SURFICIAL GEOLOGY OF THE GIBSON CITY WEST 7.5-MINUTE QUADRANGLE: CHAMPAIGN, FORD, AND MCLEAN COUNTIES, ILLINOIS

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36 Pages

This project involved the construction of a detailed surficial geologic map of the Gibson City West, Illinois 7.5-Minute Quadrangle. This work supports the broader efforts of the Illinois State Geological Survey to complete detailed geologic mapping of the State. This work is part of the Illinois State Geological Survey Mahomet Aquifer priority mapping project, which has been advanced in STATEMAP efforts since 2010. The Mahomet Aquifer System is the principal source of water for much of central Illinois. An increasing reliance on groundwater from the Mahomet Aquifer System and the societal importance of surficial deposits has created a need to characterize the region's surficial geology. Products of this study will be accessible to decision-makers in the area to address a wide variety of local and county-wide issues that include water-supply planning, remediation of contaminated sites, identifying potential aggregate resources, designing and constructing foundations and structures, and preserving natural areas.

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SURFICIAL GEOLOGY OF THE GIBSON CITY WEST 7.5-MINUTE QUADRANGLE: CHAMPAIGN, FORD, AND MCLEAN COUNTIES, ILLINOIS

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H. S. W.

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CHAPTER I: INTRODUCTION AND BACKGROUND

Introduction

Geologic maps and their derivative products are valuable tools that provide a fundamental understanding of the earth and strengthen the scientific basis for informed land-use and natural resource management decisions. These maps portray the spatial distribution and age relationships of rock, sediment, and soil units, allowing users to visualize and understand the geology of an area. Geologic materials underlie the foundations of homes, industries, and infrastructure; yield vital mineral, energy, and water resources; and inherently generate natural hazards; thus, geologic maps hold substantial economic and societal worth (Geological Society of America, 2017). In the United States, detailed, publicly available geologic maps communicate information essential to the policy decisions of federal, state, and local agencies and for economic development (Geological Society of America, 2017; Bernknopf et al, 1996).

A National Cooperative Geologic Mapping Program (NCGMP), established by the National Geologic Mapping Act of 1992 (United States Cong., 1992) and reapproved in 2018 by the National Geologic Mapping Act Reauthorization Act (United States Cong., 2018), supports the construction of geologic maps in the United States. The NCGMP promotes the production of updated maps in the nation through cooperation and coordination of the United States Geological Survey (USGS) and the State Geological Surveys (United States Cong., 1992). Federal and state mapping projects conducted by the USGS and State Geological Surveys are supported by the FEDMAP and STATEMAP subcomponents of the NCGMP, respectively, while student-mapping projects conducted in union with coordinating academic institutions are supported by the EDMAP subcomponent of the NCGMP.

The Illinois State Geological Survey (ISGS) actively participates in both STATEMAP and EDMAP programs to complete detailed mapping of the state. The ISGS, with advice and consent of the multipurpose, multiagency Illinois Geologic Mapping Advisory Committee (IGMAC), meets annually to systematically evaluate the 1,071 7.5-Minute Quadrangles in the state on the basis of twenty-three economic, educational, environmental, geologic, and hazard factors; areas with the highest priority and need are selected for mapping projects. Depending on the needs of the selected Quadrangle, mapping projects aim to advance a geologic theme, such as bedrock geology, surficial geology, and others. Bedrock geology maps provide information on consolidated rock, while surficial geology maps provide information on unconsolidated sediment overlying bedrock at the surface.

Since 2008, priority mapping in Illinois has been focused on the Mahomet Aquifer System region in the east-central region of the state (Figure 1). The Mahomet Aquifer System is a large, productive, regional aquifer that underlies 15 counties and serves as the principal source of groundwater providing about 58 million gallons of water per day to 120 public water systems and to approximately 1 million people in many surrounding communities, including large cities in the region (e.g. Champaign-Urbana, Illinois (Kempton et al., 1991) and Bloomington-Normal, Illinois (Kempton and Visocky, 1992)). This portion of the Mahomet Aquifer was designated a Sole Source Aquifer by the U.S. Environmental Protection Agency in 2015, as more than half of the population relies on the Mahomet Aquifer system as a source of drinking water (United States Environmental Protection Agency, 2015). Due to the need for detailed geologic mapping of the Mahomet Aquifer system priority mapping area in east-central Illinois at the 1:24,000

