Illinois Geologic Map
Illinois Map 16

Surficial Geology of the Middle Illinois River Valley

Bureau, Marshall, Peoria, Putnam, and Woodford Counties, Illinois

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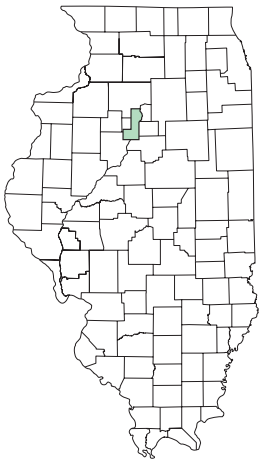
2010



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Introduction

Mapping of the Middle Illinois River valley region was partially funded by the Illinois Department of Transportation (IDOT). The purpose of the mapping was to assist IDOT planning and design for upgrade and possible rerouting of Illinois State Highway 29 between Chillicothe and its junction with Interstate 180.

Value of the Map

This surficial geology map shows the occurrence of geologic units at the land surface and implies the succession and presence of units in the subsurface. For example, the Tiskilwa Formation (unit symbol "t") outcropping on a slope below the Batestown Member (unit symbol "l-b"), indicates that the Tiskilwa Formation underlies the Batestown Member beneath the upper part of the hill. These relations are illustrated in the legend and cross sections.

The surficial geology map, in combination with information on the subsurface distribution of geologic materials, is valuable for identification of opportunities and limitations for future land development, as well as anticipation of the likely consequences of past and future land-use decisions. Typical applications of the map include estimation of groundwater resource potential, occurrences of potential aggregate resources, geologic conditions that may present hazards for construction, and the capability of the geologic setting to support certain land uses such as a landfill.

Map Preparation

Units on the surficial geology map were identified and mapped from field observations and descriptions of natural outcrops and man-made exposures; logs of water wells, engineering borings, and other boreholes; new test drilling; geophysical investigations; and previously completed geologic maps (Stumpf and Weibel 2005; McKay et al. 2007a, 2007b, 2007c; Stumpf 2010), topographic maps, and aerial photographs. Stratigraphic nomenclature is from Hansel and Johnson (1996), Willman and Frye (1970), and Willman et al. (1975). ArcGIS software was used to compile and analyze field data and to prepare the map.

Field work was completed between 2001 and 2007. More than 250 outcrops were described by Illinois State Geological Survey (ISGS) field geologists. Records of boreholes of various types were compiled, locations verified, available samples and cores studied, and drillers' descriptions examined and interpreted. Records include 9 new ISGS boreholes, 339 highway and engineering boreholes, 40 new hand auger holes, 354 water wells, and 17 coal test boreholes (fig. 1). These data were supplemented by nearly 9 line-miles of seismic reflection profiles along Highway 29 to determine the depth to bedrock where the highway is located along bedrock uplands. Reported borehole locations were verified using (1) plat books, (2) direct contacts with landowners and well drillers, (3) address verification, (4) visits to locations in the field, or (5) visual inspection of locations on digital orthophotographs. U.S. Department of Agriculture (USDA) soil maps were useful in delineating loess thickness and postglacial alluvium. Digital soil maps were provided by the USDA Natural Resources Conservation Service for portions of these counties: Peoria (Walker 1992), Marshall (USDA 2000), Putnam (Zwicker 1992b), Bureau (Zwicker 1992a), and Woodford (Teater 1999). These county soil series maps were combined and generalized into soil parent material groupings by Berg et al. (2004).

