Three-dimensional Geologic Mapping for McHenry County

Jason F. Thomason and Donald A. Keefer

Illinois State Geological Survey

Prairie Research Institute

University of Illinois at Urbana-Champaign

November, 2013

CONTENTS PAGE

Acknowledgements	iii
List of Figures	iv
Introduction	1
Previous Studies	3
Geologic Framework	3
Methods	7
Fieldwork	7
Database Management	10
Geologic Mapping Workflow	10
Maps	12
3-D Geologic Map	12
2-D Derivative Maps	16
Aquifer Delineation and Characterization	16
Major Sand and Gravel Aquifers	16
Surficial Aquifer	16
Pearl-Ashmore Aquifer	21
Basal Aquifer	23
Minor Sand and Gravel Aquifers	25
Yorkville Aquifer	25
Glasford Aquifer	25
Non-Aquifers	28
Confining Units	28
Haeger semi-confining unit	28
Yorkville confining unit	30
Tiskilwa confining unit	30
Glasford confining unit	30
Basal confining unit	34
Interconnectivity of Aquifers	34
Aquifer Contamination Potential	37
Summary and Future Work	38
References	40
Appendices	
A. Graphic Logs of Testholes Drilled from 2008-2009	
B. Geophysical Profiles and Geologic Interpretations	
C. GSI3D Cross Sections	
D. Subsurface Viewer User Manual	
E. Maps of (a) Aquifer Extent and Thickness and (b) Aquifer Sensitivity	

ACKNOWLEDGEMENTS

This project was made possible largely through joint funding by the government of McHenry County and the Illinois State Geological Survey (ISGS). Significant funding was also provided by the State of Illinois through the Regional Water Supply Planning Initiative and by the United States Geological Survey through the Great Lakes Geologic Mapping Coalition.

The authors would like to acknowledge the support of many McHenry County officials, without whose support this project would not have been successful. These officials include County Board Chairman Ken Koehler, former Water Resources Manager, Cassandra McKinney, Director of Planning and Development Dennis Sandquist, Chief Stormwater Engineer Cory Horton, and Groundwater Protection Specialist Sarah Berg. We would also like to thank former Land and Facilities Manager Tom McCarthy of the McHenry County Conservation District (MCCD), and his staff, for their support and for granting us access to MCCD property for fieldwork. We also thank Ed Weskerna of the McHenry County Soil and Water Conservation District, and we acknowledge the cooperation by the municipalities of Crystal Lake (and the Crystal Lake Park District), Woodstock, Hebron, Marengo and Harvard. We also acknowledge and thank the numerous private landowners who graciously allowed access to their properties.

We would like to acknowledge the significant contributions and support of colleagues at the Illinois State Geological Survey, including Tim Larson, Ahmed Ismael, Steve Sargent, Tim Young, Mike Barnhardt, Brandon Curry, Steve Brown, Jennifer Carrell, Dick Berg and our drilling crews, including Jack Aud, Travis Griest, Aaron Blacker, and Rich Padilla. Their efforts are all appreciated. Significant contributions were made by former graduate students Drew Carlock and Jodi Lau from Illinois State University. Colleagues at the British Geological Survey were instrumental in assisting with the construction of the 3-D map, particularly related to our use of GSI3D mapping software. In this regard, we would like to thank Holger Kessler, Bruce Napier, Ricky Herrington, and Ben Wood. Hans-Georg Sobisch, of Insight Geologische Softwaresysteme GmbH, provided critical help by producing the interactive 3-D map software and project file. This report was completed under the direction of Dr. E. Donald McKay III, Director of the Illinois State Geological Survey, and Dr. William W. Shilts, Executive Director, Prairie Research Institute.

FIGURES PAGE

1. Map and perspective view of 3-D mapping study area 2
2. Surficial geologic map of McHenry County 4
3. Schematic cross section and geologic framework of McHenry County 5
4. Map of testhole locations 8
5. Map of geophysical profile locations 9
6. Examples of 3-D visualization of geologic data 11
7. Example of cross section from GSI3D 13
8. Network of cross sections used to build 3-D map 14
9. Perspective views of 3-D map 15
10. 3-D map user interface 17
11. Outwash fan in western McHenry County 19
12. Distribution and thickness of the Surficial Aquifer 20
13. Distribution and thickness of the Pearl-Ashmore Aquifer 22
14. Distribution and thickness of the Basal Aquifer 24
15. Distribution and thickness of the Yorkville Aquifer 26
16. Distribution and thickness of the Glasford Aquifer 27
17. Distribution and thickness of the Haeger Semi-Confining Unit 29
18. Distribution and thickness of the Yorkville Confining Unit 31
19. Distribution and thickness of the Tiskilwa Confining Unit 32
20. Distribution and thickness of the Glasford Confining Unit 33
21. Distribution and thickness of the Basal Confining Unit 35
22. Example of interconnected aquifers 36
23. Aquifer contamination potential of McHenry County 39

INTRODUCTION

Growth in water demand within the Chicago Metropolitan area, together with declining water levels in deep bedrock wells and strictly regulated use of Lake Michigan water have led to a regional awareness of the need for science-based, sustainable water supply management. The Illinois State Geological Survey (ISGS) has been a primary scientific resource to local and regional decision-makers in the area (CMAP, 2010), providing technical expertise, reports and maps regarding the distribution and character of aquifers in Illinois. The inherent limitations of Lake Michigan and the deep bedrock aquifers have led many communities to evaluate the potential for additional groundwater withdrawals from shallow sand and gravel aquifers. The distribution and thickness of these aquifers vary widely across Illinois and detailed mapping is needed to better predict the quantity of sustainable groundwater for these aquifers and to better assess their sensitivity to potential contamination. Many communities in northeastern Illinois are beginning to evaluate the long-term water resource potential of sand and gravel aquifers within the shallow glacial sediments. McHenry County responded to this regional issue by adopting a water-resources management strategy that was tied into public education and involvement, and recognized the importance of updated geologic and hydrologic information on the distribution and resource potential of aquifers throughout the county.

In 2008, after meetings and discussion with county staff, the County of McHenry contracted the Illinois State Geological Survey (ISGS) to develop a detailed 3-D geologic map of the shallow sand and gravel aquifer systems in McHenry County, providing particular emphasis to the aquifers in the western half of the county. Fieldwork, database development, and mapping by the ISGS were initiated during 2008, coincident with a separate regional ISGS mapping project of the Fox River Basin (FRB). That FRB mapping effort was funded by the Illinois Department of Natural Resources through the Water Supply Planning and Management Initiative, and involved the development of a generalized, regional 3-D map of the glacial sediments for use in a regional groundwater flow model of the FRB. Also that year, the county secured a contract with the US Army Corps of Engineers (USACE) for the design and installation of a county-wide shallow groundwater observation-well network. The ISGS assisted in the design and development of that network. Following completion of that network, the county contracted with the US Geological Survey, Illinois Water Science Center, to install real-time monitoring equipment in all of these wells.

In 2009, McHenry County contracted with the Illinois State Water Survey (ISWS) to develop a groundwater flow model of McHenry County. To support this new groundwater modeling task, the scope of the ISGS 3-D mapping project was amended by adding the development of a generalized geologic framework model that met the 9-layer design and geographic extent of the flow model (Figure 1; Meyer, in preparation). That generalized geologic framework model was delivered to the ISWS as contracted, and is not discussed in this report. This report discusses the development of a detailed 3-D geologic map and hydrogeologic framework of the glacial deposits within McHenry County.

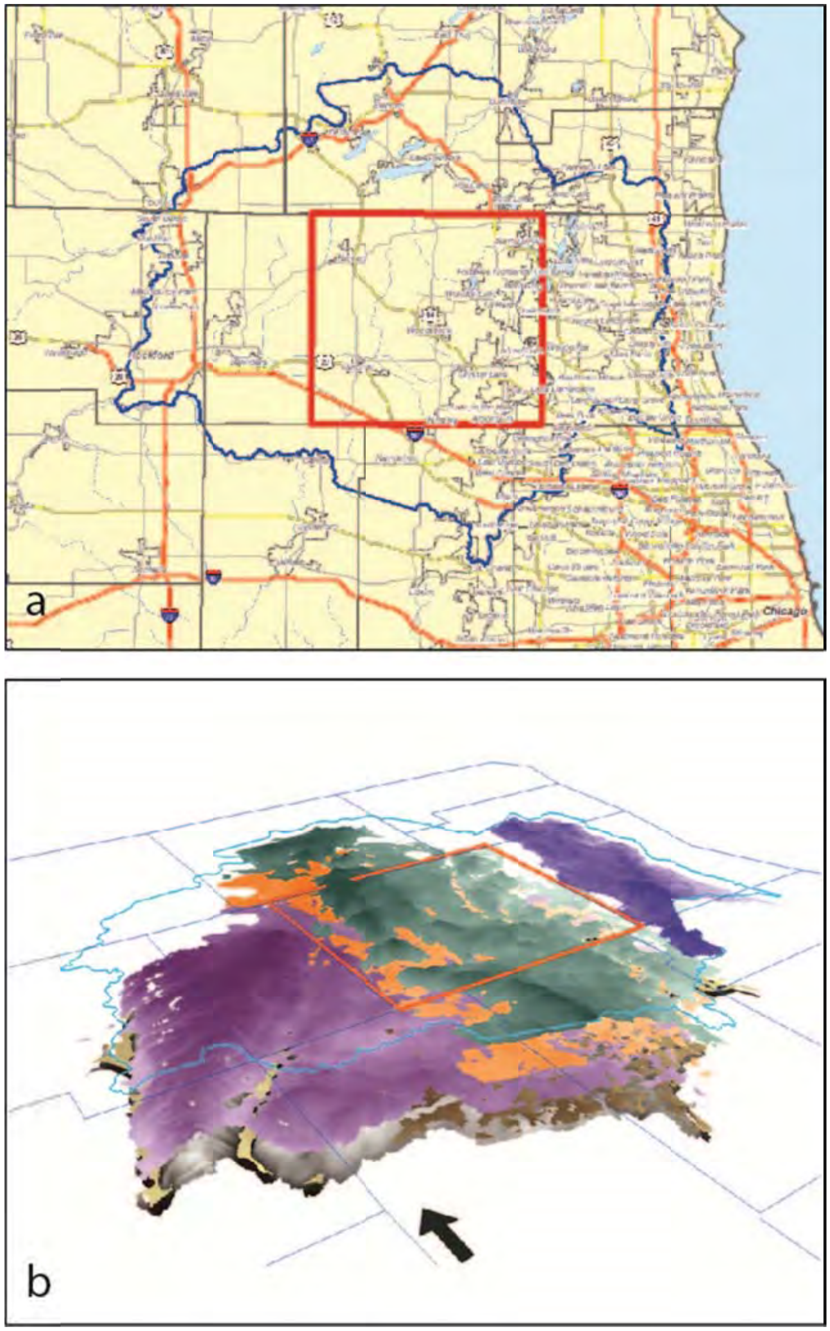


Figure 1. (a) Extent of 9-layer regional geologic framework model (shown in blue) developed for use in the ISWS groundwater-flow model of northeastern Illinois, and (b) a perspective view of the 9 geologic surfaces in that model. McHenry County boundary is shown in red, which corresponds to the extent of the detailed 3-D geologic mapping area addressed in this report.

PREVIOUS STUDIES

The geology and resources of McHenry County have been topics of interest to geologists for over a century (Alden, 1904). The character and distribution of the rich sand and gravel resources in McHenry County have been studied numerous times (Anderson and Block, 1962; Masters, 1978; Cobb and Fraser, 1981). The important glacial record preserved in McHenry County has been part of numerous studies in northeastern Illinois and southeastern Wisconsin (Alden, 1904; Schneider, 1983; Wickham et al., 1988; Berg, 1994; Curry et al., 1997) and have solidly established the glacial history, lithologic framework, and hydrogeologic framework of the area. Geological studies in support of regional and local planning interests also have been conducted for decades (Hackett and McComas, 1969; Specht and Westerman, 1976; Kempton et al., 1977; Curry et al., 1997), and as the population has grown in McHenry County, the availability and contamination potential of groundwater resources have been studied repeatedly (Visocky et al., 1985; Gilkeson et al., 1987; Berg, 1994; Meyer, 1995; Curry et al., 1997).

The most recent and comprehensive geological study in McHenry County was conducted by Curry et al. (1997), which incorporated a field program of drilling with associated 1:24,000-scale surficial geologic mapping to develop county-wide map products for planners and decision makers (Figure 2). In that study, the geologic materials were classified and mapped in the context of lithology (material character and texture) and hydrogeology (aquifer/non-aquifer). County-wide geologic maps, aquifer maps, 2-D cross sections, and local site studies were developed as products. Furthermore, a hydrogeologic framework was developed for the shallow sand and gravel aquifers throughout the county. This study starts from Curry et al. (1997) and uses new data, new software, and new mapping techniques to add new local details and develop integrated, 3-D geologic and hydrogeologic framework models.

GEOLOGIC FRAMEWORK

Across the landscape, most of the natural resources and ecosystems of McHenry County are a result of glacial activity during the Quaternary Period of geologic time (2.6 mya to 11 kya). Regional topographic ridges and valleys, lowland wetland ecosystems, and locations of modern streams are clear examples of the importance of recent glaciations in shaping modern-day McHenry County. The geologic framework supporting those landscapes and surface water features was summarized by Curry et al. (1997) and modified for this study (Figure 3).

The oldest Quaternary deposits recorded in McHenry County are those of the Banner Formation (found only in the subsurface), which are 730-190 kya. Those deposits are likely discontinuous and have only been found occasionally throughout the study area (Curry et al., 1997; Curry, 1995). Due to their infrequent detection, we do not understand the distribution of Banner Formation deposits, and so they were not mapped in this study. They are buried by more extensive, younger glacial deposits of the Illinois Episode (190,000 to 130,000 years ago), which

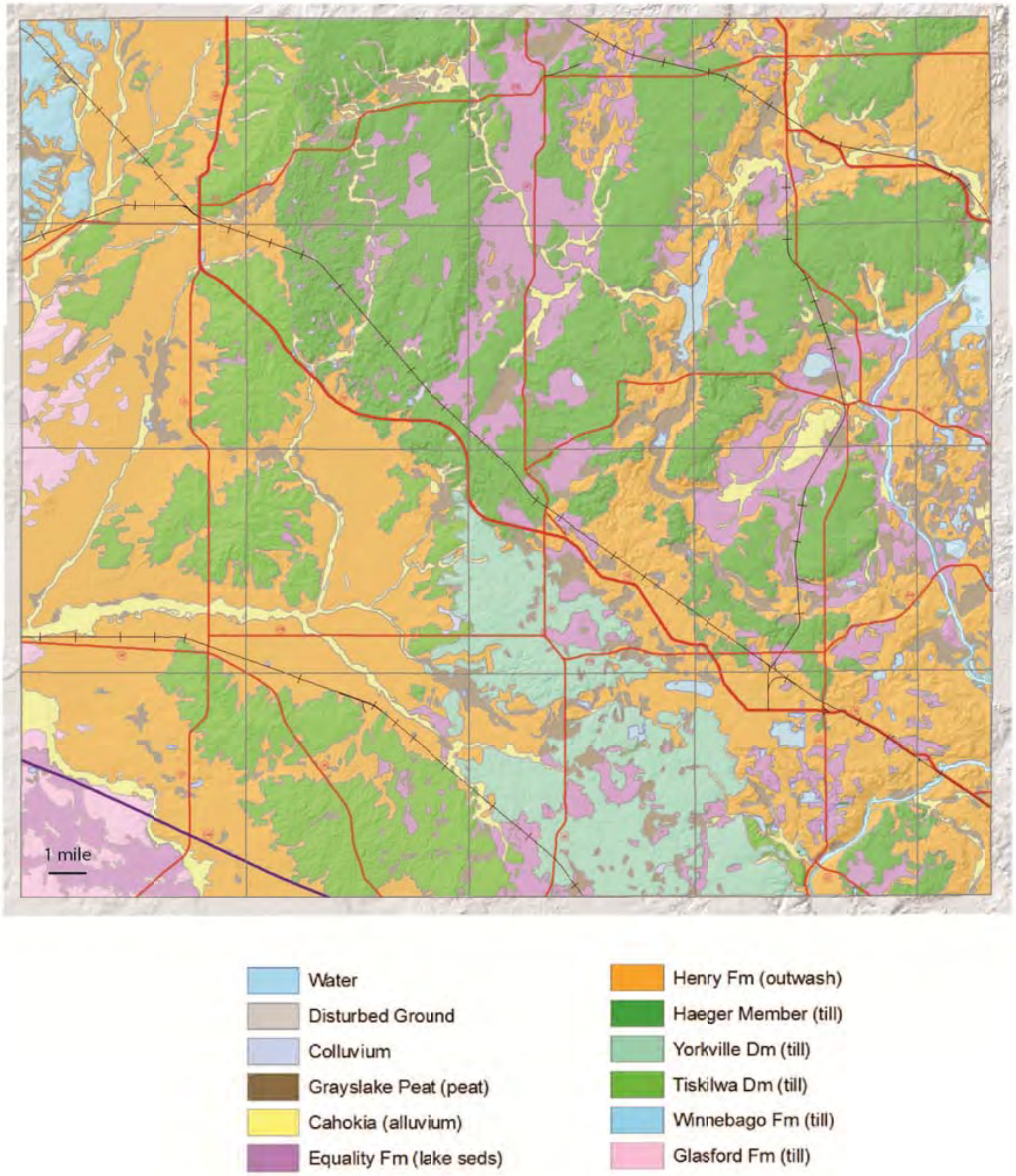


Figure 2. Surficial geologic map of McHenry County (modified from Curry et al., 1997). Major highways are indicated in red and purple. Railroads are indicated in black. Township boundaries are indicated in gray.

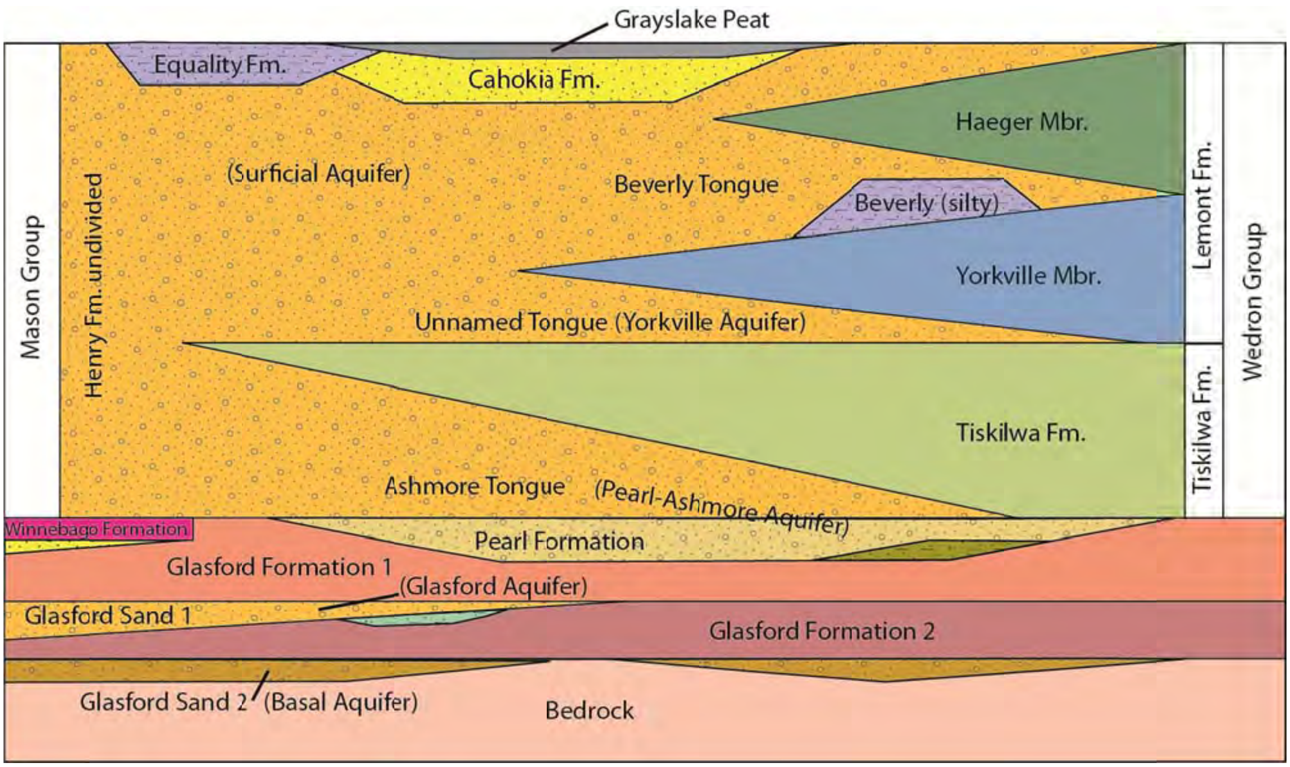


Figure 3. Schematic cross section (oriented east-west) of lithostratigraphic units and associated aquifers in McHenry County (modified from Curry et al., 1997).

include both the Glasford and Winnebago Formations. Two extensive sequences of Glasford Formation deposits were mapped as part of this study (Figure 3). These formations include sand and gravel sediments deposited by glacial meltwater, silt-rich lake sediments, and poorly sorted, clay-rich, ice-contact sediments.

After the Illinois Episode, a period of non-glaciation occurred (130,000-55,000 years ago), which weathered some of the older glacial sediments, and eroded and removed others. During the early Wisconsin-Episode (~55,000-29,000 years ago), organic-rich soils formed in wind-blown silt across the landscape. These soils, recognized as the Morton-Robein complex sediments, are commonly found preserved in the subsurface of McHenry County, beneath younger deposits of the Wisconsin-Episode glaciation.

At least three separate glacial advances during the Wisconsin Episode glaciation (~29,000 to 14,000 years ago) deposited and sculpted most of the sediments and landscapes that we see presently in McHenry County. Some of these more prominent landscapes include, for example, the areas of Marengo Ridge Conservation Area, Glacial County Park, which formed along the edges of former glaciers. Other prominent landscape features include the modern pathways of the Kishwaukee River, Nippersink Creek, and the Fox River, which were the former paths of glacial meltwater streams and often contain thick sequences of coarse-grained sand and gravel. Thin deposits of modern river sediments and lake sediments (Cahokia and Equality formations, respectively) are present in active stream valleys and lake environments. A more extensive explanation of the nature and character of glacial deposits in McHenry County can be found in Curry et al. (1997).

Rather than develop a new aquifer naming strategy for the sand and gravel aquifers, we used the definitions and names from Curry et al. (1997). In their report, Curry et al. (1997) identified 6 different sand and gravel aquifers associated with specific glacial events or episodes. For this study, the extent and thickness of each aquifer was delineated based on the county-wide 3-D geologic map, which considered the complete glacial sequence of deposits. Similar to Curry et al, in this study 3 of these aquifers (Surficial Aquifer, Pearl/Ashmore Aquifer, Basal Aquifer) were identified as major sand and gravel aquifers capable of supporting domestic, industrial, and municipal water supplies through most of their mapped extents. Two other aquifers (Yorkville Aquifer and Glasford Aquifer) were found to be minor aquifers, capable of supporting small-demand applications like domestic water supplies. While the Yorkville and Glasford Aquifers are typically thin and not overly productive, their distributions were found to be more extensive than in Curry et al. (1997), and they were found to be locally in contact with larger sand and gravel aquifers. In Curry et al. (1997), another aquifer (named the Tiskilwa Aquifer), was mapped and described as discontinuous lenses of sand and gravel within the Tiskilwa Formation. In this study, the Tiskilwa Aquifer was not mapped as an individual unit. Rather, the deposits of that aquifer were included within either the Pearl/Ashmore Aquifer (south central part of the study area) or the Surficial Aquifer (northeast corner of the study area), which is consistent with the geologic framework described in Curry et al. (1997).

METHODS

The main objective of this study was to build a 3-D geologic map of the glacial deposits within McHenry County. From this 3-D, derivative 2-D maps were produced that depict the thickness, sedimentology and hydraulic characteristics of the shallow sand and gravel aquifers. This project integrated new field exploration techniques, database standardization and refinement, and 3-dimensional visualization and analyses.

FIELDWORK

This study was initiated by an intensive 2-year field investigation that was twofold. First, a strategic plan was developed to drill testholes throughout the county (Figure 4) to help further delineate the distribution of key glacial deposits and better understand their hydrogeologic character and variability. Drilling locations were chosen based on accessibility and geologic interest. In two field seasons (2008-2009), the ISGS drilled 17 wireline-mud rotary testholes, which included continuous lithologic cores to bedrock and downhole geophysical logs at most locations (gamma ray and electrical resistivity). As part of this contract, McHenry County funded the drilling for 11 of these testholes, mainly in the western half of the county (Figure 4). The remaining 6 testholes were funded by the Department of Natural Resources through the Water Supply Planning and Management Initiative. Coincident with ISGS drilling efforts, 14 other testholes were drilled as part of the contract between McHenry County and the USACE to install a regional groundwater observation-well network (Figure 4). These testholes are in addition to 25 others drilled from previous studies in the county during the past two decades (from Curry et al., 1997). All of these testhole data were incorporated into the 3D geologic map. Graphic logs of the testhole data are available in Appendix A.

Secondly, to complement the drilling data, in 2008-2009 the ISGS collected over 30 miles of 2-dimensional (2-D) geophysical profiles (16.8 miles of seismic reflection) and 15.6 miles of electrical Earth resistivity) (Figure 5). McHenry County funded the collection of 20.3 miles of geophysical data, mainly in the western half of the county, and the Department of Natural Resources funded the collection of 12.1 miles of geophysical data in the eastern half of the county through the Water Supply Planning and Management Initiative. The 2-D seismic profile data were collected by striking the ground with a small, induced seismic source (i.e. hammer) and using a set of specialized sensors, called geophones, to record the vibratory response of the earth. Processed seismic reflection data show density changes in the subsurface, which are largely a function of lithologic changes, to depths of up to 300 feet below land surface. Electrical Earth resistivity methods use a small induced electrical source to measure electrical properties of materials in the subsurface, which are also used as proxies for lithologic properties. Both of these methods, especially when combined at the same location, provide useful 2-D representations of geologic materials below land surface. These field data have been the key

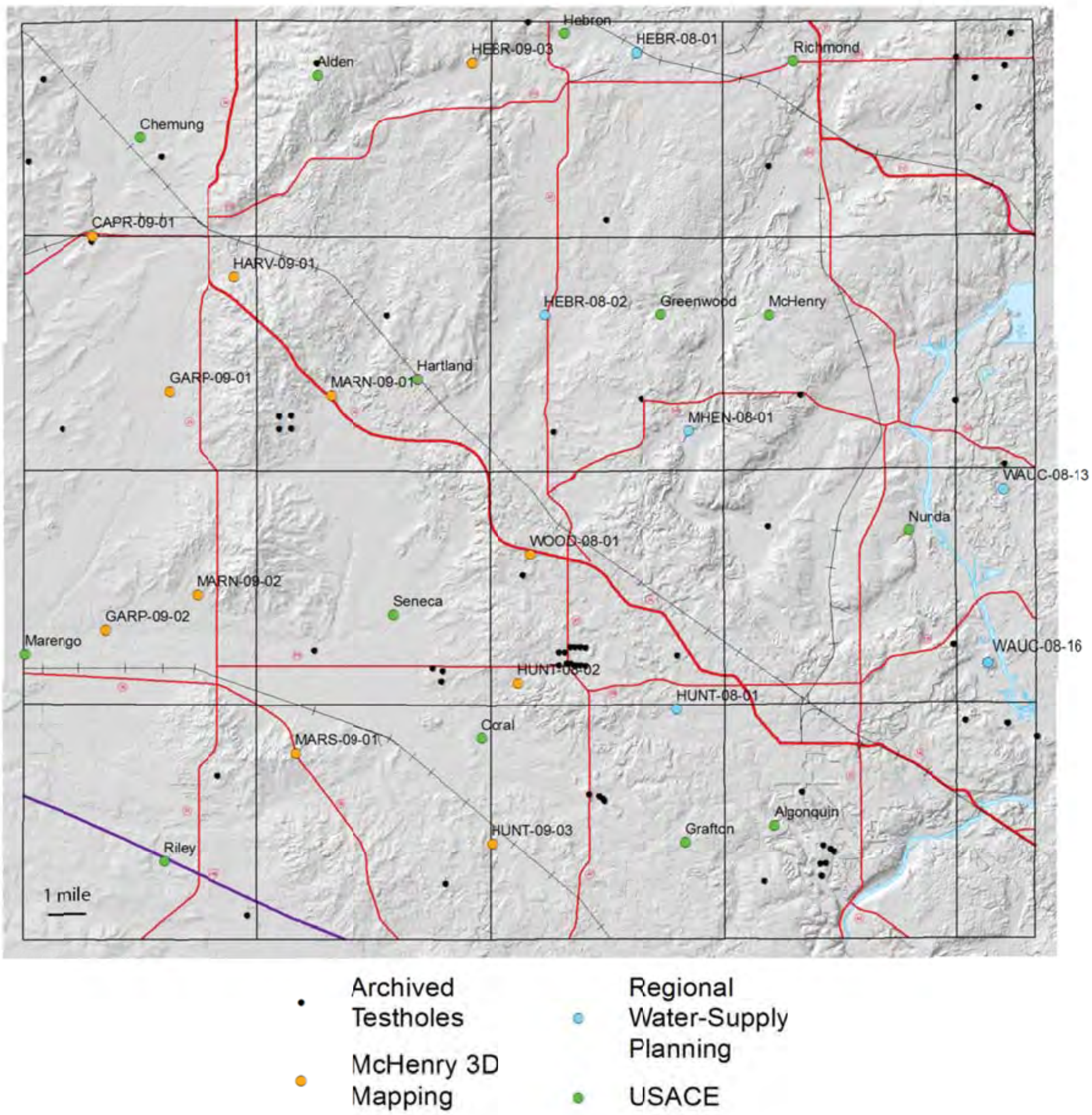


Figure 4. Locations of test holes used for the McHenry 3-D mapping project. Test holes for McHenry 3-D Mapping, Regional Water-Supply Planning, and the USACE projects were drilled in 2008-2009.

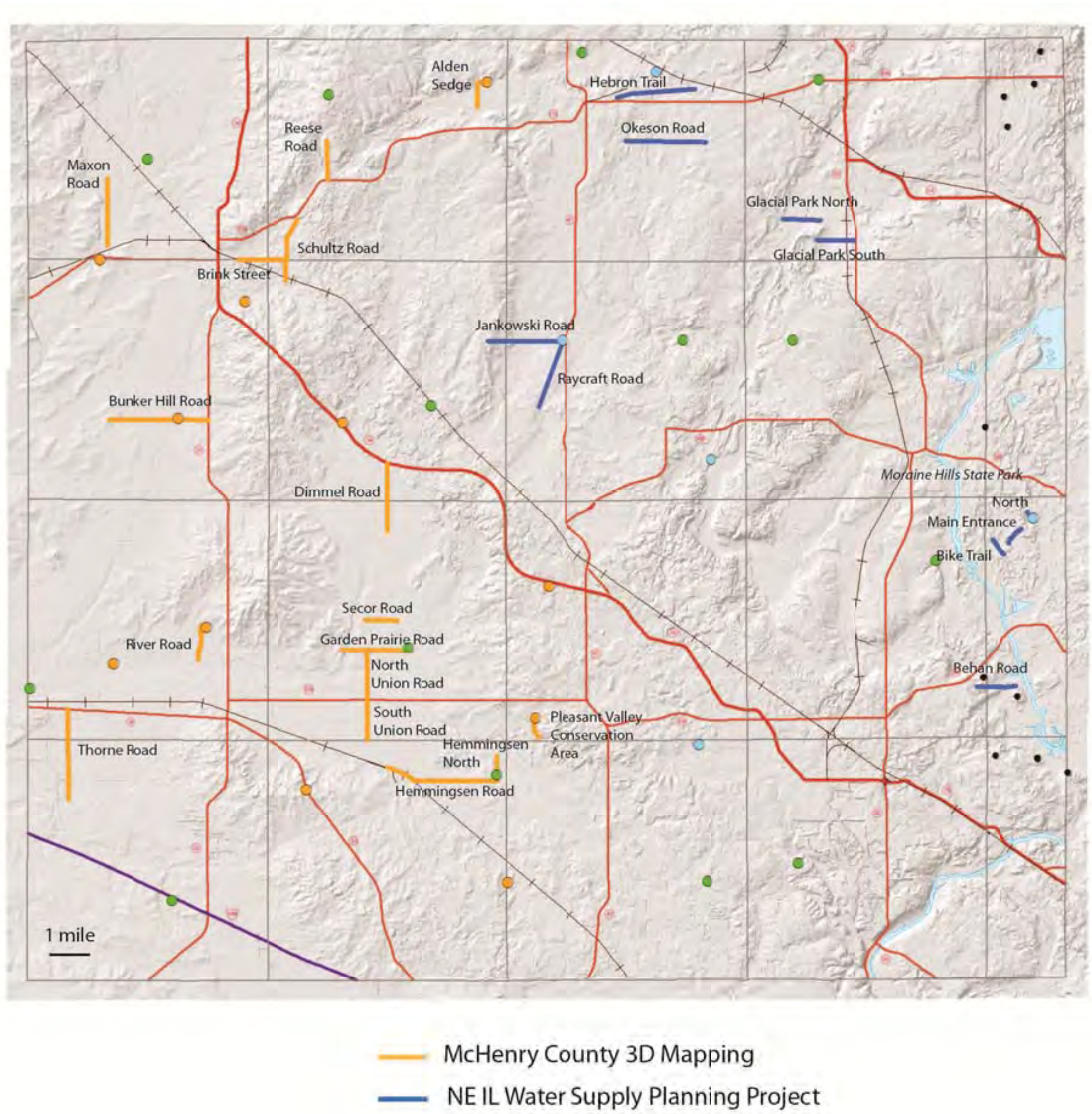


Figure 5. Locations of 2-D geophysical profiles collected during 2008-2009 for the McHenry County 3-D mapping project. Locations of test holes are also indicated (see Figure 4 for test-hole names).

datasets for regional and local geologic interpretation in this study of McHenry County. The geophysical profile data and interpretations are available in Appendix B.

DATABASE MANAGEMENT

A primary data source that was utilized in McHenry County is the historical water-well database at the ISGS. Project staff utilized a two-pronged quality control effort to (a) standardize the lithologic terms used in the drillers' descriptions and (b) improve the quality of the locational information for each well. These efforts helped improve the accuracy of both geologic interpretations of the well records and the resulting map unit boundaries that were drawn.

Standardization of the water-well log descriptions is required for 3-D visualization and mapping of geologic data. Since 2008, ISGS staff standardized approximately 95% of the descriptions from water-well records in McHenry County. Those descriptions were generalized into 17 lithologies (e.g. sand, sand and gravel, clay and gravel, etc.). Some variability was inherently lost through standardization, but a standardized scheme was developed that optimized data quality and work efficiency.

In addition to lithologic standardization, errors associated with data point locations were addressed. Poor location data results in incorrect land surface elevations of water-well records, which, in turn, results in incorrect depths of lithologic units and their descriptions. Since many of the glacial deposits include thin layers, errors in land surface elevation of less than 5 feet can often make it impossible to correctly correlate some units between adjacent wells. Thus, in McHenry County, the locations of approximately 83% of the ~21,000 available water-well records were verified to the best location available (e.g. street address). The locations of approximately 2,000 engineering borings were also verified. A digital database of both standardized water-well records and verified locations is provided with this contract report.

GEOLOGIC MAPPING WORKFLOW

Key to 3-D geologic mapping is the ability to visualize and interpret the landscape and available subsurface geologic data in 3-D space. For this project, that was achieved using the software packages ArcGIS (esri.com) and Geovisionary (virtalis.com) (Figure 6). These software packages allow for rapid 3-D visualization of a range of data types (e.g., water-well lithologic logs, downhole geophysical logs, 2-D resistivity profiles). Furthermore, these tools allowed for dynamic, real-time analyses in 3-D space of data and interpretations. In McHenry County, using ArcGIS tools, more than 11,000 stratigraphic interpretations were made in the water-well records since the start of the project (2008). Geovisionary was used as a supplemental 3-D visualization tool to ArcGIS. Geovisionary is capable of displaying high resolution datasets (e.g. LiDAR, aerial photography) in full resolution in a 3-D visualization environment along with other subsurface geologic data (e.g. water-well records and geophysical profiles) (Figure 6). These combined 3-D visualization and analyses tools have been key assets

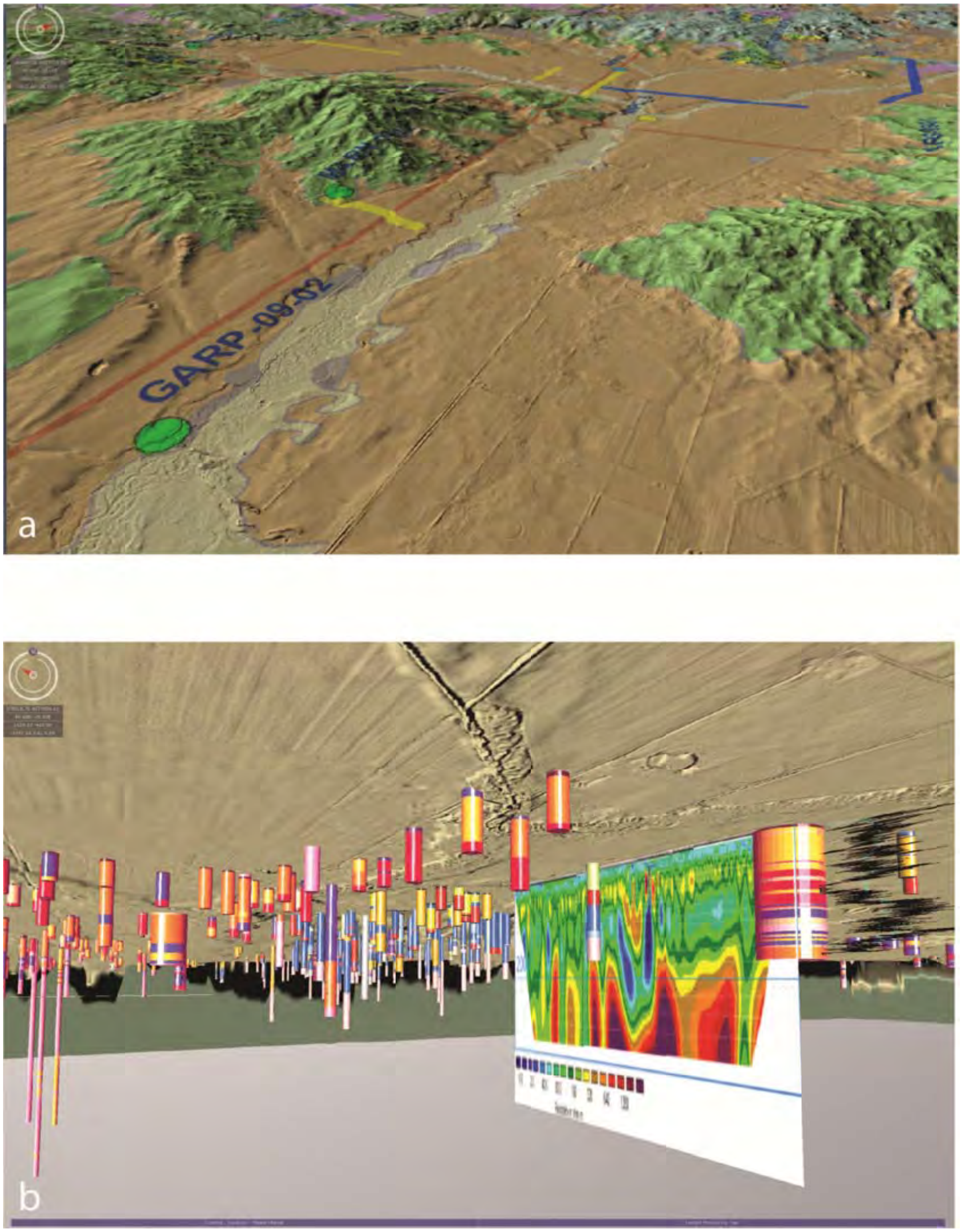


Figure 6. Three-dimensional visualization of (a) land-surface elevation model and (b) subsurface data in Geovisionary. In (a), the geologic map of McHenry County is overlain on the land-surface elevation model. In (b), lithologic descriptions of water-well logs and testholes are color-coded and viewed with 2-D geophysical profile data.

to this study and have contributed towards improving the quality and accuracy of the map products.

A software package called GSI3D was utilized as the final 3-D map-building tool. GSI3D is a 3-D geologic mapping package developed by Insight, GmbH, and the British Geological Survey (Mathers et al., 2011) that constructs 3-D maps from interpreted geological cross sections and allows for versatile representations of the subsurface geology (Figure 7). Borehole interpretations and interpolated surfaces, generated from ArcGIS and Geovisionary, were used in GSI3D and incorporated into cross-section interpretations. The cross section-based approach (Figures 8 and 9) allowed further incorporation of geologic relationships between units.

MAPS

3-D GEOLOGIC MAP

An interactive, digital 3-D geologic map was developed as a primary product of this project. The 3-D map is viewed within the Subsurface Viewer software, a free software package specific to viewing exported and encrypted GSI3D models. Similar to GSI3D, the graphic-user interface in Subsurface Viewer includes map-view, 3-D-view, and section-view windows (Figure 10). It also includes a borehole viewer to show the geology of selected water-well or testhole data, or the interpreted geology at any user-defined location within the 3-D geologic map.

The 3-D geologic map dataset includes: (a) all of the water-well records used in the 3-D mapping efforts, (b) 40 interpreted cross sections used, in part, to build the 3-D geologic map, (c) 3-D block model that shows the extent and relative thickness of each geologic unit, and (d) 2-D maps that include land-surface topography, municipalities and roads, land-surface geology, and fieldwork locations.

The 3-D map of McHenry County is comprised of 22 geologic units associated with the unconsolidated, glacial deposits (Figures 3 and 7). The highest confidence in the 3-D map is near and along the 40 key-cross sections (Figure 8). In general, those key-cross sections are oriented north-south and east-west and located approximately 1 to 2 miles apart across the county. The key-cross sections were interpreted using the highest-quality water-well logs, testhole data and geophysical profile data. Secondary-cross sections (total of 70) were interpreted most often along topographic valley edges and valley bottoms to further delineate the boundaries and geometries of individual units (e.g., uppermost Henry Formation and modern stream deposits). The secondary cross sections were critical to increase the quality and confidence of the 3-D map between key cross sections and to improve the mapped contacts between units near land surface. The secondary cross sections helped, in part, to minimize anomalies in areas with very thin geologic units and areas of high topographic relief, because due to software limitations, land surface topography was generalized to a resolution of 100 meters.

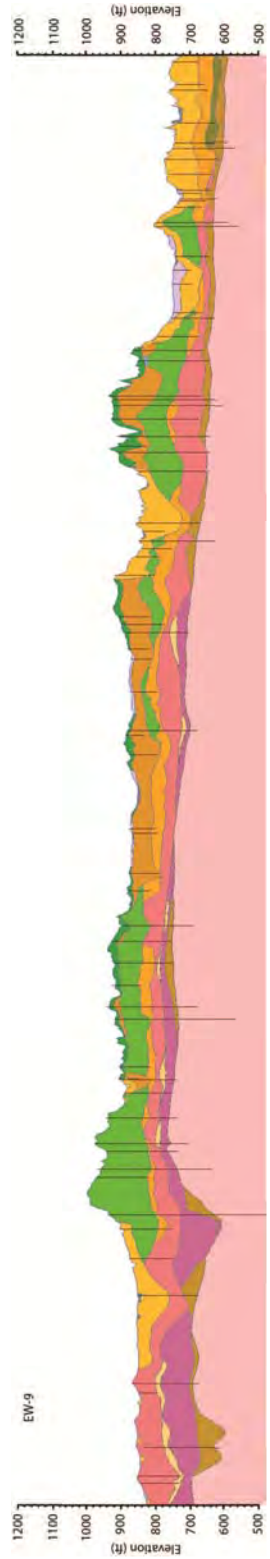


Figure 7. Example of cross section (EW-9 as shown in Figure 8) generated in GSI3D. The 40 key-cross sections are available in Appendix C.

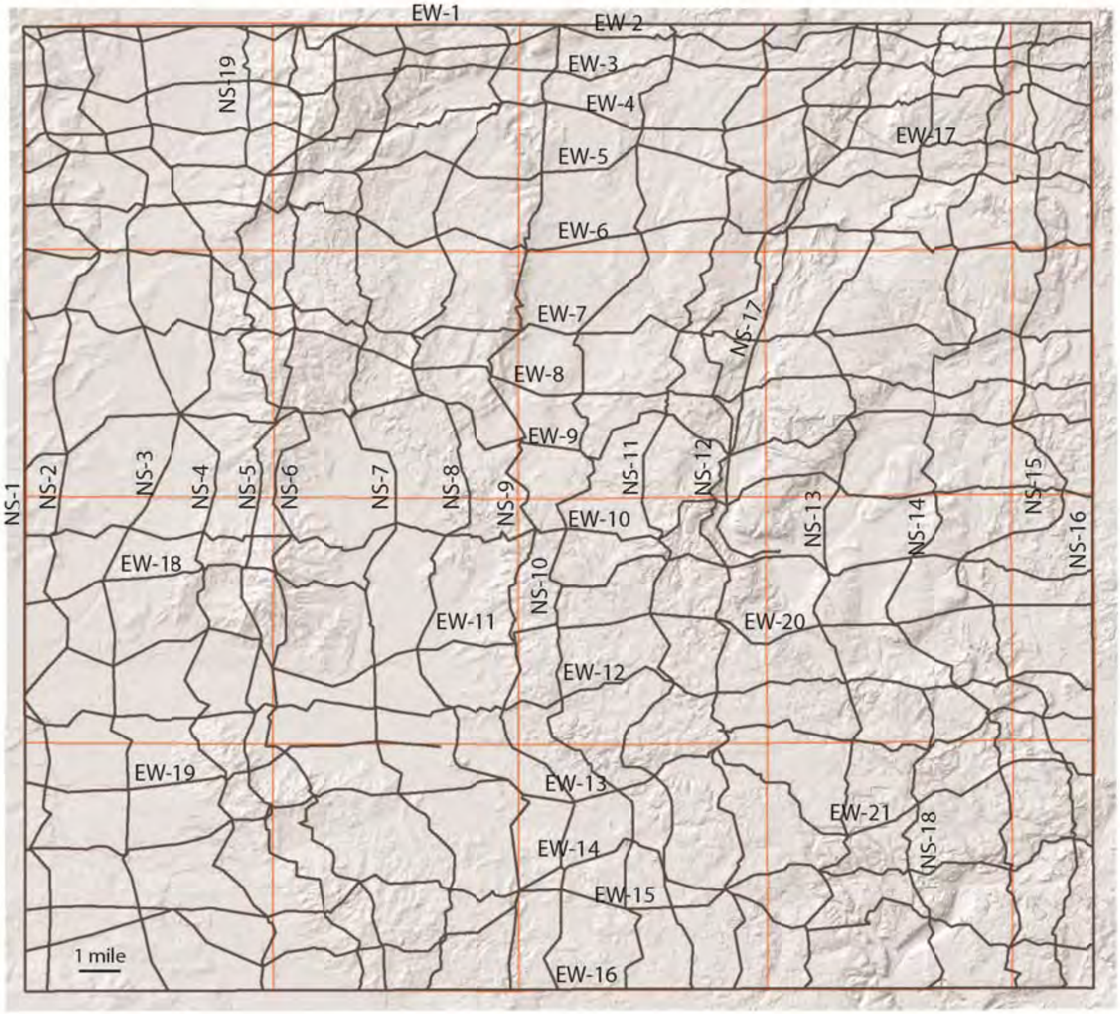


Figure 8. Locations and names of key-cross sections used in GSI3D model of McHenry County. The map base is a shaded relief map with township boundaries are indicated in red.

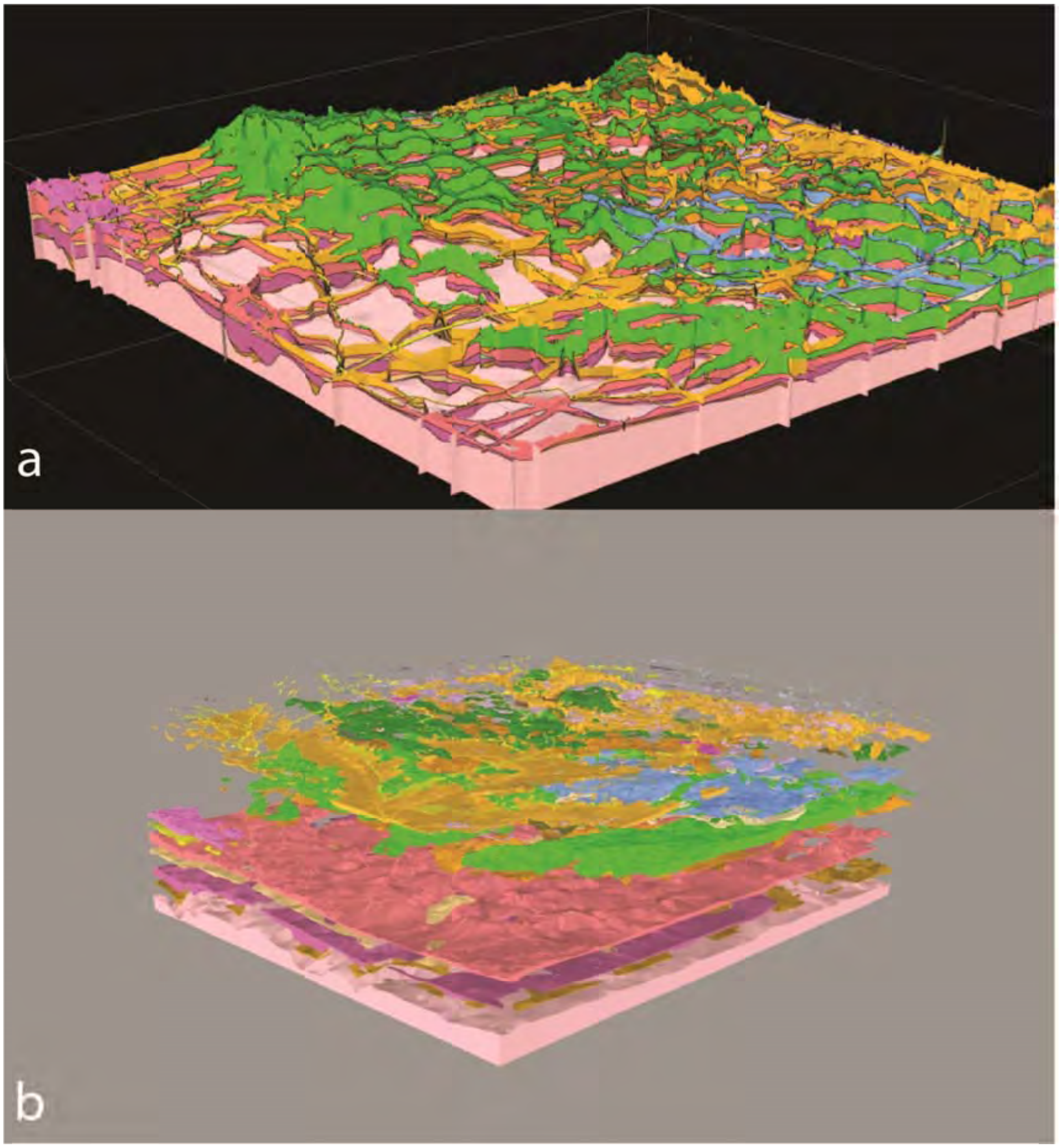


Figure 9. Perspective views (from southwest) of (a) the cross-section network used in GSI3D to build (b) the 3-D geologic map. In (b), the geologic units are separated vertically for easier viewing.

Given these datasets, Subsurface Viewer allows the user to explore the 3-D geologic map in a variety of ways (Figure 10). First, the spatial relationships between field data, topography, infrastructure and geology can be efficiently viewed within the map-view window. Second, geologic units can be visualized in the 3-D window as single or combined units. This allows versatile visualization and manipulation of the 3-D geologic map and associated data in a regional context. Lastly, the software allows the user to view the mapped geology along any arbitrary line of cross section or at any individual location within the 3-D mapping area. The 3-D map is available as a digital product with this report, and the Subsurface Viewer User Manual (Terrington et al., 2009) is available in Appendix D.

2-D DERIVATIVE MAPS

A variety of individual maps were generated for each mapped aquifer. Maps of the extent and thickness of aquifer materials are available in Appendix E. Those maps were generated from data and results extracted directly from the 3-D map. In the map of the Surficial Aquifer, in addition to its extent and thickness, the interpreted geologic setting of the aquifer materials was also mapped and described. This analysis offers more insight into local aquifer variability and hydraulic character.

Maps of aquifer sensitivity to contamination were also generated for each aquifer and for the entire county based on the classification scheme and methodology of Berg (2001). Data for the maps were derived directly from the 3-D map and exported from GSI3D (Appendix E). Aquifer sensitivity to contamination is defined as the relative ease with which a contaminant of any kind released on or near the land surface can migrate to an aquifer (Berg, 2001). Thus, it is a function of the characteristics of geologic materials and is not dependent upon specific land-use or contaminant characteristics (Berg, 2001).

AQUIFER DELINEATION AND CHARACTERIZATION

MAJOR SAND AND GRAVEL AQUIFERS

Surficial Aquifer

The Surficial Aquifer (unit Hen1 in the 3-D map) is mapped collectively across McHenry County as the shallow sand and gravel deposits often exposed at land surface. It consists largely of coarse-grained deposits of the Henry Formation, which are associated with meltwater streams during Wisconsin-Episode glaciations (Figure 3). In the eastern third of McHenry County, the aquifer often includes significant thicknesses (up to 100 feet) of the coarse-grained Beverly Tongue of the Henry Formation as well as a fine-grained portion of the Beverly Tongue. In these areas, particularly in the uplands surrounding the regional river valleys, the Surfical Aquifer is overlain by a thin layer of sandy Haeger diamicton. The extent of the Surficial Aquifer is typically confined within the ancient, broad glacial meltwater valleys, which also host

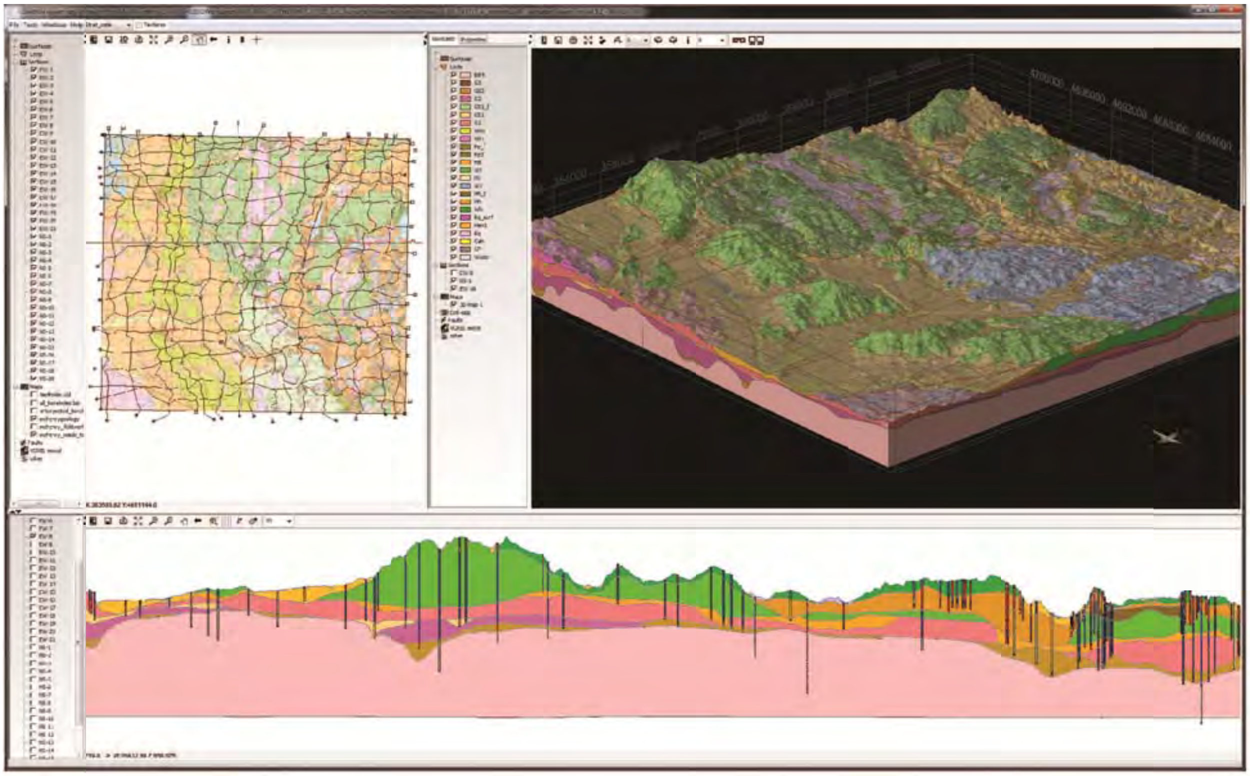


Figure 10. User interface for Subsurface Viewer for 3-D geologic map of McHenry County. Map view (upper left), 3-D view (upper right), and cross section view (bottom).

the modern alluvial valleys of the Kishwaukee River, Nippersink Creek, Boone Creek, and the Fox River (Figure 11). In these areas, the Surficial Aquifer includes recent alluvial deposits of the Cahokia Formation that often consist of interbedded fine gravel, sand, and silt. Furthermore, in these areas, the aquifer likely includes older, pre-Wisconsin Episode outwash sediments. Although the aquifer is mapped collectively across the county as a single unit, its extent is divided by a major surficial watershed boundary (i.e. Kishwaukee River vs. Fox River), which likely has important implications for regional groundwater-flow paths through the aquifer. The thickness of the aquifer varies from less than 5 feet along the edges of alluvial and outwash valleys to greater than 120 feet in the valley bottoms (e.g. Kishwaukee River Valley, Fox River Valley, and the area of Wonder Lake) (Figure 11).

The geologic context of the Surficial Aquifer deposits can help explain the textural variability of the deposits (Anderson and Block, 1962; Cobb and Fraser, 1981), which has important implications for aquifer character (Curry et al., 1997). Because the Surficial Aquifer is usually exposed at land surface, the most optimal and abundant data sources (soils texture data, land surface models, exposures) were used to interpret the geologic context. The distribution of textural variability is most strongly a function of proximity to former ice margins, which control meltwater energy and thus texture of deposited sediment. Locations closer to the ice margin have higher fluvial energy than positions farther from the ice margin, and therefore result in deposition of coarser material relative to these more distant locations. For example, in west-central McHenry County, southeast of the Brookdale Conservation Area, a large glacial meltwater outwash fan (Figure 12) developed in front of a former ice margin. The texture of the fan deposit changes gradually from very coarse gravel along the former ice margin (which is located along Rt 14) to medium sand located about 5 miles south (along Garden Valley Road). In McHenry County, these common relationships are reflected directly in the soil characteristics and offer important insights into the variability of this aquifer unit. The map of the Surficial Aquifer in Appendix E shows the extents of variable depositional environments, which correspond to regional textural variability at or near land surface. However, there is certainly textural variability below land surface that is not reflected in soils or landforms.

Subsurface data, such as from testholes, geophysical data, and water-well records, have allowed for a better understanding of both local and regional subsurface textural variability in the Surficial Aquifer. Examples include the occurrence of lenses of fine-grained materials within thick, coarser-grained deposits or gradational textural changes within outwash sediments (e.g. testholes with borehole names GARP-09-02 and HUNT-08-01, respectively, Appendix A). Regionally, in the Kishwaukee River Valley, the upper part (~60%) of the aquifer sediments is consistently fine-medium sand that is underlain by coarser sediments (fine-medium gravel). This relationship is consistent throughout the water-well and testhole datasets (e.g. GARP-09-02 and Seneca, Appendix A). In areas of Wonder Lake, our drilling has supported previous interpretations that coarse-grained sediments, that include the Surficial Aquifer, are often present continuously from land surface to bedrock (e.g. MHEN-08-01, Appendix A). Furthermore, this

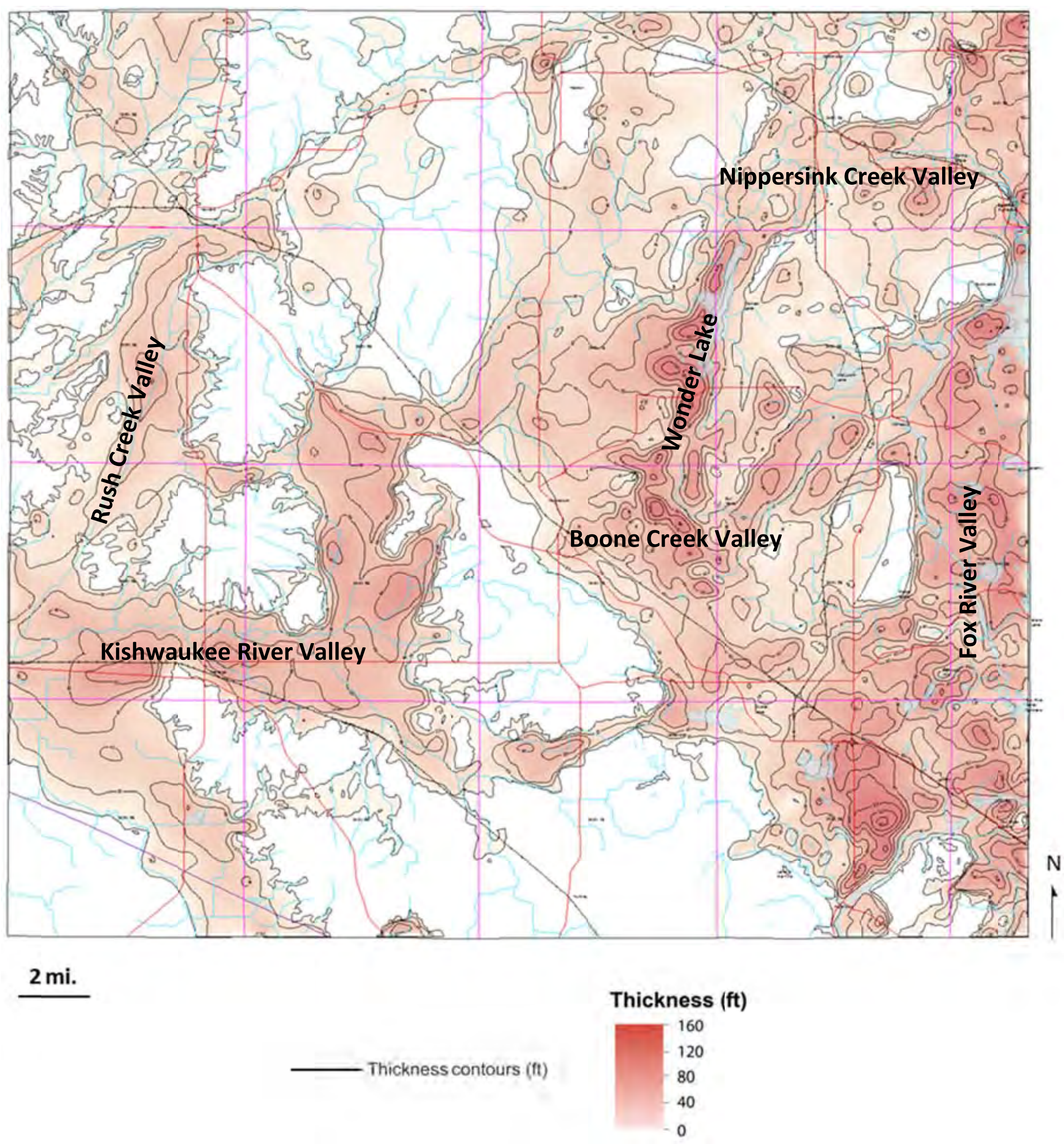
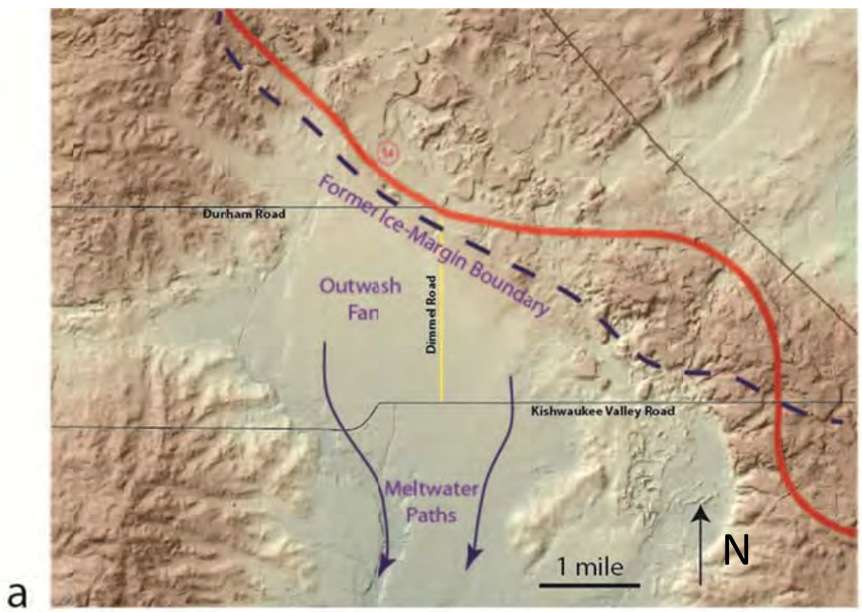


Figure 11. Distribution and thickness of the Surficial Aquifer. 1:62,500 scale map is available in Appendix E.



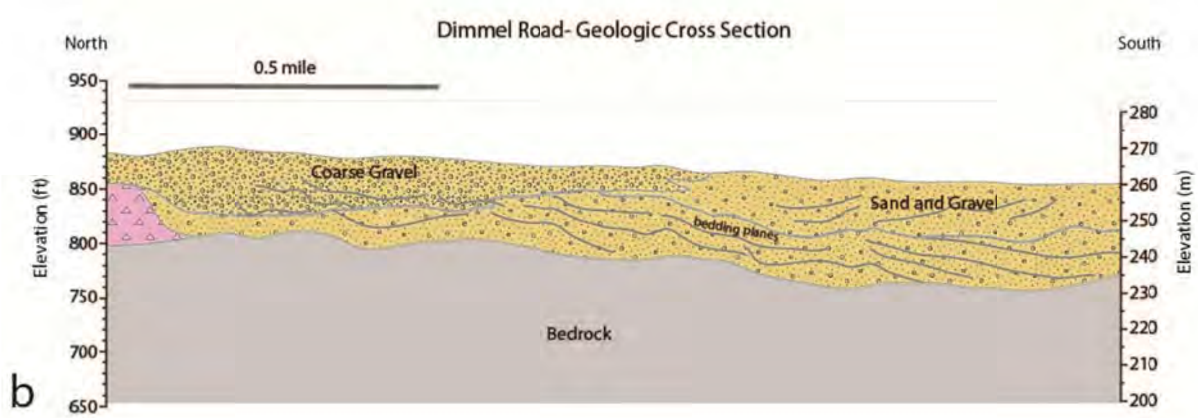


Figure 12. (a) Shaded relief map of west-central McHenry County showing locations of outwash fan deposits and geophysical profile at Dimmel Road. (b) Geologic cross section along Dimmel Road interpreted from 2-D geophysical data. Sediment texture becomes finer from north to south, corresponding to the respective increase in distance from the former ice margin.

study has helped delineate regional trends of textural variability of the aquifer in the Fox River Valley (e.g. WAUC-08-13, Appendix A; Figure B19, Appendix B).

The Surficial Aquifer is commonly utilized for domestic, municipal, and agricultural water supplies throughout the county. In the area of the Kishwaukee River Valley, the Surficial Aquifer is the major water source for not only domestic supplies, but agricultural supplies as well. Within the Kishwaukee River and its tributaries (e.g. Rush Creek and Coon Creek), shallow agricultural wells often seasonally draw large amounts of water (on the order of thousands of gallons per minute) from this aquifer. Furthermore, the City of Marengo extracts over half of its water supply from shallow wells in the Surficial Aquifer (IEPA, 2008). Similarly, within the Fox River Valley, the Surficial Aquifer is a primary domestic water supply, and other municipalities or water companies (e.g. City of McHenry) utilize the aquifer to varying extents (IEPA, 2008).

Pearl-Ashmore Aquifer

The Pearl-Ashmore Aquifer (unit Ha in the 3-D map) is largely composed of coarse-grained outwash deposits associated with the retreat of Illinois-Episode glaciation (Pearl Formation) and the advance of early Wisconsin-Episode glaciation (Ashmore Tongue, Henry Formation) (Figure 3) in McHenry County. The Pearl Formation sediments are largely meltwater-stream sediments deposited in front of the retreating ice margin of the Illinois-Episode glaciation. These sediments are often composed of coarse sand and/or gravel, but may certainly contain significant fractions of fine-medium sand (e.g Hartland, Appendix A). These sediments are often overlain by outwash deposits associated with the Ashmore Tongue of the Henry Formation (Figure 3). Similar to the Pearl Formation, the Ashmore Tongue deposits most often vary from coarse sand and gravel to fine-medium sand (e.g. HUNT-09-03, Appendix A). In many areas throughout the county, non-glacial organic sediments of the Robein Member (Roxana Silt) are found between the Pearl Formation and Ashmore Tongue (e.g. Coral, Appendix A). This organic silt marks the former land surface prior to the advance of the Wisconsin Episode glaciers and is a key stratigraphic unit for geologic correlations. Throughout the county, the Pearl-Ashmore Aquifer may be composed of exclusively Ashmore Tongue (Nunda and HARV-09-01, Appendix A), exclusively Pearl Formation (Hartland, Appendix A), or most commonly a combination of both (Coral and McHenry, Appendix A). Where the Robein Member is absent, the distinction between the Pearl Formation and Ashmore Member is often ambiguous. The Pearl-Ashmore Aquifer is generally present in the eastern ¾ of McHenry County, but it is often thin and discontinuous in the western, north-central, and southeastern parts of the county (Figure 13). Where present, the aquifer is generally less than 40 feet thick, but may be greater than 100 feet thick in local areas throughout the county. The aquifer is often overlain by the fine-grained diamicton of the Tiskilwa Formation.

This project has helped provide new insights into not only the distribution of the Pearl-Ashmore Aquifer, but the character of aquifer sediments as well. Reconstructions of the landscape prior to the Wisconsin-Episode glaciation suggest that the thickest parts of the aquifer

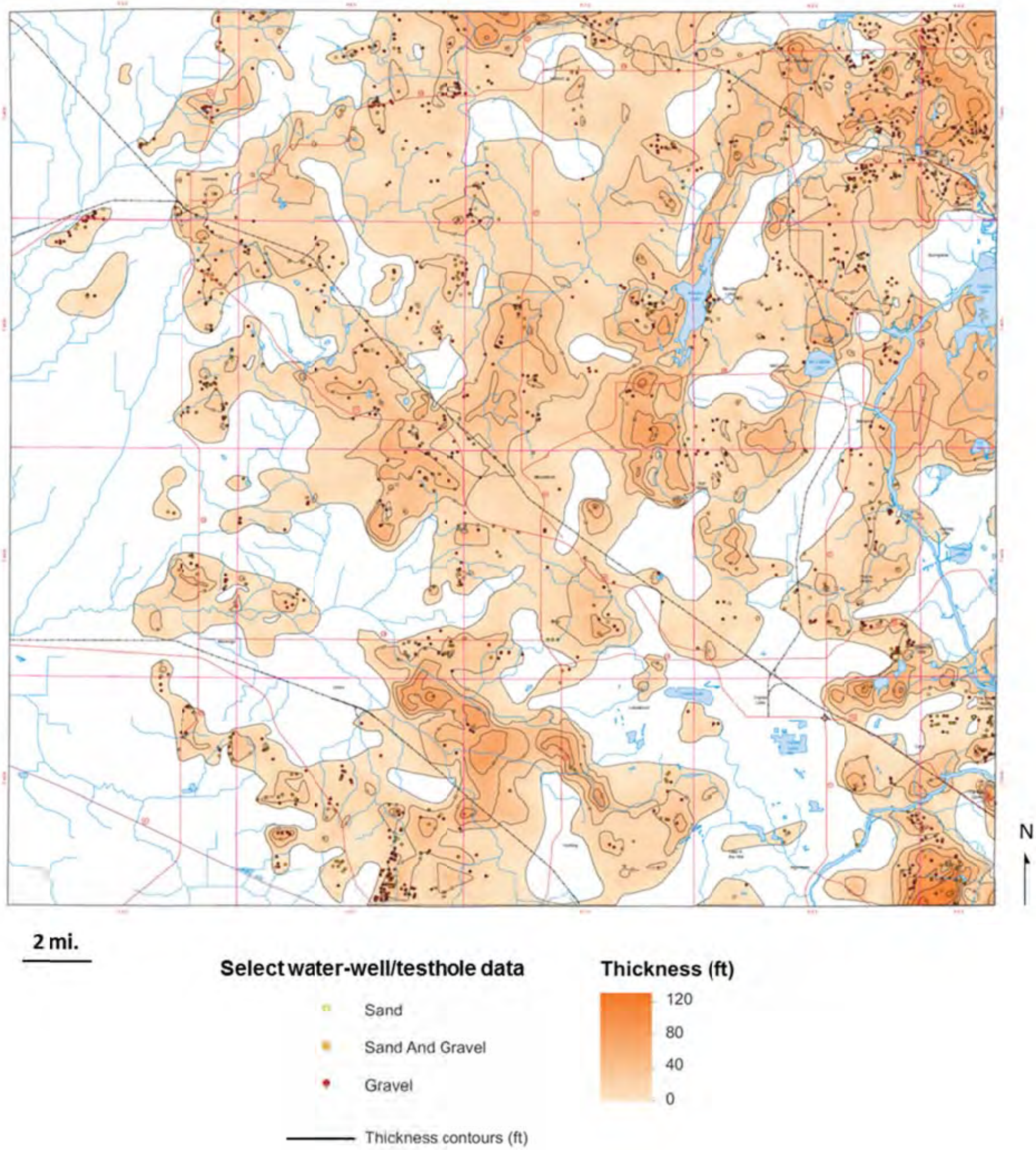


Figure 13. Distribution and thickness of the Pearl-Ashmore Aquifer. 1:62,500 scale map is available in Appendix E.

(central and south-central McHenry County, Figure 13) may be associated with rapid accumulation of coarse-grained outwash between former ice margins and uplands of the former landscape. Those sediments may include gradational textural changes associated with former ice-margin positions, but that interpretation is speculative without further study. Furthermore, in the central, north central, and eastern parts of the county, significant thicknesses of finer-grained sorted sediments (fine, silty sand or silt) are interbedded with aquifer materials or underlie them (e.g. HEBR-08-01 and Richmond, Appendix A). These sediments may certainly contribute to local variability of groundwater flow through the aquifer.

The Pearl-Ashmore Aquifer is heavily utilized throughout the county as a domestic and municipal water supply. The City of Woodstock, which is completely dependent on sand and gravel aquifer resources, relies partly on this aquifer for its demanding water supply needs (total of approximately 2.31 mgd: IEPA, 2008). Other cities such as Algonquin, Cary, and Hebron are also partially dependent on this aquifer for water supply (IEPA, 2008). Futhermore, thousands of domestic water supply wells withdraw from this aquifer throughout the county. The results of this study indicate that some areas of the Pearl-Ashmore Aquifer may be important as a water supply for future use. Some of the thickest and coarsest fractions of the aquifer are located southeast of the City of Harvard (e.g. HARV-09-01, Appendix A), adjacent to the northern perimeter of the City of Woodstock, and in south-central McHenry County northwest of the City of Huntley (e.g. HUNT-09-03, Appendix A). These areas of the aquifer currently contribute to some domestic supplies and are largely unutilized by municipalities.

Basal Aquifer

The Basal Aquifer (unit GS2 in the 3-D map) is composed largely of sand and gravel deposits located at the bottom of the glacial sediment succession, and it is often in contact with shallow Silurian-Ordovician bedrock units. Thus, both sand and gravel and bedrock may certainly be hydraulically connected and act as a single aquifer unit. The sand and gravel portion of aquifer materials are likely associated with glacial meltwater streams that infilled lowlands and bedrock valleys during the earliest glacial events in McHenry County. Regionally, these deposits are often spatially discontinuous and usually deeply buried. However, in the western part of McHenry County, the Basal Aquifer is consistently present in deep bedrock valleys, which were the major drainage ways for glacial meltwater at that time (Figure 14). The Basal Aquifer is generally less than 40 feet thick, but in some areas within the bedrock valley bottoms, the aquifer can be greater than 100 feet thick. In many areas, it is often overlain by dense, fine-grained diamicton of the Glasford Formation. New field data and mapping suggest that in certain areas within bedrock valleys, the aquifer sediments may be extremely coarse (coarse gravel to cobble gravel) and relatively thick (as much as 40 feet thick) (e.g. GARP-09-02, Appendix A and Figure B29). In other areas within bedrock valley bottoms (e.g. northwest corner of McHenry County), the aquifer may be very thick (greater than 100 feet), but in other areas in the northwest part of the county, it may be generally fine-grained (e.g., silty sand).

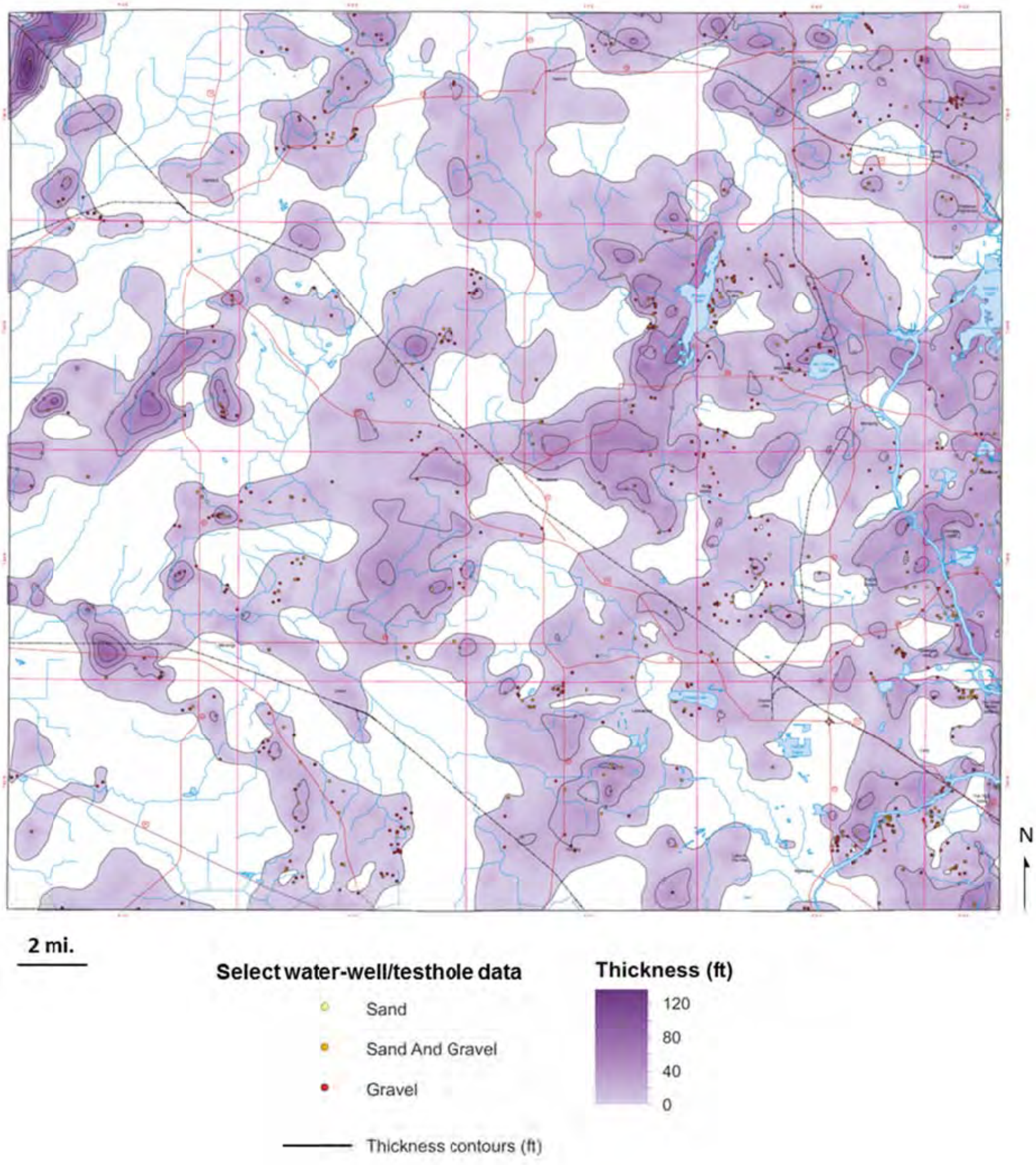


Figure 14. Distribution and thickness of the Basal Aquifer. 1:62,500 scale map is available in Appendix E.

The Basal Aquifer is utilized commonly as a domestic and municipal water supply throughout the county. For example, the cities of Algonquin, Cary, Crystal Lake, Marengo, McHenry, and Woodstock utilize this aquifer for a significant source of their water supplies (IEPA, 2008). Thousands of domestic wells throughout the county also extract from this aquifer for their water supply needs. The results of this study suggest that parts of the Basal Aquifer in the western third of McHenry County may be important for its future development as a water supply. The increased thickness and coarseness of the aquifer in these areas (e.g., areas of the Kishwaukee River Valley and Rush Creek Valley) may play important roles in regional water planning and protection.

MINOR SAND AND GRAVEL AQUIFERS

Yorkville Aquifer

The Yorkville Aquifer (unit Hy in the 3-D map) is composed largely of outwash sand and gravel and is typically shallower than the Pearl-Ashmore Aquifer. The aquifer sediments are associated with a Wisconsin Episode glacial event that advanced partly into McHenry County after the advance that deposited the Pearl-Ashmore Aquifer sediments (Figure 3). This aquifer is relatively thin (usually less than 20 feet thick) and spatially discontinuous, and it is almost always overlain by the fine-grained Yorkville diamicton. The aquifer is primarily located in the south-central part of McHenry County, but the results of this study suggest that the extent of the aquifer (Figure 15) is larger than previously mapped (Curry et al., 1997). It likely cannot support municipal use of its water, but it is used exclusively as an important domestic water supply in that part of the county (see testhole HUNT-08-02, Appendix A; Appendix E).

