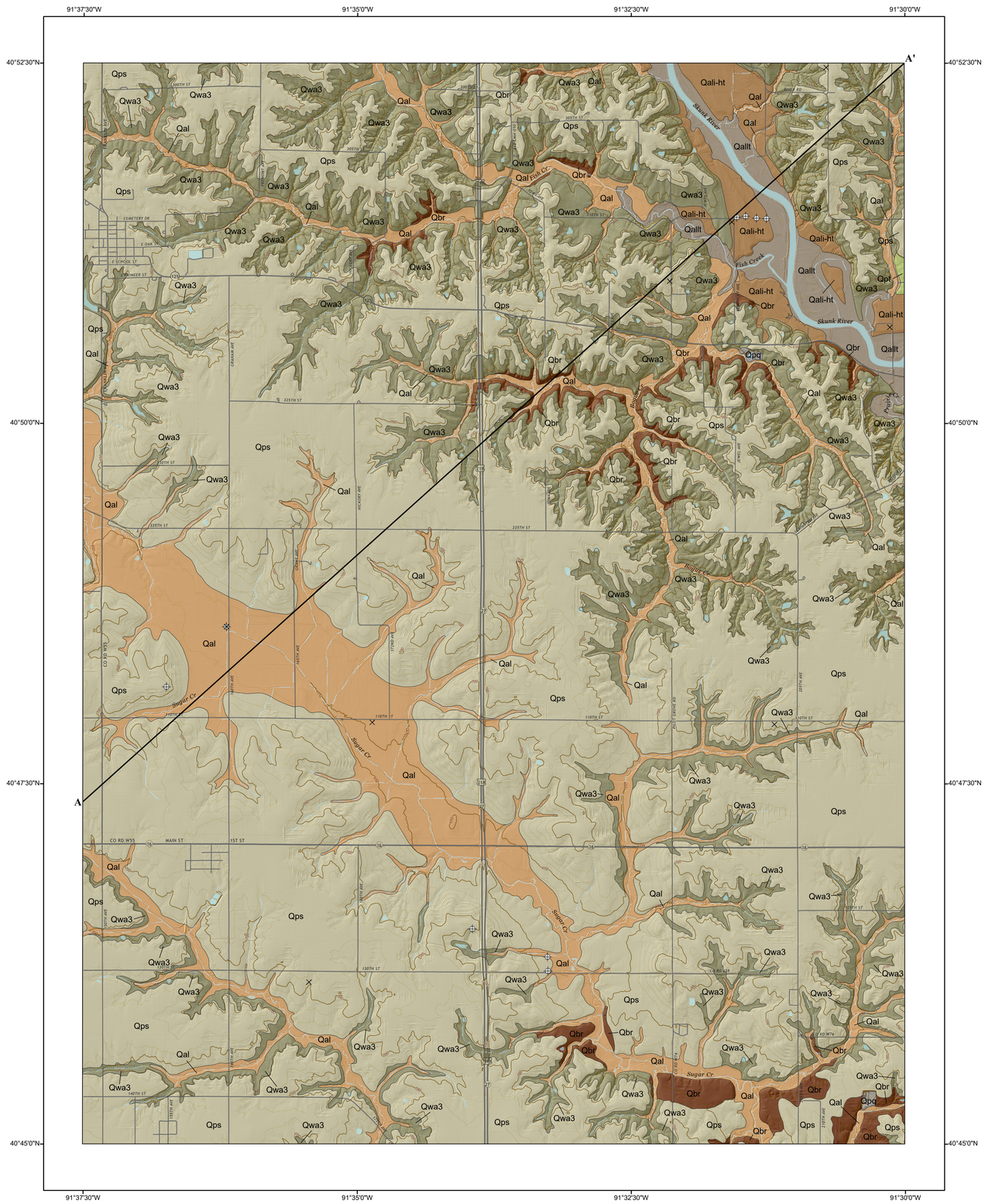
Surficial Geologic Map of the Salem (Iowa) 7.5' Quadrangle



1:24,000

0 0.5 1 2 3 4 Miles

0 0.5 1 2 3 4 Kilometers

CONTOUR INTERVAL 10 FEET

MN 0°50′ 15 MILS · GN 0°58′ 17 MILS

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Legend

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 or 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 formation glacial tills, Peoria Formation loess or eolian sand, or Noah Creek Formation sand and gravel. Associated with low-relief modern floodplains, 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 portions of Sugar Creek.