Regional Geologic Setting

The surficial geology map and accompanying cross sections delineate geologic materials (lithostratigraphic units) that are classified by their sediment type or rock type (lithology) and relative position and age (stratigraphy). The lithostratigraphic units in the Middle Illinois River valley region have a complex pattern of occurrence. Glacial and fluvial (river) deposits, in places greater than 300 feet thick, occur beneath the uplands east of the valley, west of the valley in the area north of the Putnam/Marshall County line above the Princeton Bedrock Valley (see cross section A–B), and immediately north and extending westward from Chillicothe above the Wyoming Bedrock Valley (see cross section B–C); glacial deposits 0 to 100 feet thick overlie Pennsylvanian age bedrock west of the valley and south of the Putnam/Marshall County line; and thick fluvial deposits occur in the Illinois River valley. Bedrock valleys in the area are delineated on a regional bedrock topography map (Berg et al. 2009).

Landforms

The map spans a region near the maximum extent of the last (Wisconsin Episode) glaciation, and the landforms in the area reflect the combined action of glacial and fluvial processes. Where uneroded, the uplands adjacent to the valley are gently rolling and are crossed by several arcuate ridges (moraines) that range in width from less than a mile to several miles. These moraines mark margins of the Wisconsin Episode glacier as it paused in its retreat to the northeast (Hansel and McKay 2010). The modern river is a low-gradient channelized system with extensive, shallow, backwater lakes. The river valley ranges from less than two miles to nearly seven miles wide, and its valley floor is as much as 300 feet below the highest uplands. Several terraces rise as much as 100 feet above the Illinois River. The modern meander belt of the river occupies a narrow portion of the valley that is joined by tributary streams draining the uplands to the east and west of the valley. These streams occur in deeply eroded valleys cut into the uplands and exposing glacial deposits and bedrock. Some tributaries have deposited large alluvial fans where they enter the main river valley.

Heritage of Rivers and Glaciers

The Illinois River and its antecedent river systems have been shaped by several episodes of blockage, overriding, and diversion of their flow by continental glaciers that depos-