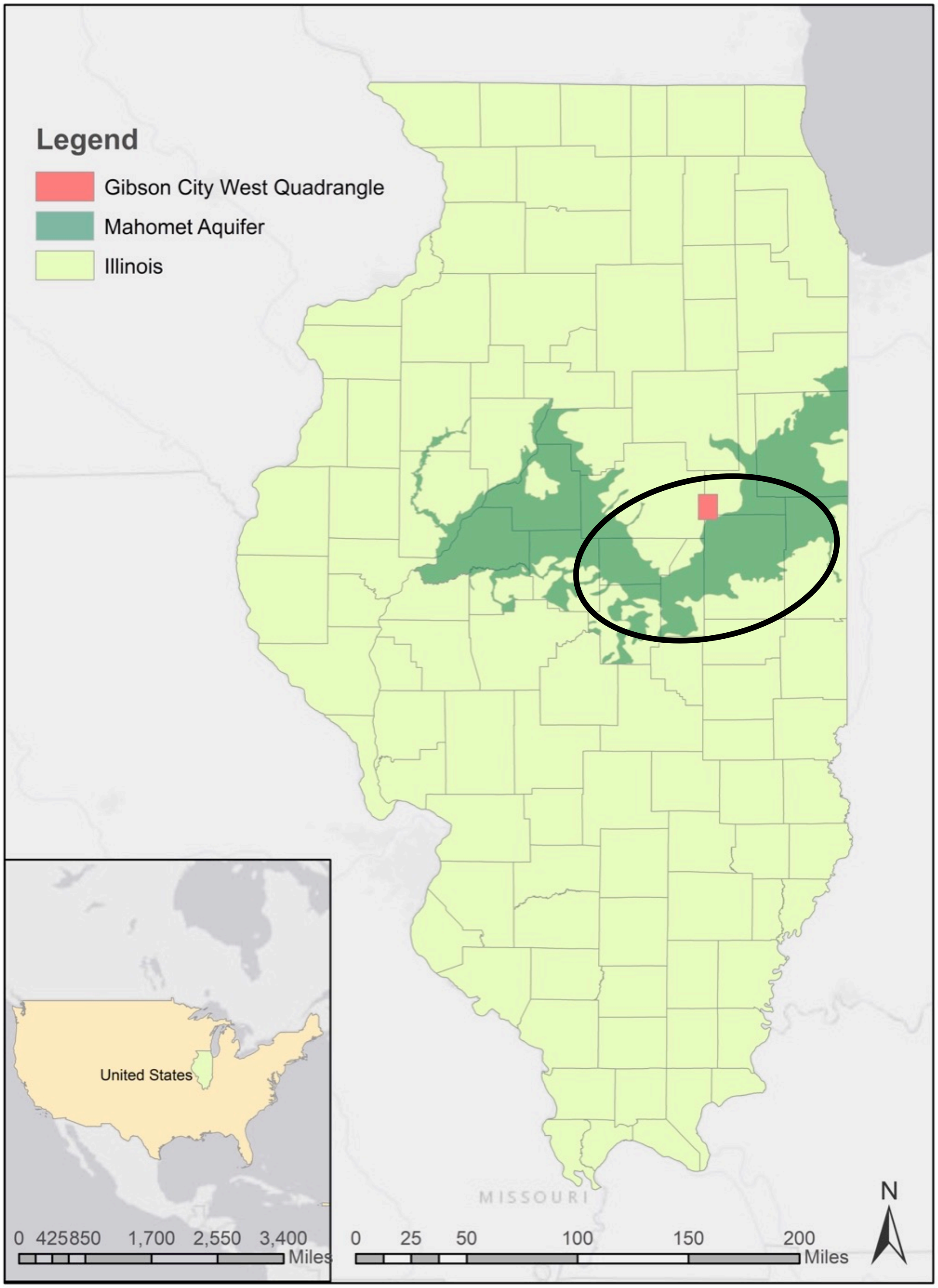

Figure 1. Location map of the Gibson City West 7.5 Minute Quadrangle (red polygon). The approximate location of the ISGS Mahomet Aquifer priority mapping area is indicated by the black oval.

scale, the Gibson City West 7.5-Minute Quadrangle was selected in 2016 by the ISGS and IGMAC to be mapped in coordination with Illinois State University as part of the NCGMP EDMAP Program.

Objectives

In support of the broader efforts of the ISGS to complete detailed mapping of Illinois and priority mapping of the Mahomet Aquifer system region, this project involves the construction of a detailed surficial geologic map for the Gibson City West 7.5-Minute Quadrangle at the 1:24,000 scale. This mapping effort strives to advance the understanding of the distribution of Quaternary-aged glacial materials that overlie the Mahomet Aquifer system and underlie the foundations of homes, industries and infrastructure in the east-central Illinois region. Surficial geology data and other relevant datasets will be acquired using traditional field mapping methods and online resources that are available and free to the public. Data will be compiled to construct a final interpreted map product for the surficial geology of the Gibson City West Quadrangle.

Study Area

The Gibson City West Quadrangle is located in southeast McLean County, southwest Ford County, and northwest Champaign County, Illinois (Figure 1). The Quadrangle extends between 40°22’30” and 40°30’00” north latitude and 88°22’30” and 88°30’00” west longitude. The Quadrangle is comprised primarily of rural agricultural land, but includes the small town of Gibson City on its eastern boundary. Elevations range from 750 to 800 feet above sea level, which are some of the highest elevations in the glaciated part of Illinois. In east-central Illinois, the highest surface elevation is located east of Bloomington on the crest of the Bloomington Moraine in McLean County (Stephenson, 1967). The lowest elevations exist where the Sangamon River leaves the area (Stephenson, 1967). The Sangamon River, a primary drainage in central Illinois, flows eastward across the southern portion of the study area and Drummer Creek flows southward through the eastern area (Figure 2). The Mahomet Aquifer system underlies the southern portion of the Quadrangle trending east-west across east-central Illinois (Figure 1). The Quadrangle is located within the Upper Sangamon River Valley, which is also part of the NSF-funded Intensively Managed Landscape Critical Zone Observatory project for central Illinois- a project that aims to better understand the environment and the impact of intensively managed lands.

The statewide Surficial Deposits of Illinois map by Stiff (2000) and Quaternary Deposits of Illinois by Lineback (1979) are currently the highest resolution surficial geologic maps of the Gibson City West Quadrangle area at scales of 1:500,000. A variety of statewide maps provide useful insight regarding regional features in the Gibson City West margins, including surface topography (Luman et al., 2002), quaternary ice age deposits (ISGS Staff, 2005), loess thickness, end moraines of the Wisconsin Glacial Episode, and drift thickness (Grimley, 2015). In the late 1990's, the ISGS published a variety of county-scale maps for McLean County that advanced such themes as bedrock topography (McLean et al., 1997b), surface topography (McLean and Riggs, 1997), drift thickness (McLean et al., 1997a), and thickness of sand and gravel deposits (Riggs and Abert, 1998), but these maps have a scale of 1:100,000 and do not provide complete information about the surficial geology of the Gibson City West Quadrangle at a sufficient level of detail. One county-scale map of the LiDAR Surface Topography of Champaign County was published in 2014 by the ISGS at the 1:62,500 scale (Domier and Luman, 2014); the ISGS has not yet published a county-scale map of Ford County.

Surficial geologic mapping at the 1:24,000 scale has been completed for much of McLean County; however, very little of Champaign County and none of Ford County has been surficially mapped at a scale less than 1:500,000. Completed 7.5-minute surficial maps in McLean County include the following EDMAP and Student Map Quadrangles completed by Illinois State University students and published by the ISGS: Arrowsmith (Murphy et al., 2014), Bloomington East (Ludwikowski et al., 2016), Bloomington West (McGillivray et al., 2015), Chenoa (Olson et al., 2014), Colfax (Maxwell et al., 2015), Danvers (Foote et al., 2014), Gridley (Williams and Malone, 2015), Holder (Meinzer et al., 2014), Normal East (Sugano et al., 2014), Normal West (Weedman et al., 2014), Mackinaw (Woodside, 2007), Merna (Trzinski et al., 2014), and Saybrook (Rickels et al., 2016). Completed 7.5-minute surficial maps in Champaign County include the following STATEMAP Quadrangles completed and published by the ISGS: Gifford (Stumpf, 2011), Mahomet (Grimley et al., 2016), and Rantoul (Stumpf, 2014). The Gibson City West Quadrangle is the first surficial geologic mapping effort in Ford County at the 1:24,000 scale.