Glasford Aquifer

The Glasford Aquifer (unit GS1 in the 3-D map) is located largely in the western part of McHenry County (Figure 16) and is mostly composed of outwash sand and gravel deposits associated with the Illinois-Episode glaciation (Oregon Member) (Willman and Frye, 1970). Similar to the Basal Aquifer, the extent of the Glasford Aquifer is typically confined to the buried bedrock valleys in the western part of McHenry County. Our mapping has improved the understanding of the aquifer extent, and our field data have allowed for better insight into aquifer character. The results of this study suggest that the extent of the Glasford Aquifer is broader and more continuous than previously mapped (Curry et al., 1997). Furthermore, in some areas (see testhole Seneca, Appendix A) there is a fine-grained silty component to the aquifer, which may be present more extensively throughout the deposit. The textural variability of the aquifer also may be locally variable within the scale a few miles (e.g. Figure B9, Appendix B). In most areas, the aquifer is overlain by fine-grained diamicton sediments of the Illinois Episode, but where the overlying sediments are thin, the aquifer is often in close spatial proximity to the Pearl-Ashmore Aquifer. Thus, in this study, these aquifer units were sometimes indistinguishable as separate mappable units. In that case, the coarse-grained sediments were

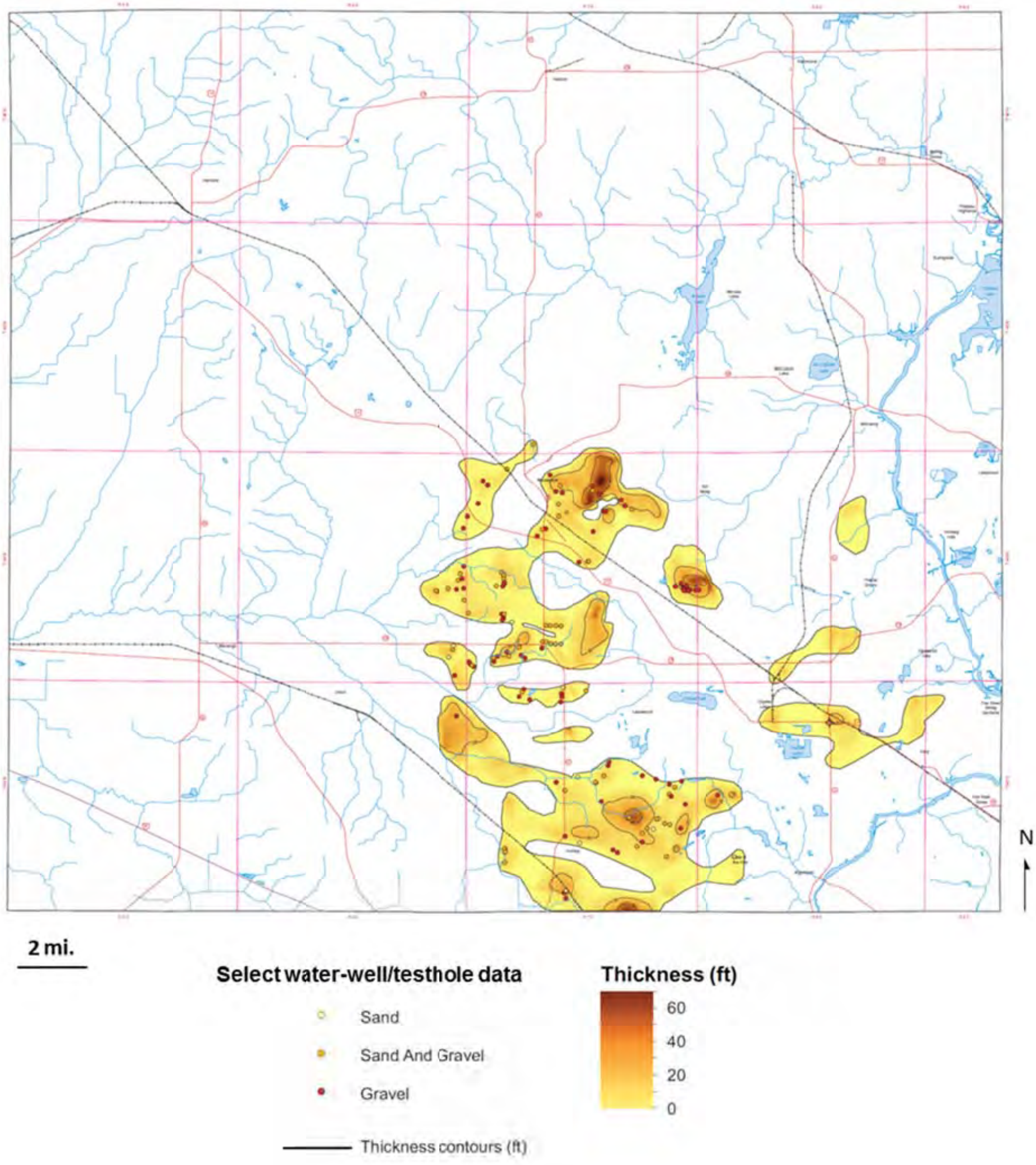


Figure 15. Distribution and thickness of the Yorkville Aquifer. 1:62,500 scale map is available in Appendix E.

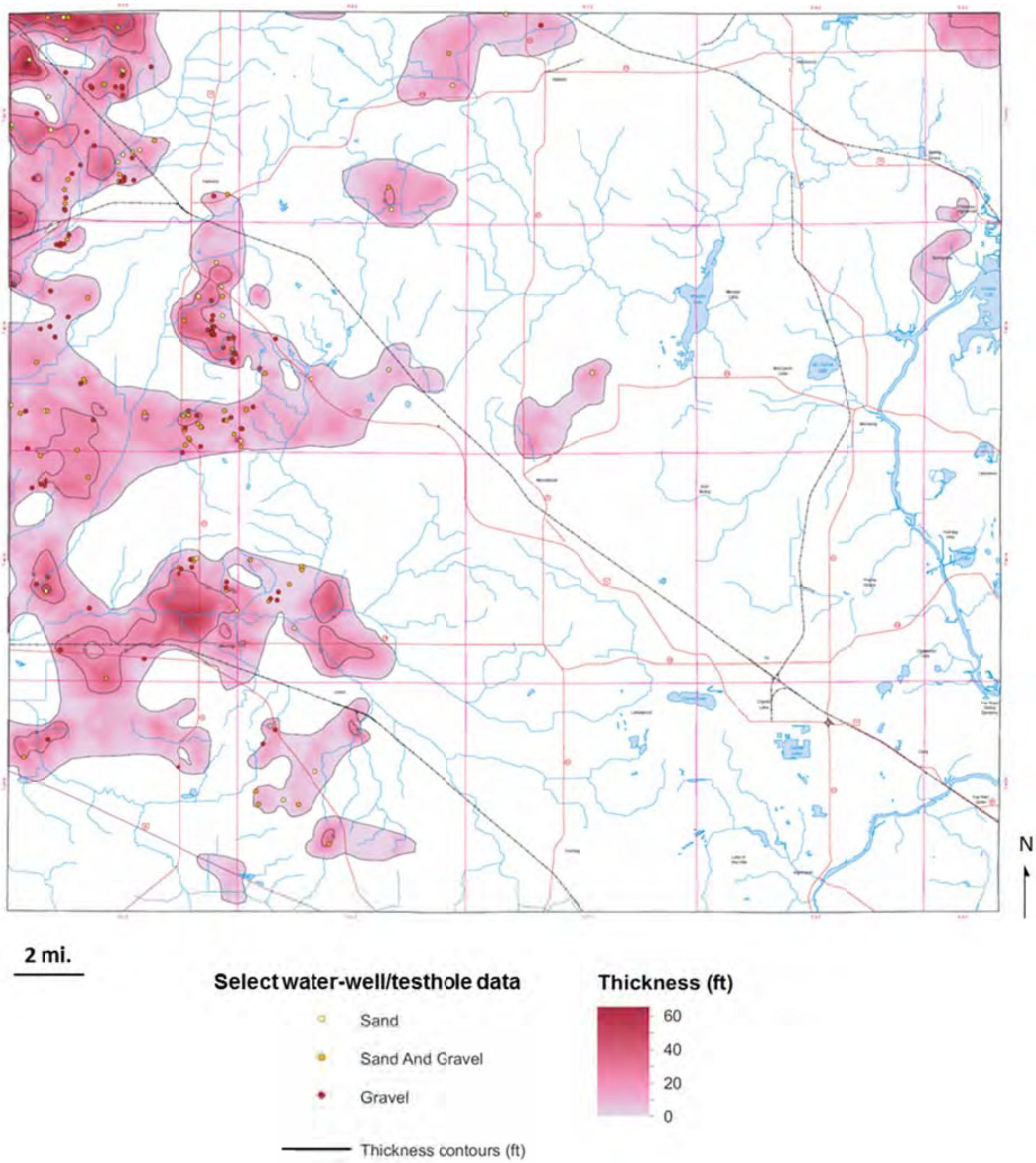


Figure 16. Distribution and thickness of the Glasford Aquifer. 1:62,500 scale map is available in Appendix E.

most often mapped as Pearl-Ashmore Aquifer. The Glasford Aquifer is utilized largely as a domestic water supply, but it has not typically been developed independently as a municipal supply. Similar to the Basal Aquifer, the results of our study suggest that areas of the Glasford Aquifer in the Kishwaukee River Valley and Rush Creek Valley may be important for long-term water-supply management.

NON-AQUIFERS

In addition to coarse-grained aquifer sediments, important components of glacial aquifer systems are the finer-grained, non-aquifer deposits. In McHenry County, non-aquifer sediments act as aquitards in the regional groundwater flow system, and they act as confining units to local sand and gravel aquifers. These deposits most often include diamictons (mix of unsorted clay and silt with pebbles) that record major glacial advances, and these deposits often separate the sand and gravel deposits of various aquifers. Other non-aquifer sediments include ancient lake sediments composed of sorted silty-fine sand, silt, or clay. Typically in McHenry County, the distribution of lake sediments, especially in the subsurface, is discontinuous, variable, and poorly understood. Lastly, fine-grained bedrock such as shale or unfractured limestone are important non-aquifer deposits. This section discusses the distribution and character of key diamicton deposits in McHenry County.

CONFINING UNITS

Haeger Semi-Confining Unit

The Haeger semi-confining unit (unit Wh in the 3-D map) is largely composed of the youngest glacially-derived diamicton deposit in McHenry County, and it most often occurs at land surface in the northeastern half of the county (Figure 17). The sediments of the Haeger confining unit are associated with the Woodstock Phase of glaciation during the Wisconsin Episode (Curry et al., 1997). This unit often occurs as a sandy loam with discontinuous lenses of sand and gravel or silty sand, and when it is especially coarse-grained, it may resemble outwash sand and gravel. In areas near modern streams and rivers, it is sometimes buried by thin deposits of the Cahokia, Equality, or Henry Formations. The deposit generally ranges in thickness between a few feet to tens of feet and most commonly occurs in the topographic uplands around modern stream valleys. In those areas, the Haeger diamicton consistently overlies Beverly Member outwash, which is a major component of the Surficial Aquifer. Thus, in these areas, if the diamicton texture is relatively fine-grained, the Haeger diamicton may act as a thin, leaky confining unit to the Surficial Aquifer. In some areas where the diamicton may be particularly coarse grained and partially saturated (e.g. north-central McHenry County), it may potentially contribute as a component of the Surficial Aquifer.

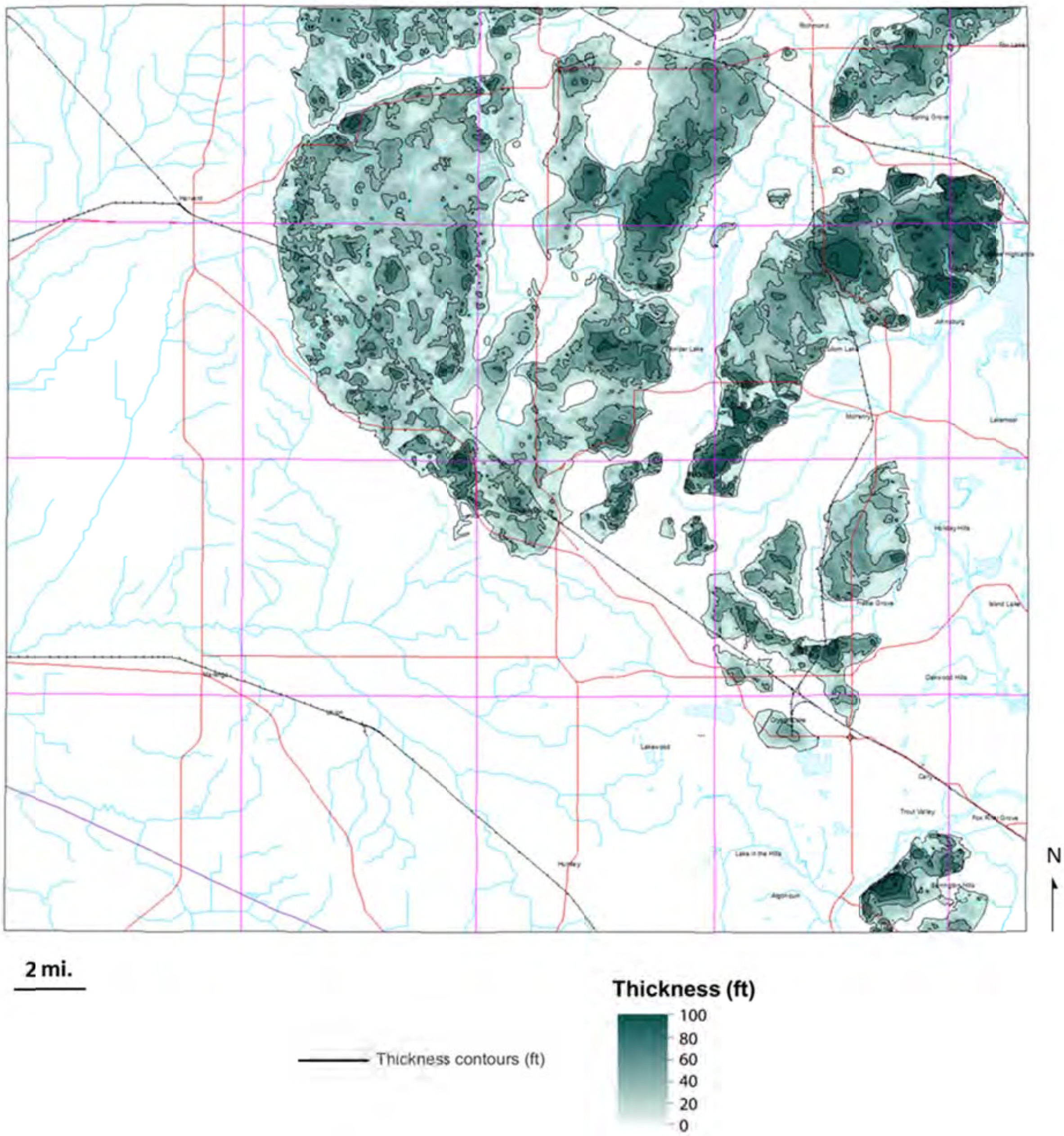


Figure 17. Distribution and thickness of the Haeger semi-confining unit.

Yorkville Confining Unit

The Yorkville confining unit (unit Wy in the 3-D map) is composed largely of a silty-clay loam diamicton that occurs in the south-central and southeast parts of McHenry County (Figure 18). It occurs at land surface in south-central McHenry County as part of the Barlina Moraine, which is associated with the Livingston Phase of the Wisconsin-Episode glaciation (Curry et al., 1997). When it occurs at land surface, the Yorkville confining unit often includes thin, surficial alluvial deposits or fine-grained ice-walled lake sediments (Curry and Petras, 2011) that overly the thicker diamicton. The diamicton is fine-grained and clay-rich, which may reflect the incorporation of local lake sediments as the glacier overrode them. The unit is buried further east by Woodstock Phase sediments such as the Beverly Tongue of the Henry Formation and the Haeger diamicton. The Yorkville confining unit is generally 20 to 50 feet thick and may locally reach up to 100 feet thick. Although spatially discontinuous, especially in the subsurface, it generally overlies the sand and gravel sediments of the Yorkville Aquifer and acts as the primary confining unit to that aquifer.

Tiskilwa Confining Unit

An extensive and primary aquitard in McHenry County is the Tiskilwa confining unit (unit Wt in the 3-D map), which is composed primarily of a dense, silty-clay loam diamicton, but it may also contain thin lenses of sand and gravel or some thin beds of lake sediments. The deposits of this unit are associated with the Marengo Phase of the Wisconsin-Episode glaciation, which formed the prominent Marengo Moraine in western McHenry County (Curry et al., 1997). This confining unit is commonly present at land surface in the western third of the county along the Marengo Moraine, but it is most often buried in the eastern half of the county. When present, it ranges in thickness from generally 20 feet to over 250 feet (Figure 19). The unit is often thin and discontinuous in modern alluvial valleys such as the Kishwaukee, Boone Creek, and Fox River Valleys, which is likely a result of non-deposition or erosion of the diamicton along the major meltwater drainageways either during or after the Marengo Phase of glaciation. This unit is the primary confining unit to the Pearl-Ashmore Aquifer throughout most of the county.

Glasford Confining Unit

Similar to the Tiskilwa confining unit, the Glasford confining unit (unit G1 in the 3-D map) is composed primarily of dense silty-clay loam diamicton, but it may also contain significant thicknesses of ancient lake sediments or thin lenses of sand or gravel. This unit is associated with the Illinois-Episode, and it is probably composed largely of the Oregon Member of the Glasford Formation (Curry et al., 1997). However, differentiating the diamicton members of the Glasford Formation was beyond the scope of this study. This unit is the most continuous and extensive confining unit in the county, although it is locally thin and discontinuous in the Fox River Valley. The unit is generally 30-60 feet thick, but locally, it may be up to 150 feet thick (Figure 20). It is the primary confining unit for the Glasford Aquifer in the western part of the county, but it is also likely a primary confining unit to the Basal Aquifer in the eastern half of

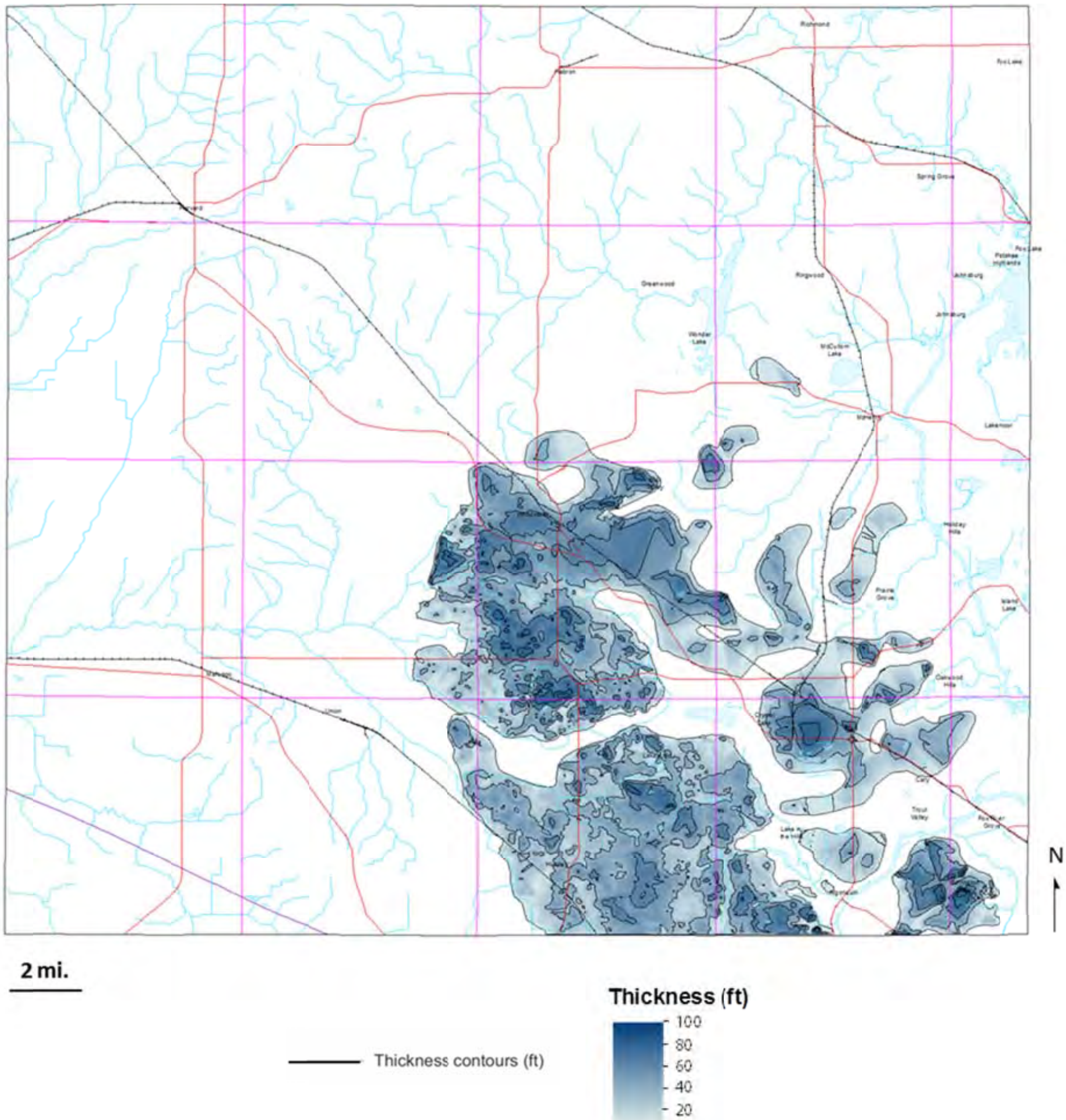


Figure 18. Distribution and thickness of the Yorkville confining unit.

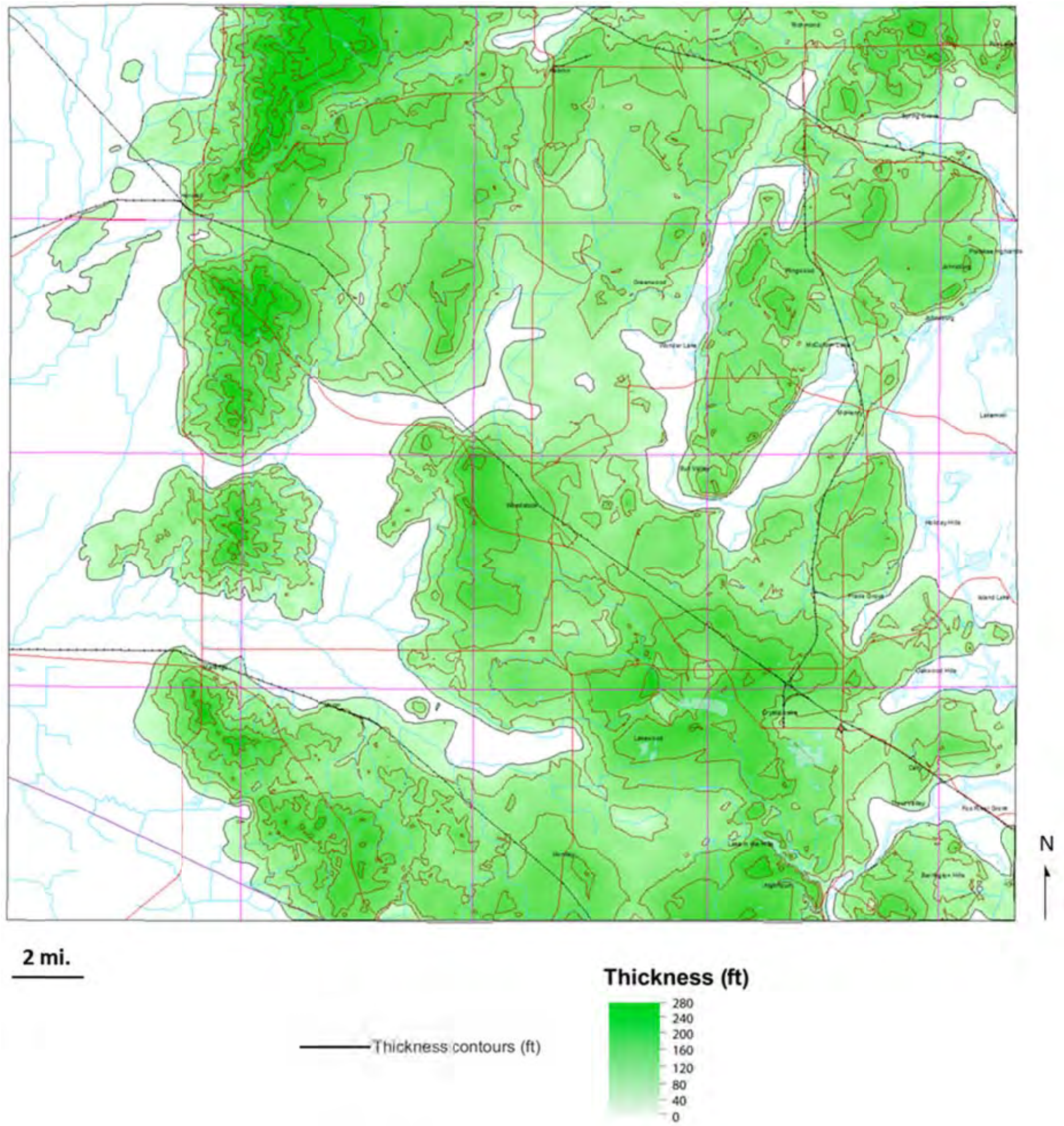


Figure 19. Distribution and thickness of the Tiskilwa confining unit.

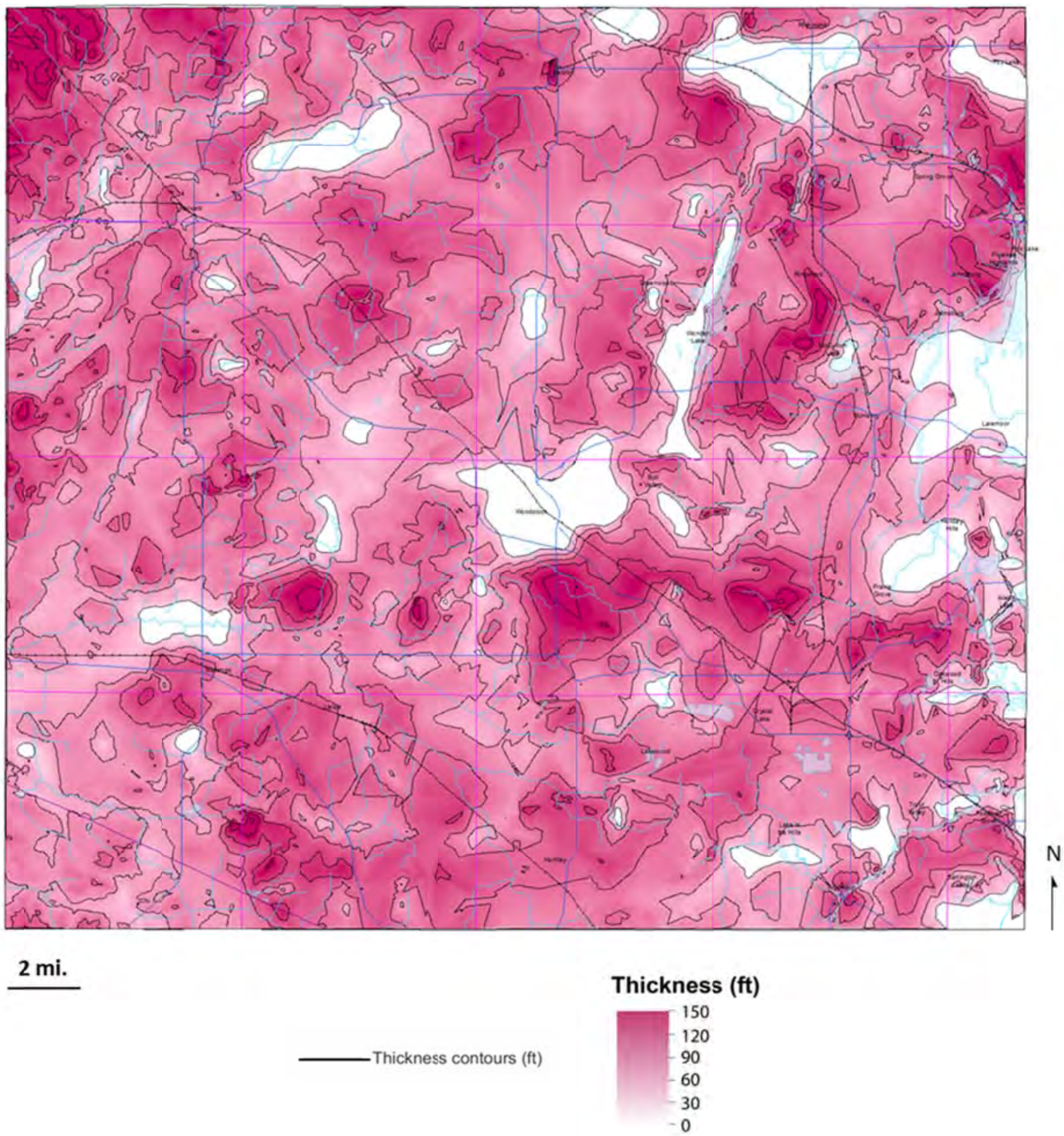


Figure 20. Distribution and thickness of the Glasford confining unit.

the county. Stratigraphically, the Glasford confining unit underlies the Pearl-Ashmore Aquifer and is a lower-bounding confining unit to that aquifer.

Basal Confining Unit

The Basal confining unit (unit G2 in the 3-D map) is also composed primarily of dense, silty-clay diamicton, but it may include gravelly lenses or zones of fine-grained lake sediments. This unit is derived from Illinois-Episode glacial sediments, similar to, but older than, the Glasford confining unit sediments. Thus, they likely include diamictons older than the Oregon Member of the Glasford Formation (Curry et al., 1997). The Basal confining unit is largely confined to the western half of McHenry County, and its distribution is largely controlled by the occurrence of the overlying Glasford Aquifer (Figure 21). Where the Glasford Aquifer is absent, the differentiation between the Glasford confining unit and Basal confining unit is vague. Thus, usually in those areas, fine-grained deposits (such as diamictons) were mapped collectively as the Glasford confining unit. The Basal confining unit is typically 30-60 feet thick, but it may be as great as 180 feet thick in some parts of the deep bedrock valleys in the western part of the County.

INTERCONNECTIVITY OF AQUIFERS

The complex glacial history of McHenry County is reflected in the variable extents and occurrences of the multiple sand and gravel aquifers throughout the county. A key component of that complexity is the interconnectivity of the various aquifers. In other words, in some areas of McHenry County, individual aquifers may be in contact with one another, thus complicating groundwater flow paths between and amongst them. These spatial relationships become especially important when groundwater withdrawal and pumping scenarios are introduced. They also are important when considering contamination flowpaths from the surface and into and through the subsurface and therefore the potential for contamination to aquifers.

The most likely occurrences of interconnected aquifers in McHenry County are within the Kishwaukee River, Boone Creek, and Fox River Valleys. In particular, the Kishwaukee River Valley and the Fox River Valley are likely the locations of major re-occupied meltwater-drainage ways for multiple glacial events in the Quaternary Period. In these valleys, outwash deposits of multiple glacial events are likely in contact with one another, and continuous confining units, such as diamictons, are absent. Therefore, the sediments within these valleys may act collectively as a single aquifer that is connected hydraulically to confined or semi-confined aquifers outside of the valleys (Figure 22).

Another area of aquifer interconnectivity occurs at the base of the glacial succession of sediments. The Basal Aquifer is, by definition, in contact with the bedrock surface. The shallow bedrock in McHenry County is often fractured, porous, and thus commonly utilized as a productive bedrock aquifer. Because the sediments of the Basal Aquifer are in contact with the

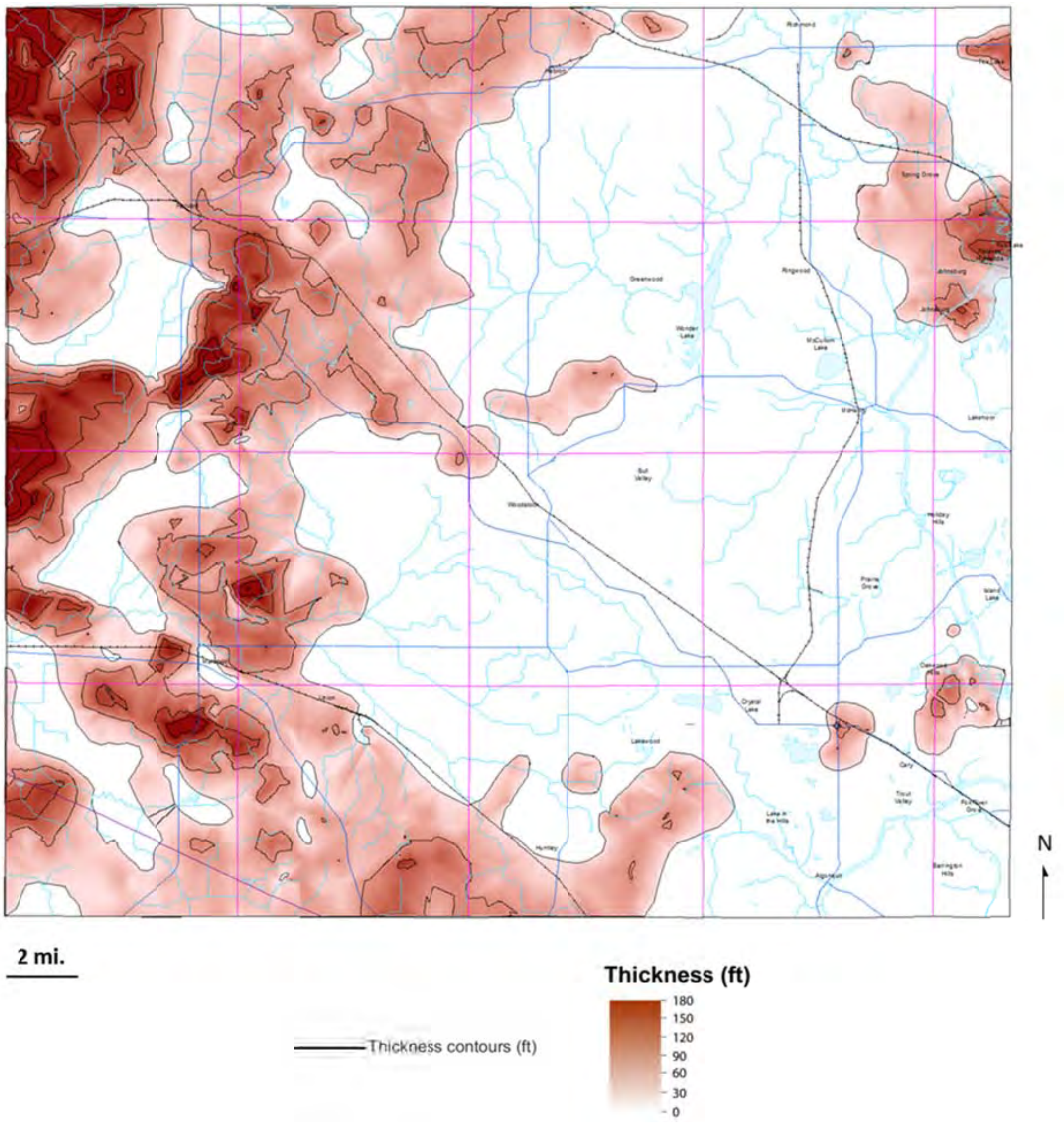


Figure 21. Distribution and thickness of the Basal confining unit.

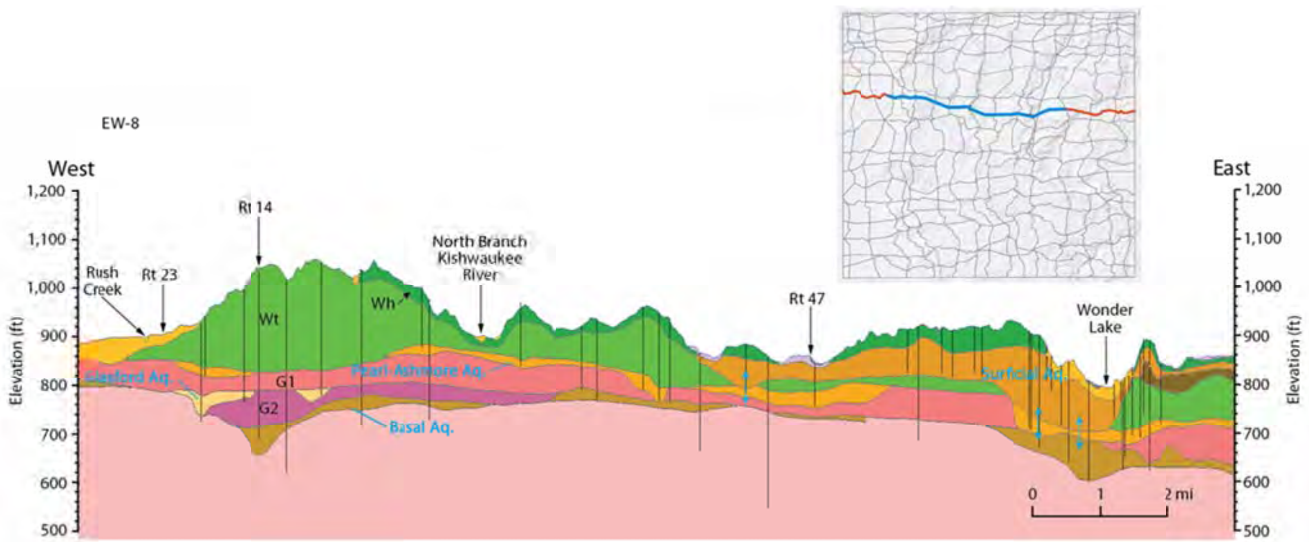


Figure 22. Excerpt of cross-section EW-8 showing interconnected aquifers (indicated by blue arrows) near the areas of Wonder Lake and Rt. 47. The location of this cross section is indicated in blue on the inset map of the county.

shallow bedrock aquifer, the two systems may often act as a single aquifer system. Furthermore, in areas such as the Boone Creek Valley (e.g. MHEN-08-01, Appendix A) and the Fox River Valley, aquifer materials may be present continuously from land surface to bedrock. Thus, all of the local sand and gravel aquifers may potentially be hydraulically connected to the shallow bedrock aquifer.

Other areas of aquifer interconnectivity are discontinuous and variable. In north-central McHenry County, particularly north of the City of Woodstock, the Tiskilwa and Yorkville confining units are thin and discontinuous (e.g., HEBR-08-02, Appendix A; Figures B15 and B22, Appendix B). Thus, multiple aquifer units are often interconnected, may be collectively present from land surface to bedrock, and thus collectively act and contribute as a single aquifer (Berg, 1994). Furthermore, in parts of west-central McHenry County, where the Glasford confining unit is thin or discontinuous, the Pearl-Ashmore Aquifer is often in close spatial proximity with the Glasford Aquifer. Thus, it may be quite feasible that these aquifers are locally interconnected. Thus, interconnectivity of these aquifers may occur anywhere that a major confining unit is either discontinuous or absent.

AQUIFER CONTAMINATION POTENTIAL

Many previous studies have developed methodologies and maps to identify areas of relative potential for shallow groundwater contamination (Kempton, 1981; Kempton and Cartwright, 1984; Berg, et al., 1984; Berg and Kempton, 1984). These studies have developed systematic evaluations that incorporate mappable variables such as ranges of aquifer thickness, ranges of aquifer depths, generalized 2-D maps that describe subsurface stratigraphy (i.e., stack-unit maps), aquifer-occurrence probability, and soils data. Before this 3-D mapping study, the potential for shallow aquifer contamination (also called aquifer sensitivity) in McHenry County was evaluated most recently by Curry and others (1997). In that study, 1:24,000-scale stack-unit maps were developed and used to evaluate contamination potential to a depth of 100 feet. The methodology was based on previous studies of stack-unit mapping (Gross, 1970; Kempton, 1981; Kempton and Cartwright, 1984). Berg (2001) describes a methodology that allows for a variety of datasets, including stack-unit maps, to evaluate contamination potential to infinite depths. This study uses data from the 3-D geologic map and the methodology of Berg (2001) to evaluate aquifer sensitivity across the county (Figure 23). The primary datasets in our study were depth-to-aquifer maps and aquifer-thickness maps, both of which were derived directly from the 3-D map. The methodology assumes that potential contamination sources would be released at or near land surface.

The shallow aquifer sensitivity across McHenry County varies from low to high sensitivities (Figure 22). The highest sensitivities are located in areas of thick aquifer sediments (20-50 feet thick) that are shallow (from land surface to 20 feet deep). In McHenry County, those areas include the Rush Creek and Kishwaukee River Valleys, the Boone Creek and

Nippersink Creek Valleys, and the Fox River Valley. In these areas, not only are aquifer sediments thick and shallow, but water-table depths are often quite shallow (sometimes within 5 feet of land surface). Moderately-high aquifer sensitivities are often located where the Haeger diamicton is present or where the Yorkville confining unit is thin. Areas of moderately-low to low sensitivity are most often located where the Tiskilwa Confining unit or the Yorkville Confining Unit are thick and at land surface. These relationships are not unlike those found in Curry and others (1997), but the resolution of the units of sensitivity has likely been improved greatly by 3-D mapping in this study. Sensitivity maps for each individual aquifer are available in Appendix E.

SUMMARY AND FUTURE WORK

It is of utmost importance to better understand the geologic framework of the shallow aquifer system in McHenry County, because the residents and municipalities of the county are so largely dependent on that system for water supply. The complex relationships between aquifer distribution and multi-aquifer interconnectivity, and their influence on aquifer recharge and contamination potential, are major controls on the local and regional groundwater flow system. Therefore, this study has integrated decades of geologic work in McHenry County with new data and interpretations to provide a predictive 3-D map of the county's geologic framework. This 3-D map will allow a reasonable estimate of the geologic setting in the contexts of the glacial geologic framework and the shallow sand and gravel aquifer system.

Users of this map may investigate the predicted 3-D geology at a variety of scales. Such predictions are, of course, dependent upon data availability and mapping resolution of a given area, but they may include point locations with the county or transects across any portion of the county. Thus, the 3-D map and associated report/maps will allow not only county and municipal agencies to make better decisions about water-supply planning, but they may also provide local residents and businesses basic geologic information associated with their private water supplies.

This report also provides an important geologic base for future assessments of natural resource availability, management, or protection. Such studies may include, for example, quantitative estimates of regional-water supply and groundwater recharge or estimates of aggregate resource availability. The report also provides key geologic information that may help with a wide variety of local or regional environmental studies such as wetland delineation and conservation, landfill siting investigation, contaminated site remediation, or water quality evaluation. The management of natural resource and environmental issues can only benefit from studies, like this one, aimed at increasing our understanding of geologic complexity.

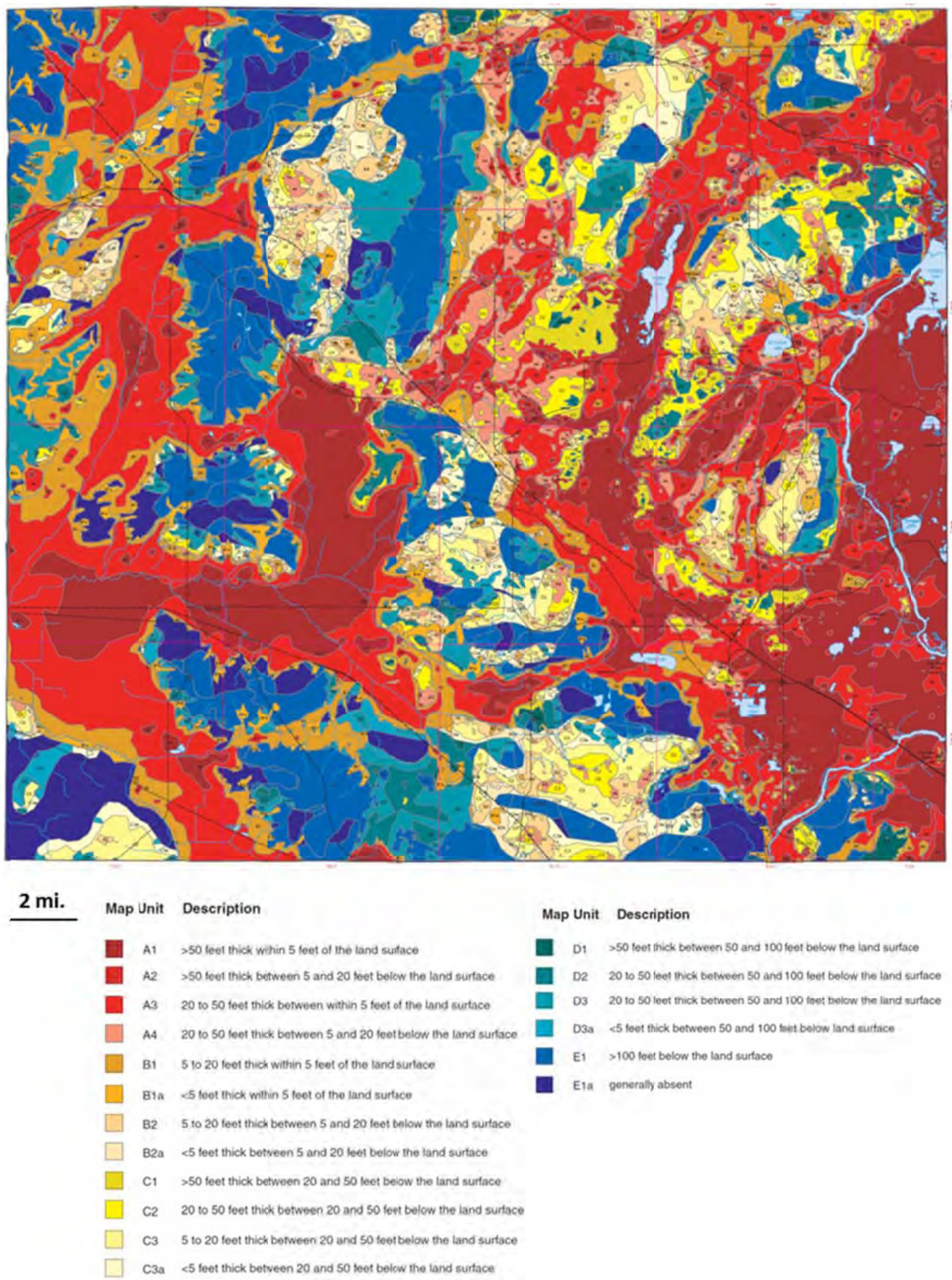


Figure 23. Aquifer sensitivity map of McHenry County derived from the 3-D map. 1:62,500 scale map is available in Appendix E. Sensitivity maps of all the individual aquifers are also available in Appendix E.

REFERENCES

Alden, W.C., 1904, The Delavan Lobe of the Lake Michigan Glacier of the Wisconsin Stage of Glaciation and Associated Phenomena: U.S. Geological Survey Professional Paper 34, 106 pp.

Anderson, R.C. and D.A. Block, 1962, Sand and gravel resources of McHenry County, Illinois: Illinois State Geological Survey Circular 336, 15 pp.

Berg, R.C., 1994, Geologic aspects of a groundwater protection needs assessment for Woodstock, Illinois: A case study: Illinois State Geological Survey Environmental Geology 146, 27 pp.

Berg, R.C., 2001, Aquifer Sensitivity Classification for Illinois Using Depth to Uppermost Aquifer Material and Aquifer Thickness: Illinois State Geological Survey Circular 560, 14 pp.

Berg, R.C. and J.P. Kempton, 1984, Potential for contamination of shallow aquifers from land burial of wastes: Illinois State Geological Survey map, in color, scale 1:500,000.

Berg, R.C., B.B. Curry, and R. Olshansky, 1999, Tools for groundwater protection planning: An example from McHenry County, Illinois, USA; Environmental Management, v. 23, pp. 321-331

Berg, R.C., J.P. Kempton, and K. Cartwright, 1984, Potential for contamination of shallow aquifers in Illinois: Illinois State Geological Survey Circular 532, 30p.

Chicago Metropolitan Agency for Planning (CMAP), 2010, Water 2050: Northeastern Illinois Regional Water Supply/Demand Plan, March 2010, 186 pp.

Cobb, J.C. and G.S. Fraser, 1981, Application of Sedimentology to Development of Sand and Gravel Resources in McHenry and Kane Counties, Northeastern Illinois: Illinois State Geological Survey, Illinois Mineral Notes 82, 17 p.

Curry, B.B., 1995, Groundwater protection mapping for McHenry County, Illinois: Drilling report: Illinois State Geological Survey Open-File Report 1995-1, 123 pp.

Curry, B.B., R.C. Berg, and R.C. Vaiden, 1997, Geologic Mapping for Environmental Planning: Illinois State Geological Survey Circular 559, 92 pp.

Curry, B.B. and J. Petras, 2011, Chronological framework for the deglaciation of the Lake Michigan lobe of the Laurentide Ice Sheet from ice-walled lake deposits: Journal of Quaternary Science, vol. 26, no. 4, pp. 402-410.

Gilkeson, R.H. S.S. McFadden, D.E. Laymon, and A.P. Visocky, 1987, Hydrogeologyic evaluation of groundwater resources in buried bedrock valleys, northeastern Illinois: Proceedings of the Focus Conference on Midwestern Ground Water Issues, Natuional Water Well Association, p. 245-267.

Gross, D.L., 1970, Geology for planning in DeKalb County, Illinois: Illinois State Geological Survey Environmental Geology Notes, v. 33, 26 p.

Hackett J.E. and M.R. McComas, 1969, Geology for Planning in McHenry County: Illinois State Geological Survey Circular 438, 31 pp.

Illinois Environmental Protection Agency (IEPA), 2008, Data retrieved from The Safe Drinking Water Information System/State Version (SDWIS/State) of the United States Environmental Protection Agency.

Kempton, J.P., 1981, Three-Dimensional Geologic Mapping for Environmental Studies in Illinois: Illinois State Geological Survey, Environmental Geology Notes 100, 43 p.

Kempton, J.P. and K. Cartwright, 1984, Three-dimensional geologic mapping; a basis for hydrogeologic and land-use evaluations: Bulletin of the Association of Engineering Geologists, v. 21, no 3., p. 317-335.

Kempton, J.P., J.E. Bogner, and K. Cartwright, 1977, Geology for Planning in Northeastern Illinois. VIII Regional Summary. Illinois State Geological Survey Open File Series 1977-2, 84 p.

Masters J.M., 1978, Sand and gravel and peat resources in northeastern Illinois: Illinois State Geological Survey Circular 503, 11 p.

Mathers, S.J., B. Wood, and H. Kessler, 2011, GSI3D 2011 Software Manual and Methodology; British Geological Survey Internal Report, OR/11/020, 152 pp.

McHenry County, 2009, McHenry County, Illinois 2030 Comprehensive Plan, 125 pp.

Meyer, S., 1998, Ground-Water Studies for Environmental Planning, McHenry County, Illinois: Illinois State Water Survey Contract Report 630, 141 pp.

Meyer, S., in preparation, Groundwater Modeling for Water-Resource Management in McHenry County, Illinois: Illinois State Water Survey Contract Report.

Schneider, A.F., 1983, Wisconsinan stratigraphy and glacial sequence in southeastern Wisconsin: Geoscience Wisconsin, v. 7, p. 59-85.

Specht, S.A. and A.A. Westerman, 1976, Geology for Planning in Northeastern Illinois: Geology for Planning in McHenry County: Illinois State Geological Survey Open File Series 1976-3, 39 pp.

Terrington R.L, S.J. Mathers, H. Kessler, V. Hulland, S.J. Price, 2009, Subsurface Viewer 2009: User Manual V1_02009, British Geological Survey Open Report, OR/09/027, 23 pp.

Visocky, A.P., M.G. Sherill, and K. Cartwright, 1985, Geology Hydrogeology, and Water Quality of the Cambrian and Ordovician Systems in Northern Illinois: Illinois State Geological Survey and Illinois state Water Survey, Cooperative Groundwater Report 10, 136 pp.

Wickham, S.S., W.H. Johnson, and H.D. Glass, 1988, Regional Geology of the Tiskilwa Till Member, Wedron Formation, Northeastern Illinois: Illinois State Geological Survey Circular 543, 35 pp.

APPENDIX A

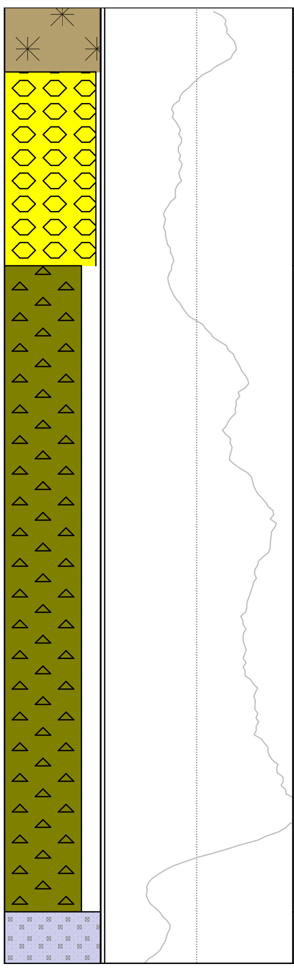
Graphic Logs of Testholes Drilled in 2008-2009

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY	**J. Thomason**
API NO.	**121114381200**
DRILLING METHOD	**CME 75 - Wireline**
DATE LOGGED	**June-2009**
BOREHOLE NUMBER	**CAPR-09-01**
TOWNSHIP/RANGE/SECTION	
CORE NUMBER	**CAPR-09-01**
NEAREST CITY / TOWN / LANDMARK	**Chemung, IL**
COUNTY	**McHenry**
PROJECT NAME	**McHenry County 3-D Mapping**
QUADRANGLE	**Capron**
OWNER	**MCCD (Beck's Woods)**
DRILLED BY	**Travis Greist (ISGS)**
DATUM	**NAD 83**
ELEVATION	**880**
LOCATION OF BORING	**N: 4697165.84 E:362454.99**
LOCATION	MCCD property (undeveloped), no well, boring at north end of small field north of Beck's Woods
WATER LEVEL	
TIME	
DATE	
CASING DEPTH	
START TIME	
END TIME	
START DATE	
END DATE	

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation
0						O	(0.0) soil; organic sandy loam; medium sand, oxidized, poor cohesion	Mason Group, Henry Formation, (glaciofluvial), Hen1
						G	(2.5) gravel; coarse, rounded, 0.1-6 cm dia, mixed lithologies	
10						Dm	(10.0) diamicton; silt loam, 5YR5/2 (reddish gray), v. dense, pebbly, some cobbles, bouldery from 10-15'	Glasford Formation, Oregon Member (subglacial till), G1
20								
30								
						B	(35.0) bedrock; Silurian dolomite	Silurian Dolomite

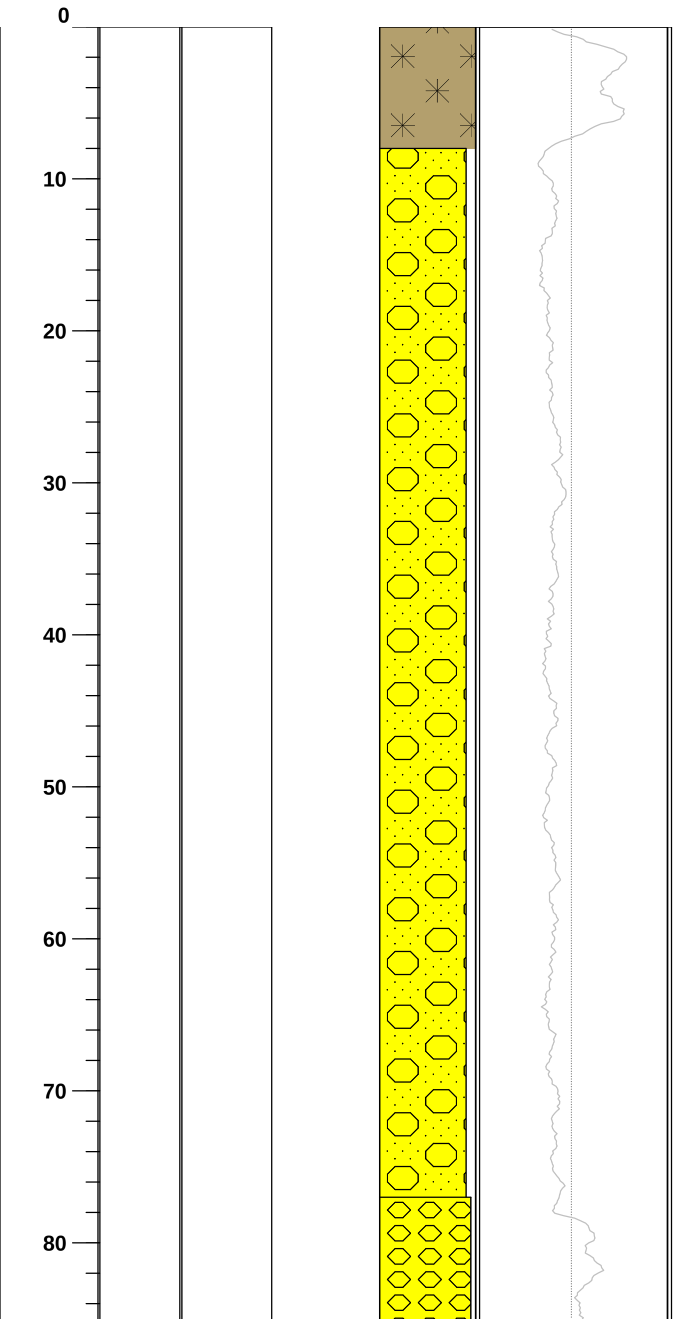


ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

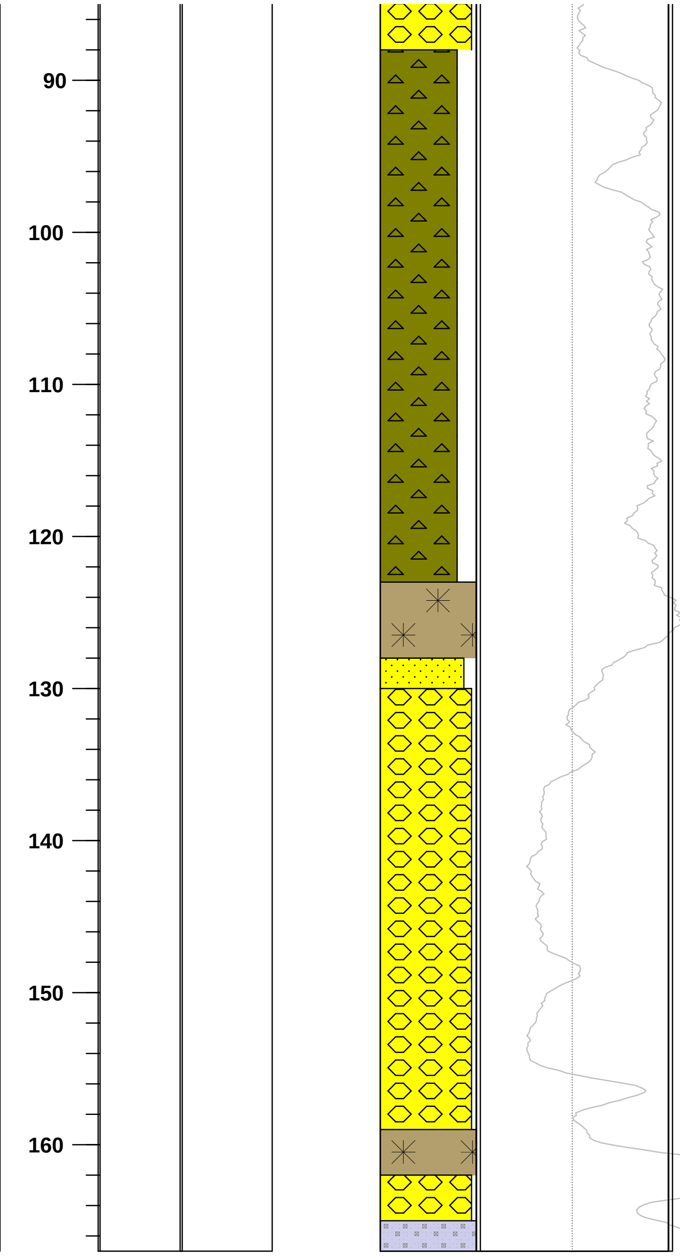
Field	Value
LOGGED BY	J. Thomason
API NO.	121114381800
DRILLING METHOD	CME 75 - Wireline
DATE LOGGED	July-2009
BOREHOLE NUMBER	GARP-09-01
TOWNSHIP/RANGE/SECTION	
CORE NUMBER	GARP-09-01
NEAREST CITY / TOWN / LANDMARK	Chemung, IL
COUNTY	McHenry
PROJECT NAME	McHenry County 3-D Mapping
WATER LEVEL	
QUADRANGLE	Garden Prairie
OWNER	MCCD (Bunker Hill Road)
TIME	
DRILLED BY	Travis Greist (ISGS)
DATUM	NAD 83
ELEVATION	855
LOCATION OF BORING	N: 4690715.86 E:365507.18
DATE	
START TIME	
END TIME	
LOCATION	Book property, no well, boring located on north side of Bunker Hill Road in small property just east of Rush Creek
CASING DEPTH	
START DATE	
END DATE	

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Geologic Material Description	Interpretation
(0.0) soil, modern organic soil	Henry Formation, (glaciofluvial)
(8.0) sand and gravel; v. mixed lithologies of medium gravel, angular to sub-rounded, poor recovery	
(77.0) gravel; w/ diamicton?	

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



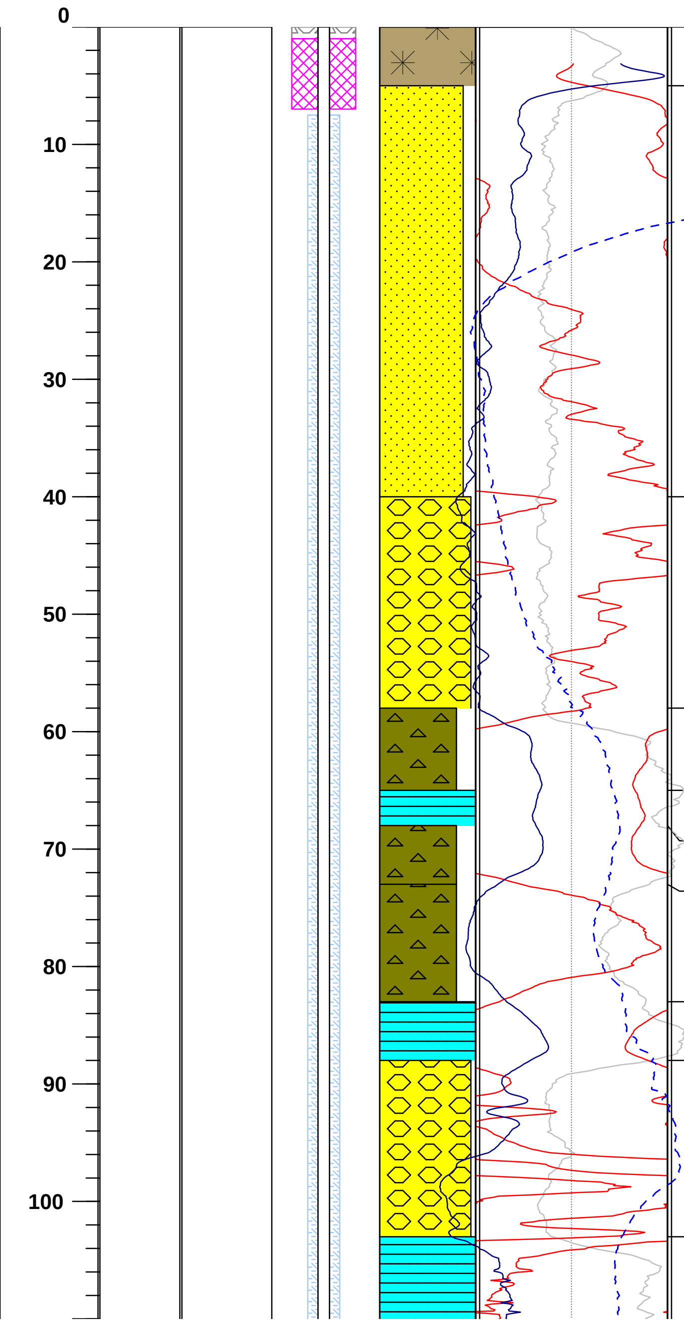
Geologic Material Description	Environment - Interpretation
(88.0) diamicton; clay loam, pebbly, 2.5Y4/2(dk.gr.brn), dense, homogeneous	Glasford Formation, Oregon Member (subglacial till), G1
(123.0) soil; paleosol, silty clay loam, 10YR2/1(black) to GLEY2.5/5G, few pebbles	Yarmouth Paleosol, Banner Formation, G2
(128.0) sand; fine, silty, interbedded w/ fine silt and illuviated clay	Banner Formation (glaciofluvial), GS2
(130.0) gravel; coarse, w/ some diamicton smears and beds at 148, 155'	Banner Formation (glaciofluvial), GS2
(159.0) soil; paleosol, silt loam, organic rich, 10YR3/2(v.dk.gr.brn), large pieces of black shale	Pike Paleosol, GS2
(162.0) gravel; w/ diamicton?	Pre-Illinoiis Episode (subglacial), GS2
(165.0) bedrock; fossiliferous limestone, vuggy, Ordovician	Silurian Dolomite, Bdrk

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

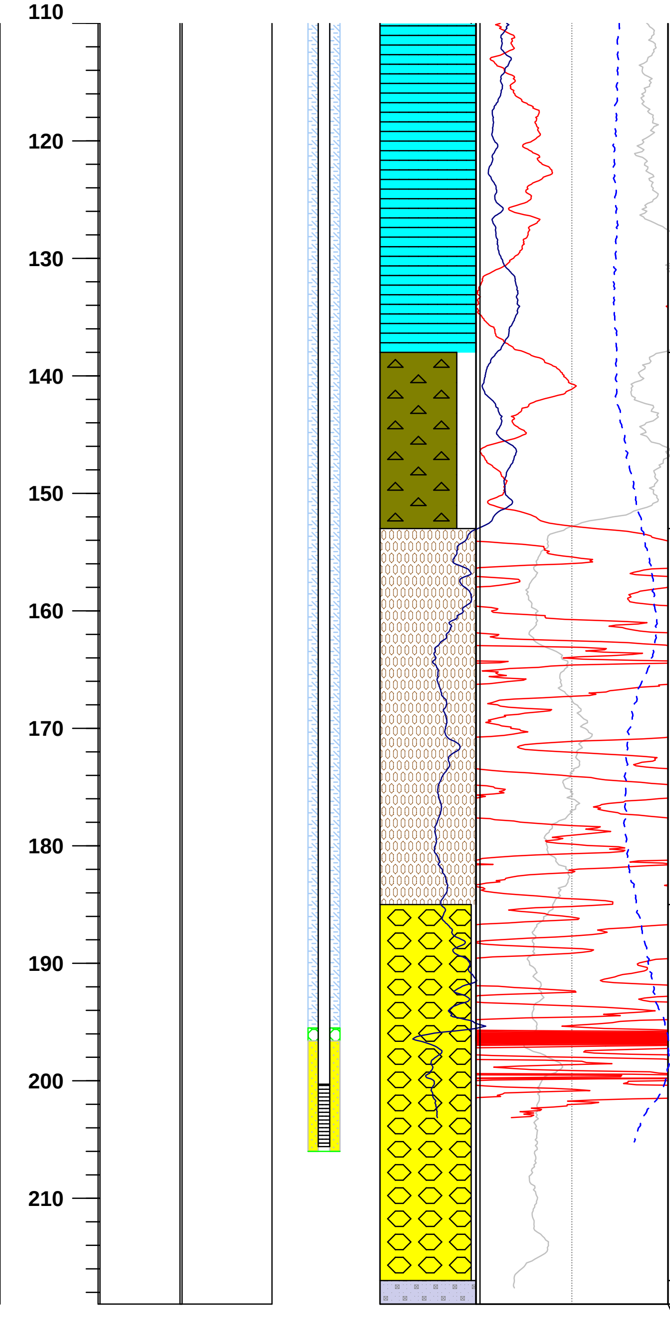
LOGGED BY	J. Thomason
API NO.	121114384000
DRILLING METHOD	CME 75 - Wireline
DATE LOGGED	13-August-2009
BOREHOLE NUMBER	GARP-09-02
TOWNSHIP/RANGE/SECTION	
CORE NUMBER	GARP-09-02
NEAREST CITY / TOWN / LANDMARK	Marengo, IL
COUNTY	McHenry
PROJECT NAME	McHenry County 3-D Mapping
WATER LEVEL	
QUADRANGLE	Garden Prairie
OWNER	MCCD (Thorne Road)
TIME	
DRILLED BY	Travis Greist (ISGS)
DATUM	NAD 83
ELEVATION	789
LOCATION OF BORING	N: 4680890.079 E:362712.345
DATE	
START TIME	
END TIME	
LOCATION	MCCD property (undeveloped), west side of Thorne Road, north end of small field
CASING DEPTH	
START DATE	
END DATE	

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Facies Code	Geologic Material Description	Interpretation
O	(0.0) soil; silt loam, organic, 10YR2/2(v.dk.brn)	Mason Group, Henry Formation, (glaciofluvial), Hen1
S	(5.0) sand; medium, oxidized, saturated, homogenous, increased gravel w/ depth	
G	(40.0) gravel; coarse, fine to cobble, some sand	
Ds	(58.0) diamicton; mixed w/ gravel and silty clay; 7.5YR4/2(dk.red gr.)	Glasford Formation, Oregon Member (subglacial till), G1
Fm	(65.0) silty clay; (7.5YR4/2) massive	
Ds	(68.0) diamicton; mixed w/ gravel and silty clay; 7.5YR4/2(dk.red gr.)	
Dm	(73.0) diamicton; silty clay loam, 7.5YR4/3(reddish brn), dense homogenous, pebbly	
Fm	(83.0) silty clay; (7.5YR4/3) far less pebbly than above	
G	(88.0) gravel; coarse, rounded pebbles, no sand, some diamicton smears	Glasford Formation, sandy facies (glaciofluvial), GS1
F	(103.0) clay; silty clay; 5YR5/2(reddish gr.), stringers of fine sand, massive to weakly bedded, plastic	Glasford Formation, Fairdale Member, (subglacial), G2

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Facies Code	Geologic Material Description	Environment - Interpretation
Dm	(138.0) diamicton; silty clay loam, 10YR4/1(dk.gr.), dense but plastic, pebble sand to med gravel	
Dg	(153.0) diamicton; v. gravelly w/ cobbles, 7.5YR5/2(brn), dense, pebbly	Glasford Formation, Kellerville Member, (subglacial), G2
G	(185.0) gravel; v. coarse, cobble gravel, talus debris?	Bedrock Aquifer, (glaciofluvial), GS2
B	(217.0) bedrock; carbonate, vuggy, Ordovician	Silurian Dolomite

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: **J. Thomason**		API NO.: **121114381300**
DRILLING METHOD: **CME 75 - Wireline**	DATE LOGGED: **07-July-2009**	BOREHOLE NUMBER: **HARV-09-01**
TOWNSHIP/RANGE/SECTION:		CORE NUMBER: **HARV-09-01**
NEAREST CITY / TOWN / LANDMARK: **Harvard, IL**		COUNTY: **McHenry**

PROJECT NAME: **McHenry County 3-D Mapping**

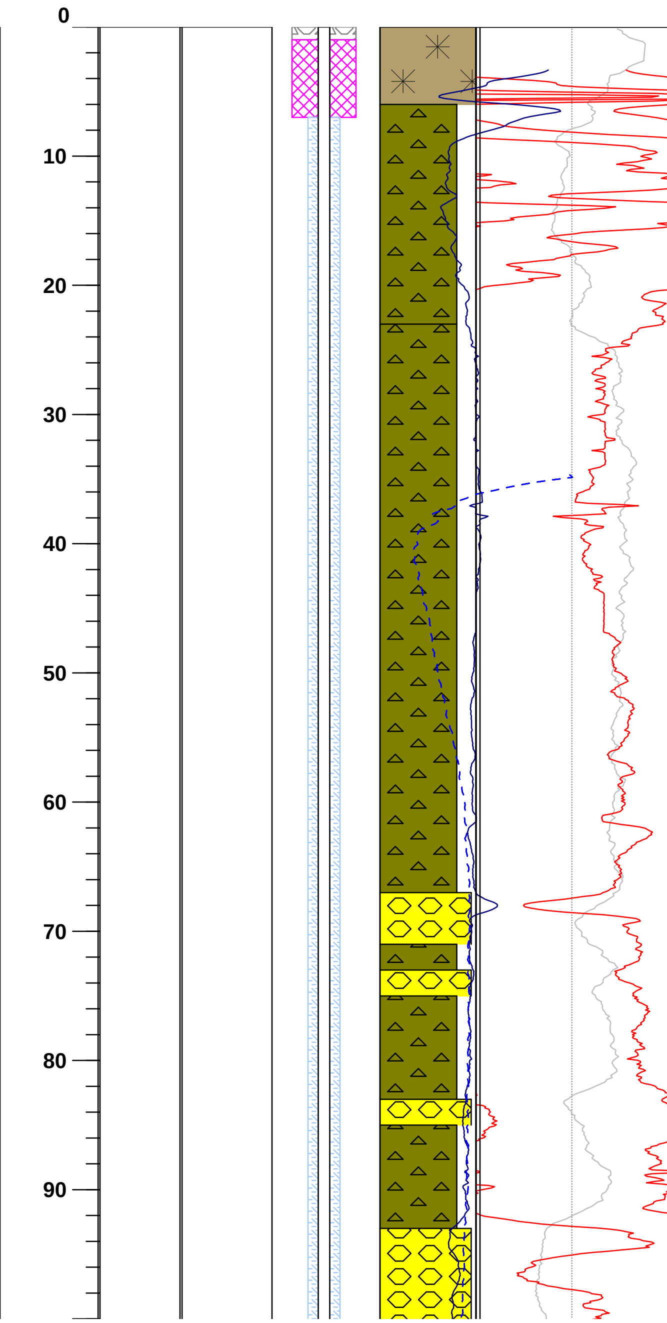
OWNER: **McHenry County Conservation District (Rush Creek Conservation Area)**

DATUM	ELEVATION	LOCATION OF BORING	
NAD 83	**942**	**N: 4695379.59**	**E:368271.498**

LOCATION: Rush Creek Conservation Area-boring/well in grass field ~50 feet west of southernmost parking area

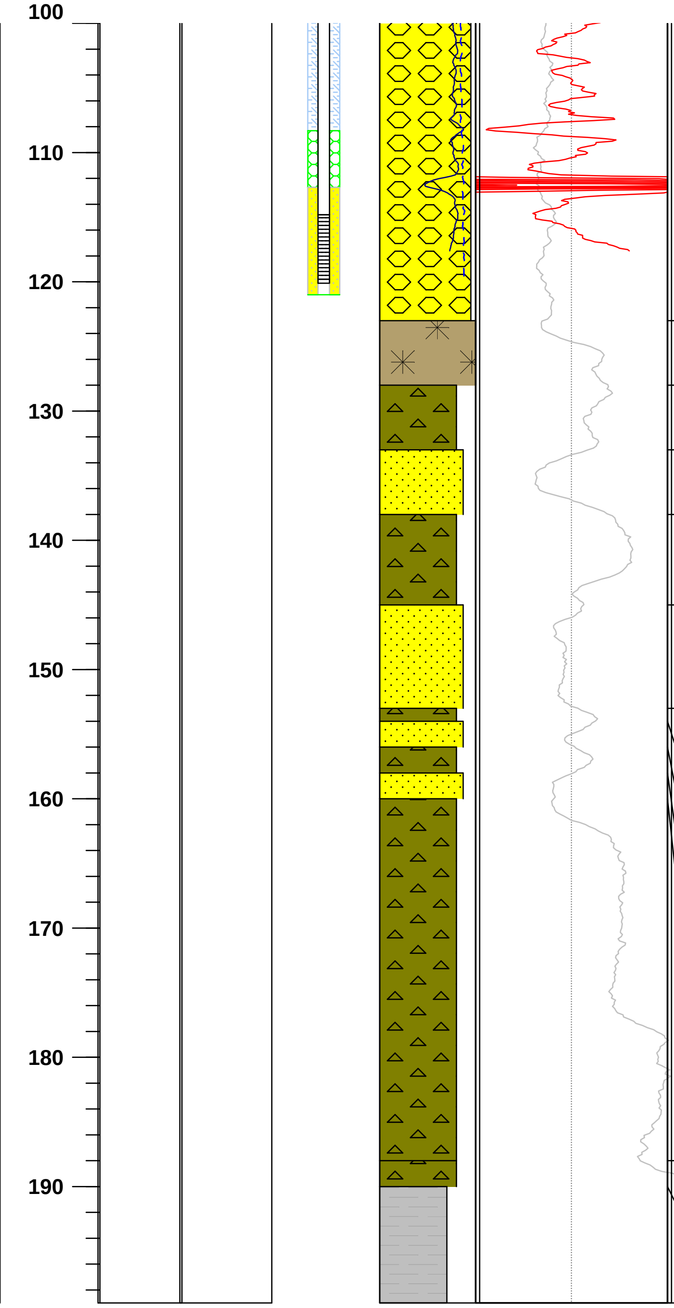
WATER LEVEL				QUADRANGLE: **Harvard**
TIME				DRILLED BY: **Jack Aud (ISGS)**
DATE				START TIME / END TIME
CASING DEPTH				START DATE / END DATE

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50, 20 Cond 80, 0 Resist 30, 9.4 Temp 10.5



Facies Code	Geologic Material Description	Interpretation
S	(0.0) sand; silt loam, organic 10YR3/3(dk.brn), soil formed in fine sand, some small pebbles	Henry Formation (glaciofluvial), Hen1
Ds	(6.0) diamicton; v.sandy loam, 10YR5/4(yellowish brn), poorly cohesive, pinkish w/ rounded faceted pebbles; thin beds of sand from 15-23	Wedron Group, Haeger Member (subglacial till), Wh
Dm	(23.0) diamicton; silty clay loam, 5YR5/3 (reddish brn), gravelly, cobbly, pebbly, dense	Wedron Group, Tiskilwa Formation (subglacial till), Wt
G	(67.0) gravel; lense	
Dm	(71.0) diamicton; silty clay loam, 5YR5/3 (reddish brn), gravelly, cobbly, pebbly, dense	
G	(73.0) gravel; lense	
Dm	(75.0) diamicton; silty clay loam, 5YR5/3 (reddish brn), gravelly, cobbly, pebbly, dense	
G	(83.0) gravel; lense	
Dm	(85.0) diamicton; silty clay loam, 5YR5/3 (reddish brn), gravelly, cobbly, pebbly, dense	
G	(93.0) gravel; coarse, clean, mixed lithologies	Mason Group, Henry Formation, Ashmore Tongue (glaciofluvial), Ha

Depth (ft.) [cont'd]	Recovery (Recovered / Driven)	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Facies Code	Geologic Material Description	Environment - Interpretation
S	(123.0) soil; paleosol in sandy diamicton, greenish brn w/ organics	Robein Silt (paleosol), G1
Dm	(128.0) diamicton; no recovery	Glasford Formation, Oregon Member (subglacial till), G1
S	(133.0) sand; no recovery	
Dm	(138.0) diamicton, silty clay loam, 5YR5/3(reddish brown), interbedded w/ sand	
S	(145.0) sand; medium, homogenous interbedded w/ diamicton	Glasford Sand, GS1
Dm	(153.0) diamicton, silty clay loam, 5YR5/3(reddish brown), interbedded w/ sand	
S	(154.0) sand; medium, homogenous interbedded w/ diamicton	
Dm	(156.0) diamicton, silty clay loam, 5YR5/3( ), interbedded w/ sand	Glasford Formation, Fairdale Member (subglacial till), G2
S	(158.0) sand; medium, homogenous interbedded w/ diamicton	
Dm	(160.0) diamicton; silty clay loam, 5YR4/3(reddish brn), dense, pebbly, sandy	
Dmo	(188.0) diamicton; silt loam, dk brown, organic?	Banner Formation (subglacial till), G2
B	(190.0) bedrock; shale, weathered	Maquoketa Shale, Ordovician, Bdrk

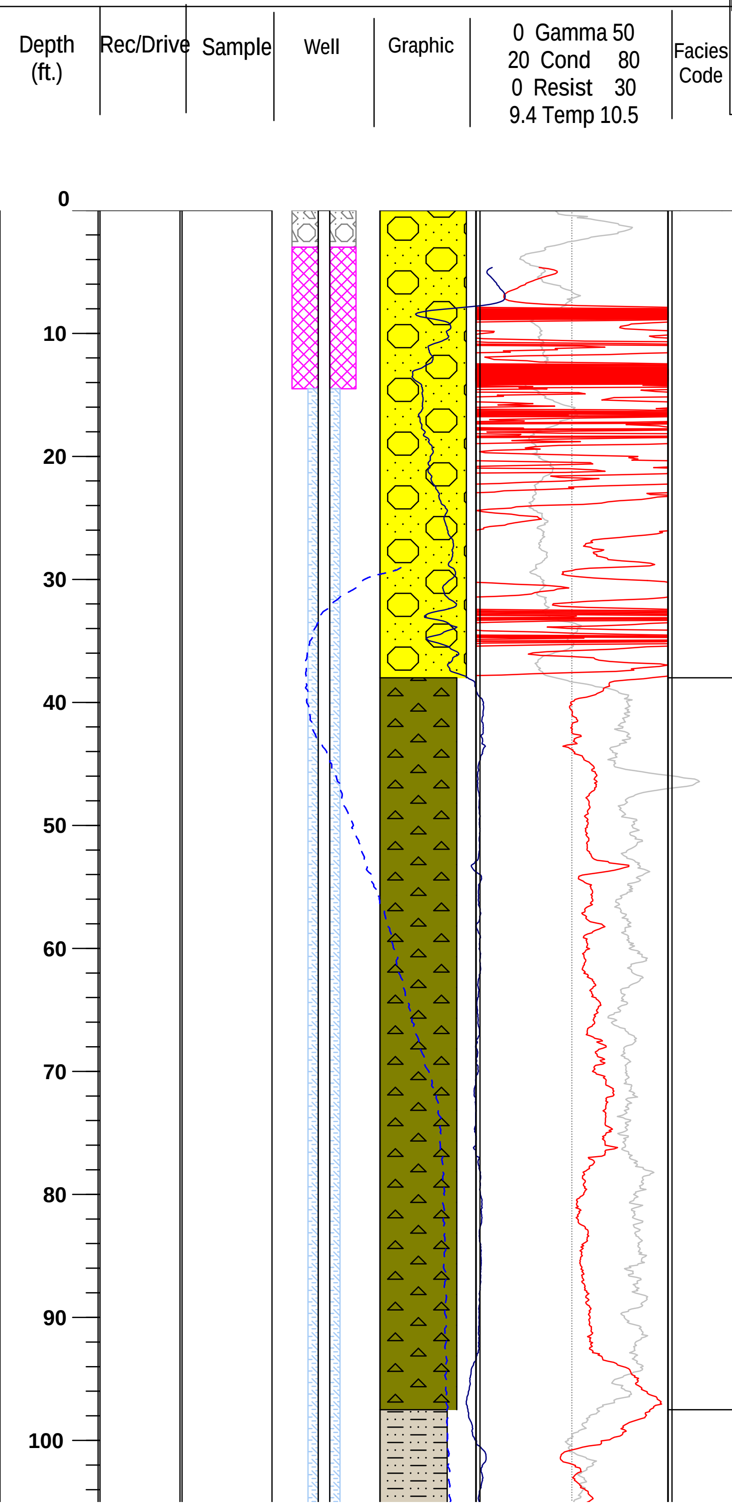
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: **J. Thomason**		API NO.: **121114361800**
DRILLING METHOD: **CME 75 - Wireline**	DATE LOGGED: **8-Sept-08**	BOREHOLE NUMBER: **HEBR-08-01**
TOWNSHIP/RANGE/SECTION: **46N 7E Sec 10 (NESWNE)**		CORE NUMBER: **HEBR-08-01**
NEAREST CITY / TOWN / LANDMARK: **Hebron**		COUNTY: **McHenry**