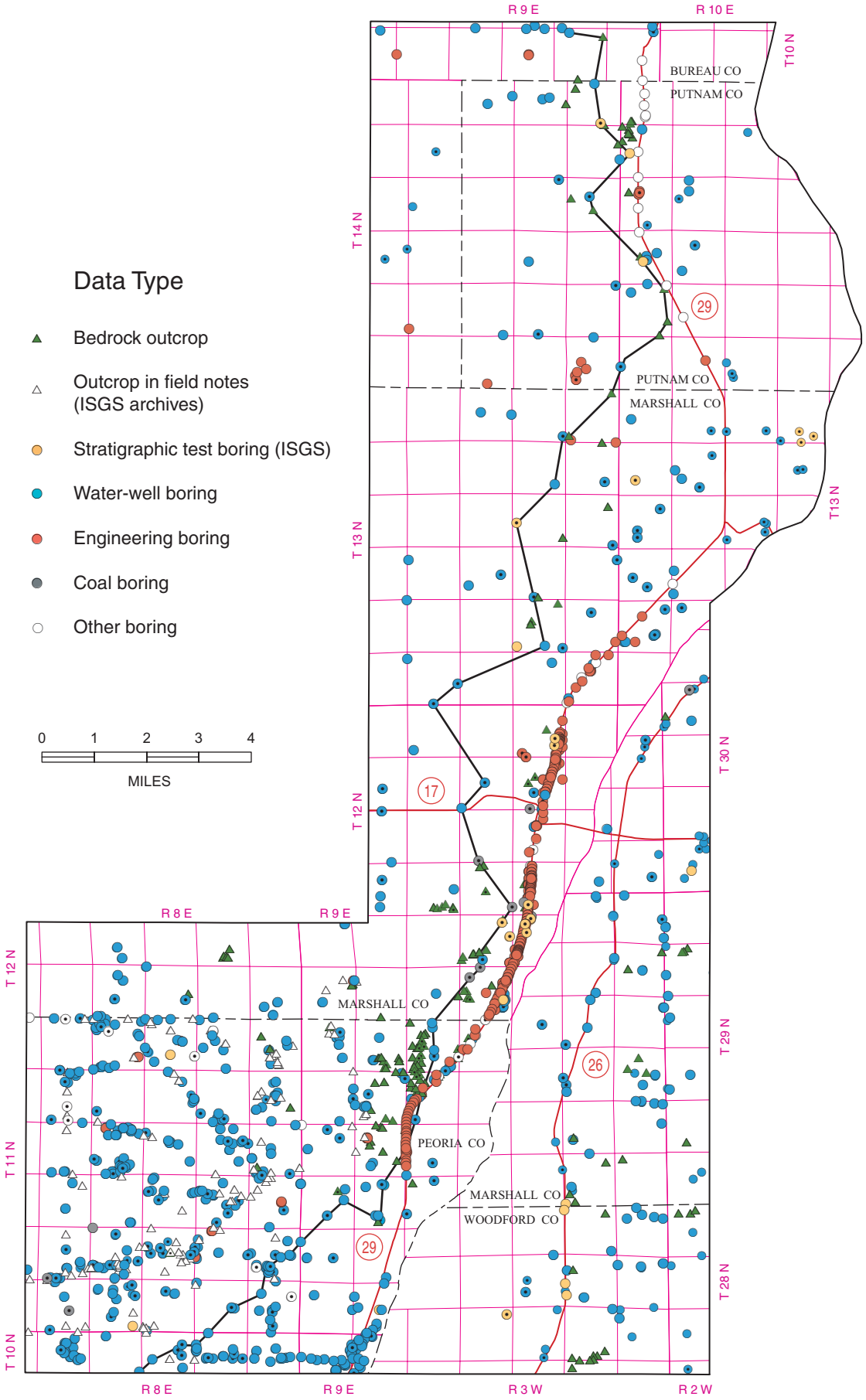

Figure 1 Locations of wells, borings, and outcrops.

ited till sheets across the area during the Quaternary Period (McKay et al. 2008). Preglacial rivers shaped the uppermost surface of the relatively soft shale bedrock into gently rolling uplands cut by a deep and wide bedrock valley. During this time, more than 500,000 years ago, the Ancient Mississippi River occupied the Middle Illinois Bedrock Valley, which was wider than, but generally parallel to, the modern valley (Berg et al. 2009). When the last of several glaciers flowed into the valley, the Ancient Mississippi River was blocked between about 24,800 calendar years before present (cal yr B.P.) (McKay and Berg 2008) and diverted to western Illinois where it occupied and enlarged the valley of the ancient Iowa River (the present Mississippi River). The overridden Ancient Mississippi River valley and its fill of river sediments were nearly completely buried by glacial deposits. The Lake Michigan lobe reached its maximum extent west of the Illinois River valley and then retreated to the northeast. Meltwater generally following the course of the modern Illinois River cut the present valley, deposited thick sand and gravel deposits, sculpted and preserved high terraces, and yielded dust to winds that transported silt downwind and blanketed the local uplands with loess. As the river downcut its valley, tributary streams were lengthened and incised. With the disappearance of continental glaciers and the return of warmer climate and reduced discharge and sediment load, the Illinois River meandered in its oversized valley, creating its modern channel, bars, natural levees, backwater lakes, and floodplain. Gradually, glacial sand and gravel were reworked and covered with overbank silt and clay, while tributary streams built alluvial fans.

Mapped Deposits

Descriptions are organized by mode of origin and listed from youngest to oldest.

Disturbed Land
Significant areas, particularly near the towns of Chillicothe, Lacon, and Henry have been disturbed by human activity, mainly from surface mining of sand and gravel and from construction of levees and retention ponds.

Peat Deposits
Grayslake Peat includes modern accumulations of peat in low wet areas on the floodplain of the Illinois River. Peat is rarely more than a few feet thick. The unit is mapped east of the river near the mouths of Snag Creek and Dry Creek.

