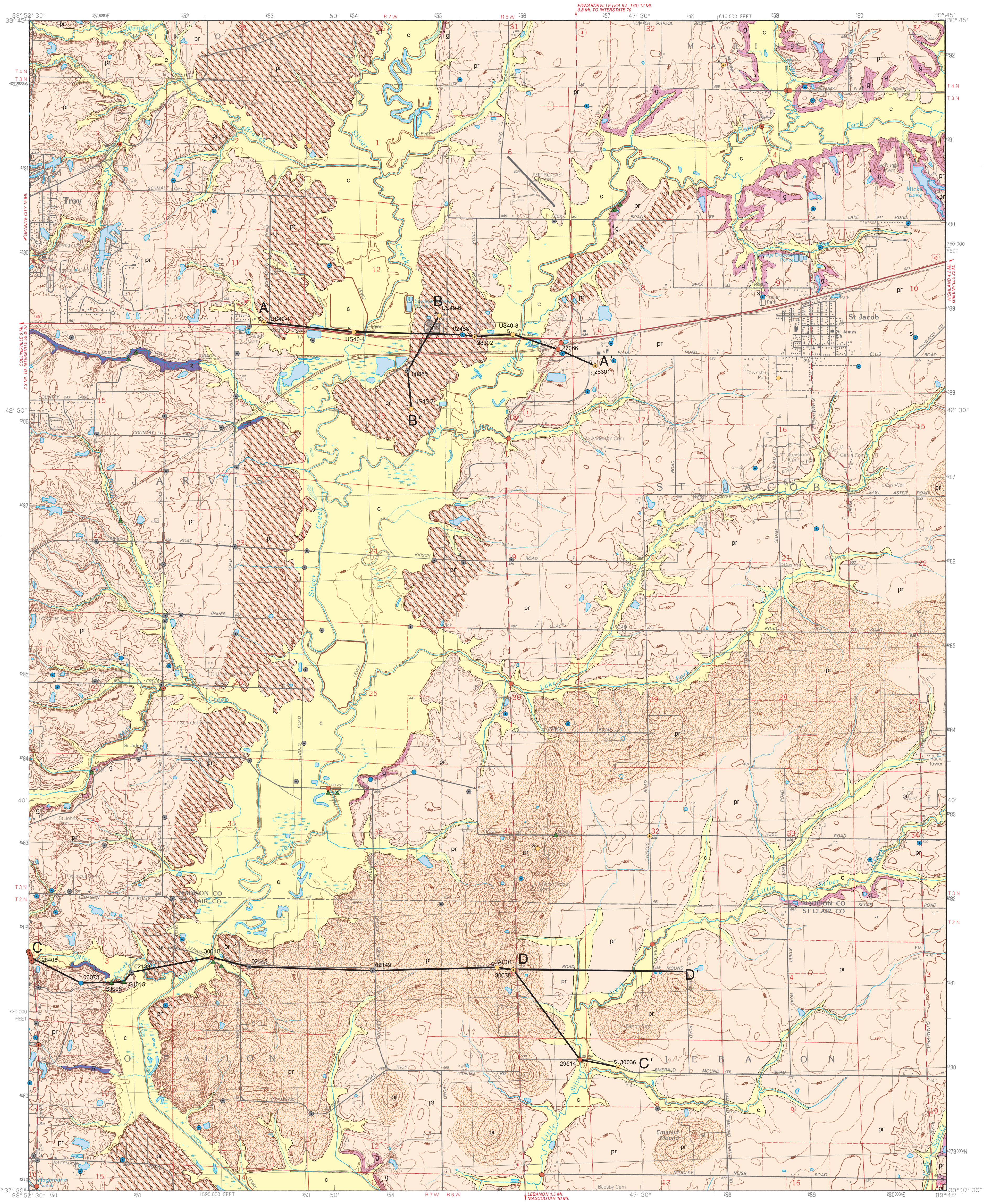
Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

SURFICIAL GEOLOGY OF ST. JACOB QUADRANGLE

MADISON AND ST CLAIR COUNTIES, ILLINOIS

Illinois Preliminary Geologic Map
IPGM St. Jacob-SG

Andrew C. Phillips
2004



QUATERNARY DEPOSITS

HUDSON EPISODE (~12,000 years before present (B. P.) to today)

Description	Unit	Interpretation/Occurrence
Mixed fine sediment, silty clay to silt loam to sandy loam to fine sand, local sand and gravel lenses; massive, graded, to well stratified; gray to brown; leached; very soft to moderately stiff; moist to very moist; up to 30 feet thick	Cahokia Formation c	**Stream sediment** in modern stream valley floodplains; mainly redeposited loess; may be coarser grained in lower portion where sediment is derived from till and buried glacial stream deposits

WISCONSIN EPISODE (~75,000 years - 12,000 B.P.)

Description	Unit	Interpretation/Occurrence
Silt loam; massive to weakly stratified; yellowish brown to gray to brown with pink hue; mainly leached but may be weakly reactive; friable; contains modern soil solum in upper 2 to 5 feet (commonly weathered to silty clay loam); up to 15 feet thick	Peoria and Roxana Silts pr (underlain by Hagarstown Member, Pearl Formation) pr (underlain by Pearl Formation, undifferentiated) pr	**Loess** (wind blown sediment), but including some slope deposits; upper and thicker portion is Peoria Silt (yellow brown to gray); lower portion is Roxana Silt (brown with pink hue to gray); thickest on uneroded uplands in west-southwest and immediately east of Silver Creek
Mixed fine sediment, clay, silty clay, silt with few sand lenses; massive to laminated; gray, may have pink hue; very soft to soft; moist; reactive; up to 10 feet thick	Equality Formation (cross sections only) e	**Lake sediment,** deposited in slackwater lakes formed when mouth of drainage was blocked by rapid sediment accumulation in trunk valley, includes nearshore (stream) facies; occurs below the Cahokia Formation in Silver Creek and its major tributaries below 420 ft elevation

ILLINOIS EPISODE (~200,000 years - 130,000 B.P.)

