Illinois Geologic Quadrangle Map
IPGM-SG

Surficial Geology of Mascoutah Quadrangle
St. Clair County, Illinois

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2006
Introduction

The surficial geology map of the Mascoutah 7.5-minute Quadrangle, located in Illinois about 20 miles southeast of downtown St. Louis, Missouri, provides an important framework for land and groundwater use, resource evaluation, engineering assessment, environmental hazards, and geological studies. This study is part of a broader geologic mapping program undertaken by the ISGS in developing areas of the St. Louis Metro East region (Grimley and McKay 2004, Phillips 2004).

The Mascoutah Quadrangle is located in east-central St. Clair County, about 15 miles southeast of the Mississippi River valley (fig. 1) and about 25 miles northeast of the maximum extent of glacial ice during the Illinois and pre-Illinois Episodes (Grimley et al. 2001). Glacial ice in southwestern Illinois generally advanced from the northeast, originating from the Lake Michigan basin during the Illinois Episode and from the Lake Michigan basin and/or the more eastern Great Lakes Region during pre-Illinois episodes (Willman and Frye 1970). Deposits of both glacial episodes have also been reported by McKay (1979) and Phillips (2004) in this region. Glacial ice did not reach the study area during the Wisconsin Episode; however, glacial meltwater streams from the upper Mississippi River drainage basin deposited outwash throughout the middle Mississippi Valley. This outwash was the source for loess deposits (windblown silt) that blanket uplands in southwestern Illinois. Outwash from Illinois and pre-Illinois Episodes was regionally deposited in ancestral valleys of Silver Creek (Phillips 2004) and the Kaskaskia River, both of which drained to the south and southwest.

Methods

Surficial Map

The surficial geology map is based in part upon soil parent material data (Wallace 1978, NRCS 1999), supplemented by data from outcrop studies, stratigraphic test holes obtained for this STATEMAP project, engineering borings from Illinois Department of Transportation (IDOT) and St. Clair County Highway Department, coal test borings, and water-well records. Map contacts were also adjusted according to the surface topography, geomorphology, and observed

Figure 1 Shaded relief map of the St. Louis Metro East area (southern portion). The Mascoutah Quadrangle is outlined in yellow.
landform-sediment associations. Important data points used for the surficial geology map, cross sections, or landform-sediment associations are shown on the map.

Cross Sections
The cross sections portray unconsolidated deposits as would be seen in a vertical slice through the earth down to bedrock (vertically exaggerated 20 times). The lines of cross section are indicated on the surficial map. Data used for subsurface unit contacts (in approximate order of quality) are from studied outcrops, stratigraphic test holes, engineering boring records, water-well records, coal test borings and oil-well records. Units less than 5 feet in maximum thickness are not shown on the cross sections. Dashed contacts are used to indicate where data are less reliable or not present. The full extent of wells that penetrate deeply into bedrock is not shown.

Surficial Deposits
The surficial deposits can be divided into 4 landform-sediment associations: (1) dissected uplands in northwestern portion of quadrangle, that include relatively thin glacial and wind-blown (loess) sediments with sporadic bedrock outcrops; (2) ridges and knolls, mainly in central and southwestern areas, containing ice-contact sediment, with loess cover; (3) broad terraces and tributary valleys, containing glacial and postglacial waterlain sediments, with loess covering the older surfaces; and (4) terraces and modern floodplain of the Kaskaskia River valley, containing near-surface waterlain sediment from the last glaciation to recent times. There are also older concealed deposits, from earlier glaciations, below the described units. Their occurrence and thickness is more closely related to the bedrock surface topography (fig. 2). Areas of disturbed ground are mapped mainly at former strip mines for coal that include areas of waste material (in artificial hills) and also areas of removed sediment and rock (under lakes).