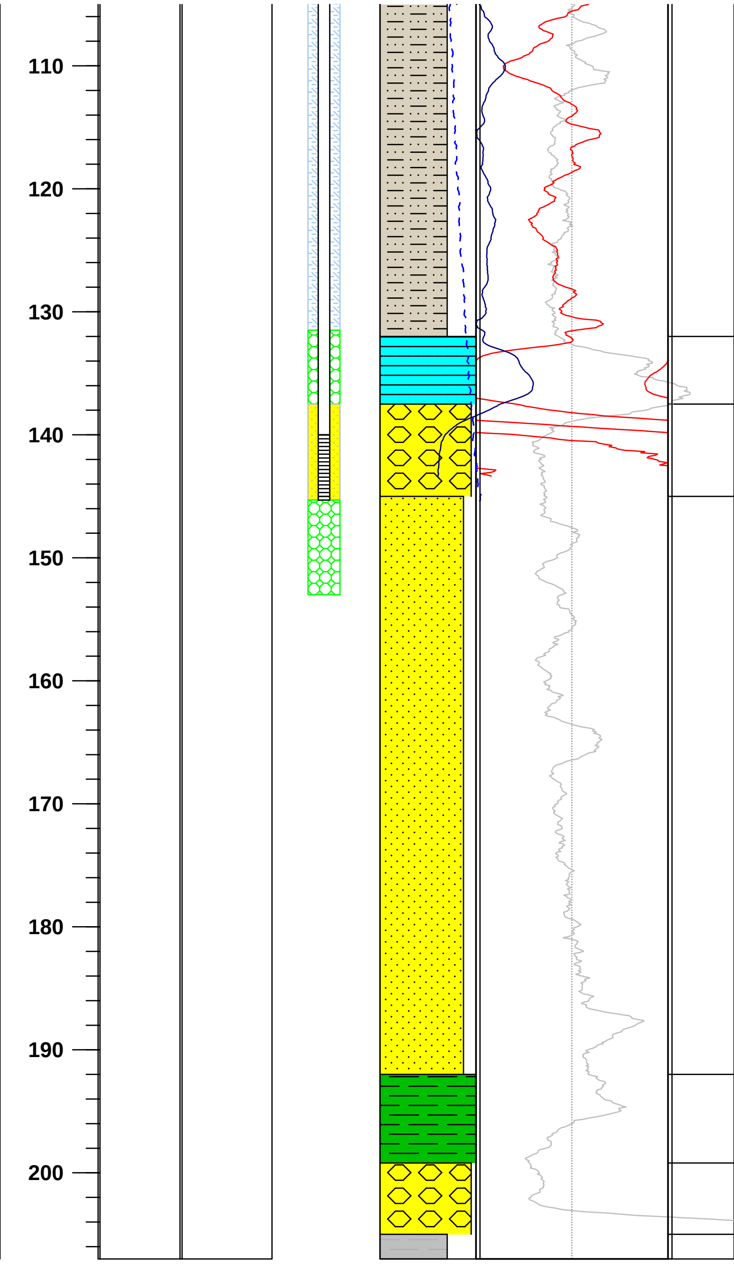
PROJECT NAME: **Northeast Illinois Water Supply Planning**				
OWNER: **McHenry County Conservation District (Martini Tract)**				
DATUM: **NAD 83**	ELEVATION: **898**	LOCATION OF BORING: **N: 4704339**	**E:385029**	
LOCATION: MCCD property, Martini Tract location along Seaman Road, ~30 southeast of entrance into field				

WATER LEVEL				QUADRANGLE: **Hebron**	
TIME				DRILLED BY: **Jack Aud (ISGS)**	
DATE				START TIME	END TIME
CASING DEPTH				START DATE	END DATE



Geologic Material Description	Interpretation
(0.0) sand and gravel; coarse w/ some finer lenses, moderately rounded, mixed lithology	Henry Formation (Beverly Tongue); outwash
(38.0) diamicton; silty clay loam, 2.5YR4/3, pebbly, massive, homogenous, dense	Tiskilwa Formation; subglaciall till
(97.5) sand and silt; interbedded w/ laminated silt beds, beds 1-5' thick, <1mm laminations	Henry Formation (Ashmore Tongue); low energy outwash

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Geologic Material Description	Environment - Interpretation
(132.0) clay; silty clay (7.5YR5/3, brown), massive, dense, small sand pods (<1.0 cm)	Equality Formation (Peddicord Tongue); lacustrine
(137.5) gravel; medium to coarse (max 3cm dia), moderately well rounded, mostly dolomite	Pearl Formation; glaciofluvial
(145.0) sand; medium sand w/ some gravel, some beds of laminated silt, silty beds 185-192	Pearl Formation; shallow lacustrine
(192.0) silt; bedded w/ pebbles, dense, like diamicton, 7.5YR4/2 (brown)	Pearl Formation; lacustrine
(199.2) gravel; coarse, bedrock rubble	Pearl Formation; glaciofluivial
(205.0) bedrock; green shale	Maquoketa; shale bedrock

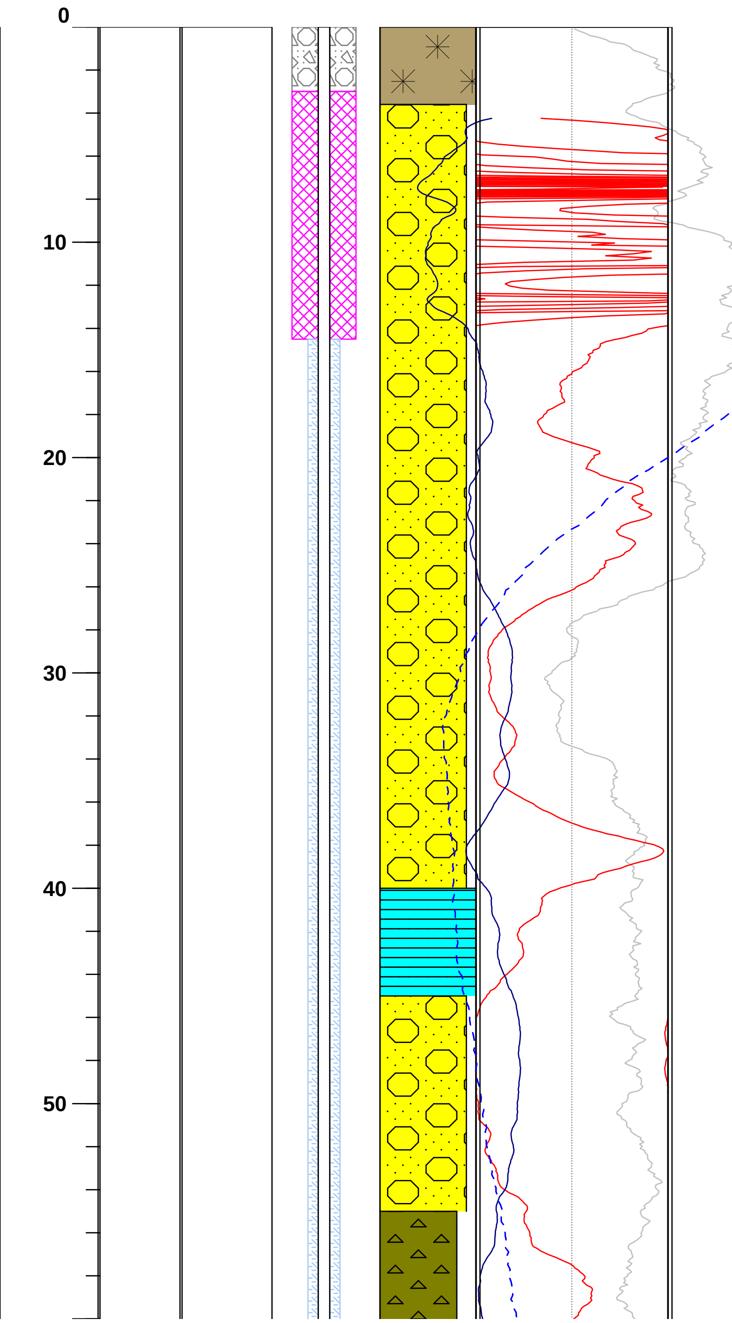
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: J. Thomason (field), D.Carlock (lab)	API NO.: 121114361900
DRILLING METHOD: CME 75 - Wireline; DATE LOGGED: 15-Sept-08	BOREHOLE NUMBER: HEBR-08-02
TOWNSHIP/RANGE/SECTION: 46N 7E Sec 18 (SE,SE,SW)	CORE NUMBER:
NEAREST CITY / TOWN / LANDMARK: Woodstock, IL	COUNTY: McHenry
PROJECT NAME: Northeast Illinois Water Supply Planning	QUADRANGLE: Hebron
OWNER: McHenry County Conservation District	DRILLED BY: Jack Aud (ISGS)
DATUM: NAD 83; ELEVATION: 868; LOCATION OF BORING: N: 4693586 E:381059	START TIME / END TIME
LOCATION: Northwest corner of Jankowski and Raycraft Roads, in small field ~100 feet north of field entrance	START DATE / END DATE

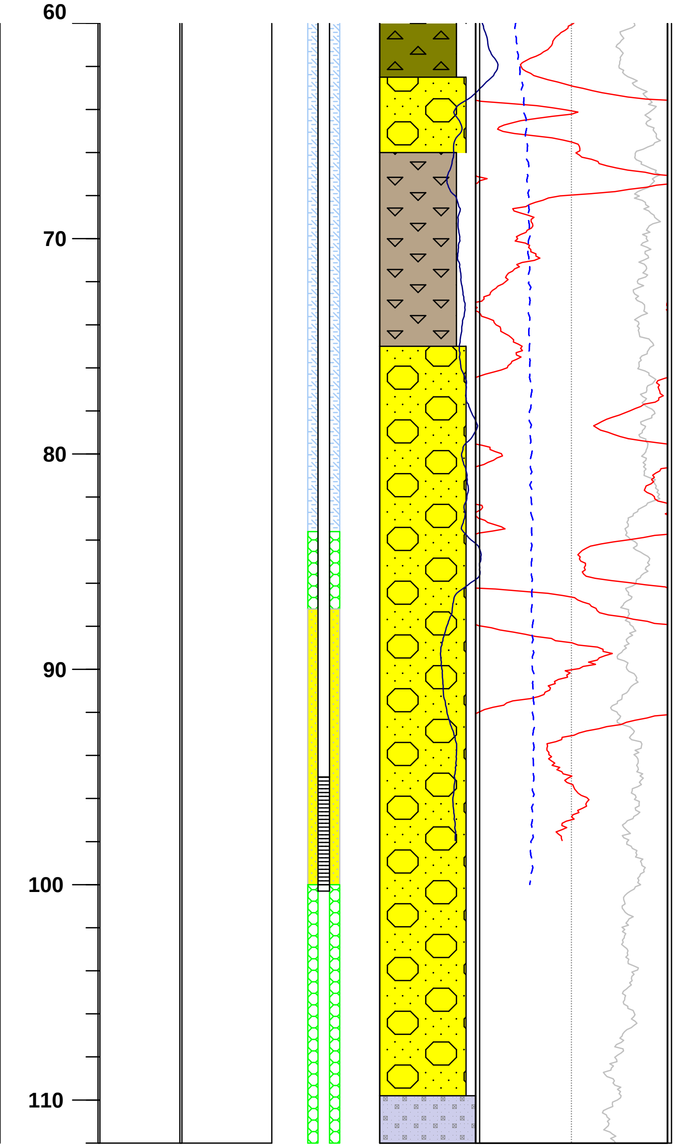
WATER LEVEL			
TIME			
DATE			
CASING DEPTH			

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5 | Facies Code



Geologic Material Description	Interpretation
(0.0) modern soil horizon	Modern Soil
(3.6) sand and gravel; poorly sorted, dry, silty clay at 14.5-15 and sandy loam at 35-38.5	Henry Fm, Beverly tongue (glaciofluvial)
(40.0) clay; no recovery	Equality Formation, (lacustrine)
(45.0) sand and gravel; medium, moderately rounded pebbles, mixed lithologies	Henry Formation (Beverly Tongue), glaciofluvial
(55.0) diamicton; silty clay loam (10YR3/2, dark grayish brn), firm, increasing pebbles with depth	Lemont Formation (Yorkville member); subglacial till

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Geologic Material Description	Environment - Interpretation
(62.5) sand and gravel; medium to coarse, large mafic cobbles, poor recovery	Henry Fm, glaciofluvial
(66.0) diamicton; poor recovery, piece of pink diamicton, silty clay loam (7.5 YR4/3, brown)	Tiskilwa Formation; subglacial till
(75.0) sand and gravel; coarse, large basalt boulder at 102.4 feet	Henry Formation (Ashmore Tongue); glaciofluvial
(109.8) bedrock; dolomite	Silurian Bedrock

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY **J. Thomason/ T.Hodson**			API NO. **121114381100**
DRILLING METHOD **CME 75 - Wireline**	DATE LOGGED **25-June-2009**		BOREHOLE NUMBER **HEBR-09-03**
TOWNSHIP/RANGE/SECTION			CORE NUMBER **HEBR-09-03**
NEAREST CITY / TOWN / LANDMARK **Hebron**			COUNTY **McHenry**
WATER LEVEL			QUADRANGLE **Hebron**
TIME			DRILLED BY **Jack Aud (ISGS)**
DATE			START TIME / END TIME
CASING DEPTH			START DATE / END DATE

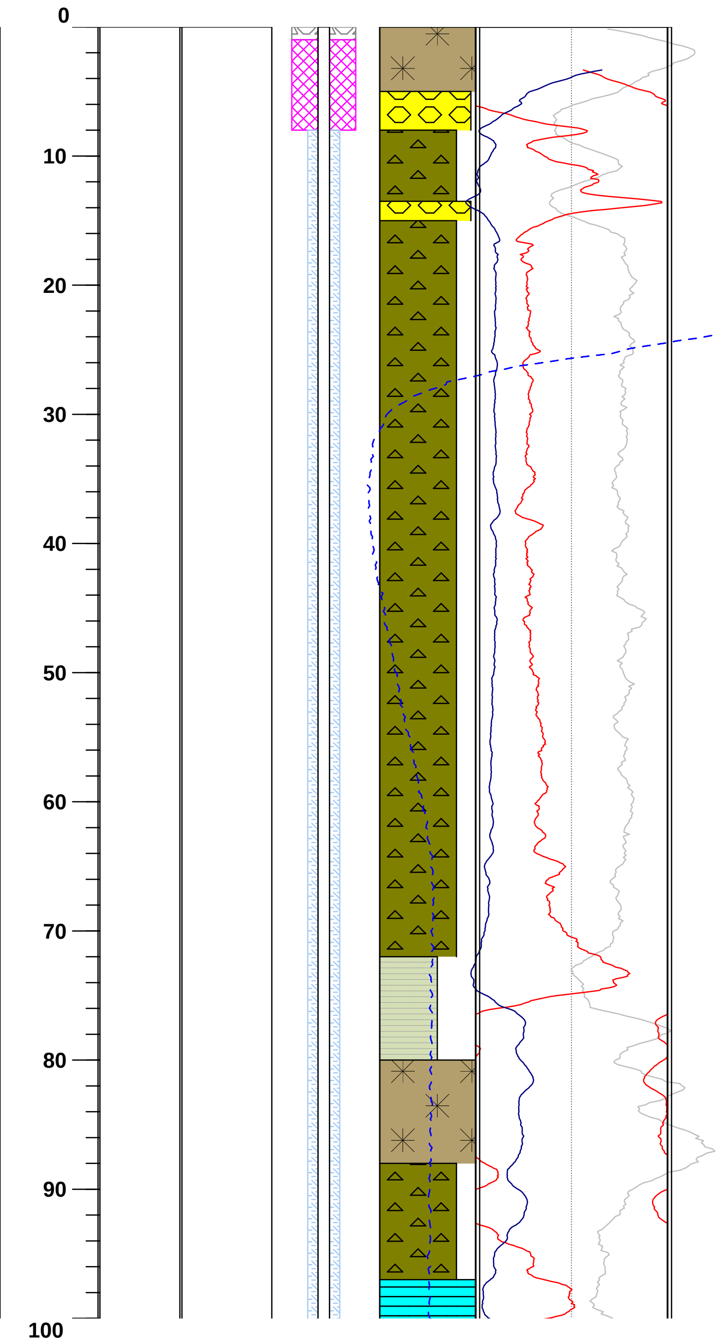
PROJECT NAME
McHenry County 3-D Mapping

OWNER
McHenry County Conservation District (Alden Sedge Bianchini)

DATUM	ELEVATION	LOCATION OF BORING	
NAD 83	**949**	**N: 4704038.27**	**E:378218.863**

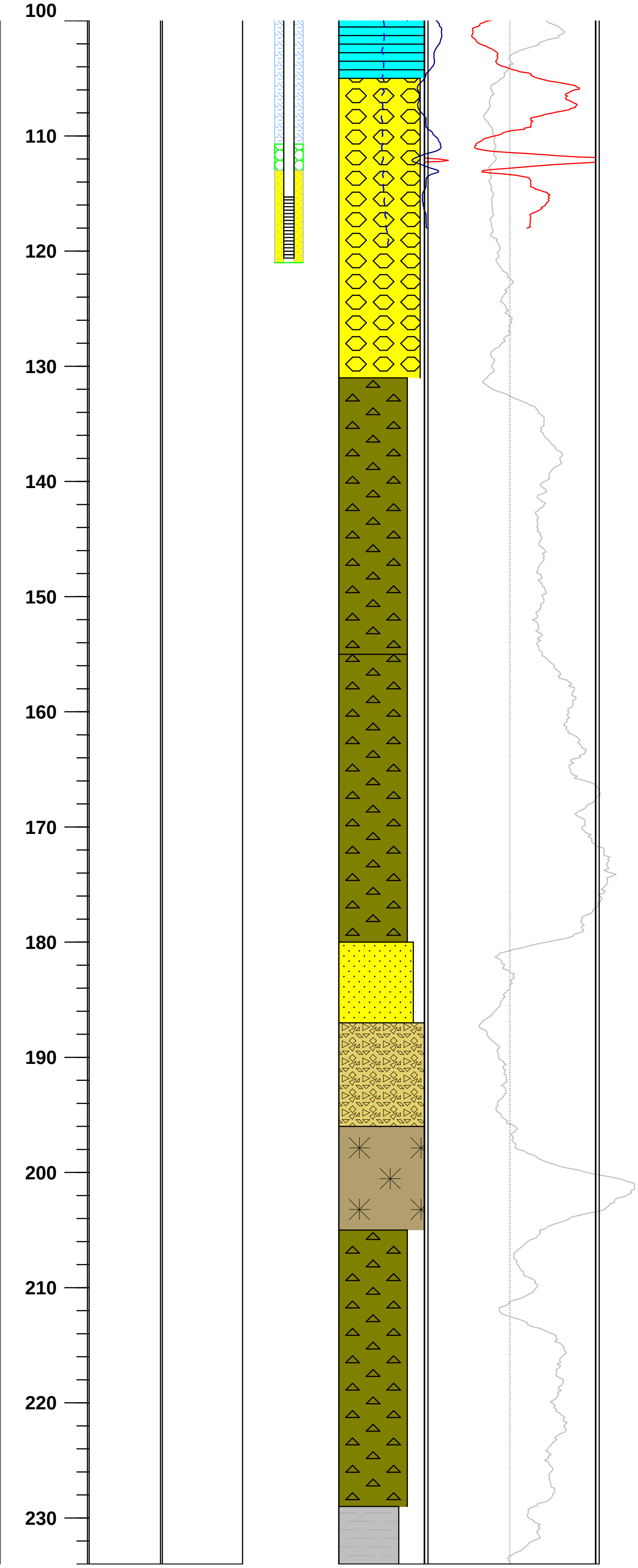
LOCATION Alden Sedge Bianchini on south side of Hebron Road, west of Nippersink Creek and west of large silos.

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code



Geologic Material Description	Interpretation
(0.0) modern soil; developed in diamicton; 10YR5/6 (yellowish brown)	Modern Soil
(5.0) gravel, coarse	Henry Formation, glaciofluvial
(8.0) diamicton; loam, soft, 5YR5/6 (yellowish red)	
(13.5) gravel, dolomite cobbles w/ trace diamicton	
(15.0) diamicton; clay loam, 10YR5/3 (brown), lenses of sand and gravel, dense, pebbly	Tiskilwa Formation, subglacial till
(72.0) clay; silty clay, laminated with silt beds; 10YR4/4(d.ylw.brn), trace gravel	Equality Formation, (Peddicord Member) glaciolacustrine
(80.0) silt; silt loam; 7.5YR2.5/1(black) w/ b-horizon below; wood and organic matter; diamicton parent material	Robein Silt
(88.0) diamicton; silt loam, weathered, 5Y4/3(olive)	Glasford Formation, undifferentiated
(97.0) clay; interbedded w/ v. fine sand;	Pearl Formation, fine facies

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
105.0						(105.0) gravel; coarse, subrounded, mixed lithologies	Pearl Formation, coarse facies
131.0						(131.0) diamicton; no recovery; lower gamma than below	Glasford Formation, subglacial till
155.0						(155.0) diamicton; silty clay loam; 10YR5/3 (brown); sparse pebbles	Glasford Formation, subglacial till
180.0						(180.0) sand; medium sand with fine gravel; v. poorly sorted w/ some well sorted lenses	Glasford Sand 1
187.0						(187.0) gravel w/diamicton; silty clay loam (10YR5/2, grayish brn); mixed lithologies	Glasford Formation (undifferentiated)
196.0						(196.0) soil; silty clay, 5Y3/2(lt.olive gray); paleosol in diamicton	Buried Soil (undifferentiated)
205.0						(205.0) diamicton; clay loam, 5Y5/2(olive gray), dense, pebbly	Diamicton (undifferentiated)
229.0						(229.0) shale; Ordovician shale, Maquoketa shale; blue-green	Maquoketa Shale

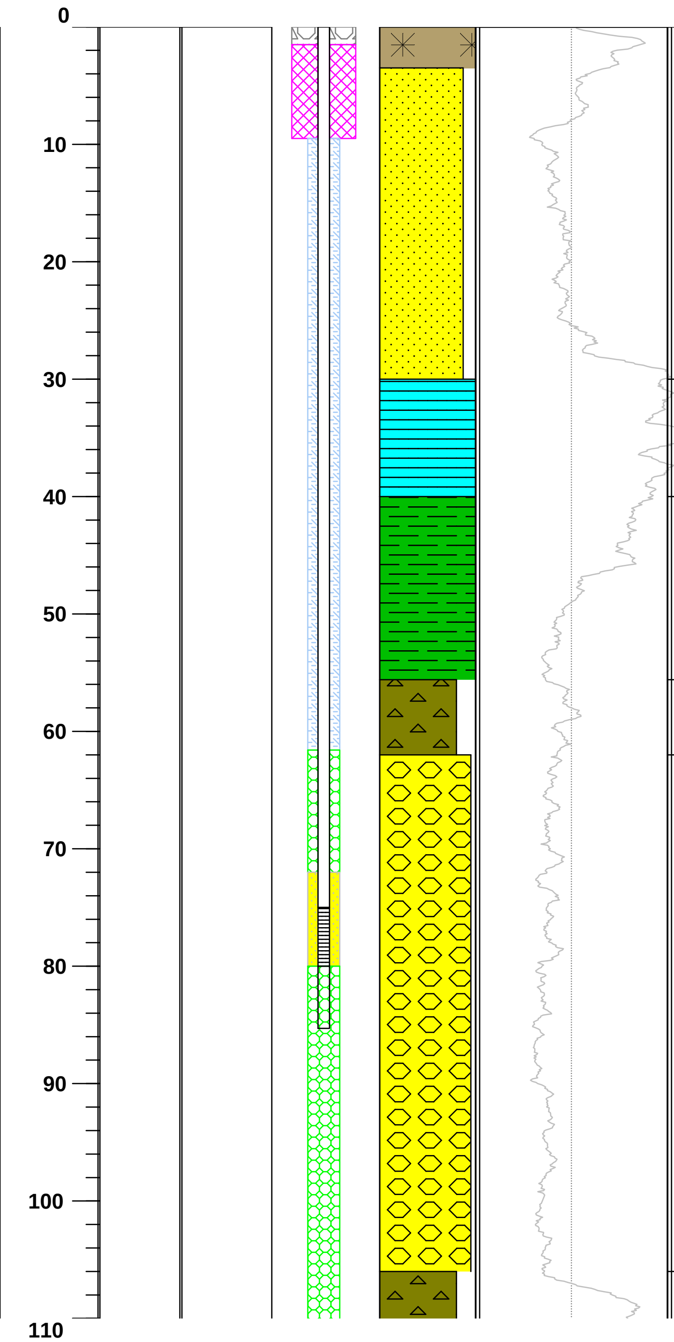


ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY	J. Thomason (field), D.Carlock (lab)
API NO.	121114362200
DRILLING METHOD	CME 75 - Wireline
DATE LOGGED	1-Oct-08
BOREHOLE NUMBER	HUNT-08-01
TOWNSHIP/RANGE/SECTION	43N 7E Sec 2 (NW,NE,NE)
CORE NUMBER	
NEAREST CITY / TOWN / LANDMARK	Crystal Lake, IL
COUNTY	McHenry
PROJECT NAME	Northeast Illinois Water Supply Planning
WATER LEVEL	
QUADRANGLE	Huntley
OWNER	McHenry County Conservation District (Wold Tract)
TIME	
DRILLED BY	Jack Aud (ISGS)
DATUM	NAD 83
ELEVATION	892
LOCATION OF BORING	N: 4677231.80683 E:386254.715444
DATE	
START TIME	
END TIME	
LOCATION	northwest corner of small grass area north of maintenance facility, ~200 feet west of Lily Lake Road
CASING DEPTH	
START DATE	
END DATE	

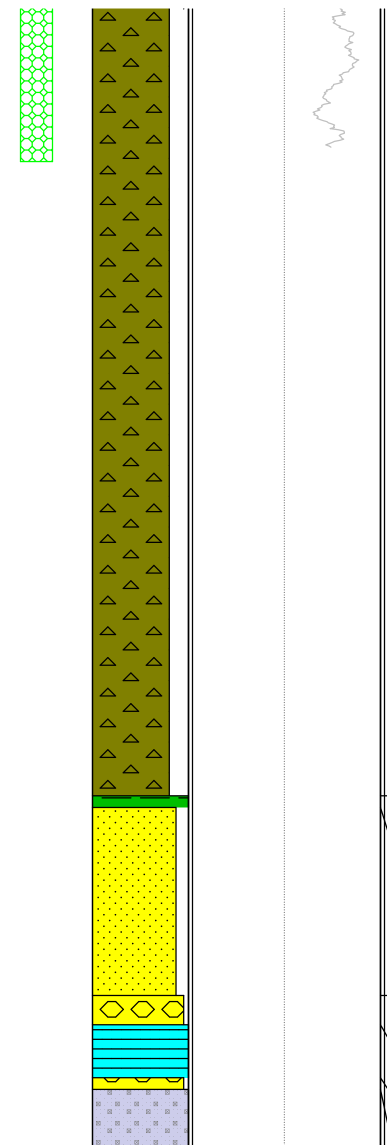
Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5 | Facies Code | Geologic Material Description | Interpretation



Facies Code	Geologic Material Description	Interpretation
S	(0.0) modern soil horizon, med sand w/ organics	Henry Formation, surficial
	(3.5) sand; medium to coarse with some gravel and silt lenses	
Fl	(30.0) clay; massive, v. plastic, dense	Equality Formation, glaciolacustrine
Fs	(40.0) silt; laminated w/ f. sand; trace pebbles, soft	
Dm	(55.6) diamicton; sandy loam diamicton; 2.5 YR 4/3; poorly cohesive, dense, dry, till?	Henry Formation, glaciofluvial
G	(62.0) gravel; coarse, rounded	
Dm	(106.0) diamicton; hard, dense, 2.5 YR 4/2, silty clay loam	Tiskilwa Formation, basal till

Depth (ft.) [cont'd]	Recovery: Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
110						matrix, intact shell at 172	
177.0					Fs	(177.0) silt; w/ small organics	
178.0					S	(178.0) sand; medium sand, well sorted w/ organics, wood @ 181, organic laminae	Pearl Formation, coarse facies glaciofluvial
194.0					G	(194.0) gravel; medium to coarse	
196.5					Fl	(196.5) clay; dense, 10YR4/3, some laminae w/ trace pebble	Pearl Formation, fine facies glaciolacustrine
201.0					G	(201.0) gravel; dense, weathered bedrock?	Silurian dolomite
202.0					B	(202.0) bedrock; dolomite	

Depth scale: 110, 120, 130, 140, 150, 160, 170, 180, 190, 200

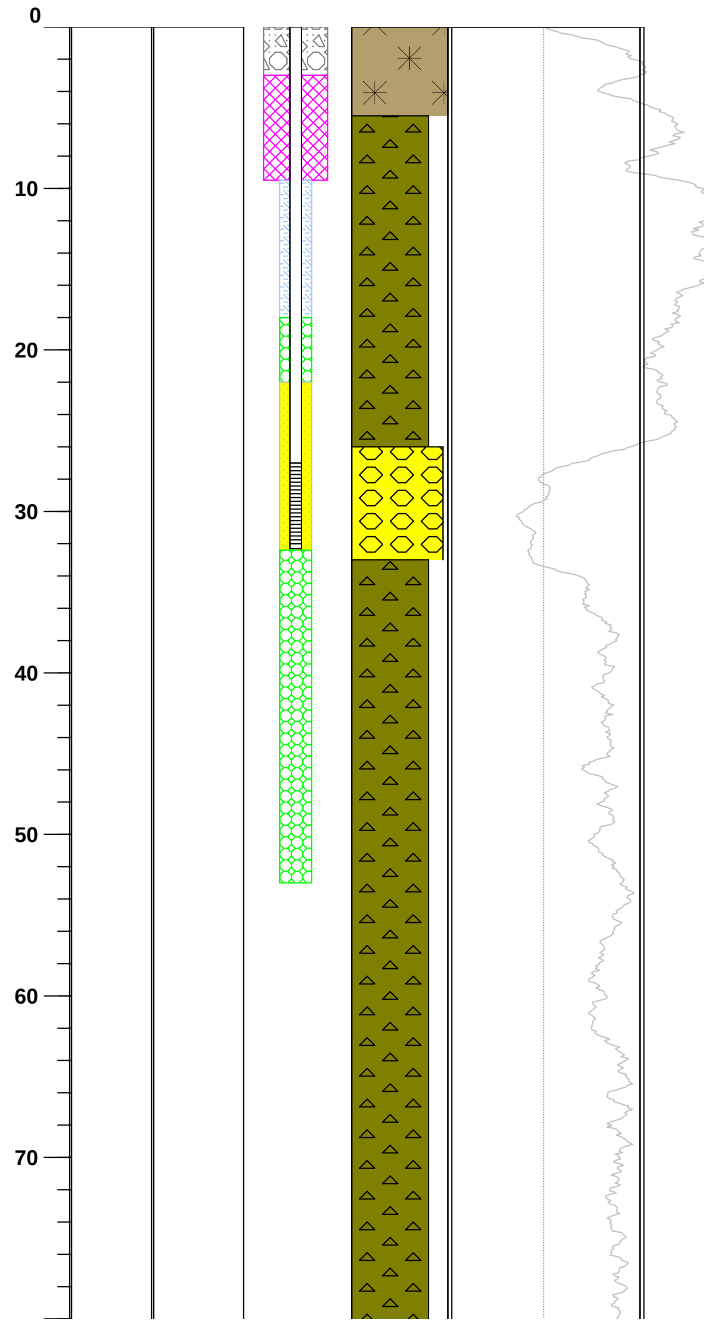


ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

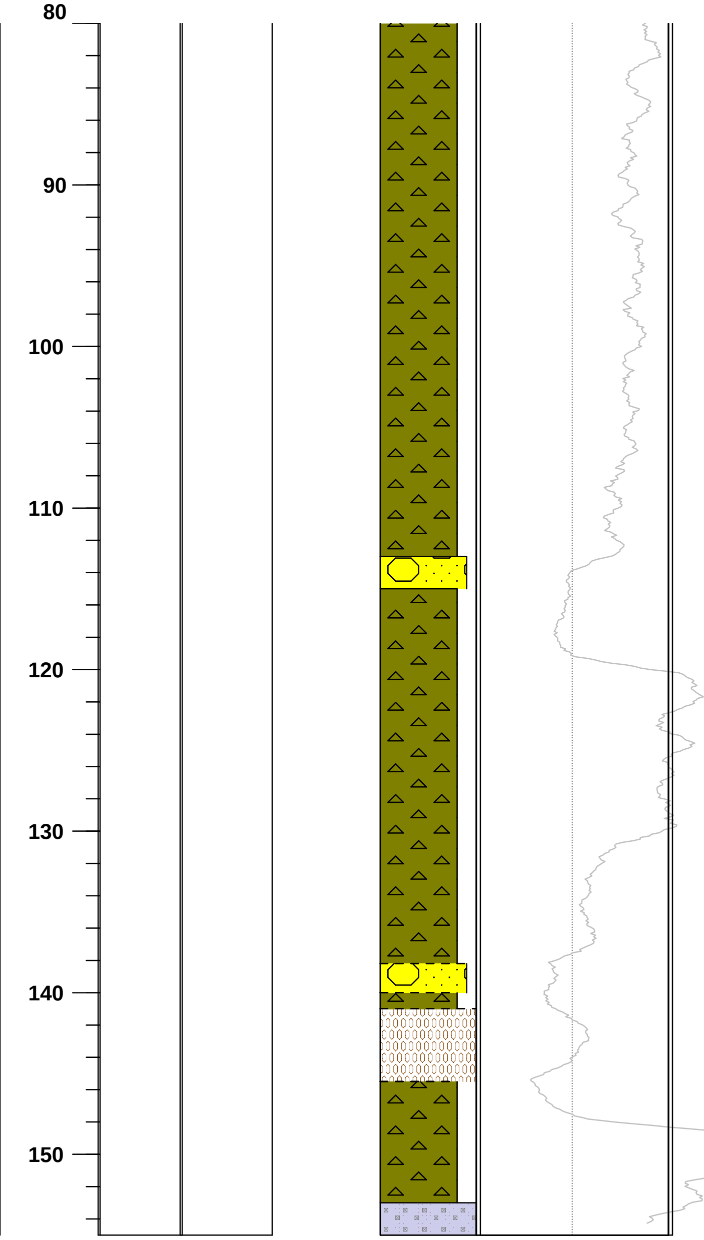
LOGGED BY	D.Carlock (field and lab)
API NO.	121114366900
DRILLING METHOD	CME 75 - Wireline
DATE LOGGED	7-Oct-08
BOREHOLE NUMBER	HUNT-08-02
TOWNSHIP/RANGE/SECTION	44N 7E Sec 31 (SE,SW,NE)
CORE NUMBER	
NEAREST CITY / TOWN / LANDMARK	Woodstock, IL
COUNTY	McHenry
PROJECT NAME	Northeast Illinois Water Supply Planning
QUADRANGLE	Huntley
OWNER	McHenry County Conservation District (Pleasant Valley Cons. Area)
DRILLED BY	Jack Aud (ISGS)
DATUM	NAD 83
ELEVATION	873
LOCATION OF BORING	N: 4678412.169 E: 379700.362
LOCATION	north of small parking area at entrance of Pleasant Valley Conservation Area, off of Pleasant Valley Road
WATER LEVEL	
TIME	
DATE	
CASING DEPTH	
START TIME	
END TIME	
START DATE	
END DATE	

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Geologic Material Description	Interpretation
(0.0) modern soil	Lemont Formation (Yorkville Member), subglacial till
(5.5) diamicton; silty clay loam, 10YR4/2	
(26.0) gravel; rounded, coarse, mostly dolomite, some igneous	Henry Formation (Undifferentiated), glaciofluvial
(33.0) diamicton; silty clay loam, 10YR4/3, sandy and pebbly, pinkish?	Tiskilwa Formation, basal till

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	**Geologic Material Description**	**Environment - Interpretation**



Geologic Material Description	Environment - Interpretation
(113.0) sand and gravel; medium	Henry Formation (Ashmore Tongue), glaciofluvial
(115.0) diamicton; dark brown at top (Robein); green below (Sangamon)	Glasford Formation, basal till
(138.2) sand and gravel; coarse	Pearl Formation, glaciofluvial
(140.0) diamicton; gray, silty clay loam with some sand	Glasford Formation, basal till
(141.0) diamicton w/ sand and gravel; medium to coarse, rounded	Glasford Formation, till w/ gravel
(145.5) diamicton; silty clay loam, mottled dk.red and dk.gray, pebbly	Glasford Formation, basal till
(153.0) bedrock; dolomite	Silurian dolomite

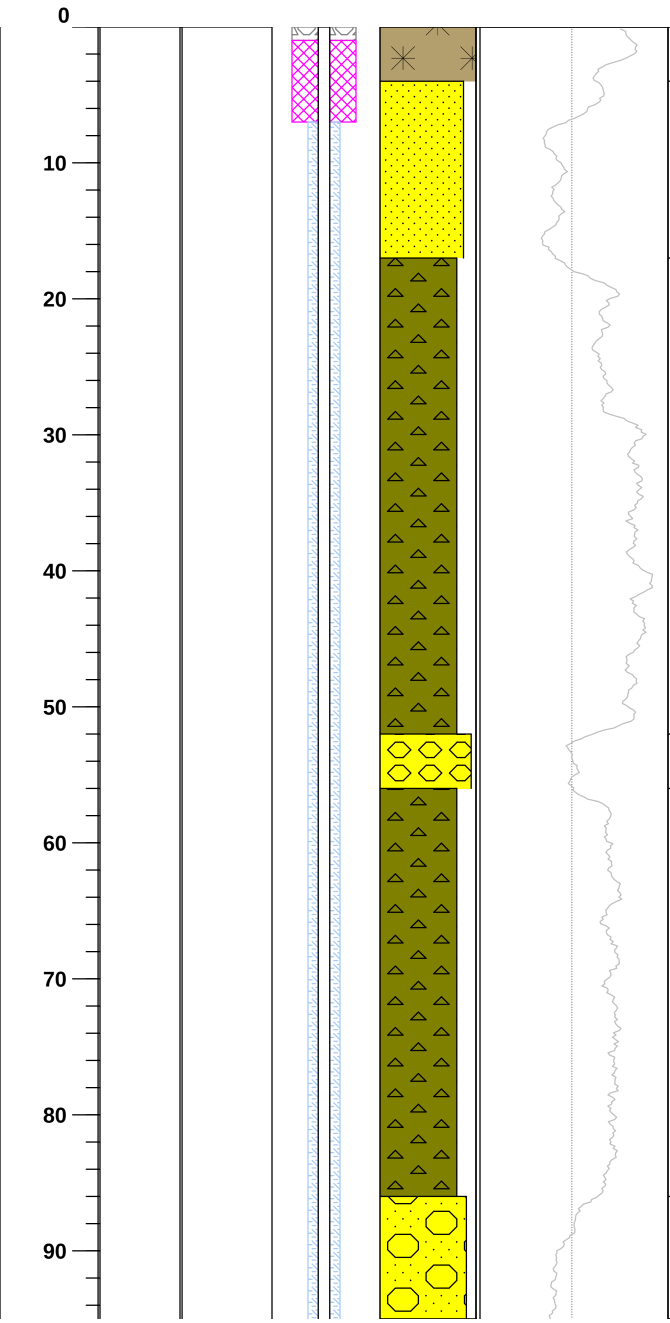
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY **T.Hodson/J.Thomason**				API NO. **121114381700**
DRILLING METHOD **CME 75 - Wireline**		DATE LOGGED **05-August-2009**		BOREHOLE NUMBER **HUNT-09-03**
TOWNSHIP/RANGE/SECTION				CORE NUMBER **HUNT-09-03**
NEAREST CITY / TOWN / LANDMARK **Huntley, IL**				COUNTY **McHenry**

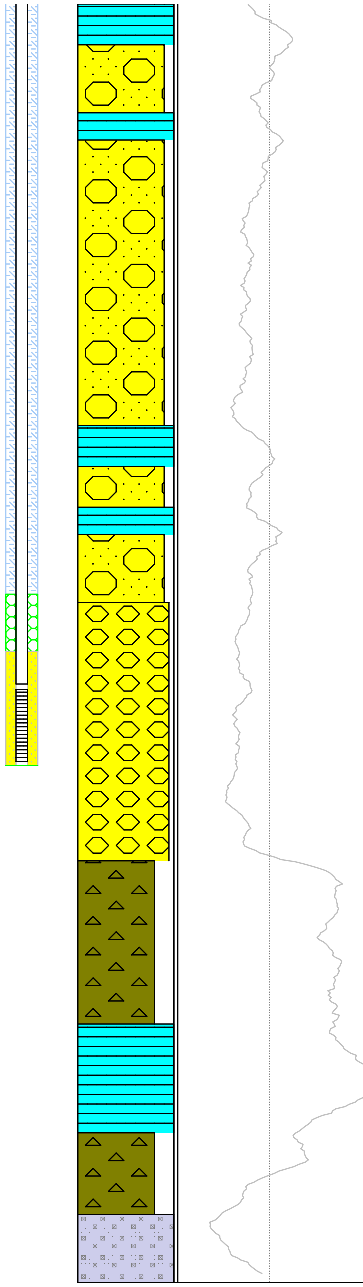
PROJECT NAME **McHenry County 3-D Mapping**			WATER LEVEL			QUADRANGLE **Huntley**
OWNER **MCCD (Hennig Parcel-undeveloped)**			TIME			DRILLED BY **Travis Greist (ISGS)**
DATUM **NAD 83**	ELEVATION **878**	LOCATION OF BORING **N: 4671795.188 E:378476.675**	DATE			START TIME / END TIME
LOCATION MCCD property (undeveloped), northernmost end of Diekman Road off of Marengo Road, ~100 feet north of			CASING DEPTH			START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 20 Cond 80 0 Resist 30 9.4 Temp 10.5



Facies Code	Geologic Material Description	Interpretation
O	(0.0) soil; silty clay-clay; 7.5YR5/4(dk.brn), non cohesive	Mason Group, Henry Formation, soil, Hen1
S	(4.0) sand; medium-coarse w/ fine gravel	
Dm	(17.0) diamicton; silty clay loam, 7.5YR5/4(brn), dense, pebbly	Wedron Group, Tiskilwa Formation (subglacial till), Wt
G	(52.0) gravel; gravel lense in diamicton	
Dm	(56.0) diamicton; silty clay loam, 7.5YR5/4(brn), dense, pebbly	
SG	(86.0) sand and gravel; fine-med gravel; some beds of silt and clay	Mason Group, Ashmore Member (glaciofluvial), Ha

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
					F	(95.0) clay interval, 5Y5/2(olive gray)	
100					SG	(98.0) sand and gravel; fine-med gravel; some beds of silt and clay	
					F	(103.0) clay interval, 5Y5/2(olive gray)	
110					SG	(105.0) sand and gravel; fine-med gravel; some beds of silt and clay	
120							
					F	(126.0) clay interval, 5Y5/2(olive gray)	
130					SG	(129.0) sand and gravel; fine-med gravel; some beds of silt and clay	
					F	(132.0) clay interval, 5Y5/2(olive gray)	
140					SG	(134.0) sand and gravel; fine-med gravel; some beds of silt and clay	
					G	(139.0) gravel; coarse, mixed lithology, cobbles	
150							
160					Dm	(158.0) diamicton; silty clay loam, 10YR5/2(gr.brn), dense, pebbly	Glasford Formation, Oregon Member (subglacial till), G1
170					Fl	(170.0) clay; silty, laminated, dense, 10YR5/2(gr.brn)	
180					Dm	(178.0) diamicton; silty clay loam, 10YR5/2(gr.brn), softer than above	Glasford Formation, Fairdale Member, (subglacial), G2
					B	(184.0) bedrock, carbonate	Silurian Dolomite



ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY **T.Hodson (field), J.Thomason (lab)**		API NO. **121114381400**
DRILLING METHOD **CME 75 - Wireline**	DATE LOGGED **July-2009**	BOREHOLE NUMBER **MARN-09-01**
TOWNSHIP/RANGE/SECTION		CORE NUMBER **MARN-09-01**
NEAREST CITY / TOWN / LANDMARK **Woodstock, IL**		COUNTY **McHenry**

PROJECT NAME
McHenry County 3-D Mapping

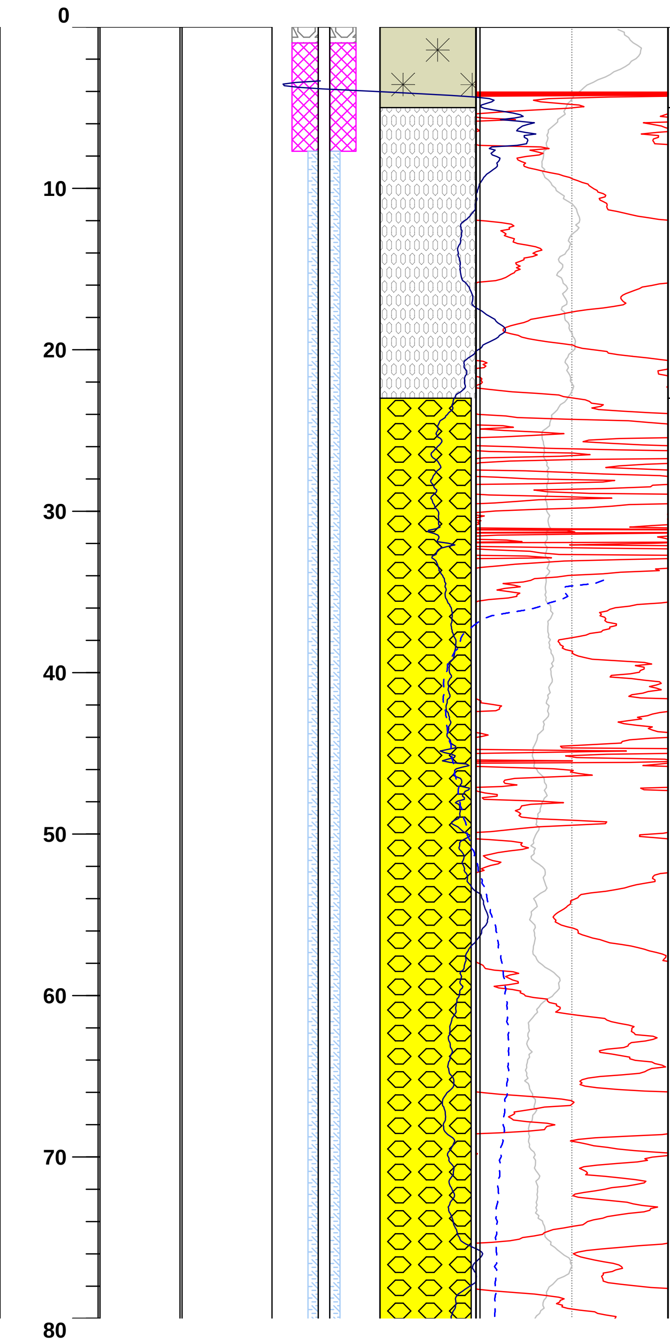
OWNER
McHenry County Conservation District (Brookdale Conservation Area)

DATUM	ELEVATION	LOCATION OF BORING	
NAD 83	**907**	**N: 4690422.08**	**E:372153.444**

LOCATION Brookdale Conservation Area-MCCD property (undeveloped), boring/well located within small grove of

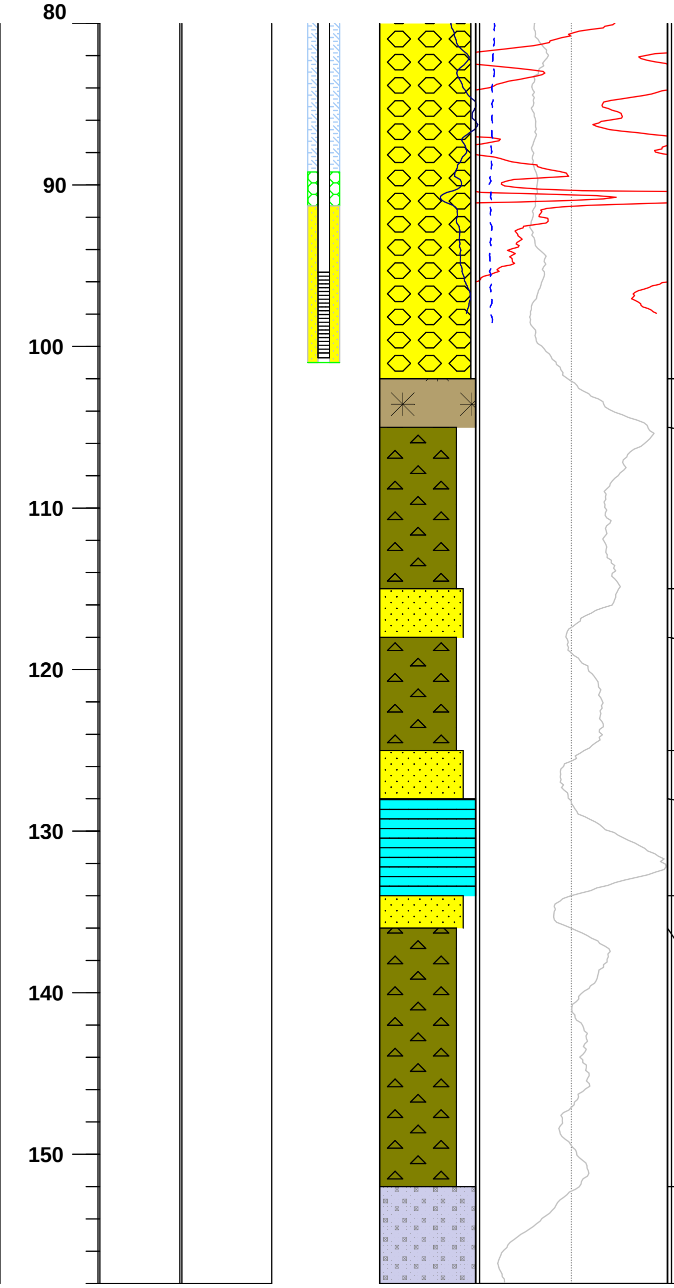
WATER LEVEL				QUADRANGLE **Marengo North**
TIME				DRILLED BY **Travis Greist**
DATE				START TIME / END TIME
CASING DEPTH				START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 20 Cond 80 0 Resist 30 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Facies Code	Geologic Material Description	Interpretation
Fill	(0.0) fill; foundation of homestead	
Gd	(5.0) gravel; cobbles, coarse, poor recovery, higher gamma suggests some fines	
G	(23.0) gravel; cobbly, coarse, mixed lithologies, angular to rounded, seems to coarsen w/ depth	

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation

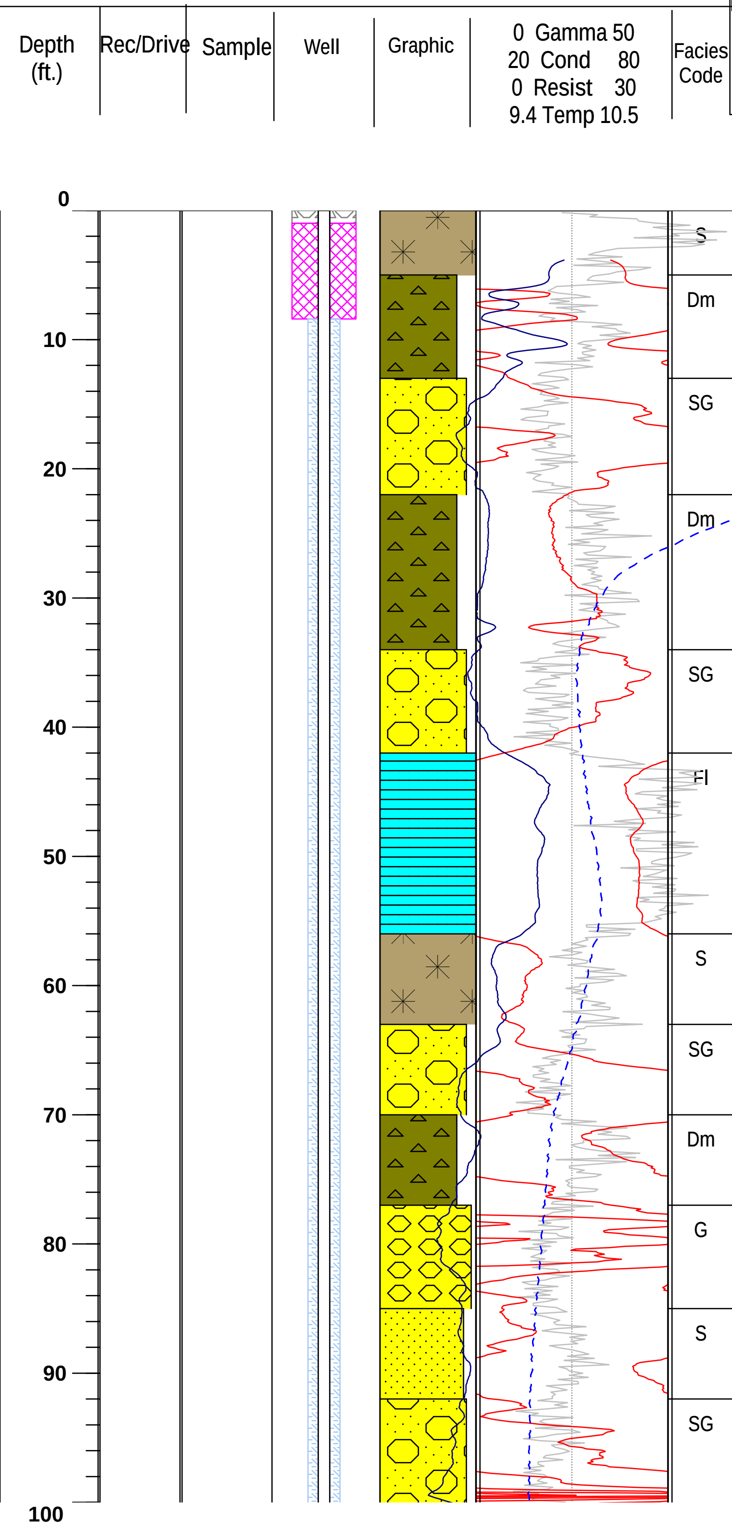


Facies Code	Geologic Material Description
O	(102.0) soil; paleosol in diamicton parent material
Dm	(105.0) diamicton; silt loam; gravelly, 2.5Y5/2 (lt. olive brn)
S	(115.0) sand lense
Dm	(118.0) diamicton; silt loam; gravelly, 2.5Y5/2 (lt. olive brn)
S	(125.0) sand lense
Fc	(128.0) clay; dense, weakly laminated, 2.5Y5/2(lt.olive brn)
S	(134.0) sand lense
Dm	(136.0) diamicton w/ sand; interbedded, silt loam diamicton, 2.5Y5/2(lt. olive brn)
B	(152.0) bedrock; Silurian dolomite

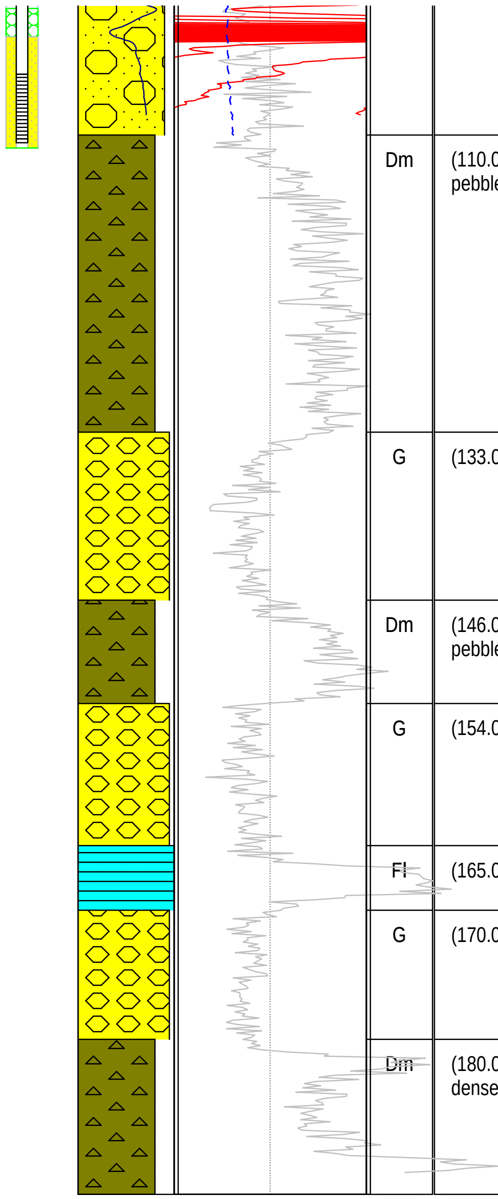
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: D.Carlock/J.Thomason		API NO.: 121114381500
DRILLING METHOD: CME 75 - Wireline	DATE LOGGED: 16-July-2009	BOREHOLE NUMBER: MARN-09-02
TOWNSHIP/RANGE/SECTION:		CORE NUMBER: MARN-09-02
NEAREST CITY / TOWN / LANDMARK: Marengo, IL		COUNTY: McHenry
PROJECT NAME: McHenry County 3-D Mapping	WATER LEVEL:	QUADRANGLE: Marengo North
OWNER: MCCD (River Road Location)	TIME:	DRILLED BY: Travis Greist (ISGS)
DATUM: NAD 83; ELEVATION: 827; LOCATION OF BORING: N: 4682287.615 E: 366488.572	DATE:	START TIME: ; END TIME:
LOCATION: MCCD property along south side of River Road, former homestead, no buildings, west of Rt 23 and Elizabeth St.	CASING DEPTH:	START DATE: ; END DATE:



Facies Code	Geologic Material Description	Interpretation
S	(0.0) soil; organic w/ mottles of silty clay loam w/ sand lenses	Mason Group, Henry Formation, (colluvium), Hen1
Dm	(5.0) diamicton; silty clay loam, brown-pink, colluvium?	
SG	(13.0) sand and gravel; medium, fine-medium pebbles, poorly sorted, rounded, lt brn	Mason Group, Beverly Member (glaciofluvial), Hb
Dm	(22.0) diamicton; silty clay loam, dense, pebbly, pink-gray	Wedron Group, Tiskilwa Formation (subglacial till), Wt
SG	(34.0) sand and gravel; med-coarse, pebble-cobble gravel	Mason Group, Ashmore Member (glaciofluvial), Ha
Fl	(42.0) clay; clay loam, laminated w/ fine sand lenses; pink-gray	Peddicord Formation, (glaciolacustrine), G1
S	(56.0) soil; paleosol, sandy loam, gray, formed in sand parent material	Robein Silt (paleosol), G1
SG	(63.0) sand and gravel; med sand w/ f-coarse pebbles, small cobble gravel, gray	Glasford Formation, Oregon Member (subglacial till), G1
Dm	(70.0) diamicton; sandy loam, pink-gray	
G	(77.0) gravel; coarse, cobble gravel	Glasford Formation, sandy facies (glaciofluvial), GS1
S	(85.0) sand; fine, gray	
SG	(92.0) sand and gravel; coarsening downward, 75%carbonate pebbles	



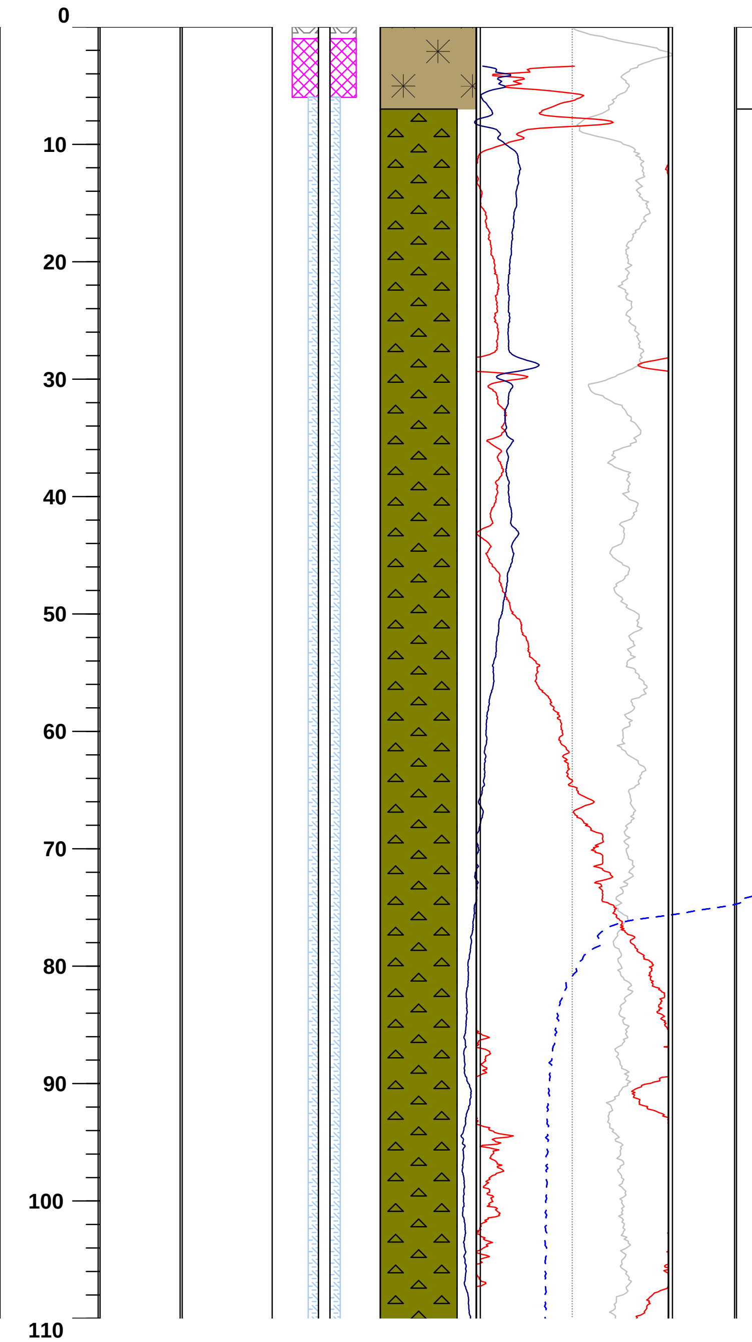
Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
100							
110					Dm	(110.0) diamicton; silty clay loam, gray, dense, large pebbles to cobbles	Glasford Formation, Fairdale Member, (subglacial), G2
120							
130					G	(133.0) gravel; coarse, large cobbles	Glasford Formation, Fairdale Member, Sandy facies, (glaciofluvial), GS2
140							
					Dm	(146.0) diamicton; silty clay loam, gray, dense, large pebbles to cobbles	
150							
					G	(154.0) gravel; coarse, large cobbles	
160							
					Fl	(165.0) clay; silty clay loam, laminated w. v.f.sand	
170					G	(170.0) gravel; fine-medium cobble gravel	
180					Dm	(180.0) diamicton; silty clay loam, 10YR4/3(brown), v. dense, swelling	Glasford Formation, Kellerville Member, (subglacial), GS2
190							

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

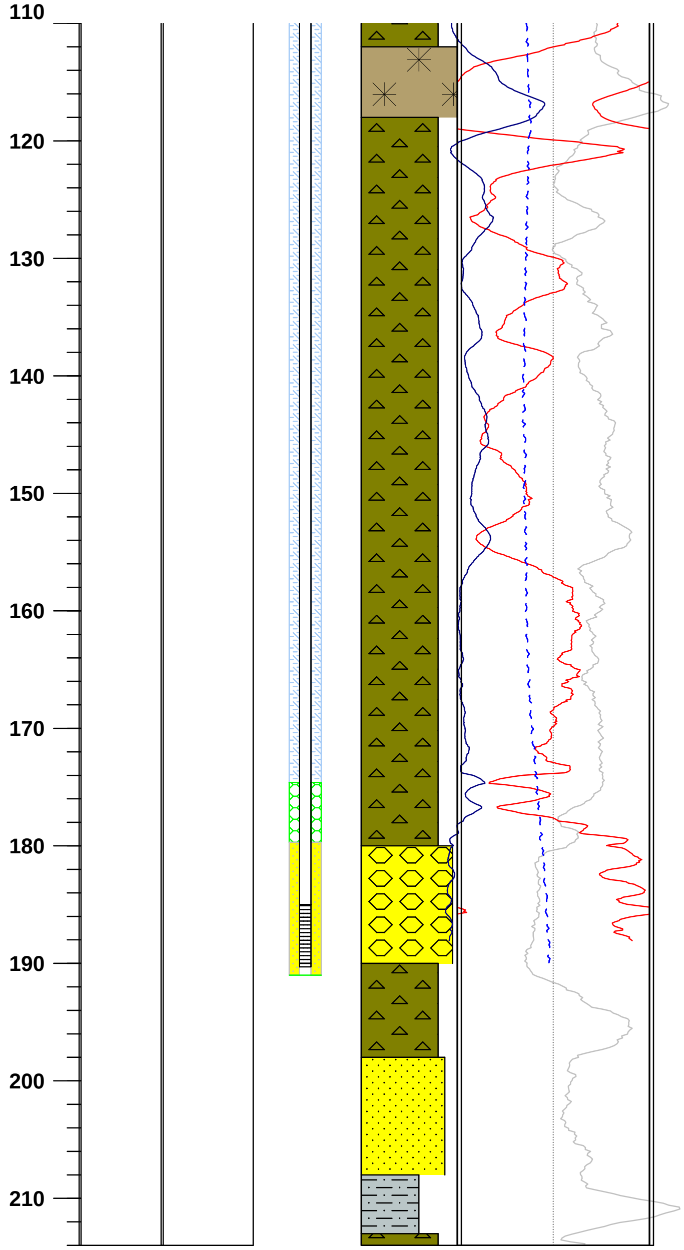
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY	D.Carlock/J.Thomason
API NO.	121114381600
DRILLING METHOD	CME 75 - Wireline
DATE LOGGED	29-July-2009
BOREHOLE NUMBER	MARS-09-01
TOWNSHIP/RANGE/SECTION	
CORE NUMBER	MARS-09-01
NEAREST CITY / TOWN / LANDMARK	Marengo, IL
COUNTY	McHenry
PROJECT NAME	McHenry County 3-D Mapping
QUADRANGLE	Marengo South
OWNER	MCCD (Coral Woods Maintenance Facility)
DRILLED BY	Travis Greist (ISGS)
DATUM	NAD 83
ELEVATION	928
LOCATION OF BORING	N: 4675675.164 E:370447.834
LOCATION	MCCD maintenance facility, west side of Rt 20 north of Coral Road in small grass field north of office and barn
WATER LEVEL	
TIME	
DATE	
CASING DEPTH	
START TIME	
END TIME	
START DATE	
END DATE	

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation
0							(0.0) soil/fill; silty clay loam in gravel fill, mixed w/ quartzite, large cobbles, boulders	Fill, Wt
7							(7.0) diamicton; silty clay loam, 7.5YR5/4-10YR4/4(brn-dk.ylw.brn), pebbly, sandy intervals from 30-45, dense	Wedron Group, Tiskilwa Formation (subglacial till), Wt



Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Geologic Material Description	Environment - Interpretation
(112.0) soil; paleosol, clay loam, Gley4/56Y (olive/brn), organic w/ wood fragments	Robein Silt (paleosol), G1
(118.0) diamicton; silty clay loam, 10YR4/3(brown), w/ sandy intervals from 118-140, variable texture	Glasford Formation, Oregon Member (subglacial till), G1
(180.0) gravel; coarse, angular, fine to coarse cobbles	Glasford Formation, sandy facies (glaciofluvial), GS1
(190.0) diamicton; silty clay loam, very dense	Glasford Formation, Fairdale Member, (subglacial), G2
(198.0) sand; fine, w/sandy loam, 10YR5/3 (brn)	Glasford Formation, Fairdale Member, Sandy facies, (glaciofluvial), GS2
(208.0) silt-clay; fine, diamicton-like, lacustrine?	Glasford Formation, Fairdale Member, Fine facies, (glaciolacustrine), GS2
(213.0) bedrock; carbonate	Silurian Dolomite

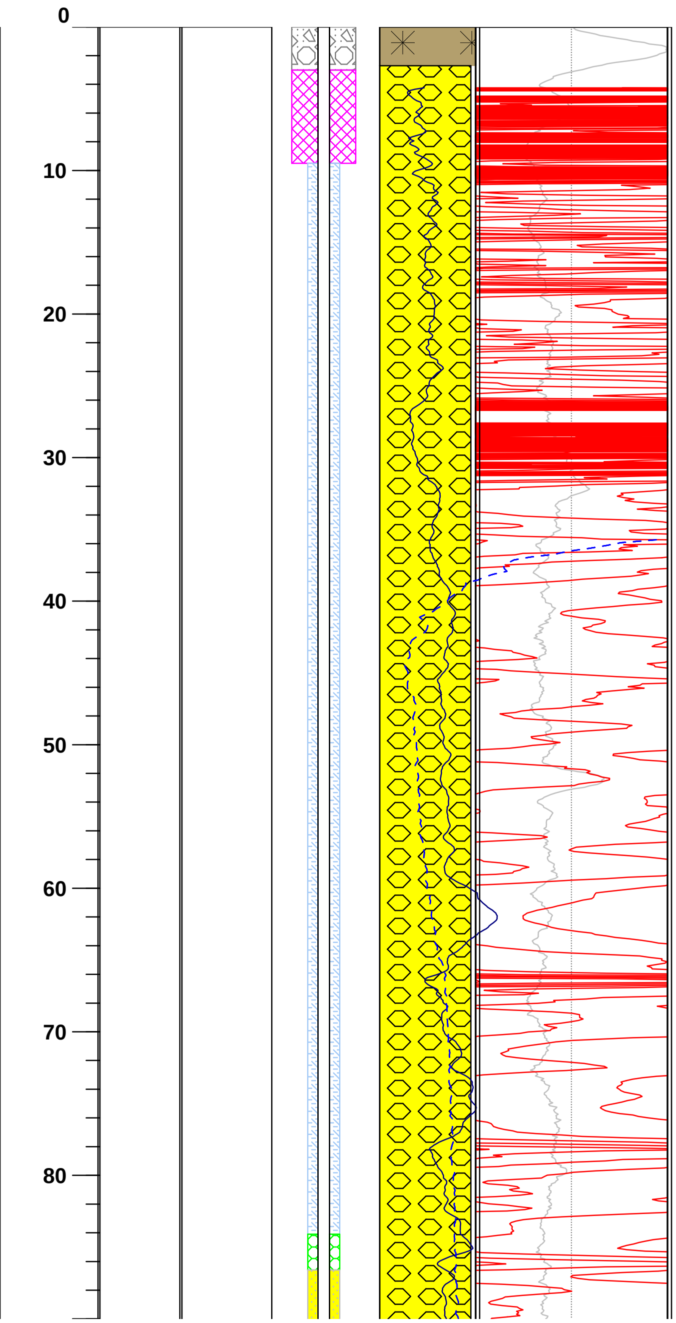
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

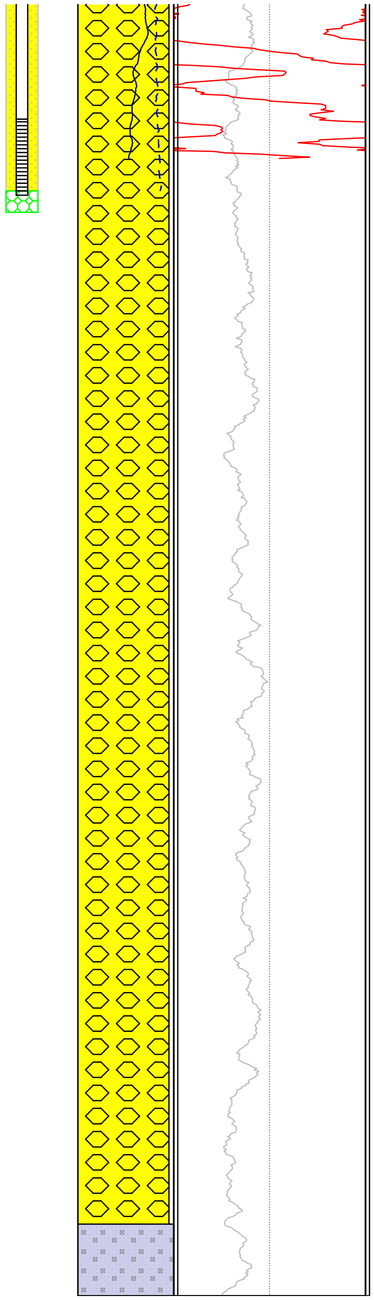
LOGGED BY **J. Thomason (field), D.Carlock (lab)**		API NO. **121114362000**
DRILLING METHOD **CME 75 - Wireline**	DATE LOGGED **18-Sept-08**	BOREHOLE NUMBER **MHEN-08-01**
TOWNSHIP/RANGE/SECTION **45N 7E Sec 25 (SW,SW,SW)**		CORE NUMBER **MHEN-08-01**
NEAREST CITY / TOWN / LANDMARK **Woodstock, IL**		COUNTY **McHenry**

PROJECT NAME **Northeast Illinois Water Supply Planning**			WATER LEVEL		QUADRANGLE **McHenry**
OWNER **McHenry County Conservation District (Wold Tract)**			TIME		DRILLED BY **Jack Aud (ISGS)**
DATUM **NAD 83**	ELEVATION **860**	LOCATION OF BORING **N: 4688698.654 E:386955.154**	DATE		START TIME / END TIME
LOCATION	1/8 mile east of Cold Spring Road, along wooded/gated access road into preserve (former hunt club)		CASING DEPTH		START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation
0–90							(0.0) modern soil horizon	Henry Formation (Beverly Tongue); glaciofluvial
							(2.7) sand and/or gravel; coarse to very coarse, very poor recovery from 0-45; no recovery from 45-175, some sand lenses throughout	



Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
90							
100							
110							
120							
130							
140							
150							
160							
170						(175.0) bedrock; dolomite	Silurian dolomite
180							



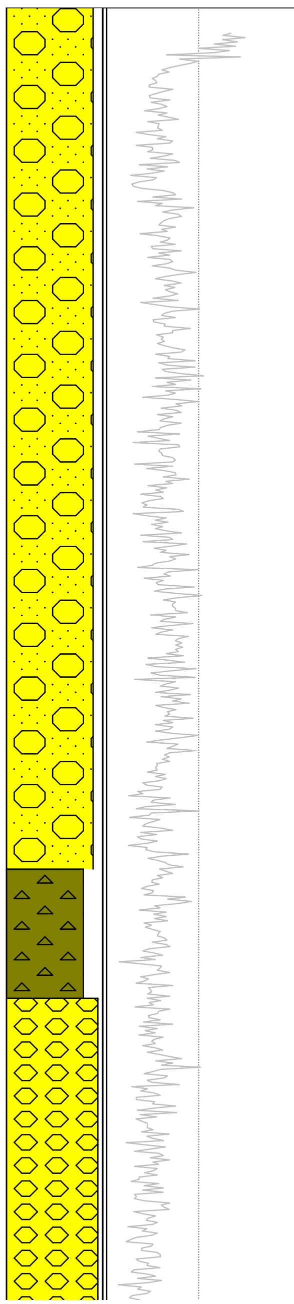
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY	M.L. Barnhardt
API NO.	121114023800
DRILLING METHOD	CME 75 - Wireline
DATE LOGGED	11-01-2002
BOREHOLE NUMBER	WAUC-02-12
TOWNSHIP/RANGE/SECTION	T44N R8E Sec 25 (Quarters: NENESE)
CORE NUMBER	
NEAREST CITY / TOWN / LANDMARK	Wauconda
COUNTY	McHenry
PROJECT NAME	STATEMAP/Central Great Lakes Mapping Coalition
WATER LEVEL	
QUADRANGLE	Wauconda
OWNER	Prairieview Education Center, McHenry County Conservation District
TIME	
DRILLED BY	Jack Aud (ISGS)
DATUM	NAD 83
ELEVATION	842.7
LOCATION OF BORING	N: 4679741.16 E: 397749.73
DATE	
START TIME	2:00 P.M.
END TIME	3:00 P.M.
LOCATION	2112 Behan Road, Crystal Lake, IL; by barn in NW corner parking lot
CASING DEPTH	
START DATE	10/17/2002
END DATE	10/23/2002

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50, 20 Cond 80, 0 Resist 30, 9.4 Temp 10.5 | Facies Code | Geologic Material Description | Interpretation

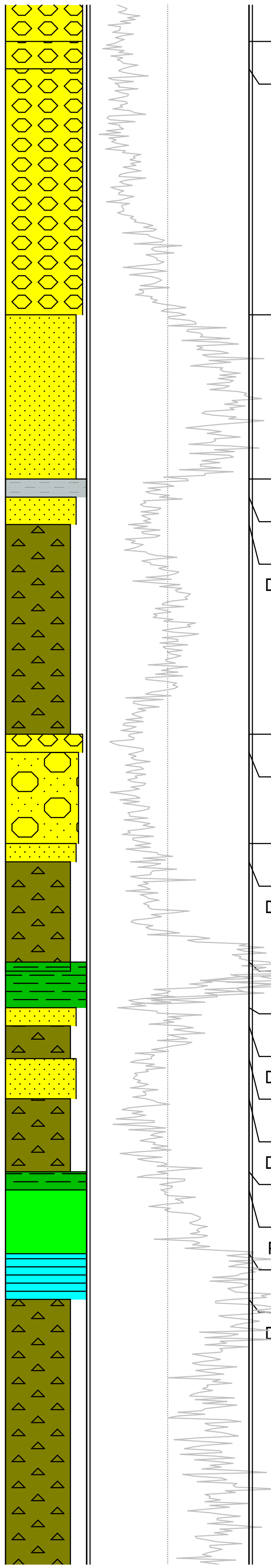
Depth scale: 0, 10, 20, 30, 40, 50, 60



Depth (ft.)	Facies Code	Geologic Material Description	Interpretation
0–40	S	(0.0) sand with gravel; gravelly sandy clay loam-clay loam texture; modern soil ; site is surface modified; sticky; gravel is very fine with some medium, subangular-subrounded; sand is moderately to poorly sorted (Auger Cutting to 11'); (3.5-8) sand with gravel; increasing sand with gravel - becoming loose or very friable; sand is medium with very fine gravel; (8-11) single grain - more fine sand than above; moderately well sorted with very fine gravel, rounded to subrounded; (11-16) sand with gravel; bedded, beds of fine sand-very well sorted, medium sand-coarse sand with very fine gravel; very poorly sorted; occasional thin lenses very fine sand-silt; gravel increasing with depth; (16-18) sand, very fine-fine @16.5-18; (18-21) gravel, @ 20.5' - gravelly, very fine-medium, rounded to subrounded; moderately well sorted; (21-23) gravel; very fine-medium; clear boundary to decreasing gravel below; (23-25) sand; medium-coarse sand, very poorly sorted with fine-medium gravel; very fine sand @24'; (25-26) sand; medium with very fine gravel; (26-30) sand; medium-coarse, poorly to very poorly sorted, with gravel, very fine-medium, poorly sorted; bedded with lenses of very fine-fine sand and medium-coarse sand; (30-31) sand; very fine-fine sand @ 30.5-31' ; (31-32.5) gravel; gravel with sand, gravel is very poorly sorted, mostly very fine gravel; sand is moderately-poorly sorted; (32.5-34) sand; abrupt change - very fine sand, very well sorted, some silt; (34-35) gravel; gravelly, fine sand lense; (35-37) gravel; medium-coarse, very poorly sorted, igneous and dolomite, subrounded to subangular; (37-38) diamicton; possible diamicton @37.5', silty; (38-40) gravel; medium-coarse, moderately well sorted	Henry formation 1(proglacial fluvial); Haeger member till (subglacial)
40–46	Dm	(40.0) diamicton; increasing silt and sand, some white silt @ 41' - possible diamicton; (41-46) gravelly - very large pebbles and cobbles	Haeger member undivided (proglacial/icemarginal/subglacial)
46–60	G	(46.0) gravel; abrupt contact to gravel @ 46', medium-coarse, poorly sorted, subrounded to subangular; (47.3-50) abrupt contact with very coarse gravel; gravel is igneous, dolomitic, some boulder size gravel; (50-62) very coarse; drilled 49-61' in very coarse gravel	Haeger member (ice marginal); Henry Formation- Beverly (proglacial fluvial)

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation

Depth: 60, 70, 80, 90, 100, 110, 120, 130, 140



Facies Code: G, G, S, F, S, Dm, G, S, S, Dm, F, S, Dm, S, Dm, S, Fo, F, Dm

Geologic Material Description

(62.0) gravel with diamicton; gravel with sand, sandy loam; 10YR6/8; brownish yellow; very poorly gravel; sorted

(63.5) gravel - very coarse; (76-77) fine-medium

(77.0) sand; very fine, very well sorted; sand is strongly bedded, some cross-bedding; silt lense @78' ; (78-80) compact, laminated, 10YR5/4; yellowish brown; white very fine sand-silt in bedding planes, becoming 10YR4/2; dark grayish brown; (80-81) laminated, strongly; (81-83) becoming massive silt with some black organic smears (3-5mm diameter); (83-85) silt loam texture, very dense to silty clay loam; black organic-rich(?) lenses, somewhat continuous, ~ 2-5mm wide; (85-86) massive, some lenses of silt

(86.0) clay with silt; strongly laminated with bands of organics

(87.0) sand; coarse sand-medium sand at top then becoming fine sand; faint thin bedding, very well sorted

(88.5) diamicton; coarse gravel pieces in loamy sand; 10YR5/2; grayish brown; matrix possible diamicton; (90-92) loam to clay loam; 10YR5/2; grayish brown; abrupt change in color @ 92'; 10YR4/3; brown; (92-100) very pebbly, subrounded-angular; very fine-coarse gravel size; increasing silt @ 94'; fine sand lenses @ 99'

(100.0) gravel; fine-coarse, rounded, moderately well sorted, some sand - medium, poorly sorted; some silt

(101.0) sand with gravel; sand is medium - but poorly sorted; gravel is very fine-fine, moderately well sorted to poorly sorted, mostly rounded to subrounded

(106.0) sand; medium-fine, well sorted

(107.0) diamicton; sandy laom; 2.5Y5/2; grayish brown; diamicton @ 107' - sandy loam, gravelly, very fine-fine; medium-coarse sand inclusions

(112.5) silt; silty clay loam, laminated

(115.0) sand; medium sand lense - poorly sorted; silt @ 115.5'

(116.0) diamicton; silt loam to loam, pebbly

(117.8) sand; loamy fine sand with gravel - very fine-medium, rounded to subrounded

(120.0) diamicton; sandy loam; 5Y6/2; light olive gray; very friable; (122-124) very pebbly, very fine-medium gravel, subrounded to subangular; sand inclusions, some Mn stains, some faint clay bridges and skins around pebbles

(124.0) silt; peat, some fibrous, mostly sapric, black silt

(125.0) peat; very high organic content; some very fine sand inclusions

(128.5) clay; with organics, decreasing OM content @ ~130'; diamicton, becoming very dense, very hard, leached, few very fine pebbles, subangular; poss. Geosol (Sangamon?); (130-131) some very fine pebbles, becoming gritty @ 131'