Qalt - 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 belt of the Skunk River. Overlies Noah Creek Formation sand and gravel. Occupies the lowest position on the floodplain ie. modern channel belts. Seasonal high water table and frequent flooding potential.

Qali-ht - Intermediate-High Terrace (DeForest Formation-Roberts Creek and Gunder members) 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 Formation sand and gravel along the Skunk River. 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. Seasonal high water table and low to moderate flooding potential.

WISCONSIN EPISODE

Qnw - Sand and Gravel (Noah Creek Formation) Generally 3 to 9 m (10-30 ft) of yellowish brown to gray, poorly to well-sorted, massive to well-stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel with few intervening layers of silty clay. This unit is buried by Peoria Formation silt or younger Hudson-age alluvial deposits associated with the Skunk River valley and encompasses deposits that accumulated in river valleys during the Wisconsin Episode. This unit is shown only on the cross-section.

Qpt - Loess Mantled Terrace (Peoria Formation-silt and/or sand facies) 2 to 7 m (7-22 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 the Farmdale Geosol developed in Pisgah Silt which in turn 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).

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 and/or 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.

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. 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 Dolomite, Limestone, Shale and Sandstone (DeForest, Noah Creek, Peoria, Wolf Creek, and Alburnett formations) - 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 the Salem Quadrangle with the following descriptions:

PALEOZOIC

CARBONIFEROUS SYSTEM

PENNSYLVANIAN SUBSYSTEM

Pcl - Shale and Sandstone (lower Cherokee Group) Lower-Middle Pennsylvanian. Pennsylvanian units occur as erosional outliers reaching a thickness of up to 13 m (45 ft) within the mapping area. This unit consists of shale/mudstone, light to medium gray, part silty to sandy and fine to medium quartz sandstone, rarely conglomeratic. Some shales are carbonaceous to phosphatic with minor coal. No outcrops of this unit were identified in the mapping area.

MISSISSIPPIAN SUBSYSTEM

Mpsl – Limestone, Sandstone, and Dolomite (Pella or "St. Louis" formations) Middle-Upper Mississippian, Meramecian-lower Chesterian. This map unit ranges between 9 and 18 m (30 – 60 ft) thick and reaches a maximum thickness of 29 m (95 ft) in the mapping area. It is dominated by limestone, sandstone, dolomitic limestone, and dolomite with minor shale and chert. Limestones of the Pella Formation are typically sub-lithographic with scattered to abundant fossils, primarily brachiopods, echinoderms, and ostracods. The "St. Louis" Formation is dominated by limestone, sandy limestone, sandstone, and dolomite, variably cherty. The limestone facies of this unit can be fossiliferous with brachiopods, echinoderms, and several varieties of coral while the dolomitic facies typically exhibit fossil molds. Some fossils are silicified. Sandstones of the "St. Louis" Formation are typically very fine to medium quartz sandstones that are poorly to moderately cemented with calcite or quartz. The lower portion of the "St. Louis" Formation is commonly gray to dark brown dolomite, locally brecciated and sandy, with rare fossils. This mapping unit dominates the bedrock surface in the mapping area and is overlain by Quaternary sediments or Pennsylvanian outliers. No outcrops were identified in the mapping area although excellent exposures of the lower portion of this mapping unit were observed in a small active quarry in the extreme southeast corner of the mapping area.

Mws – Shale, Dolomite, and Limestone (Warsaw Formation) Upper Osagean. The Warsaw Formation varies in thickness reaching a maximum thickness of approximately 17 m (55 ft). This unit can generally be divided into two major lithologic groupings, a lower argillaceous dolomite sequence and an upper shale dominated sequence. The upper shale is typically light to medium gray, silty, and variably dolomitic with minor chert, sand, and sparse quartz geodes. The lower dolomite, sometimes referred to as the "geode beds," is argillaceous to shaly, with scattered to abundant quartz geodes. Minor limestone units occur locally as thin, lensatic beds with crinoidal packstone/grainstone fabrics. Brachiopods, echinoderm debris, and bryozoans are found throughout this mapping unit, although these fossils are more common in the carbonate lithologies. This unit exhibits wide variability, leaving only the upper shale or lower dolomite in place, suggesting strong erosional unconformities above and below this mapping unit. Outcrops of this unit were not observed in the mapping area.