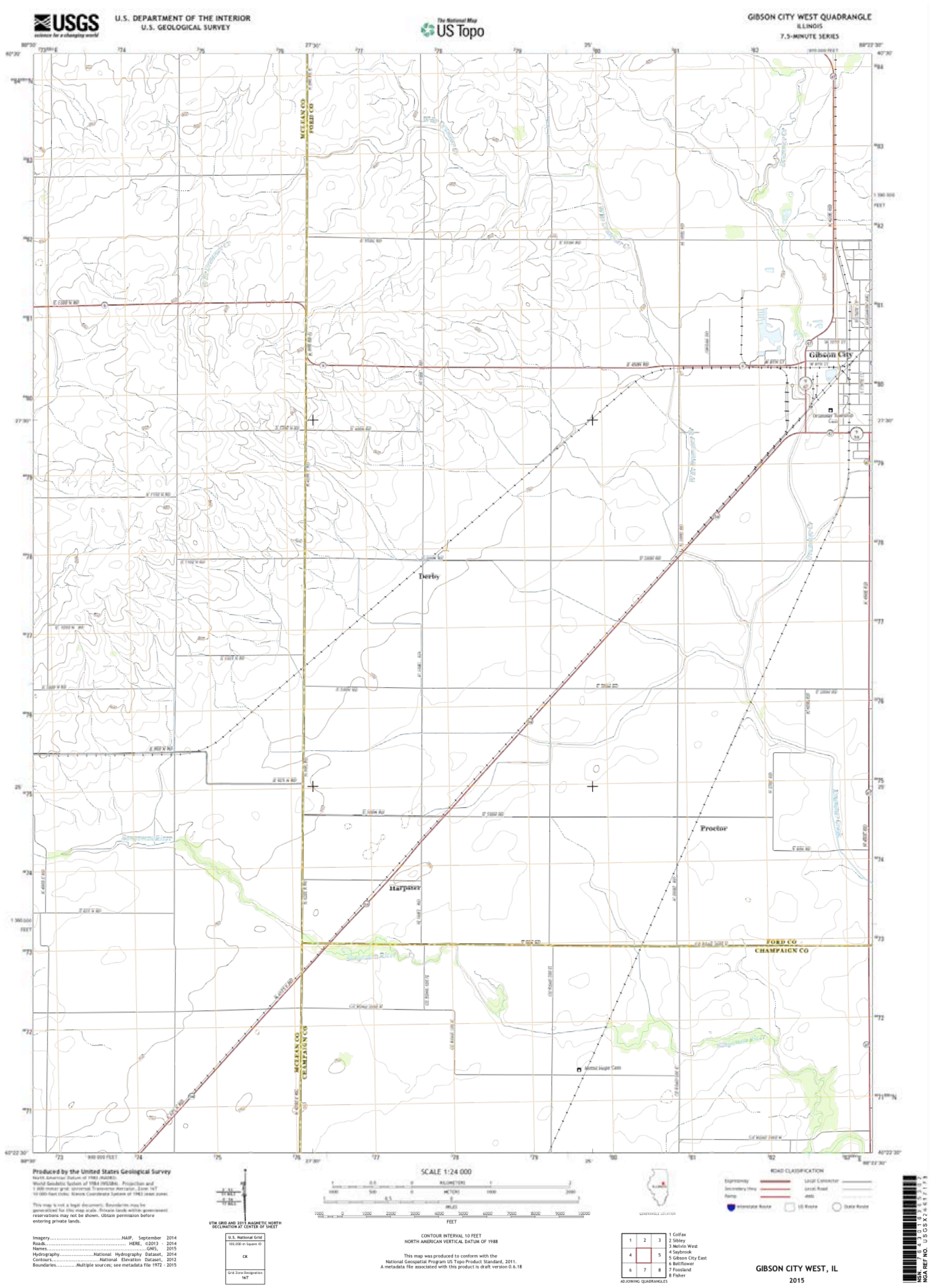

Figure 2. USGS topographic map of Gibson City West Quadrangle (USGS, 2018).

Geologic Setting

The Gibson City West Quadrangle and surrounding area are located within the Bloomington Ridged Plain physiographic province of Illinois. This region marks the path left behind by the advance and retreat of the Laurentide Ice Sheet as it deposited material in a series of widely-spaced, broad end moraines alternating with nearly flat ground moraine plains (Leighton et al., 1948). Moraines and glacial sediment in this region were deposited during the most recent glaciation of the Wisconsin Episode when the Peoria and Decatur Sublobes, comprising the Lake Michigan Lobe of the Laurentide Ice Sheet, flowed into Illinois from the northeast out of the Lake Michigan Basin (Johnson et al. 1986, Hansel and Johnson 1996). The Quadrangle marks the convergence of the Peoria and Decatur Sublobes at the Gibson City Reentrant (Johnson et al., 1986). To the west of the Lake Michigan Lobe, the Peoria Sublobe is marked by the Bloomington Morainic System, while the Decatur Sublobe marked by the Illiana Morainic System to the east (Johnson et al., 1986).

At the surface, glacial deposits of the Gibson City West Quadrangle are Wisconsin and Hudson in age (Figure 3; Figure 4). The postglacial Hudson Episode succeeds glacial activity of the Wisconsin Episode, representing a warm period of weathering that continues to the present. The Wedron and Mason Groups of the Wisconsin Episode represent the majority of materials in the Quadrangle, however, the Cahokia Formation and Peoria Silt of the Hudson Episode occur in lesser amounts within the Quadrangle. The Cahokia Formation is a silty alluvium deposit derived from the erosion of loess and till and present along rivers and streams (Willman and Frye, 1970).

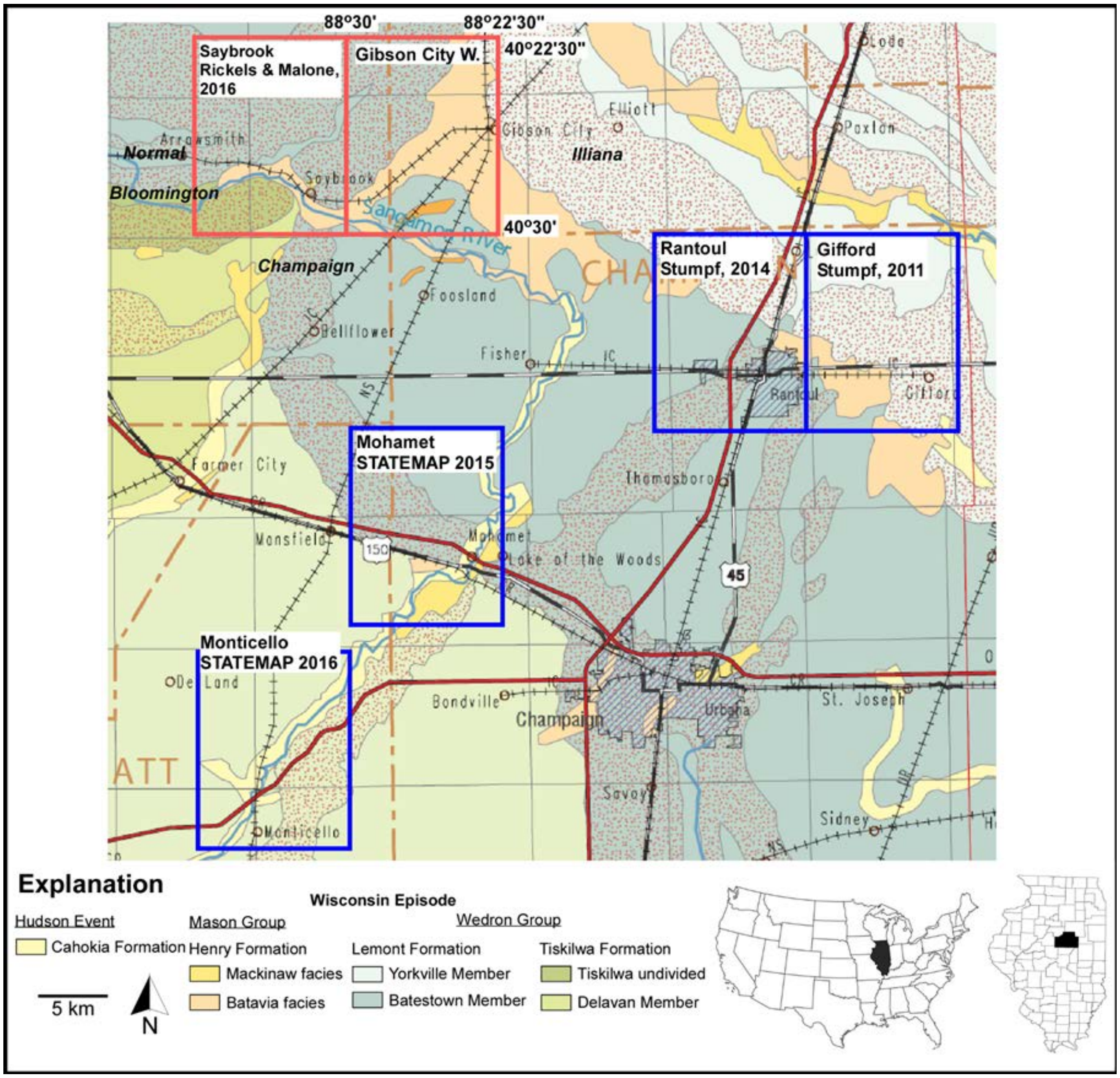

Figure 3. Regional surficial geology of east-central Illinois, including the Gibson City West Quadrangle and previously completed surficial geologic map. Modified from Stiff (2000), *Surficial Deposits of Illinois*. Copyright ©2000 University of Illinois Board of Trustees. Used with permission of the Illinois State Geological Survey.