Description	Unit	Interpretation/Occurrence
Silt loam; massive or thin bedded; light brown to pale brown; generally leached; typically 5 feet or less, but up to 25 feet thick	Teneriffe Silt (cross sections only) tr	**Loess and stream sediment**; limited in spatial extent; thinnest in upland (loess) positions, thicker as valley fill (stream sediment); contains Sangamon Geosol
Mixed, sand, gravel, and diamicton; interbedded; reddish brown, brown, gray; leached to strongly reactive; soft to very stiff; up to 70 feet thick	Hagarstown Member Pearl Formation (cross sections only) pl-h	**Ice marginal deposits,** including debris flow, outwash, and till, characteristically variable; forms ridges and mounds on uplands but includes associated buried units; covered by up to 15 ft of loess, overlies or intertongues with Pearl or Glasford Formations; contains Sangamon Geosol in upper portions
Fine to coarse sand, loose sand to sandy loam, gravel and silt lenses; may be clay-rich in upper few feet where a buried soil occurs; reddish brown, brown, gray; leached to strongly reactive; medium dense to dense; up to 15 feet thick	Pearl Formation undifferentiated (cross sections only) pl	**Meltwater stream sediment**; forms terraces along Sugar Fork and Silver Creek where it is buried by loess, buried by Cahokia Formation in Silver Creek; contains Sangamon Geosol in upper portions except where eroded; covered by up to 5 ft of loess or stream sediment on surficial map units
Diamicton, pebbly loam; massive; includes lenses of silt, sand and gravel (predominantly in upper part) up to 10 feet thick and hundreds of feet wide; olive brown to dark gray to dark grayish brown; upper few feet is weathered, brown, softer, more clay rich, and relatively moist; lower portion is commonly more uniform, stiff to very hard, low moisture, and calcareous; lowest 5 to 10 feet also commonly more clay rich; up to 70 feet thick	Glasford Formation g	**Till**; weaker and more moist upper portion is supraglacial till, lower dense portion is basal till; pervasive below Peoria and Roxana Silts; underlies stream sediment (Cahokia Formation) in tributary valleys; crops out along stream valley slopes; Sangamon Geosol developed in upper few feet; covered by up to 5 ft of loess on surficial map units
Silt loam to silt; massive, jointed; strong brown to gray; leached to reactive; very stiff; low moisture content; fossiliferous zones, may exhibit liesegang banding; up to 20 feet thick	Petersburg Silt pb	**Proglacial or slackwatwer lake sediment**, may include nearshore facies; underlies Glasford or Pearl Formations; crops out in Ogles Creek; may contain lower portion of Sangamon Geosol

PRE-ILLINOIS EPISODES (~700,000 - 400,000 years B.P.)

Description	Unit	Interpretation/Occurrence
Diamicton, clay loam to loam; crudely bedded to massive, more variable at base; mainly few thin silt and sand lenses but basal sands are up to 20 feet thick and extend laterally thousands of feet; very stiff; low to moderate moisture; upper part is olive brown to dark grayish brown (sometimes with pinkish hue), lower part is dark gray; leached to strongly reactive; up to 100 feet thick	Omphghent member Banner Formation (cross sections only) b-o	**Till and ice marginal sediment**; Yarmouth Geosol may be developed in upper 10 feet but commonly truncated; mainly basal till, but may include proglacial debris flow, lake or stream sediment in basal portions; appears to form core of upland ridge in south, thinner occurrences in north
Mixed fine sediment, clay, silty clay, silt, loam, and zones of fine to medium sand; massive, graded, or laminated; olive brown to olive gray, gray; leached to strongly reactive; up to 25 feet thick	Harkness Silt Member Banner Formation (cross sections only) b-h	**Lake and stream sediment**; occurs in major bedrock valleys below Omphghent Member
Mixed fine sediment, loam, silt loam, silty clay loam, and clay, with fine sand to gravel near base of unit; weakly stratified to well stratified, fines upwards but variable; stiff to hard; moderately to very moist; olive gray to olive brown; leached; up to 25 feet thick	Canteen member Banner Formation (cross sections only) b-c	**Stream and lake sediment**, nonglacial; contains one or more paleosols, may include residuum; overlies bedrock
Mixed, silt, sand, silty to sandy diamicton	Undifferentiated (cross sections only)	**Till, stream sediment, or loess**; in areas with sparse data or where boring and outcrop observations are not correlatable

PRE-QUATERNARY DEPOSITS

PALEOZOIC BEDROCK

Description	Unit	Interpretation/Occurrence
Mixed shale, fine sandstone, conglomerate, limestone; upper portion may be weathered to clay, loam, or diamicton	Near-surface bedrock R	Mainly buried but crops out or is within 5 feet of the surface of tributary valley bottoms west of Silver Creek areas; at depth (cross sections), shale, siltstone and sandstone are equally common; mainly Pennsylvanian, but weakly lithified Tertiary sandstones and conglomerate occur in southeast

Data Type

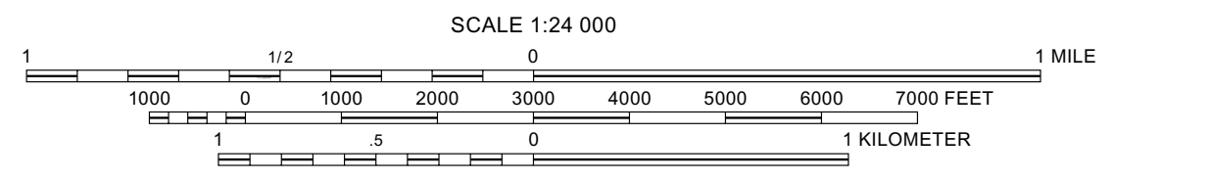
- ▲ Outcrop
- ● Stratigraphic boring
- ● Water well
- ● Engineering boring
- ● Coal boring
- SG⊙ Boring with samples (S) or geophysical log (G); dot indicates to bedrock
- —— Contact
- – – – – – Inferred contact
- A—A′ Line of cross section
- ▭ Water

Note: Numeric labels indicate the county number, a portion of the 12-digit API number on file at the ISGS Geological Records Unit. (Outcrop labels indicate field number.)

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography compiled from imagery dated 1986. Field checked 1988. Map edited 1991.

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

Recommended citation:
Phillips, A.C., 2004, Surficial Geology of St. Jacob Quadrangle, Madison and St. Clair Counties, Illinois: Illinois State Geological Survey, Illinois Preliminary Geologic Map, IPGM St. Jacob-SG, 1:24,000.



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

Released by the authority of the State of Illinois: 2004

Geology based on fieldwork by A. Phillips, 2003-2004.

Digital cartography by M. Barrett, 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.