Modern River Deposits
The Cahokia Formation, comprising silt and clay, occurs on the floodplain and in tributaries and backwater lakes of the Illinois River; sand dominates the main channel of the river. Gravel and sand occur in channels and bars of many tributary streams. Where tributary streams such as Sandy Creek, Clear Creek, Senachwine Creek, and Crow Creek enter the main Illinois River valley, these streams have deposited significant alluvial fans containing silt, sand, and gravel.

Gravity Deposits
The Peyton Formation includes variably textured deposits on slopes and toe slopes. Its grain-size composition largely reflects the texture of the upslope diamictons, loess, and bedrock from which it was derived. The unit includes mine spoil piles that are too small to map individually north and south of Sparland in areas formerly mined on a small scale. The Peyton Formation is prevalent along the lower slopes of the west bluff north of Chillicothe. Because of the scale of mapping, these deposits are not delineated in detail along the steep slopes at the edge of the Illinois River valley.

Wind Deposits
Peoria Silt (loess) is wind-blown silt that is thickest on uplands nearest the river. Loess was blown from floodplain surfaces during the last glacial episode (Wisconsin) when the river was carrying meltwater. It took several thousand years for the wind-transported dust to accumulate to the thicknesses found today. The Parkland facies of the Henry Formation is well-sorted fine sand in dunes that occur on some terraces in the Illinois River valley, particularly southwest of Chillicothe.

Outwash Deposits
The Mackinaw facies of the Henry Formation comprises thick sand and gravel deposits in large raised terraces in the Illinois River valley and smaller terraces in its tributary valleys, such as Senachwine Creek in Peoria and Marshall Counties. The Mackinaw facies is a thick deposit of the main river channel and a significant source of groundwater and material mined for aggregate. The Dry Creek tongue of the Henry Formation is an upland, ice-marginal, outwash deposit of sand and gravel that occurs between the Batestown Member and the underlying Tiskilwa Formation. This unit is widespread in the subsurface, but is generally thin and forms a local aquifer. The Dry Creek tongue outcrops locally in the eastern bluff of the Illinois River valley and is well exposed in a large borrow pit near the mouth of Dry Creek, SW¼ NW¼ Sec. 11, T29N, R2W, Woodford County. The Ashmore Tongue of the Henry Formation comprises main river channel deposits of sand and gravel that underlie the Tiskilwa Formation, the oldest of the Wisconsin Episode tills in the area, and that fill much of the lower part of the Ancient Mississippi Bedrock Valley. Like the other facies of the Henry Formation, the Ashmore Tongue is a significant aquifer. Evidence from the mapping of these outwash deposits in the bedrock valley has shown that the age of most of the sand and gravel is Wisconsin Episode and that the rest correlates to the Illinois Episode Pearl Formation (McKay and Berg 2008, McKay et al. 2008). Pearl Formation sand and gravel deposits have limited extent in the mapped area, and, where they occur, they are interbedded with Illinois Episode tills. Recent optically stimulated luminescence (OSL) age determinations from outcrops in Rattlesnake Hollow on units mapped as Henry Formation and Pearl Formation confirm their Wisconsin Episode and Illinois Episode ages, respectively (cross section C–D). Four dates from borehole 20609

north of Putnam have a weighted mean of 24,800 cal yr B.P. and confirm a Wisconsin Episode age for the Ashmore Tongue of the Henry Formation that fills the lower part of the Princeton Bedrock Valley (cross section A–B).

Wisconsin Episode Tills

The Batestown Member of the Lemont Formation includes olive-brown to gray-brown, pebbly, silty clay loam diamicton. Diamicton is a name for an unsorted or poorly sorted sedimentary deposit that contains a wide range of particle sizes, such as a till that contains clay, silt, sand, gravel, cobbles, and boulders. The Batestown Member overlies the Tiskilwa Formation beneath most upland areas, except the area west of Chilicothe. The Tiskilwa Formation, a reddish brown to gray, pebbly loam-textured diamicton, is widespread and thick, exceeding 100 feet locally. Where the lower 5 to 30 feet is gray to greenish gray, it is correlated with the Delavan Member. Where the lower part is silty and contains wood and other plant fragments, it is classified as the Oakland facies. Although not mapped separately, the Delavan Member is distinguished on cross sections where possible. The Oakland facies is recognizable in outcrop but was too discontinuous to map. In the field the Delavan can be mistaken for the older Hulick Member, which has a similar color and grain size, but the Hulick tends to contain more coal clasts. In a unique occurrence, reddish till of the Tiskilwa Formation overlies the Ashmore Tongue and underlies the Mackinaw facies of the Henry Formation in three boreholes (01106, 22439, and 23489) in the Illinois River valley in and near Chillicothe (cross section C–D). The upper surface of the Ashmore Tongue at these locations records the level of the outwash valley fill in the Ancient Mississippi River at the time it was overridden by the Wisconsin Episode glacier, which deposited the Tiskilwa Formation, and the bottom of the Mackinaw facies atop the Tiskilwa marks the depth of scour of the Illinois River after the glacier retreated and the river entrenched itself, forming much of the valley as it appears today.

Marker Beds

Where present, marker beds are particularly useful in confirming stratigraphic position within the complex succession of the area. The Robein Member of the Roxana Silt is known mostly from drillers' logs that record the presence of "peat, humus, organic sediment, or wood." The lower and generally thicker part of the Roxana Silt is a reddish brown silt (loess) deposit that is distinctive in outcrop and marks the base of Wisconsin Episode deposits. This part of the Roxana is rarely noted by drillers. The Roxana Silt directly overlies the Sangamon Geosol. A Geosol is an ancient soil profile that consists of one or more soil horizons, usually buried, that developed through weathering of deposits when they were exposed at a former land surface. In places, the Roxana is overlain by calcareous, gray to brownish gray loess of the Morton Tongue of the Peoria Silt. Organic material also occurs in the Oakland facies of the Tiskilwa Formation.

The Sangamon Geosol is a prominent weathered zone noted in outcrops and in drilling records. It began forming about 130,000 years ago on the landscape left by the retreating Illinois Episode glacier and continued to develop as the surface weathered. The Sangamon Geosol was buried 45,000 to 50,000 years ago by the first loess deposits (Roxana Silt) of the Wisconsin Episode. The Sangamon Geosol is easily identifiable from distinctive characteristics that contrast with those of other deposits, which are generally unweathered:

- **Drainage** Under well-drained, oxidizing conditions, weathering yielded soil colors that are typically browner or redder than the parent material. Profiles that developed under water-saturated or poorly drained conditions have grayish or greenish colors.
- **Horizonation** The succession of A, B, and C soil horizons (solum 3 to 5 feet thick where complete) are particularly noticeable because the A horizon may be enriched in organic carbon and dark gray to black, and the B horizon is enriched with clay.
- **Mineral alteration** Paleosols in Illinois are developed in parent materials that are naturally calcareous (contain the minerals calcite and dolomite). Thus, a strong indication of weathering is leaching (loss of calcite and dolomite) of the originally calcareous parent material.

Illinois Episode Tills

Three Illinois Episode tills occur in the region. The Radnor Member of the Glasford Formation is gray pebbly silty clay loam glacial diamicton that contains the Sangamon Geosol developed in its upper part and is notably variable in lithology. The Radnor was rarely observed in outcrop and was not mapped. The grayish brown pebbly loam Hulick Member and grayish brown silty clay loam Kellerville Member of the Glasford Formation crop out locally and are well exposed along Rattlesnake Hollow in SW¼, Sec. 27, T12N, R9E, Marshall County (cross section C–D, McKay et al. 2008). In borehole 20609 (cross section A–B), the Hulick Member directly overlies bedrock at the bottom of the bedrock valley beneath thick Ashmore Tongue.

Pre-Illinois Episode Deposits

Notably absent from the mapped area are deposits older than the Illinois Episode. Thick sand and gravel mapped extensively by us (McKay et al. 2008) and by previous workers (Horberg 1950, 1953; Horberg et al. 1950; McComas 1968) in the Ancient Mississippi Bedrock Valley area were once correlated to the "Sankoty Sand." These deposits were later named the Sankoty Member of the Banner Formation (Willman and Frye 1970). The Sankoty was thought to be "Kansan" or older, but new age determinations that we have obtained using the OSL method on sand samples collected from boreholes and outcrops date all of the sand and gravel deposits in the mapped area to the Illinois or Wisconsin Episodes (i.e., they range from nearly 200,000 to about

20,000 years old, McKay and Berg 2008). The oldest sands found overlie, interfinger with, or underlie Illinois Episode till sheets in the area. No deposits, fluvial or glacial, older than Illinois Episode have been found. Our interpretation is that this restricted distribution resulted from erosion of the old deposits by the Ancient Mississippi River, which left only remnants of those units as the river widened and deepened its valley repeatedly during the Illinois and Wisconsin Episodes. If pre-Illinois Episode sand (Sankoty Member) or pre-Illinois Episode tills (Banner Formation) once were present in the mapped reach, those deposits also were eroded or reworked by the Ancient Mississippi River.

Bedrock

The uppermost bedrock is Pennsylvanian in age and comprises shale and clay with beds of sandstone and limestone and several thin coal seams. Rock outcrops and areas of thin colluvium over rock are shown of the map. Rock types are not differentiated. Bedrock exposures are most extensive in the western bluffs of the Illinois River valley north of Chillicothe from the mouth of Hardscrabble Hollow northward to just south of the Marshall/Putnam County line.

Earth Resources and Hazards

Sand and Gravel

Numerous active and abandoned sand and gravel pits occur on the outwash terraces of the Illinois River valley. These are mapped as areas of disturbed land (see areas near Chillicothe and Lacon). Minable reserves of sand and gravel that underlie large terraces in the valley are mapped as the Mackinaw facies of the Henry Formation. Other sand and gravel units, namely the Ashmore Tongue and the Dry Creek tongue of the Henry Formation, have been mined locally, but are generally overlain by prohibitively thick overburden, making the economics of extraction less favorable.

Coal

Several coal seams, including the Danville and the Colchester Coal Members of the Carbondale Formation, have been mined historically near Sparland (Chenoweth and Meyers, 2002, 2004a, 2004b). Most mines in the Danville Coal Member (formerly the Sparland Coal) were small, shallow, drift mines. The Colchester Coal Member has been mined underground in two large workings, one just north of Sparland and one 1.25 miles south of Sparland. The last active mine ceased operations in 1968.

Groundwater

Sand and gravel deposits form a substantial aquifer in the Illinois River valley area (McComas 1968) where private residential, irrigation, municipal, and industrial wells draw from the Mackinaw facies and the Ashmore Tongue of the Henry Formation. These sand and gravel units, with a combined thickness that exceeds 100 feet in many areas, are overlain by little or no fine-grained deposits within the Illinois River valley (cross section C–D). Recharge of water from rainfall in the valley is rapid, and the aquifer tends to have high sensitivity to contamination (Berg 2001). Beneath the uplands, the Ashmore Tongue forms a significant aquifer beneath large areas where it is generally overlain by tens to over 100 feet of glacial diamicton (cross section A–B). These relatively fine-grained tills offer a measure of protection for the aquifer from surface sources of contamination. Notable exceptions are those areas where tributaries have eroded the diamicton cover (Berg 2001). Sands of the Dry Creek tongue are widespread, but thin, in their occurrence between the Batestown and Tiskilwa diamictons. Nevertheless, the Dry Creek tongue is widely used as a private residential groundwater supply. Shallow bedrock in the area does not generally yield significant quantities of water, although bedrock wells may provide sufficient supplies for single homes.