Dissected Uplands (west of Silver Creek valley)
The upland area in the northwest portion of the quadrangle is blanketed by up to 15 feet of loess (windblown silt) that is underlain by relatively thin glacial till and ice-marginal deposits. Where mapped, the loess (Peoria and Roxana Silts) is typically 7 to 15 feet thick, with thinner deposits occurring on steeper eroded slopes. The loess was deposited during the last glaciation (Wisconsin Episode) when silt-size particles, from Mississippi Valley glacial meltwater, were periodically windswepied and carried in dust clouds eastward to vegetated upland areas, where they gradually settled across the landscape. The loess deposits are typically a silt loam to heavy silt loam where unweathered. In the modern soil solum (generally the upper 3 to 4 feet), the loess is altered to a heavy silt loam or silty clay loam (Wallace 1978). The Peoria Silt is the upper and younger loess unit. The Roxana Silt, with a slight pinkish hue, is the lower loess unit (Hansel and Johnson 1996). Both loess units are here relatively thin, slightly to moderately weathered, leached of carbonates, and fairly similar in physical properties.

On some side slopes and ravines, where the loess has been eroded to less than 5 feet thick, the underlying diamict (a massive, poorly sorted mixture of clay, silt, sand, and gravel), weathered diamicton, and/or associated sorted sediment are mapped as the surficial unit (Glasford Formation). Compared to overlying loess deposits, the Glasford diamicton is considerably more pebbly and dense, has a lower moisture content (11–16 %), and greater unconfined compressive strength (Qc), than loess deposits (table 1). The Glasford Formation, deposited during the Illinois Episode, may in places include sand and gravel lenses deposited from glacial meltwater streams within, in front of, or below glacial ice. The upper 10 to 12 feet of Glasford Formation, where uneroded, is generally more weathered, is leached of carbonates, has a higher water content and is less stiff than the majority of the unit. Stronger alteration features are prevalent in the upper 4 to 6 feet of Glasford Formation, including root traces, fractures, carbonate leaching, oxidation or color mottling, strong soil structure, clay accumulation, and/or clay skins. This weathering is due to the occurrence of a buried interglacial soil known as the Sangamon Geosol, that further helps to delineate the Glasford Formation from overlying loess deposits. Oxidation and fracturing may extend 10 to 20 feet or more into the Glasford diamicton.

Pennsylvanian sandstone, shale, and limestone crops out in a few places along Hazel Creek and tributaries to Hazel Creek (e.g., Secs. 3 and 10, T1S, R7W) and also in places along Silver Creek (e.g., NW, Sec. 34, T1S, R7W), where up to 8 feet of fossiliferous limestone is exposed above the creek level. This western and northwestern portion of the map is a topographic high on the bedrock surface (fig. 2), up to 150 feet higher in bedrock elevation than to the east, which explains why glacial meltwater deposits (sand and gravelly sand) and associated terraces occur primarily east of Silver Creek. It also explains the thinner drift in this area (generally <50 feet) and the former activity of surface mines.

Upland Ridges and Knolls
In the east-central portion of the quadrangle, a prominent ridge system, consisting of curvilinear hills and knolls, occurs in a general east-northeast to west-southwest orientation, approximately parallel to regional ice flow during the Illinois Episode (fig. 1; Grimley et al. 2001). Such areas, historically termed the “ridged drift”, tend to contain a higher proportion of loamy to sandy deposits than in surrounding areas. The lithologically complex deposits in the ridges are classified as the Hagarstown Member of the Pearl Formation. The Hagarstown Member was originally classified as a member of the Glasford Formation since it is generally overlies glacial till (Willman and Frye 1970), but was later redefined as a member of the Pearl Formation (Killey and Lineback 1983) due to its closer association with glacial stream deposits and
Table 1  Physical and chemical properties of selected map units (typical ranges listed).