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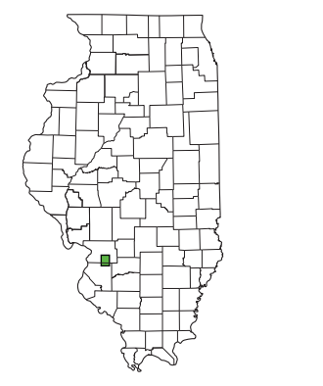

1	2	3
4	🟩	5
6	7	8

ADJOINING QUADRANGLES
1 Edwardsville
2 Marine
3 Grantfork
4 Collinsville
5 Highland
6 O'Fallon
7 Lebanon
8 Trenton

½°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2004

ROAD CLASSIFICATION

Primary highway, hard surface	━━	Light-duty road, hard or improved surface	——
Secondary highway, hard surface	━━	Unimproved road	——

(64) Interstate Route (50) U.S. Route (158) State Route

Introduction

This map depicts geologic materials found within 5 feet of the ground surface in the St. Jacob 7.5-minute Quadrangle, Madison County, southwestern Illinois (fig. 1). The cross sections show the extent of surficial and buried units down to bedrock. Previously published maps of the area have been at 1:500,000 scale (Lineback 1979; Stiff 2000), although there has been unpublished research at larger scales. This project builds upon the earlier work, especially Fox et al. (unpublished map) by adding new observations of the surface and subsurface, incorporating them into a digital database, and interpreting them at large scale. The morphology of a major bedrock valley was refined (fig. 2), the sediments in the bedrock valleys, modern valleys, and in upland ridges were distinguished, and areas with relatively good and relatively poor geologic control were identified. Prediction of the occurrence of buried units far from the lines of cross section should be made with care; additional studies are necessary if greater detail is desired. This product can be used for preliminary geologic assessments of construction siting issues, geologic hazards, groundwater resources, environmental protection, and other activities. The work is part of the ISGS Metro-East mapping program, intended to provide critical geologic data in this rapidly developing area.

Regional Setting

The St. Jacob 7.5-minute Quadrangle is located a few miles east of bluffs that overlook the Mississippi River valley (fig. 1). The landscape can be considered as three geomorphic regions: 1) river valleys, 2)gently sloping uplands, and 3) ridged or hummocky uplands. River valleys, including some terraces and small fans on valley sidewalls, are mainly comprised of waterlain sediments. The larger north to south trending stream valleys in the region, such as Silver, Sugar, and Cahokia creeks, were conduits of meltwater from the last glacier to cover this region. The Silver Creek drainage is tributary to the Kaskaskia River valley to the south (not shown). Constriction of the Silver Creek valley near Ogles Creek may have been caused by near-surface bedrock on the west and the presence of glacial ice on the east. Rough topography of smaller tributary valley walls in the western and extreme northeastern portions of the quadrangle is evidence of resistant till or bedrock near the surface.

Uplands are a composite of glacial, stream, lake, and windblown sediment (loess). The upland topography is generally subdued like much of the regional upland surface to the north, whereas there are prominent elongate ridges and steep mounds on the uplands in the southern half. These features are part of a train of similar ridges and mounds trending northeast-southwest across the region (fig. 1). In addition to these geomorphic regions, there are concealed deposits unrelated to surficial landforms. Instead, the occurrence and thickness of these deposits are partly controlled by the bedrock topography (fig. 2).

The Quaternary sediment overlying bedrock was deposited during at least three episodes of glaciation, which were separated by relatively warm, interglacial episodes, including the present-day postglacial episode. Before the earliest known Quaternary glaciation, erosion had exposed much of the land surface to bedrock and created a broad, deep stream valley trending north to south across the quadrangle (fig. 2). Bedrock valley walls were probably deeply incised by tributary streams such as is seen today in far southern and extreme northwestern Illinois. During the pre-Illinois and the Illinois glacial episodes, glaciers flowed over the region from the northeast to the southwest, extending across the Mississippi Valley to the St. Louis area (McKay 1979; Grimley et al. 2001). The glaciers sculpted the pre-existing landscape and left deposits of diamicton (a poorly sorted mixture of rocks, sand, silt, and clay), deposited as till at the glacier bed or as sediment piles sloughed off of glacier margins or in crevasses. Sorted silt, sand, and gravel were deposited from meltwater streams. During the last (Wisconsin Episode) glaciation, ice only advanced into the northeastern quadrant of Illinois, reaching about 80 miles to the northeast of St. Jacob. Its main influence in this area was to discharge large volumes of sediment into the Mississippi River to create extensive plains of meltwater sediment. During glaciation, silt was eroded by westerly winds off the unvegetated sandy floodplains in the Mississippi Valley, to be deposited across the upland landscape as blankets of loess. Between glaciations, streams continued to erode some sediment out of their valleys, and soils developed on the fresh land surface.

Postglacial stream sediment is derived mainly from erosion of the loess covering the uplands, but erosion has also exposed older Quaternary sediments and bedrock. Clearing of forests during early European colonization, and possibly earlier during Amerindian civilization centered at the Cahokia Site in western Madison County, led to extensive upland erosion and sediment accumulation in creek valleys. Relatively recent stream incision into these sediments and older deposits is attributed to large water discharges with initially low sediment loads brought about by recent climate changes, land use changes, or both.

Methods

The surficial map was constructed by interpretations of parent materials from soils surveys (NRCS 1999, NRCS 2002) that were validated with outcrop observations and modified to conform to topography, interpretations of borehole data, analysis of shallow seismic shear wave data acquired for this project, and compilation of fieldnotes from previous ISGS research. Borehole data sources included new borings acquired for this project, and stratigraphic, geotechnical, water, and coal boring records stored in the ISGS Geological Records Unit. Some landforms were interpreted by airphoto analysis. Computer modeling was used to construct the bedrock topography. The quality of the geologic and locational descriptions of archived data vary considerably in detail and accuracy. Outcrops described in this study provide critical two-dimensional perspectives of map unit variability and contact characteristics, but exposures are limited to near-surface units. ISGS stratigraphic boring descriptions and geotechnical logs typically provided the most detail and could be located most accurately. Except for a few select companies, water-well descriptions provided by drillers were generally of low value because few lithological boundaries were distinguished, typically only the drift/bedrock interface, and locations tend to be imprecise. Positions of boring and outcrop locations shown on the map are based upon the best available information for each point. Horizontal and vertical accuracy of verified locations range between approximately 1 to 200 ft and 1 to 20 ft, respectively. Surficial contacts were correlated between observation points by interpreting landform-sediment relationships on topographic maps. Buried unit boundaries are assumed to be well known within 1000 ft of each observation point. Boundaries extending further than that in the cross sections are dashed. Stratigraphic nomenclature follows Hansel and Johnson (1996) and Willman and Frye (1970), as appropriate.