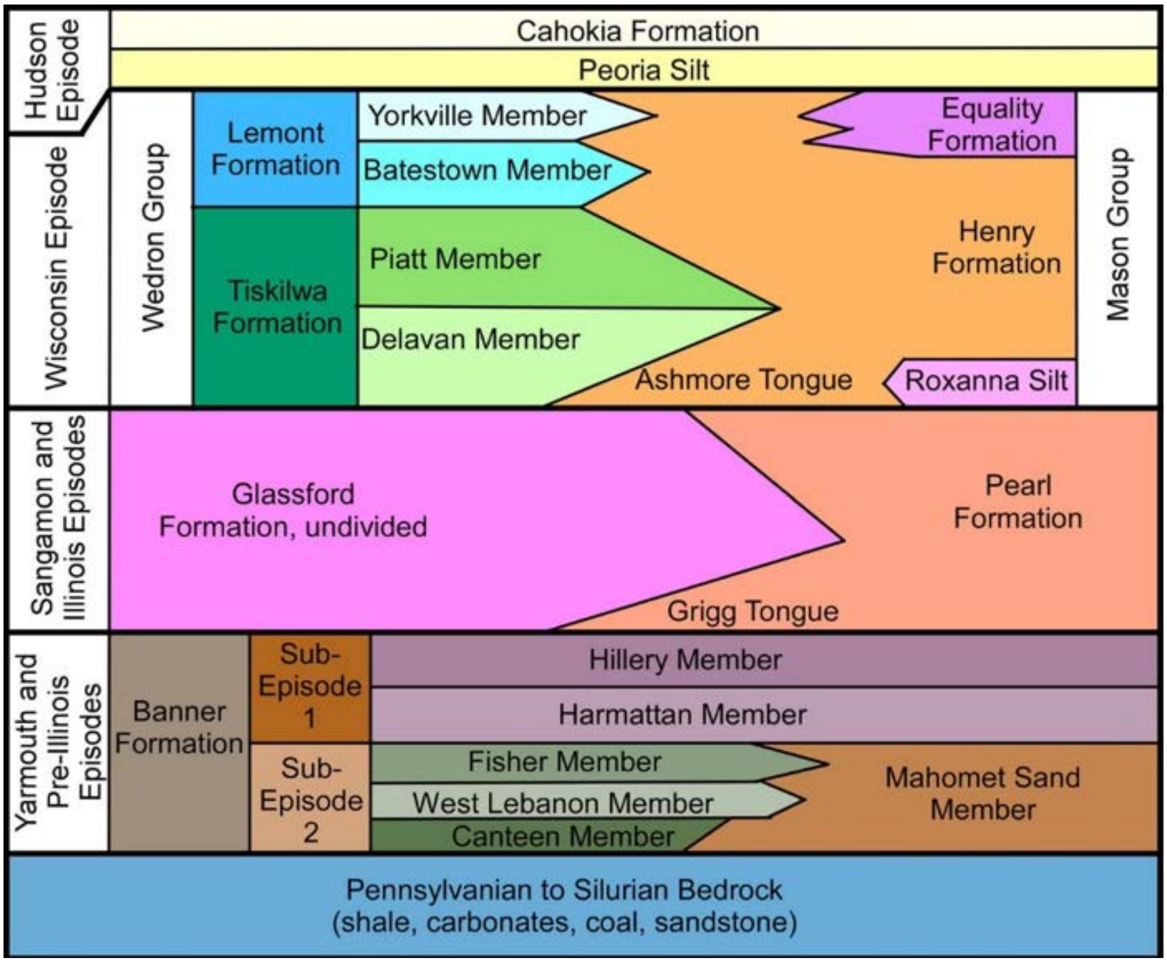

Figure 4. Generalized stratigraphic column of Quaternary units in east-central Illinois. After Stumpf and Atkinson (2015), *Geologic Cross Sections Across the Mahomet Bedrock Valley, Champaign, Ford, McLean, Piatt, and Vermilion Counties, Illinois*. Copyright ©2015 University of Illinois Board of Trustees. Used with permission of the Illinois State Geological Survey.

The Peoria Silt is a light yellow tan, clayey silt (Hansel and Johnson, 1996) that likely covers the area in a thin layer of windblown loess as a result of modern soil, but is generally not included on surficial geologic maps in adjacent areas as it is less than 5 feet thick.

Mason Group materials represent predominantly proglacial sedimentary environments of the Wisconsin Episode that produced fine to coarse grained, sorted-sediment deposits, including loess, eolian sand, lacustrine sediment, and outwash (Hansel and Johnson, 1996). The Mason Group is represented in the Quadrangle by the Batavia and Wasco Members of the Henry Formation as glacial outwash deposits. The Batavia Member deposited mostly along the fronts of moraines as outwash plains (Hansel and Johnson, 1996) and the Wasco Member consists of ice-contact sand and gravel in kames, eskers, and deltas. The Mackinaw Member of the Henry Formation, the Equality Formation, and Roxana Silt are not present within the quadrangle.

Wedron Group materials include ice-marginal and till diamicton deposits (Hansel and Johnson, 1996). In this region of Illinois, the Wedron Group includes the Tiskilwa and Lemont Formations. The Tiskilwa Formation consists of red to gray, medium textured diamicton units that oxidize to red brown, brown, or yellow brown (Hansel and Johnson, 1996); the overlying Lemont Formation consist of gray, fine to coarse grained diamictons that oxidize to brown, olive brown, or yellow brown (Hansel and Johnson, 1996). The Bloomington Morainic System and surrounding ground moraine is composed of the Batestown Member, Lemont Formation (Curry et al., 2018). The Illiana Morainic System is composed of the Yorkville Member, Lemont Formation (Curry et al., 2018). Locally in the Peoria and Decatur Sublobe areas, diamicton of the Batestown Member oxidizes more yellow and is finer than diamicton of the Yorkville Member (Hansel and Johnson, 1996).

In the subsurface, older materials of the Sangamon, Illinois, Yarmouth, and Pre-Illinois Episodes underlie Wisconsin-aged deposits. The Glasford Formation includes glacial tills and outwash deposits of the Sangamon and Illinois Episodes (Willman and Frye, 1970). Illinois-aged outwash sands and gravels are assigned to the Pearl Formation (Willman and Frye, 1970). Sand and gravel deposits of the Mahomet Sand Member, Banner Formation fill in the Mahomet Bedrock Valley (Horberg, 1945; 1953) where the Mahomet Aquifer system is housed. The Mahomet Aquifer system formed when sand and gravel deposited by glacial meltwater flowed away from the ice sheet and filled the Mahomet Bedrock Valley (Stephenson, 1967; Kolata 2010). Postglacial and glacial deposits of the Quaternary Period overlie Pennsylvanian to Silurian bedrock.