<table>
<thead>
<tr>
<th>Geotechnical properties</th>
<th>Particle size and compositional data</th>
<th>Clay mineralogy</th>
<th>Carbonate content</th>
<th>Geophysical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>w (%)</td>
<td>Q_u (tons/ft^2)</td>
<td>Sand (%)</td>
<td>Silt (%)</td>
<td>Clay (%)</td>
</tr>
<tr>
<td>Cahokia Formation</td>
<td>20–33 (if saturated)</td>
<td>0.25–1.25</td>
<td>2–10</td>
<td>variable texture</td>
</tr>
<tr>
<td>Equality Formation</td>
<td>22–45 (if saturated)</td>
<td>0.25–1.5</td>
<td>2–8</td>
<td>ND</td>
</tr>
<tr>
<td>Henry Formation</td>
<td>ND</td>
<td>0.5–2.0</td>
<td>15–40</td>
<td>ND</td>
</tr>
<tr>
<td>Peoria and Roxana Silts</td>
<td>20–30</td>
<td>0.5–2.0</td>
<td>5–10</td>
<td>2–9</td>
</tr>
<tr>
<td>Berry Clay Member</td>
<td>14–20</td>
<td>0.5–1.75</td>
<td>8–11</td>
<td>ND</td>
</tr>
<tr>
<td>Pearl Formation</td>
<td>ND</td>
<td>0.1–2.0</td>
<td>5–50</td>
<td>generally &gt;50% sand; some gravel</td>
</tr>
<tr>
<td>Hagarstown Member</td>
<td>19–22 (where loamy)</td>
<td>0.1–2.0</td>
<td>8–25</td>
<td>variable texture; sometimes 50–90% sand</td>
</tr>
<tr>
<td>Glasford Formation (till)^5</td>
<td>11–20</td>
<td>2.0 to &gt;4.5</td>
<td>10–45</td>
<td>15–41</td>
</tr>
<tr>
<td>Banner Formation (till)^5</td>
<td>13–23</td>
<td>2.0 to &gt;4.5</td>
<td>11–35</td>
<td>15–40</td>
</tr>
<tr>
<td>Canteen Member, Banner Formation</td>
<td>17–24</td>
<td>1.5–4.0</td>
<td>ND</td>
<td>2–28</td>
</tr>
<tr>
<td>Shale bedrock</td>
<td>ND</td>
<td>&gt;4.5</td>
<td>50–100</td>
<td>ND</td>
</tr>
</tbody>
</table>

1Geotechnical properties: based on hundreds of measurements (total for all units) from about 25 engineering (bridge) borings and 8 stratigraphic test borings in the quadrangle. w, moisture content = mass of water/mass of solids (dry). Q_u, unconfined compressive strength. N, blows per foot (standard penetration test).

2Particle size and compositional data: based on a more limited dataset (~20 samples) from 8 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); using Scintag X-ray diffractometer (about one-fourth more illite than previous results by H.D. Glass with General Electric diffractometer).

3Geophysical data: natural gamma, relative intensity of natural gamma radiation (data from 3 stratigraphic borings). MS, magnetic susceptibility (×10^-8 m^3/kg) (detailed data from 8 stratigraphic borings).

4ND, no data available.

5Properties for Glasford Formation are mainly for calcareous till (excludes sand and gravel lenses and strongly weathered zones); weathered upper portions can be less stiff, more clayey, leached of carbonates and have higher water contents.
Figure 2  Bedrock topography of the Mascoutah Quadrangle. Section boundaries are shown in red, and cross section lines are shown in black. Localities of all data that reliably indicate the bedrock surface are shown (many data are not shown on surficial map). Scale is 1:100,000.
for consistency with Wisconsin Episode classifications. Near-surface Hagarstown Member (mapped solid reddish brown), with <5 feet of loess cover occurs in ravines along Pleasant Ridge where the loess has been eroded. Where 5 to 15 feet of loess blankets the Hagarstown Member, stipples are shown on the map to indicate this unit in the subsurface. Previous studies in south-central Illinois have noted significant sand and gravel in similar ridges (Jacobs and Lineback 1969); however, some ridges contain a high proportion of intermixed diamicton and fine-grained sediment (Phillips 2004). In the Pleasant Ridge area of the Mascoutah Quadrangle, the Hagarstown Member can include up to 110 feet thick of various grades of well sorted to poorly sorted sand, (cross section B–B’), including some gravelly zones and some zones of very fine sand. Such sandy areas (with a loess cover) are shown with larger stipples and tend to occur in hills on the southeast side of the main ridge system, based on test holes, water well records and geophysical studies. Deposits of Hagarstown Member on the main portion of Pleasant Ridge (Secs. 19 and 20, T1S, R6W; center of Sec. 24, T1S, R7W) include interbedded sand, loam, and diamicton, as well as ice-thrusted inclusions of pre-Illinoian paleosol fragments (Yarmouth Geosol), glacial, and preglacial materials.