Foundation Conditions

Surficial diamictons (Batestown and Tiskilwa) in the area are generally hard and compact and provide good foundation support for general construction. In contrast, areas mapped as Cahokia Formation often have significant limitations as construction sites because of low bearing strengths of these deposits and because these areas locally are subjected to periodic flooding. Grayslake Peat may be highly compressible and unsuitable as a foundation material. Sand and gravel deposits of the Henry Formation usually perform satisfactorily as foundation materials for general construction when properly compacted in flat terrain, but should be avoided in sloping areas, where their erodibility can lead to loss of support. Shale and clay may be subject to consolidation, shrinking and swelling, or slope failure.

Excavation Conditions

Loess deposits, which are the surficial deposit across most of the uplands, are easily excavated, as are sand and gravel deposits of the Henry Formation in the Illinois River valley. Outcrops of the Ashmore Tongue, however, have been observed to contain zones cemented with calcium carbonate (calcite) where they occur along tributary streams. Such zones may approach the durability of concrete and reach thicknesses of 10 feet. All of the mapped diamictons contain coarse clasts ranging in size from pebbles to, rarely, boulders with diameters of more than 6 feet. Where present, these may hinder excavation. Shale, the predominant bedrock lithology, is relatively easy to excavate, but thick limestone and sandstone beds occur locally.

Dam Construction

Widespread subsurface sand and gravel deposits that crop out along the base of the slopes in many tributary valleys and underlie much of the area are potential hazards to new construction of earth-fill dams. Where such sand bodies occur, they could act as pathways for substantial volumes of water to infiltrate, bypass a dam, and limit the ability of a reservoir to hold water. In the extreme, leakage beneath or around a dam could cause it to become unstable.

Waste Disposal
In areas where aquifers are near the land surface, including most of the Illinois River valley, groundwater in those aquifers may be highly sensitive to contamination from near-surface sources (Berg 2001), such as from septic systems, waste disposal sites, spills, and non-point sources of pollution. Diamictons are generally considered suitable hosts for disposal of solid waste (Krapac et al. 1991) because of their relatively low hydraulic conductivity and high capacity to adsorb many contaminants. Better long-term containment of waste and leachate would generally be expected where a host diamicton is not highly fractured or underlain by or interfingered with sand or sand and gravel units. Site investigations should be undertaken to determine the suitability of a given site for waste disposal.

Ground Failure and Mine Subsidence
Slope instability has long been a problem along steep bluffs along several reaches of Illinois Route 29 where shale, colluvium, and glacial drift materials have slumped (Robert A. Bauer 2002, unpublished data). Deposits resulting from past slumping, sheetwash, or landslides are mapped as Peyton Formation. This material generally has low strength and can be remobilized by new excavation that steepens a slope, undercuts the toe of a slope or loads an upper slope, or by activities that increase water infiltration.

Parts of the area have been undermined historically for extraction of coal. Numerous shallow abandoned coal mines formerly tapped coal seams in the bluffs on the west side of the river near Sparland and along Thenius Creek. Underground mines tapped the Danville Coal and Colchester Coal in the same area. Chenoweth and Meyers (2004a, 2004b) have mapped known mine workings.

Erosion and Sedimentation
Headward erosion, deepening and widening of gullies, and incision of the upper reaches of tributaries are long-term ongoing processes and are particularly a problem in soft, erodible loess deposits. Sediment yield from gullies is passed downstream to tributary streams and to the Illinois River. Larger tributary streams, which transport the gully-contributed sediment, store some sediment on their floodplains and in bars in their channels, add to sediment load through bank erosion, and transport sediment to the Illinois River. One long-term impact of sediment carried through the gully-tributary system is the large alluvial fans (mapped as Cahokia Formation) that in many places have significantly displaced the main channel of the Illinois River.

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