CHAPTER II: METHODOLOGY

Surficial geologic map development of the Gibson City West Quadrangle began with the construction of an interpreted, preliminary draft based on soil survey data obtained from the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS). Residual soils that cover the area have been mapped by the USDA NRCS and can be traced back to their parent glacial material from which they developed. Soil data for Champaign, Ford, and McLean Counties were available as a downloadable polygon shapefile (USDA NRCS, 2016; 2016; 2014), which stores location and attribute information of geographic soil features represented by polygons.

The soil shapefile was imported into ESRI's ArcMap ™ software (Version 10.6.1), and the vector data were clipped to the Gibson City West 7.5-minute Quadrangle boundary (obtained from the ISGS Illinois Geospatial Data Clearinghouse (IGDC) (1998)) (Figure 5). Each polygon stores six categories of attribute data, including an object identification number created by ArcMap as a unique identifier (objectid), feature geometry (shape), soil survey area code that corresponds to the county in which a feature is located (areasymbol), spatial data version (spatialver), map unit symbol (musym), and map unit key (mukey) as seen in Figure 6. The map unit symbol was used to identify soil types as defined by the Custom Soil Report for Champaign, Ford, and McLean Counties (USDA NRCS, 2017; 2001; 2004; 2004). The soil report lists soil types based on their map unit names and includes a parent glacial material type.

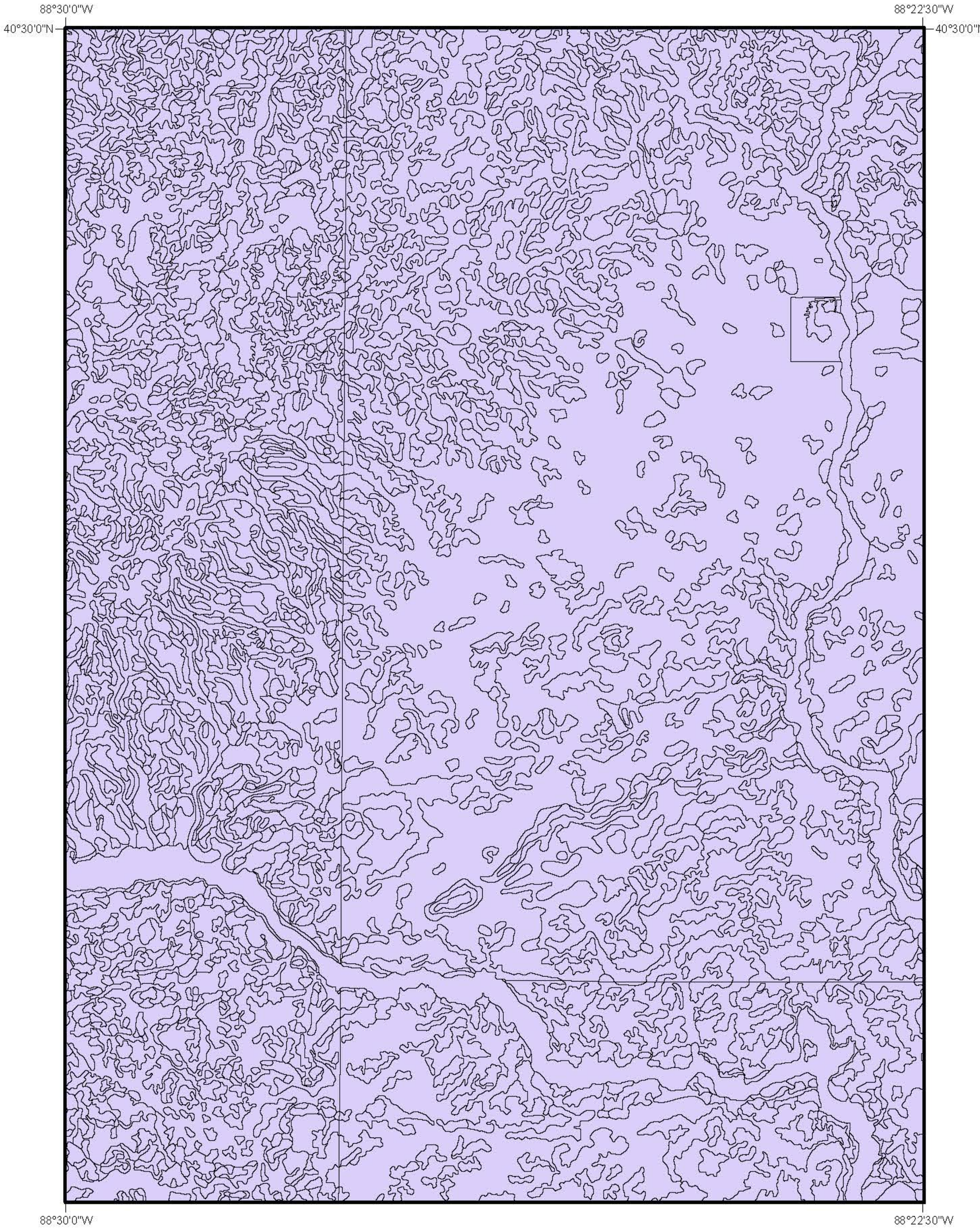

Figure 5. USDA NRCS soil data for the Gibson City West Quadrangle as a polygon shapefile (USDA NRCS, 2016; 2016; 2014) prior to classification of soil polygons.

Table

Gibson City West Soil Data

OBJECTID *	Shape *	AREASYMBOL	SPATIALVER	MUKEY	MUSYM
1	Polygon	IL053	4	198275	56B
2	Polygon	IL053	4	198358	375B
3	Polygon	IL053	4	198310	149A
4	Polygon	IL053	4	243748	481A
5	Polygon	IL053	4	198275	56B
6	Polygon	IL053	4	198296	146A
7	Polygon	IL053	4	198310	149A
8	Polygon	IL053	4	198297	146B2
9	Polygon	IL053	4	198310	149A
10	Polygon	IL053	4	243748	481A
11	Polygon	IL053	4	198310	149A
12	Polygon	IL053	4	198365	687B
13	Polygon	IL053	4	243748	481A
14	Polygon	IL053	4	243748	481A
15	Polygon	IL053	4	198296	146A
16	Polygon	IL053	4	198310	149A
17	Polygon	IL053	4	243748	481A
18	Polygon	IL053	4	243748	481A
19	Polygon	IL053	4	198275	56B
20	Polygon	IL053	4	198306	148B
21	Polygon	IL053	4	243748	481A
22	Polygon	IL053	4	198285	91A
23	Polygon	IL053	4	198313	330A
24	Polygon	IL053	4	243748	481A
25	Polygon	IL053	4	243748	481A

1 (0 out of 2233 Selected)

Gibson City West Soil Data

Figure 6. USDA NRCS soil data attribute table (records for 25 out of 2,233 total soil polygons shown).

The soil polygons were then attributed to their parent materials. To do this, the attribute table of the soils shapefile containing each polygon's map unit name was exported as an Excel spreadsheet. Three new fields were added to the Excel sheet to identify the parent material description (Parent_Mat), map unit (Map_Unit), and generalized glacial deposit type (General) for each soil polygon. Map units and corresponding parent material descriptions were obtained from the Custom Soil Report and recorded in the spreadsheet under their respective fields. Parent materials were then interpreted as more generalized glacial deposit types, including alluvium, loess, outwash, till, etc. Parent materials and generalized glacial deposit types were then imported back into ArcMap and attached to each soil polygon by joining the updated Excel spreadsheet to the soil data attribute table, as seen in Figure 7. Symbology for soil polygons were then categorized by their generalized glacial deposit types (General); the subsequent preliminary soils map is described further in the Results section.

Elevation data were acquired from the ISGS IGDC in the form of LiDAR (Light Detection and Ranging) digital terrain model (DTM) hillshade GIS rasters for Champaign, Ford, and McLean Counties (ISGS, 2008; ISGS, 2105; ISGS, 2012) with 0.3 meter spatial resolution. County LiDAR rasters were imported into ArcMap, clipped to the Gibson City West Quadrangle boundary, and mosaicked together to form a LiDAR hillshade map of the quadrangle.

Well records within the Gibson City West Quadrangle were obtained from the ISGS Illinois Water and Related Wells (ILWATER) online database in the form of an Excel spreadsheet (ISGS, 2015). Data for 144 wells within the Quadrangle boundary include information regarding API numbers, status of the well, latitude and longitude, section/township/range, well name, and more. Scanned well logs including lithologic for most wells were used to examine the top approximately 50 feet of the subsurface. Tops of well logs were interpreted and assigned as loess, till, outwash, or alluvium, and used to verify the parent materials map and identify any discrepancies. Information included on a reliable well log should

Table

Gibson City West Soil Data

OBJECTID *	Shape *	AREASYMBOL	County	MUKEY	MUSYM	Parent_Mat	Map_Unit	General
1545	Polygon	IL113	McLean	199128	614B	Loess and in the underlying till	Chenoa silty clay loam	Till
1546	Polygon	IL113	McLean	199133	622B2	Till	Wyanet silt loam	Till
1547	Polygon	IL113	McLean	199133	622B2	Till	Wyanet silt loam	Till
1551	Polygon	IL113	McLean	199059	60C2	Loamy till	La Rose silt loam	Till
1552	Polygon	IL113	McLean	199133	622B2	Till	Wyanet silt loam	Till
1554	Polygon	IL113	McLean	199072	145B2	Loess over loamy till	Saybrook silt loam	Till
1556	Polygon	IL113	McLean	199072	145B2	Loess over loamy till	Saybrook silt loam	Till
1560	Polygon	IL113	McLean	199133	622B2	Till	Wyanet silt loam	Till
1565	Polygon	IL113	McLean	199123	541B2	Loess over till	Graymont silt loam	Till
1566	Polygon	IL113	McLean	199133	622B2	Till	Wyanet silt loam	Till
1567	Polygon	IL113	McLean	199072	145B2	Loess over loamy till	Saybrook silt loam	Till
1568	Polygon	IL113	McLean	199072	145B2	Loess over loamy till	Saybrook silt loam	Till
1569	Polygon	IL113	McLean	199057	59A	Loess over loamy till	Lisbon silt loam	Till
1574	Polygon	IL113	McLean	199063	67A	Calcareous loess and or glacial drift	Harpster silty clay loam	Till
1576	Polygon	IL113	McLean	199134	622C2	Till	Wyanet silt loam	Till
1579	Polygon	IL113	McLean	199057	59A	Loess over loamy till	Lisbon silt loam	Till
1580	Polygon	IL113	McLean	199072	145B2	Loess over loamy till	Saybrook silt loam	Till
1581	Polygon	IL113	McLean	199133	622B2	Till	Wyanet silt loam	Till
1583	Polygon	IL113	McLean	199134	622C2	Till	Wyanet silt loam	Till
1584	Polygon	IL113	McLean	199058	60B2	Loamy till	La Rose silt loam	Till
1585	Polygon	IL113	McLean	199061	60D2	Loamy till	La Rose silt loam	Till
1588	Polygon	IL113	McLean	199072	145B2	Loess over loamy till	Saybrook silt loam	Till
1589	Polygon	IL113	McLean	199133	622B2	Till	Wyanet silt loam	Till
1592	Polygon	IL113	McLean	199134	622C2	Till	Wyanet silt loam	Till
1594	Polygon	IL113	McLean	621819	290B2	Silty loess over loamy till	Warsaw loam	Till

0 (0 out of 2233 Selected)

Gibson City West Soil Data

Figure 7. Parent materials descriptions (Parent_Mat), map units (Map_Unit), and generalized glacial deposit type (General) fields from Excel spreadsheet joined to original USDA NRCS soils data attribute table. ‘General’ field used to categorize soils as interpreted glacial deposits.

include a description of the main rock types encountered along with their thickness and depth. In actuality, most logs did not provide information clear or detailed enough to confidently rely on. However, a stratigraphic boring drilled by the ISGS and logged thoroughly by ISGS Associate Quaternary Geologist, Andrew Stumpf, which contained formation and member names with detailed descriptions. This well was used as a reliable reference of the subsurface of the region.

Field work within the Gibson City West Quadrangle was conducted in fall 2017 and summer 2018 in order to physically observe surficial deposits where they crop out. The USGS Gibson City West 7.5-minute topographic map (USGS, 2018; Figure 2) was used to navigate the quadrangle. Most outcrops were observed in steep ditches and along the banks of the Sangamon River and Drummer Creek; overall, outcrop sites were sparse, as much of the region is covered at the surface by soil in agricultural farm fields. Examples of typical outcrops are included in Figure 8. At each outcrop observation, surficial deposits were described and later interpreted as a formal lithostratigraphic unit as defined by Frye and Willman (1975) and Hansel and Johnson (1996).

A final surficial geologic map of the Gibson City West Quadrangle was constructed using the compilation of the following data: soil, LiDAR, well log, and field outcrop. Glacial deposits indicated on the parent materials map were translated as lithostratigraphic Quaternary units based on those found in the Handbook of Illinois Stratigraphy (Frye and Willman, 1975) and those described by Hansel and Johnson (1996). To delineate lithostratigraphic contacts, polygons were created and digitized in ArcMap. Polygons, LiDAR data, and topographic map vector data, including roads, county lines, etc., (USGS NGTOC, 2018) were imported into a topographic map style template (USGS NGTOC, 2016) in ArcMap. An explanation for surficial geologic units and map features was created using Adobe® Illustrator®; the final surficial geologic map was exported from ArcMap and combined with the explanation in Illustrator®.

Figure 8. Examples of typical outcrops observed during field work. Yellow unit is interpreted as the Batestown Member, Lemont Formation.