The upper 5 to 15 feet of material immediately above Hagarstown Member of Pearl Formation is a clay loam to sandy clay loam with pedogenic alteration features (clay skins, root traces, etc.) This deposit, mapped as Berry Clay Member of Pearl Formation, includes ice-contact sand deposits that were weathered and pedogenically mixed with overlying silt deposits during interglacial soil development (by the Sangamon Geosol). Secondary alteration such as clay infiltration into originally sandy zones has resulted in finer textures in these zones. The Berry Clay Member was originally defined as an accretionary deposit on the Glasford Formation (Willman and Frye 1970); however, its use is here being extended to an accretionary deposit or significant weathered zone in the upper Pearl Formation.

The origin of Pleasant Ridge may ultimately be related to the presence of a bedrock topographic high in the central portion of the quadrangle (fig. 2; near section 19). This bedrock high, oriented roughly parallel to regional ice flow (NE-SW), likely caused a divergent flow of glacial ice during the waning phase of Illinois Episode glaciation. As thinning ice flowed to the southwest over this bedrock high, cavities may have developed underneath glacial ice possibly leading to development of a subglacial channel and/or a crevasse system. During the final melting phase, subglacial channels may have become open-air channels in reentrant areas between local sublobes that developed near and in the wake of bedrock high obstacles. Supraglacial channels, common to interlobate areas, could also have developed, leading to sediment accumulation (e.g. debris flows) on the ice surface adjacent to bedrock highs. Thus, the origin of the ridged-drift landscape and deposits may be quite complex and similar to that in the kettle-moraine area of southeastern Wisconsin (Carlson et al. 2005). Upon melting of glacial ice, the sediment in supraglacial, subglacial and ice-marginal channels would begin to form the observed ridges. The sediment in supraglacial channels would normally include some sorted sediment as well as debris flows and inclusions of till, as is found in northern portions of Pleasant Ridge. Areas on the southern side of Pleasant Ridge that are dominantly sandy may be related to ice marginal channels that developed between bedrock topographic highs and the active glacier as the ice margin retreated.

**Broad Terraces and Tributary Valleys**

Terraces, formed during the last 2 glaciations (Illinois and Wisconsin Episodes) and tributary valleys (all valleys other than the Kaskaskia River valley) are comprised of coarse- to fine-grained stratified stream or lake deposits, with up to 15 feet of loess covering the oldest surfaces (Illinois Episode). Areas of such terraces and valleys cover much of the quadrangle, particularly in central and northeastern portions. Terraces in the Kaskaskia River valley are discussed in the next section.

The oldest terrace is the loess covered Illinois Episode terrace, mapped as loess and hachured where sand and gravel outwash (Pearl Formation) occurs at depth. This terrace is mapped principally in the northern portion of the map, north of Pleasant Ridge. Here, surface elevations for the terrace range from about 440 to 415 feet asl (above sea level). Due to a cover of loess and accretionary material, elevations for the top of the unweathered loose sand (typically fine to medium grained) are typically 420 to 390 feet asl. Elevations of 400 to 395 feet asl are consistently found for the top of the sand across the northeastern portion of the map near Mascoutah and immediately to the south (cross section A–A’). The Illinois Episode age for this terrace is based on the presence of interglacial soil alteration features (Sangamon Geosol) and finer grained accretionary deposits at the top of the outwash sequence. Accretionary deposits, up to 20 feet thick, are included in the Berry Clay Member of the Pearl Formation. These deposits likely include glacial and interglacial lake sediments as well as eolian silt additions, all pedogenically altered. The Berry Clay Member is consistently covered by 10 to 15 feet of Wisconsin Episode loess deposits (Peoria and Roxana Silts). The underlying outwash deposits were deposited by glacial meltwater streams along the south and southwest flowing Silver Creek and Kaskaskia River valleys, as the waning Illinois Episode ice margin receded to the northeast.

Two younger terraces, of last glacial age (Wisconsin Episode), are found in central and southern portions of the map and contain lake sediment related to slackwater conditions in Silver Creek and Kaskaskia River valleys. The older of these two terraces, the upper terrace, is the most extensive and was likely formed during the peak of the Wisconsin Episode when Mississippi River sediment aggradation was at its peak level, causing slackwater conditions far up the
low-gradient Kaskaskia River valley. Since this older terrace is typically covered by 3 feet of Peoria Silt, incision of the terrace occurred prior to late glacial times (likely prior to 15,000 radiocarbon years). Deposits in this terrace consist of predominantly weakly to prominently stratified silt loam and silty clay loam with minor beds of fine sand. Such deposits in the upper terrace, much of which appears to be reworked and redeposited loess material, are mapped as Equality Formation (unit e-2). Portions of this unit, where relatively thick and unweathered, may be calcareous and even fossiliferous. At one exposure along the Kaskaskia River (no. 30275; Sec. 22, T1S, R6W), small (<5 mm) fossil gastropods were found in calcareous deposits of unit e-2, immediately below unit e-1. Gastropods found were mainly aquatic and indicate shallow water conditions. At some locations (including 30275), lower portions of unit e-2 have a slight reddish-brown cast, are leached and slightly more clayey; all likely a result of redeposition of Roxana Silt during the mid-Wisconsin Episode. Where present, this zone typically grades into the Berry Clay Member of Pearl Formation below.

Deposits of Equality Formation in the younger and lower terrace are generally more clay-rich, ranging from silty clay loam to silty clay and have faint to prominent stratification. Such deposits, mapped as unit e-1, have been found to be leached of carbonates and are generally stronger brown in color, compared to the more tan or gray unit e-2. The younger terrace also has a much thinner loess cover (<1 foot), which was the one basis for separation of soil series by soil mappers (Wallace 1978; NRCS 1999). The age of the e-1 terrace may be similar in age to that of the sandy Savanna Terrace in northwest Illinois and the Wood River Terrace in the Mississippi Valley east of St. Louis, both of which have a thin (~1 foot) loess cover. The Wood River Terrace experienced its last phase of aggradation between 15,500 and 13,000, and was incised ~12,300–12,000 radiocarbon years ago when the Mississippi River downcut (Hajic 1993).

Postglacial stream deposits in Silver Creek, Rayhill Slough, Reinhardt Slough and other tributary valleys are mainly fine-grained (silty clay loam to silt loam) and weakly stratified. These deposits, mapped as Cahokia Formation, can include loamy zones or beds of fine sand, particularly at the unit base or in channels. The Cahokia Formation in these valleys is <20 feet thick and consists mainly of reworked loess and lake deposits from surrounding areas. The fine-grained nature of these deposits can be explained by the rare occurrence of sand, gravel or till exposures in the creek drainage area. Due to periodic flooding during postglacial times, areas mapped as the Cahokia Formation have relatively youthful modern soil profiles that generally lack B horizons compared with profiles for upland soil (Wallace 1978, NRCS 1999).

Kaskaskia River Valley
Near-surface deposits in the postglacial Kaskaskia River valley consist of interstratified fine to medium sand, silt loam, silty clay loam, and silty clay. Sandy deposits (up to 20 feet thick) in channels and point bars of the Kaskaskia River are mapped at Cahokia-sandy facies (c(s)); sandy deposits range from recent and historical in modern point bars to possibly mid-early Holocene (last 10,000 years) at higher elevations. The clayey facies of the Cahokia Formation is separated into two units; older deposits generally on low terraces above 390 feet (unit c(c)-2) and younger deposits at lower elevation on the modern floodplain (unit c(c)-1). Both deposits range from silt loam to silty clay loam to silty clay and are interpreted mainly as overbank flood deposits and swale fills. Deposits of c(c)-2 are relatively thin (generally <10 ft.) and overlie last glacial deposits of the Equality or Henry Formation. Aerial photographs display overflow channels crossing to the SSW across Sections 4 and 9 (T2S, R6W) in low areas. These features probably represent high flood events (or chutes) during the Holocene that deposited c(c)-2. Both c(c)-2 and c(c)-1 are interstratified laterally with sandy deposits of c(s). Aerial photographs portray many abandoned meander channels within the modern floodplain, all now infilled with clayey sediment (c(c)-1). Exposures along the Kaskaskia River generally display well sorted fine to medium sand below 8 to 15 feet of clayey floodplain deposits. At one exposure (no. 30274; Sec. 5, T2S, R6W), fossil wood in a gray silt at the base of the clayey Cahokia (at river level ~15 foot depth below top of bank) was radiocarbon dated at 6020 +/- 100 years (ISGS-5875).