Sediment Assemblages and Properties

Uplands
Most of the upland surface is comprised of a blanket of loess, which covers thick glacial, ice-marginal, and non-glacial stream deposits. The Peoria Silt and the underlying Roxana Silt loess units are not differentiated here because their geotechnical properties are very similar (Table I), but they have been studied extensively by McKay (1979), Wang et al. (2003), and others. Original textures of silt loam to heavy silt loam have been modified within the modern solum to heavy silt loam to silty clay loam (NRCS 1999, NRCS 2002). The loess is thickest (approximately 15-20 ft) closest to its Mississippi Valley source area in the west and thins to about 10 ft on uneroded uplands in the east.

A third loess unit, the Teneriffe Silt, occurs locally. Although mainly massive silt to silt loam, it may include fine sand lenses. The upper part of the Teneriffe Silt usually contains weathering characteristics of the Sangamon Geosol, a buried soil formed during the last warm interglacial episode. Distinctive alteration features include color mottling, strong soil structure, lack of carbonate, extensive clay coatings, and common iron-manganese concentrations. The strength of these features help distinguish the Teneriffe Silt from the overlying Roxana Silt. Stratified facies of the Teneriffe Silt are interpreted as ice-marginal stream or lake sediments (e.g. Little Silver Creek, cross section C-C') and thus may be correlative with the Pearl Formation (below).

Two distinctive relatively coarse-grained units (the Pearl Formation-Hagarstown Member and the Pearl Formation, undifferentiated) buried beneath 10-15 ft of loess are depicted on the map by patterned areas. The Hagarstown Member of the Pearl Formation is associated with northeast-southwest trending ridges and irregular to conical mounds. The sediments may have been deposited in ice-contact environments such as end moraines, kames, eskers, or meltwater streams, or proglacial lakes. The Hagarstown Member is characteristically variable. Although sand and gravel bodies tens of feet thick may occur, especially in the elongate landforms and even in inter-ridge areas, their lateral extent may be very restricted and some landforms may be primarily composed of diamicton (fig. 3; Jacobs and Lineback 1969; Heigold et al 1985; Stiff 1996). A core through Terrapin Ridge (cross section C-C') recovered mainly diamicton directly below the Peoria and Roxana Silts. The upper few feet of the Hagarstown Member typically contain the Sangamon Geosol.

The Pearl Formation, undifferentiated, is mainly meltwater stream sediment. In low terraces on both sides of Silver Creek with upper elevations of about 470 ft, the Pearl Formation, undifferentiated, is covered by about 15 ft of loess (cross section B-B'). The fine to medium sand and some gravel were deposited when Silver Creek was an outlet for meltwater from the Illinois Episode glacier. Where weathered during development of the Sangamon Geosol, the texture may have been altered to loam, or may even have sufficient clay to have a diamicton texture.

Along side slopes and valley walls, where erosion has thinned the loess blanket to 5 ft or less, the Glasford Formation is shown on the surficial map. Sediments in the Glasford Formation include diamicton, weathered diamicton, and associated sorted sands and gravels. The sediment was deposited mainly as till and ice-contact sediment. The ice-contact sediment is distinguished from the Hagarstown Member in that it lacks topographic expression of the deposit and sorted sediments are a more minor component. The Glasford Formation is pervasive under the uplands, reaching thicknesses of 60-70 ft. Diamicton of the Glasford Formation is loamy, very stiff, with low water content (Table I). Lenses of sand and gravel, up to 10 ft thick and hundreds of feet wide, have been described in the upper part and base of the Glasford Formation in neighboring quadrangles in Madison County (Phillips 2004; Phillips and Grimley, 2004). Within the St. Jacob Quadrangle, similar lenses are grouped with the Hagarstown Member, and there are fewer sorted sediment lenses within the Glasford Formation. The lower third of the Glasford Formation is slightly more clay-rich and softer, perhaps due to incorporation of underlying clayey units and shale. The Glasford Formation also has relatively low strength and high moisture content within the weathering profile of the Sangamon Geosol, in part due to higher clay content.

The Petersburg Silt, a hard, jointed, massive silt loam with low moisture content, crops out below Glasford and Pearl Formations in lower Ogles Creek (cross section C-C'). Upright spruce (Picea sp.) root wads and horizontal logs occur in the lower part. Willow leaf and moss fragments are evidence of wetland or nearshore depositional environments (C. Yansa, personal communication). In other parts of Madison County, the Petersburg Silt was interpreted as backwater lake and stream sediment that filled pre-Illinois episode valleys (Phillips 2004; Grimley 2004). At the Ogles Creek section, the unit was deposited along the western side of an Illinois Episode valley. The eastern side of the valley was either eroded out by the Illinois Episode glacier, or the glacier itself formed the eastern valley wall.

Stream Valleys
The Silver Creek, East Fork Silver Creek, and Little Silver Creek valleys are filled with postglacial stream sediment (Cahokia Formation) and floored by glacial stream sediment (Pearl Formation or Teneriffe Silt) that attest to their existence as meltwater outlets during the Illinois Episode. Most other valleys contain only the Cahokia Formation and are thus more recent features. The Cahokia Formation is up to 30 ft thick. It is generally fine grained because the sediment source was primarily loess, but the texture varies from silty clay deposited in backwater environments and abandoned meanders, to loamy sediments associated with deposition near channels. Layers of sand occur at depth, and up to several feet of sand and gravel that was concentrated by stream processes from older deposits (till or glacial stream sediment) may occur at the base of the unit. Distinguishing coarse-grained Cahokia Formation from deposits of the underlying Pearl Formation is difficult in the subsurface because the textures of the units can be very similar. However, some geotechnical records distinguish brown colors that may be attributed to the weathering profile of the Sangamon Geosol in the upper few feet of the Pearl Formation. In addition, it is generally assumed that the Cahokia Formation is leached to slightly calcareous, whereas the Pearl Formation below the Sangamon Geosol is calcareous.

In the major creek valleys between the Cahokia and Pearl Formations and below the 420 ft elevation are thin occurrences of soft, moist, calcareous, fossiliferous, massive to laminated silt loam and clay. They are classified in the Equality Formation and interpreted to be slackwater lake deposits. They are correlated to terraces in the lower Silver Creek and Kaskaskia River valleys. The slackwater lakes developed when large volumes of sediment were deposited as outwash in the Kaskaskia River from the Wisconsin Episode glacier, raising the base level of the tributary valleys more quickly than they could adjust, thus causing them to flood.

Smaller tributary streams are incised into upland sediments. In valleys that drain into Silver Creek from the west, the Glasford Formation or bedrock may be exposed in the channel bed or covered by a thin lag deposit. In some valleys the incision has been so great, perhaps related to increased runoff from changing landuse and climate over the past century, that the channels are separated from their original floodplains. Where incision has slowed because of resistant units at the channel bottoms, new terraces are being constructed from flood sediment within the channels.