CHAPTER III: RESULTS

Parent Materials, LiDAR, and Surficial Geologic Maps

The interpreted parent materials map indicates five glacial deposit types within the Gibson City West Quadrangle: alluvium, lacustrine deposits, loess, outwash, and till (Figure 9). Alluvium, outwash, and till deposits represent the majority of deposits, with minor amounts of lacustrine and loess. Alluvium generally follows the course of major waterways; till is located primarily to the northwest and southeast divided by a large outwash deposit. Loess occurs within the northwest till region, and lacustrine deposits occur sporadically within the outwash region. These glacial deposits can be correlated with landforms that exist within the quadrangle using the LiDAR hillshade map (Figure 10). Topography changes that are difficult to detect in the field are highlighted on the LiDAR map, making landforms much more easily distinguishable.

Channel incisions that cut through the southern and eastern portions of the quadrangle represent the lowest elevations and correspond with alluvium deposits. Till deposits generally correspond with the highest elevations within the quadrangle. To the northwest, a relatively steep landform resembling a ridge contains the highest elevations within the quadrangle and corresponds with till deposits; a hummocky, irregular surface with relatively high elevations to the southeast also corresponds with till. Flat, generally featureless terrain separates these features and corresponds with outwash deposits. Loess is generally associated with the ridge in the northwest, while lacustrine deposits occur in the flat outwash region with low elevations. Several narrow, linear, winding ridges appear within the outwash region, as indicated by the orange boxes in Figure 10. Without the LiDAR map, these features would have gone completely

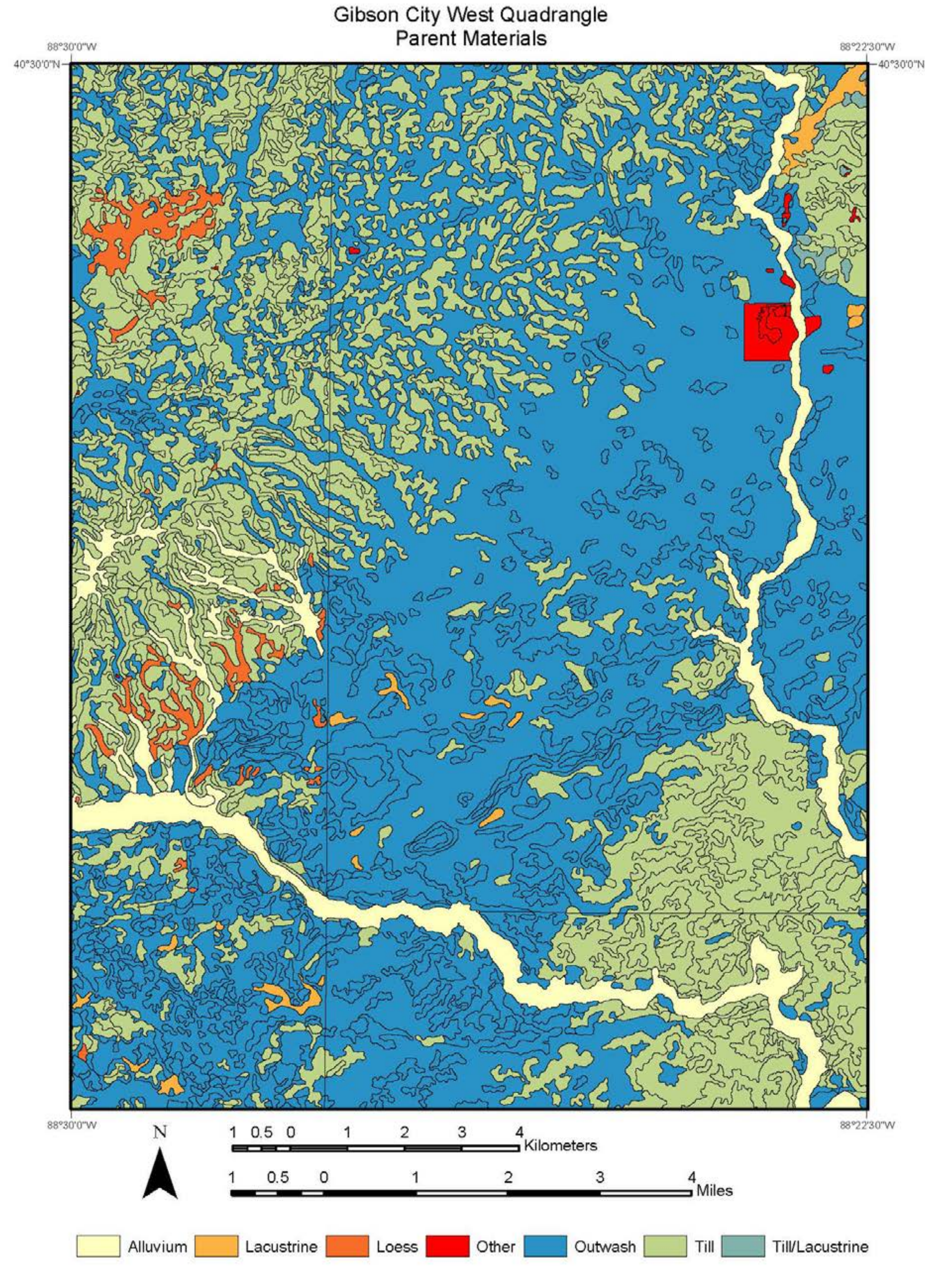

Figure 9. Interpreted parent materials map of soils.