Mkeo – Limestone, Dolomite, Chert, and Shale (Keokuk Formation) Upper Osagean. The Keokuk Formation typically ranges from 12 to 23 m (40 – 75 ft) in thickness in the mapping area. This unit is dominated by tan to gray interbedded skeletal limestones displaying packstone/grainstone fabrics. Nodular to bedded chert, in part fossiliferous, is common in the lower half of the sequence. Dolomite, variably argillaceous, and thin shales also occur throughout the unit. The unit displays multiple hardground surfaces and bone beds with scattered to abundant fish debris, the most prominent of these serves as a marker bed at the base of the formation (sometimes referred to as the Burlington-Keokuk or B-K bone bed). Brachiopods, crinoids, bryozoans, solitary corals, and fish bones and teeth occur throughout this unit as both abraded debris and partly articulated specimens. Molds of sponge spicules are noted in the dolomite facies. Traces of glauconite and locally abundant geodes were also observed within the mapping area. Outcrops of this unit were not observed in the mapping area.

Mb – Limestone, Dolomite, and Chert (Burlington Formation) Lower Osagean. The Burlington Formation can be up to 29 m (95 ft) thick in the mapping area. This unit is subdivided into three members (in ascending order: the Dolbee Creek, Haight Creek, and Cedar Fork), characterized by distinct lithologic groupings. The Dolbee Creek Member is dominated by white to tan skeletal limestone displaying packstone/grainstone fabrics and nodular to bedded chert. The Haight Creek Member is characterized by dolomite with an intermittent unit of skeletal limestone (sometimes referred to as the "middle grainstone") and thick beds of chert. A glauconite-rich zone marks the lower contact between the Dolbee Creek and can be used as a regional marker bed. Fossil molds are also present in the dolomite facies. The Cedar Fork Member is a pure white crinoidal packstone limestone unit which is usually differentiated from the packstones of the overlying Keokuk Formation by its white appearance. Occasional fish debris and glauconite are also observed in this member. Outcrops of the Burlington Formation were not found in the mapping area.

Mk – Dolomite, Limestone, and Siltstone (Kinderhookian formations) Lower Mississippian. The Kinderhookian sequence ranges in thickness from 5 to 15 m (20 – 50 ft) with a maximum thickness of 27 m (90 ft) in the mapping area. This unit comprises three formations (in ascending order: the McCraney, Prospect Hill, and Wassonville), characterized by distinct lithologic groupings. The McCraney Formation is composed of thin, sandy, fossiliferous, sub-lithographic limestone and dark brown, unfossiliferous dolomite generating a unique "zebra striped" appearance in outcrop. A basal oolite is locally present. The Prospect Hill Formation is a light to medium gray, dolomitic siltstone that grades to shale in some locations. This unit is often laminated with vertical and horizontal burrow fabrics and faint cross stratified bedforms. Fossils are rare to absent although fossil molds are locally abundant. The Wassonville Formation, now including the former Starr's Cave Formation as the basal member, consists of massive dolomite that is variably cherty grading into dolomitic limestone lower in the section. The basal Starr's Cave Member is a fossiliferous limestone with packstone/grainstone fabrics and is commonly oolitic. Crinoids (partly articulated) are the dominant fossil type of the Starr's Cave Member. A diverse assemblage of brachiopods are present with lesser amounts of blastoids, starfish, corals, bryozoans, and trilobites reported.

DEVONIAN SYSTEM

Der – Siltstone and Shale (English River Formation) Upper Devonian, Famennian. The English River Formation is up to 6 m (20 ft) within the mapping area. This unit is dominated by gray to olive-green siltstone with apparent bioturbated fabrics. Bivalves and brachiopods are common, especially in the upper beds, with scattered to abundant fossil molds as well. This unit only appears in the cross-section, not on the map.

Dss – Shale (Saverton Shale Formation) Upper Devonian, Famennian. The Saverton Shale Formation can be up to 30 m (100 ft) within the mapping area. This unit is dominated by green-gray shale, commonly burrowed with sparse to absent macrofossils. This unit only appears in the cross-section, not on the map.

OTHER FEATURES

Water features - Rivers, lakes and small ponds. Extent mapped as shown on the USGS 7.5' topo map and as identified on aerial imagery.