Concealed Deposits
Pre-Illinois episode Quaternary deposits (Banner Formation) are distinguished from the Glasford Formation by selected physical and chemical properties (Table I) and by the weathering profile of an interglacial soil (Yarmouth Geosol) developed in the upper part. The Yarmouth Geosol was typically truncated by the Illinois Episode glacier and may only be recognized by a zone leached of carbonate. Within the St. Jacob Quadrangle, three units of the Banner Formation are distinguished. They include 1) diamicton interpreted to be till (the informal Omphghent member; McKay 1986), 2) variably textured sorted sediments deposited in glacial streams and lakes (Harkness Silt Member), and 3) weathered, non-glacial, fine to medium textured sorted sediments (the informal Canteen member; Phillips 2004). The Omphghent member is thick and overlies all older units in the southern portion of the St. Jacob Quadrangle (cross section C-C') and in quadrangles to the north. It was eroded during the Illinois Episode or not deposited in the northern portion of the quadrangle as shown in boreholes 28301 and 28302 (cross section A-A'). The upper portion of the Omphghent member east of Silver Creek is similar to the Glasford Formation in texture and hardness. These properties grade downwards to finer textures (silt loam), lower strengths, and moderate water contents more typical of the Omphghent member as found further west (McKay 1986; Table I). A thick sand and gravel lens occurs near the bottom of the Omphghent member under Terrapin Ridge (cross section C-C').

The occurrence of the Harkness Silt Member is restricted to the main bedrock valley (cross sectin C-C'). The stratified sands, silts, and clays, cold-climate plant (spruce), gastropod, and ostracod fragments, and pebbles with erratic lithologies attest to deposition in streams and lakes during a pre-Illinois glacial episode, possibly in an ice-marginal setting.

A weak paleosol (sediment leached of carbonate and olive color), variable textures, lack of erratic pebbles, and clay mineralogy similar to bedrock distinguish the Canteen member within the Banner Formation. The unit may contain stream, lake, and slope sediment, as well as additional paleosols. The sediments are intepreted to be non-glacial in origin and directly overlie bedrock. The Canteen member is restricted to bedrock valleys (cross sections, fig. 2), and it has been found in boreholes penetrating buried bedrock valleys from northern St. Clair to northern Madison Counties (fig. 1).

Geologic Resources

Groundwater Resources
There are limited groundwater resources in the drift of the St. Jacob Quadrangle. Although the Pearl Formation and sand and gravel lenses within the Glasford Formation are potentially productive, the bodies are generally restricted in extent, varied in location, and thus they are difficult to target for drilling. For data in the ISGS Geological Records Unit, most wells developed within drift are between 25 and 50 feet deep with large diameters. They are predominantly completed within the Glasford Formation. Less than half of those are screened in sand or gravel lenses 1 to 10 feet thick; the rest are screened in till and probably capture water from thinner sand lenses and fractures. Contamination potential for shallow aquifers in uneroded uplands is low to moderate (Berg et al. 1984). Although potential confining layers of loess and till are sufficiently thick over much of the quadrangle, sand and gravel lenses in the shallow-buried Hagarstown Member, Pearl Formation, and Glasford Formation provide potential subsurface pathways for contaminants (c.f. Berg et al. 1984). The Sangamon Geosol likewise provides a clay-rich horizon, up to 3 ft thick, that could substantially retard downward groundwater flow (c.f. Herzog et al. 1989). However, soil structure, fractures, as well as the many small lenses of sand within the upper part of the Glasford Formation may provide pathways for contaminants to underlying layers.

Acknowledgements

I would like to thank the private landowners and municipalities who graciously permitted us to drill on their properties. The Illinois Department of Transportation and county transportation departments of Madison and St. Clair Counties also provided access to land and their drilling records. G. Berning, Natural Resources Conservation Service, helped with landowner contacts. Kohnen Concrete Products helped to confirm the locations of many of the water wells they drilled. Seismic data were acquired by Andre Pugin and his ISGS collaborators. Chris Stohr logged natural gamma and determined stratigraphic borehole locations with GPS. Brandon Curry (ISGS), Catherine Yansa (Michigan State University), and Alex Wiedenhoeft (USDA Forest Service) provided fossil identifications. The ISGS drill team continued its excellent core recovery. The mapping was supported by United States Geological Survey STATEMAP Contract 03HQAG0112.

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Table 1 Physical and chemical properties of selected map units (typical ranges listed)

UNIT	w (%)	Qu (tsf)	N	sand	silt	clay	clay mineralogy	natural gamma	MS
Cahokia Fm.	21 - 30	0.3 - 1.5	3 - 11	coarse sand to silt loam			*n.d.*	variable	*n.d.*
Peoria and Roxana Silts	16 - 28	0.2 - 2.0	4 - 12	1 - 8	70 - 78	19 - 23	very high expandables	mod.	10 - 20
Equality Fm.	20 - 44	0.5 - 1.0	2 - 8	*n.d.*	*n.d.*	*n.d.*	*n.d.*	*n.d.*	*n.d.*
Teneriffe Silt	*n.d.*	*n.d.*	*n.d.*	10	75	15	high expandables	*n.d.*	7 – 8
Pearl Fm., undifferentiated	15 - 34	<0.25 - 1.8	1 - 15	*n.d.*	*n.d.*	*n.d.*	60 - 80 % illite	low	2 – 10
Hagarstown M.	*n.d.*		*n.d.*	silt to loamy diamicton			60 - 80 % illite	low to high	5 - 10
Glasford Fm. *	8 - 20	0.8 - 4.4	15 - 60	26 - 43	37 - 54	20 - 29	56 - 68 % illite	mod.-high	20 - 40
Petersburg Silt	<20	>4.5	*n.d.*	0 – 6	75 – 95	6 - 20	expandables > illite	*n.d.*	*n.d.*
Omphghent m. *	19 - 26	1.4 - 2.2	6 - 14	22 - 52	19 - 50	28 - 30	46 - 57 % illite	high	20 - 80
Harkness Silt M.	*n.d.*	3.0 - >4.5	*n.d.*	silt to loam				mod. to high	7 – 10, high spikes
Canteen m.	*n.d.*	0.5 - >4.5	*n.d.*	3 - 40	35 - 60	10 - 45	high expandables	mod. to high	6 - 20
sandstone or shale bedrock	10 - 20	4.0 - >4.5	>50	*n.d.*	*n.d.*	*n.d.*	*n.d.*	very high	7 - 20