Environment - Interpretation

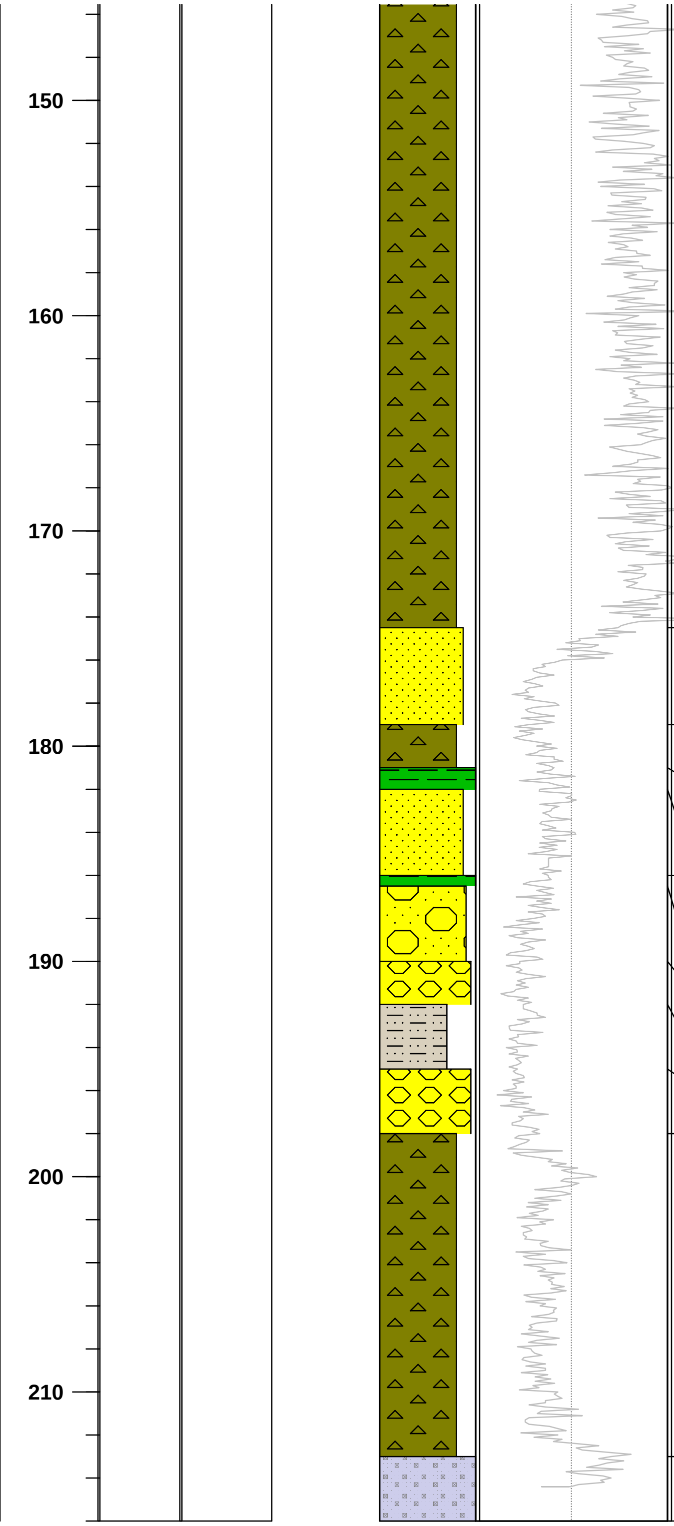
Equality Formation- below Beverly tounge (glaciolacustrine)

Tiskilwa undivided (subglacial)

Equality Formation- Peddicord (glaciolacustrine)

Pre-Wisconsinan 1- (subglacial)

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Facies Code	Geologic Material Description	Environment - Interpretation
	(131.0) diamicton; diamicton/clay, slightly calcareous; 5Y4/1; dark gray; very coarse sand-coarse sand pieces, white with 2-3mm pebbles common, plastic; (135-136) increase in pebble frequency and size; somewhat contorted sediments @135.5-136' ; (136-140) better diamicton; 7.5YR5/2; brown; white silt inclusions (small <1cm); (140-150) same as above; occasional thin white silt along short fractures, pebbles mostly 5-10mm size, occasionally up to 50mm; dense, firm, moderately calcareous; (150-160) zones of very coarse sand-coarse sand and 2-3mm pebbles; firm to hard, very dense; texture is more silt loam, heavy, silty clay loam than loam, sticky, somewhat plastic; (160-170) occasional black and blue-green shale clasts; (170-174.5) some silt fracture @ 173'	
S	(174.5) sand; fine sand in thin lense @ 174.5; thin silt and fine sand-very fine sand lenses - horizontal @ 175.5' ; (176.5-179) mostly fine; 10YR6/2; light brownish gray; poorly-moderately well sorted; some silt, trace gravel, loose	Pre-Wisconsinan 1- (proglacial fluvial)
Dm	(179.0) diamicton; large pebble, gravelly zone @ 179'	
F	(181.0) silt; silt with very fine sand, massive, soft	
S	(182.0) sand; very fine sand with silt; (184-186) sand with silt, very fine sand/silt	
F	(186.0) silt; silty	
S	(186.5) sand with gravel; @186.5' cobble; sand and gravel, very poorly sorted; sand is mostly fine-medium, very poorly sorted; gravel is very fine-medium mostly, some medium-coarse	
G	(190.0) gravel; medium-coarse, poorly sorted; sand is fine-medium, poorly sorted	
S	(192.0) sand with silt; increasing sand and silt, very poorly sorted, weakly calcareous	
G	(195.0) gravel; medium-coarse with sand	
Dm	(198.0) diamicton; loam to clay loam; 2.5Y5/2; grayish brown; cobble-boulder-size rocks in beds; black/gray shale, igneous, dolomite pebbles/cobbles, calcareous; (200-203) diamicton, @201' gravel bed, fine-coarse, poorly sorted, few pieces diamicton intermixed in sample; (203-210) diamicton; as above; loam; 2.5Y6/2; gritty, somewhat sticky; weakly calcareous @ 208.5' ; (210-213) diamicton; increasing sand with depth, fewer large pebbles than above; loamy sand or sandy loam, gravelly; gravel is mostly very fine - 2-4mm size	Pre-Wisconsinan 2- (subglacial)
B	(213.0) bedrock; dolomite, weathered 213-213.5' then solid rock; bedrock top @ 213', total depth 216'	Bedrock (Silurian shallow marine)

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY **J. Thomason (field), D.Carlock (lab)**		API NO. **121114362100**
DRILLING METHOD **CME 75 - Wireline**	DATE LOGGED **22-Sept-08**	BOREHOLE NUMBER **WAUC-08-13**
TOWNSHIP/RANGE/SECTION **44N 9E Sec 5 (NE,NW,SW)**		CORE NUMBER **WAUC-08-13**
NEAREST CITY / TOWN / LANDMARK **Island Lake, IL**		COUNTY **McHenry**

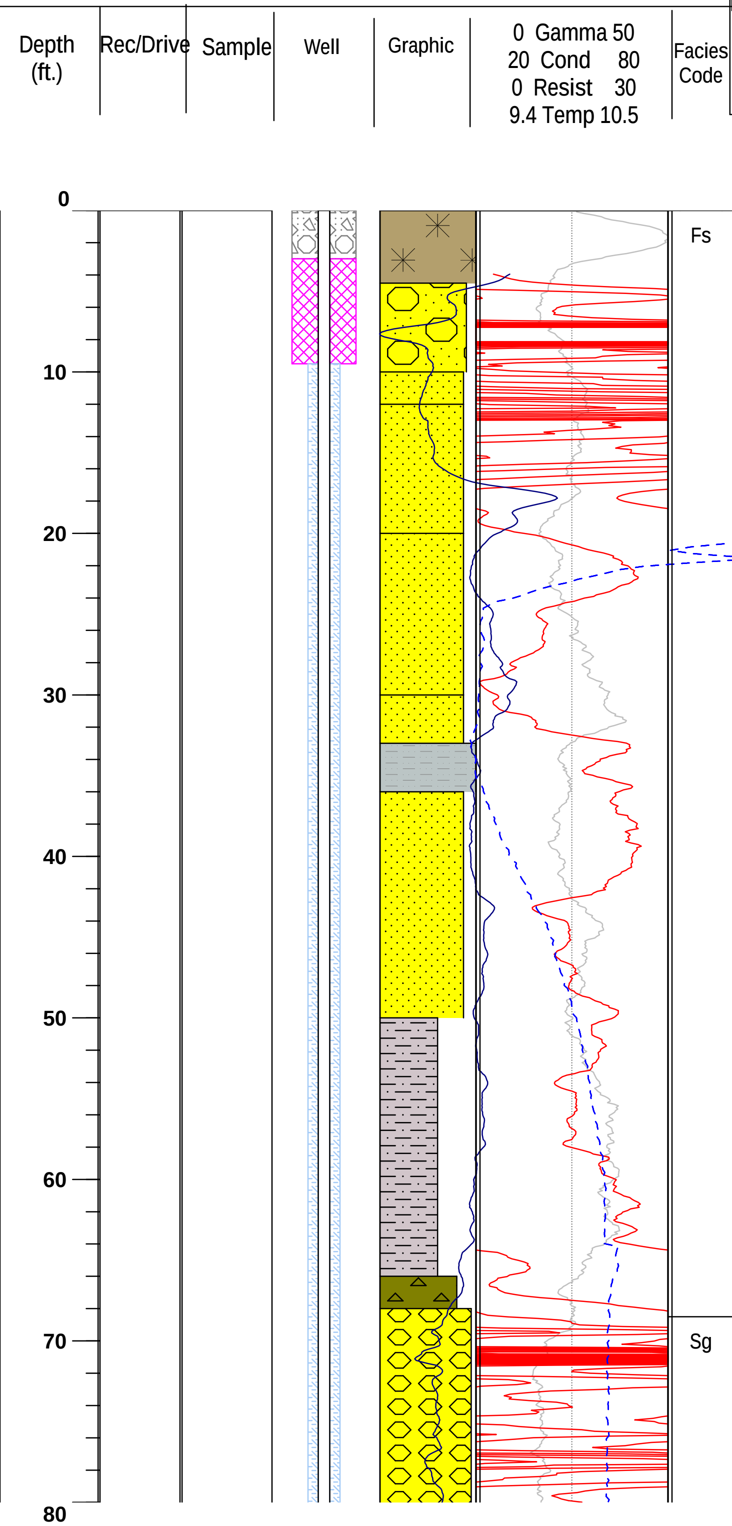
PROJECT NAME
Northeast Illinois Water Supply Planning

OWNER
IDNR-Moraine Hills State Park

DATUM	ELEVATION	LOCATION OF BORING	
NAD 83	**766**	**N: 4686092.87**	**E:399902.565**

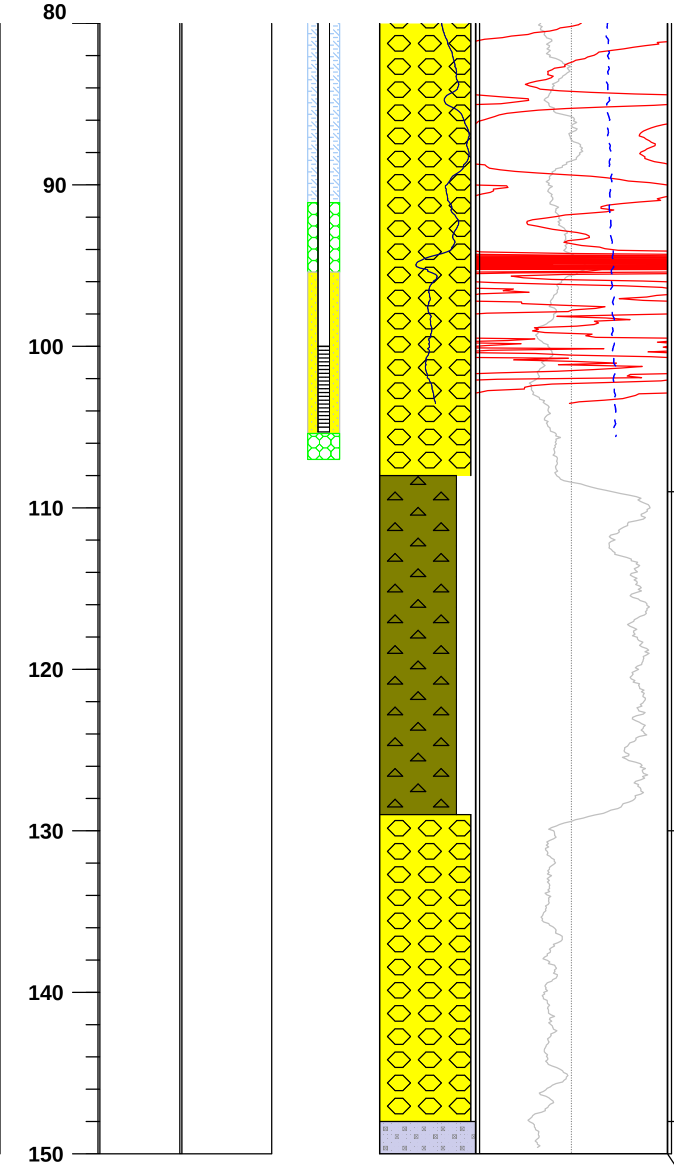
LOCATION northwest corner of small grass area north of maintenance facility, ~200 feet west of Lily Lake Road

WATER LEVEL				QUADRANGLE **Wauconda**	
TIME				DRILLED BY **Jack Aud (ISGS)**	
DATE				START TIME	END TIME
CASING DEPTH				START DATE	END DATE



Facies Code	Geologic Material Description	Interpretation
Fs	(0.0) soil	Equality Fm, (shallow lacustrine)
	(4.5) sand and gravel; medium, moderately rounded	
	(10.0) sand; fine, oxidized, thinly bedded	
	(12.0) sand; medium w/ silty lense, well sorted, cohesive	
	(20.0) sand; medium, well sorted sand grading to finer sand and silt w/ depth, laminated silt @ 27'	
	(30.0) sand; medium, well sorted sand	
	(33.0) clay; massive clay with interbed of silt (10YR5/2)	
	(36.0) sand; medium sand w/ increasing silt w/ depth	
	(50.0) silt; laminated silt w/ some sand lenses, finer w/ depth (10YR5/2)	
	(66.0) diamicton; very cohesive, coarse sand and gravel pebbles, diamicton?, poor recovery	
Sg	(68.0) gravel; coarse gravel, poorly rounded pebbles to large cobbles, thin lenses of cohesive diamicton at 82' and 94'	Henry Formation (Beverly Member), glacofluvial

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
80–108							
108–129					Dm	(108.0) diamicton; silty clay loam, dense, large cobbles common, (7.5YR4/2)	Glasford Formation, subglacial till
129–148					G	(129.0) gravel; coarse, angular, small to large cobbles, mostly carbonate	Pearl Formation, undifferentiated
148–150					B	(148.0) bedrock; dolomite	Silurian dolomite



ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

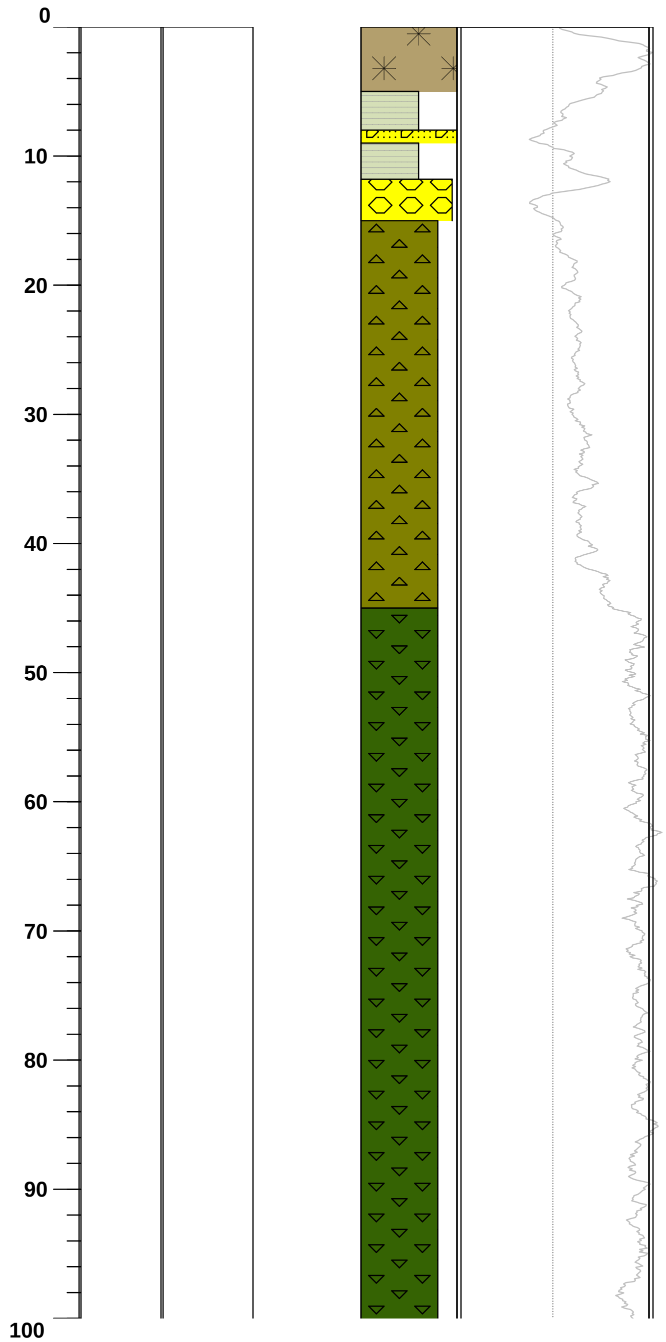
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY **Tim Hodson (field)**			API NO. **121114367200**
DRILLING METHOD **CME 75 - Wireline**	DATE LOGGED **10-16-08**		BOREHOLE NUMBER **WAUC-08-16**
TOWNSHIP/RANGE/SECTION **T44N R9E Sec 30 SWSESE**			CORE NUMBER **WAUC-08-16**
NEAREST CITY / TOWN / LANDMARK **Island Lake, IL**			COUNTY **McHenry**

PROJECT NAME **Central Great Lakes Mapping Coalition**			
OWNER **McHenry County Conservation District**			
DATUM **NAD 83**	ELEVATION **795**	LOCATION OF BORING **N:399269**	**E:4678948**
LOCATION	~0.2 miles south of Behan Road along unmarked road. Large grass field south of small gravel borrow pit		

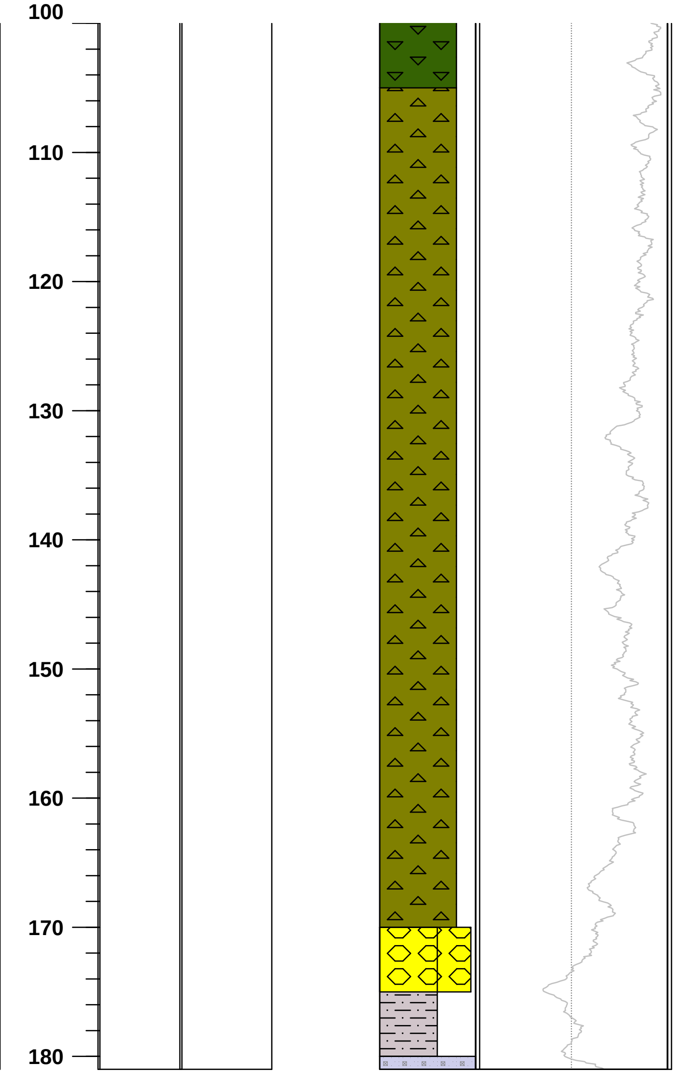
WATER LEVEL				QUADRANGLE **Wauconda**	
TIME				DRILLED BY **Jack Aud (ISGS)**	
DATE				START TIME **2:00 PM**	END TIME **12:00 PM**
CASING DEPTH				START DATE **10/16/08**	END DATE **10/22/08**

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 20 Cond 80 0 Resist 30 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Geologic Material Description	Interpretation
(0.0) Modern soil	Lemont Formation (Haeger Member)-related lacustrine sediments with coarse beds (proglacial)
(5.0) Silty clay, laminated, (10YR4/6), diamicton?	
(8.0) Sand, v. poorly sorted with med gravel	
(9.0) Silty clay, (10YR4/6), laminated w/ lenses of silty sand and gravel	
(11.8) Gravel, coarse	
(15.0) Diamicton, sandy loam, (10YR4/4) d. yellow brown	Lemont Formation (Haeger Member?), subglacial
(45.0) Diamicton, silty clay loam, dense, (7.5YR4/2) dark reddish gray,	Tiskilwa Formation, subglacial till

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



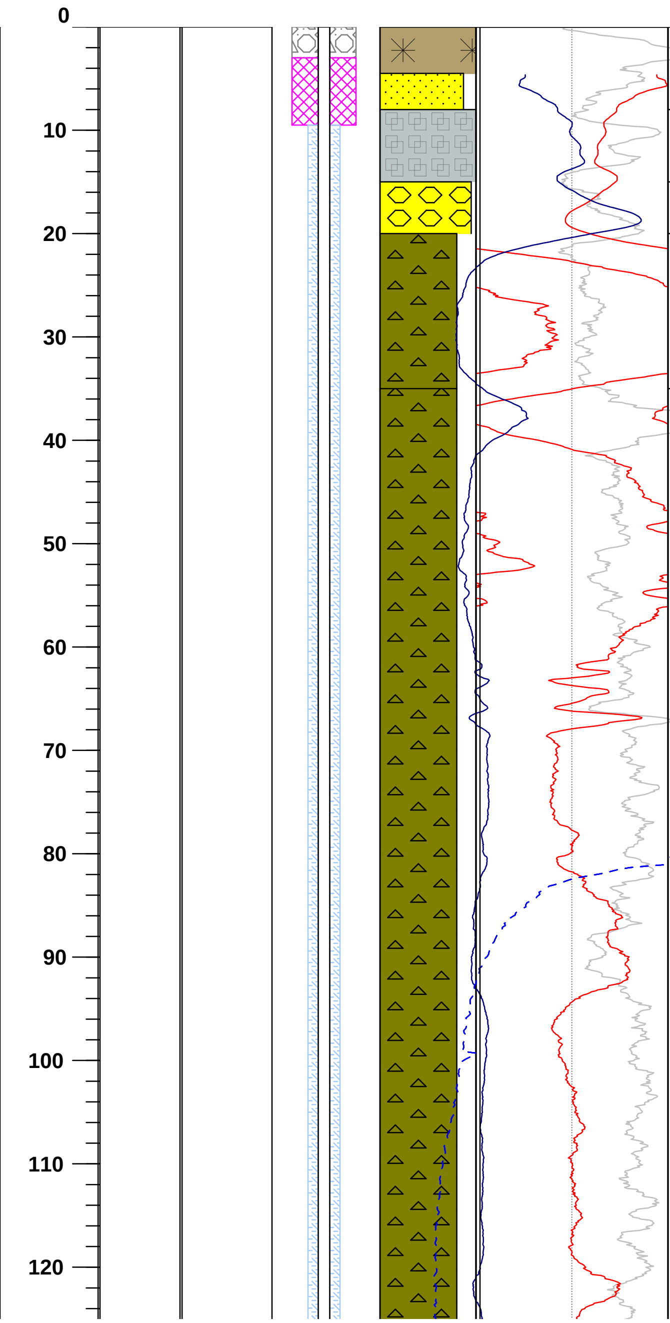
Geologic Material Description	Environment - Interpretation
(105.0) Diamicton, silty clay loam, sandier than above, (7.5YR4/2) dark reddish gray, gravelly intervals at 115', 145'; wood fragment at 105.5'	Glasford Formation, subglacial till
(170.0) Gravel, medium pebbles, moderately rounded	
(170.0) Silt w/ very fine sand; laminated, few pebbles, (10YR4/3)	
(180.0) Bedrock, dolomite	Silurian Bedrock (shallow marine)

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

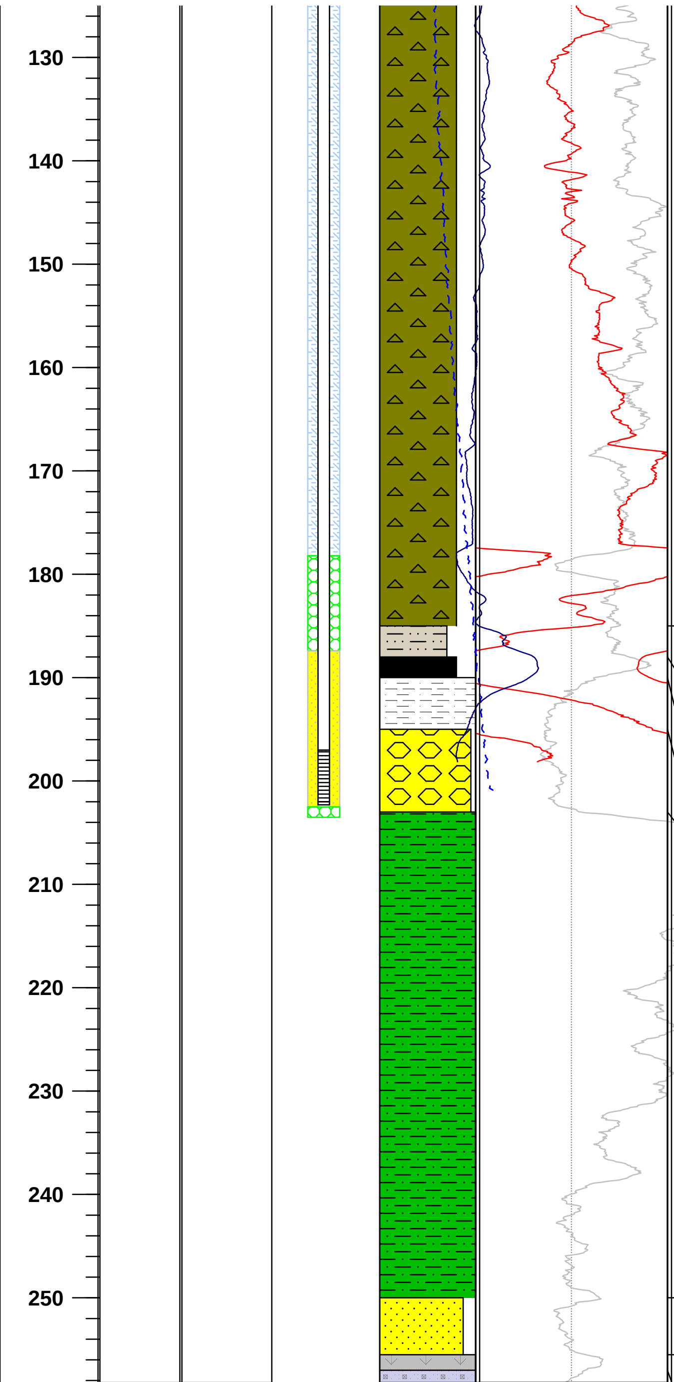
LOGGED BY	J. Thomason (field), D.Carlock (lab)
API NO.	121114367100
DRILLING METHOD	CME 75 - Wireline
DATE LOGGED	9-Oct-08
BOREHOLE NUMBER	WOOD-08-01
TOWNSHIP/RANGE/SECTION	44N 7E Sec 17 (NW,NW,NW)
CORE NUMBER	WOOD-08-01
NEAREST CITY / TOWN / LANDMARK	Woodstock, IL
COUNTY	McHenry
PROJECT NAME	McHenry County 3D Geologic Mapping
QUADRANGLE	Woodstock
OWNER	McHenry County Soil and Water Conservation District
DRILLED BY	Jack Aud (ISGS)
DATUM	NAD 83
ELEVATION	943
LOCATION OF BORING	N: 4683708.908 E:380312.018
LOCATION	SE corner of Rt 14 and Dean Street, MCSWC property, ~50' south of parking lot in grass field
WATER LEVEL	
TIME	
DATE	
CASING DEPTH	
START TIME	
END TIME	
START DATE	
END DATE	

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5



Facies Code	Geologic Material Description	Interpretation
S	(0.0) modern soil	Henry Fm, fine facies (STREAM SEDIMENTS?)
	(4.5) sand; sandy loam, oxidized	
Fl	(8.0) clay; mottled w/ gravelly seams at 10.5,12,15'	
G	(15.0) gravel; soft? No recovery	Henry Fm, surficial (OUTWASH), <15,500 yrs old
Ds	(20.0) diamicton; gravelly and sandy loam, 5YR4/2, low density and poor cohesion	Lemont Fm, Haeger member? (TILL?), ~15,500 yrs old
Dm	(35.0) diamicton; sandy loam 7.5YR4/2, soft and dense zones	Tiskilwa Fm, basal till (TILL), ~25,500 yrs old

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Facies Code	Geologic Material Description	Environment - Interpretation
Fls	(185.0) sand and silt; lt brown, w/ organic fragments	Henry Fm, fine facies of Ashmore Tongue (LAKE SEDIMENTS, LOESS?), ~25,750 yrs old
O	(188.0) loam; sandy loam, organic rich, paleosol (Robein?)	Robein Silt (SOIL), ~36,000 yrs old
O	(190.0) loam; sandy loam, organic rich, paleosol (Sangamon?)	Sangamon Paleosol (SOIL)
G	(195.0) gravel; coarse, no recovery	Pearl Fm (OUTWASH), ~130,000 yrs old?
Fls	(203.0) silt and sand; often laminated silt/sand w/ lenses of v.f. sand, 10YR5/2 (grayish brn)	Pearl Fm, fine facies (LAKE SEDIMENTS)
S	(250.0) sand; v.f. sand, well sorted, some bedding and cross bedding	Pearl Fm, coarse facies (LAKE SEDIMENTS)
Bw	(255.5) weathered bedrock; (dolomite)	Bedrock: Silurian dolomite (DEEP OCEAN), ~410,000,000 yrs old
B	(257.0) bedrock; dolomite	

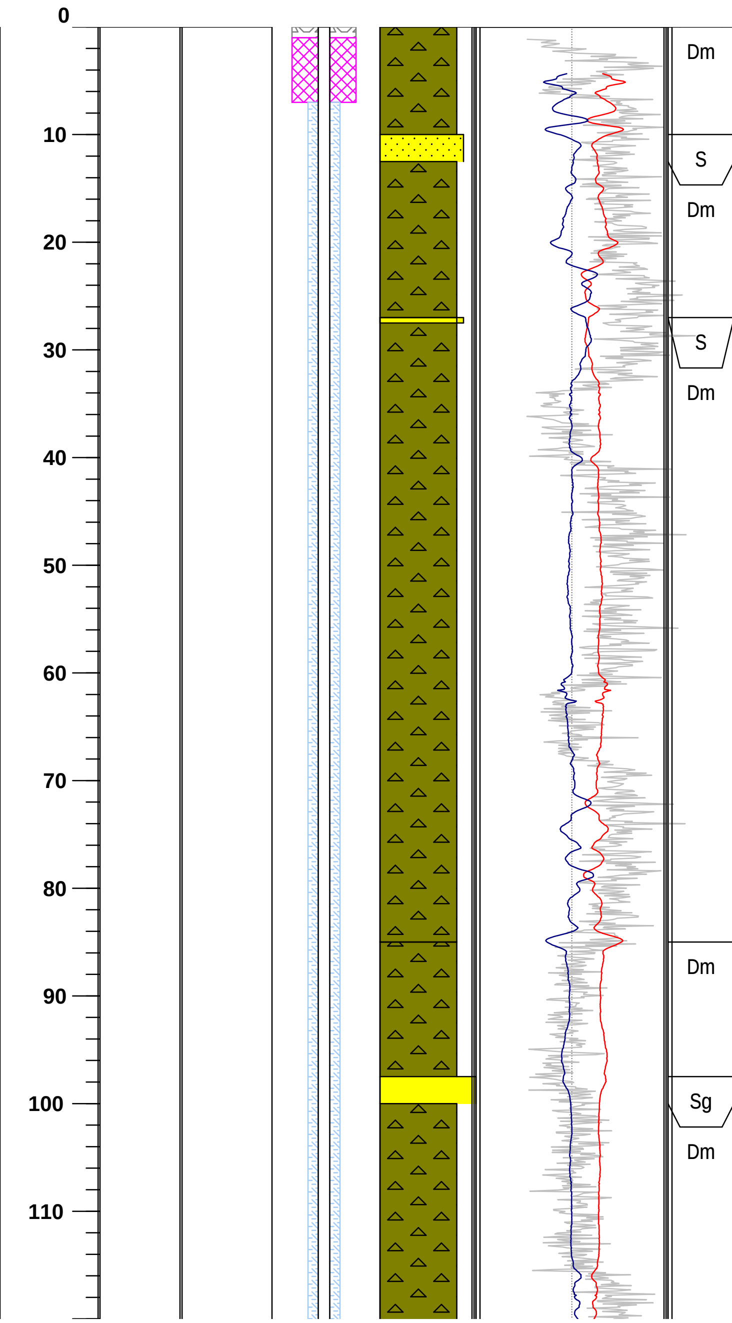
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: **Gary Braun-STS Consulting**		API NO.
DRILLING METHOD: **Rotosonic**	DATE LOGGED: **10/31/08**	BOREHOLE NUMBER: **Alden**
TOWNSHIP/RANGE/SECTION		CORE NUMBER: **Alden**
NEAREST CITY / TOWN / LANDMARK: **Harvard**		COUNTY: **McHenry**

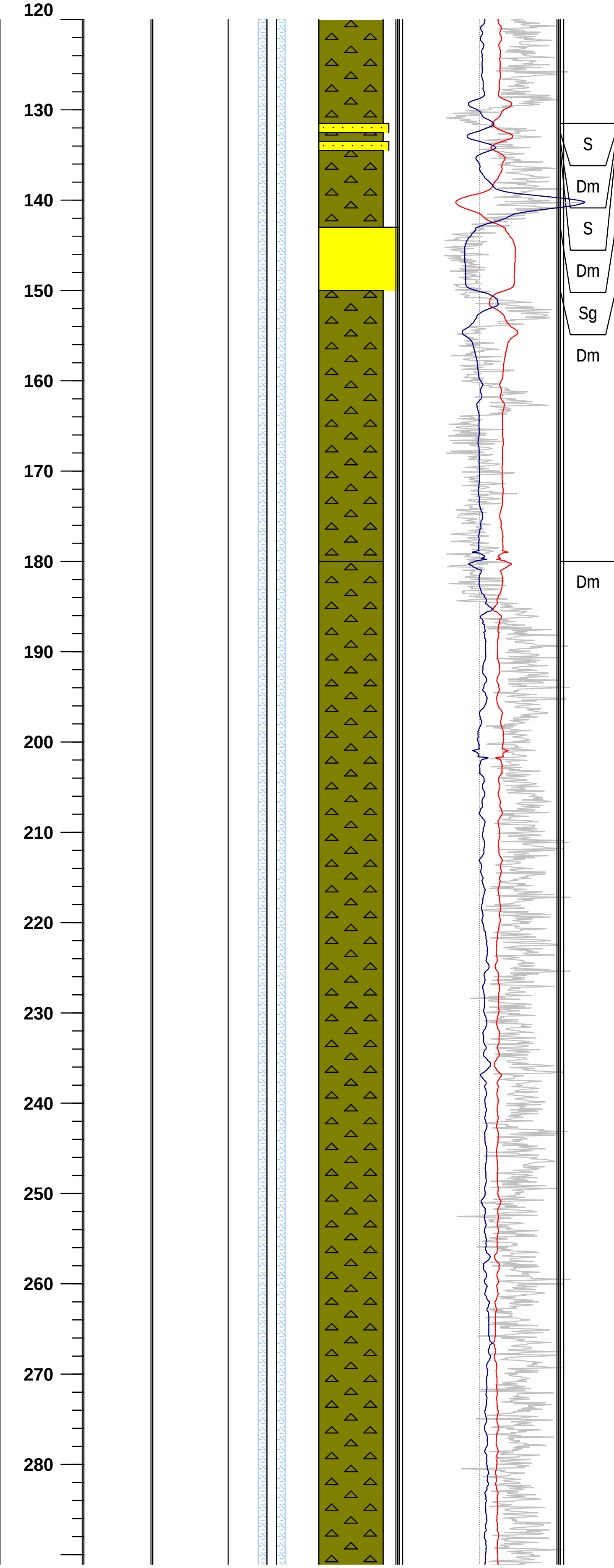
PROJECT NAME: **McHenry County Observation Well Network**			WATER LEVEL	QUADRANGLE: **Harvard**
OWNER			TIME	DRILLED BY
DATUM: **NAD 83**	ELEVATION: **1175**	LOCATION OF BORING: **N: 4703647 E:371828**	DATE	START TIME / END TIME
LOCATION: USACE Alden Township Borehole/Well(s)			CASING DEPTH	START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



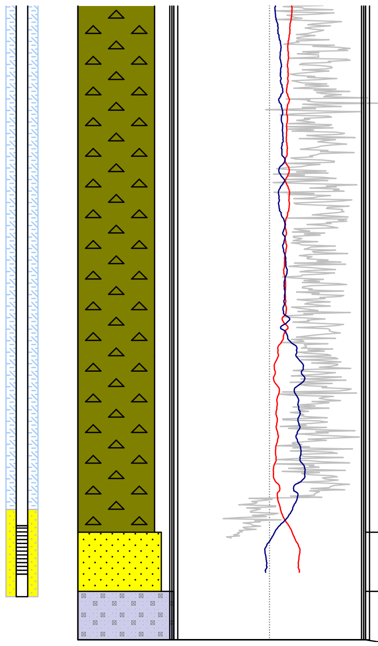
Facies Code	Geologic Material Description	Interpretation
Dm	(0.0) diamicton; sandy silt, some f-c gravel, dense below 6 ft, noncohesive, red mottling (1-3ft)	Wh
S	(10.0) sand; fine to coarse sand, little fine gravel, dense, moist to wet (SW), clay seam at 12.0 ft	
Dm	(12.5) diamicton; brown sandy clay, trace to little gravel, stiff, damp (CL), matrix supported diamicton	Wt
S	(27.0) sand; thin sand seam	
Dm	(27.0) diamicton; light pinkish gray silty clay, little sand and gravel, stiff to very stiff, damp (CL)	
Dm	(85.0) diamicton; pink and grownish gray, silty clay, some sand and gravel, very stiff, moist (CL)	
Sg	(97.5) sand and gravel; brownish gray clayey sand and gravel; soft, slightly cohesive,	
Dm	(100.0) diamicton; pink and brownish gray, silty clay, some sand and gravel, very stiff, moist (CL)	

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Facies Code	Geologic Material Description
S	(131.5) sand; soft, clayey sand lense (SC)
Dm	(132.5) diamicton; pink and grownish gray, silty clay, some sand and gravel, very stiff, moist (CL)
S	(133.5) sand; soft, clayey sand lense (SC)
Dm	(134.5) diamicton; pink and grownish gray, silty clay, some sand and gravel, very stiff, moist (CL)
Sg	(143.0) sand and gravel; brown and sandy, gravelly sand, some silt (GW/SW), interbedded with diamicton
Dm	(150.0) diamicton; brown silty clay, some sand and gravel, stiff to v. stiff, (CL), interbedded w/ gravel (from gamma)?
Dm	(180.0) diamicton; brown silty clay, some sand and gravel, stiff to v. stiff, (CL), some large gravel (1/2-1") below 215, color change to gray-brown at 315

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
290							
300							
310							
320							
330							
340					S	(340.0) sand; gray fine-coarse sand, loose, wet (SW)	Ha
					Bdrk	(345.5) bedrock, dolomite?	Bdrk
350							



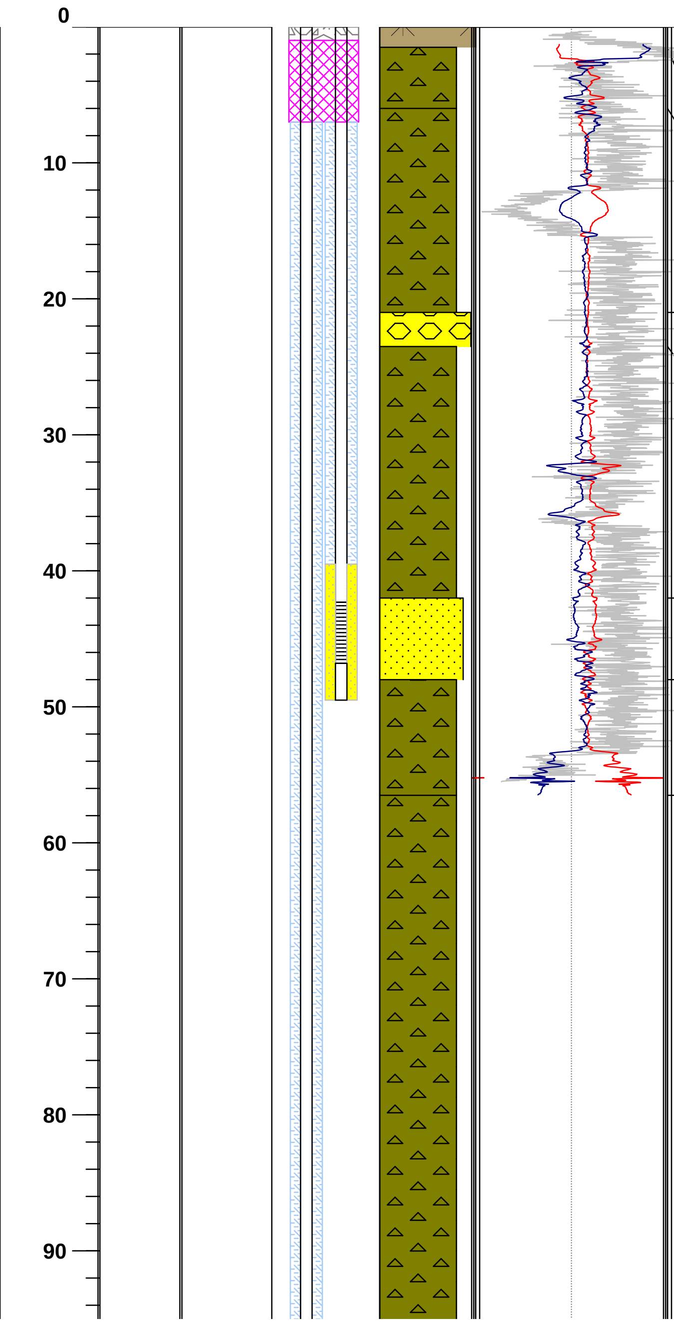
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY **Gary Braun-STS Consulting**		API NO.
DRILLING METHOD **Rotosonic**	DATE LOGGED **10/17/08**	BOREHOLE NUMBER **Algonquin**
TOWNSHIP/RANGE/SECTION		CORE NUMBER **Algonquin**
NEAREST CITY / TOWN / LANDMARK **Crystal Lake**		COUNTY **McHenry**

PROJECT NAME **McHenry County Observation Well Network**	WATER LEVEL				QUADRANGLE **Crystal Lake**
OWNER	TIME				DRILLED BY
DATUM **NAD 83** / ELEVATION **879** / LOCATION OF BORING **N: 4672366 E: 390180**	DATE				START TIME / END TIME
LOCATION USACE Algonqin Township Borehole/Well(s)	CASING DEPTH				START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation
0						O	(0.0) soil; black organic (CL), clayey silt, tr. sand and gravel, hard (topsoil)	Wy
						Dm	(1.5) diamicton; brown/black mottled silty clay, very stiff, little sand and gravel (CL)	
						Dm	(6.0) diamicton; olive gray silty clay, trace coarse sand and fine to medium gravel, stiff, damp, trace orange & black mottles (CL)	
20						G	(21.0) gravel; gray sandy gravel, loose, wet (GW), intra-till gravel	Hy
						Dm	(23.5) diamicton; brownish gray sandy silty clay, little coarse sand to fine gravel, trace medium gravel, stiff, moist (CL), medium plasticity	Wt
40						S	(42.0) sand; grayish brown medium sand, little fine gravel, trace c. sand, loose, wet (SP), clay stringer at 44', gravelly at 47-48'	
						Dm	(48.0) diamicton; grayish-pinkish brown silty sandy clay, little fine to coarse gravel, stiff to very stiff, damp (SC), gradual bottom contact	
						Dm	(56.5) diamicton; grayish-pinkish brown silty clay, little sand and gravel, very stiff to hard, damp (CL), medium plasticity, large cobble at 102.5	



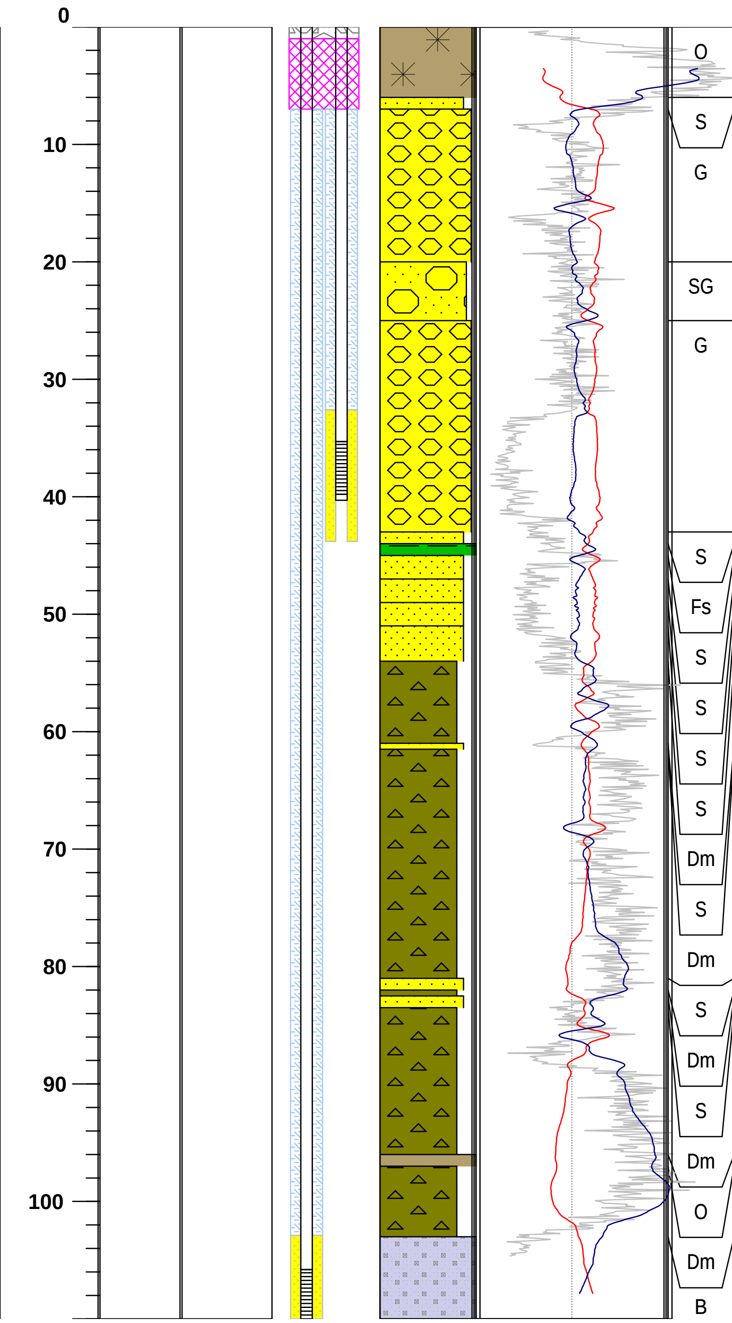
Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
100							
					S	(103.0) sand; brown fine sand, moderately dense, wet (SP), intra-till sand	
					Dm	(105.0) diamicton; reddish-grayish brown, silty clay, little sand and fine to medium gravel, very stiff, damp (CL), medium to low plasticity	
110							
120							
130					Dm	(130.0) diamicton; dark brown-dark grayish brown, silty clay, little sand and gravel, very stiff to hard (CL)	
140							
150							
160							
170							
					Dm	(175.0) diamicton; light gray silt, little fine to medium gravel, trace clay, extremely hard, dry (burned by sonic barrel), hardpan (ML)	
180							
					B	(185.0) bedrock, gray dolomite, hard, fresh, micro-crystalline, thinly bedded	Bdrk

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: STS Consulting			API NO.
DRILLING METHOD: Rotosonic	DATE LOGGED: 11/06/08		BOREHOLE NUMBER: Chemung
TOWNSHIP/RANGE/SECTION			CORE NUMBER: Chemung
NEAREST CITY / TOWN / LANDMARK: Chemung			COUNTY: McHenry
PROJECT NAME: McHenry County Observation Well Network	WATER LEVEL		QUADRANGLE: Capron
OWNER	TIME		DRILLED BY
DATUM: NAD 83 / ELEVATION: 896 / LOCATION OF BORING: N: 4701188 E:364481	DATE		START TIME / END TIME
LOCATION: USACE Chemung Township Borehole/Well(s)	CASING DEPTH		START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



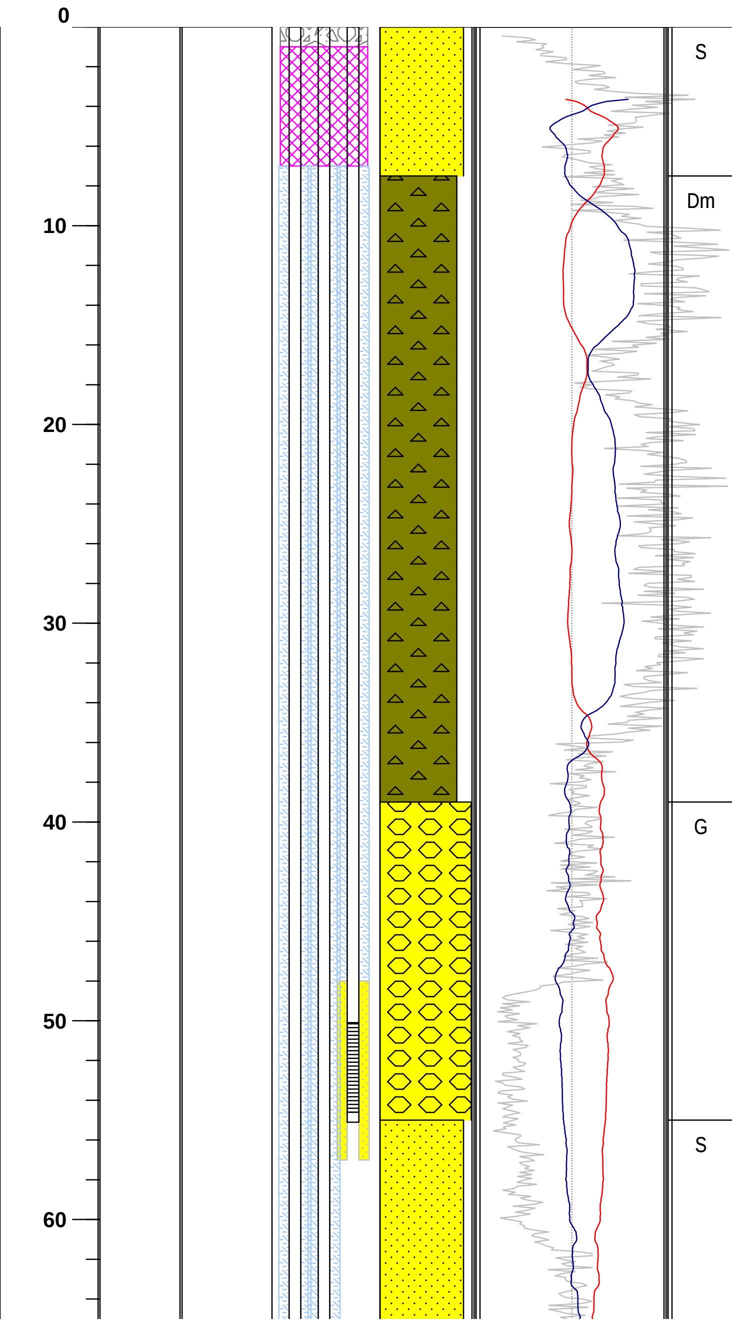
Geologic Material Description	Interpretation
(0.0) soil; light brown to dark brown organic silty clay, mottled below 1.5', trace sand, gravel and organics, stiff, high plasticity	Hen1
(6.0) sand; brown medium sand, medium density, moist (SP)	
(7.0) sand; brown fine to coarse sandy gravel, loose, wet (GW)	
(20.0) sand and gravel; gray gravelly sand, loose, wet (SW)	
(25.0) gravel; fine, little m-c gravel and sand, clean, loose, well sorted gravel (GP)	
(43.0) sand; gray medium, tr. Gravel, loose, wet (SP)	
(44.0) silt; gray, dense, wet (ML)	
(45.0) sand; brownish gray medium sand, med dense (SP), clay stringer at 47'	
(47.0) sand; brownish gray gravelly medium sand, loose, wet (GW/SP)	G1
(49.0) sand; brownish gray medium sand, dense, wet (SP) (tr. Gravel)	
(51.0) sand; gray gravelly sand, loose, wet (GW/SP) w/ well sorted sand lense at 52-53'	
(54.0) diamicton; dark olive gray silty clay to clayey silt (loamy), little c. sand and f. gravel, hard, not plastic, ILLN till	
(61.0) sand; gray medium sand seam, dense, wet, (SP)	
(61.5) diamicton; reddish brown silty loamy clay, little sand and gravel, hard, not plastic, low water content, matrix supported diamicton (till)	
(81.0) sand; gray medium sand seam, dense (SP), trace gravel, red mottles	G3
(82.0) diamicton; reddish brown silty loamy clay, little sand and gravel, hard, not plastic, low water content, matrix supported diamicton (till)	Bdrk

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	**Geologic Material Description**	**Environment - Interpretation**
110						(82.5) sand; gray medium sand seam, dense (SP), trace gravel, red mottles	
						(83.5) diamicton; reddish brown silty loamy clay, little sand and gravel, hard, not plastic, low water content, matrix supported diamicton (till)	
						(96.0) soil; dark brown w/ black mottling and bedding, silty clay, some organics, stiff, high plasticity (CL), buried soil horizon?	
						(97.0) diamicton; olive gray silty loam, some sand and gravel (increased gravel w/ depth), not plastic hard, damp (CL), basal till	
						(103.0) bedrock; light gray to buff dolomite, thinly bedded w/ muddy interbeds evident in upper 2 ft	

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

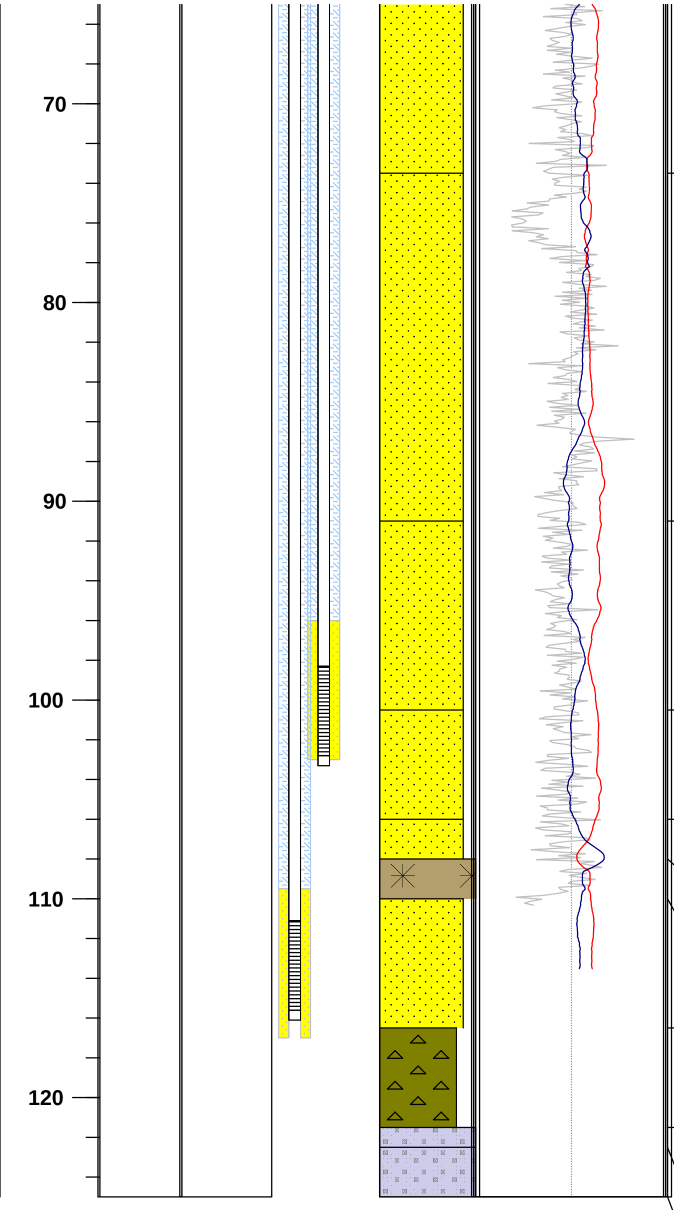
LOGGED BY: **Gary Braun-STS Consulting**			API NO.
DRILLING METHOD: **Rotosonic**	DATE LOGGED		BOREHOLE NUMBER: **Coral**
TOWNSHIP/RANGE/SECTION			CORE NUMBER: **Coral**
NEAREST CITY / TOWN / LANDMARK: **Huntley**			COUNTY: **McHenry**
PROJECT NAME: **McHenry County Observation Well Network**	WATER LEVEL		QUADRANGLE: **Huntley**
OWNER	TIME		DRILLED BY
DATUM: **NAD 83** / ELEVATION: **850** / LOCATION OF BORING: **N: 4676153 E:378114**	DATE		START TIME / END TIME
LOCATION: USACE Coral Township Borehole/Well(s)	CASING DEPTH		START DATE / END DATE

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5



Facies Code	Geologic Material Description	Interpretation
S	(0.0) sand; brown/dark borwn mottled gravelly sand, little silt, loose, moist to wet below 7' (GW-SW)	Hen1
Dm	(7.5) diamicton; gray fat clay, trace c. sand and fine gravel, soft, moist (CH), highly plastic, massive, matrix supported diamicton, silt seam at 34, sand/gravel seam at 35	Wy
G	(39.0) gravel; gray fine gravel, some sand, trace medium-coarse gravel, very loose, wet (GP)	Hy
S	(55.0) sand; gray gravelly coarse sand, very loose, wet (SP)	Ha

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation

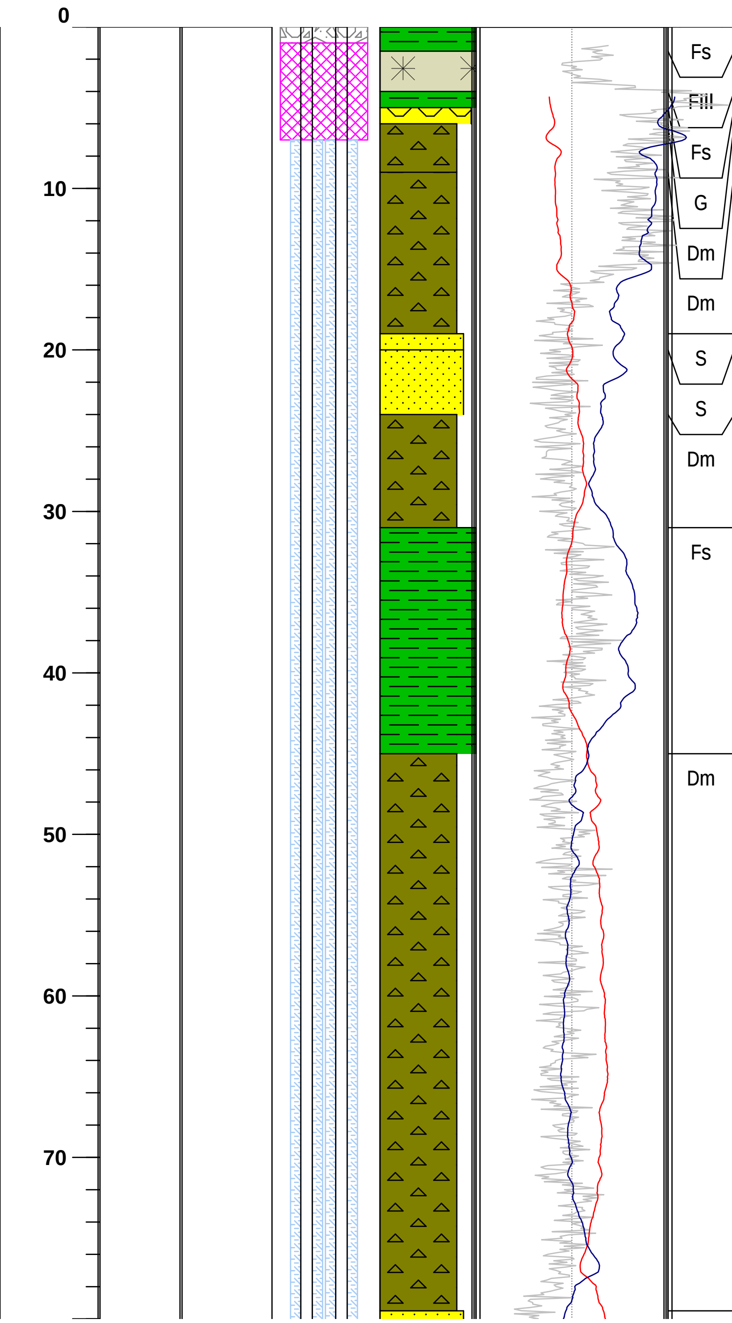


Facies Code	Geologic Material Description	Environment - Interpretation
S	(73.5) sand; gray fine sand, moderately dense, wet (SP)	
S	(91.0) sand; brownish gray medium sand, trace fine gravel, loose, wet (SP), gravelly zone at 92	
S	(100.5) sand; gray gravelly medium sand, loose, wet (SW)	
S	(106.0) sand; gray medium sand, mod dense, well sorted, wet (SP)	
O	(108.0) soil; very dark gray organic silt, w/ brown and black layering and mottling, dense, not plastic or cohesive (CL)	Pe
S	(110.0) sand; gray medium sand, trace gravel, mod dense, wet (SP) (well graded)(fining upward sequence)	
Dm	(116.5) diamicton; brownish gray clayey silt, little sand and gravel, hard, damp (CL)	G1
B	(121.5) bedrock; weathered, wet	Bdrk
B	(122.5) bedrock; weathered, dry	

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

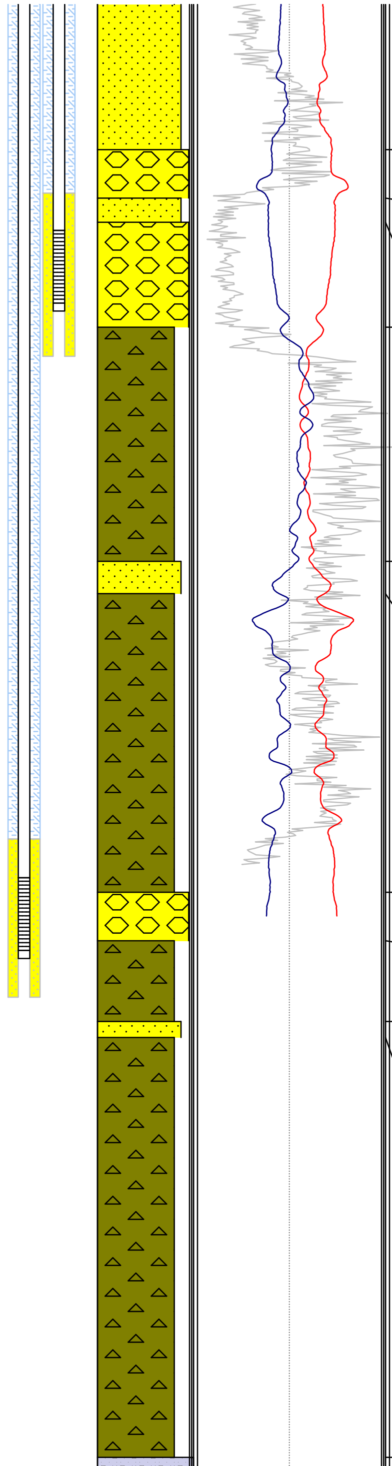
LOGGED BY: STS Consulting	API NO.
DRILLING METHOD: Rotosonic	DATE LOGGED
BOREHOLE NUMBER: Grafton	TOWNSHIP/RANGE/SECTION
CORE NUMBER: Grafton	NEAREST CITY / TOWN / LANDMARK: Crystal Lake
COUNTY: McHenry	QUADRANGLE: Crystal Lake
PROJECT NAME: McHenry County Observation Well Network	OWNER
DRILLED BY	
DATUM: NAD 83	ELEVATION: 878
LOCATION OF BORING: N: 4671722 E:386523	LOCATION: USACE Grafton Township Borehole/Well(s)
WATER LEVEL	TIME
DATE	CASING DEPTH
START TIME	END TIME
START DATE	END DATE

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5 | Facies Code | Geologic Material Description | Interpretation



Facies Code	Geologic Material Description	Interpretation
Fs	(0.0) silt; soil; lt to dk brown, clayey organic silt, trace sand and gravel	Eq
Fill	(1.5) fill; lt brown medium gravel, dry, mod dense	
Fs	(4.0) silt; black clayey organic silt, soft, damp (CL)	Wy
G	(5.0) gravel; gray medium gravel, loose, moist (GP)	
Dm	(6.0) clay; brown and black mottled sitly clay w/ medium gravel, little sand, mod stiff, moist (CL to GC)	
Dm	(9.0) diamicton; brownish gray silty clay, little coarse sand, trace fine to coarse gravel, stiff, damp (CL), matrix supported diamicton	
S	(19.0) sand; gray med sand, trace coarse sand and gravel, loose, wet (SP)	Hy
S	(20.0) sand; gray coarse sand, little f-med gravel, very loose, wet (SP), no bedding/grading identified	
Dm	(24.0) diamicton; grayish brown sandy clay, little silt and gravel, very soft, moist (SC), low plasticity, matrix supported diamicton till	
Fs	(31.0) silt; grayish brown clayey silt, soft, low to medium plasticity, moist (CL-ML), massive w/ possible deformations (clasts poor), diamictic, sand seams at 43-44'	
Dm	(45.0) diamicton; grayish brown sandy clay, little gravel, trace cobbles, stiff to very stiff, moist (SC), little to no plasticity, massive diamicton, pinkish hue (Tiskilwa Till)	Wt

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation
80					S	(79.5) sand; brownish gray, medium to coarse sand, loose, wet (SW), clay stringers at 81, 82'	Ha
90					G	(89.0) gravel; gray sandy fine gravel, loose, wet (GP)	
					S	(92.0) sand; gray gravelly fine to coarse sand, loose, wet (SW)	
					G	(93.5) gravel; gray fine to coarse gravel, med-coarse sand, loose, wet (GW)	
100					Dm	(100.0) diamicton; brownish gray silty clay, trace to little fine to coarse gravel and sand, very stiff to hard, damp (CL), medium plasticity, matrix supported massive diamicton, till	G1
110					S	(114.5) sand; gray intra-till clayey sand w/ fine to med gravel, loose (SC-GC)	
120					Dm	(116.5) diamicton; br gr sandy clay, some f to c gravel, stiff, damp, not plastic, matix supported, thinly to medium bedded diamicton w/ frequent f sand partings and occ black mottling between bed planes, very hard, gravel seam at 127'	
130					G	(135.0) gravel; brownish gray fine to coarse gravel, little sand, trace silt/clay, lose, wet (GW), inter-till gravel	
140					Dm	(138.0) diamicton; same as above	
					S	(143.0) sand; brownish clayey sand, med dense (SC)	
150					Dm	(144.0) diamicton; same as above, harder w/ depth	
160							
170					B	(170.0) bedrock; dolomite	Bdrk

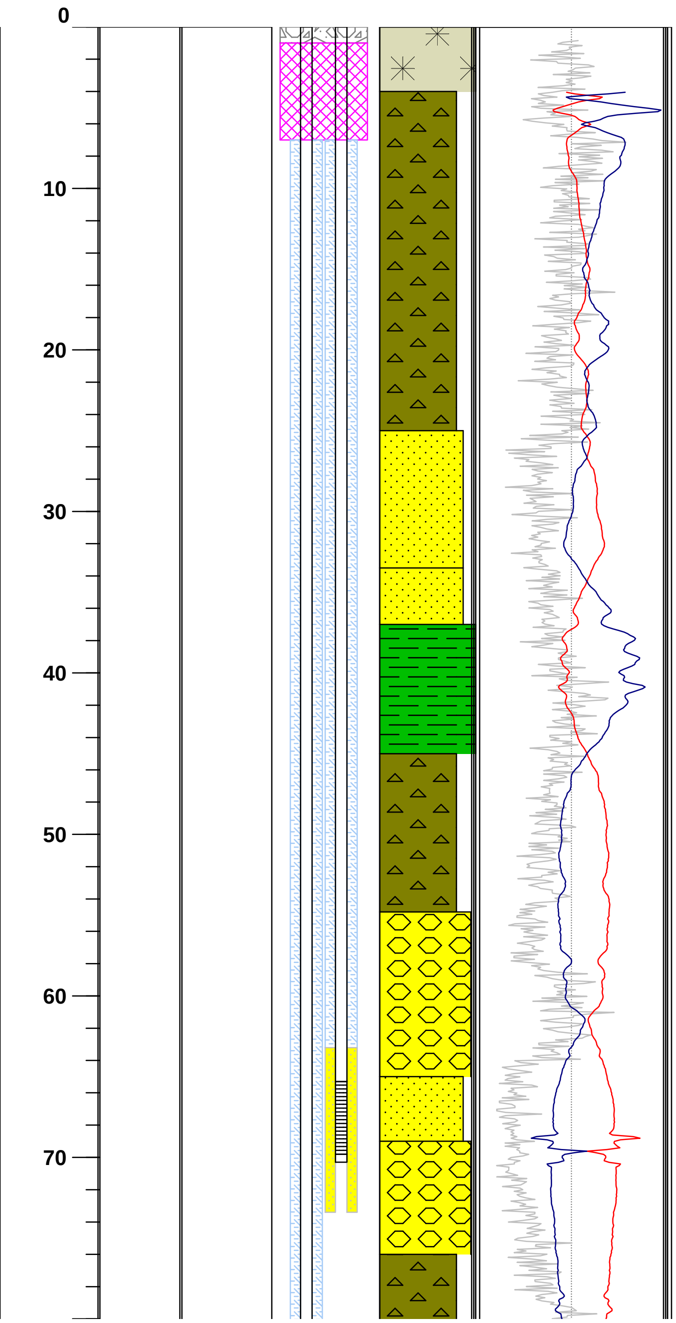


ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

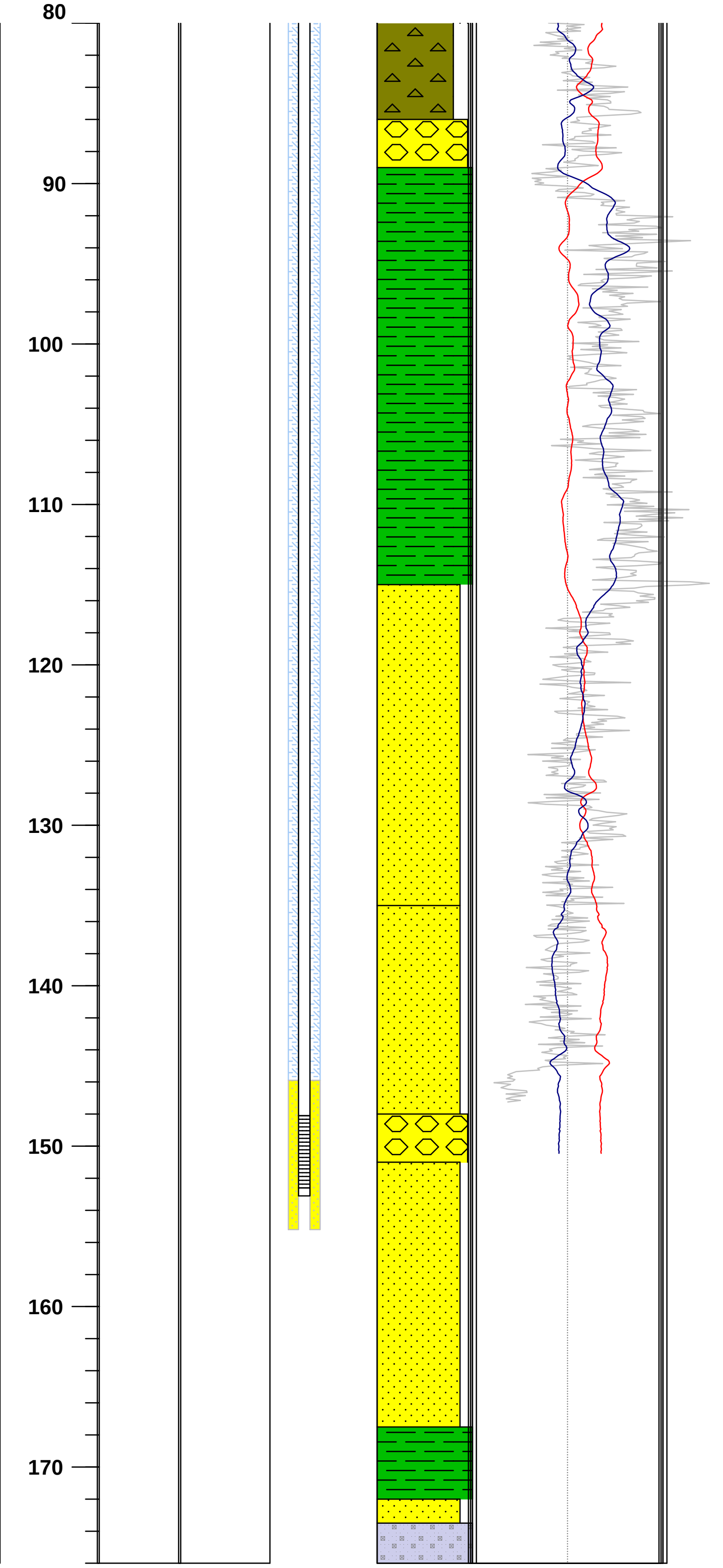
LOGGED BY: **Gary Braun-STS Consulting**			API NO.
DRILLING METHOD: **Rotosonic**	DATE LOGGED: **09/23/08**		BOREHOLE NUMBER: **Greenwood**
TOWNSHIP/RANGE/SECTION			CORE NUMBER: **Greenwood**
NEAREST CITY / TOWN / LANDMARK: **Woodstock**			COUNTY: **McHenry**
PROJECT NAME: **McHenry County Observation Well Network**	WATER LEVEL		QUADRANGLE: **Hebron**
OWNER	TIME		DRILLED BY
DATUM: **NAD 83** / ELEVATION: **855** / LOCATION OF BORING: **N:4693517 E:385894**	DATE		START TIME / END TIME
LOCATION: Along north side of Wondermere Rd., 0.26 miles east of intersection with Greenwood Rd.(Obs Well)	CASING DEPTH		START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Geologic Material Description	Interpretation
(0.0) fill/soil; gravel, cinder block, sand, loose, damp w/ modern soil horizons	Wh
(4.0) clay; mottled brown, reddish brown, sandy-silty clay, some f. gravel	
(25.0) sand; gray fine gravelly coarse sand, little fine to medium sand and medium to coarse gravel, loose, wet (SW)	Hb
(33.5) sand; grayish brown fine sand, dense, wet	
(37.0) silt; grayish brown silt, dense to stiff, some plasticity, trace fine gravel, moist to wet (ML)	
(45.0) diamicton; pebbly	
(54.8) gravel; gray fine gravel, some medium gravel, little coarse sand, very loose, wet (GP to GW)	
(65.0) sand; brown medium sand, moderately dense, wet (SP)	
(69.0) gravel; brownish gray fine gravel, little fine and coarse gravel, loose, wet (GW)	
(76.0) diamicton; brownish gray silty clay, little fine gravel, stiff, moist to wet (CL to GC), with occasional gravel seams	Wt

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Geologic Material Description	Environment - Interpretation
(86.0) gravel; brownish gray fine gravel, loose, wet (GP)	
(89.0) silt and sand; often laminated w/ pods of sand; contorted	
(115.0) sand; gray fine sand, dense, wet (SP)	Ha
(135.0) sand; brown medium sand, trace fine gravel, loose, wet (SP)	
(148.0) gravel; brownish gray fine gravel, very loose, wet (GP), fining upward	
(151.0) sand; brown medium sand, trace fine gravel, moderately dense, wet (SP)	
(167.5) silt; light brownish gray silt, trace coarse gravel, dense, non cohesive, wet (ML)	G1
(172.0) sand; light gray silty sand, with f. gravel (angular), med density, wet	Bdrk
(173.5) bedrock; dolomite, light gray, hard	

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY **Gary Braun-STS Consulting**		API NO.
DRILLING METHOD **Rotosonic**	DATE LOGGED **11/11/08**	BOREHOLE NUMBER **Hartland**
TOWNSHIP/RANGE/SECTION		CORE NUMBER **Hartland**
NEAREST CITY / TOWN / LANDMARK **Harvard**		COUNTY **McHenry**

PROJECT NAME
McHenry County Observation Well Network

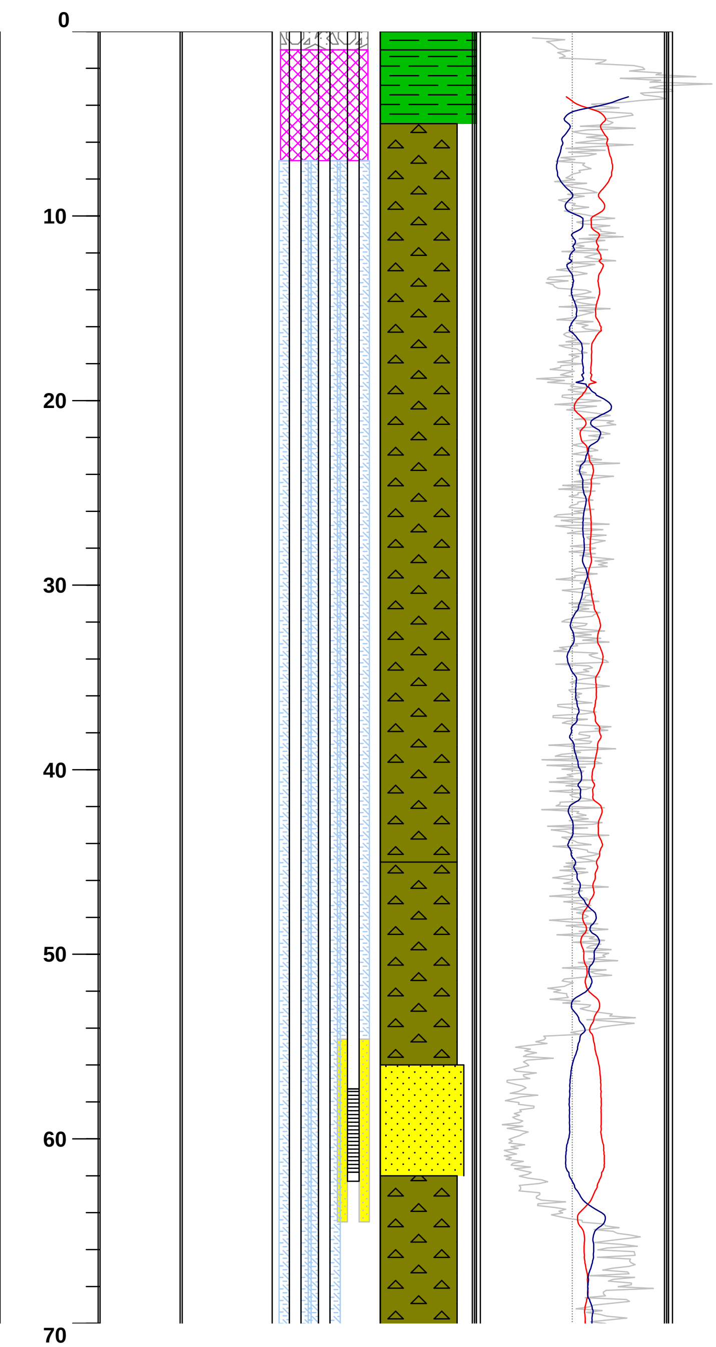
OWNER

DATUM	ELEVATION	LOCATION OF BORING	
NAD 83	**922**	**N: 4705173**	**E:382069**

LOCATION USACE Hartland Township Borehole/Well(s)

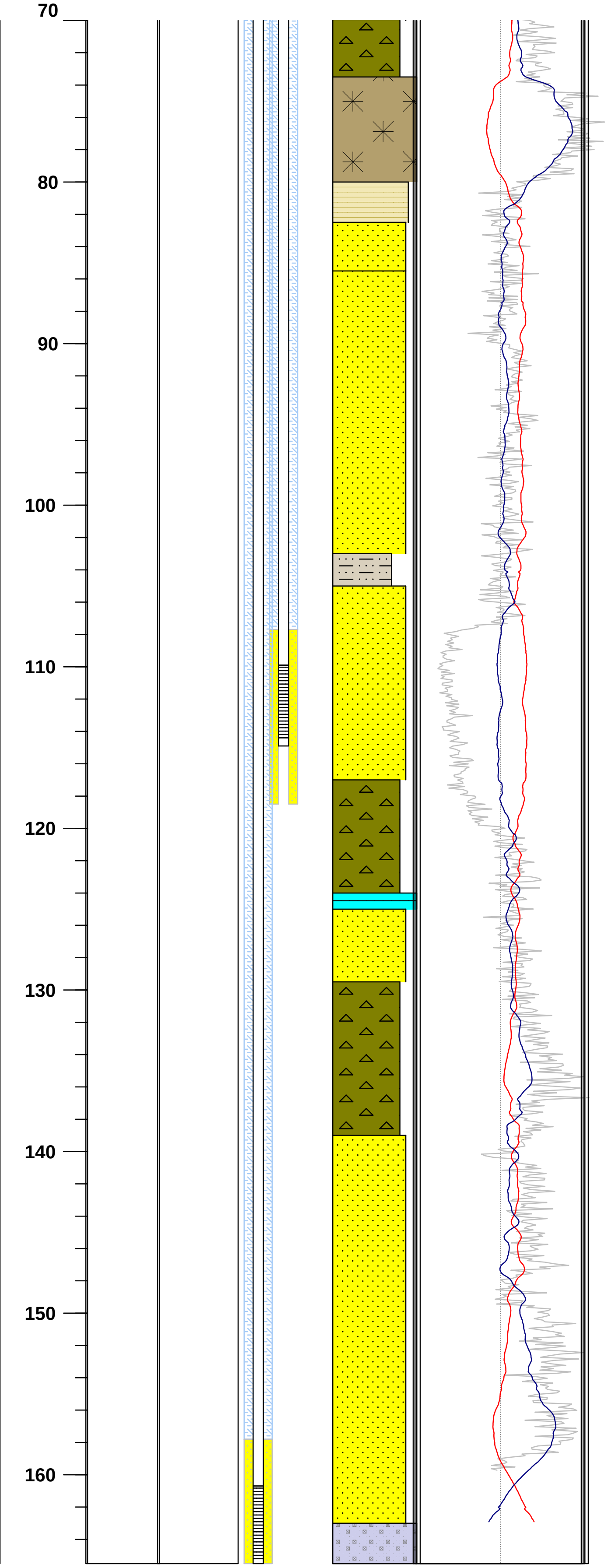
WATER LEVEL				QUADRANGLE **Harvard**	
TIME				DRILLED BY	
DATE				START TIME	END TIME
CASING DEPTH				START DATE	END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 20 Cond 80 0 Resist 30 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Geologic Material Description	Interpretation
(0.0) silt; dark brn organic sandy silt, dense, damp (OL)	Hen1
(1.0) silt; brown sandy silt, little gravel, trace organics, clay (SM), loose, damp	
(5.0) diamicton; brown to gray sandy silt, little f-c gravel, trace clay, very dense, damp (ML) not plastic, not cohesive, matrix supported diamicton	Wt
(45.0) diamicton; gray w/ pinkish tint-silty clay, little f-c sand and gravel, stiff, damp (lean clay) (ML-CL), cont. matrix supported diamicton	
(56.0) sand; gray coarse sand, little med sand and f-m gravel, trace f sand, silt and clay, loose, wet (SW), intra till granular unit	
(62.0) diamicton; reddish brown sitly clay, little sand and gravel, hard, damp (CL), low water content, med plasticity when water added, matrix supported diamicton, till, Tiskilwa	