New drill holes for this map project

New geophysics data point

Bedrock outcrops

IGS GEOSAM data points - records available at www.iowageologicalsurvey.org

W7696 **Wells used for geologic cross-section**

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

Correlation of Map Units

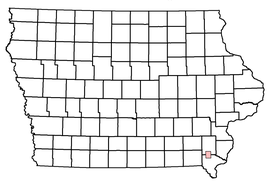
General Lithology	Shallow Bedrock	Valley	Upland	Episode	Series	Stage
Alluvium	Qbr	QalIt	Qal	Hudson	Holocene	Quaternary
		Qali-ht				
Loess		Qpt	Qps	Wisconsin	Pleistocene	
Outwash		Qnw				
Glacial Till		Qwa3		Pre-Illinois		
Bedrock	Pcl*			Pennsylvanian		
	Mpsl*			Mississippian		
	Mws*					
	Mkeo*					
	Mb*					
	Mk*					
	Der*			Devonian		
	Dss*					

*Units only shown on the Cross-Section

Adjacent 7.5' Quadrangles

LOCKRIDGE EAST, IOWA	MOUNT PLEASANT, IOWA	NEW LONDON, IOWA
HILLSBORO, IOWA	SALEM, IOWA	LOWELL, IOWA
FARMINGTON, IOWA	DONNELLSON, IOWA	WEST POINT, IOWA

Location Map



Base map from USGS Salem 7.5' Digital Raster Graphic (IGS GIS file IA_Salem_USGS_topo.tif) which was scanned and modified from the Salem 7.5' Topographic Quadrangle map, published by The US Geological Survey in 2019
Land elevation contours (10' interval).

Iowa Geological Survey digital cartographic file Salem_SurficialGeology.mxd, version 6/30/19 (ArcGIS 10.5)
Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15N, datum NAD83.

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.

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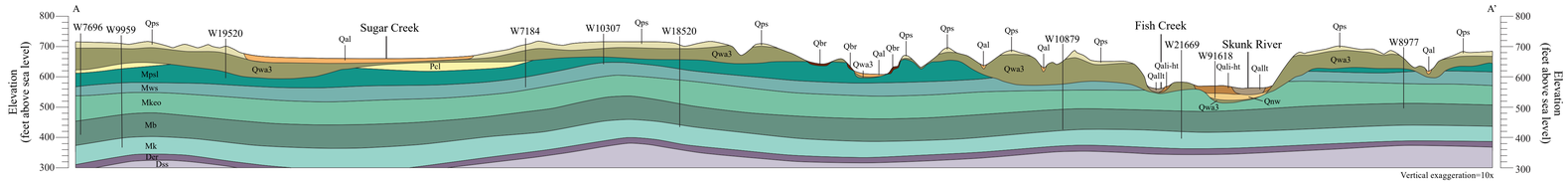
Geologic Cross-Section A-A'



Surficial Geologic Map of the Salem 7.5' Quadrangle, Henry and Lee Counties, Iowa

Iowa Geological Survey
Open File Map OFM-19-4
June 2019

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Introduction to the Surficial Geologic Map of the Salem 7.5' Quadrangle, Henry and Lee Counties, Iowa

The Salem Quadrangle is located in southeastern Iowa on the Southern Iowa Drift Plain landform region (Prior and Kohrt, 2006). The map area is dominated by loess mantled till plains in the uplands, and glacial outwash and finer-grained alluvial deposits within the Skunk River and its tributaries. Stratigraphically, this area contains Wisconsin age Peoria Formation loess deposits mantling Pre-Illinoian age glacial deposits. The Illinoian glacial deposits, which are only present in a small area of southeastern Iowa, are located just to the east of the mapping area. The terminal moraine is approximately two to three miles east of the Salem Quadrangle. The thickness of Quaternary materials varies widely across the quadrangle, generally ranging from 0 to 18 m (0-60 ft) and reaching a maximum thickness of 50 m (165 ft) in a bedrock valley in the northeastern part of the mapping area. Shallow rock areas, as identified on the county soil surveys (Lockridge, 1979; Seaholm, 1985), are located along Sugar Creek as well as the Skunk River and its tributaries including Fish and Bogue creeks.

Mapping the Mount Pleasant and Salem quadrangles is the third phase of a multi-year program to map the surficial geology of southeast Iowa. It has been nearly 40 years since Hallberg (1980a,b) established the stratigraphy for the Illinoian and Pre-Illinoian glacial advances in eastern and southeastern Iowa. The majority of the drill cores and outcrops for those studies were to the north and east of the Salem Quadrangle and provide the stratigraphic framework for the mapping area. Additional data available since that time (LIDAR, DEMs, and digital soil surveys) have allowed for the refinement of the Illinoian boundary and greater detail in mapping the valleys. The only other surficial map of the area consists of the Des Moines 4° x 6° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991). Several Iowa Geological Survey (IGS) field trip guidebooks outline the Pleistocene, Devonian, and Mississippian stratigraphy (Witzke et al., 2002; Witzke and Tassier-Surine, 2001), but their focus is on the area near Burlington (to the east).

The soil surveys of Henry and Lee counties (Lockridge, 1979; Seaholm, 1985) provided information regarding shallow rock areas, helped guide valley mapping units, and defined slope areas where glacial till is exposed. Subsurface information was mostly derived from the analysis of water well cutting samples reposited by the IGS. Additionally, the IGS drilled nine new cores in the quadrangle to characterize the Quaternary sediments and establish unit thicknesses. Lithologic and stratigraphic information from these samples are stored in the online GeoSam database of the IGS.

The glacial history of Iowa began more than two million years ago, as at least seven episodes of Pre-Illinoian glaciation occurred between approximately 2.6 and 0.5 million years ago (Boellstorff, 1978a,b; Hallberg, 1980a). In east-central Iowa, Hallberg (1980a,b) formally classified the units into two formations on the basis of differences in clay mineralogy: the Alburnett Formation (several undifferentiated members) and the younger Wolf Creek Formation (the Winthrop, Aurora, and Hickory Hills members). Both formations are composed predominantly of till deposits, but other materials are present. Paleosols are formed in the upper part of these till units. A limited area of southeastern Iowa was glaciated during the Illinois Episode, around 190,000-130,000 years ago (Curry et al., 2011). These deposits are to the east of the mapping area, but the valley configuration and alluvial deposits may have been influenced by the Illinoian glacial advance. Following the Illinoian glaciation, this area underwent landscape development and erosion until deposition of the Wisconsin Episode loess began. The Pre-Illinoian till is only exposed in drainages and relatively steep sideslopes.

In eastern Iowa, the highly eroded and dissected Pre-Illinoian upland and older terraces are mantled by two Wisconsin loess units. The older Pisgah Formation is thin and includes loess and related slope sediments that have been altered by colluvial hillslope processes. The unit is characterized by the presence of a weakly developed soil recognized as the Farmdale Geosol. It is not uncommon to see the Farmdale developed throughout the Pisgah Formation and into the underlying older Sangamon Paleosol. The Pisgah loess was most likely deposited on the eastern Iowa landscape from 30,000 to 24,000 years ago (Bettis, 1989) and is typically buried by Peoria Formation loess. The Peoria Formation loess accumulated on stable landsurfaces in eastern Iowa from 25,000 to 21,000 years ago. Peoria Formation eolian materials mantle the upland till units and are present on the Wisconsin outwash terraces. On the uplands, the Peoria Formation is a uniform silt loam; in the valleys the silt commonly grades downward to fine sand.

The Skunk River deposited coarse sand and gravel associated with glacial outwash (Noah Creek Formation) of the Des Moines Lobe during the Wisconsin Episode. Based on the alluvial framework established by Esling (1984), three terrace assemblages can be identified: the Early and Late Phase high terraces, and Low Terrace deposits. The high terraces are characterized by the presence of Peoria and Pisgah formation sediments overlying alluvium, with or without the intervening Sangamon Paleosol. Low Terrace deposits are younger and not overlain by the Peoria loess. These terraces may be found along the Skunk River. Hudson age deposits are associated with fine-grained alluvial, organic, and colluvial sediments and include the DeForest Formation which is subdivided into the Camp Creek, Roberts Creek, and Gunder members. These deposits are present in valleys and upland drainages throughout the map area.

Surficial deposits in the map area are composed of six formations (youngest to oldest): Hudson DeForest; Wisconsin Peoria, Pisgah, and Noah Creek; and Pre-Illinoian Wolf Creek and Alburnett. Four bedrock mapping units (Pennsylvanian lower Cherokee Group; and the Mississippian Pella or "St. Louis", Warsaw, and Keokuk formations) are exposed at the bedrock surface in the Salem Quadrangle. The Mississippian Pella or "St. Louis" formations and the Pennsylvanian lower Cherokee Group comprise the bedrock surface in most of the map area, especially in the upland areas. The other Mississippian units occur within the bedrock valleys.

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