Geotechnical Properties: Compiled from 30-40 bridge borings from across the quadrangle and 3 stratigraphic borings
w = % moisture content = mass of water / mass of solids (dry)
Qu = unconfined compressive strength, Pocket Penetrometer method
N = blows per foot (Standard Penetration Test)

Particle size distribution and clay mineralogy: Compiled from discrete sampling of 4 stratigraphic borings
sand = % > 63 µm; silt = % 4-63 µm; clay = % < 4 µm (proportions in the < 2 mm fraction)
clay mineralogy = proportions of expandables, illite, and kaolinite/chlorite (in < 4 µm clay mineral fraction); these calculations using Scintag diffractometer calculations indicate about ¼ more illite than previous results by H.D. Glass with General Electric X-ray diffractometer

Geophysical Data:
MS = magnetic susceptibility (x 10^{-5} SI units), compiled from quasi-continuous sampling of 3 stratigraphic borings
natural gamma radiation compiled from continuous downhole logs of 1 stratigraphic boring

n.d. = no data available
* properties for Glasford Fm. and Omphghent m. are mainly for calcareous till (excludes sand and gravel lenses and strongly weathered zones)

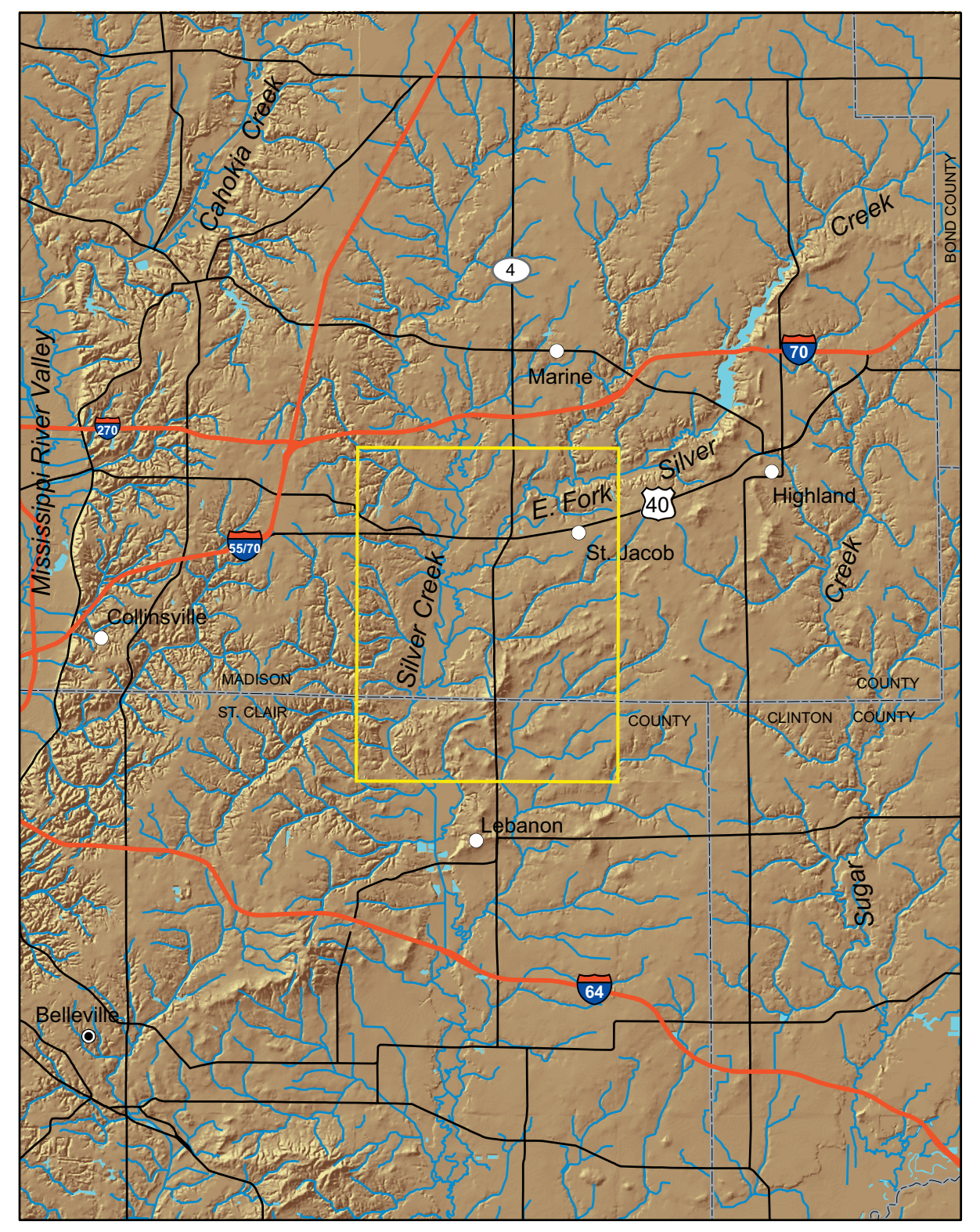


Figure 1 This map depicts the three dimensional landscape in the region around the St. Jacob 7.5-minute Quadrangle (yellow outline) with a simulated light source from the northwest. The quadrangle lies east of the Mississippi River floodplain on the western edge of the Kaskaskia River basin. The Illinois Episode glacier constructed the smooth surface of the uplands at the glacier bed but constructed the northeast-southwest trending train of ridges and mounds at the glacier margin or in crevasses. Larger valleys were Illinois Episode meltwater channels. Rough topography of smaller stream valleys along the western margin and northeast corner of the quadrangle shows deep postglacial incision into the upland surface.

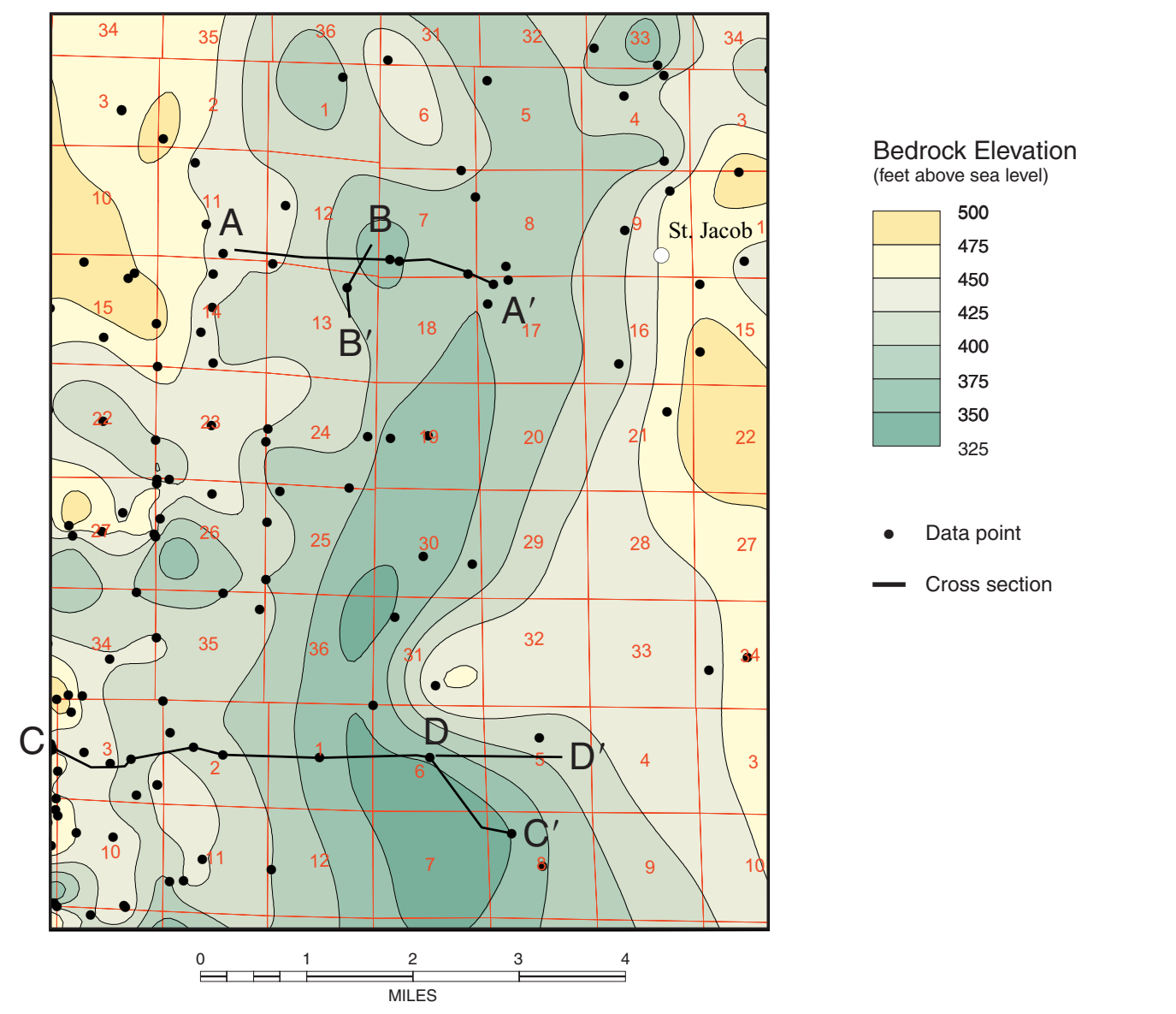
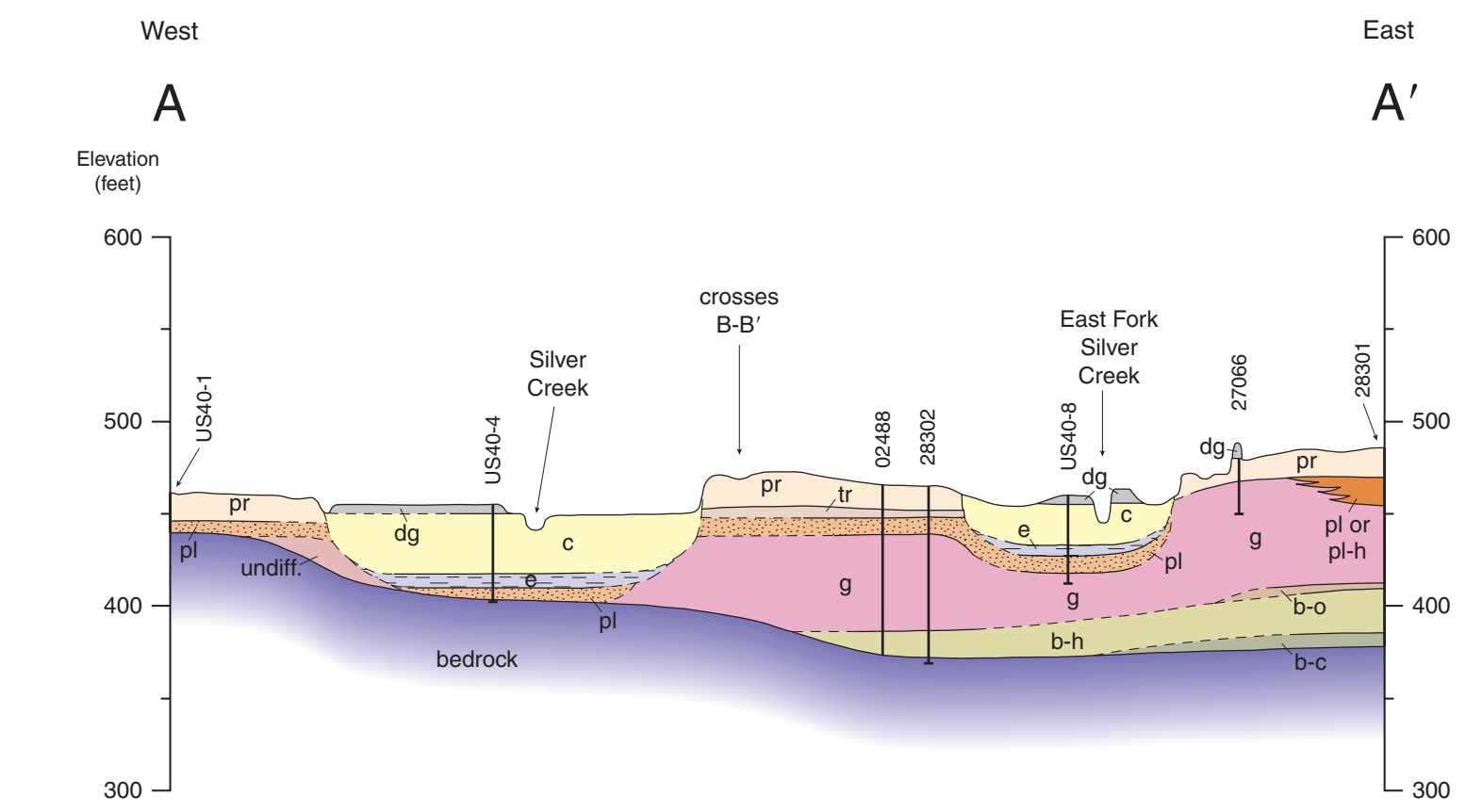
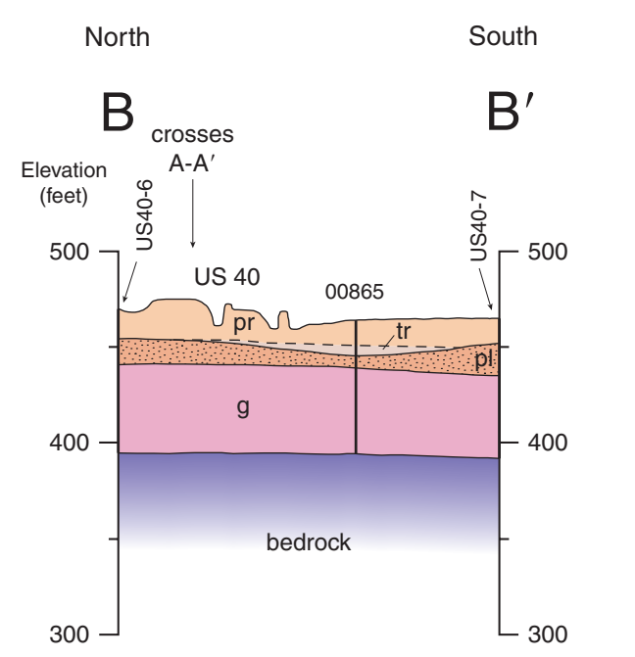
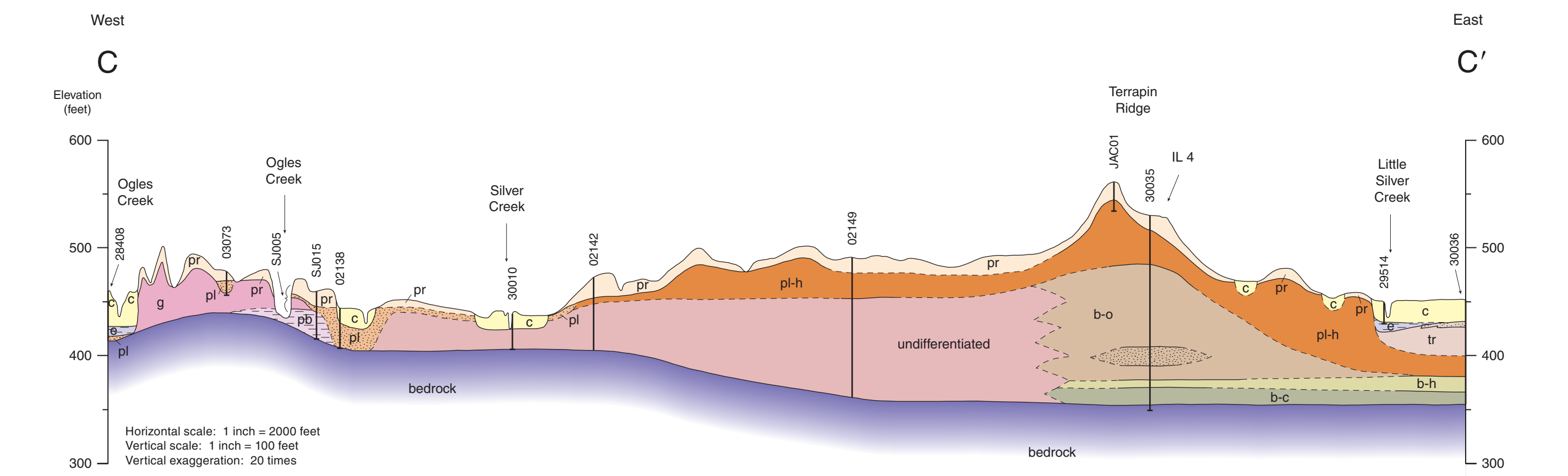