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Geologic Material Description	Environment - Interpretation
(73.5) clay; dark olive gray silty clay, little sand and gravel, hard, damp (CL)	Pe
(80.0) sand and clay; olive gray clayey sand to sandy clay, trace gravel, stiff to dense, moist (SC)	
(82.5) sand; olive gray to reddish brown gravelly sand, mod dense, wet (GW-SW)	
(85.5) sand; gray medium sand, trace to little f-m gravel, trace f sand, loose, wet (SP)	
(103.0) sand and silt; interbeds of fine sand and silt stringers	
(105.0) sand; gray medium sand, trace to little f-m gravel, trace f sand, loose, wet (SP)	
(117.0) diamicton; gray sandy clay, little f-c gravel, soft, moist (SC), diamicton transition	G1
(124.0) silt; reddish brown silty clay, stiff (CL)	
(125.0) sand; grayish brown fine sand, little med sand, tr silt, c sand and f-m gravel, dense, wet (SP to SN), abrupt contacts above and below	GS1
(129.5) diamicton; gray silty clay, little sand and gravel, very stiff to hard, moist (CL), medium plasticity, matrix supported diamicton	G2
(139.0) sand; gray medium sand, trace fin gravel, mod dense, wet (SP)	GS2
(163.0) bedrock; dolomite	Bdrk

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

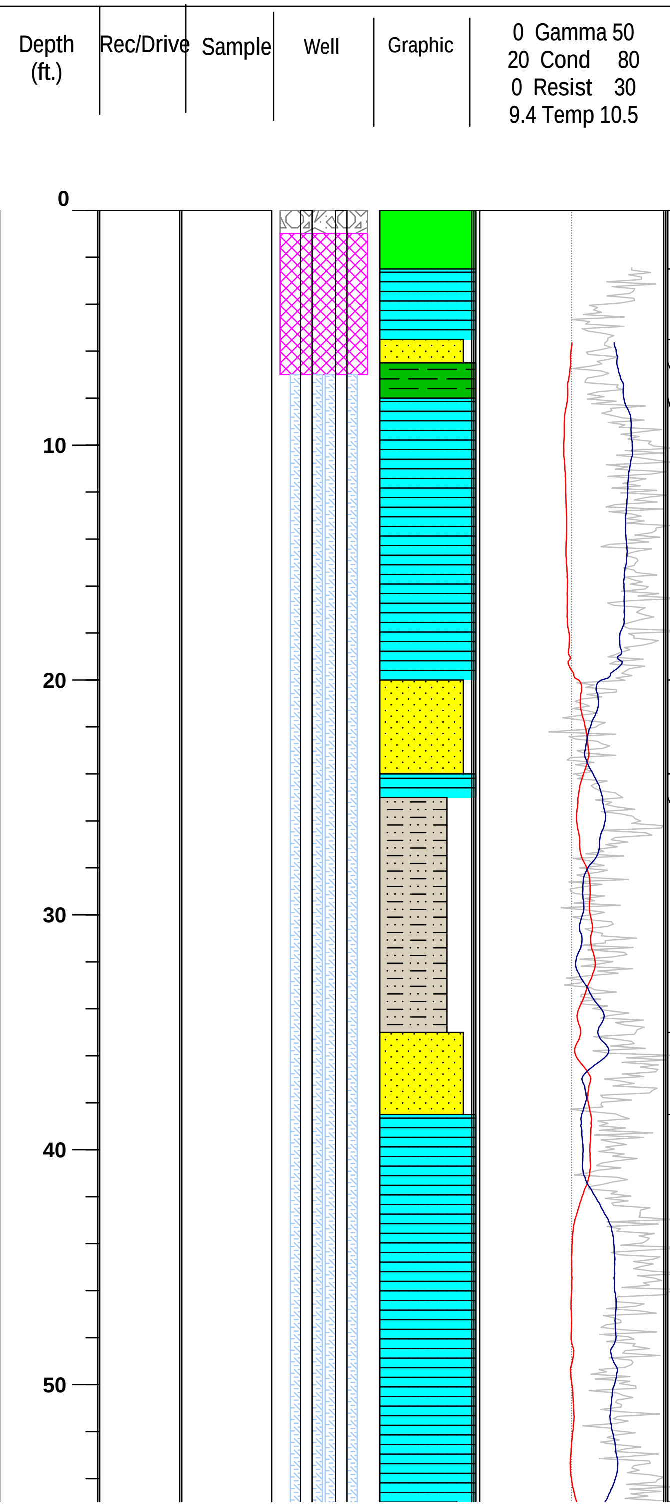
LOGGED BY: **Gary Braun-STS Consulting**		API NO.
DRILLING METHOD: **Rotosonic**	DATE LOGGED: **09/26/08**	BOREHOLE NUMBER: **Hebron**
TOWNSHIP/RANGE/SECTION		CORE NUMBER: **Hebron**
NEAREST CITY / TOWN / LANDMARK: **Hebron**		COUNTY: **McHenry**
WATER LEVEL		QUADRANGLE: **Hebron**
TIME		DRILLED BY
DATE		START TIME / END TIME
CASING DEPTH		START DATE / END DATE

PROJECT NAME: **McHenry County Observation Well Network**

OWNER

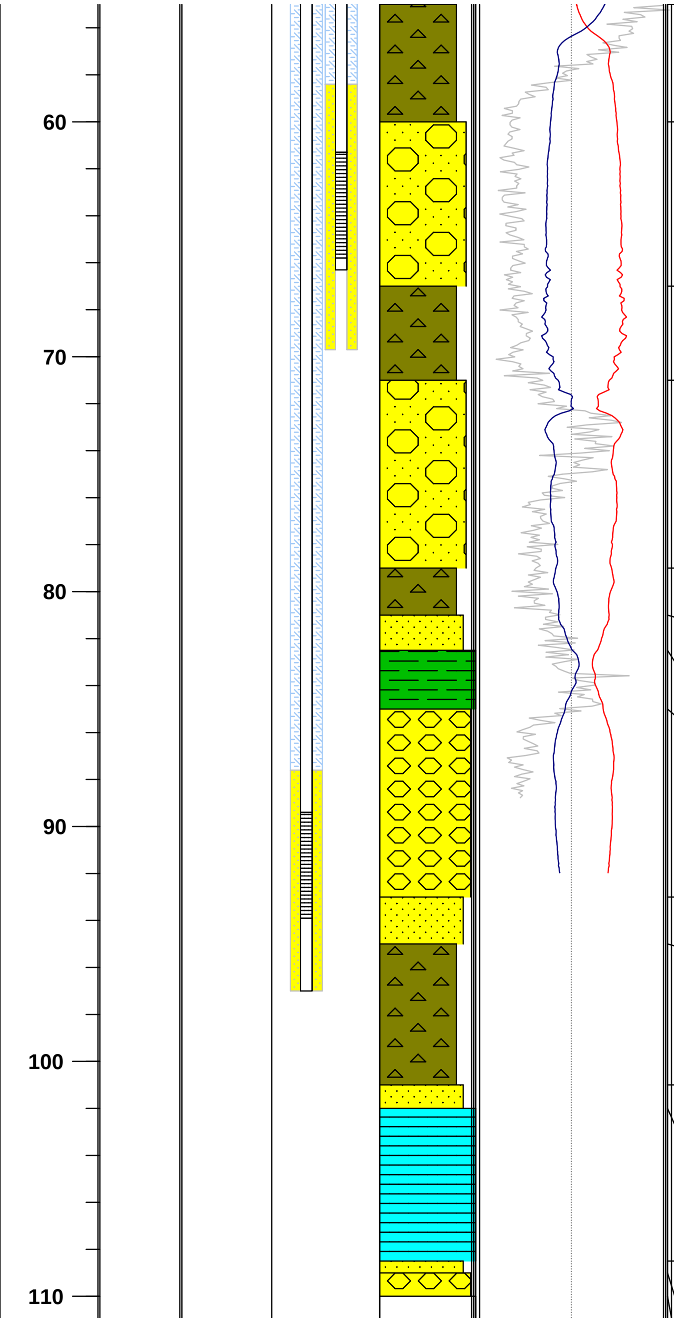
DATUM	ELEVATION	LOCATION OF BORING	
NAD 83	**871**	**N: 4705173**	**E:382069**

LOCATION USACE Hebron Township Borehole/Well(s)



Facies Code	Geologic Material Description	Interpretation
O	(0.0) soil; black organic silt/peat	Eq
Fc	(2.5) clay; gray, reddish brown to dark brown, silty clay, little sand, stiff, moist	
S	(5.5) sand; br to reddish br mottled med sand, dense, wet (SP)	
Fs	(6.5) silt; grayish brown, sandy silt, dense, wet (ML) abrupt lower contact	
Fc	(8.0) clay; brownish gray silty clay, stiff to very stiff, trace sand, trace fine gravel, damp (CL)	
S	(20.0) sand; brownish gray medium sand, dense, wet (SP), intraclay sand, abrupt lower contact	
Fc	(24.0) clay; gray silty clay, soft, moist (CL)	
Ss	(25.0) silt; brownish gray fine sandy silt, medium dense, wet (ML-SM), interbedded with sand stringers	
S	(35.0) sand; grayish brown silty sand, loose to medium dense, wet (SM)	
Fc	(38.5) clay; brownish gray silty clay, soft, very plastic (CH)	Wt

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Facies Code	Geologic Material Description	Environment - Interpretation
Dm	(55.0) diamicton; brownish gray sand and gravelly clay, soft, wet (GC/SC), not very plastic	
SG	(60.0) sand; gray fine to coarse gravelly sand, loose, wet (GW/SW), w/ gravel seams	Ha
Dm	(67.0) diamicton; brownish gray silty sandy gravelly clay, very hard (CL), clayey sand and gravel lense at 69, diamicton	G1
SG	(71.0) sand and gravel; brownish gray fine to coarse sand and gravel, little silt and clay, dense, wet (SW/GW) to (SC/GC), diamicton, slightly cohesive where no gravel	
Dm	(79.0) diamicton; grayish brown (slightly reddish) silty clay, w/ sand and gravel, very hard (CL)	
S	(81.0) sand; gray medium sand, little gravel, loose, wet (SP)	GS1
Fs	(82.5) silt; brownish gray silt to clayey silt, hard, damp (ML), occassional clay (CL-ML) in thin beds	
G	(85.0) gravel; gray sandy fine gravel, little med gravel, loose, wet (GW), some angular gravel	
S	(93.0) sand; gray gravelly sand, med dense to loose, wet (SP)	
Dm	(95.0) diamicton; gray clayey silt, little fine gravel and coarse gravel, stiff to very stiff w/ occassional silt interbeds (CL-ML)	G2
S	(101.0) sand; gray medium sand, little f gravel, loose (SP)	GS2
Fc	(102.0) clay; gray silty clay, extremely hard, little fine gravel and coarse sand, damp (CL)	
S	(108.5) sand; med sand	
G	(109.0) gravel; fine to coarse gravel	
B	(110.0) bedrock; dolomite	Bdrk

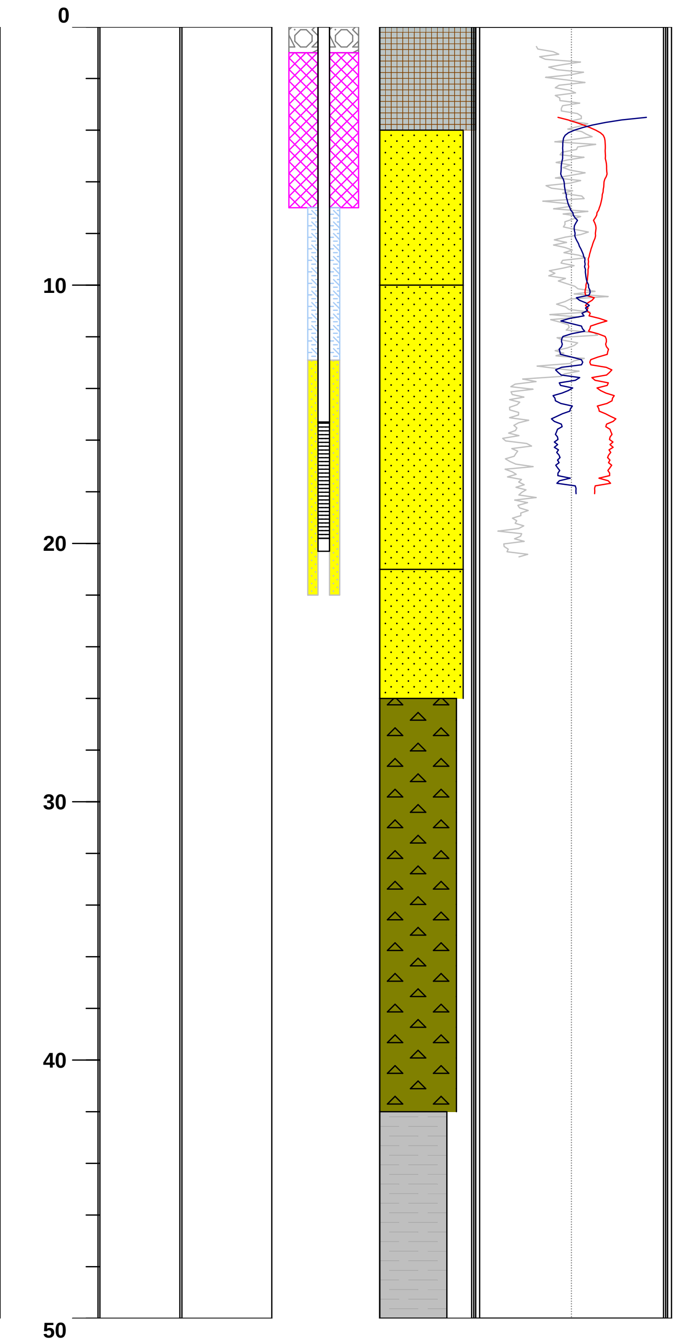
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: **Gary Braun-STS Consulting**		API NO.
DRILLING METHOD: **Rotosonic**	DATE LOGGED: **10/29/08**	BOREHOLE NUMBER: **Marengo**
TOWNSHIP/RANGE/SECTION		CORE NUMBER: **Marengo**
NEAREST CITY / TOWN / LANDMARK: **Marengo**		COUNTY: **McHenry**

PROJECT NAME: **McHenry County Observation Well Network**			WATER LEVEL	QUADRANGLE: **Garden Prairie**
OWNER			TIME	DRILLED BY
DATUM: **NAD 83**	ELEVATION: **780**	LOCATION OF BORING: **N: 4679955 E:359358**	DATE	START TIME / END TIME
LOCATION: USACE Marengo Township Borehole/Well(s)			CASING DEPTH	START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code



Geologic Material Description	Interpretation
(0.0) clay and sand; brown to dark brown sandy clay to clayey sand (sand content increases w/ depth), stiff to very dense, moist (SC)	Eq
(4.0) sand; brown fine sand, dense, wet (SP), fine gravel content increases w/ depth (none to very little, ~15 percent gravel)	Hen1
(10.0) sand; gray medium sand, trace to little coarse sand and fine gravel, trace fine sand (varies w/ bedding), loose, wet, mainly SP w/ SW beds	
(21.0) sand; brownish gray fine sand, dense, wet (SP), some clay content w/ depth	
(26.0) diamicton; gray sandy silty clay, trace f-c gravel, stiff to very stiff, low plasticity, massive matrix supported till (diamicton)	G1
(42.0) bedrock; ordovician system, maquoketa group, brainard formation, dark grayish green shale, soft, weathered differentially	Bdrk

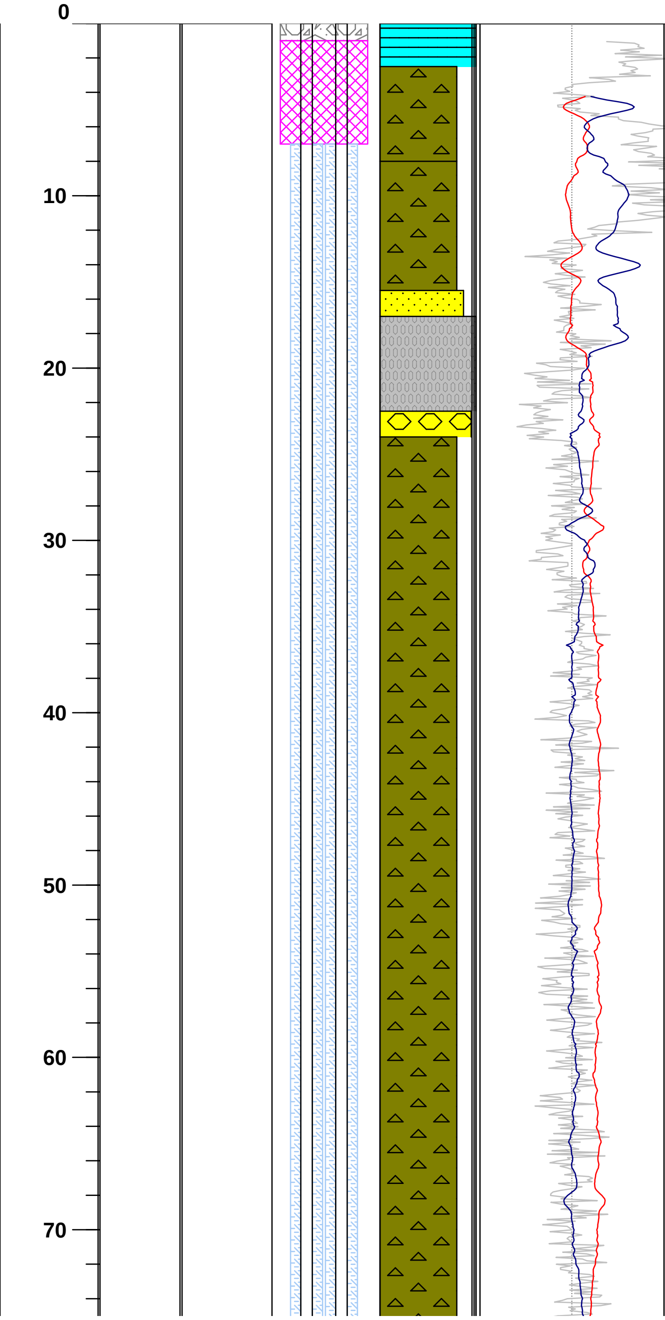
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY: STS Consulting	API NO.:
DRILLING METHOD: Rotosonic	DATE LOGGED: 10/09/08
BOREHOLE NUMBER: Nunda	CORE NUMBER: Nunda
TOWNSHIP/RANGE/SECTION:	COUNTY: McHenry
NEAREST CITY / TOWN / LANDMARK: McHenry	QUADRANGLE: McHenry
PROJECT NAME: McHenry County Observation Well Network	DRILLED BY:
OWNER:	START TIME / END TIME:
DATUM: NAD 83	ELEVATION: 784
LOCATION OF BORING: N: 4684472 E: 395933	START DATE / END DATE:
LOCATION: USACE Nunda Township Borehole/Well(s)	

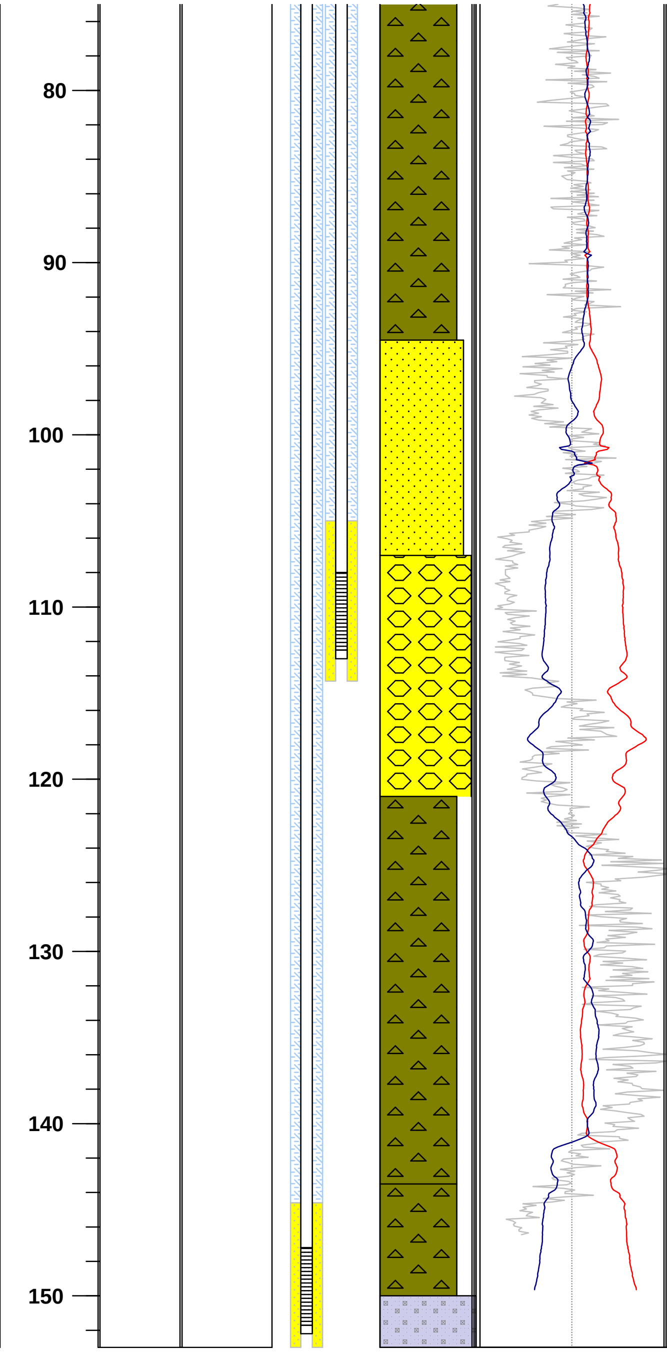
WATER LEVEL			
TIME			
DATE			
CASING DEPTH			

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50, 20 Cond 80, 0 Resist 30, 9.4 Temp 10.5 | Facies Code | Geologic Material Description | Interpretation



Facies Code	Geologic Material Description	Interpretation
Fc	(0.0) clay w/ topsoil; dark brown silty clay, little sand and organics, stiff, damp (CL-OL)	Wy
Dm	(2.5) weathered diamicton; brown/light brown mottled silty clay, little fine gravel, trace organics and sand, stiff, moist (CL)	
Dm	(8.0) diamicton; olive brown to brown silty clay, little coarse sand and fine gravel, trace medium gravel, very stiff to hard, moist (CL), diamicton'	
S	(15.5) sand; grayish brown fine sand, moderately dense, wet (SP)	Hy
Fcg	(17.0) clay; borwnish gray sandy-gravelly clay, little silt, very stiff w/ occasional med dense spots, damp (GC/SC)	
G	(22.5) gravel; gray sandy fine gravel, loose, moist to wet (GW)	Wt
Dm	(24.0) diamicton; dark pinkish brown silty clay, little coarse sand and fine to medium gravel, very hard, damp (CL), tiskilwa till	

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



Facies Code	Geologic Material Description	Environment - Interpretation
S	(94.5) sand; brownish gray medium to coarse sand with fine to medium gravel, trace to little silt and coarse gravel to cobbles, moderately dense, wet (SW to SW/GW), outwash	Ha
G	(107.0) gravel; gray medium to coarse sandy (m-c) gravel (f-c gravel), trace cobbles, loose, wet (GW)	
Dm	(121.0) diamicton; gray silty clay to clayey silt, trace fine gravel, stiff to very stiff, (w/ dense pockets), damp (CL-CL/ML), med plasticity, but reduces w/ increasing silt content, less gravel than overlying till, diamicton, (till)	G1
Dm	(143.5) diamicton; gray gravelly silt, large fractured cobbles, some sand, very hard, damp occassional granular layer, frequent dolomite clasts (GM), hardpan, not plastic	
B	(150.0) bedrock; dolomite	Bdrk

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

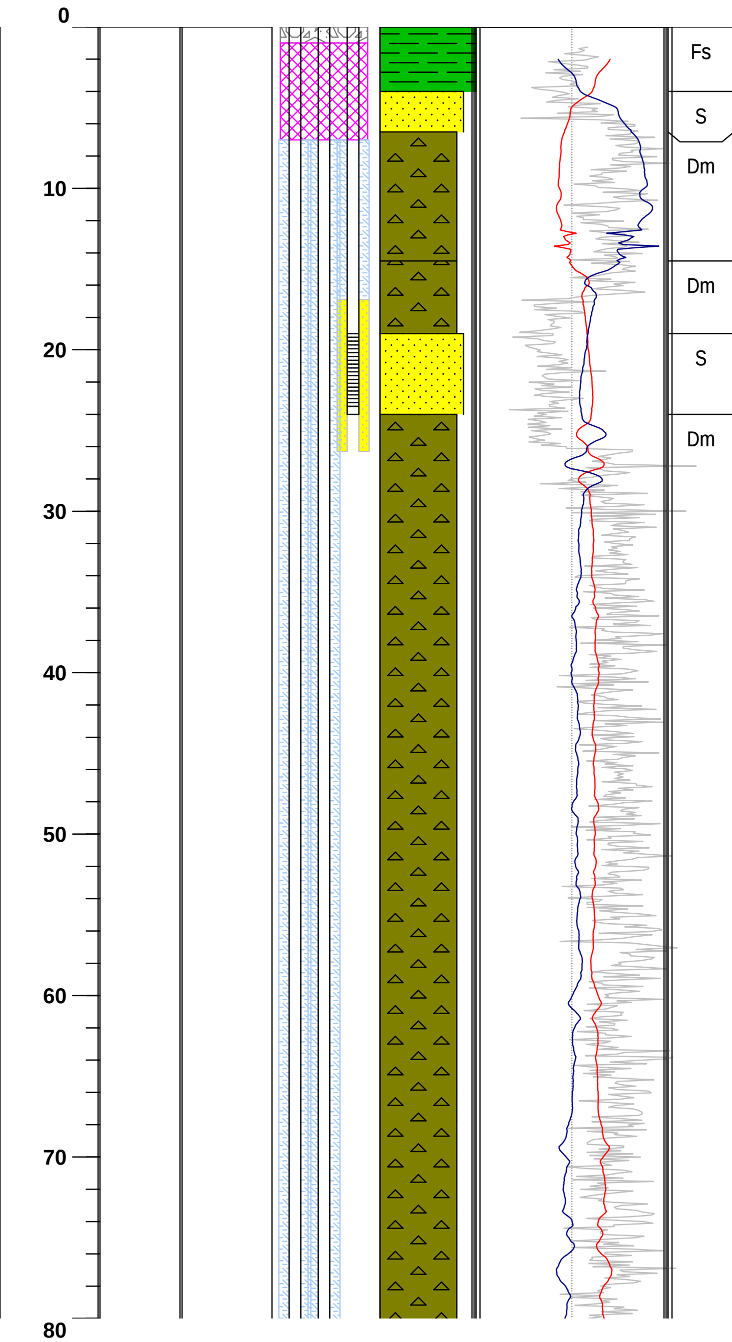
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY Gary Braun-STS Consulting			API NO.
DRILLING METHOD Rotosonic	DATE LOGGED 10/06/08		BOREHOLE NUMBER Richmond
TOWNSHIP/RANGE/SECTION			CORE NUMBER Richmond
NEAREST CITY / TOWN / LANDMARK Richmond			COUNTY McHenry

PROJECT NAME McHenry County Observation Well Network			
OWNER			
DATUM NAD 83	ELEVATION 841	LOCATION OF BORING N: 4703901	E:391561
LOCATION USACE Richmond Township Borehole/Well(s)			

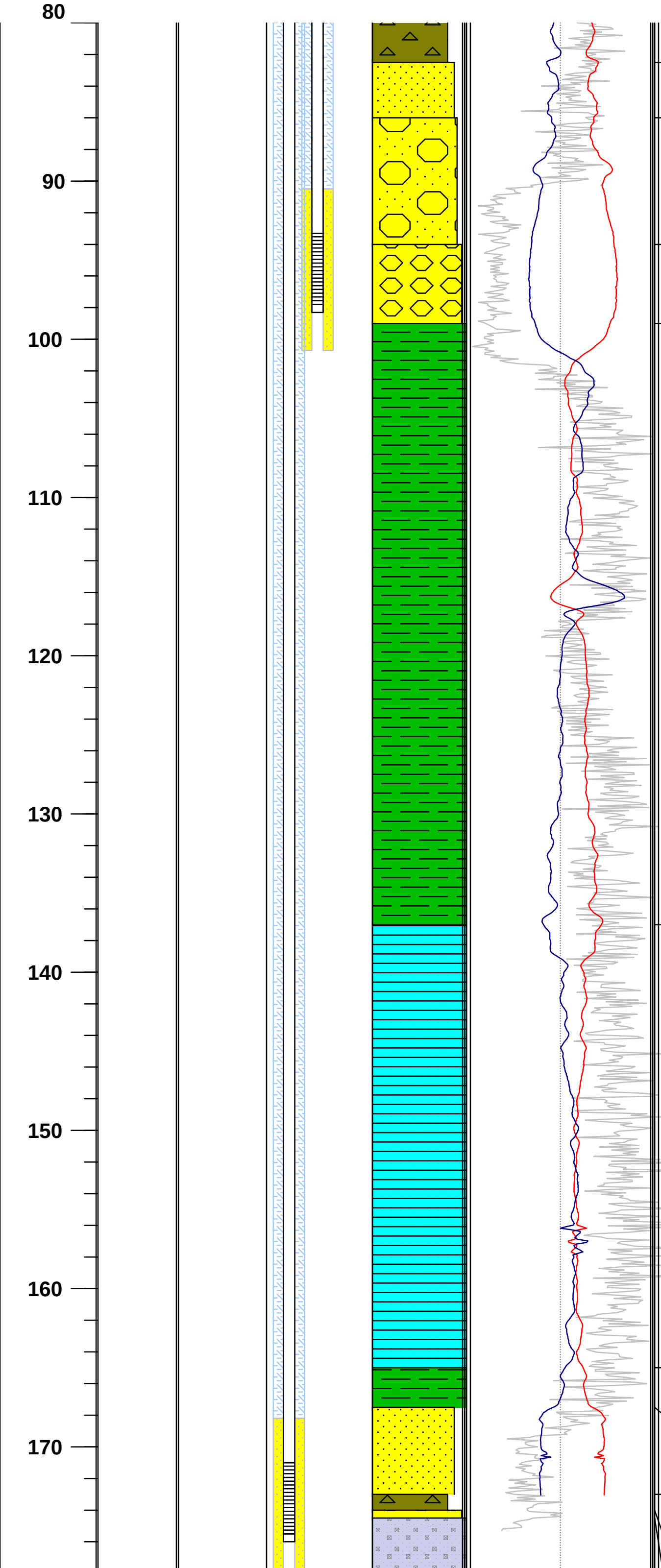
WATER LEVEL				QUADRANGLE Richmond
TIME				DRILLED BY
DATE				START TIME / END TIME
CASING DEPTH				START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Geologic Material Description	Interpretation
(0.0) silt w/ topsoil; reddish brown clayey silt w/ organics and sand, little grvel, low to no plasticity, stiff to dense, damp (ML/OL)	Hen1
(4.0) sand; brown sand, little gravel, trace silt, loose, wet (SW), shallow interflow zone	Wt
(6.5) diamicton; lt reddish brown silty clay, trace to little coarse sand and gravel, hard, damp (CL), diamicton, low to medium plasticity	
(14.5) diamicton; gray silty clay, little sand and gravel, stiff, moist to wet (where granular) (CL), w/ interbeds of clayey sand and medium sand, diamicton	
(19.0) sand; interbeds of sand and clayey sand, wet	
(24.0) diamicton; gray to brownish gray silty clay, little sand and gravel, very stiff to hard, soft from 75-82', moist to wet (CL),diamicton	

Depth (ft.) [cont'd]	Recovery Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	Geologic Material Description	Environment - Interpretation



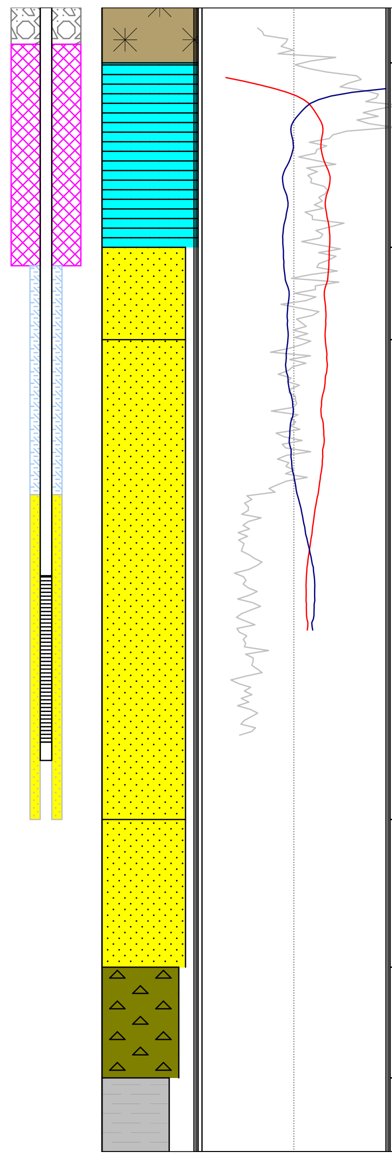
Facies Code	Geologic Material Description	Environment - Interpretation
S	(82.5) sand; brownish gray fins sand, little silt, dense, wet (SP), gravelly at 85-86', silt lense at bottom	Ha
SG	(86.0) sand and gravel; gray medium to coarse sand w/ fine to coarse gravel, content ingreasing w/ depth, fining upward sequence) (SW/GW)	
G	(94.0) gravel; gradual transition from sand and gravel above, some clean gravel	
Fs	(99.0) silt; gray clayey silt, very stiff, low plasticity (varies based on clay content), damp (CL-ML), very uniform, no sand/gravel observed	G1
Fc	(137.0) clay; brownish gray silty clay, stiff, moist, high plasticity, very uniform (same stratigraphic unit as above, more clay, less silt) (CL), glaciolacustrine	
Fs	(165.0) silt; brownish gray clayey silt, rare fine gravel, dense (not plastic)(ML)	
S	(167.5) sand; brownish gray clayey sand, trace fine-coarse gravel, dense, moist to wet (SC)	
Dm	(173.0) clay; brownish gray silty clay w/ f-m gravel, v. stiff, damp, diamicton, till	
G	(174.0) gravel; brownish gray sandy f gravel, loose, wet (GP)	
B	(174.5) bedrock; dolomite	

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LOGGED BY	STS Consulting
API NO.	
DRILLING METHOD	Rotosonic
DATE LOGGED	10/30/08
BOREHOLE NUMBER	Riley
TOWNSHIP/RANGE/SECTION	
CORE NUMBER	Riley
NEAREST CITY / TOWN / LANDMARK	Marengo
COUNTY	McHenry
PROJECT NAME	McHenry County Observation Well Network
WATER LEVEL	
QUADRANGLE	Riley
OWNER	
TIME	
DRILLED BY	
DATUM	NAD 83
ELEVATION	808
LOCATION OF BORING	N: 4671316 E:364940
DATE	
START TIME	
END TIME	
LOCATION	USACE Riley Township Borehole/Well(s)
CASING DEPTH	
START DATE	
END DATE	

Depth (ft.) | Rec/Drive | Sample | Well | Graphic | 0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5 | Facies Code | Geologic Material Description | Interpretation

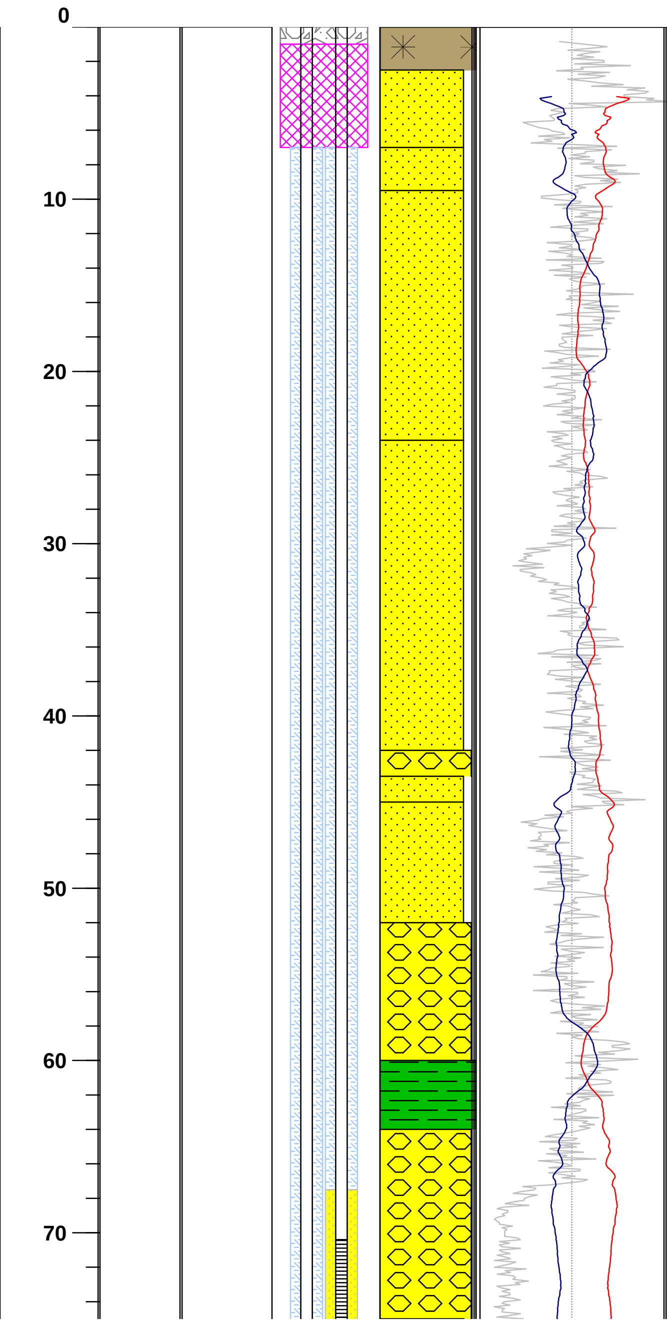


Depth (ft.)	Facies Code	Geologic Material Description	Interpretation
0	O	(0.0) soil; topsoil, black-dk brown organic clayey silt, little sand, dense (OL)	Eq
	Fc	(1.5) clay; dark brown silty sandy clay, little gravel, trace organics, soft (SC) w/ black and brown mottling, damp	
	S	(6.5) sand; brown fine to coarse sand, trace fine gravel and silt, loose, wet (SW)	Hen1
10	S	(9.0) sand; brown coarse sand, trace f-m sand and f gravel, loose, wet (SP), large cobble at bottom	
20	S	(22.0) sand; medium gray sand, little clay, t f gravel, dense, wet (SP)	
	Dm	(26.0) clay; brownish gray silty clay, little f-c gravel, trace sand, very stiff to hard, damp (CL), till	G1
30	B	(29.0) bedrock; maquoketa group, brainard formation, greenish gray shaley dolomite	Bdrk

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

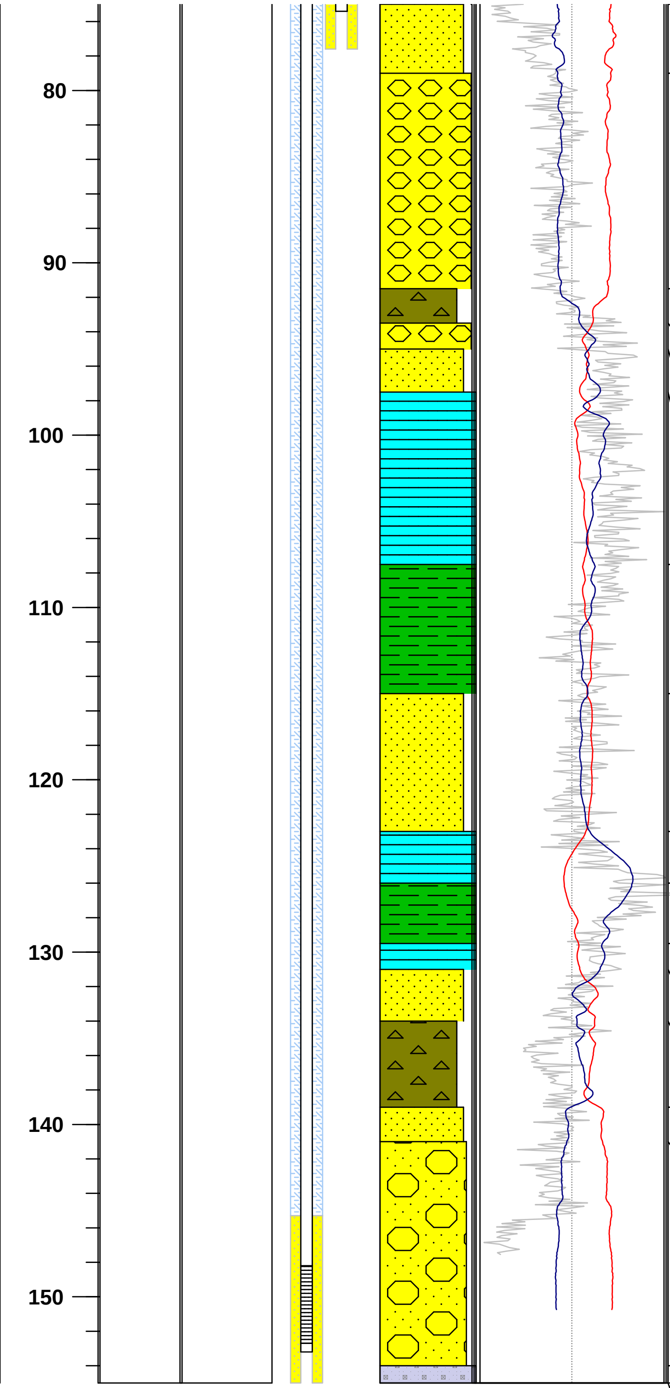
LOGGED BY: Gary Braun-STS Consulting			API NO.
DRILLING METHOD: Rotosonic	DATE LOGGED: 10/22/08		BOREHOLE NUMBER: Seneca
TOWNSHIP/RANGE/SECTION			CORE NUMBER: Seneca
NEAREST CITY / TOWN / LANDMARK: Marengo			COUNTY: McHenry
PROJECT NAME: McHenry County Observation Well Network	WATER LEVEL		QUADRANGLE: Marengo North
OWNER	TIME		DRILLED BY
DATUM: NAD 83	ELEVATION: 828	LOCATION OF BORING: N: 4681317 E: 374605	DATE	START TIME / END TIME
LOCATION: USACE Seneca Township Borehole/Well(s)	CASING DEPTH		START DATE / END DATE

Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0 Gamma 50 / 20 Cond 80 / 0 Resist 30 / 9.4 Temp 10.5	Facies Code	Geologic Material Description	Interpretation



Facies Code	Geologic Material Description	Interpretation
O	(0.0) soil; brown w/ black mottling, sandy clay to clayey sand, little organics, very stiff (CL)	Hen1
S	(2.5) sand; brown med sand, little coarse sand, trace fine sand, dense, moist to wet (SP to SW), grades into fine sand	
S	(7.0) sand; brown fine sand, dense, wet (SP)	
S	(9.5) sand; lt grayish brown medium sand, loose, wet (SP)	
S	(24.0) sand; gray medium sand, little c sand, trace f sand, loose, wet (SP) to trace (SP/SW) fine gravel	
G	(42.0) gravel; gray fine gravel, little coarse sand, loose, wet (GP)	
S	(43.5) sand; gray fine sand, med dense, wet (SP)	
S	(45.0) sand; gray coarse sand, little f-c gravel and med sand, loose, wet (SP)(although may be SW locally)	
G	(52.0) gravel; gray fine gravel to coarse sandy fine gravel, some m-c gravel, loose, wet (GW), some coarsening upward sequences	
Fs	(60.0) silt; grayish brown clayey silt, soft, little to no plasticity, well sorted (no intraclasts)(CL-ML)	
G	(64.0) gravel; gray fine to coarse gravel, very lose, clean, wet, productive (GW)	

Depth (ft.) [cont'd]	Recovery: Recovered / Driven	Sample	Graphic	Gamma (cps) 30 60 90 120	Facies Code	**Geologic Material Description**	**Environment - Interpretation**



Facies Code	Geologic Material Description	Environment - Interpretation
S	(75.0) sand; grayish brown medium sand, loose,wet, (SP)	
G	(79.0) gravel; gray sandy fine gravel, little med gravel, trace coarse gravel, very loose, wet (GW)	
Dm	(91.5) diamicton; dark brown clayey silt, little sand and gravel, hard (ML), diamicton, not plastic and abrupt gradation	G1
G	(93.5) gravel; gray fine to coarse gravel, fining upward, loose, wet (GP), abrupt contact	GS1
S	(95.0) sand; brownish gray fine sand, dense, wet (SP), very well graded with sharp contacts	G2
Fc	(97.5) clay; dark grayish brown fat clay, soft, moist, (CH), highly plastic, no intraclasts,massive with only traces of fine sand pockets, glaciofluvial	
Fs	(107.5) silt; grayish brown silt, very dense, not cohesive/not plastic, very well sored, most (ML)	
S	(115.0) sand; gray very fine sand, dense, wet (SP), well sorted	
Fc	(123.0) clay; gray fat clay, stiff, damp (CL) clean, no clasts, high plasticity	
Fs	(126.0) silt; gray w/ black layers clayey silt, soft, little plasticiy (CL-ML), black bedding only from 126-128'	
Fc	(129.5) clay; dark gray silty clay, stiff (CL)(well sorted)	
S	(131.0) sand; grayish brown fine to medium sand, little coarse sand or gravel, med dense (SP)	
Fc	(134.0) clay; brownish gray silty clay, little fine gravel and c sand, stiff, diamicton (CL)	
S	(139.0) sand; grayish brown fine sand, trace fine gravel, med dense (SP)	GS2
Sg	(141.0) sand and gravel; gray gravelly (fine gravel) coarse sand, trace medium gravel, loose (GP-SP), w/ sand seams	
B	(154.0) bedrock; gray vuggy argillaceous dolomite	Bdrk

APPENDIX B

Geophysical Profiles and Geologic Interpretations

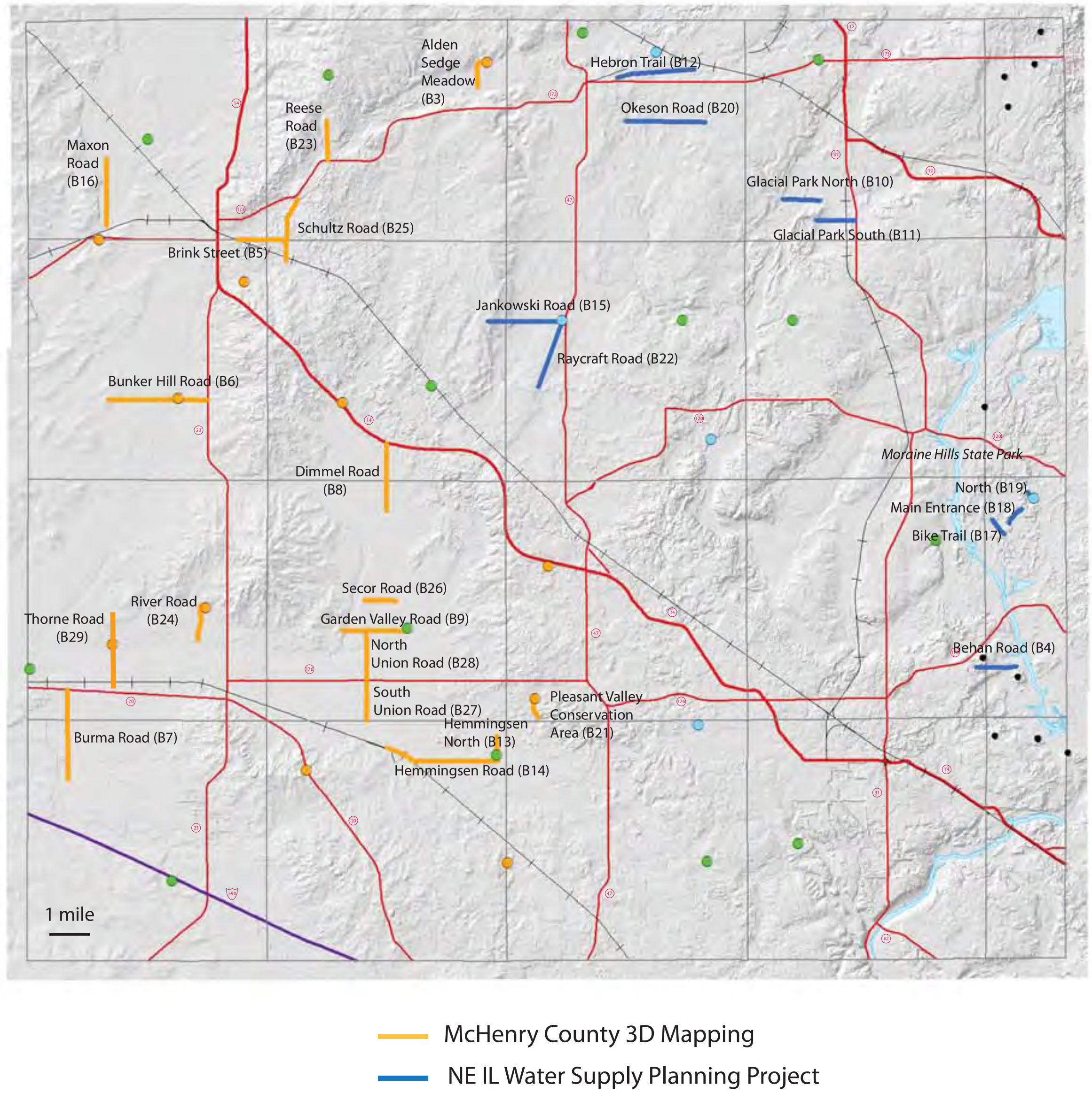


Figure B1. Locations of geophysical profiles collected in McHenry County during 2008-2009. Labels in parentheses are the relative figure numbers in Appendix B.

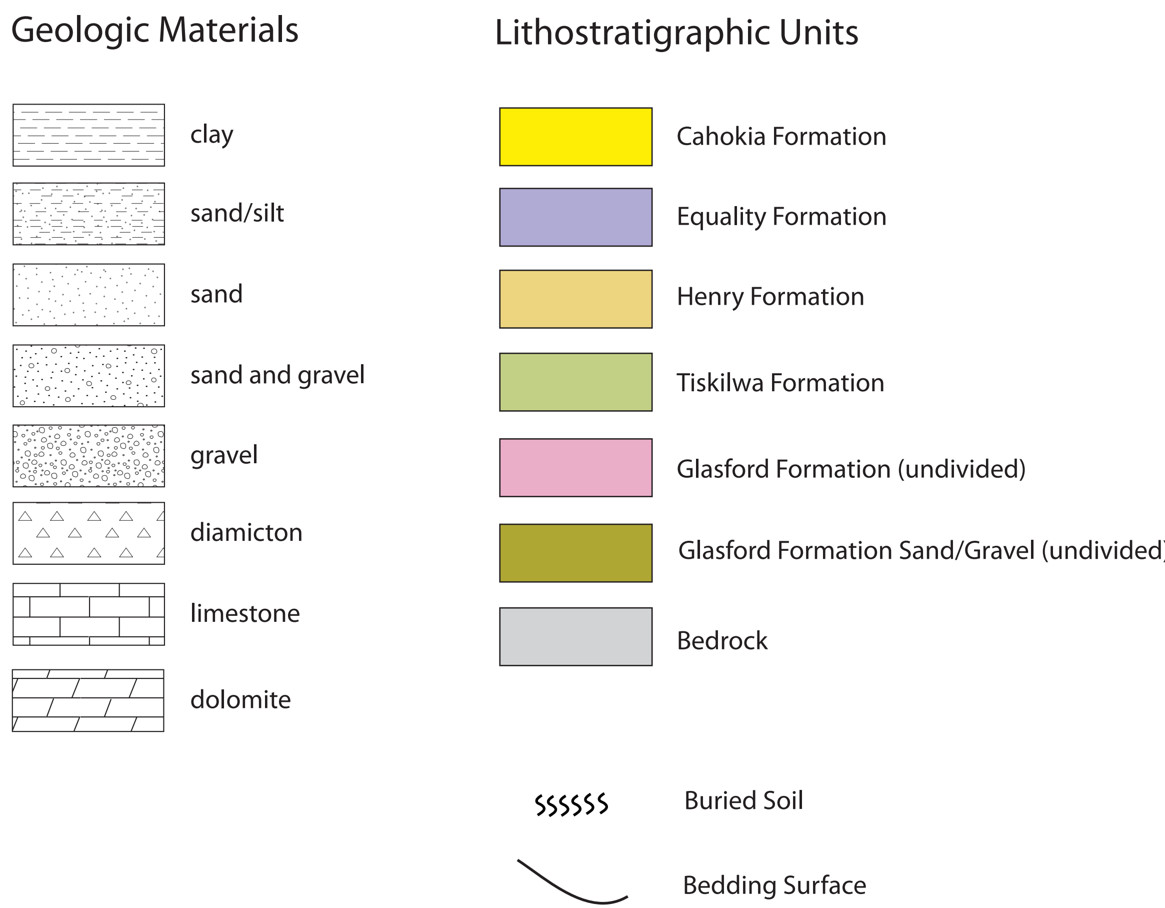


Figure B2. Legend for interpreted geophysical profiles in Appendix B.

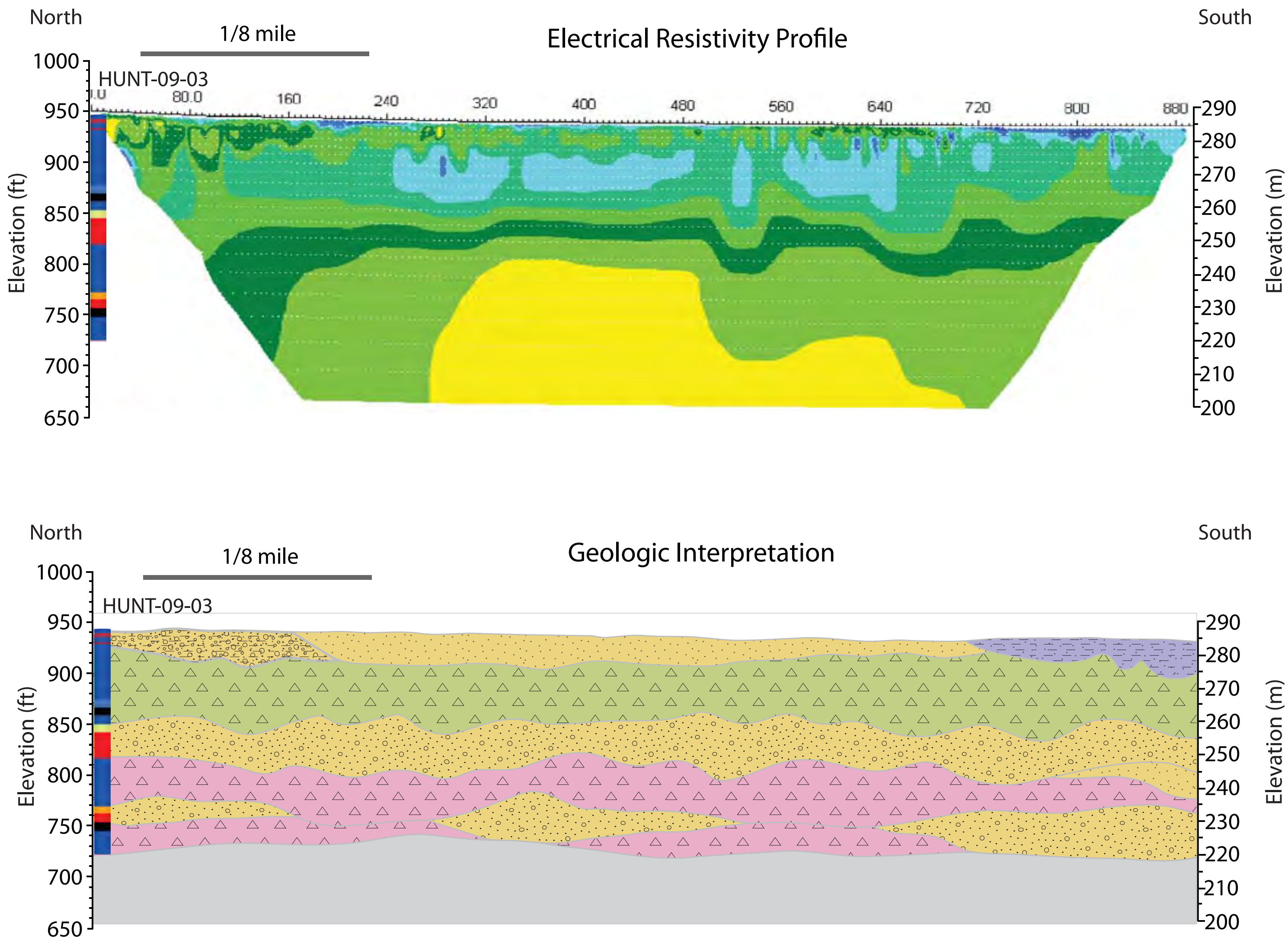


Figure B3. Geophysical data and geologic interpretation at Alden Sedge Meadow Conservation Area.

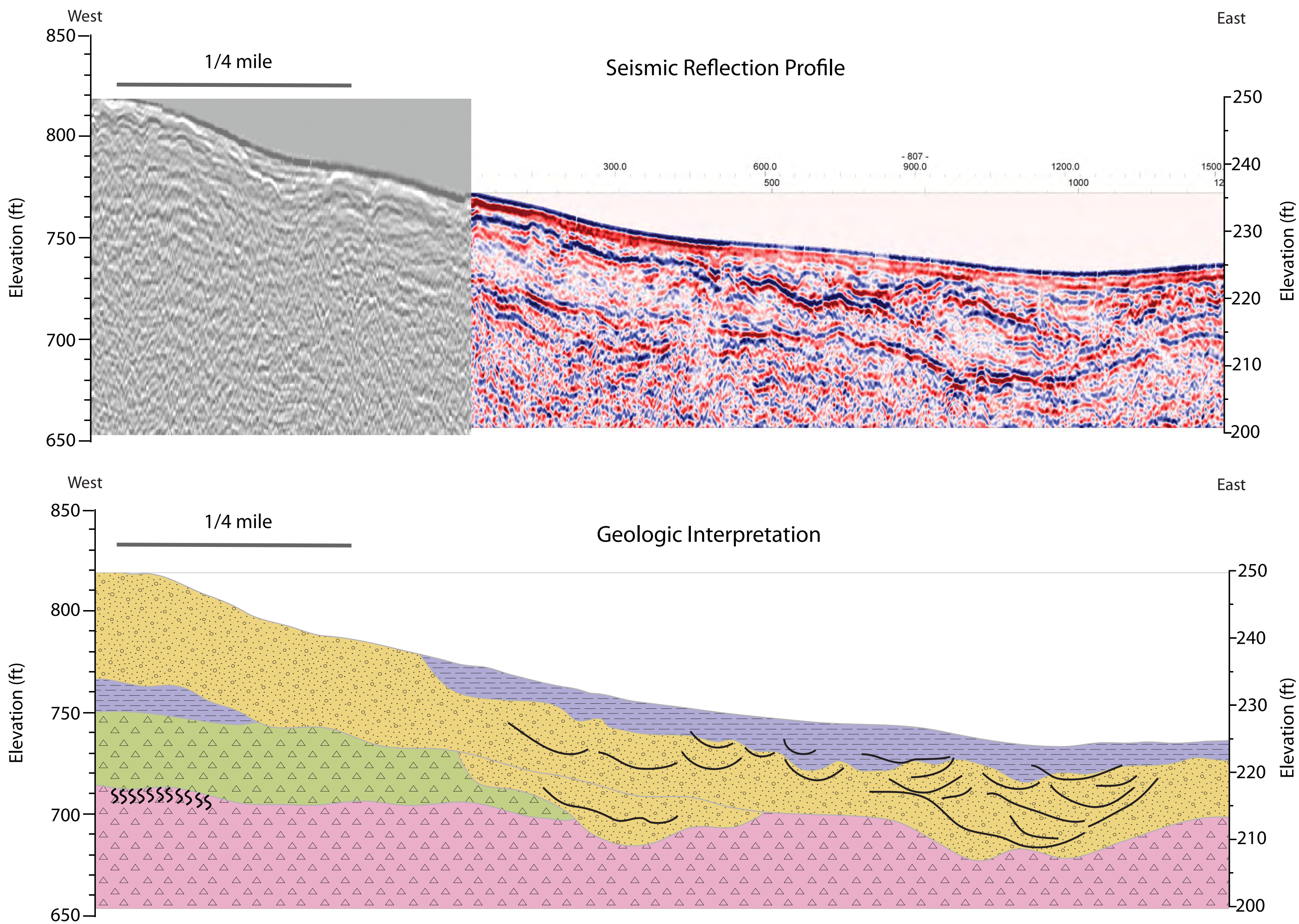
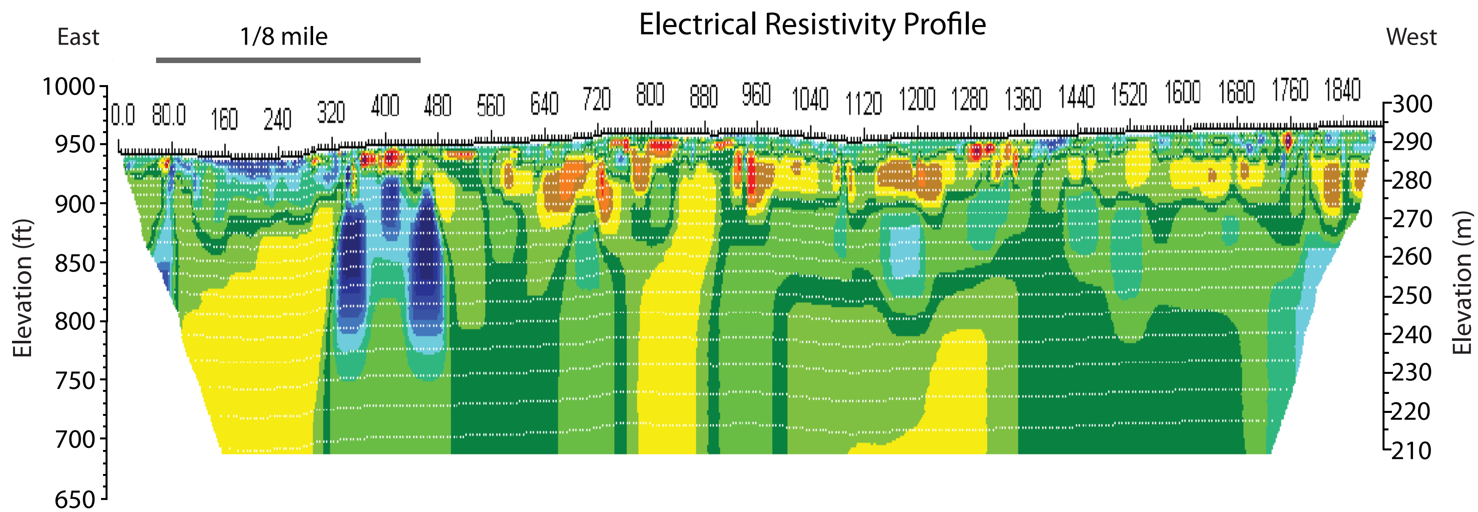


Figure B4. Geophysical data and geologic interpretation along Behan Road.



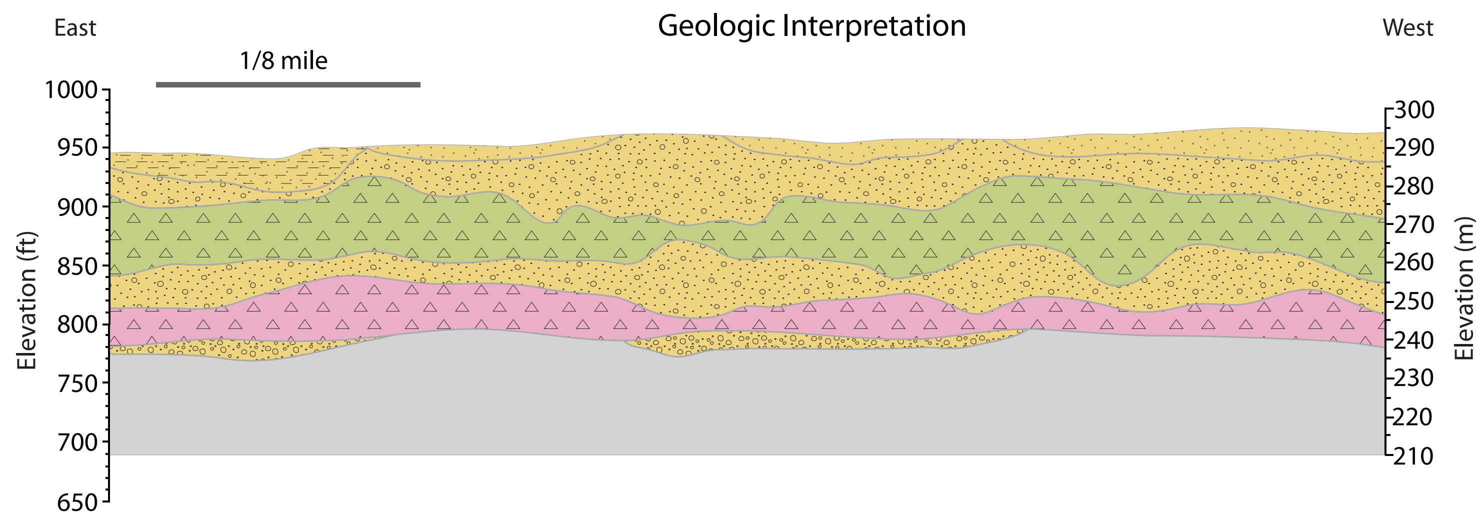


Figure B5. Geophysical data and geologic interpretation along Brink Street.

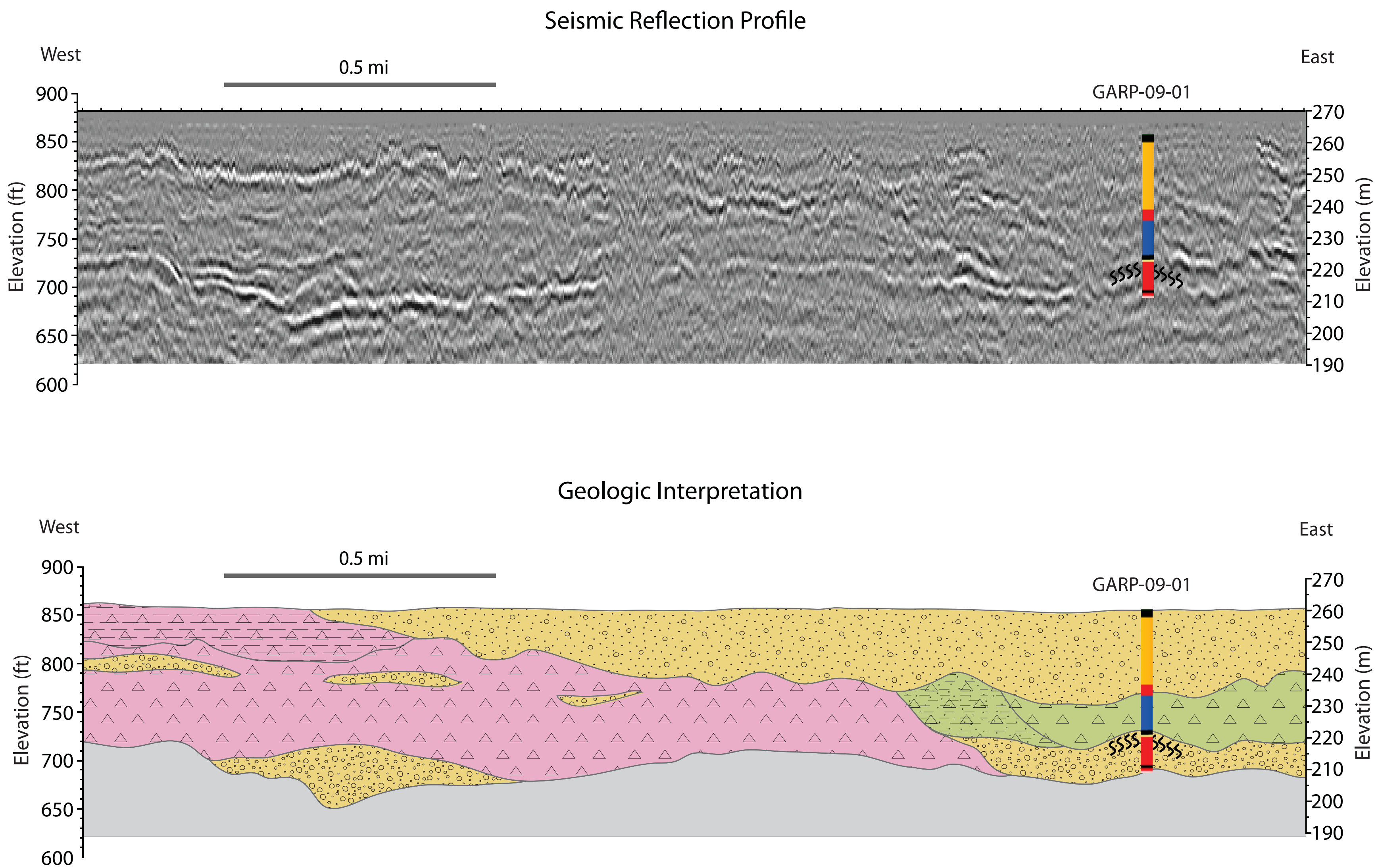


Figure B6. Geophysical data and geologic interpretation along Bunker Hill Road.

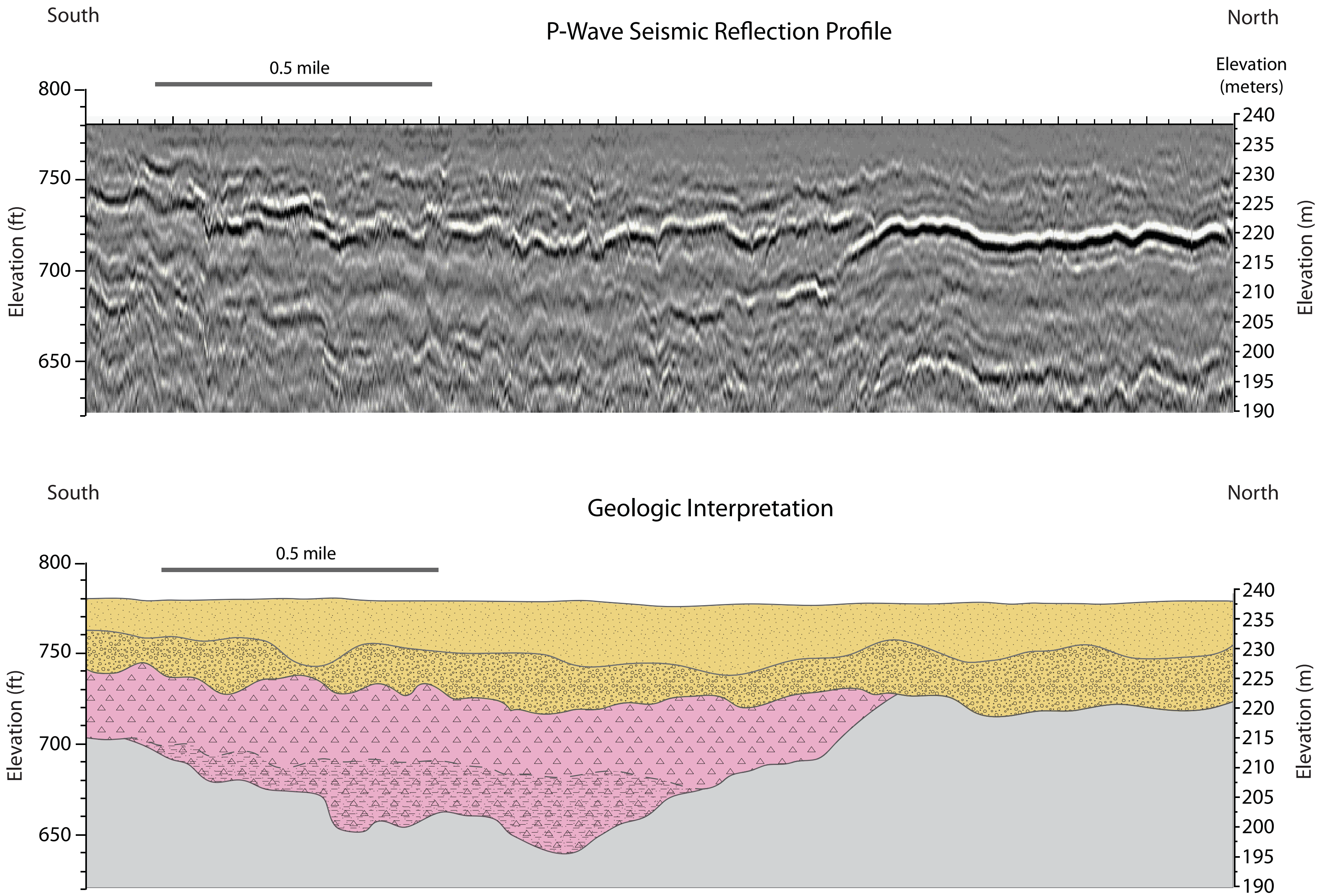


Figure B7. Geophysical data and geologic interpretation along Burma Road.

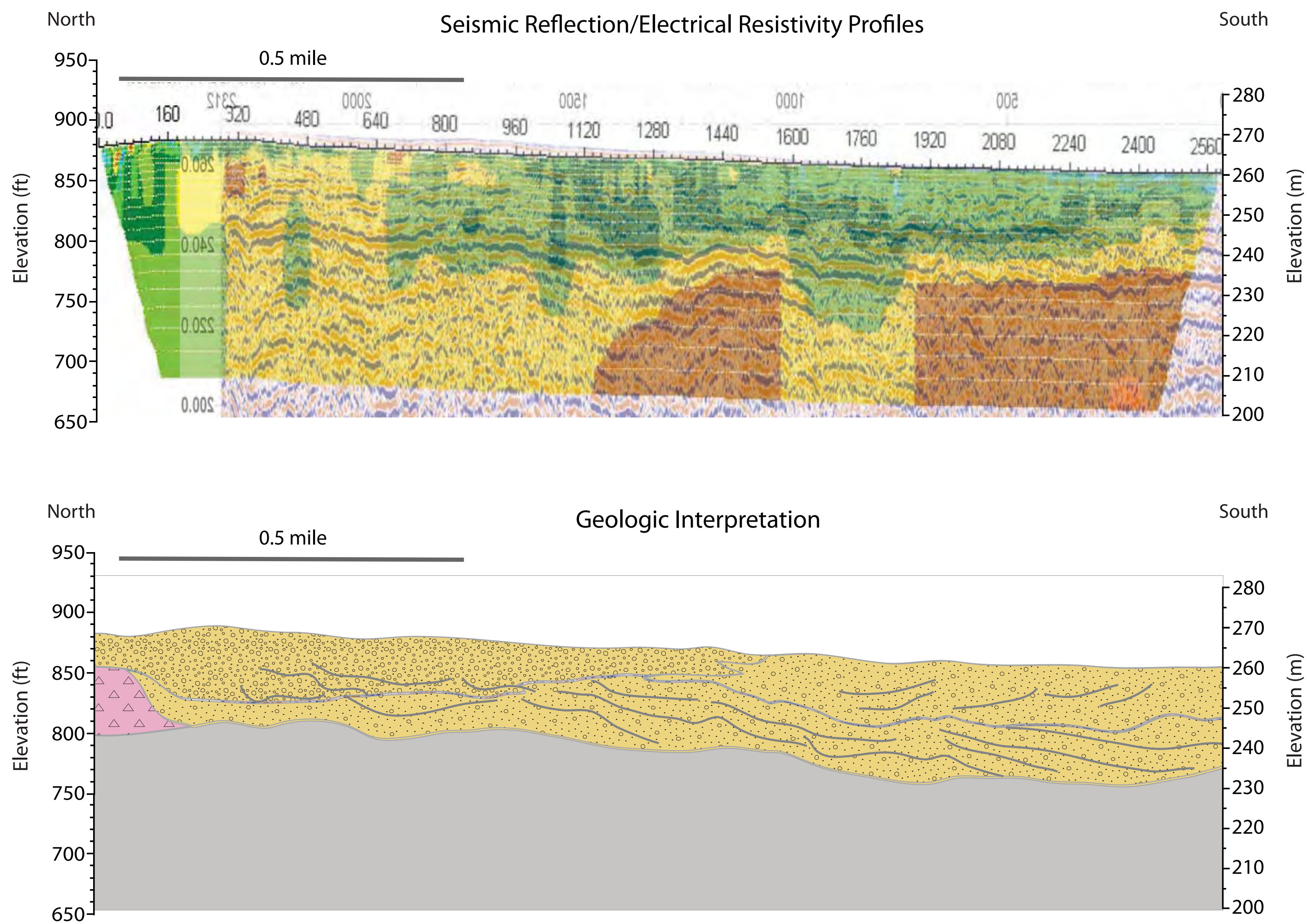


Figure B8. Geophysical data and geologic interpretation along Dimmel Road.

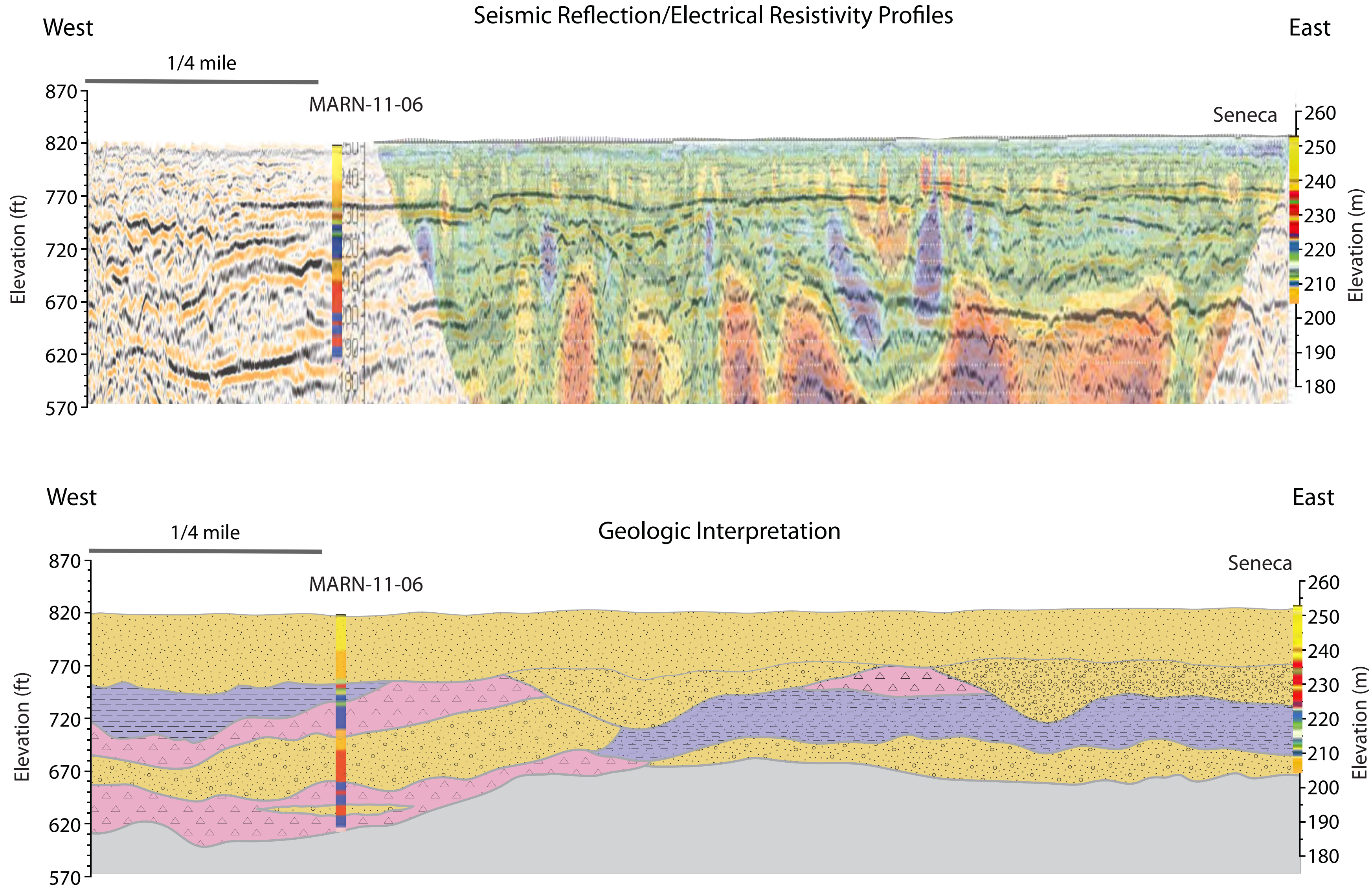


Figure B9. Geophysical data and geologic interpretation along Garden Valley Road.