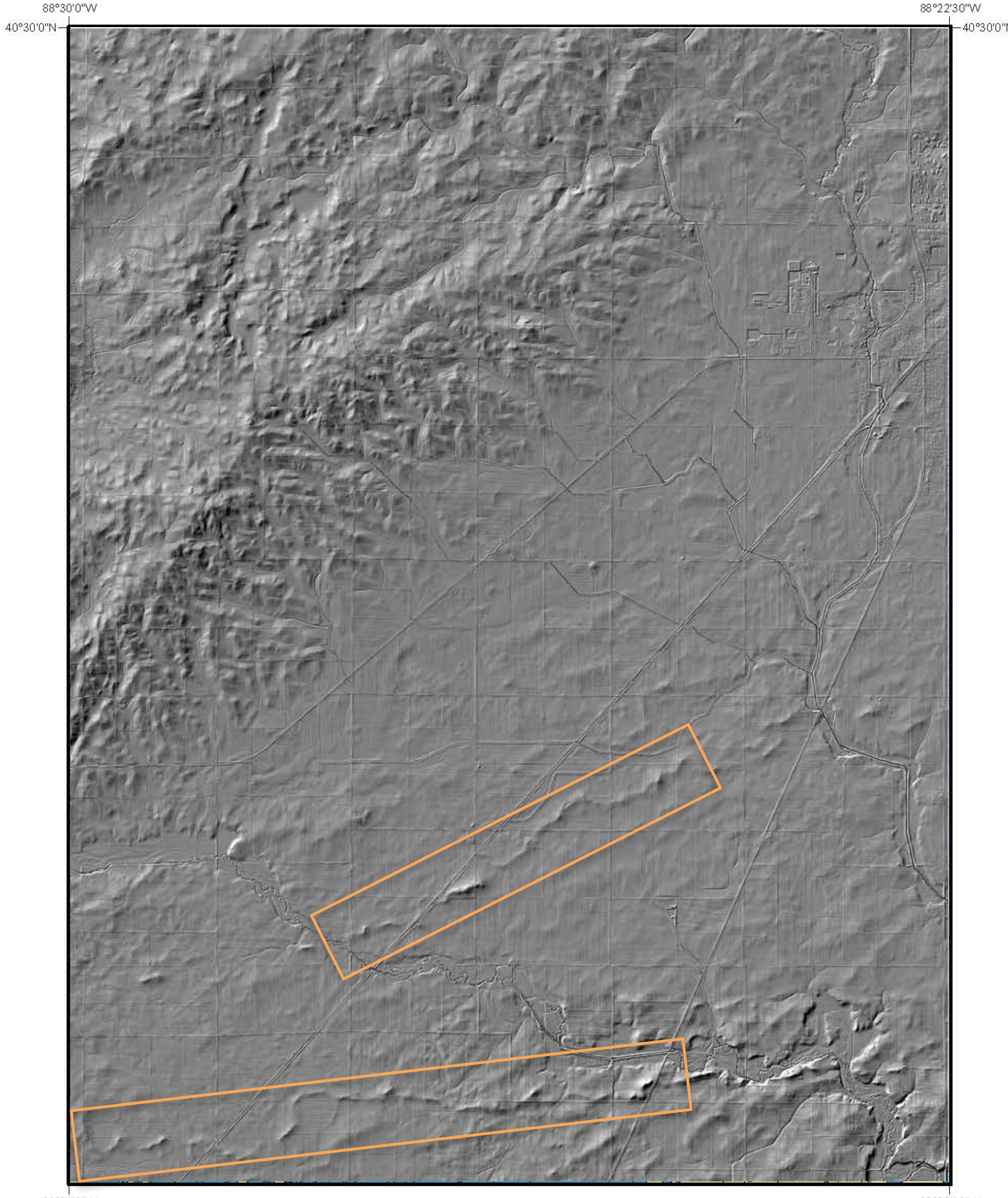

Figure 10. LiDAR hillshade map showing elevation change and highlighting major landforms within the Gibson City West Quadrangle. Orange boxes indicate linear winding ridges, interpreted as eskers.

undetected, as these features are virtually indistinguishable in the field. Alluvium, outwash, and till deposits were translated as five lithostratigraphic units; loess and lacustrine deposits were excluded based on their scarcity and thickness of less than 5 feet. These interpretations represent the basis of the final map.

The final surficial geologic map of the Gibson City West Quadrangle displays the interpreted lithostratigraphic units, LiDAR, and the ISGS stratigraphic borehole (Plate 1/. Lithostratigraphic units, from youngest to oldest, are as follows: the Cahokia Formation, the Batavia and Wasco Members of the Henry Formation, and the Batestown and Yorkville Members of the Lemont Formation. The Cahokia Formation is an alluvium deposit identified in the in low channels. The Henry Formation consists of outwash deposits represented in the quadrangle by the Batavia and Wasco Members. The Batavia Member exists in the flat, low outwash area along the front and adjacent to the ridge in the northwest region of the quadrangle. The Wasco Member represents long, narrow, channel-shaped outwash ridges. The Lemont Formation consists of till deposits represented in the quadrangle by the Batestown and Yorkville Members. The Batestown Member corresponds to the till ridge and the region including and adjacent to the hummocky region. The ISGS stratigraphic boring located just south of the Sangamon River indicated Batestown Member at the surface with a thickness of 34 feet. The Yorkville represents till to the northeast of the Batavia outwash and Batestown till.

CHAPTER IV: DISCUSSION

Surficial Geologic Map

Lithological units mapped at or near the surface within the Gibson City West Quadrangle surficial geologic map are Hudson and Wisconsin in age. Wisconsin-aged units of the Henry and Lemont Formations were deposited by Lake Michigan Lobe Ice approximately 24,200 to 14,700 years ago according to recent radiocarbon ages obtained by Curry et al. (2018) and Stumpf (2018). The Batestown Member of the Lemont Formation represents ice-marginal and ice-contact sediment deposition that formed the following features within the quadrangle: the end moraine ridge that formed at the front of the glacier, representing the Bloomington Morainic Complex (BMC) in the northeast portion of the map, and the hummocky moraine to the southeast and relatively flat ground moraine in between that both deposited under the glacier. The speckled pattern indicates the end moraine facies on the map.

The Yorkville Member of the Lemont Formation also represents ice-marginal sediment deposition toward the northeast and representing the Illiana Morainic Complex (IMC). The convergence of the two MCs is indicative of the Gibson City Reentrant, a feature that not only marks the convergence of the BMC and IMC, but also the division of the Lake Michigan Ice Lobe as the Peoria Sublobe to the west and the Decatur Sublobe to the east.

The Batavia Member of the Henry Formation is associated with proglacial deposition of outwash sediments by streams produced by Lake Michigan Lobe meltwater. The Batavia is deposited as an outwash plain or alluvial fan on the frontal sides of the Bloomington and Illiana Morainic Complexes. The Wasco Member of the Henry Formation also represents glaciofluvial ice-contact deposits produced by Lake Michigan Lobe meltwater as subglacial esker-like features.

The Hudson-aged Cahokia Formation represents postglacial, alluvial stream deposits that formed approximately 14,700 years ago until the present. The Cahokia Formation represents deposits predominantly located in channels and floodplains of the Sangamon River and Drummer Creek.

The Surficial Geologic map advances the statewide Surficial Deposits of Illinois map from Stiff (2000) (Figure 3) by providing more localized analysis and interpretation of surficial materials. Major differences include the addition of the Cahokia Alluvium, which was most likely too small to be mapped at the statewide scale, and more precise delineation of contacts, especially for the Wasco Member of the Henry Formation.

Mahomet Aquifer System

The Mahomet Aquifer is presumed to be located in the subsurface within the southern portion of the Gibson City West Quadrangle. Although permeable, coarse-grained materials like the Cahokia and Henry Formations could overlie the aquifer in places, connection between the surface units and the aquifer are unexpected. Virtually impermeable layers between the two likely prevent surface recharge to the aquifer. Wisconsin-aged diamictons (and older) likely serve as an aquitard, protecting the basal aquifer from surface contamination. In east-central Illinois, the Mahomet Aquifer generally occurs under confined or semi-confined conditions (Stephenson, 1967). This theory could be further investigated by delineating the aquifer bounds and subsurface stratigraphy within the Gibson City West Quadrangle.

CHAPTER V: CONCLUSIONS

Within this study, the construction of a detailed, surficial geologic map of the Gibson City West 7.5-Minute Quadrangle was completed to better understand the distribution of surficial geologic materials that overlie the Mahomet Bedrock Valley and the Sangamon River Basin, and underlie the foundations of homes, industries, and transportation infrastructure. During construction and interpretation of the surficial geology, LiDAR proved to be extremely useful for delineating and attributing landforms to lithostratigraphic and morphostratigraphic units. This surficial geologic map will form a basis upon which other derivative maps can be produced for specific purposes, such as assessment of groundwater resource, mineral resources, and natural hazards. Geologic data gathered here will provide a valuable framework for Mahomet Aquifer System studies and IML-CZO research.

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APPENDIX A: SURFICIAL GEOLOGY OF THE GIBSON CITY WEST, 7.5-MINUTE QUADRANGLE: CHAMPAIGN, FORD, AND MCLEAN COUNTIES, ILLINOIS

Plate 1.

See back cover.