Fine to medium sand immediately below the Cahokia and/or Equality Formations are interpreted as Henry Formation deposits, although the exact age of these deposits is unknown. Some of the Henry Formation may include sandy Cahokia Formation in upper portions or Pearl Formation near its base, as the distinction among these alluvial units can be subtle. The Pearl Formation tends to be somewhat coarser, and tends to contain more gravel than the Henry Formation in the Kaskaskia Valley area (probably due to closer proximity to ice margin). Cahokia Formation sand is generally fine to medium in texture and tend to be noncalcareous, whereas sand in the Henry Formation is generally calcareous and may be intermixed with thin calcareous beds of silt loam (intercalated with Equality Formation). The Illinois Episode Pearl Formation and pre-Illinois episode deposits occur in many places in the subsurface below last glacial and postglacial river deposits. Thus, the Kaskaskia River valley contains a complex record of fluvial and glacial deposits from perhaps the past 500,000 years, all overlying Paleozoic bedrock.

Concealed Deposits
In much of the map area, pre-Illinois episode deposits (classified as the Banner Formation) are preserved between the overlying Glasford Formation and bedrock below (see cross sections). The Banner Formation is here divided into two units: 1) an olive-brown to greenish gray, weakly laminated silty clay with some beds of fine sand (Canteen member [b-c]; lower unit); 2) a silty clay loam to loam diamicton with sand and gravel bodies (Banner Formation [b]; undifferenti-
The Banner Formation, which does not crop out or seem to occur within 30 feet of the surface, is present mainly in preglacial bedrock valleys or lowlands (fig. 2 and cross sections). In places, the Banner Formation been severely eroded by Illinois Episode glaciation or glacial meltwater streams (during deposition of Glasford or Pearl Formation), so its distribution is fairly chaotic. The Banner Formation has been entirely eroded from some of the bedrock topographic highs in the western portion of the quadrangle.

The Canteen member of the Banner Formation was found in one stratigraphic test boring (no. 30329, cross section D–D’) and in several well described water well logs (e.g., nos. 27078, 27026) where it occurs below Banner till. The Canteen member tends to infill local bedrock lowlands (fig. 2) or regional preglacial valleys (Phillips and Grimley 2004). This unit includes mainly fine-grained sediment, but can include thick beds of fine sand. In its uppermost 5 feet, the Canteen member in some places exhibits weak to moderate soil structure, typical of a buried floodplain soil. In some places, multiple alluvial paleosols are observed within the unit. The origin of this unit is interpreted as mainly preglacial Quaternary alluvium and colluvium because it lacks glacial erratics, has low magnetic susceptibility, and is noncalcareous to weakly calcareous (table 1). Its composition is thus quite similar to the local shale bedrock. Nonetheless, this unit may in places include slackwater lake deposits or redeposited loess related to early Quaternary glaciations. The Canteen Member here occurs almost exclusively between elevations of 290 and 350 feet asl.

The undifferentiated Banner Formation is interpreted mainly as till, ice-marginal sediment, and outwash. In comparison to Glasford till, the Banner till is slightly more clayey and has slightly greater water content on average (table 1). Banner till also typically has a lower carbonate content and slightly greater natural gamma radiation (table 1). In some cores, such as 30329 in the northeast part of the quadrangle, the upper few feet of Banner till is slightly pinkish, has higher carbonate content and much higher magnetic susceptibility, suggesting a more distal source area (perhaps far-travelled debris worked up to the top of glacial ice). Bodies of sand and gravel within the Banner Formation can be up to 30 feet thick and tend to occur at the unit base; some of which may be preglacial or early Quaternary.

Interglacial soil development (Yarmouth Geosol) or gleyed interglacial accretionary deposits in the uppermost Banner Formation, by definition, help to distinguish the Banner from the Glasford Formation (Willman and Frye 1970). Such interglacial deposits and/or soils are generally leached of carbonates and tend to have a greenish-gray color (as described in water-well logs) due to its typical poorly drained condition in areas where preserved below the basal unconformity of the Glasford Formation.