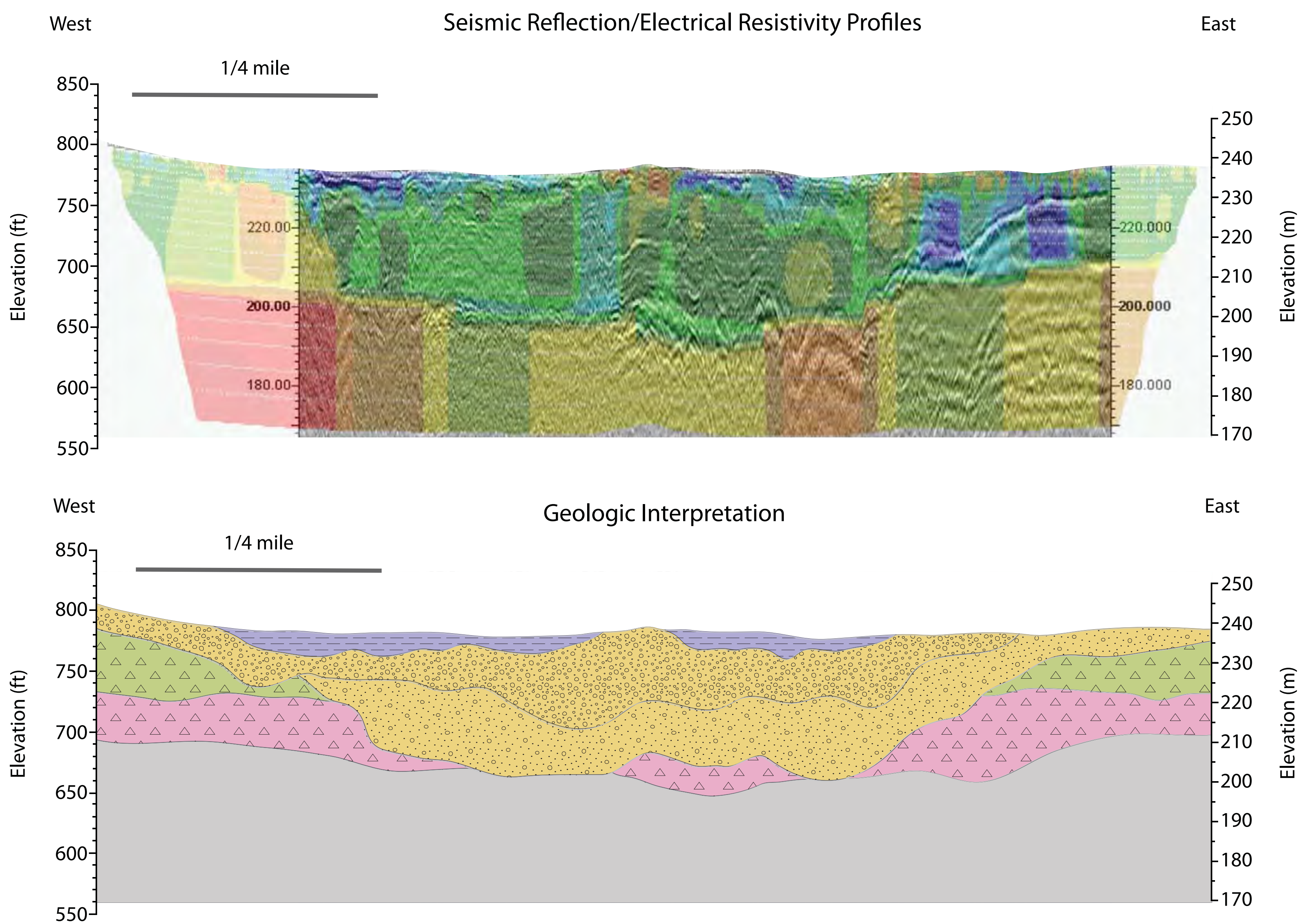


Figure B10. Geophysical data and geologic interpretation at Glacial Park-north site (along Harts Road)

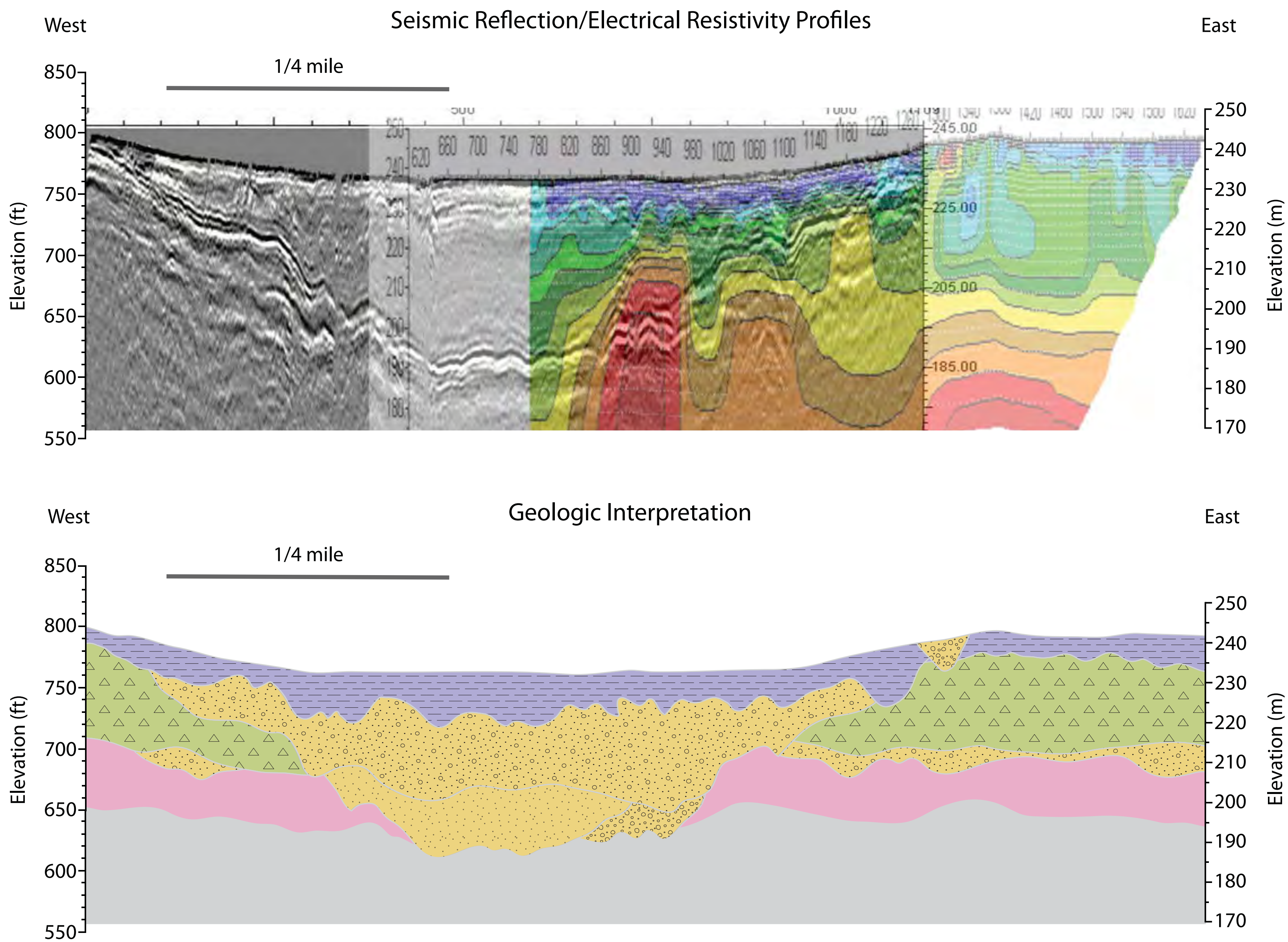


Figure B11. Geophysical data and geologic interpretation at Glacial Park-south site (along Harts Road).

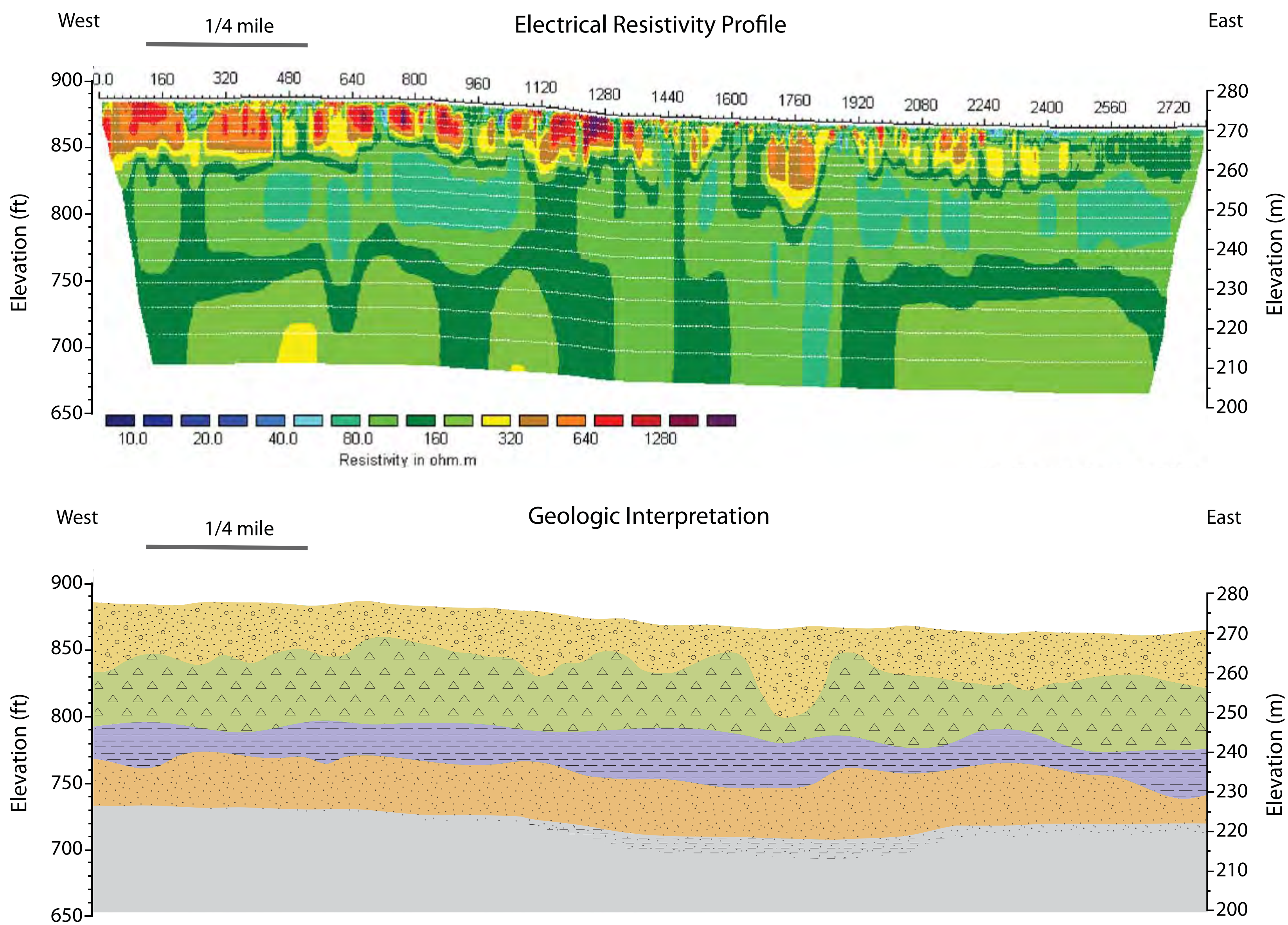


Figure B12. Geophysical data and geologic interpretation along Hebron Trail.

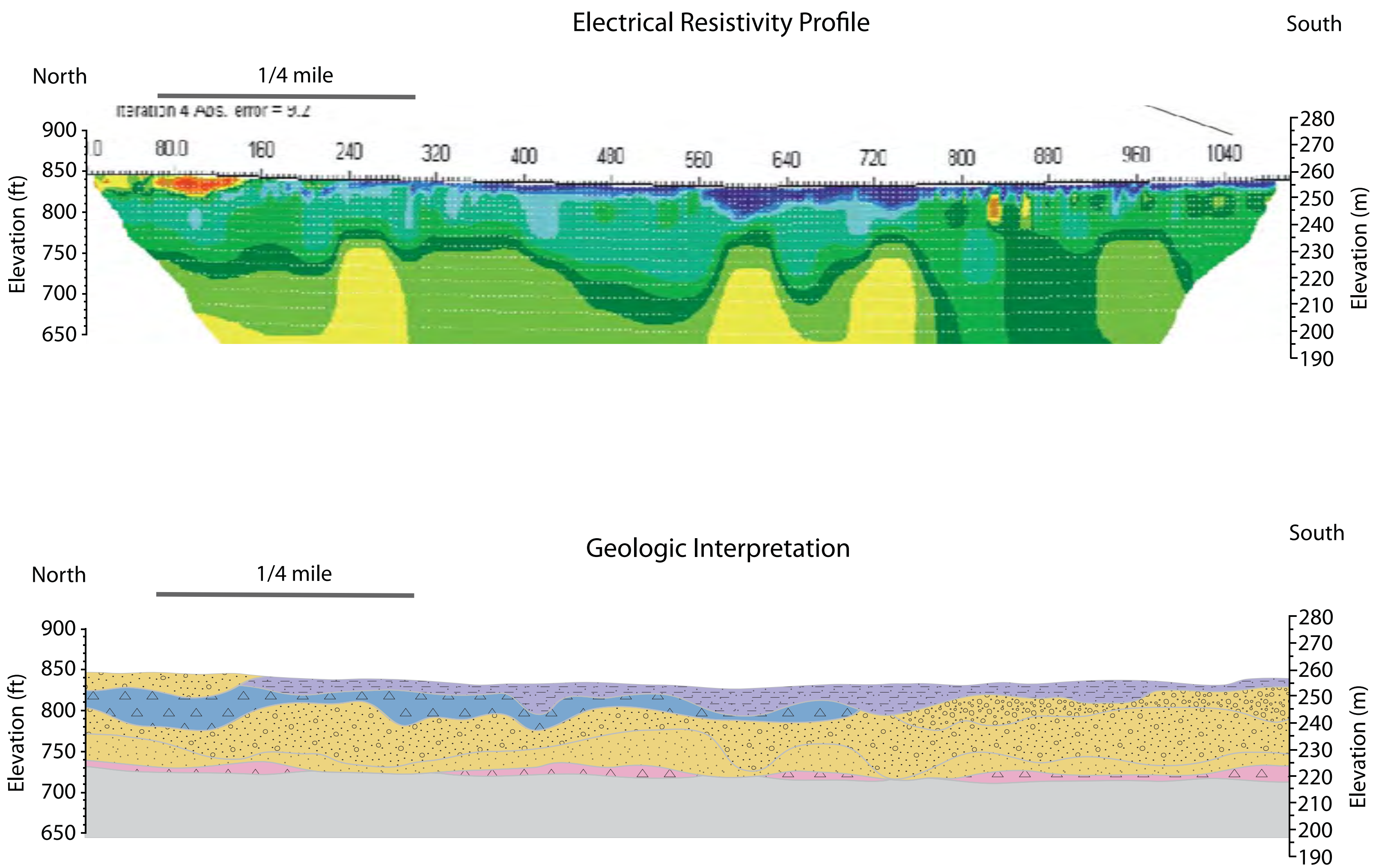
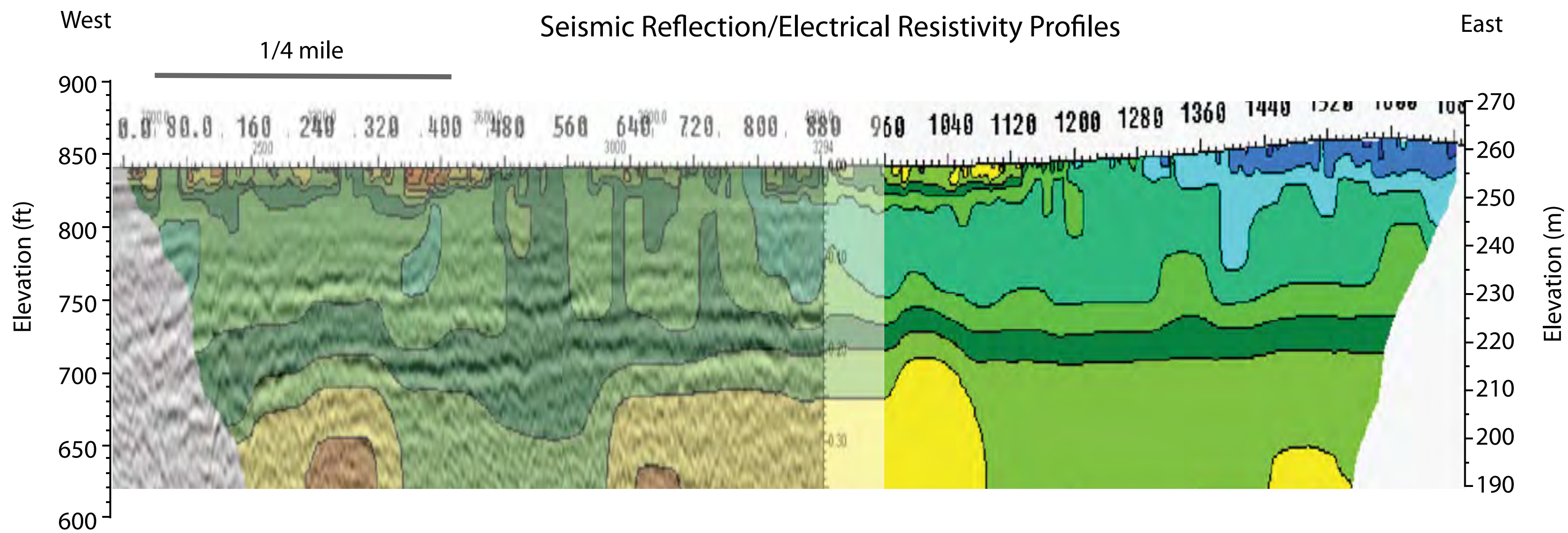


Figure B13. Geophysical data and geologic interpretation at Hemmingsen North (Pleasant Valley Conservation Area)



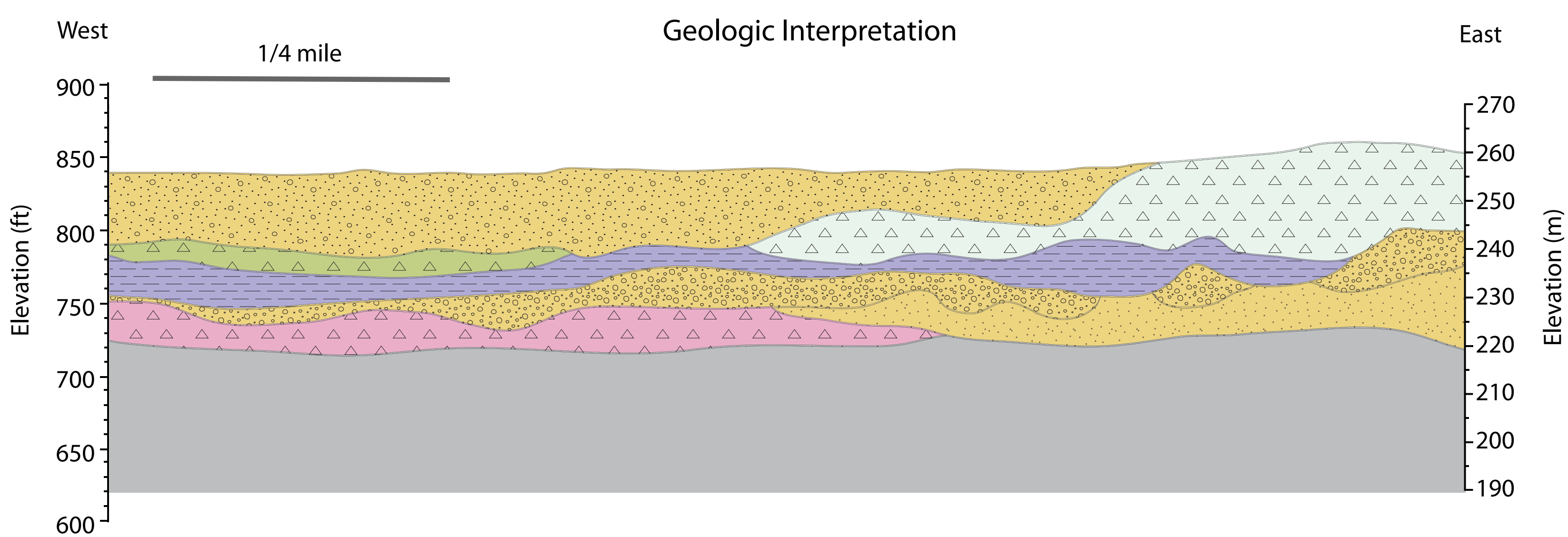


Figure B14. Geophysical data and geologic interpretation along Hemmingsen Road.

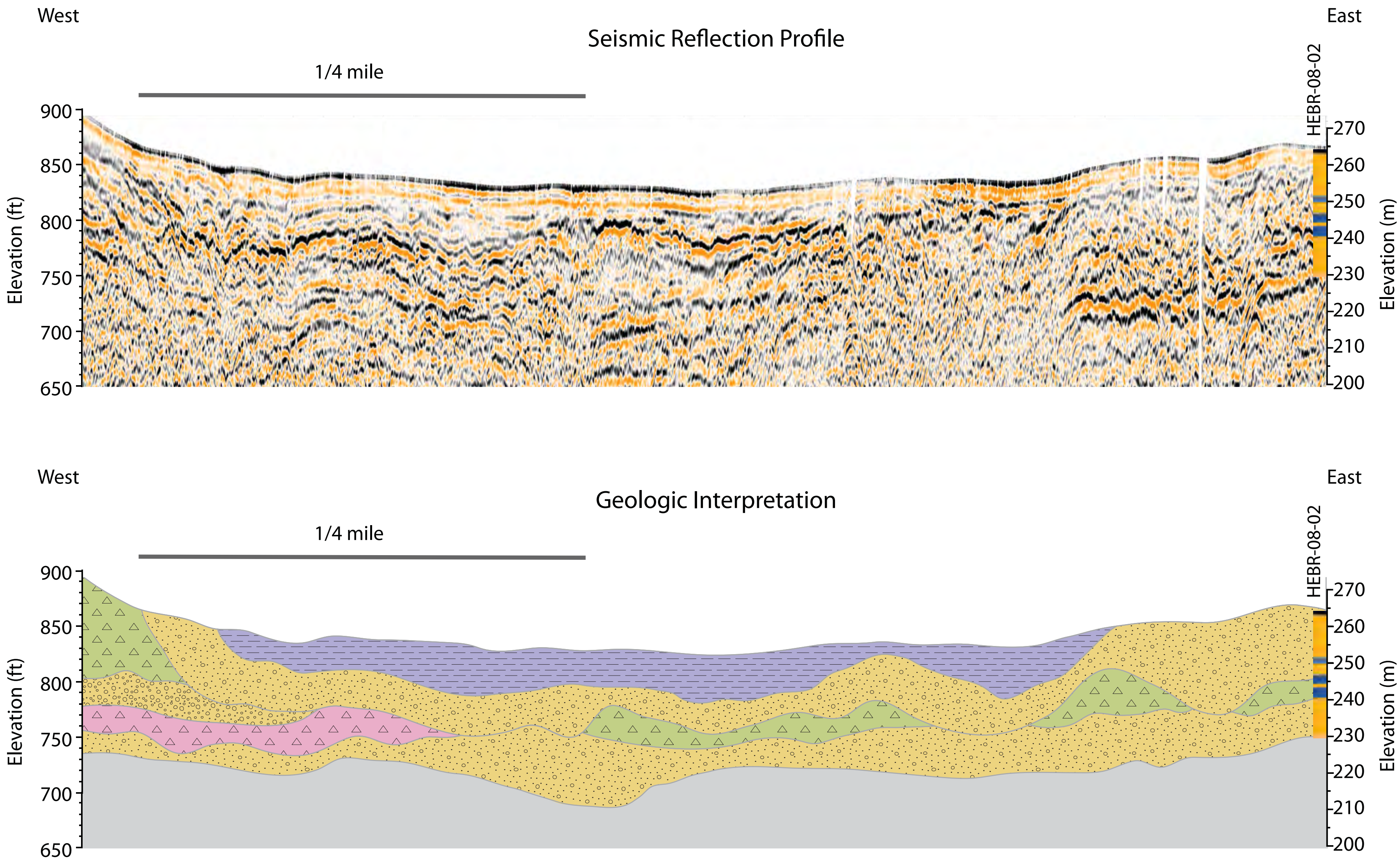


Figure B15. Geophysical data and geologic interpretation along Jankowski Road.

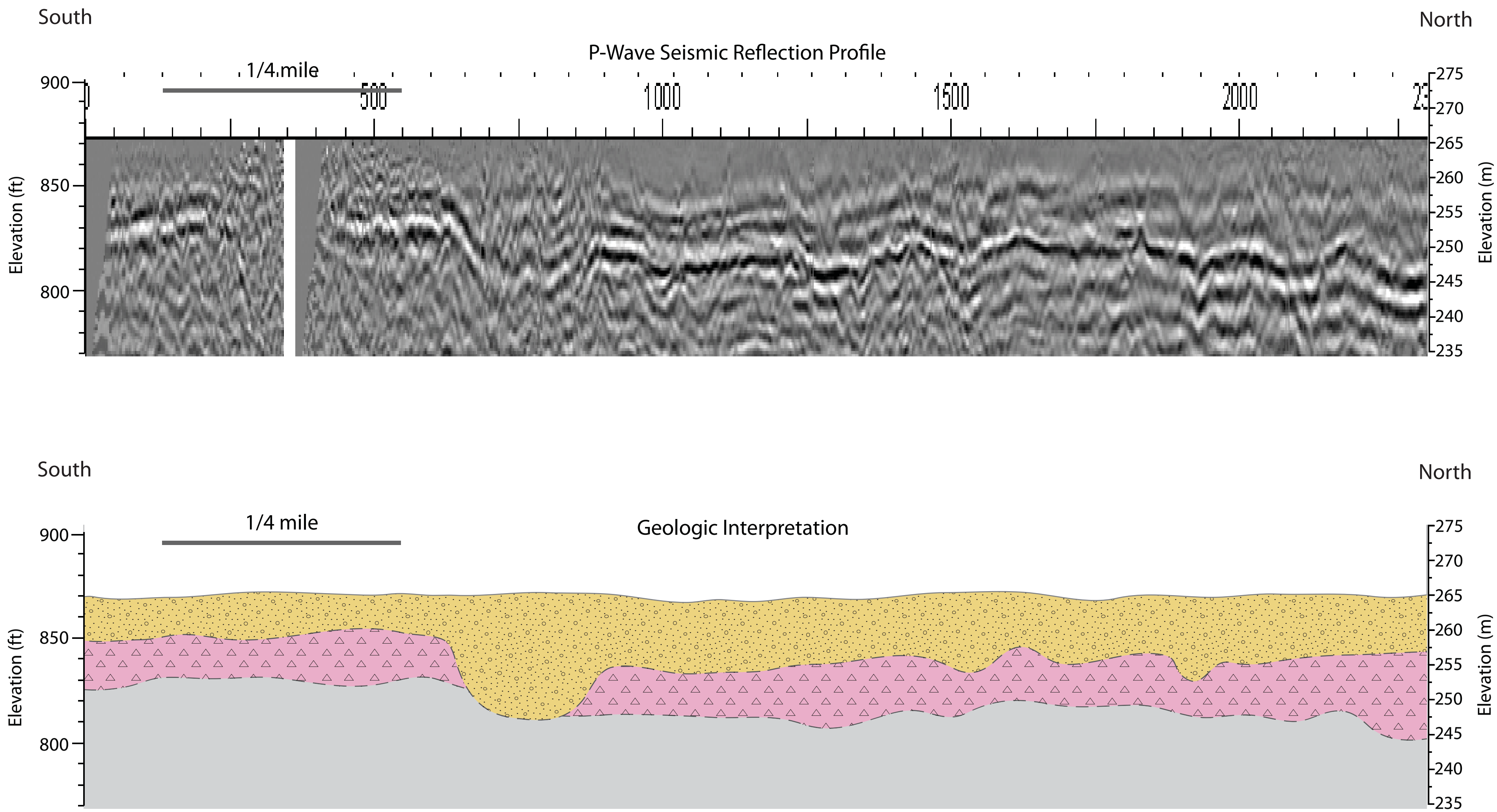


Figure B16. Geophysical data and geologic interpretation along Maxon Road.

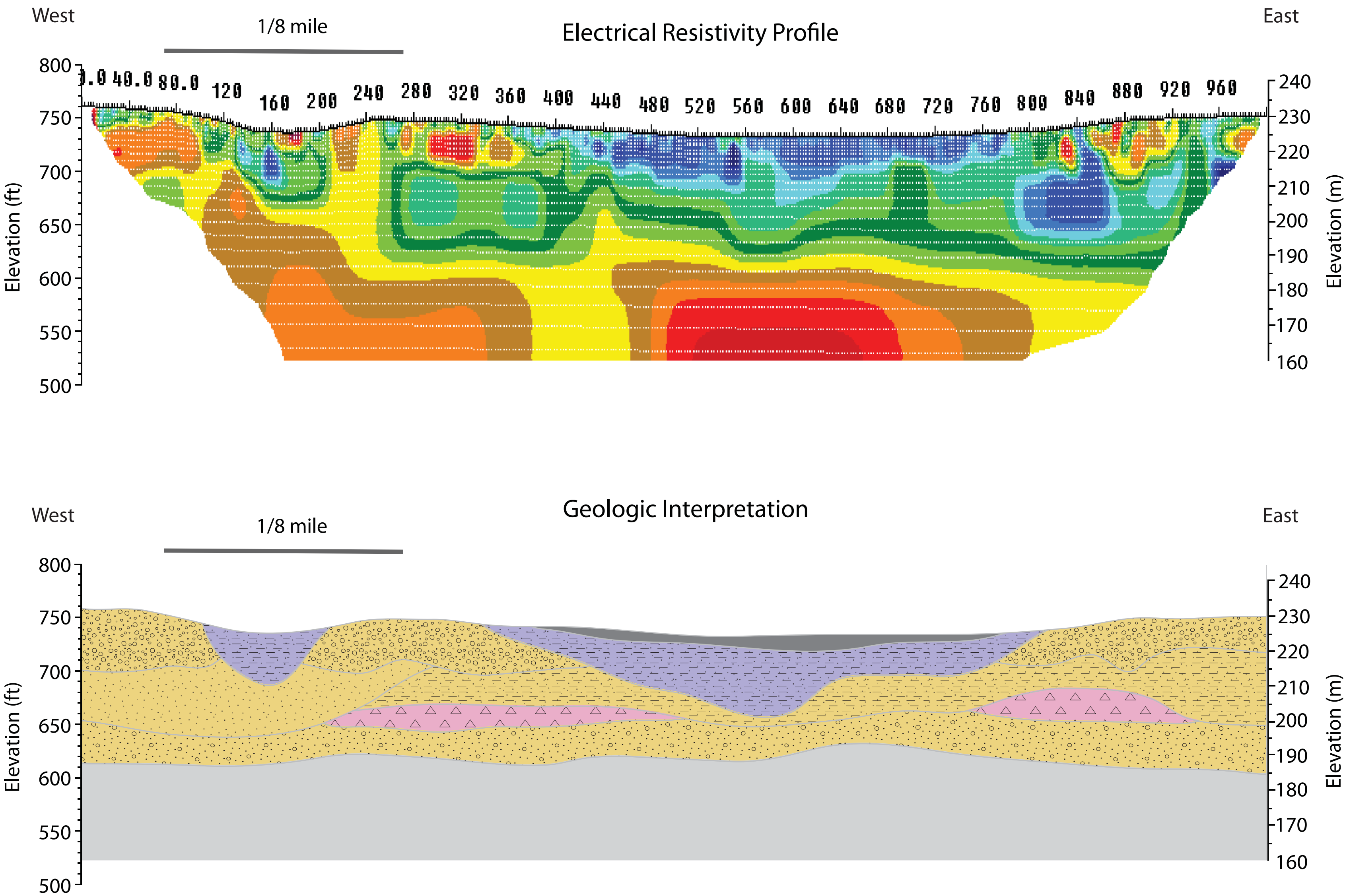
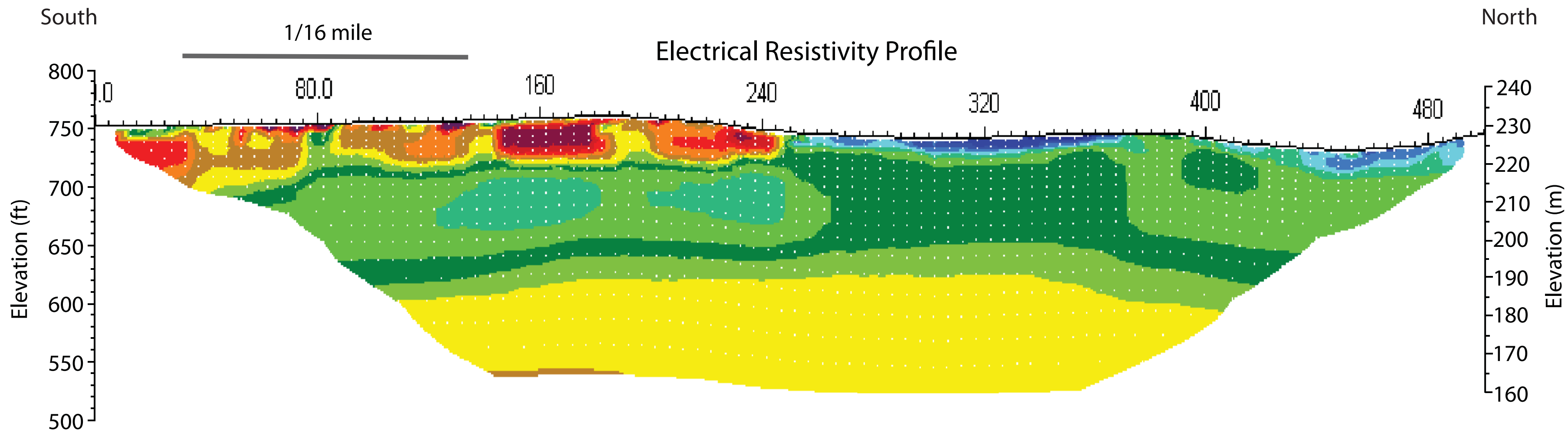


Figure B17. Geophysical data and geologic interpretation along bike trail in Moraine Hills State Park (parallel to River Road).



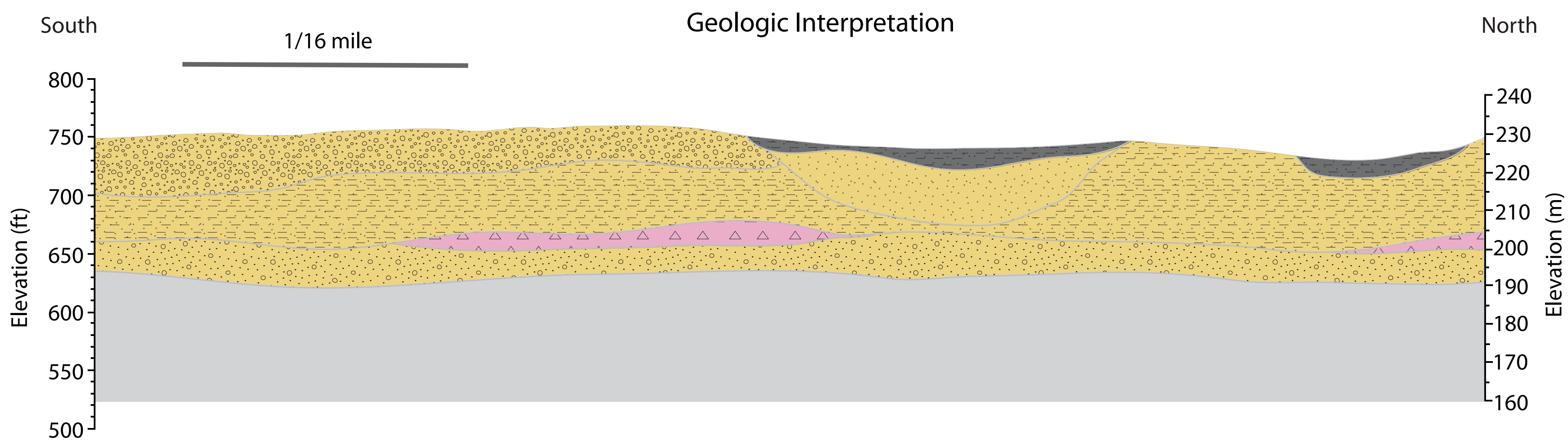


Figure B18. Geophysical data and geologic interpretation along the main entrance road to Moraine Hills State Park.

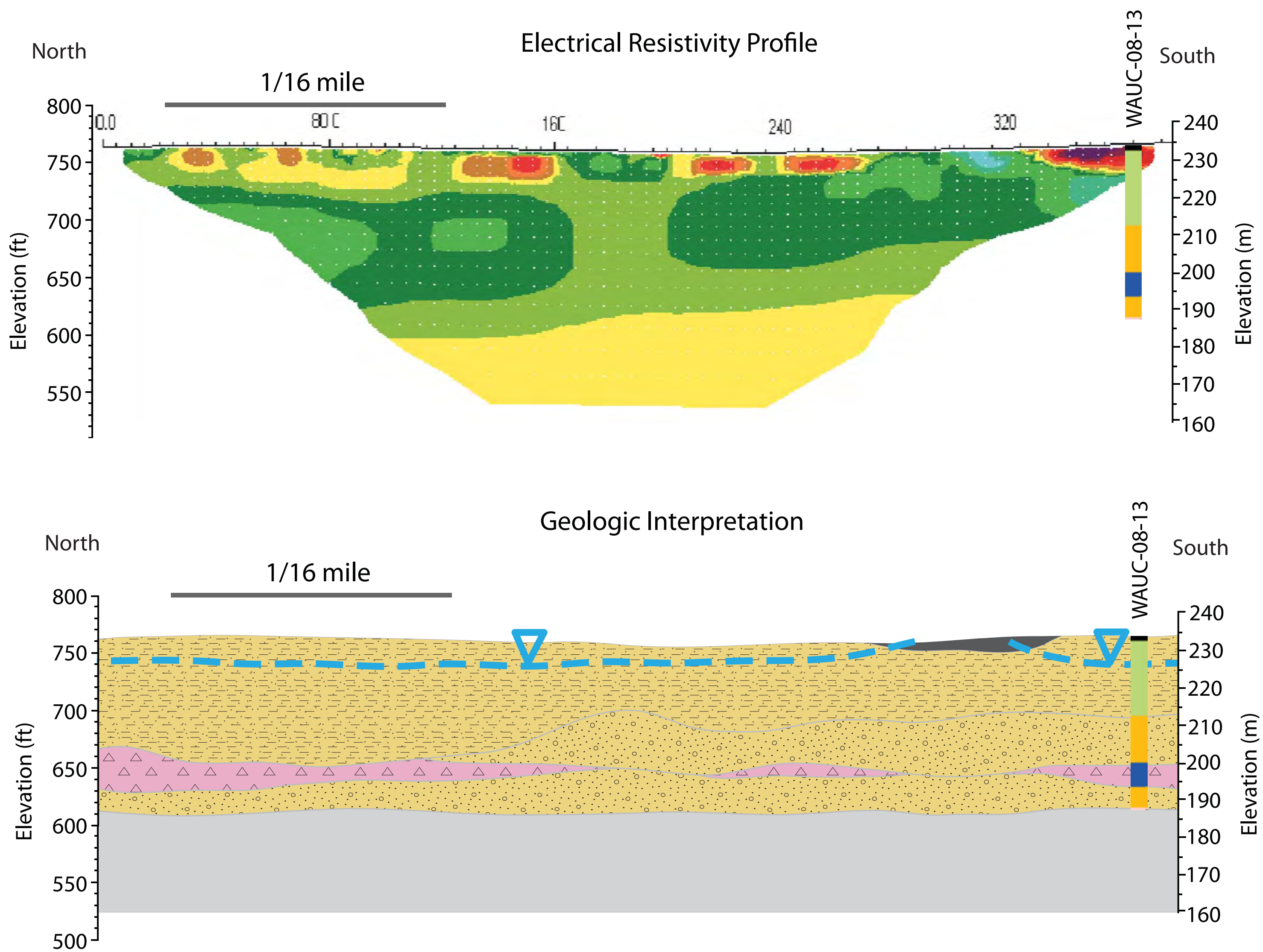
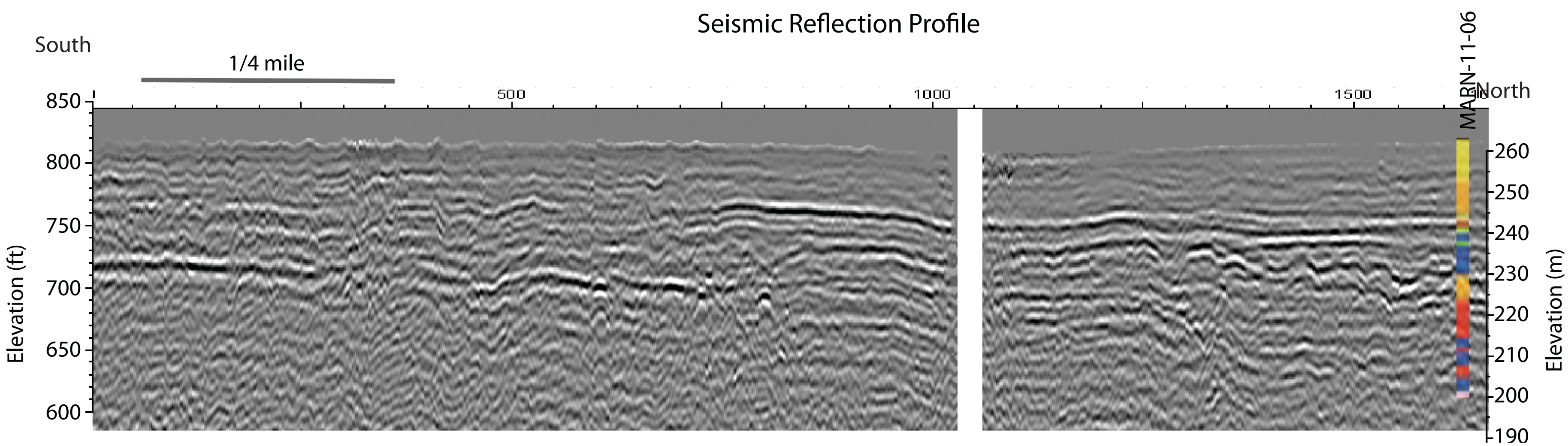


Figure B19. Geophysical data and geologic interpretation in northeast portion of Moraine Hills State Park.



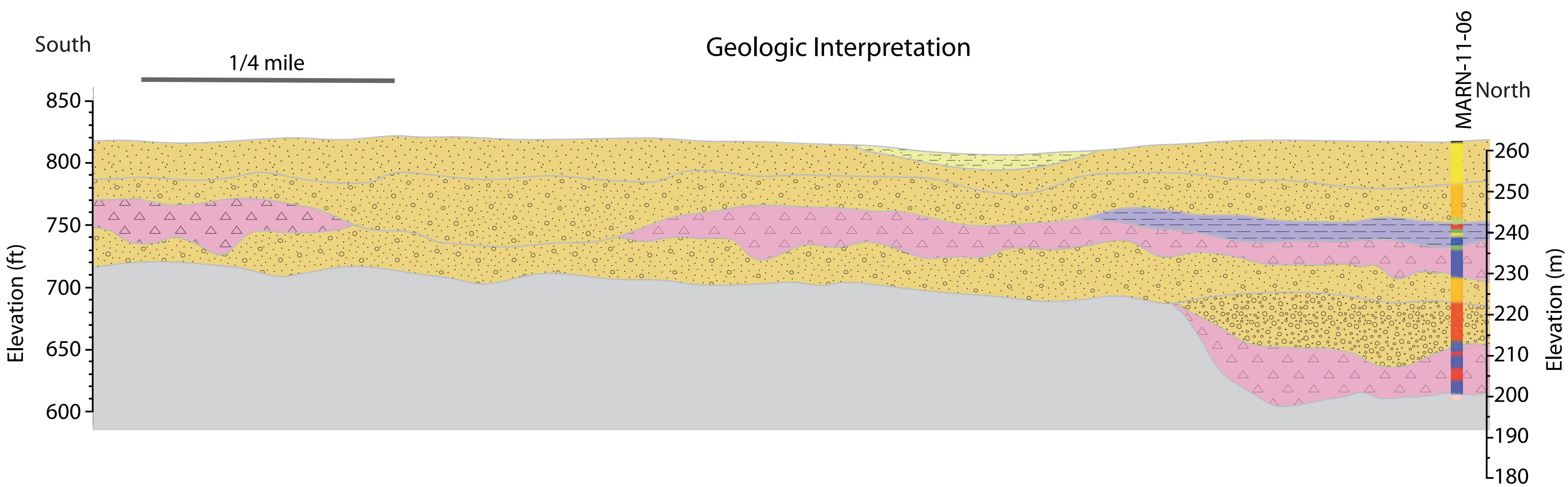


Figure B28. Geophysical data and geologic interpretation along Union Road north of Rt 176.

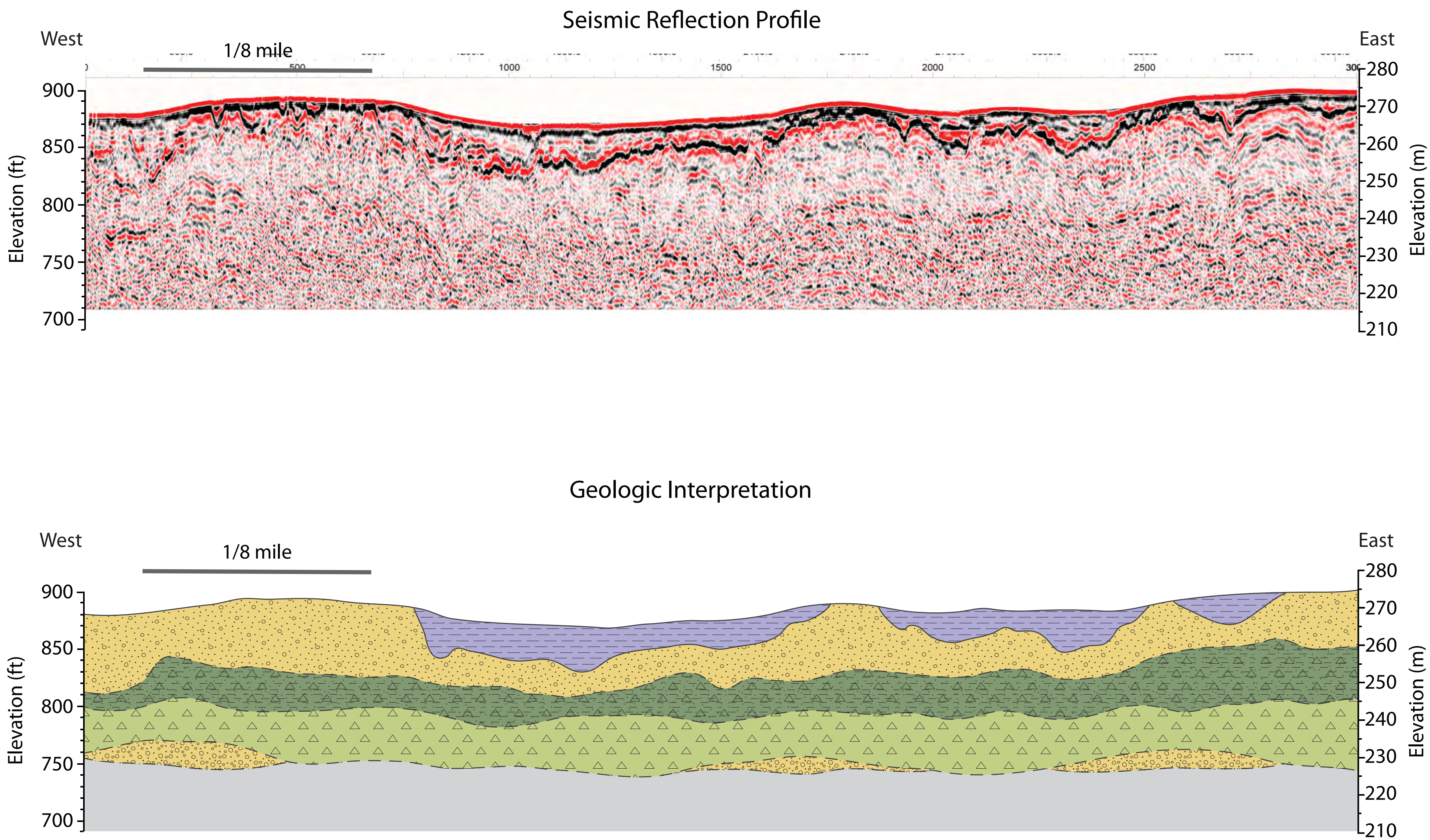
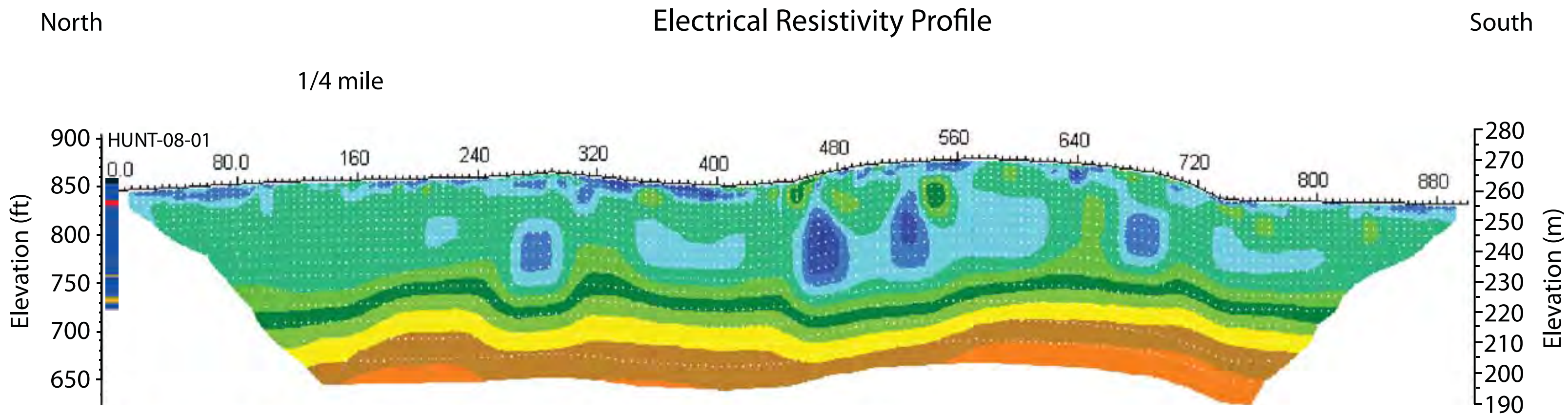


Figure B20. Geophysical data and geologic interpretation along Okeson Road.



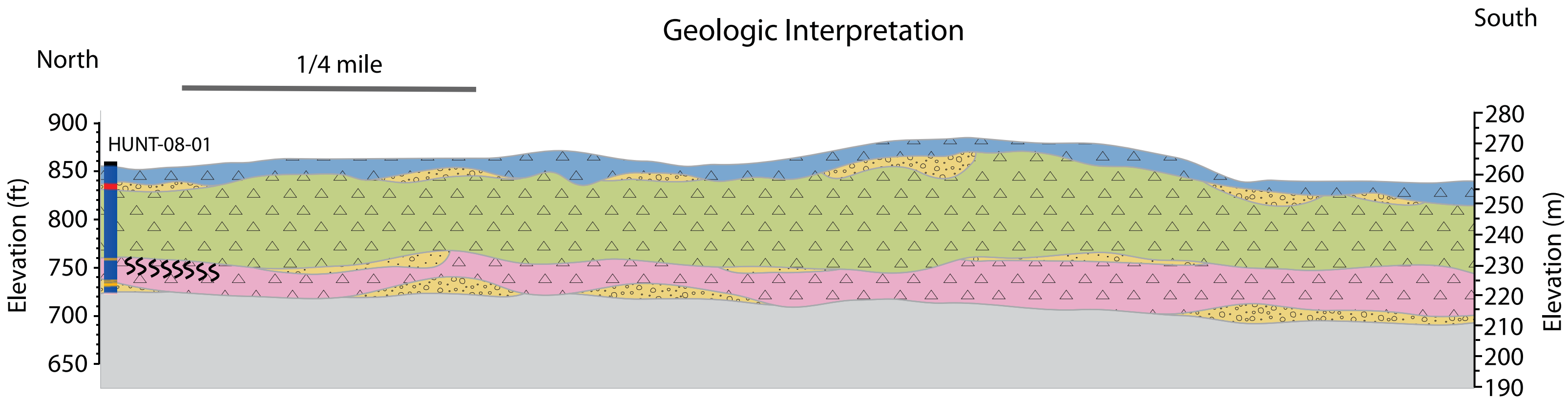


Figure B21. Geophysical data and geologic interpretation along entrance road to Pleasant Valley Conservation Area.

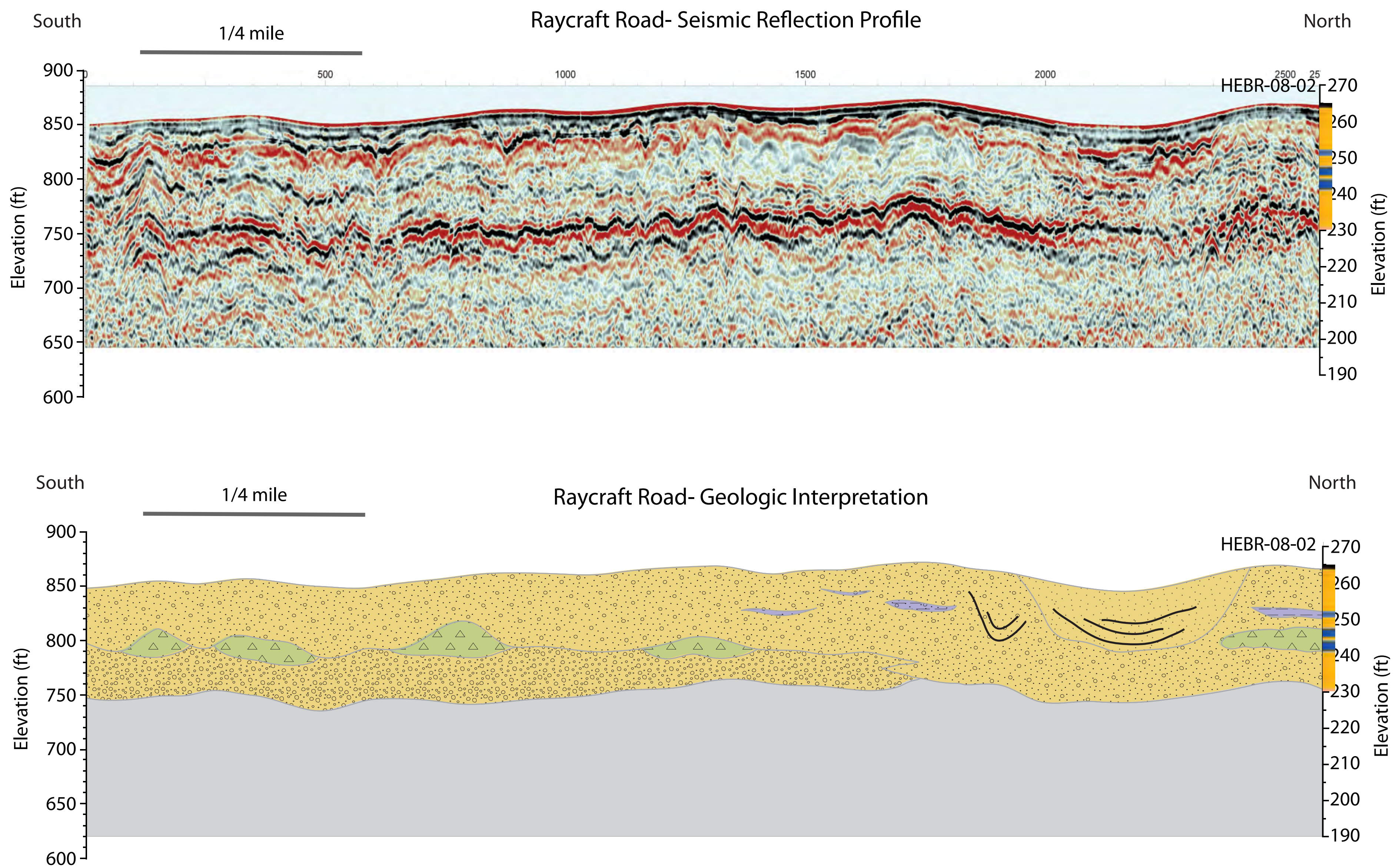
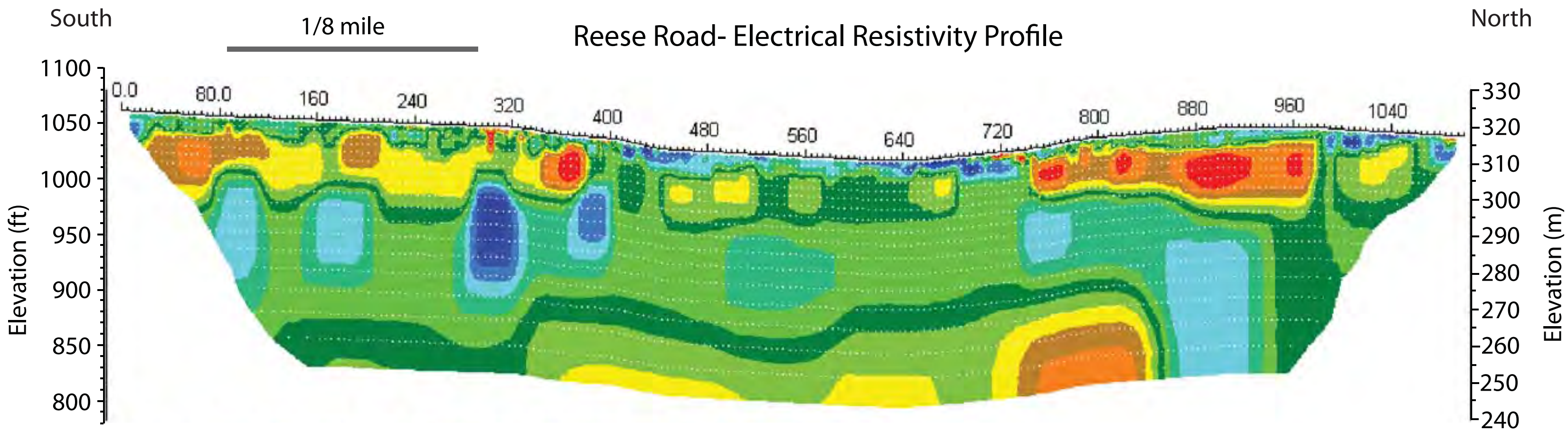


Figure B22. Geophysical data and geologic interpretation along Raycraft Road.



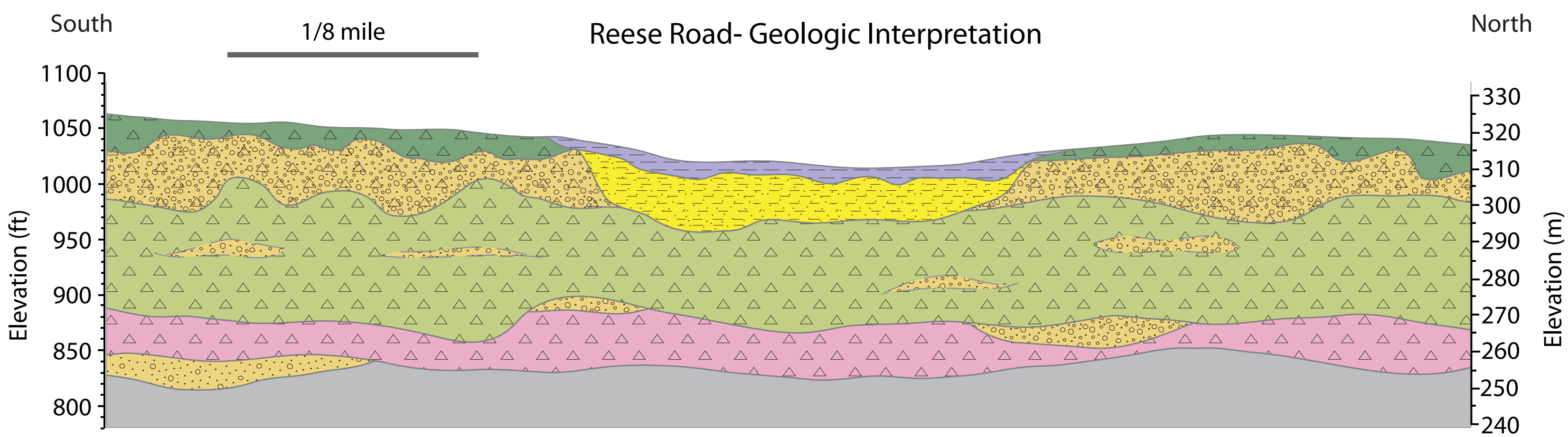


Figure B23. Geophysical data and geologic interpretation along Reese Road.

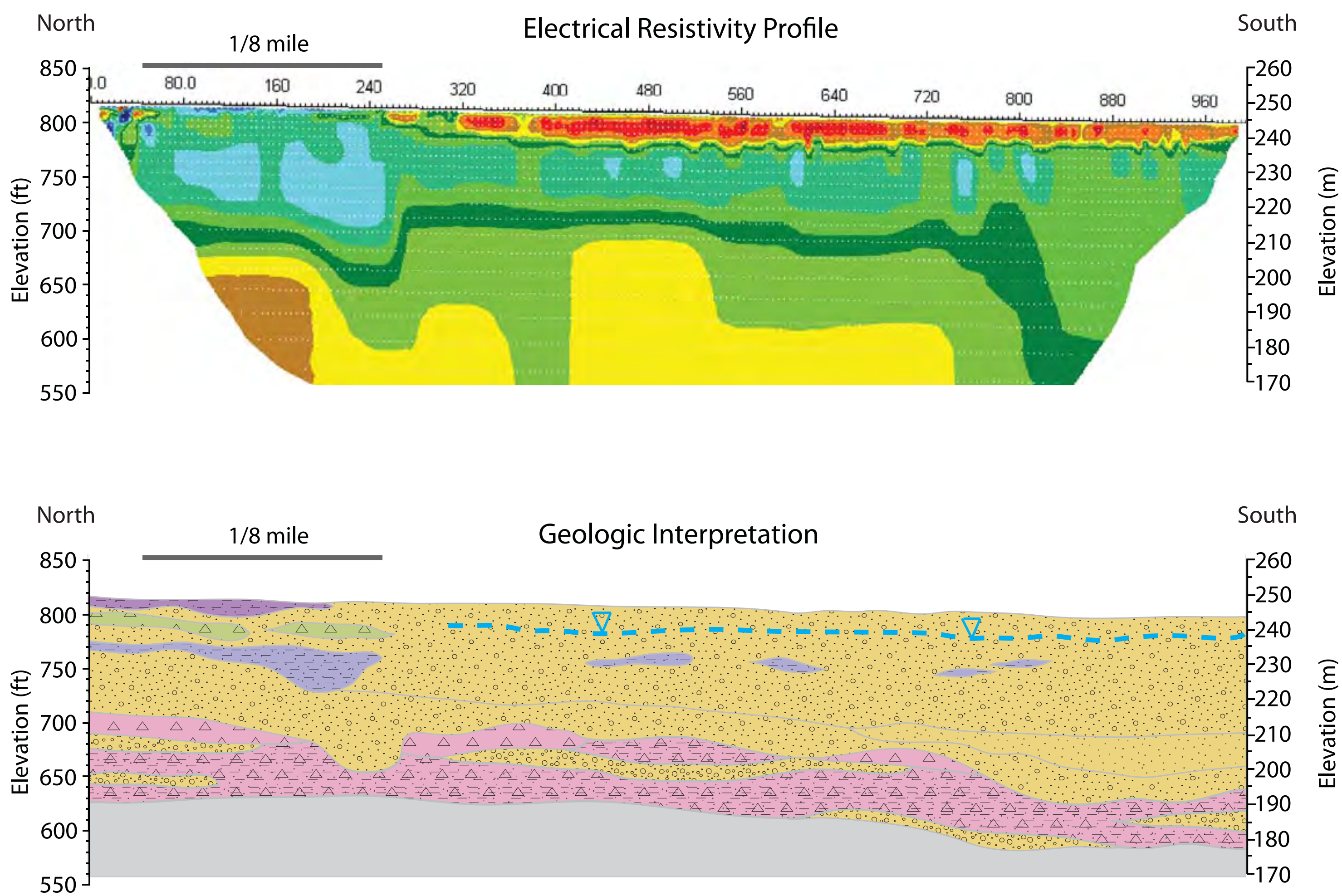


Figure B24. Geophysical data and geologic interpretation near River Road along N-S transect at testhole MARN-09-02.

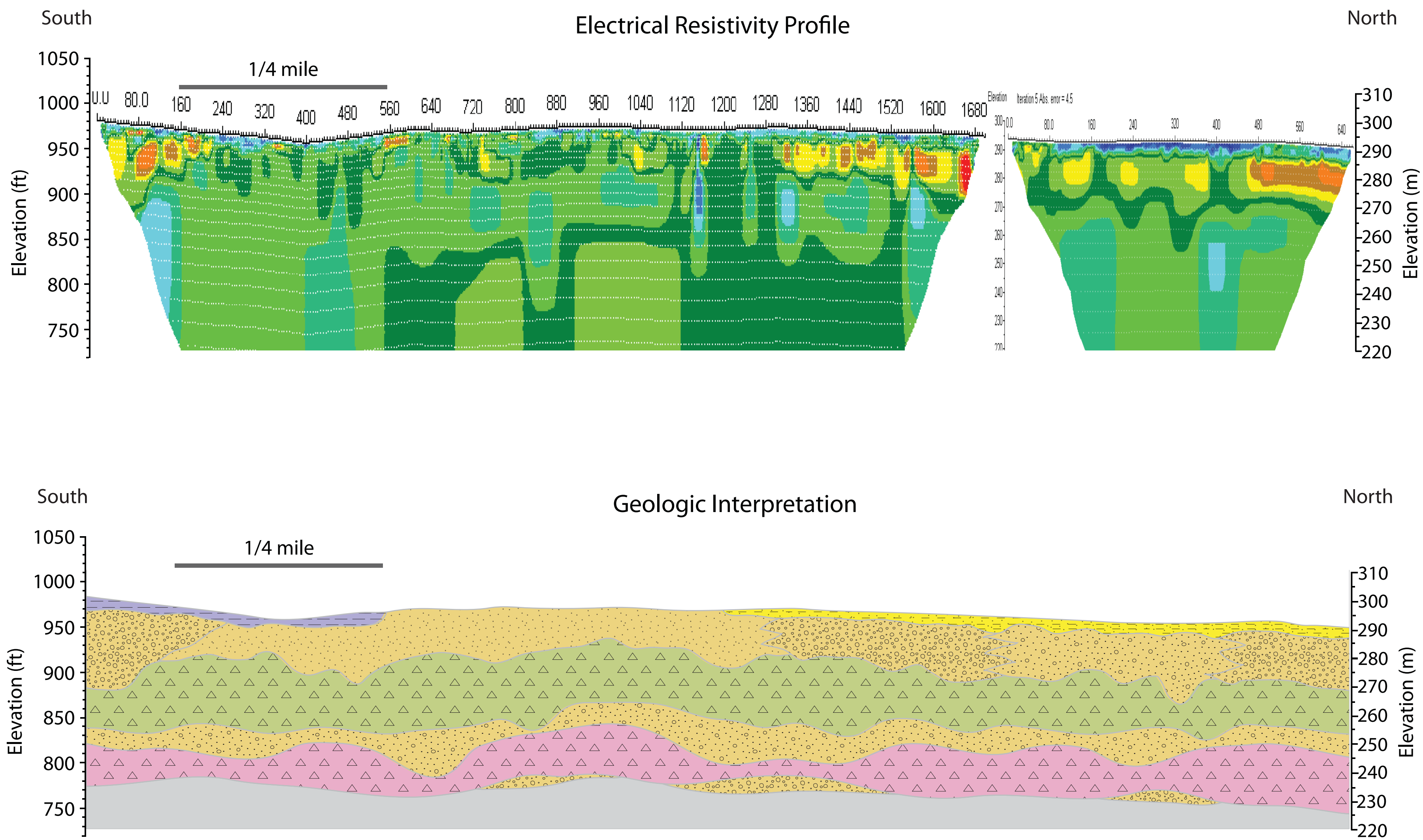


Figure B25. Geophysical data and geologic interpretation along Schultz Road.

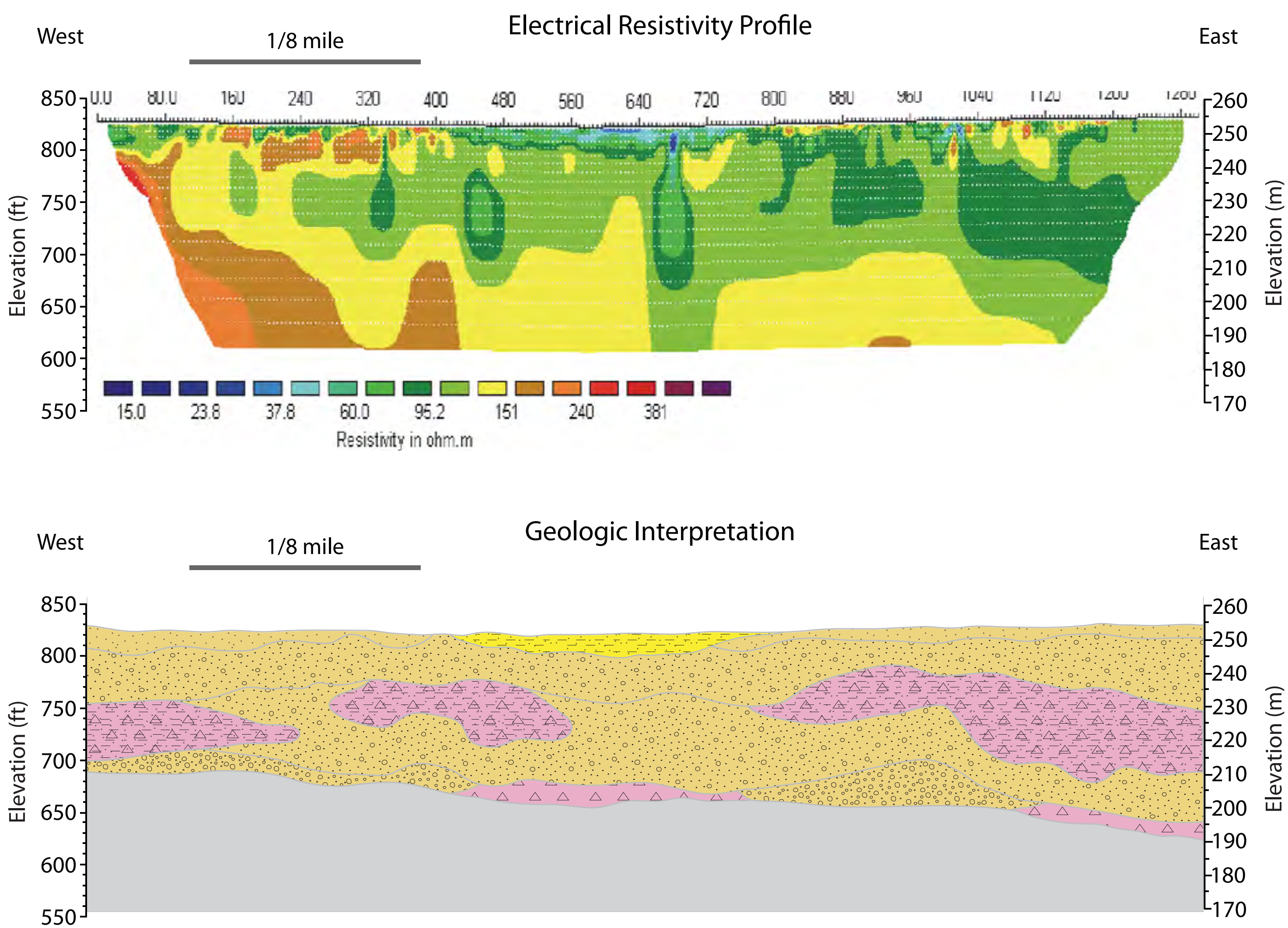


Figure B26. Geophysical data and geologic interpretation along Secor Road.

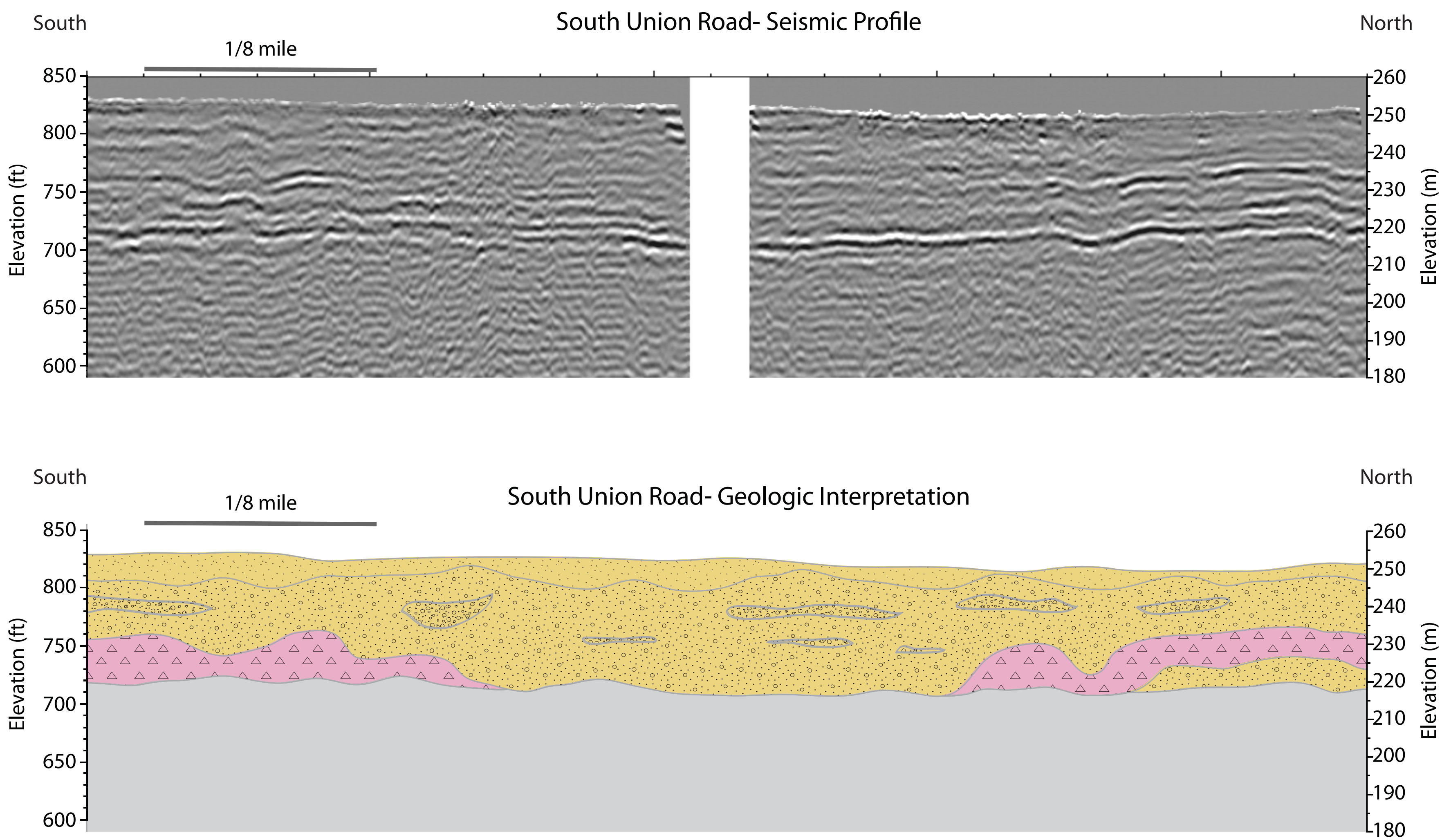


Figure B27. Geophysical data and geologic interpretation along Union Road, south of Rt 176.

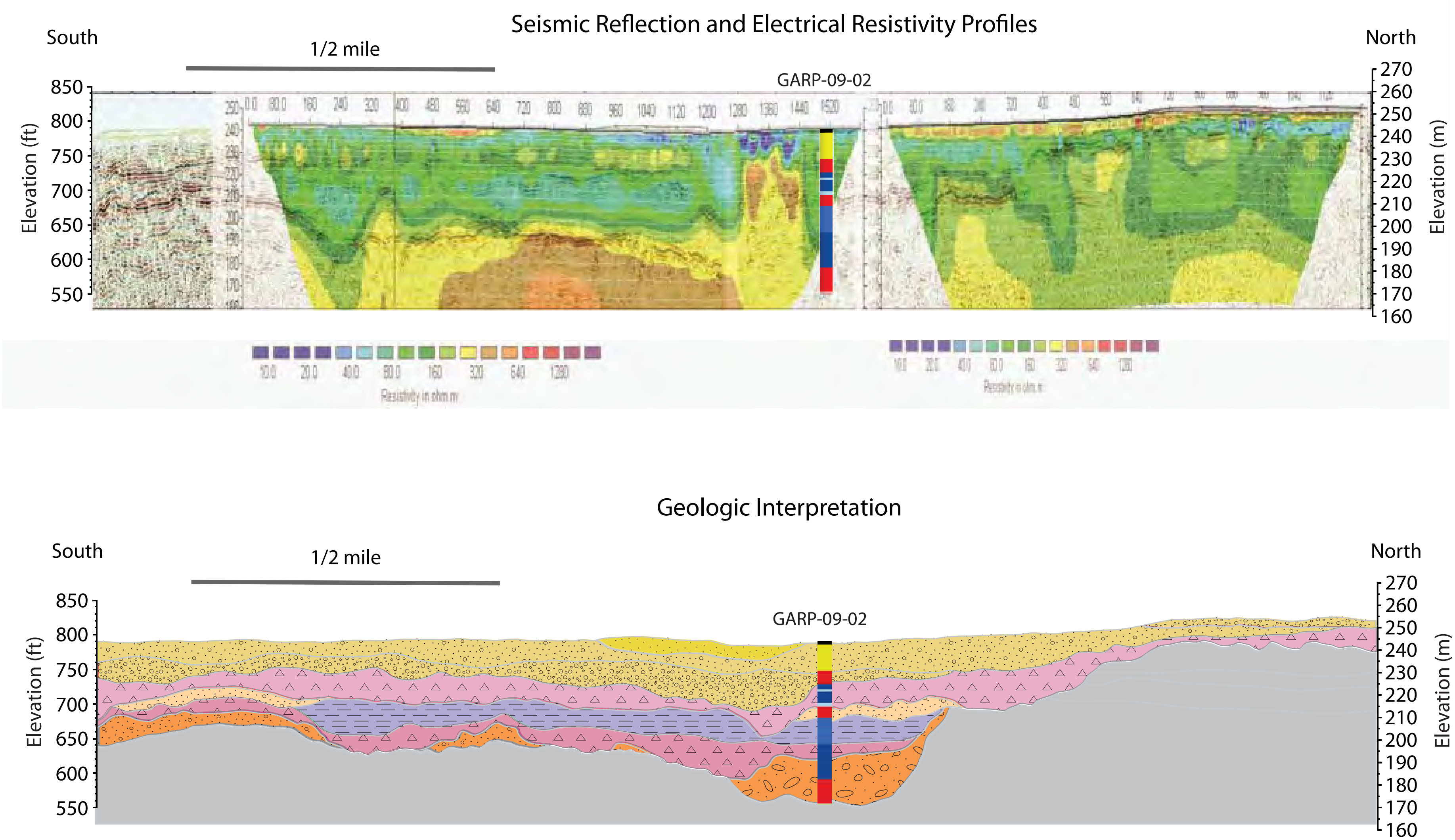


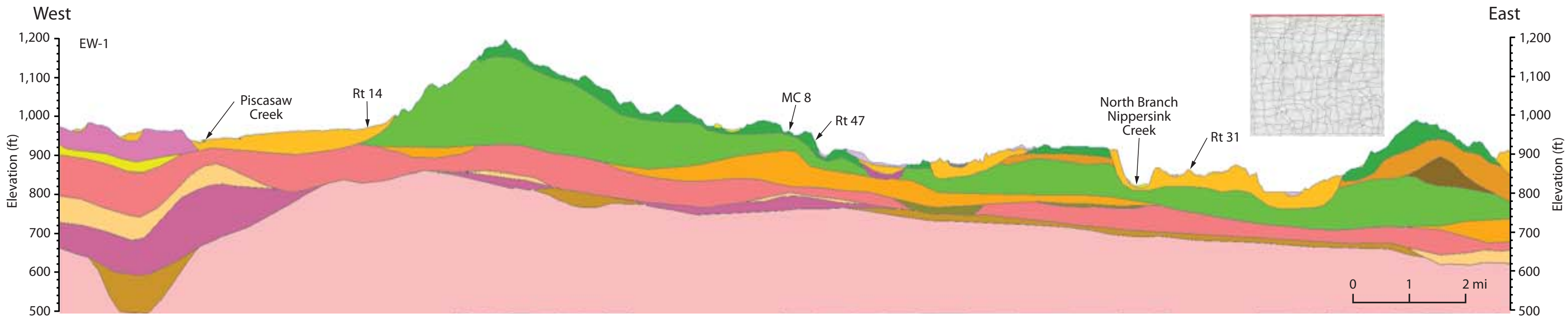
Figure B29. Geophysical data and geologic interpretation along Thorne Road.