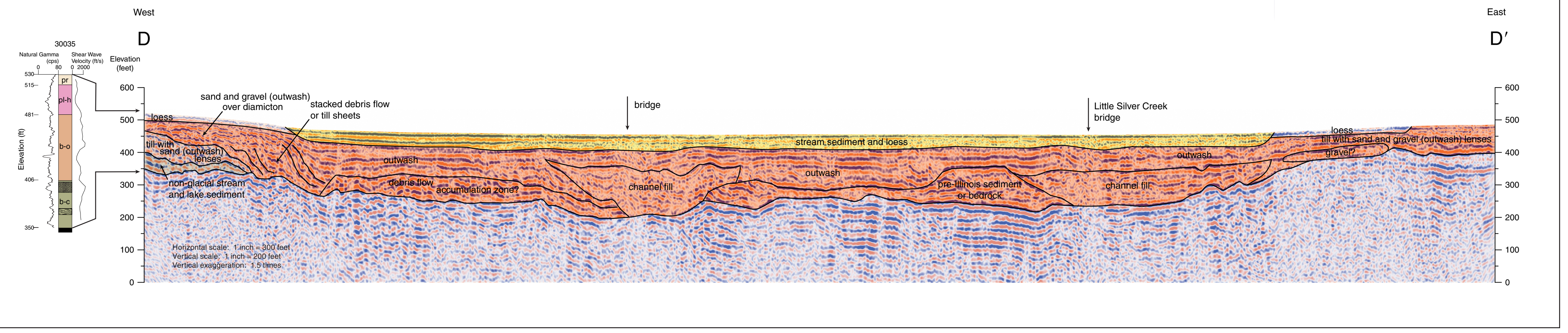
Figure 2 A wide, gently sloping bedrock valley trends north-south through the center of the St. Jacob 7.5-minute Quadrangle. Bedrock is near surface and crops out locally along the bedrock highs to the east and west.







- ▨ Sand, may contain some gravel or silt
- ☰ Laminated silt and clay
- ☐ Diamicton, massive silt, or other fine-grained sediment
- —— Contact
- – – – Inferred contact



Preliminary interpretation of sedimentary units in seismic shear wave profile along Townsend Rd. Borehole 30035 correlates from 230 feet west of the profile startpoint. Reflections (blue traces) occur where there is a sharp change in seismic velocity. Seismic patterns do not strictly correlate to stratigraphic units. Steeply dipping reflectors on the east flank of Terrapin Ridge may be sheets of till thrust onto moraine or debris flow deposits that flowed off the moraine. Horizontal reflectors within the central valley are glacial outwash stream and non-glacial floodplain deposits. Areas of chaotic to subdued reflectors may be sand or gravel accumulations in stream channels.