### Economic Resources

#### Sand and Gravel

Overall, minable deposits in the quadrangle may include various textures of sand, with some gravel, that are mapped as Hagarstown Member of Pearl Formation or outwash facies of Pearl Formation (both beneath 5 to 15 feet of loess). Sand and gravel in the Mascoutah Quadrangle was once mined at a small pit in the southwestern part of the quadrangle (Sec. 34, T1S, R7W), where approximately 50 feet of sand (relatively fine-grained) of the Hagarstown Member was encountered according to undocumented local reports. Other portions of these ice-contact ridges may contain economically usable deposits; however, in many places, the sand is relatively fine grained, limited in thickness, poorly sorted, intermixed with diamicton, and/or unpredictable in extent. In other areas, up to 110 feet of sand (fine to coarse sand with gravel) is present, but such areas may be limited in extent. Additional tests will be necessary for site-specific projects.

#### Groundwater

Groundwater is extensively used for household, public, and industrial water supplies in southwestern Illinois. Surface water resources such as the Kaskaskia River are also present in this quadrangle. Sand and gravel in the Henry Formation, Pearl Formation (outwash facies and Hagarstown Member), the Glasford Formation, and the Banner Formation constitute the predominant glacial aquifer materials in the Mascoutah Quadrangle. Known sand and gravel lenses are stippled in the cross sections (water table may be at greater than 80 feet depth in some ridges). The Pearl Formation (outwash facies) aquifer in the eastern portion of the map area is particularly extensive and is widely used for household water supply. In upland areas, sand and gravel bodies within the Glasford Formation or Hagarstown Member are sometimes utilized for household water supply. Sand and gravel in the lower Banner Formation are sometimes utilized, particularly above the ancestral Kaskaskia bedrock valley in central and eastern areas of the quadrangle. Bedrock aquifers are also commonly utilized for water supply, particularly Pennsylvanian sandstones or fractured limestones.

### Environmental Hazards

#### Groundwater Contamination

Surface contaminants pose a potential threat to groundwater supplies in near-surface aquifers that are not overlain by a confining (clay-rich and unfractured) deposit. Near-surface sand and gravel aquifers, such as in the Hagarstown Member, are most vulnerable to agricultural, strip-mine, or industrial contaminants. Confining materials, such as clayey till or lake sediment, can serve to protect buried aquifers (Berg 2001). The potential for groundwater contamination depends on the thickness and character of fine-grained alluvium, loess, or till deposits that overlie the aquifer. Deeper glacial aquifers near...
the base of the Glasford Formation or within the Banner Formation generally have a lower contamination potential than more shallow aquifers because the groundwater is protected by the a considerable thickness of clay-rich till. The Pearl Formation (outwash facies) aquifer, covering much of the eastern portion of the quadrangle, is moderately protected by 20 to 30 feet (combined) of mainly fine-grained loess, Berry Clay Member and/or Equality Formation.

**Mined-out-area Subsidence**

Approximately 10% of the quadrangle’s area was mined underground for coal between 1882 and 1989 (Chenoweth and Barrett 2001). Underground mined-out areas are predominantly in the northwestern portion of the quadrangle (north of strip mines) also immediately east of the town of Mascoutah. Coal, 6 to 9 feet thick, was mined from the Herrin (No. 6) Coal Member of the Carbondale Formation and was extracted by the room and pillar method at depths of 90 to 185 feet below ground surface. Land subsidence in mined-out areas can be a serious potential problem for developers and construction projects (Treworgy and Hindman 1991).

**Seismic Hazards**

Near-surface fine sands of the Pearl, Henry, and Cahokia Formations represent conditions that are potentially liquefiable where these units are saturated (below the water table) and experience large enough shaking. Tuttle (2005) identified paleoliquefaction features, such as ancient sand blows, in outcrops along the Kaskaskia River south and east of the Mascoutah Quadrangle, as well as at other locations in the region. These features likely formed during past earthquake activity in the New Madrid Seismic Zone or other seismic activity in southern Illinois or southeastern Missouri. Seismic shaking hazards are also an important issue in areas of loose sand, disturbed ground (fill), and soft clay in Illinois (Bauer 1999). Areas mapped with near-surface Equality Formation or especially Cahokia Formation sand and clay may be susceptible to seismic shaking because they are relatively soft, low density and unconsolidated; conditions that amplify earthquake ground motions.

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