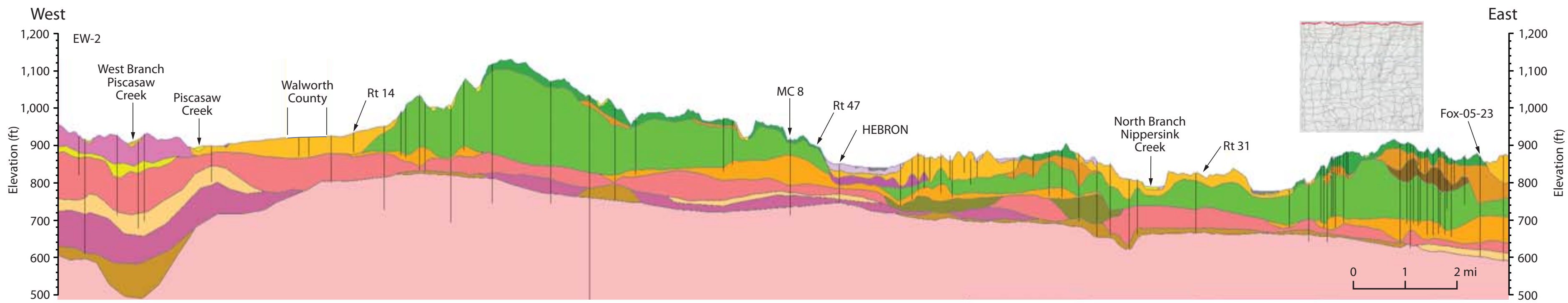
APPENDIX C

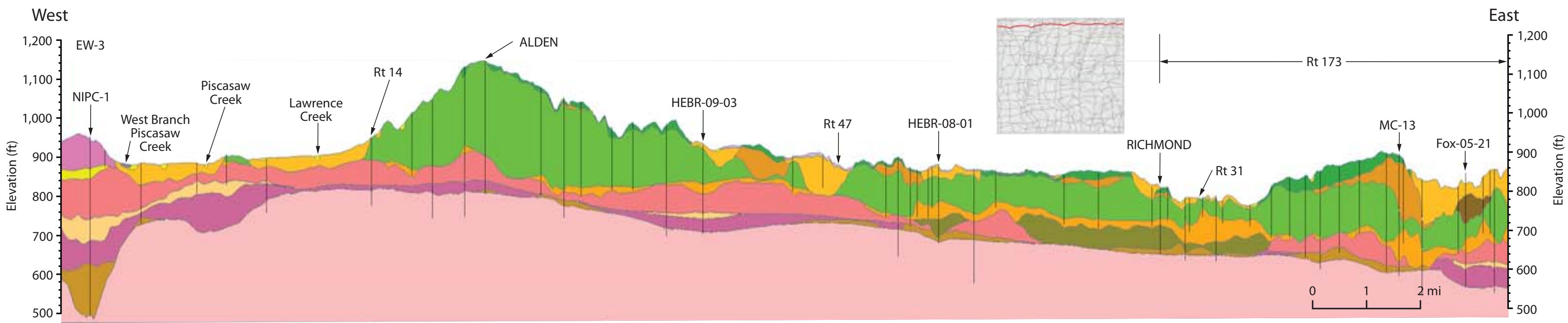
GSI3D Key-Cross Sections

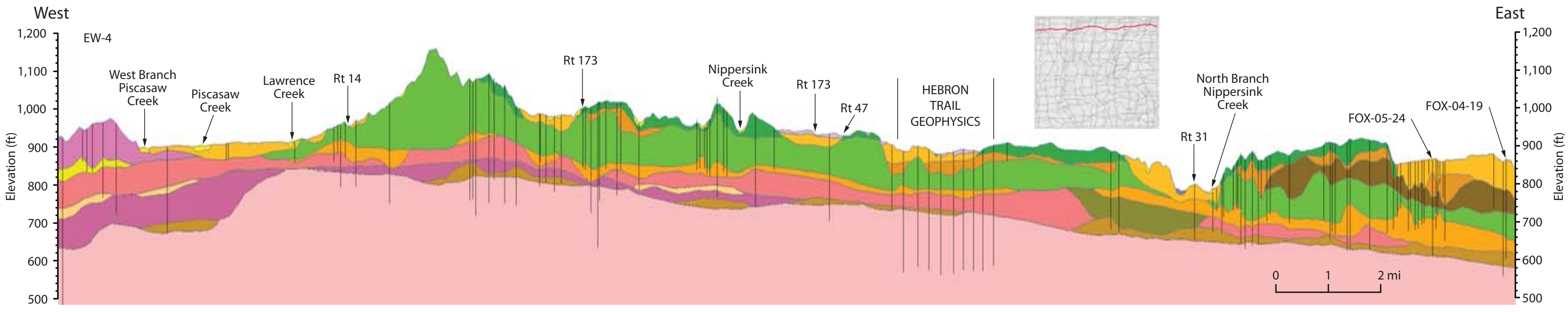
Geologic Time		Symbol	Lithostratigraphic Unit	Description	
Quaternary	Holocene		Grayslake Peat (GP)	Organic silt and muck	
			Cahokia Fm. (Cah)	Alluvial sediments; sand	
	Wisconsin Age		Equality Fm. 1 (Eq_surf)	Lake sediments; fine sand and silt	
			Henry Fm. (Hen1)	Outwash; sand and gravel	
			Equality Fm. 2 (Eq)	Lake sediments; fine sand and silt	Surficial Aquifer
			Haeger Mbr. (Wh)	Diamicton; sandy and pebbly loam	
			Beverly Tongue (Hb)	Outwash; sand and gravel	
			Beverly Tng. Fine (Hb_f)	Outwash; fine-grained sand or silt	
			Yorkville Mbr. (Wy)	Diamicton; silty clay loam w/ pebbles	
			Unnamed Henry Fm. (Hy)	Outwash; sand and gravel	Yorkville Aquifer
			Tiskilwa Fm. (Wt)	Diamicton; silty clay loam w/ pebbles	
			Ashmore Tongue (Ha)	Outwash; sand and gravel	Pearl/Ashmore Aquifer
Quaternary	Illinois Age		Pearl Fm. Fine (Pe_f)	Outwash; fine-grained sand or silt	
			Winnebago Fm. (Win)	Diamicton; silty clay loam w/ pebbles	
			Winnebago Fm. Sand (Wins)	Outwash; sand and gravel	
			Glasford Fm. 1 (G1)	Diamicton; silty clay loam w/ pebbles	
			Glasford Sand 1 (GS1)	Outwash; sand and gravel	Glasford Aquifer
			Glasford Sand 1 Fine (GS1_f)	Outwash; fine-grained sand or silt	
			Glasford Fm. 2 (G2)	Diamicton; silty clay loam w/ pebbles	
			Glasford Sand 2 (GS2)	Outwash; sand and gravel	Basal Aquifer
			Glasford Fm. 3 (G3)	Diamicton; silty clay loam w/ pebbles	
Pre-Quat.			Bedrock (Bdrk)	Dolomite, Limestone, or Shale	

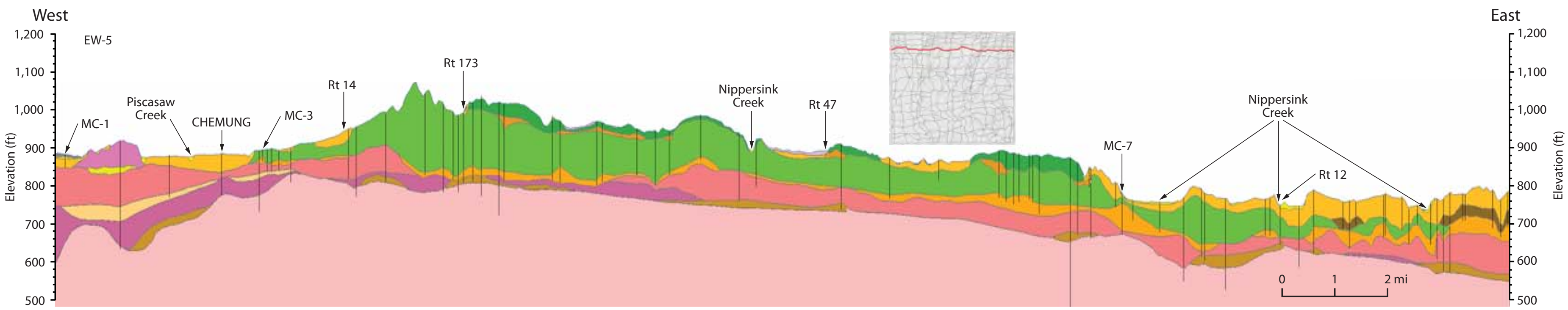
Legend for GSI3-D cross sections in Figure 7 and Appendix C. Lithostratigraphic names are indicated, and the abbreviated names (in appendices) are those associated with the 3-D map. From top to bottom, geologic units are arranged youngest to oldest, respectively. Further description of these units can be found in Curry et al (1997), Hansel and Johnson (1996), and Willman and Frye (1970).

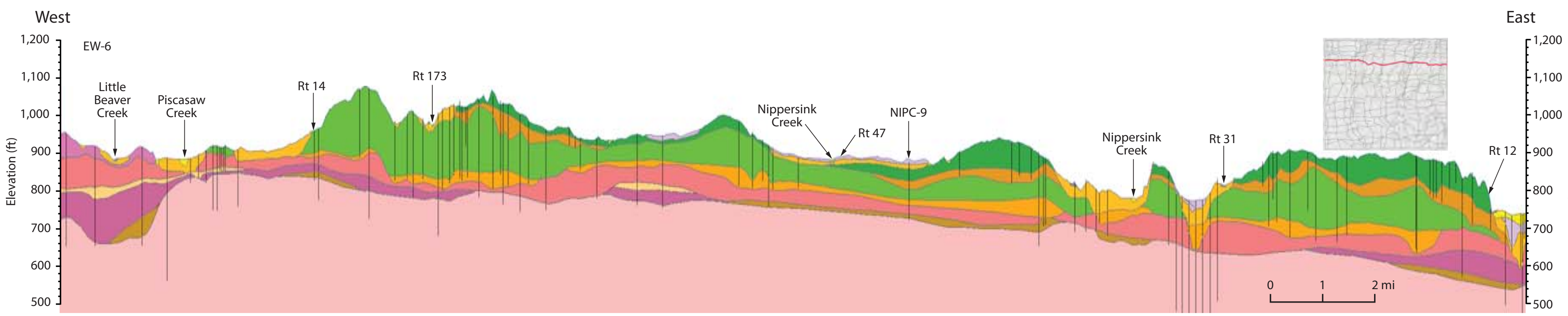

West
East
EW-1
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Piscasaw Creek
Rt 14
MC 8
Rt 47
North Branch Nippersink Creek
Rt 31
0
1
2 mi

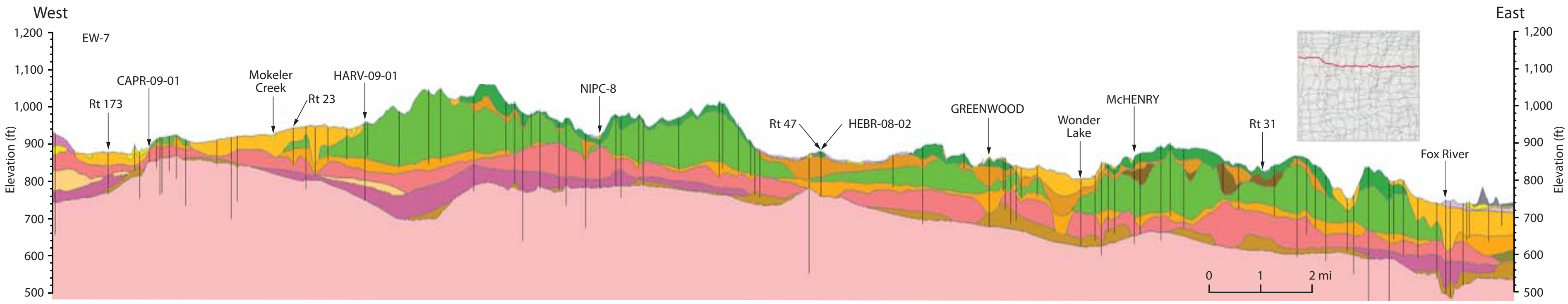

West
East
EW-2
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
West Branch Piscasaw Creek
Piscasaw Creek
Walworth County
Rt 14
MC 8
Rt 47
HEBRON
North Branch Nippersink Creek
Rt 31
Fox-05-23
0
1
2 mi

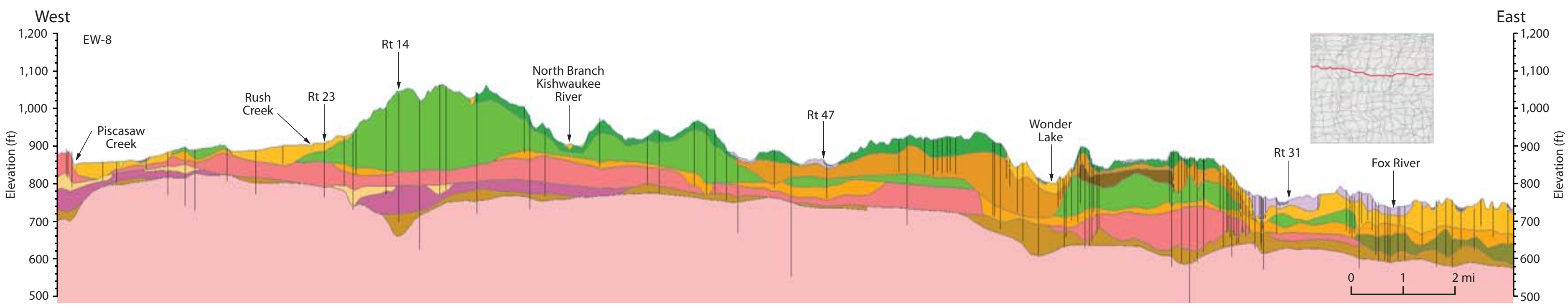

West
East
EW-3
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
NIPC-1
West Branch Piscasaw Creek
Piscasaw Creek
Lawrence Creek
Rt 14
ALDEN
HEBR-09-03
Rt 47
HEBR-08-01
Rt 173
RICHMOND
Rt 31
MC-13
Fox-05-21
0
1
2 mi

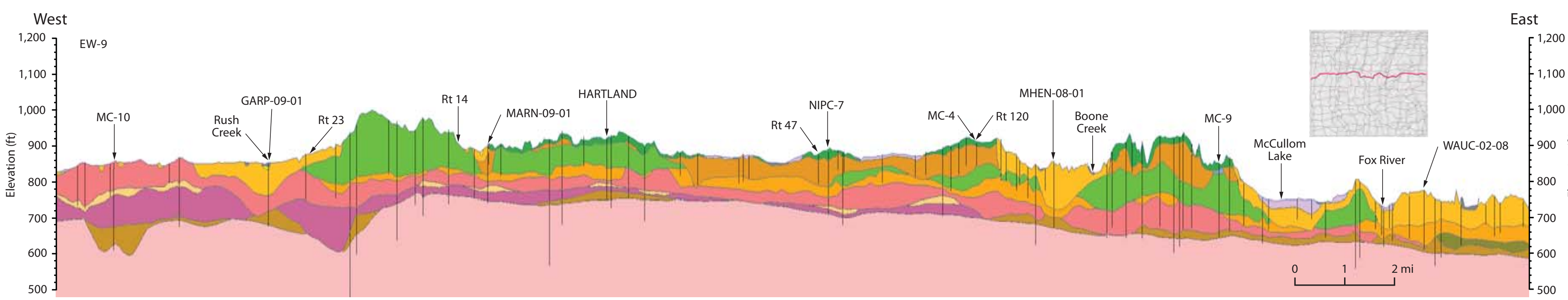

West
East
EW-4
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
West Branch Piscasaw Creek
Piscasaw Creek
Lawrence Creek
Rt 14
Rt 173
Nippersink Creek
Rt 173
Rt 47
HEBRON TRAIL GEOPHYSICS
Rt 31
North Branch Nippersink Creek
FOX-05-24
FOX-04-19
0
1
2 mi

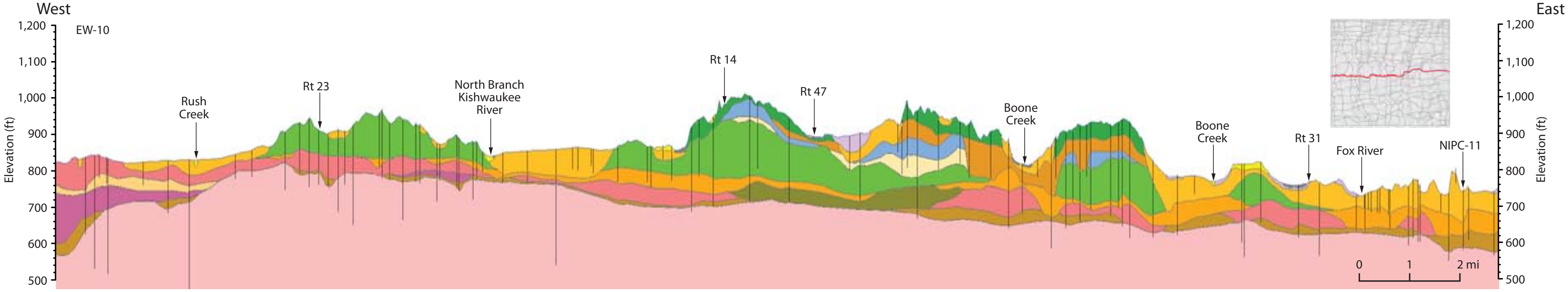

West
East
EW-5
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
MC-1
Piscasaw Creek
CHEMUNG
MC-3
Rt 14
Rt 173
Nippersink Creek
Rt 47
MC-7
Nippersink Creek
Rt 12
0
1
2 mi

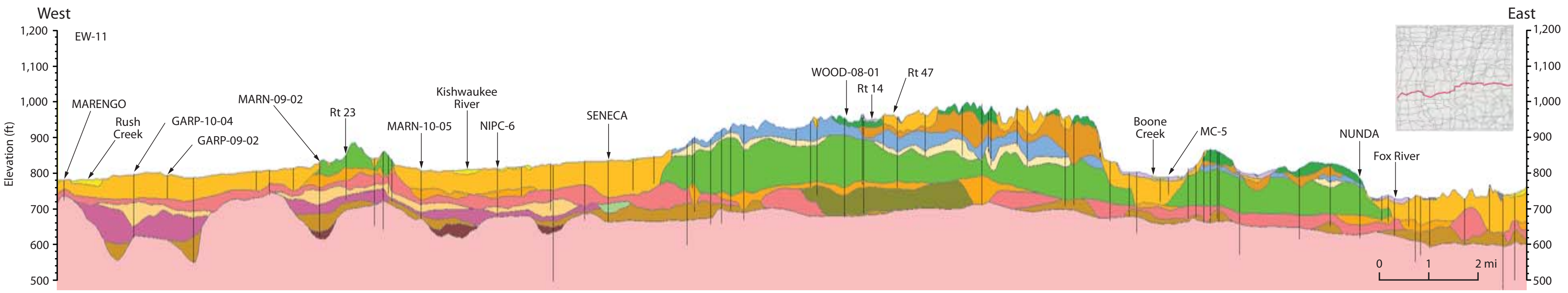

West
East
EW-6
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Little Beaver Creek
Piscasaw Creek
Rt 14
Rt 173
Nippersink Creek
Rt 47
NIPC-9
Nippersink Creek
Rt 31
Rt 12
0
1
2 mi

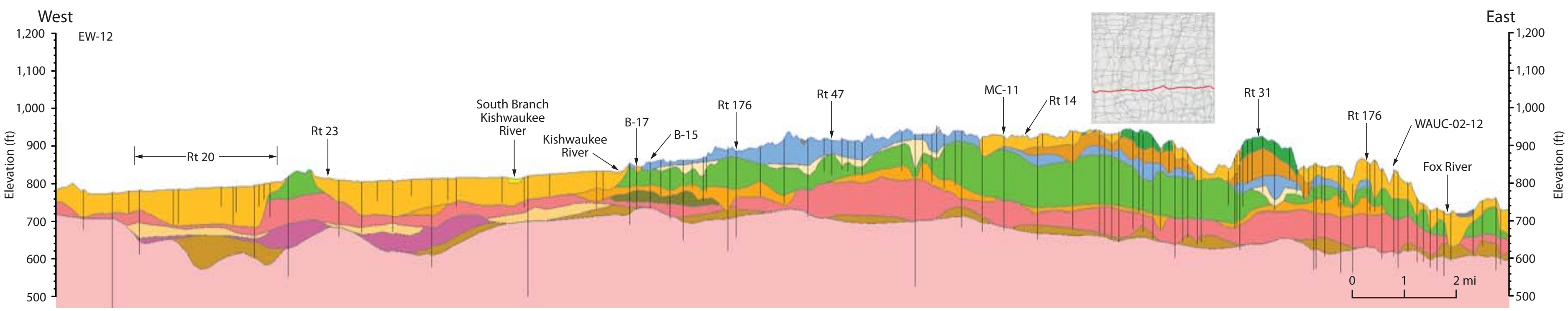

West
East
EW-7
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Rt 173
CAPR-09-01
Mokeler Creek
Rt 23
HARV-09-01
NIPC-8
Rt 47
HEBR-08-02
GREENWOOD
Wonder Lake
McHENRY
Rt 31
Fox River
0
1
2 mi

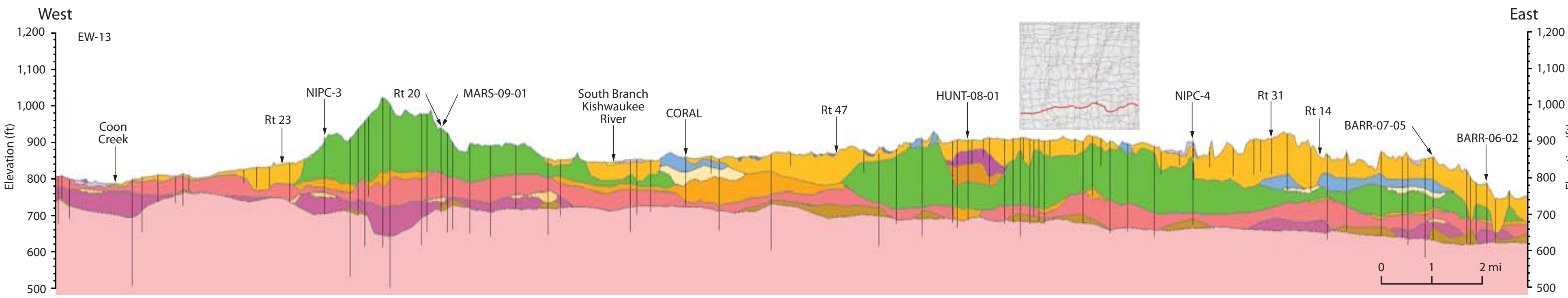

West
East
EW-8
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Piscasaw Creek
Rush Creek
Rt 23
Rt 14
North Branch Kishwaukee River
Rt 47
Wonder Lake
Rt 31
Fox River
0
1
2 mi

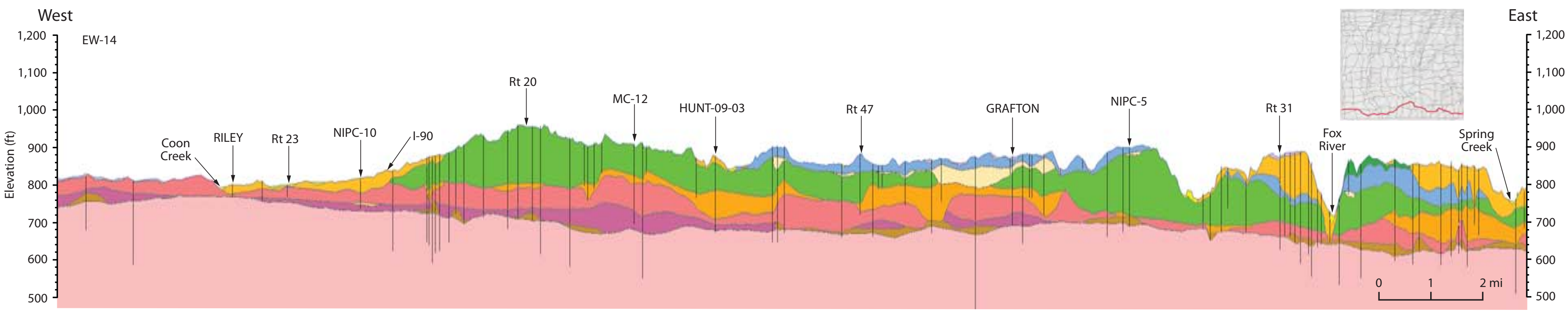

West
East
EW-9
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
MC-10
Rush Creek
GARP-09-01
Rt 23
Rt 14
MARN-09-01
HARTLAND
Rt 47
NIPC-7
MC-4
Rt 120
MHEN-08-01
Boone Creek
MC-9
McCullom Lake
Fox River
WAUC-02-08
0
1
2 mi

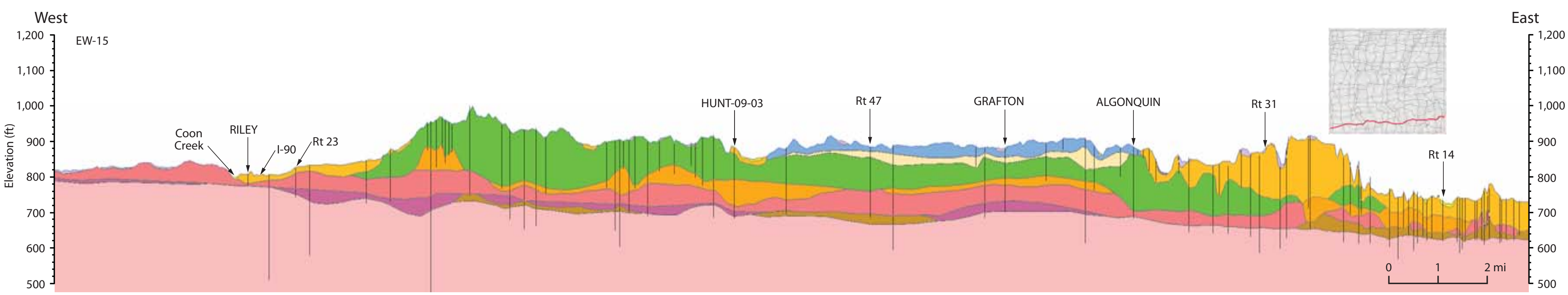

West
East
EW-10
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Rush Creek
Rt 23
North Branch Kishwaukee River
Rt 14
Rt 47
Boone Creek
Boone Creek
Rt 31
Fox River
NIPC-11
0
1
2 mi

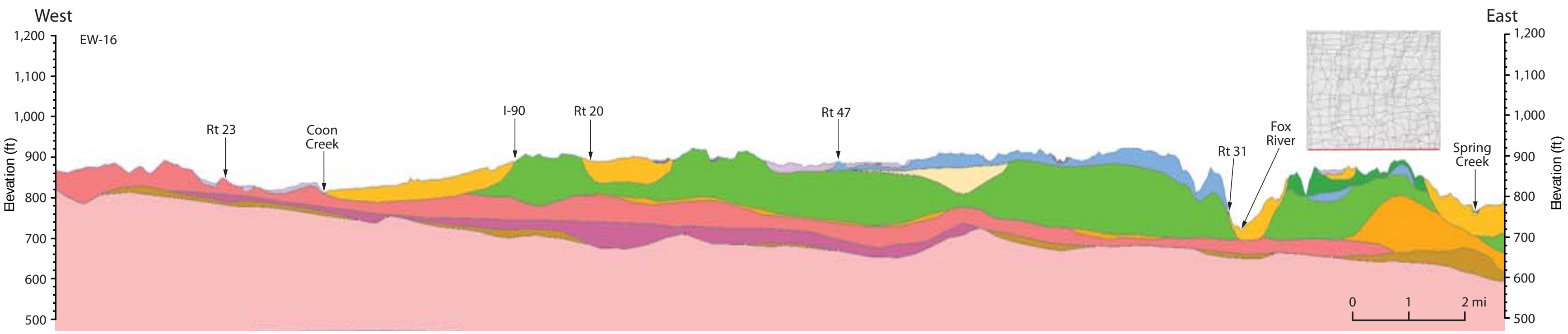

West
East
EW-11
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
MARENGO
Rush Creek
GARP-10-04
GARP-09-02
MARN-09-02
Rt 23
MARN-10-05
Kishwaukee River
NIPC-6
SENECA
WOOD-08-01
Rt 14
Rt 47
Boone Creek
MC-5
NUNDA
Fox River
0
1
2 mi

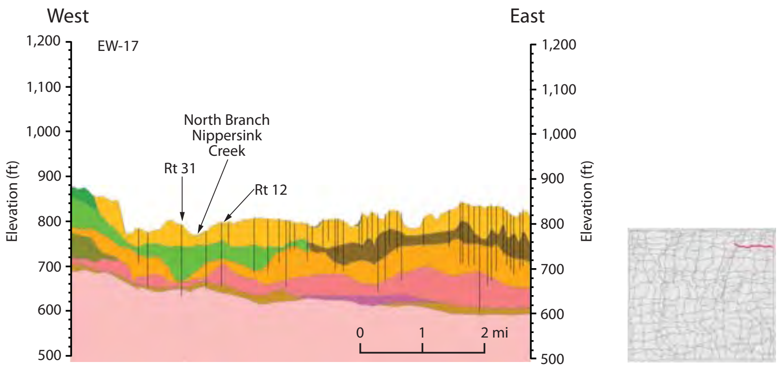

West
East
EW-12
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Rt 20
Rt 23
South Branch Kishwaukee River
Kishwaukee River
B-17
B-15
Rt 176
Rt 47
MC-11
Rt 14
Rt 31
Rt 176
WAUC-02-12
Fox River
0
1
2 mi

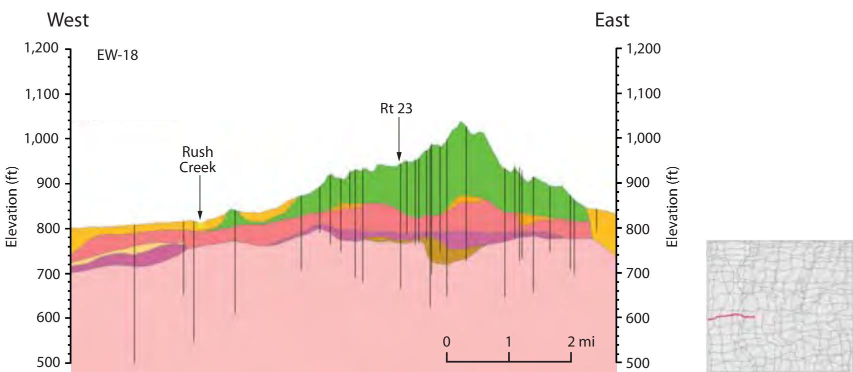

West
East
EW-13
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Coon Creek
Rt 23
NIPC-3
Rt 20
MARS-09-01
South Branch Kishwaukee River
CORAL
Rt 47
HUNT-08-01
NIPC-4
Rt 31
Rt 14
BARR-07-05
BARR-06-02
0 1 2 mi

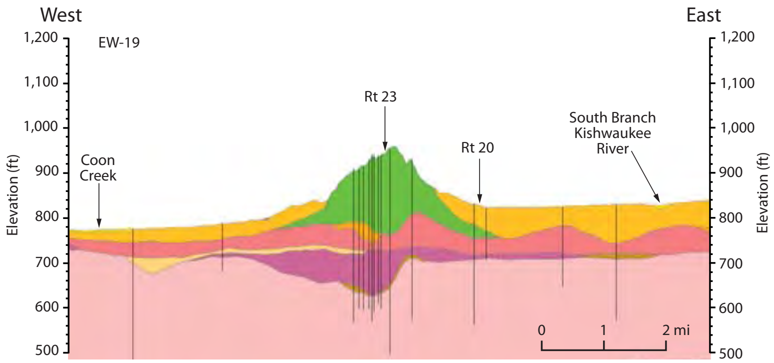

West
East
EW-14
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Coon Creek
RILEY
Rt 23
NIPC-10
I-90
Rt 20
MC-12
HUNT-09-03
Rt 47
GRAFTON
NIPC-5
Rt 31
Fox River
Spring Creek
0 1 2 mi

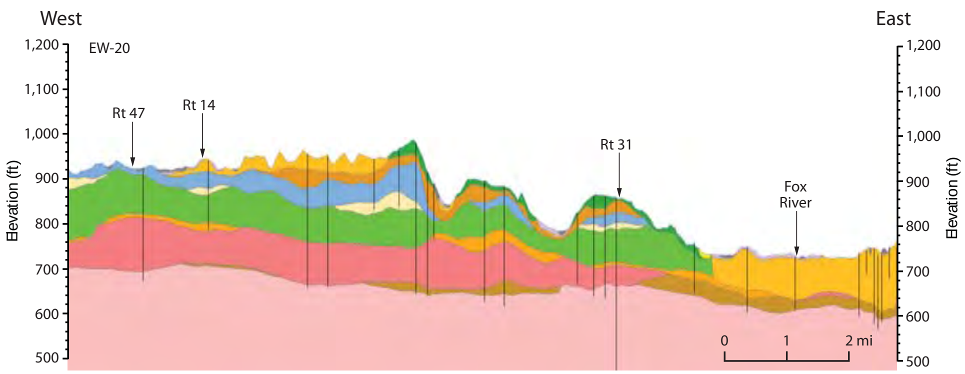

West
East
EW-15
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Coon Creek
RILEY
I-90
Rt 23
HUNT-09-03
Rt 47
GRAFTON
ALGONQUIN
Rt 31
Rt 14
0 1 2 mi

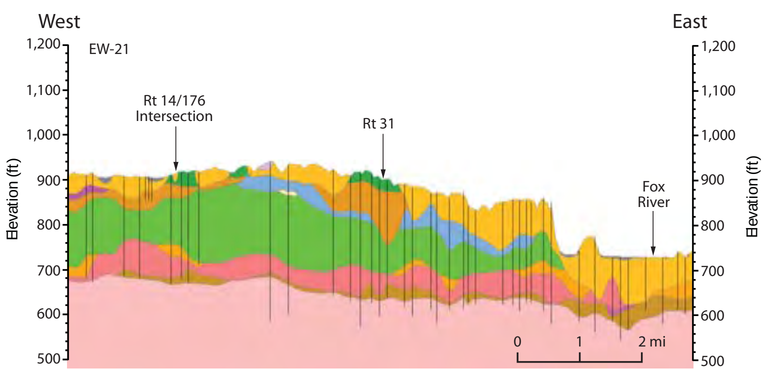

West
East
EW-16
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Rt 23
Coon Creek
I-90
Rt 20
Rt 47
Rt 31
Fox River
Spring Creek
0
1
2 mi

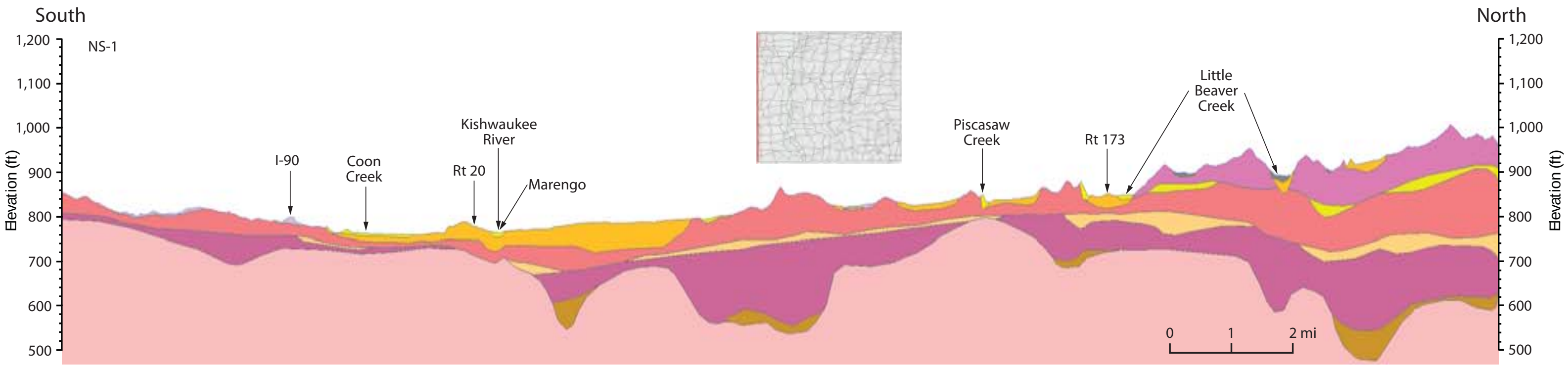

West
East
EW-17
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
North Branch Nippersink Creek
Rt 31
Rt 12
0
1
2 mi

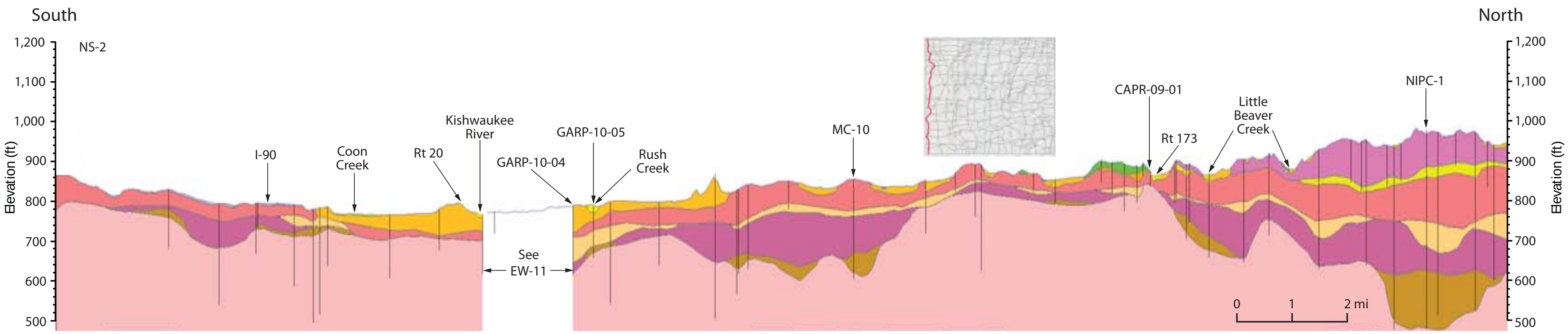

West
East
EW-18
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Rush Creek
Rt 23
0
1
2 mi

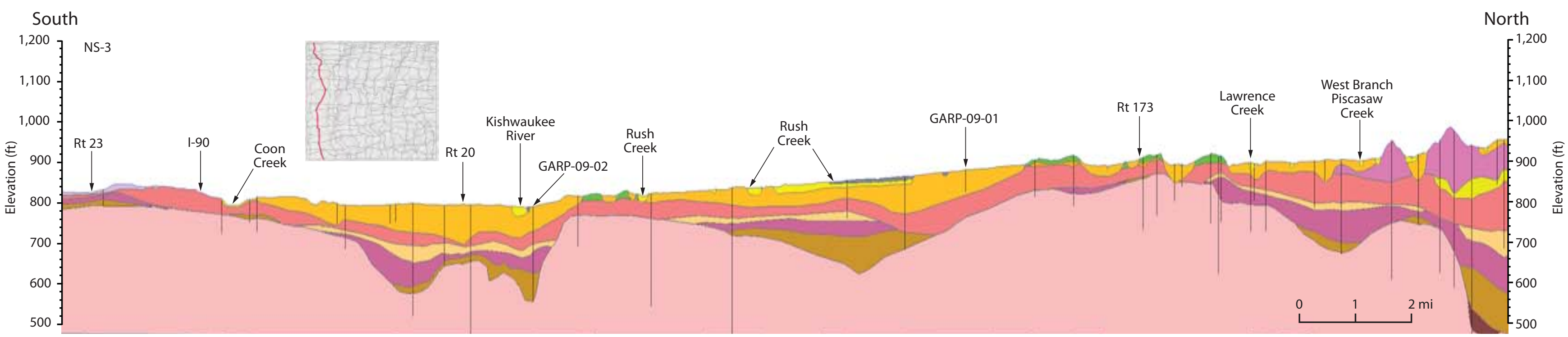

West
East
EW-19
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Coon
Creek
Rt 23
Rt 20
South Branch
Kishwaukee
River
0
1
2 mi

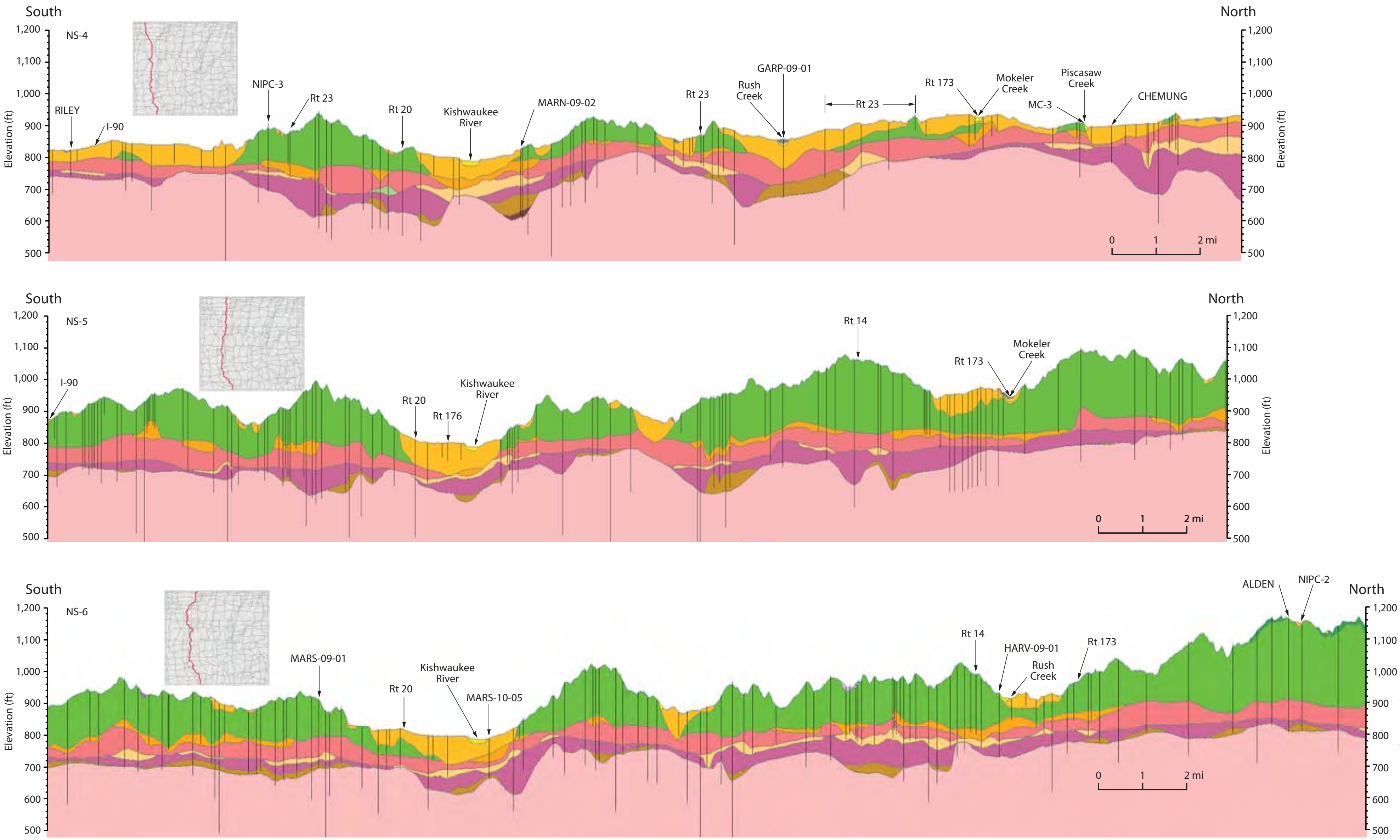

West
East
EW-20
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Rt 47
Rt 14
Rt 31
Fox
River
0
1
2 mi

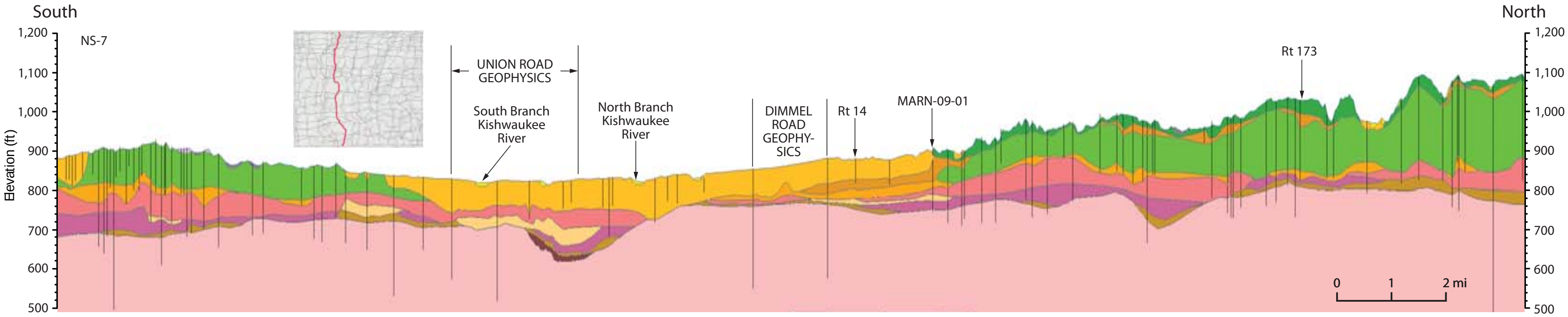

West
East
EW-21
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Rt 14/176
Intersection
Rt 31
Fox
River
0
1
2 mi

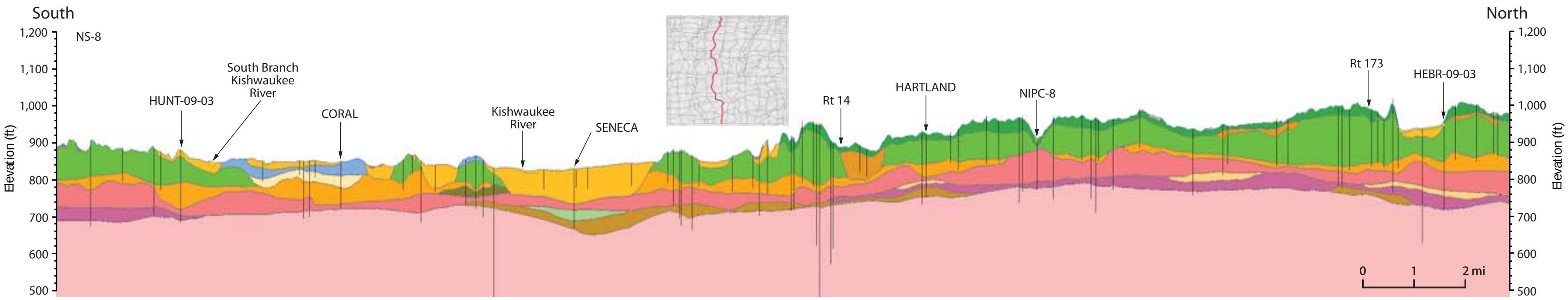

South
North
NS-1
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
I-90
Coon Creek
Rt 20
Kishwaukee River
Marengo
Piscasaw Creek
Rt 173
Little Beaver Creek
0
1
2 mi

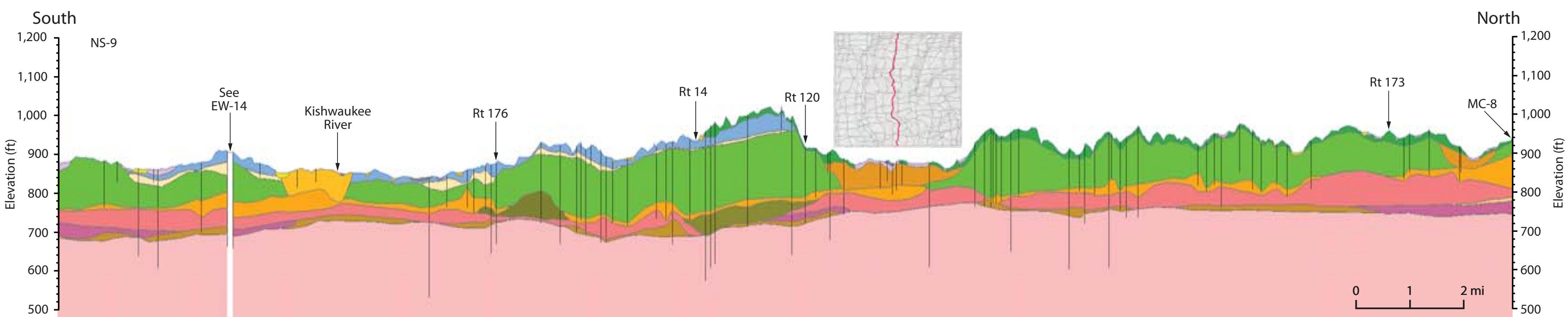

South
North
NS-2
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
I-90
Coon Creek
Rt 20
Kishwaukee River
GARP-10-04
GARP-10-05
Rush Creek
See EW-11
MC-10
CAPR-09-01
Rt 173
Little Beaver Creek
NIPC-1
0
1
2 mi

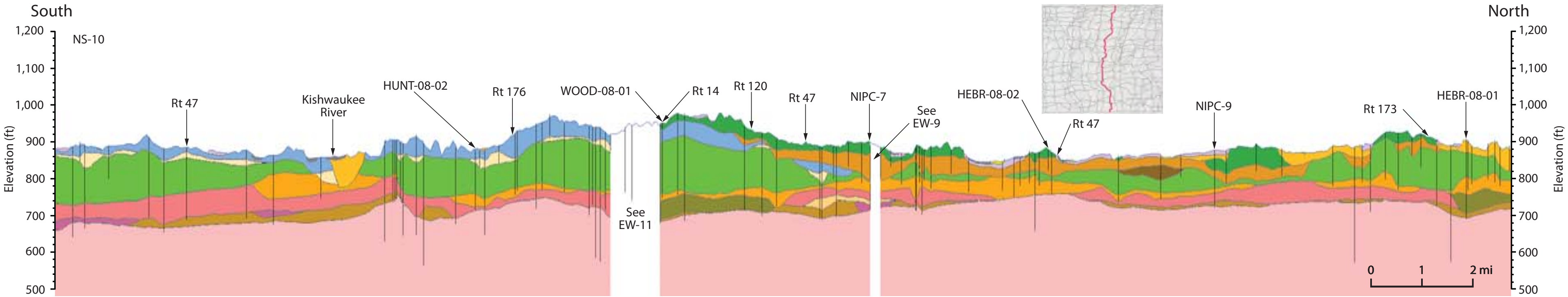

South
North
NS-3
1,200
1,100
1,000
900
800
700
600
500
Elevation (ft)
Rt 23
I-90
Coon Creek
Rt 20
Kishwaukee River
GARP-09-02
Rush Creek
Rush Creek
GARP-09-01
Rt 173
Lawrence Creek
West Branch Piscasaw Creek
0
1
2 mi

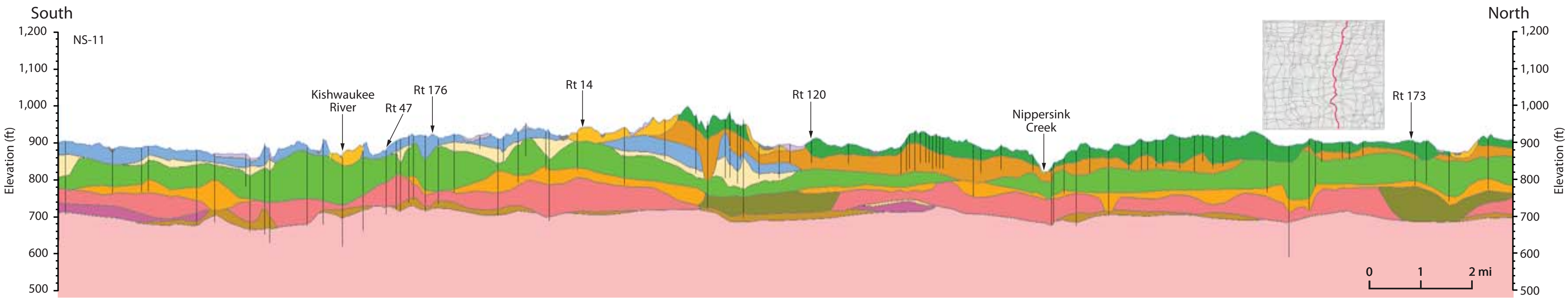

South
North
NS-4
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
RILEY
I-90
NIPC-3
Rt 23
Rt 20
Kishwaukee River
MARN-09-02
Rt 23
Rush Creek
GARP-09-01
Rt 23
Rt 173
Mokeler Creek
Piscasaw Creek
MC-3
CHEMUNG
0
1
2 mi
South
North
NS-5
I-90
Rt 20
Rt 176
Kishwaukee River
Rt 14
Rt 173
Mokeler Creek
South
North
NS-6
MARS-09-01
Rt 20
Kishwaukee River
MARS-10-05
Rt 14
HARV-09-01
Rush Creek
Rt 173
ALDEN
NIPC-2

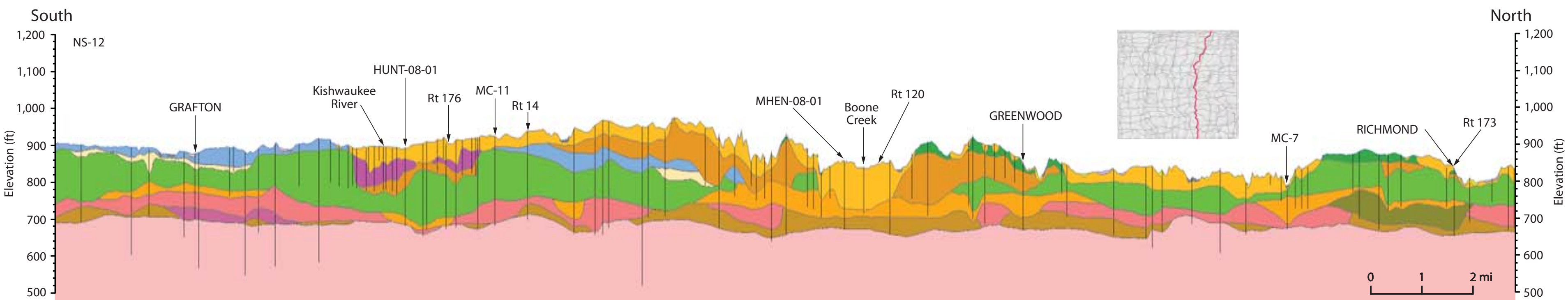

South
North
NS-7
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
UNION ROAD
GEOPHYSICS
South Branch
Kishwaukee
River
North Branch
Kishwaukee
River
DIMMEL
ROAD
GEOPHY-
SICS
Rt 14
MARN-09-01
Rt 173
0
1
2 mi

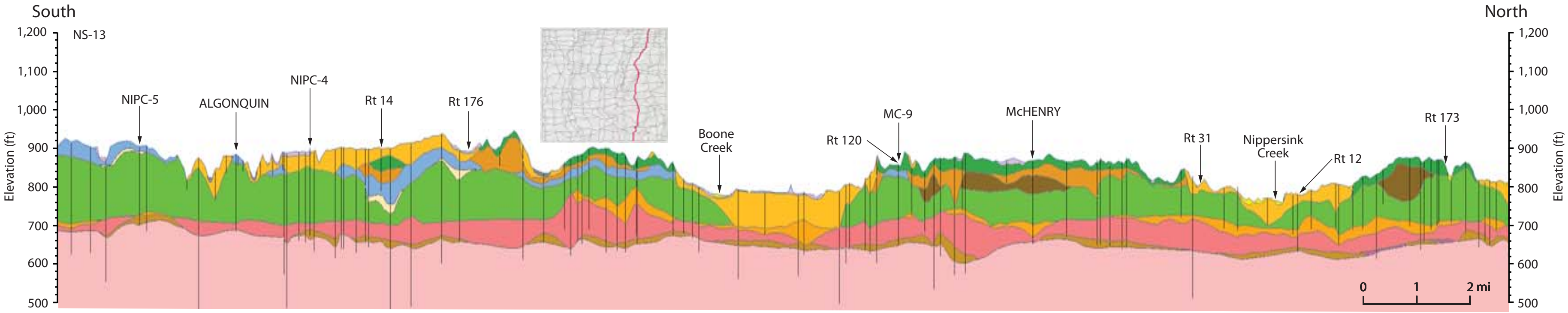

South
North
NS-8
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
HUNT-09-03
South Branch
Kishwaukee
River
CORAL
Kishwaukee
River
SENECA
Rt 14
HARTLAND
NIPC-8
Rt 173
HEBR-09-03
0
1
2 mi

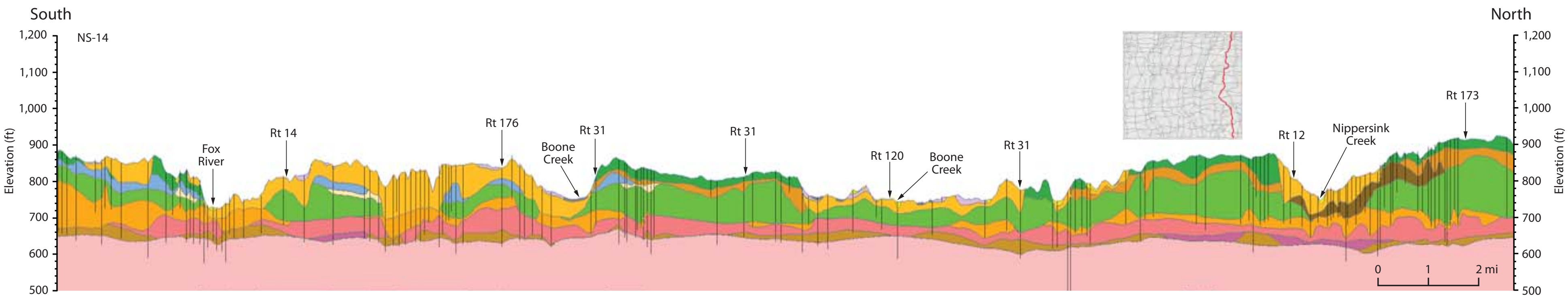

South
North
NS-9
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
See
EW-14
Kishwaukee
River
Rt 176
Rt 14
Rt 120
Rt 173
MC-8
0
1
2 mi

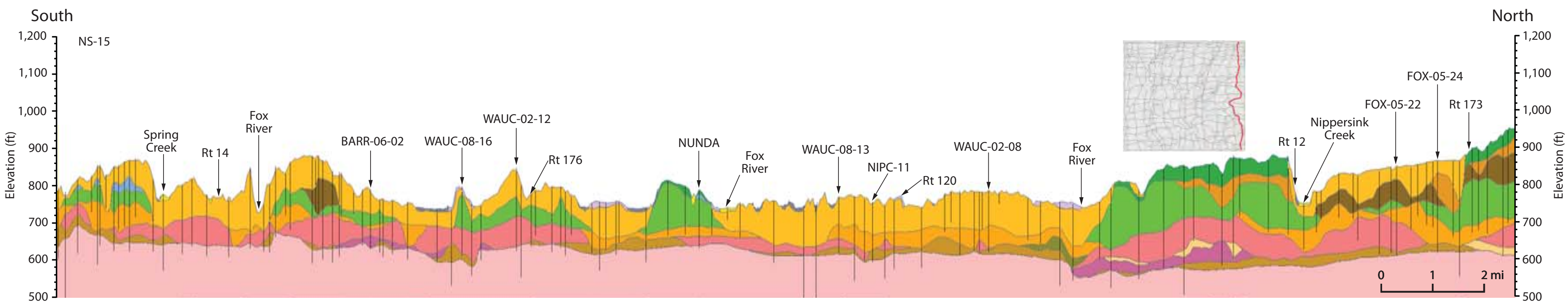

South
North
NS-10
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Rt 47
Kishwaukee River
HUNT-08-02
Rt 176
WOOD-08-01
Rt 14
Rt 120
Rt 47
NIPC-7
See EW-9
HEBR-08-02
Rt 47
NIPC-9
Rt 173
HEBR-08-01
See EW-11
0
1
2 mi

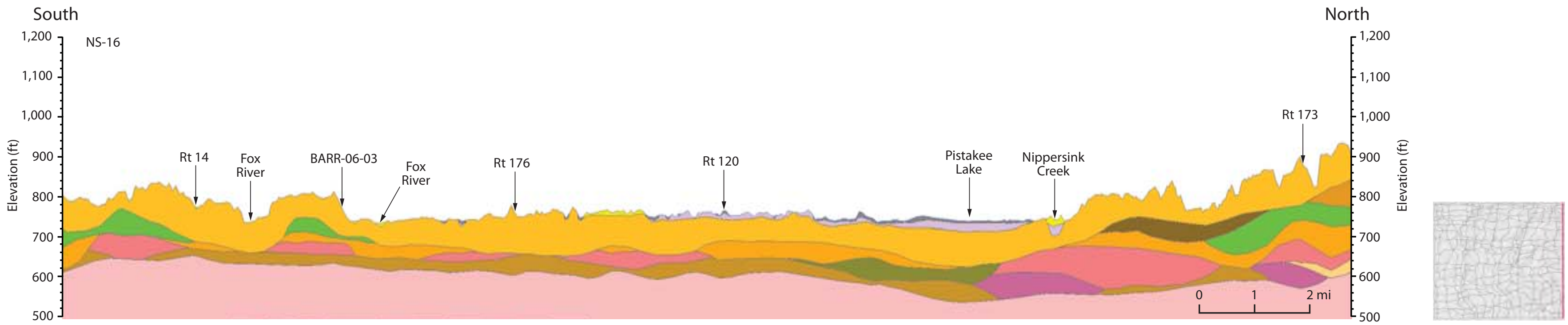

South
North
NS-11
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Kishwaukee River
Rt 47
Rt 176
Rt 14
Rt 120
Nippersink Creek
Rt 173
0
1
2 mi

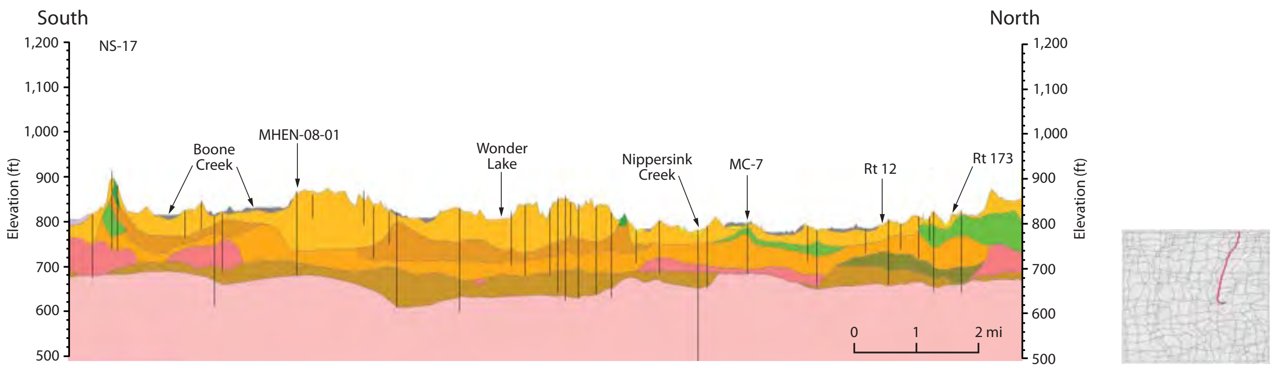

South
North
NS-12
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
GRAFTON
Kishwaukee River
HUNT-08-01
Rt 176
MC-11
Rt 14
MHEN-08-01
Boone Creek
Rt 120
GREENWOOD
MC-7
RICHMOND
Rt 173
0
1
2 mi

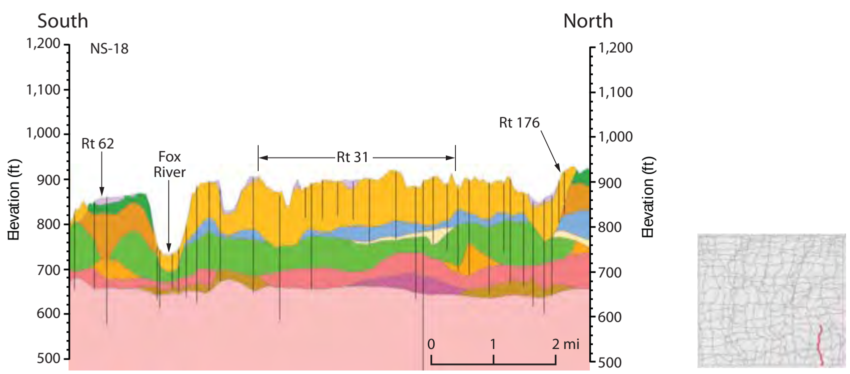

South
North
NS-13
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
NIPC-5
ALGONQUIN
NIPC-4
Rt 14
Rt 176
Boone Creek
Rt 120
MC-9
McHENRY
Rt 31
Nippersink Creek
Rt 12
Rt 173
0
1
2 mi

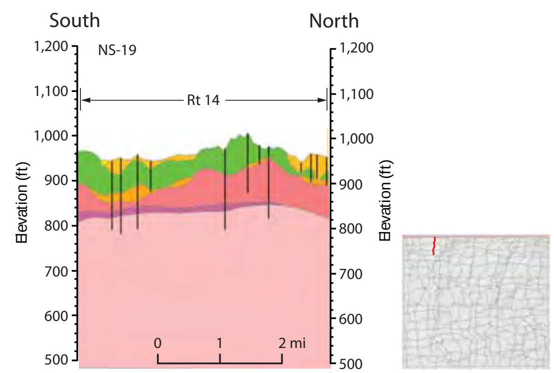

South
North
NS-14
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Fox River
Rt 14
Rt 176
Boone Creek
Rt 31
Rt 31
Rt 120
Boone Creek
Rt 31
Rt 12
Nippersink Creek
Rt 173
0
1
2 mi


South
North
NS-15
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Spring Creek
Rt 14
Fox River
BARR-06-02
WAUC-08-16
WAUC-02-12
Rt 176
NUNDA
Fox River
WAUC-08-13
NIPC-11
Rt 120
WAUC-02-08
Fox River
Rt 12
Nippersink Creek
FOX-05-22
FOX-05-24
Rt 173
0
1
2 mi


South
North
NS-16
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Rt 14
Fox River
BARR-06-03
Fox River
Rt 176
Rt 120
Pistakee Lake
Nippersink Creek
Rt 173
0
1
2 mi


South
North
NS-17
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Boone Creek
MHEN-08-01
Wonder Lake
Nippersink Creek
MC-7
Rt 12
Rt 173
0
1
2 mi


South
North
NS-18
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Rt 62
Fox River
Rt 31
Rt 176
0
1
2 mi


South
North
NS-19
Elevation (ft)
1,200
1,100
1,000
900
800
700
600
500
Rt 14
0
1
2 mi

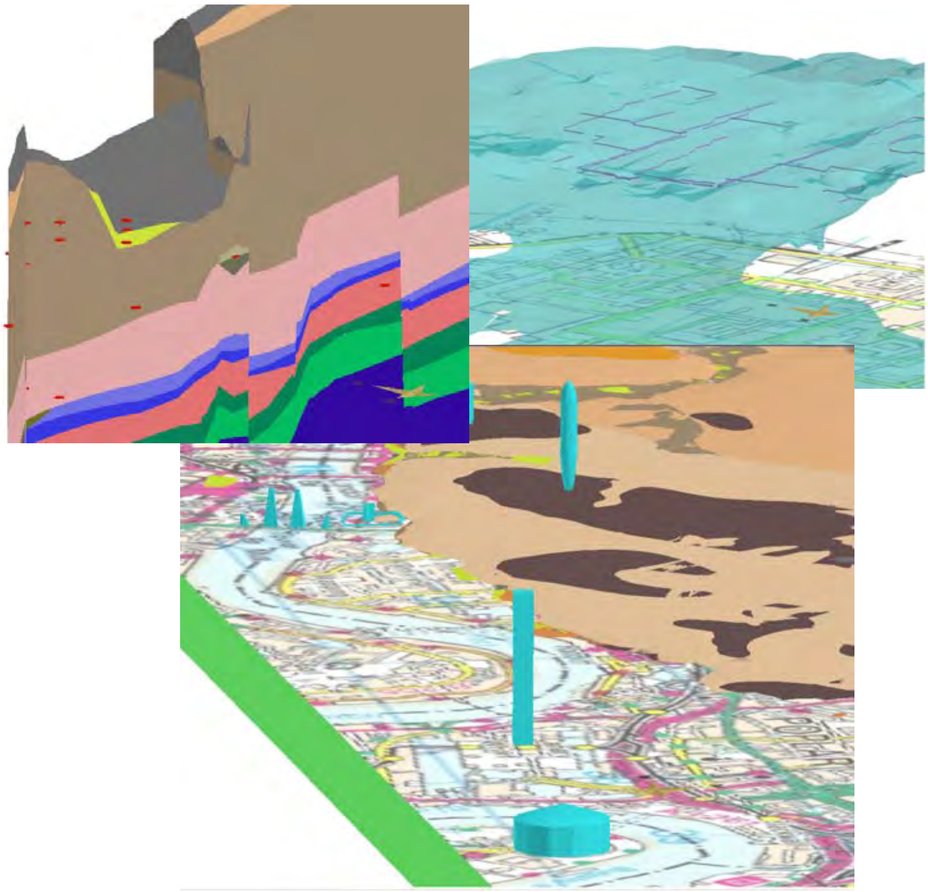
APPENDIX D

Subsurface Viewer User Manual

Subsurface Viewer 2009: User Manual V1.0

Geological Modelling Systems Team

Open Report OR/09/027



BRITISH GEOLOGICAL SURVEY

Geological Modelling Systems Team

OPEN REPORT OR/09/027

Subsurface Viewer 2009: User Manual V1.0

R. L. Terrington, S. J. Mathers, H. Kessler, V. Hulland & S. J. Price

Keywords

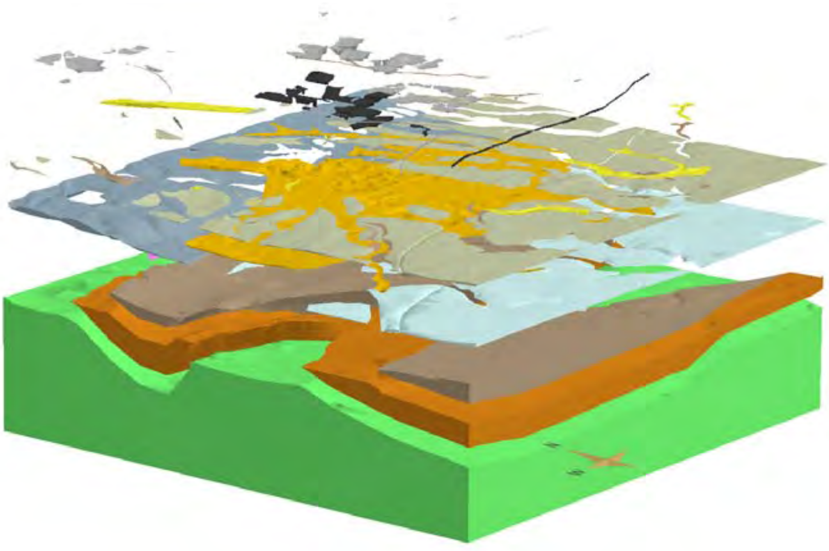
3 dimensional geological models Subsurface, Viewer, Geology, Synthetic cross-sections, slices & boreholes

Front cover

Snapshots of Subsurface Viewer model outputs showing synthetic cross-sections in 3D with water strikes, sewerage pipes embedded in till and buildings on top of bedrock in London. Exploded Chichester Model as front piece.

Bibliographical reference

TERRINGTON, R, L, MAHTERS, S. J. KESSLER, H. HULLAND, V. PRICE. S. J, SUBSURFACE VIEWER 2009: USER MANUAL V1_0.2009. *British Geological Survey Open Report*, OR/09/027. 23pp.



Keyworth, Nottingham British Geological Survey 2009

BRITISH GEOLOGICAL SURVEY

The full range of our publications is available from BGS shops at Nottingham, Edinburgh, London and Cardiff (Welsh publications only) see contact details below or shop online at www.geologyshop.com

The London Information Office also maintains a reference collection of BGS publications, including maps, for consultation.

We publish an annual catalogue of our maps and other publications; this catalogue is available online or from any of the BGS shops.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as basic research projects. It also undertakes programmes of technical aid in geology in developing countries.

The British Geological Survey is a component body of the Natural Environment Research Council.

British Geological Survey offices

BGS Central Enquiries Desk
Tel 0115 936 3143 Fax 0115 936 3276
email enquiries@bgs.ac.uk

Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG
Tel 0115 936 3241 Fax 0115 936 3488
email sales@bgs.ac.uk

Murchison House, West Mains Road, Edinburgh EH9 3LA
Tel 0131 667 1000 Fax 0131 668 2683
email scotsales@bgs.ac.uk

Natural History Museum, Cromwell Road, London SW7 5BD
Tel 020 7589 4090 Fax 020 7584 8270
Tel 020 7942 5344/45 email bgslondon@bgs.ac.uk

Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff CF15 7NE
Tel 029 2052 1962 Fax 029 2052 1963

Forde House, Park Five Business Centre, Harrier Way, Sowton EX2 7HU
Tel 01392 445271 Fax 01392 445371

Maclean Building, Crowmarsh Gifford, Wallingford OX10 8BB
Tel 01491 838800 Fax 01491 692345

Geological Survey of Northern Ireland, Colby House, Stranmillis Court, Belfast BT9 5BF
Tel 028 9038 8462 Fax 028 9038 8461

www.bgs.ac.uk/gsni/

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon SN2 1EU
Tel 01793 411500 Fax 01793 411501
www.nerc.ac.uk

Website www.bgs.ac.uk
Shop online at www.geologyshop.com

Foreword

This user manual is the published product by the British Geological Survey (BGS) for the instruction of using the Subsurface Viewer.

Acknowledgements

This user-manual has been written by Ricky Terrington in collaboration with Steve Mathers and Holger Kessler. The Subsurface Viewer was developed by INSIGHT Geologische Softwaresysteme GmbH in 2004/2005 for the visualisation and analysis of digital geoscientific spatial models. To date over 20 geological models have been packaged in the Subsurface Viewer. These geological models have been published through the GSI3D Geological Surveying and Investigation in 3D (GSI3D) software also developed by INSIGHT.

We would also like to thank Camilla Taylor for testing the usability of the Subsurface Viewer and the improvements made on the manual.

This user-guide is intended for geoscientists and geological enthusiasts in BGS, and elsewhere, for using the software and methodology to view 3D geological models in the Subsurface Viewer.

Contents

Foreword ... i

Acknowledgements ... i

Contents ... ii

Summary ... ii

1 Introduction ... 1

2 Installation and use of the Subsurface Viewer ... 1

2.1 Technical Specification for use of the Subsurface Viewer ... 2

3 Viewer Interface ... 3

3.1 The Map Window: ... 5

3.2 The Synthetic-section Window: ... 10

3.3 The 3D Window: ... 12

3.4 The Synthetic-borehole log window: ... 16

References ... 17

Glossary ... 17

Summary

This user guide describes the tools and methodology for investigating and analysing 3D geological models using the Subsurface Viewer.

1 Introduction

The Subsurface Viewer is an exciting new package developed by INSIGHT Geologische Softwaresysteme GmbH for the visualisation and analysis of digital geoscientific spatial models. This Viewer has been developed following the popularity of INSIGHT's Geological Surveying and Investigation in 3D (GSI3D) software tool that BGS uses extensively for the construction of systematic near surface models (Kessler and Mathers, 2004; Kessler *et al*, 2005; Kessler *et al*, 2009).

Geological Models are embedded within the Subsurface Viewer as the means of publication. In this way the constructed model can be examined and analysed to produce:

- Models displaying the geology or other pre-selected applied themes (e.g. hydrogeological properties)
- Geological maps (at surface and uncovered)
- User defined synthetic borehole logs
- User defined horizontal slices and vertical sections
- Visualisation of the geometry of single and combined units

Please note that the models supplied with the Subsurface Viewer are encrypted and cannot be altered, nor can users add additional data.

2 Installation and use of the Subsurface Viewer

The model and the necessary Java software and extensions will be delivered to the client on a CD-ROM or via a secure FTP site.

The executable file will install java software onto the PC if the minimum Java Runtime is not found, so administrative permissions must be set accordingly.

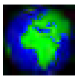
To load the Subsurface Viewer onto your computer, double click the executable (*setup.exe*) with the following icon

The executable will have a prefix of the model contained within the Subsurface Viewer. Follow the instructions that will include

- Licence Agreement
- Location of the folder for which the Subsurface Viewer will be installed
- ReadMe file which contains important information about the setup and how to get support

Press 'Finish' to complete the process and load the Subsurface Viewer on your computer.

Once installed, the *"model".exe* will appear as a short cut on your desktop view and will have the following icon.



The model can also be run from **Start>Programs>Subsurface Viewer>"Model Name"** and clicking the *"model".exe* if preferred.

To **un-install** or **change** installation settings of the Subsurface Viewer, click on the original *setup.exe* with the  icon and follow the instructions.

Each unique model is supplied with its own inbuilt version of the Subsurface Viewer and a licence. This means that the software is not a stand-alone package but is an integral part of each published model.

2.1 TECHNICAL SPECIFICATION FOR USE OF THE SUBSURFACE VIEWER

The following are the recommended **minimum hardware requirements** for using the Subsurface Viewer

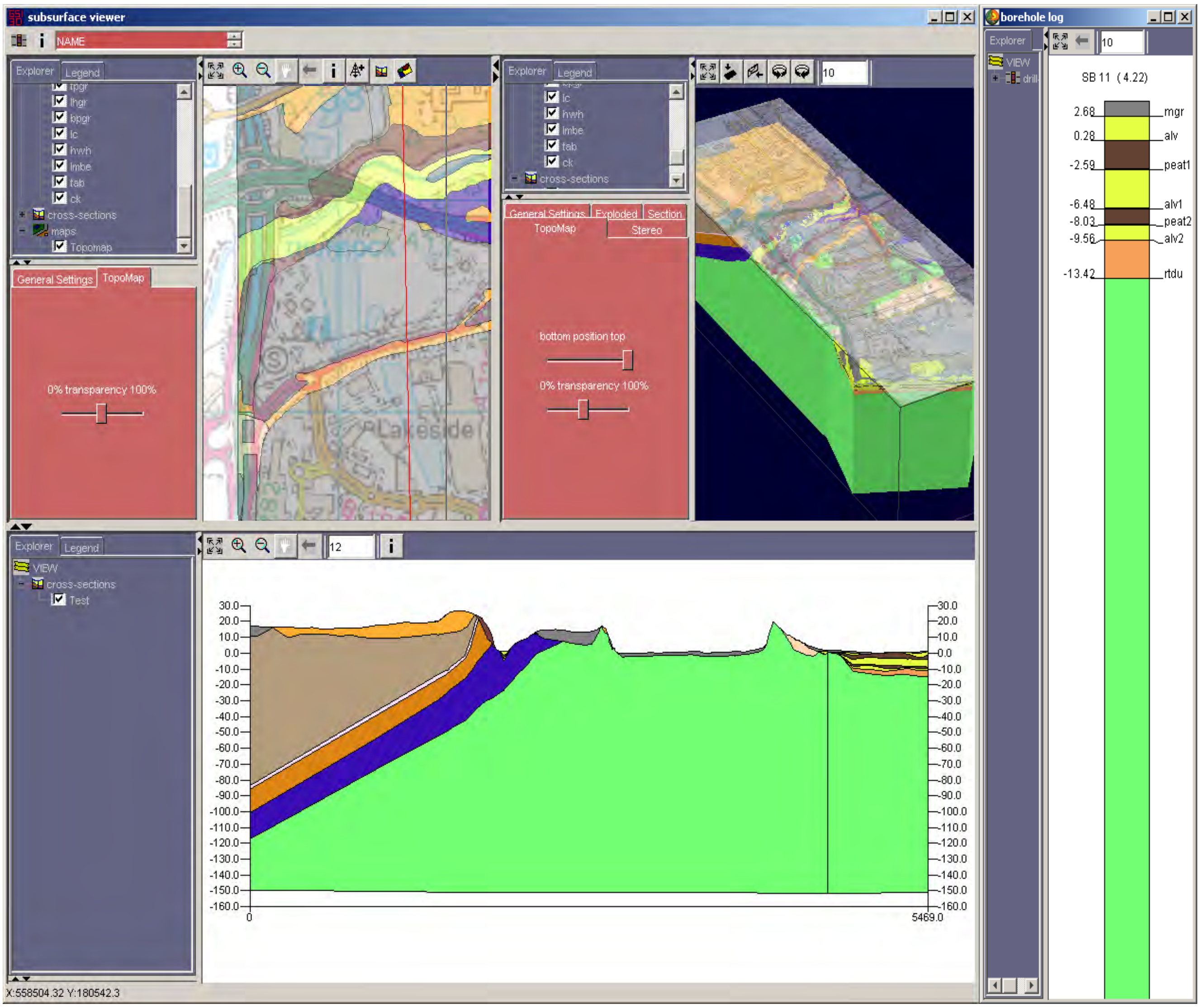
- PC running Microsoft Windows 2000/XP or Windows XP 32-bit editions only
- Either Intel Pentium family 32/64 bit processor 1GHz+ or AMD Athlon family 32/64 bit Processor 1GHz+
- **Minimum** of 256Mb of system RAM. Larger models will need 512Mb or more.
- A PC desktop graphics card using either Nvidia Geforce, Nvidia Quadro or ATI Radeon chipsets with minimum of 64Mb video RAM (**Other makes of card may be supported including those in laptops**).
- 120Mb of Hard disk for the Java + Viewer installation. (1 Mb required for Viewer only installation)

If you have any queries or problems installing or using the Subsurface Viewer please contact our enquiry team on enquiries@bgs.ac.uk or Tel: 0115 9363143

3 Viewer Interface

Note in this manual <*Lmb*> and <*Rmb*> are used for left and right mouse button clicks respectively

The Subsurface Viewer contains 4 windows for the visualisation of the model as shown below. These are clockwise from top left the Map, 3D, Synthetic borehole log, and Synthetic section windows



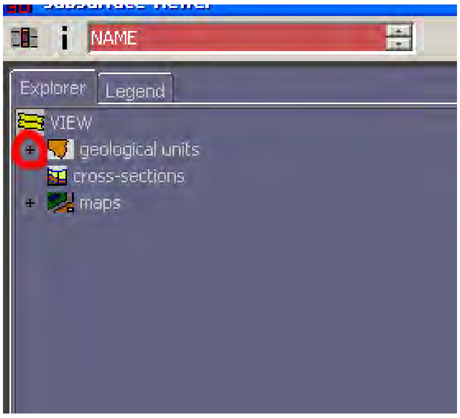
On loading the model is automatically displayed in the Map Window and the 3D Window. The Synthetic-section Window is empty until a synthetic section is drawn. The Synthetic-borehole log Window needs to be activated separately by clicking on the borehole icon (shown below) in the top left corner of the header bar and then resized.

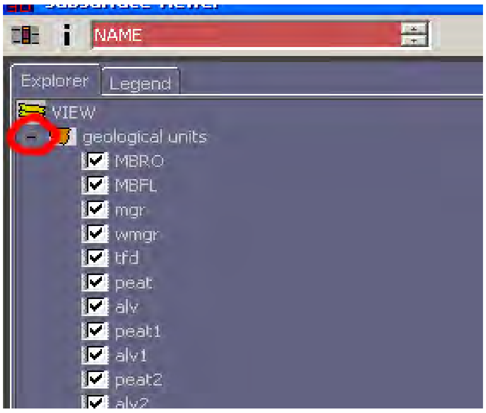
Information Tool. <*Lmb*> provides information about the software owner

The **NAME** menu indicates what attribute of the model is being displayed. By simply toggling the up and down arrows and clicking once on the attribute, a new attribute will be defined in the Map, 3D and Synthetic-section windows.

The **Explorer** tab in all windows opens the table of contents whereas the **Legend** tab reveals the colour key to the geological units in each of the three main windows.

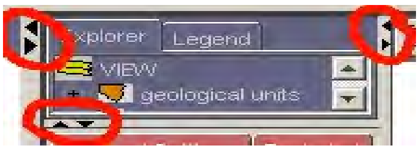
- The layers that make up the model can be viewed by double clicking the left mouse button <*Lmb*> on VIEW.
  Use + to drill down the layers and the – to zip the layers back up.





- **X** and **Y** coordinates can be viewed in the bottom left of the interface when the cursor is placed in the Map (**Note – coordinates only appear when all maps in both the Map and 3D windows have been turned off**). Additionally, a **Z** (depth in metres) value can be obtained when a synthetic cross-section has been drawn and the cursor is placed in the Synthetic-section Window.

  Dragging the border or using the arrows shown below can resize all the windows and tab boxes.

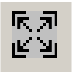


3.1 THE MAP WINDOW:

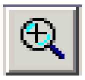
The Map Window enables the view of geological units in 2D, individually or collectively, from above or below, as coverage's or contoured bases and tops. The Map Window can also display topographic raster maps for reference, or maps indicating the uncertainty of the model.

In the Map Window the user can specify the alignment of synthetic cross-sections and the location of synthetic boreholes.

Tools include:



Zoom to full extent. <*Lmb*> click once on tool to use.



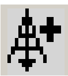
Zoom in. <*Lmb*> click on tool**.** Hold down <*Lmb*> and stretch over an area of interesting the Map Window. Release <*Lmb*> once area has been defined.

Zoom out. Click on tool once with <*Lmb*> to zoom out. Continue clicking until a desired view is obtained.

Pan. <*Lmb*> click on tool. Hold down <*Lmb*> in Map Window to drag map/model across screen. Release <*Lmb*> to reveal new position of map/model.

Information tool. <*Lmb*> click. Provides information about software owner.

Previous View. <*Lmb*> click to go back to previous view.

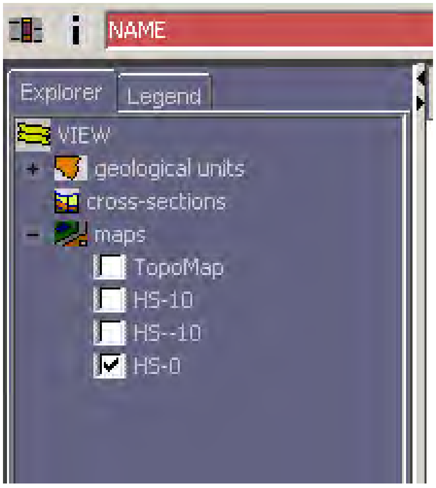


Synthetic borehole. Use <*Lmb*> on tool. Click once with <*Lmb*> at location in the Map Window where the synthetic borehole is required. Go to the Synthetic borehole log window (Section 3.4) for further details about viewing the synthetic borehole.

Synthetic cross-section. Use <*Lmb*> on tool. Click once with <*Lmb*> on Map Window. A line will appear from where the mouse was clicked on the Map Window. This will show where the cross-section will be drawn. A double-click on the <*Lmb*> will complete the cross-section and red line will appear showing the location. A synthetic section can be constructed by using as many points as required, providing there are at least two. A window will also materialize asking for the new cross-section to be named. Once named the section appears in the Synthetic-section Window. Go to the Synthetic-section Window (Section 3.2) for further details.

Synthetic Horizontal Slice. *<Lmb>* click will bring up a message box asking the user for a depth at which the 3D model will be sliced to relative to Ordnance Datum (OD). For example, if the user specified a depth of 5m, the model in the map window would have the ground above this height removed, leaving only geological units that occur at this OD in the map window view. (**Note - As the 3D model incorporates ground above and below sea level, the depth of the slice will be an absolute value, where mean sea level is taken as 0**).

This map, created from taking the horizontal slice, is held in the "maps" drop down menu under "View" in the "Explorer" tab. To return to the original view un-tick the box for the slice, as shown below.



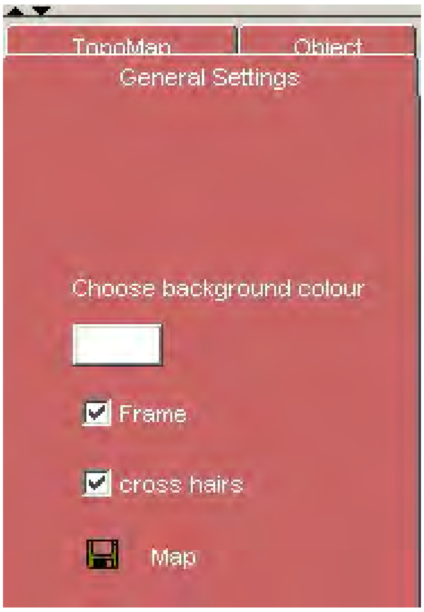
The map currently selected (HS-0) refers to a horizontal slice cut at 0m above mean sea level. (HS-10 and HS--10 refer to slices 10m above and 10m below the mean sea level, respectively).

In the side menu bar, under the "Explorer" tab *<Lmb>* click on "View" to display the **geological units, cross-sections or maps** and this will reveal the following self-explanatory options:

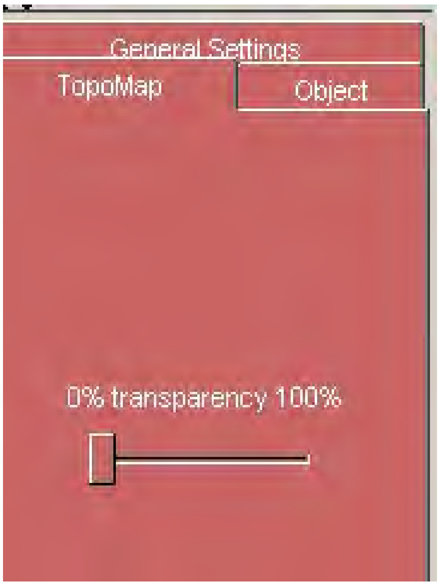
Then, having drilled down the options using the + button, *<Rmb>* click on any individual **geological unit, cross-section** or **map** to reveal two self-explanatory "send to" options plus Properties – *<Lmb>* click on Properties to reveal the **Object** tab discussed below.

<Lmb> on the **General Settings** tab reveals the screen below. Here the user can define the background colour from a palette by *<Lmb>* on the white rectangle. Also the frame and cross-

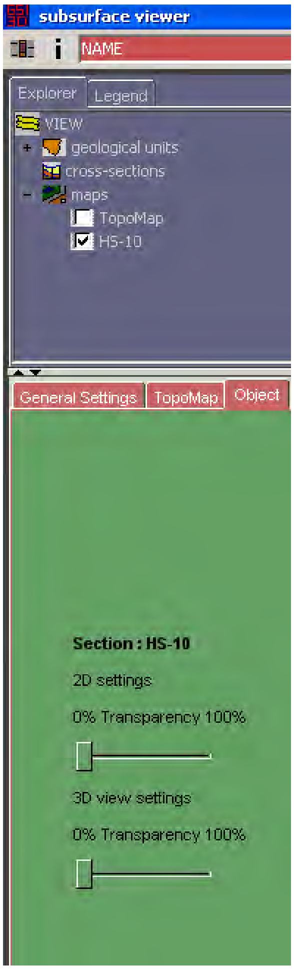
hairs can be toggled on and off. <*Lmb*> on the save map icon gives the option to save the current view as a *.png, with a user defined metre to pixel ratio (N/B future versions will enable scaled printing)



<*Lmb*> on the **TopoMap** tab opens up the following screen. The slider bar allows seamless setting of transparency in the Map Window.



Properties of other maps (not named TopoMap in the "maps" drill down menu) need to be controlled by <*Rmb*> on the map and then transparency can be adjusted in the "Object" tab, as shown below.

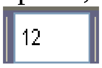


<*Rmb*> on a **Geological Unit>Properties** reveals the **Object** tab shown right. The name or code of the selected unit is displayed in bold at the top. Select whether to contour the base or top of the unit and set the preferred contouring interval in metres. The unit is shown in its pre-determined colour when the **extent of unit** is ticked on. The slider bar immediately below varies the transparency. The **3D view settings** give the option to display the geological units in one or more ways. These can be floating **contours**, a triangulated **mesh** or colour **shaded** objects. The bottom slider bar varies the transparency of the 3D colour shaded object.

3.2 THE SYNTHETIC-SECTION WINDOW:

Note – The Synthetic-section Window is only active once synthetic cross-sections have been selected in the Map Window using the **synthetic cross-section** tool.

The tool icons on the header bar of the Synthetic-section Window are identical to the Map Window.

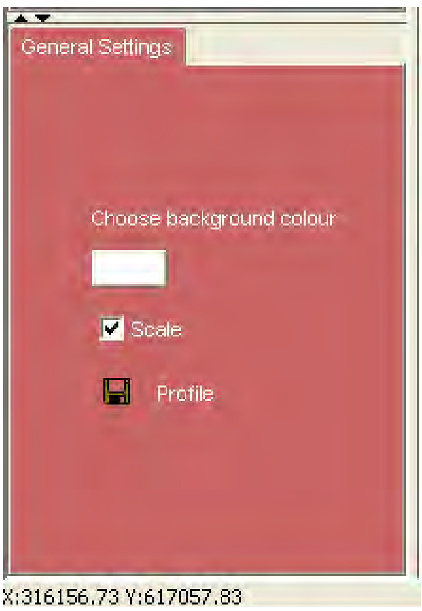
There is one additional option, which is to specify the vertical exaggeration by typing the value in the box shown here**:** 

The vertical exaggeration has to be selected by the user to display each model. Typical values however are between 5 and 25.

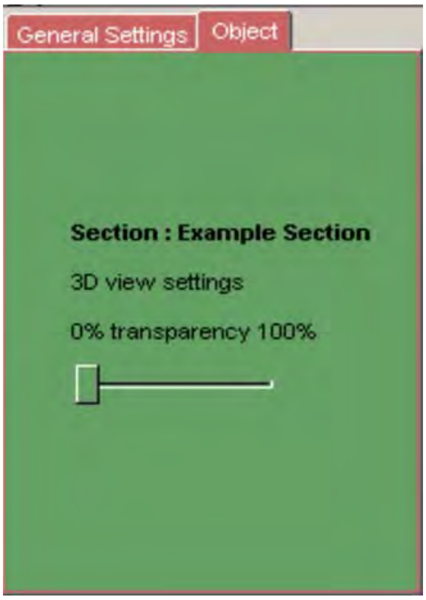
As for the Map Window, the **Explorer** tab reveals the Table of Contents whilst the **Legend** tab displays the units present in the section(s).

<Rmb> click on the **General Settings** tab reveals the screen below. Here the user can define the background colour from a palette by *<Lmb>* on the white rectangle. Also ticking the scale box creates a scaled frame surrounding the synthetic section.

<Lmb> on the save map icon gives the option to save the current view as a *.png, with a user defined metre to pixel ratio



<*Rmb*> click on any synthetic section in the table of contents enables the user to set the properties of the section using the screen below. The name of the section is shown in bold at the top of the screen. By ticking the labelling box the section can be labelled with the names of the geological units. The slider bar varies the transparency of the section in the 3D window.



Note: To view multiple synthetic cross-sections at the same time go to the **3D Window (**Section 3.3)

3.3 THE 3D WINDOW:

The 3D Window enables interactive viewing of the model and uses the left and right mouse buttons for all navigation.

Rotate model - Hold down the *<Lmb>* on the 3D Window and move the mouse until you reach the required angle. Release *<Lmb>* to halt rotation.

Zoom in/out – Hold down the *<Rmb>*, move the mouse in an upward direction to zoom out and a downward direction to zoom in. Release *<Rmb>* to halt zoom.

Pan – Hold down both buttons and move mouse in any direction to pan the model.

Additional tools in the header bar of the 3D Window include:

Spin model clockwise – Click once to start (button will then appear black), click again to switch off.

Spin model anticlockwise – Same as above

Vertical/plan view of model

Horizontal view of model

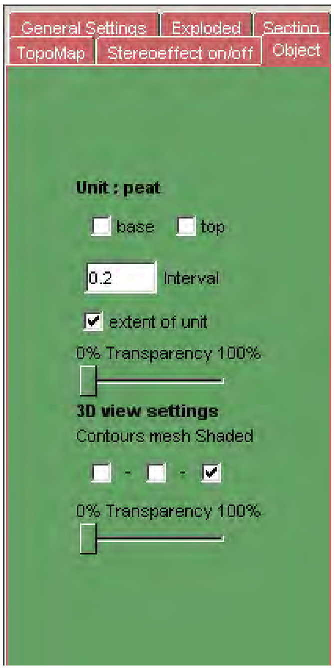
<Rmb> click (on geological properties) followed by *<Lmb>* click will give the following self-explanatory options: –

1. Hide all objects
2. Show all objects

Alternatively, each unit can be switched on or off individually by clicking on the tick as previously mentioned in the Map Window (Section 3.1).

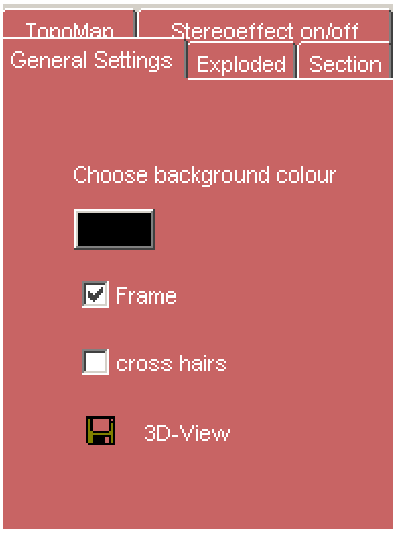
<Rmb> on an individual unit gives the option to display the properties screen by *<Lmb>* on Properties shown below

This content window is identical to that shown above in the Map Window (Section 3.1).



The menu tabs

<*Lmb*> on the **General Settings** tab gives the following screen



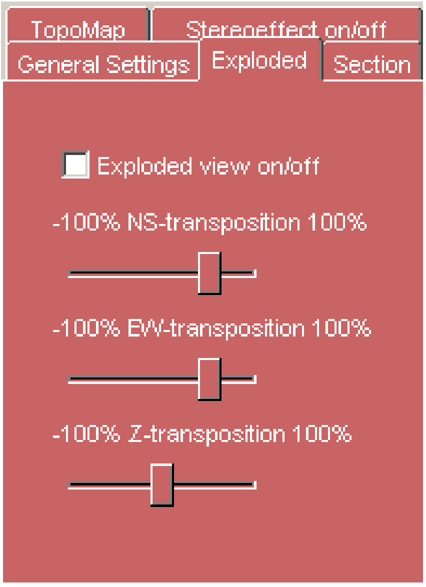
Background colour– <*Lmb*> brings up a screen to select background colour from palette

Frame – Toggles the frame on/off in 3D Window

Cross-hairs – Toggles the cross hairs on/off in 3D Window

3D-View – <*Lmb*> on the save icon gives the option to save the current view as a *.png, with a user defined metre to pixel ratio

<*Lmb*> on the **Exploded** tab gives the following screen



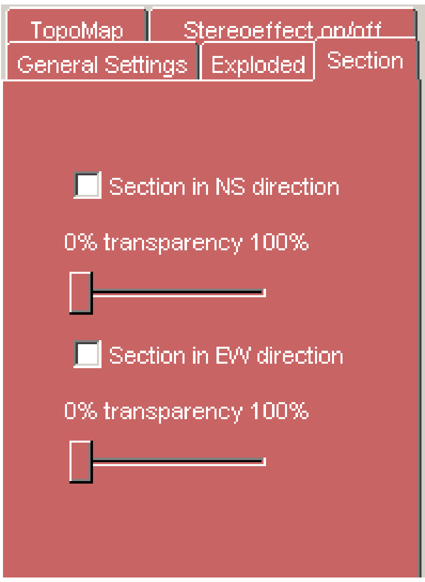
Exploded view on/off toggles the explosion of model on/off, i.e. the separation of individual geological units from other geological units.

NS-transposition – use slider bar to explode model in a north/south direction.

EW- transposition – use slider bar to explode model in an east/west direction.

Z- transposition – use slider bar to explode model in a vertical direction.

<*Lmb*> on the **Section** tab gives the following screen

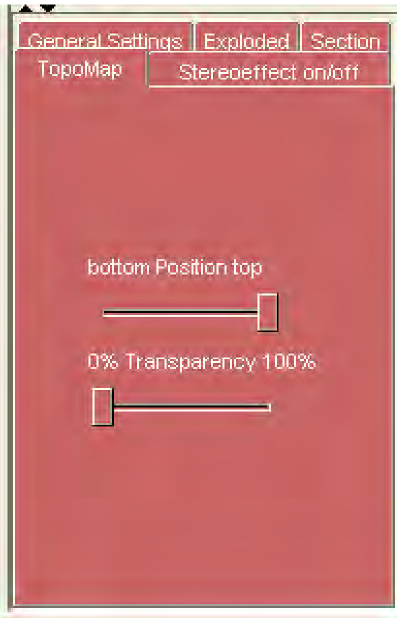


Note - Hide all geological objects to view vertical slices. Adjusting the transparency of the topological map also aids visualisation of these slices.

Section in NS-direction– tick on and then move mouse across Map Window screen to view vertical slices of the model in a north/south direction

Section in EW-direction– tick on and then move mouse across Map Window to view vertical slices of the model in an east/west direction

<Lmb> on the **TopoMap** tab to open the following screen



bottom Position top – Sets topographical position relative to model using slide bar.

Transparency – use slide bar to set transparency of topographical map.

<Lmb> on the **Stereo effect on/off** tab gives the following screen

Stereoeffect on/off – View model in 3D stereo.

color of glasses – sets colours to match colour of 3D glasses.

eye distance – use slider bar to adjust

3.4 THE SYNTHETIC-BOREHOLE LOG WINDOW:

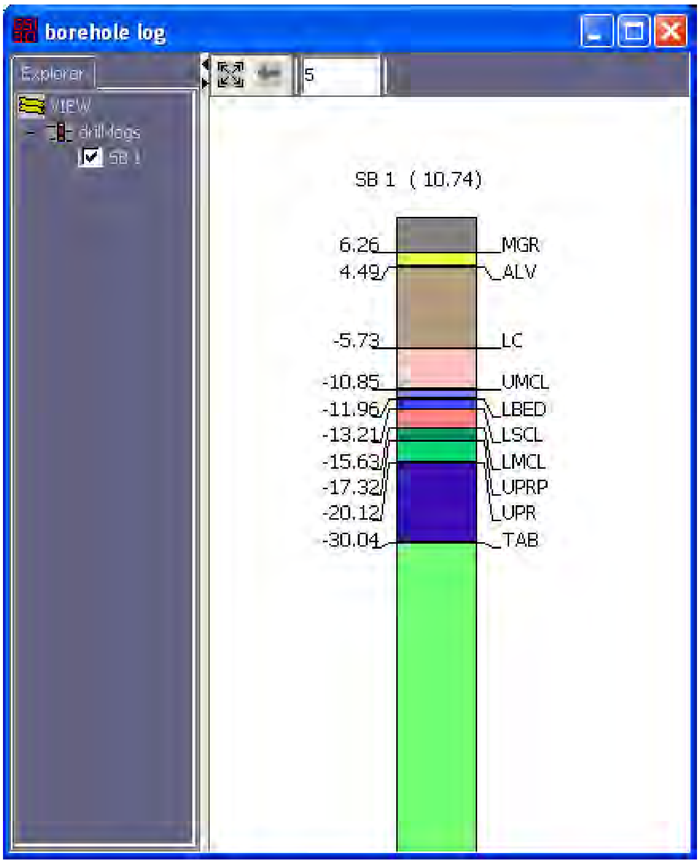
Once the synthetic borehole viewer tool has been used on the Map Window,

click on  in the top right hand corner which will open up the borehole viewer screen (shown below).

The tools in the borehole viewer screen carry the same functionality as the tools in the Map and Section windows. However, to pan hold down the <*Lmb*> to drag the borehole stick to the desired location in the display.

The borehole viewer display also shows:

- The depth to the base of each geological unit relative to OD.
- The OD and name of the synthetic borehole at top
- The name of each of the units modelled is attached to their base.



References

Kessler, H. & S.J. Mathers. 2004. Maps to Models. Geoscientist, 14/10, pp. 4-6. http://www.bgs.ac.uk/science/3Dmodelling/mapstomodels.html

Kessler, H. et al. 2005. 3D geoscience models and their delivery to customers. In: Three dimensional geologic mapping for groundwater applications, Workshop extended abstracts, Salt Lake City, Utah, 15 October 2005. Geological Survey of Canada, 2005. p. 39-42. http://crystal.isgs.uiuc.edu/research/3DWorkshop/2005/pdf-files/kessler2005.pdf

Kessler, H., Mathers, S.J. & H.-G. Sobisch. 2009. The capture and dissemination of integrated 3D geospatial knowledge at the British Geological Survey using GSI3D software and methodology. Computers & Geosciences, **35**, 1311–1321.

http://dx.doi.org/10.1016/j.cageo.2008.04.005

Glossary

Borehole Log A synthetic borehole drilled in a Z direction through the 3D geological model data.

Cross-section A vertical slice defined by a start and end point through the 3D geological model data

Horizontal Slice A horizontal slice given at a Z depth level through the 3D geological model data

Synthetic Cross-sections, boreholes or horizontal slices which are constructed using data from the triangulated surfaces stored in the Subsurface Viewer.

Topomap A map showing topographical features and landmarks of the Earth’s surface.

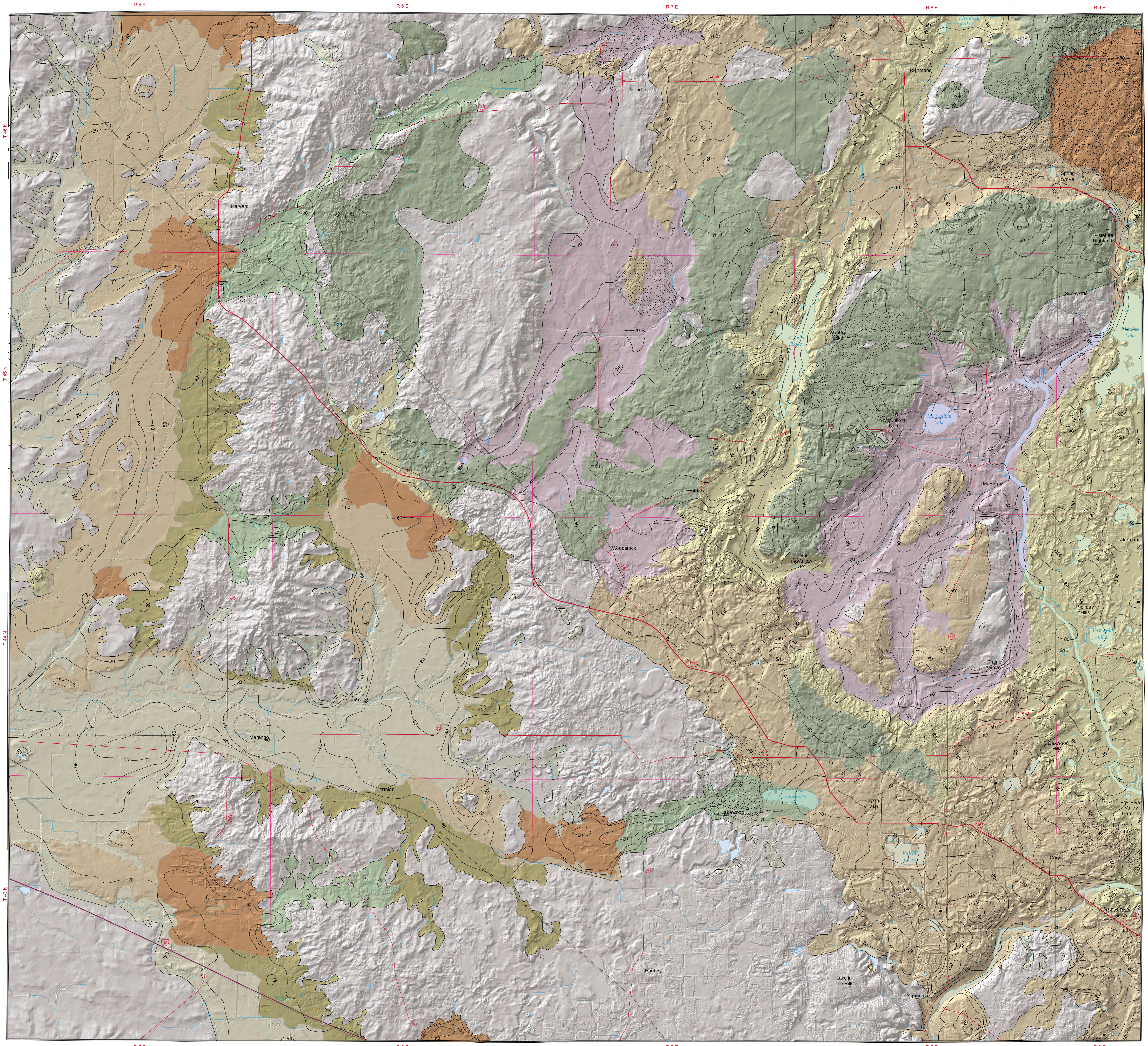
APPENDIX E

Maps of (a) Aquifer Extent and Thickness and (b) Aquifer Sensitivity

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

DISTRIBUTION AND THICKNESS OF THE SURFICIAL AQUIFER
MCHENRY COUNTY, ILLINOIS

Jason F. Thomason
2013



Introduction

In McHenry County, the Surficial Aquifer is composed of the shallowest sand and gravel deposits associated with ancient glacial meltwater streams. This aquifer is highly utilized for domestic and municipal water supplies, because it is easily accessible (shallow and often exposed at land surface) and relatively thick (often greater than 50 feet thick). Because of its location near land surface, the aquifer is a major route for deeper groundwater recharge, but it is also often highly sensitive to contamination. Furthermore, the Surficial Aquifer is often a key component of groundwater-surface water interactions, which control ecologically-sensitive areas such as wetlands and streams.

Previous studies of the Surficial Aquifer sediments have addressed the importance of understanding their geologic depositional context (and associated textural variability) and the implications on long-term aquifer sustainability and on other natural and ecological resources. These studies have addressed the geologic context of the aquifer deposits in terms of both groundwater resources (Curry et al., 1997; Berg, 1994) and sand and gravel resources (Anderson and Block, 1962; Cobb and Fraser, 1981). The latter studies have been important to better understand how sediment texture of this aquifer changes across the landscape (e.g. sand, sand and gravel, coarse gravel). Anderson and Block (1961) recognized three types of sand and gravel deposits at land surface in McHenry County: outwash plain, valley train, and ice-contact stratified drift. Cobb and Fraser (1981) developed a sedimentological model of more local deposits to predict the texture of the sand and gravel deposits in other parts of Kane and McHenry Counties. Their model incorporated the relative distances of glacial-meltwater deposits from the ice margins as a proxy for sand and gravel character (e.g. coarse-to-fine). In this map, a conceptual framework of regional depositional environments (e.g. Anderson and Block, 1962) is combined with sedimentological models of local variability (e.g. Cobb and Fraser, 1981) to gain new insight into the textural variability of the Surficial Aquifer.

Methods and Results

The distribution and thickness the Surficial Aquifer was extracted directly from the 3-D map of McHenry County. Key datasets used to delineate its distribution and thickness were relatively high-density field data (33 testholes and 30 miles of 2-D geophysical profiles) and 3-D visualization of over 20,000 water well and engineering records.

The textural variability of the aquifer was delineated based on previous models of depositional environments (Anderson and Block, 1962; Cobb and Fraser, 1981; Anderson, 1989), which includes regional depositional environments (e.g. outwash plain) and associated local sediment models (e.g. proximal outwash). These models of variability were delineated based on field data and the 3-D geologic map of distribution and thickness, newly aquired (2009) Lidar land surface model and NRCS soil survey parent material texture data (USDA, 1992). NRCS soil survey data describe only the uppermost few feet at most, but the mapped distribution of varying soil-textures is consistent with regional geologic and sedimentologic settings. Thus, the incorporation of these new datasets provided for better geologic insights into the regional and local character of the Surficial Aquifer.

References

Anderson, M.P., 1989, Hydrogeologic facies models to delineate large-scale spatial trends in glacial and glaciofluvial sediments: Geological Society of America Bulletin 101, pp. 501-511.

Anderson, R.C., and D.A. Block, 1962, Sand and gravel resources of McHenry County, Illinois: Illinois State Geological Survey, circular 336, 15 p.

Cobb, J.C., and G.S. Fraser, 1981, Application of sedimentology to development of sand and gravel resources in McHenry and Kane Counties, northeastern Illinois: Illinois State Geological Survey, Illinois Mineral Notes 82, 17 p

Curry, B. Brandon, Richard C. Berg, and Robert C. Vaiden, 1997, Geologic Mapping for EnvironmentalPlanning, McHenry County, Illinois: Illinois State Geological Survey Circular 559, 79 p.

United States Department of Agriculture, 1992, Soil survey of McHenry County, Illinois.

Thickness (ft) of Surficial Aquifer deposits.

Areas where a significant fraction of the Surficial Aquifer is composed of lacustrine sediments (fine sand and sandy silt).

LithofaciesType

Proximal Outwash: Channel and bar deposits of prograding delta or outwash fans with bedded, medium to very coarse sand and gravel with common coarse gravel beds.

Medial Outwash: Channel and bar deposits of bedded, medium sand and gravel with some coarse gravel beds.

Medial Outwash, Till Cap: Channel and bar deposits of bedded, medium to coarse sand and gravel deposits with a consistent cap (~10-20 feet thick) of gravelly-sandy till.

Medial Outwash, Lacustrine Cap; Channel and bar deposits of fine to medium sand and gravel with common gravelly beds with a cap (~10 feet thick) of fine-grained lacustrine deposits.

Distal Outwash: Channel and bar deposits of generally fining-upward sequences of bedded medium-coarse gravel to medium-coarse sand with common beds of fine-medium silty sand. Regionally, approximately the upper 60% of the sequence is composed of the sand facies.

Ice Contact: Surficial deposits of commonly coarse to very coarse gravel in ridges and mounds often marking former ice margins. These areas of topographic ridges are often underlain by thick sequences of bedded fine to medium sand gravel with common gravel beds.

Ice Marginal, Colluvial: Surficial deposits of medium to coarse gravel and or sand/gravel which likely also contain beds of finer-grained colluvial deposits along moraine slopes

Tunnel Valley: Channel deposits interpreted as subglacially derived and composed of often bedded, coarse sand and gravel.

Upland Fluvial: Generally thin channel and floodplain alluvial deposits of fine-medium sand with some gravelly beds.

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from 2008 McHenry County LiDAR.

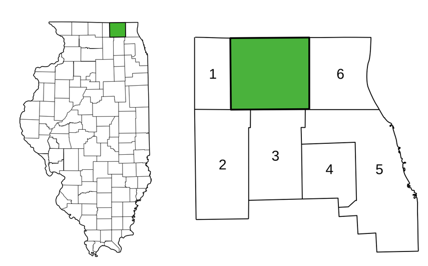
Recommended citation:
Thomason, J.F., 2013, Distribution and Thickness of the Surficial Aquifer, McHenry County, Illinois: State Geological Survey, draft contract map,1:62,500.

SCALE 1:62,500

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETERS

3°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION

Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey.

Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

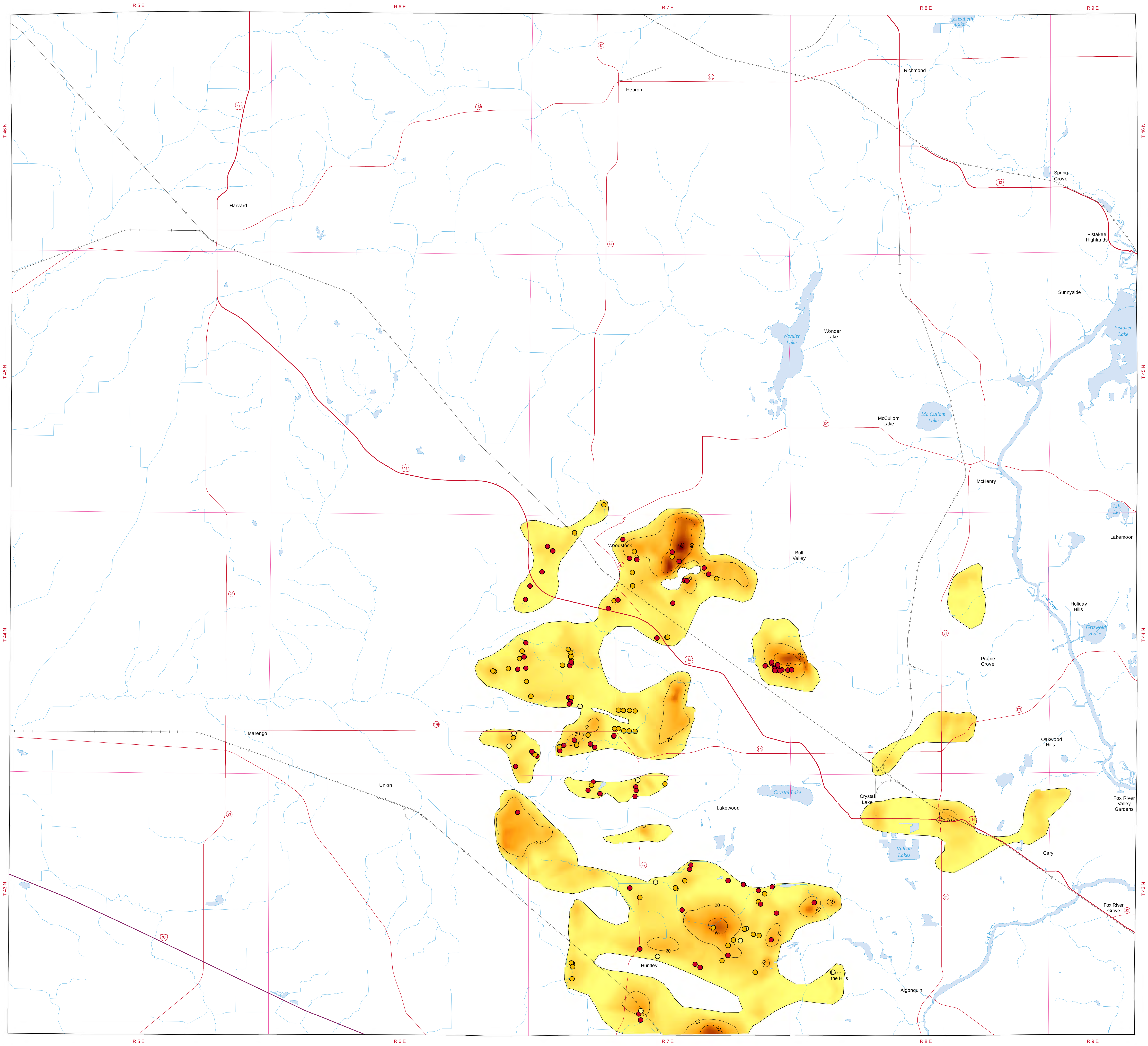
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

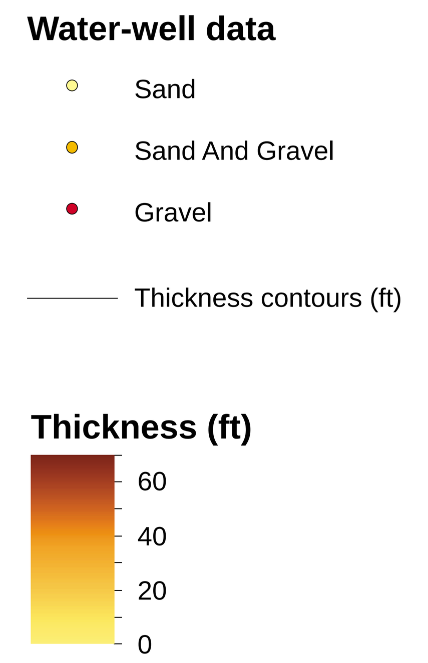
Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Distribution and Thickness of the Yorkville Aquifer
McHenry County, Illinois

Jason F. Thomason
2013

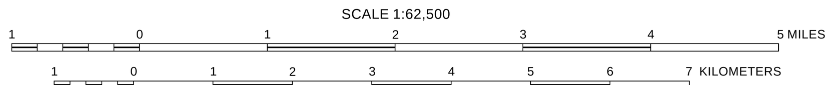


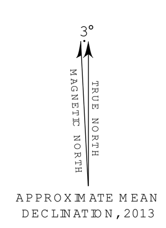


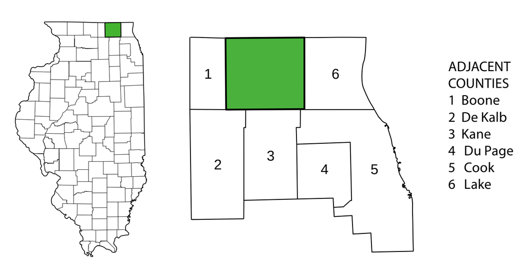
Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Distribution and Thickness of the Yorkville Aquifer, McHenry County, Illinois: State Geological Survey, draft contract map,1:62,500.

SCALE 1:62,500







ROAD CLASSIFICATION

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey.

Digital cartography by J. Carrell, Illinois State Geological Survey.

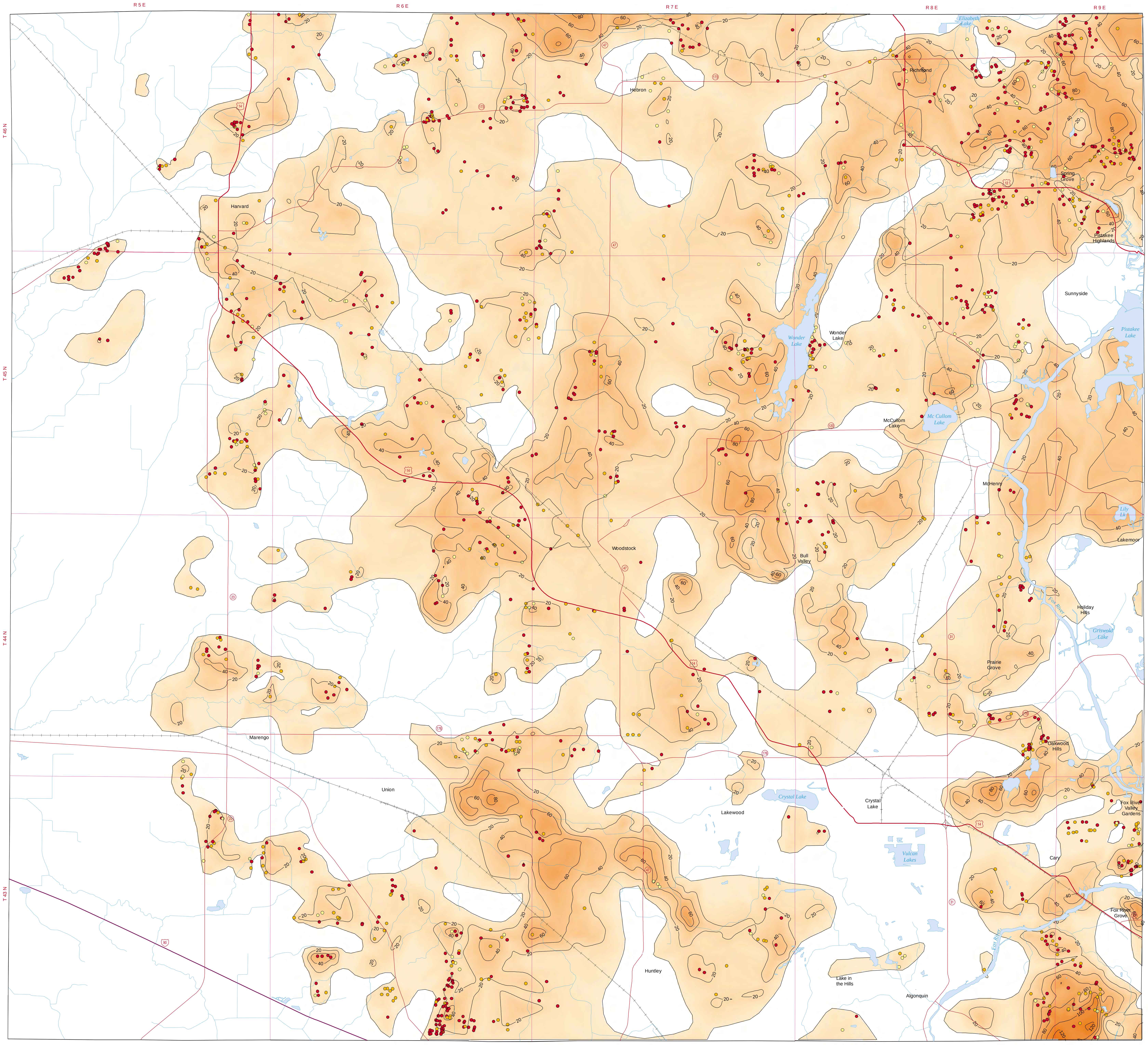
This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

DISTRIBUTION AND THICKNESS OF THE PEARL-ASHMORE AQUIFER
MCHENRY COUNTY, ILLINOIS

Jason F. Thomason
2013



Water-well data

- Sand
- Sand And Gravel
- Gravel
- Thickness contours (ft)

Thickness (ft)

120
80
40
0

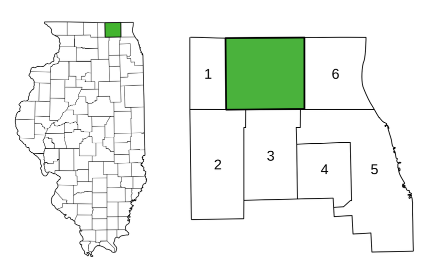
Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Distribution and Thickness of the Pearl-Ashmore Aquifer, McHenry County, Illinois: State Geological Survey, draft contract map,1:62,500.

SCALE 1:62,500
1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 KILOMETERS

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION

Interstate Route	State Route
U.S. Route	Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey.

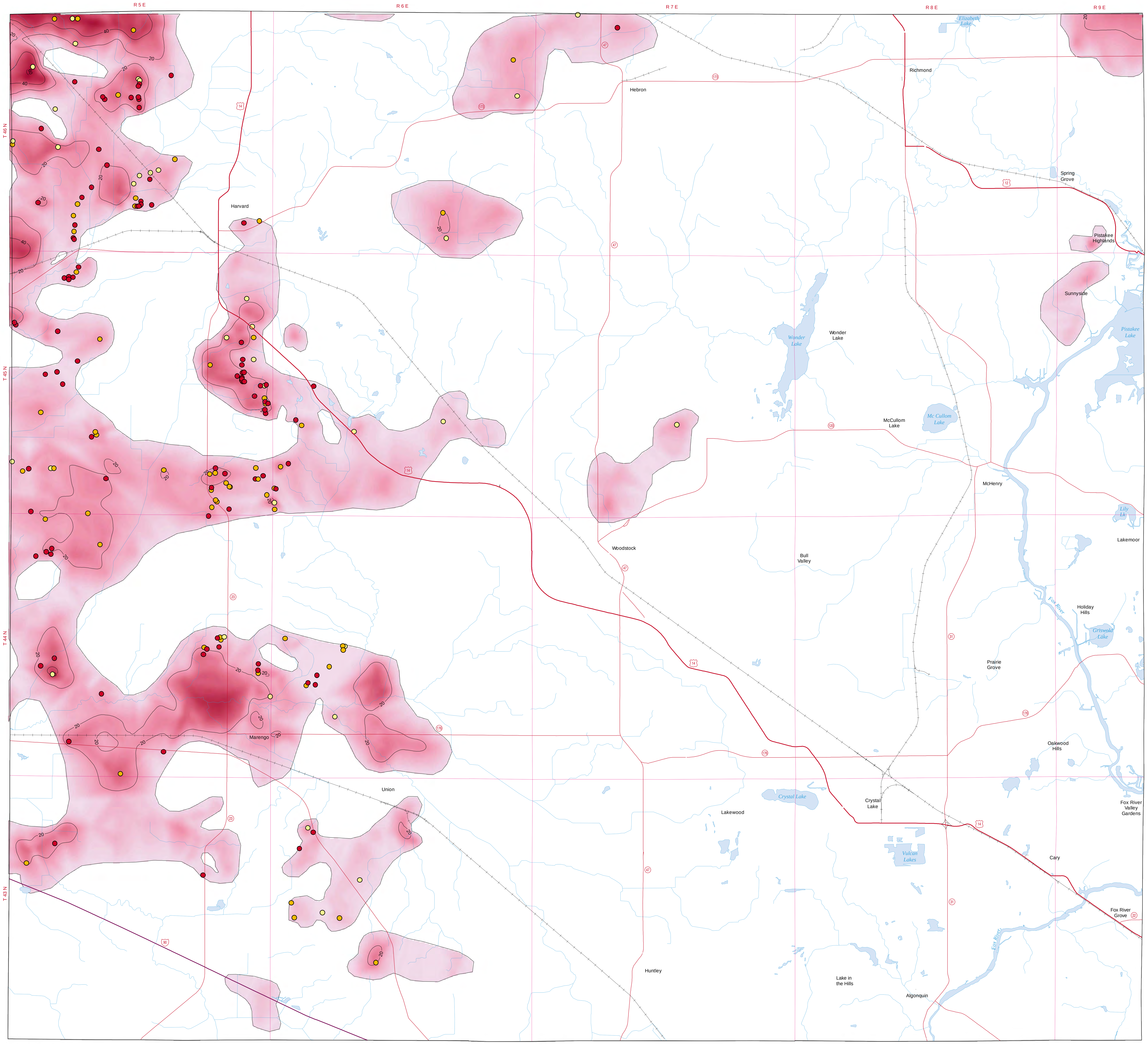
Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Distribution and Thickness of the Glasford Aquifer
McHenry County, Illinois

Jason F. Thomason
2013



Water-well data

- Sand
- Sand And Gravel
- Gravel
- Thickness contours (ft)

Thickness (ft)

60
40
20
0

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

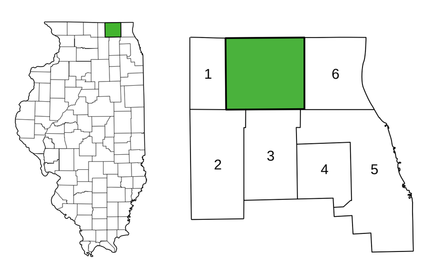
Recommended citation:
Thomason, J.F., 2013, Distribution and Thickness of the Glasford Aquifer, McHenry County, Illinois: State Geological Survey, draft contract map,1:62,500.

SCALE 1:62,500

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETERS

3°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION

Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey.

Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

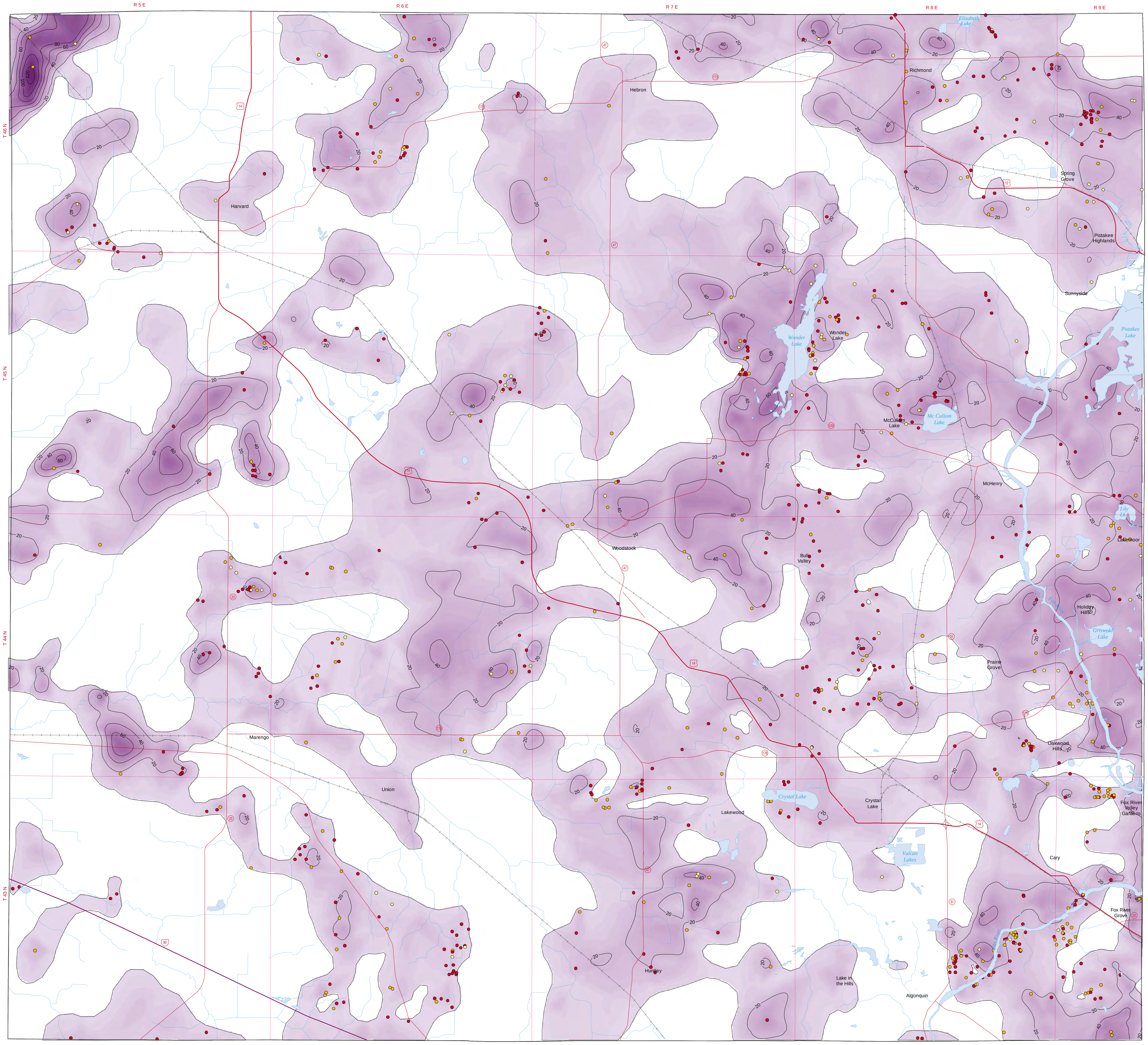
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Distribution and Thickness of the Basal Aquifer
McHenry County, Illinois

Jason F. Thomason
2013



Water-well data

- Sand
- Sand And Gravel
- Gravel
- Thickness contours (ft)

Thickness (ft)

120
80
40
0

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Distribution and Thickness of the Basal Aquifer, McHenry County, Illinois: State Geological Survey, draft contract map,1:62,500.

SCALE 1:62,500

1 0 1 2 3 4 5 MILES

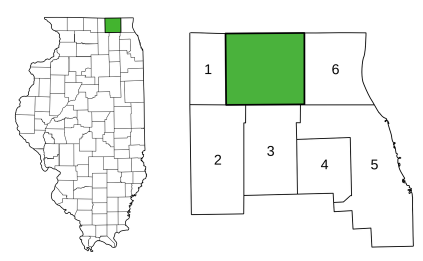
1 0 1 2 3 4 5 6 7 KILOMETERS

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

3°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION

Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey.

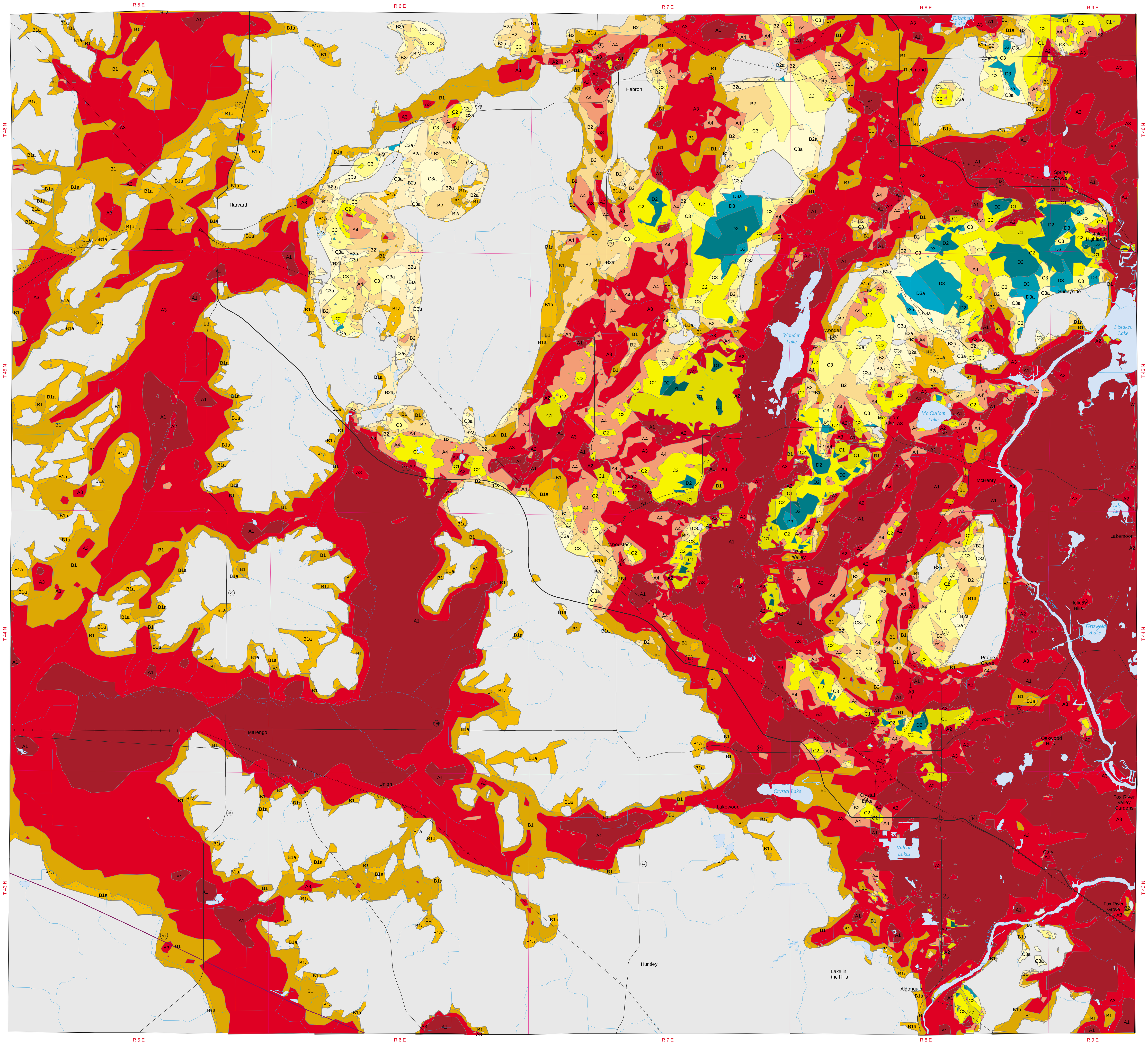
Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Surficial Aquifer Sensitivity Map
McHenry County, Illinois

Jason F. Thomason
2013



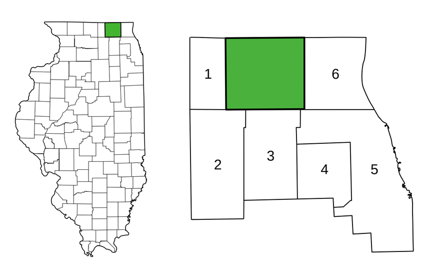
Map Unit	Description
A1	>50 feet thick within 5 feet of the land surface
A2	>50 feet thick between 5 and 20 feet below the land surface
A3	20 to 50 feet thick between within 5 feet of the land surface
A4	20 to 50 feet thick between 5 and 20 feet below the land surface
B1	5 to 20 feet thick within 5 feet of the land surface
B1a	<5 feet thick within 5 feet of the land surface
B2	5 to 20 feet thick between 5 and 20 feet below the land surface
B2a	<5 feet thick between 5 and 20 feet below the land surface
C1	>50 feet thick between 20 and 50 feet below the land surface
C2	20 to 50 feet thick between 20 and 50 feet below the land surface
C3	5 to 20 feet thick between 20 and 50 feet below the land surface
C3a	<5 feet thick between 20 and 50 feet below the land surface
D1	>50 feet thick between 50 and 100 feet below the land surface
D2	20 to 50 feet thick between 50 and 100 feet below the land surface
D3	20 to 50 feet thick between 50 and 100 feet below the land surface
D3a	<5 feet thick between 50 and 100 feet below land surface

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Surficial Aquifer Sensitivity Map, McHenry County, Illinois: State Geological Survey, contract map,1:62,500.

SCALE 1:62,500
1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 KILOMETERS

3°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION
Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey. Aquifer sensitivity analysis modified from Berg 2001.

Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

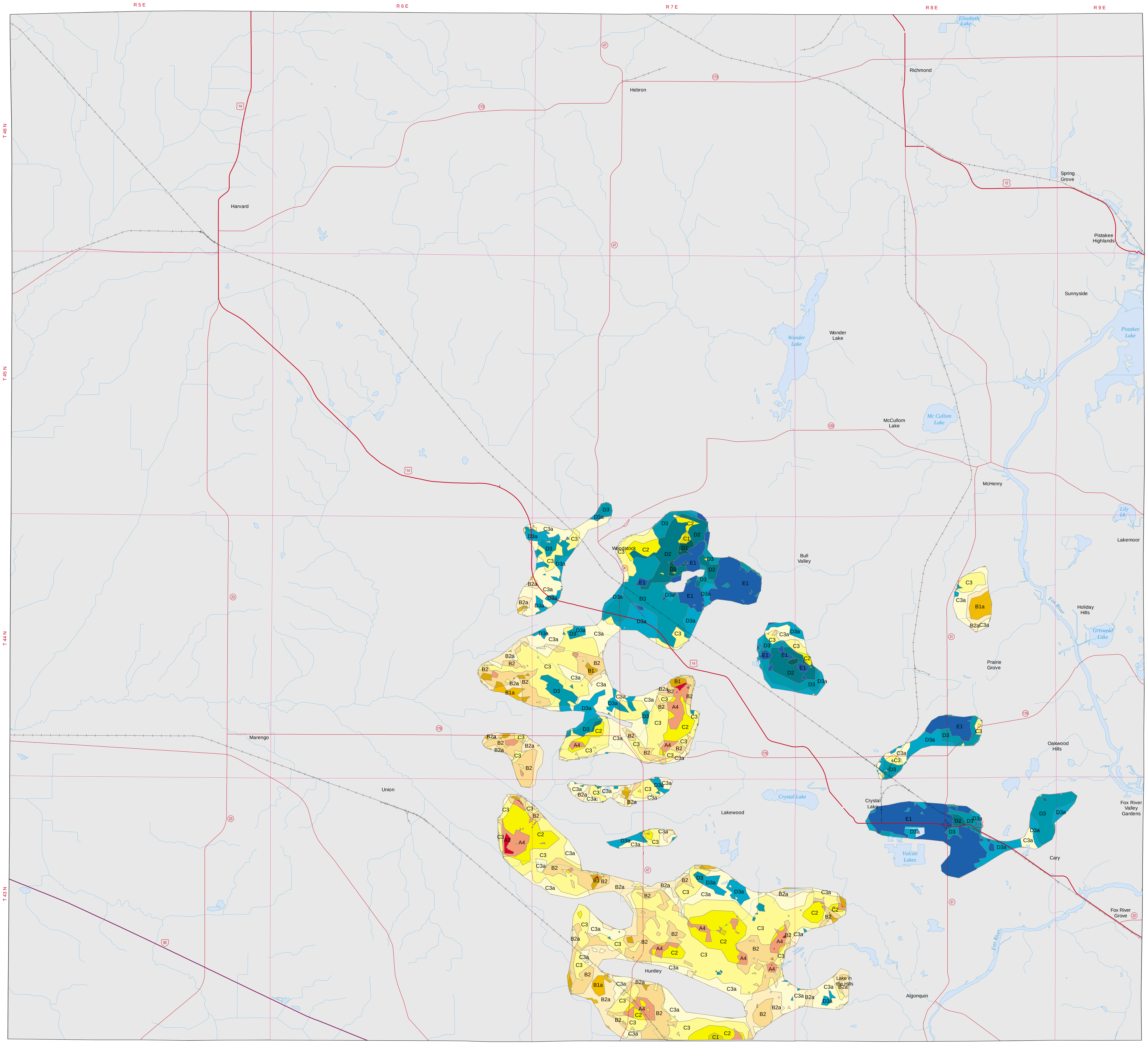
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

YORKVILLE AQUIFER SENSITIVITY MAP
MCHENRY COUNTY, ILLINOIS

Jason F. Thomason
2013



Map Unit / Description

Map Unit	Description
A3	20 to 50 feet thick between within 5 feet of the land surface
A4	20 to 50 feet thick between 5 and 20 feet below the land surface
B1	5 to 20 feet thick within 5 feet of the land surface
B1a	<5 feet thick within 5 feet of the land surface
B2	5 to 20 feet thick between 5 and 20 feet below the land surface
B2a	<5 feet thick between 5 and 20 feet below the land surface
C1	>50 feet thick between 20 and 50 feet below the land surface
C2	20 to 50 feet thick between 20 and 50 feet below the land surface
C3	5 to 20 feet thick between 20 and 50 feet below the land surface
C3a	<5 feet thick between 20 and 50 feet below the land surface
D1	>50 feet thick between 50 and 100 feet below the land surface
D2	20 to 50 feet thick between 50 and 100 feet below the land surface
D3	20 to 50 feet thick between 50 and 100 feet below the land surface
D3a	<5 feet thick between 50 and 100 feet below land surface
E1	>100 feet below the land surface

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Yorkville Aqufer Sensitivity Map, McHenry County, Illinois: State Geological Survey, contract map,1:62,500.

SCALE 1:62,500

1 0 1 2 3 4 5 MILES

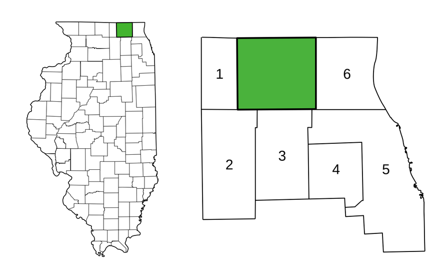
1 0 1 2 3 4 5 6 7 KILOMETERS

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

3°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2013



ROAD CLASSIFICATION

Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey. Aquifer sensitivity analysis modified from Berg 2001.

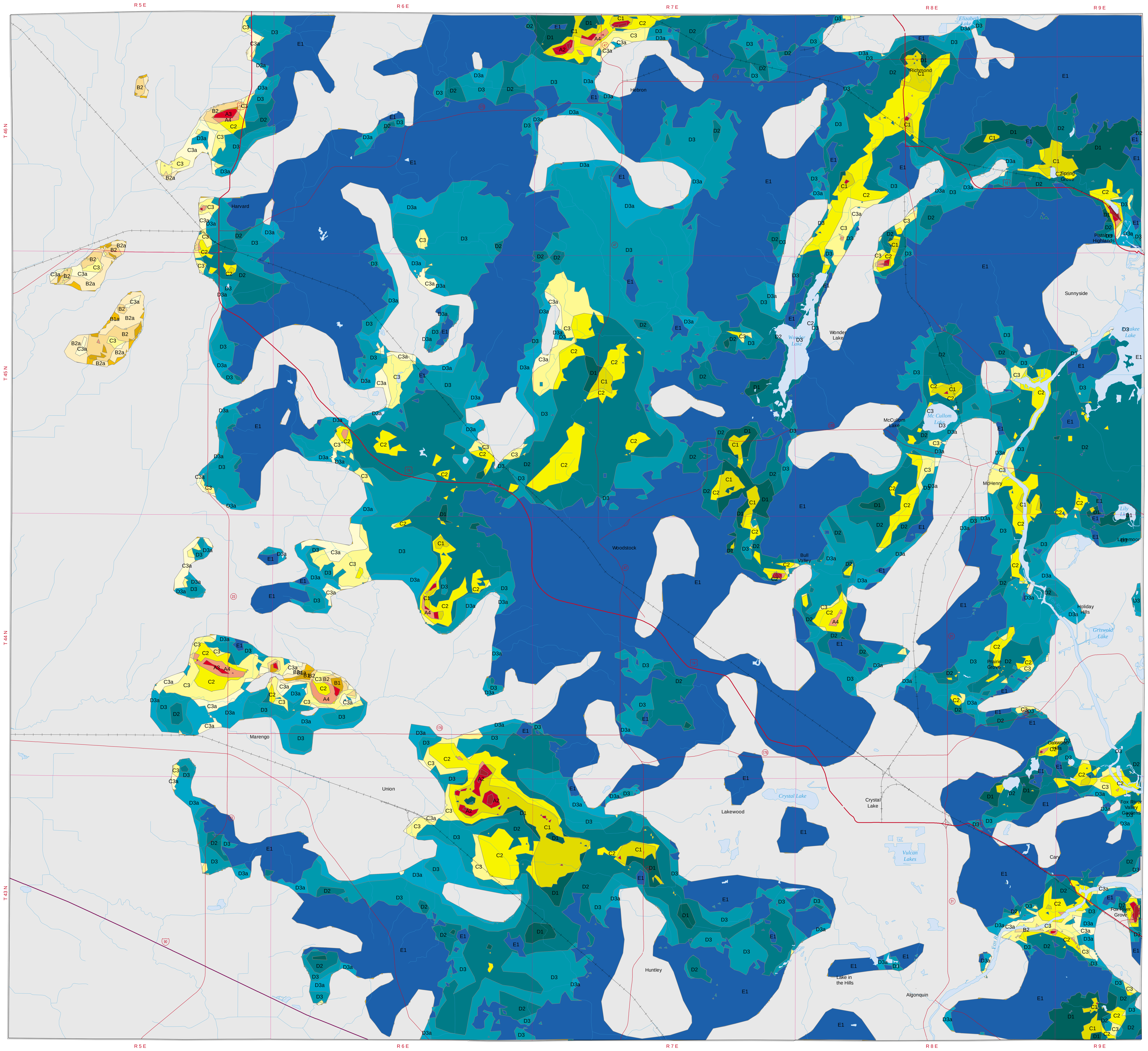
Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Pearl-Ashmore Aquifer Sensitivity Map
McHenry County, Illinois

Jason F. Thomason
2013



Map Unit	Description
A1	>50 feet thick within 5 feet of the land surface
A2	>50 feet thick between 5 and 20 feet below the land surface
A3	20 to 50 feet thick between within 5 feet of the land surface
A4	20 to 50 feet thick between 5 and 20 feet below the land surface
B1	5 to 20 feet thick within 5 feet of the land surface
B1a	<5 feet thick within 5 feet of the land surface
B2	5 to 20 feet thick between 5 and 20 feet below the land surface
B2a	<5 feet thick between 5 and 20 feet below the land surface
C1	>50 feet thick between 20 and 50 feet below the land surface
C2	20 to 50 feet thick between 20 and 50 feet below the land surface
C3	5 to 20 feet thick between 20 and 50 feet below the land surface
C3a	<5 feet thick between 20 and 50 feet below the land surface
D1	>50 feet thick between 50 and 100 feet below the land surface
D2	20 to 50 feet thick between 50 and 100 feet below the land surface
D3	20 to 50 feet thick between 50 and 100 feet below the land surface
D3a	<5 feet thick between 50 and 100 feet below land surface
E1	>100 feet below the land surface

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

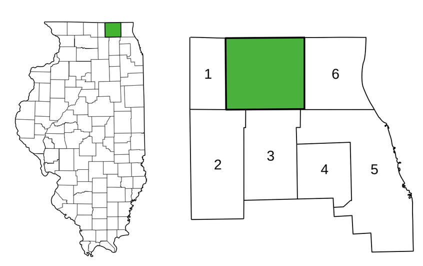
Recommended citation:
Thomason, J.F., 2013, Pearl-Ashmore Aquifer Sensitivity Map, McHenry County, Illinois: State Geological Survey, contract map,1:62,500.

SCALE 1:62,500

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETERS

3°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION

Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey. Aquifer sensitivity analysis modified from Berg 2001.

Digital cartography by J. Carrell, Illinois State Geological Survey.

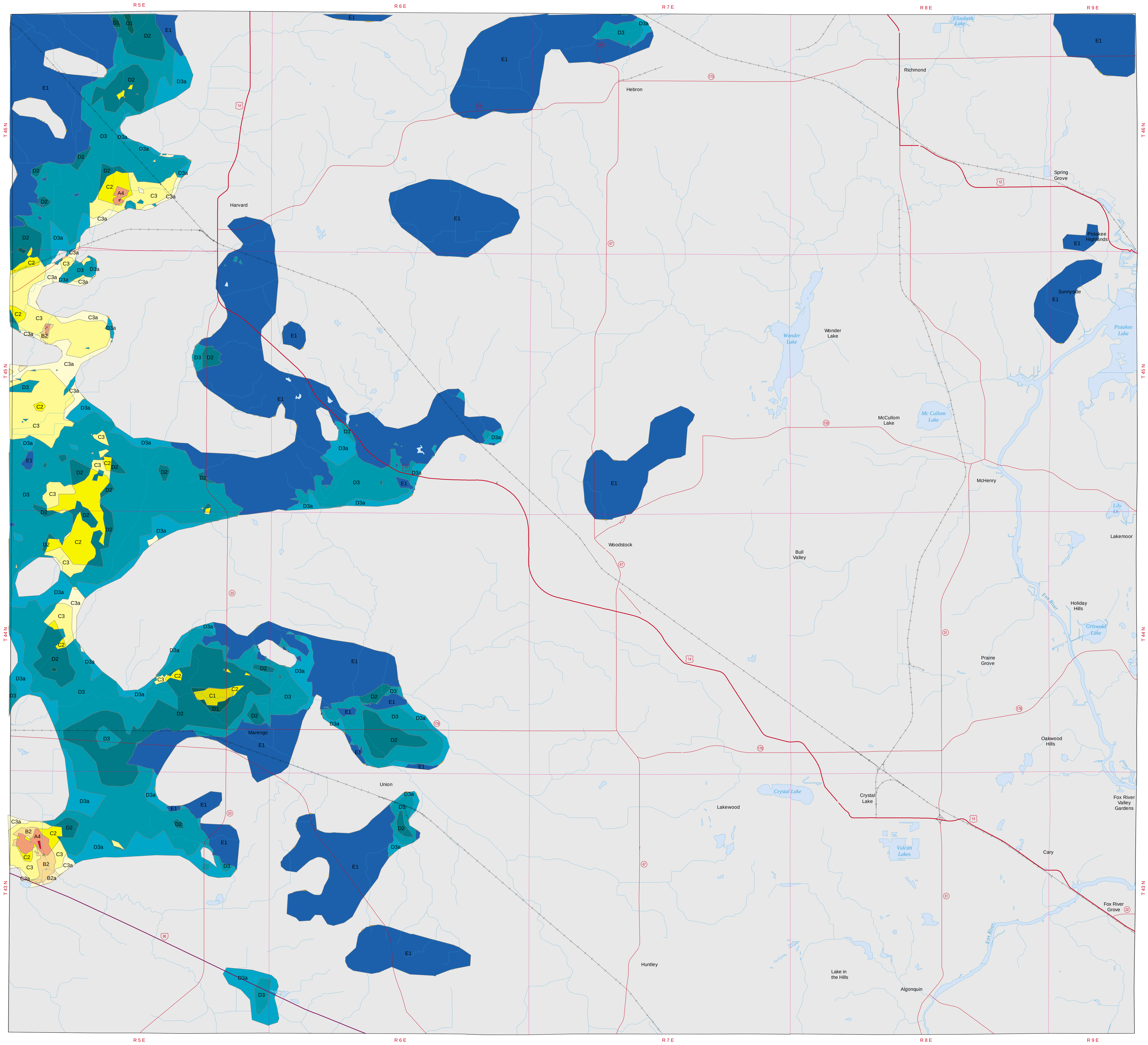
This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

GLASFORD AQUIFER SENSITIVITY MAP
MCHENRY COUNTY, ILLINOIS

Jason F. Thomason
2013



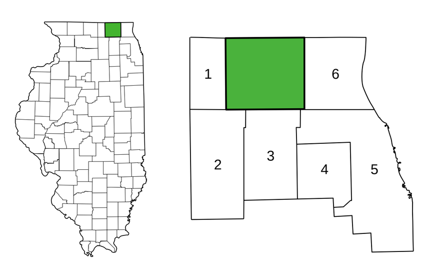
Map Unit	Description
A1	>50 feet thick within 5 feet of the land surface
A3	20 to 50 feet thick between within 5 feet of the land surface
A4	20 to 50 feet thick between 5 and 20 feet below the land surface
B1	5 to 20 feet thick within 5 feet of the land surface
B1a	<5 feet thick within 5 feet of the land surface
B2	5 to 20 feet thick between 5 and 20 feet below the land surface
B2a	<5 feet thick between 5 and 20 feet below the land surface
C1	>50 feet thick between 20 and 50 feet below the land surface
C2	20 to 50 feet thick between 20 and 50 feet below the land surface
C3	5 to 20 feet thick between 20 and 50 feet below the land surface
C3a	<5 feet thick between 20 and 50 feet below the land surface
D1	>50 feet thick between 50 and 100 feet below the land surface
D2	20 to 50 feet thick between 50 and 100 feet below the land surface
D3	20 to 50 feet thick between 50 and 100 feet below the land surface
D3a	<5 feet thick between 50 and 100 feet below land surface
E1	>100 feet below the land surface

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Glasford Aquifer Sensitivity Map, McHenry County, Illinois: State Geological Survey, contract map,1:62,500.

SCALE 1:62,500
1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 KILOMETERS

3°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION

Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey. Aquifer sensitivity analysis modified from Berg 2001.

Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

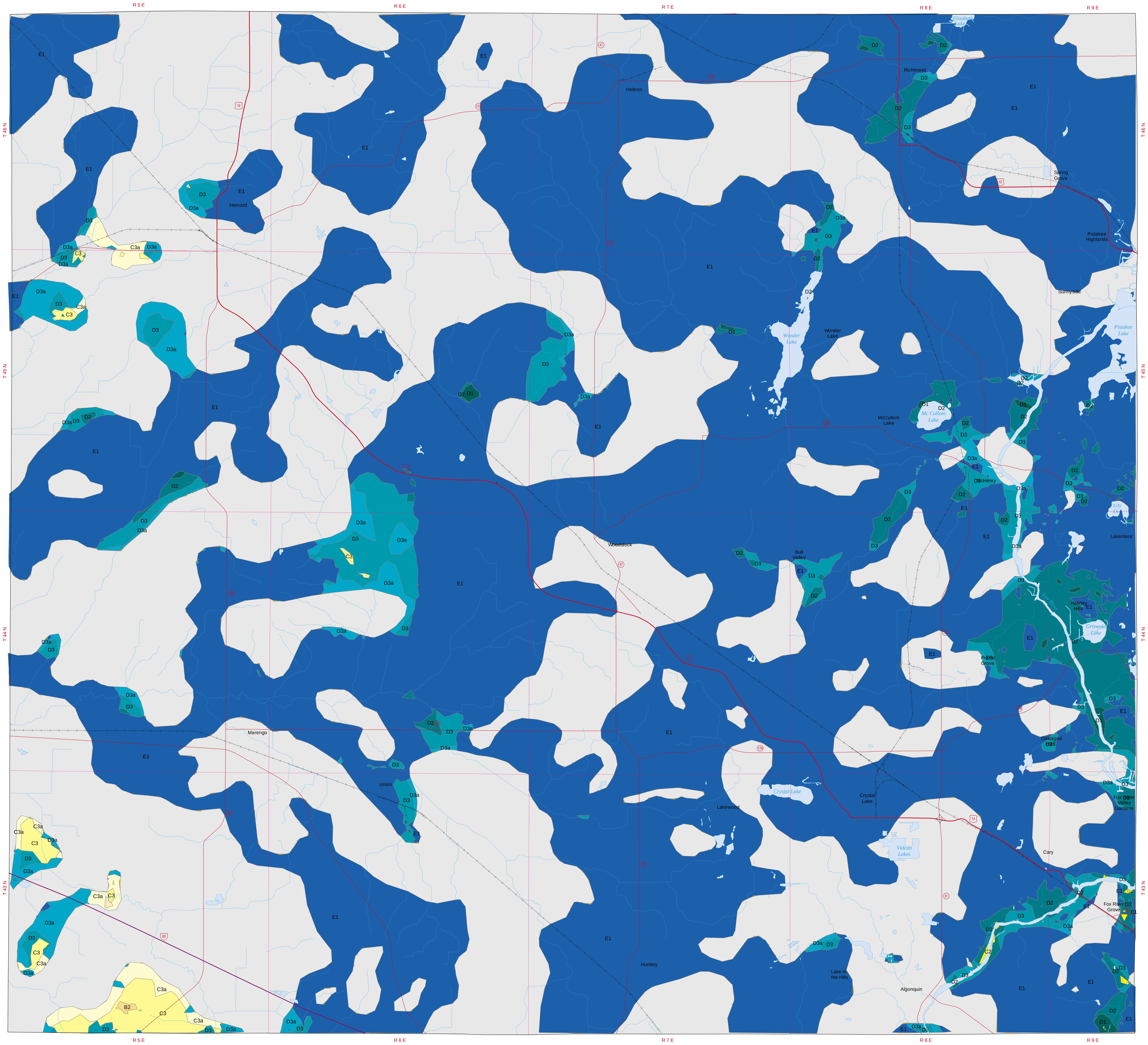
ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Basal Aquifer Sensitivity Map
McHenry County, Illinois

Jason F. Thomason
2013



Map Unit	Description
A1	>50 feet thick within 5 feet of the land surface
A3	20 to 50 feet thick between within 5 feet of the land surface
B1	5 to 20 feet thick within 5 feet of the land surface
B1a	<5 feet thick within 5 feet of the land surface
B2	5 to 20 feet thick between 5 and 20 feet below the land surface
B2a	<5 feet thick between 5 and 20 feet below the land surface
C1	>50 feet thick between 20 and 50 feet below the land surface
C2	20 to 50 feet thick between 20 and 50 feet below the land surface
C3	5 to 20 feet thick between 20 and 50 feet below the land surface
C3a	<5 feet thick between 20 and 50 feet below the land surface
D1	>50 feet thick between 50 and 100 feet below the land surface
D2	20 to 50 feet thick between 50 and 100 feet below the land surface
D3	20 to 50 feet thick between 50 and 100 feet below the land surface
D3a	<5 feet thick between 50 and 100 feet below land surface
E1	>100 feet below the land surface

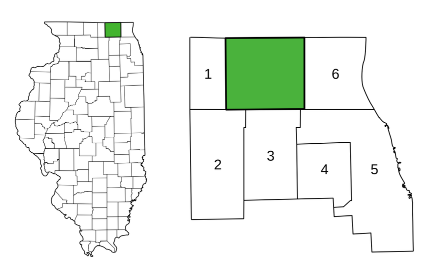
Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Basal Aquifer Sensitivity Map, McHenry County, Illinois: State Geological Survey, contract map,1:62,500.

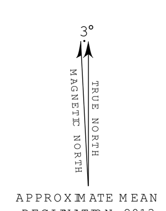
SCALE 1:62,500

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETERS



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake



APPROXIMATE MEAN DECLINATION, 2013

ROAD CLASSIFICATION

Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey. Aquifer sensitivity analysis modified from Berg 2001.

Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

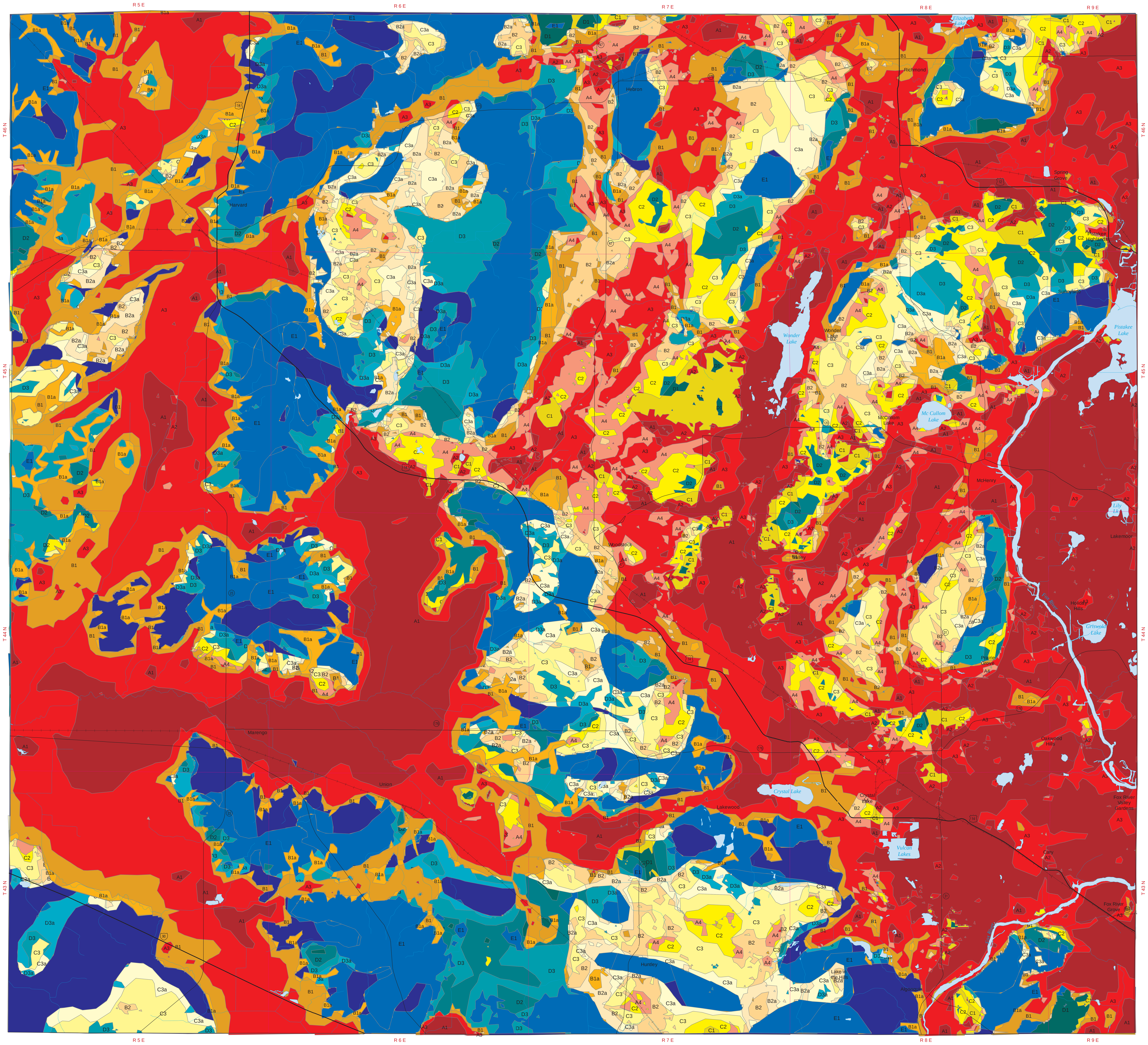
Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

Aquifer Sensitivity Map

Aquifer Sensitivity Map
McHenry County, Illinois

Jason F. Thomason

2013



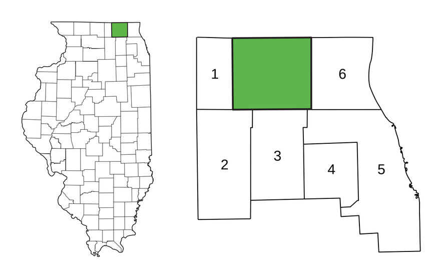
Map Unit	Description
A1	>50 feet thick within 5 feet of the land surface
A2	>50 feet thick between 5 and 20 feet below the land surface
A3	20 to 50 feet thick between within 5 feet of the land surface
A4	20 to 50 feet thick between 5 and 20 feet below the land surface
B1	5 to 20 feet thick within 5 feet of the land surface
B1a	<5 feet thick within 5 feet of the land surface
B2	5 to 20 feet thick between 5 and 20 feet below the land surface
B2a	<5 feet thick between 5 and 20 feet below the land surface
C1	>50 feet thick between 20 and 50 feet below the land surface
C2	20 to 50 feet thick between 20 and 50 feet below the land surface
C3	5 to 20 feet thick between 20 and 50 feet below the land surface
C3a	<5 feet thick between 20 and 50 feet below the land surface
D1	>50 feet thick between 50 and 100 feet below the land surface
D2	20 to 50 feet thick between 50 and 100 feet below the land surface
D3	20 to 50 feet thick between 50 and 100 feet below the land surface
D3a	<5 feet thick between 50 and 100 feet below land surface
E1	>100 feet below the land surface
E1a	generally absent

Base map compiled by Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade from USGS National Elevation Dataset. Transverse Mercator Projection. North American Datum of 1983.

Recommended citation:
Thomason, J.F., 2013, Aquifer Sensitivity Map, McHenry County, Illinois: State Geological Survey, contract map,1:62,500.

SCALE 1:62,500
1 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 6 7 KILOMETERS

3°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2013



ADJACENT COUNTIES
1 Boone
2 De Kalb
3 Kane
4 Du Page
5 Cook
6 Lake

ROAD CLASSIFICATION
Interstate Route
U.S. Route
State Route
Other paved roads

Geology based on field work and data compilation by J. Thomason, Illinois State Geological Survey. Aquifer sensitivity analysis modified from Berg 2001.

Digital cartography by J. Carrell, Illinois State Geological Survey.

This geologic map was funded in part by the County of McHenry and USGS National Cooperative Geologic Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

The Illinois State Geological Survey and the University of Illinois make no guarantee, expressed or implied, regarding the correctness of the interpretations presented in this document and accept no liability for the consequences of decisions made by others on the basis of the information presented here. The geologic interpretations are based on data that may vary with respect to accuracy of geographic location, the type and quantity of data available at each location, and the scientific and technical qualifications of the data sources. Maps or cross sections in this document are not meant to be enlarged.

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE
ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu