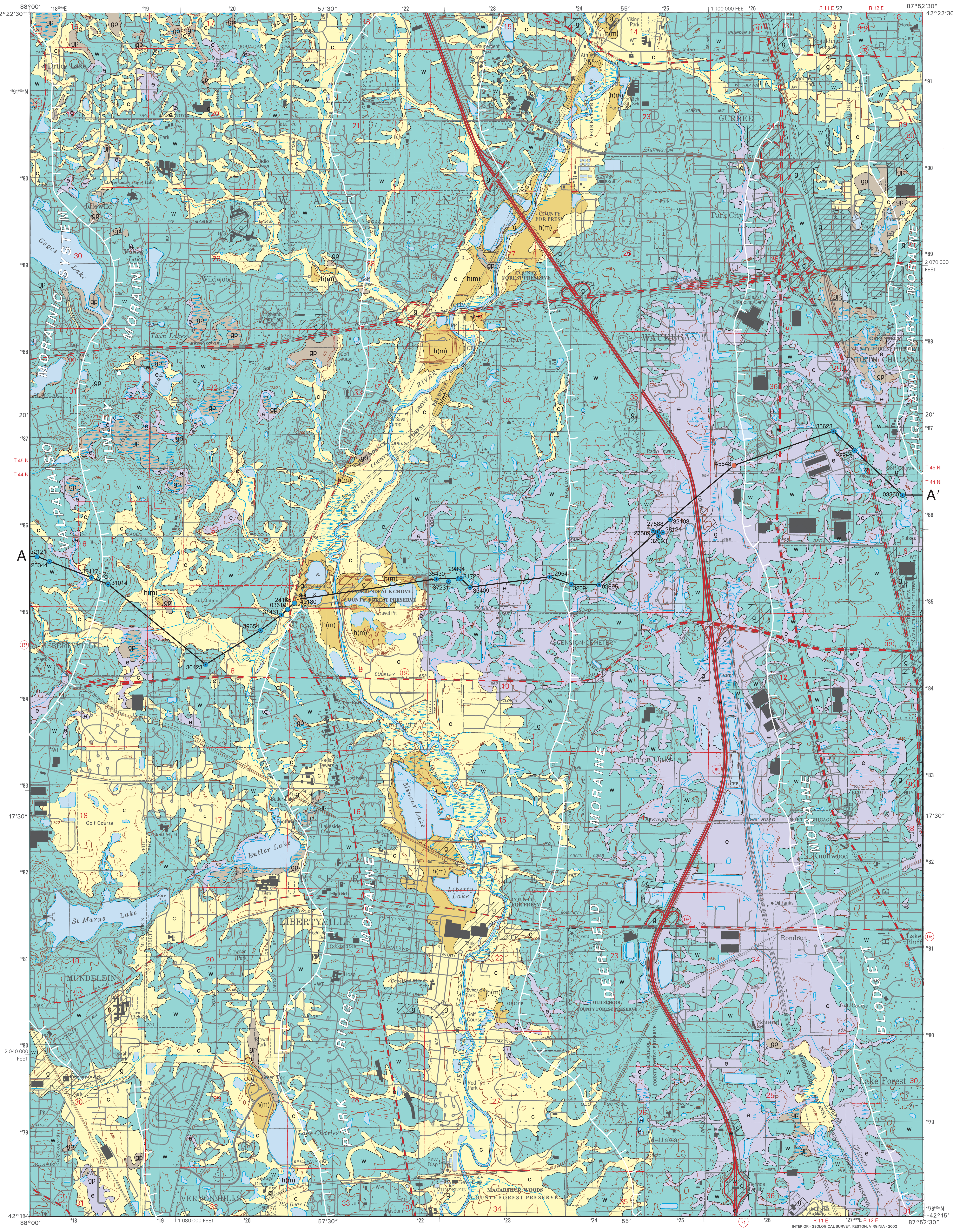
Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

SURFICIAL GEOLOGY OF LIBERTYVILLE QUADRANGLE

LAKE COUNTY, ILLINOIS

Illinois Preliminary Geologic Map
IPGM Libertyville-SG

Michael L. Barnhardt
2005



QUATERNARY DEPOSITS

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

Description	Unit	Interpretation
Fill, compacted land, or other disturbed material; highly variable in grain size (may range from clay to gravel), and may contain construction and mining debris. Typical thickness: variable	Disturbed ground (present over underlying unit) dg	**Human-disturbed deposits** modified during construction of buildings, roads, and landfills; includes excavations in gravel pits and quarries
Silt and clay; occasional sand lenses; trace gravel; stratified; brown to yellowish brown; loose to compact; may be mottled and gleyed; some bedding; organic-rich in places. Typical thickness: 1 to 20 feet	Cahokia Formation (floodplain deposits) c	**Postglacial (modern) stream sediments** deposited on active floodplains; derived mainly from eroded loess and diamicton; overlies outwash sand and gravel along Des Plaines River; may overlie or interfinger with lacustrine silt and clay; includes silty slopewash deposits along footslope and minor drainageways on moraines
Peat, muck, marl, and organic-rich sediment; may contain interbeds of silt, clay, and very fine to fine sand; black to dark brown; sediment may be gleyed and mottled; soft to firm; snail shells common. Typical thickness: 1 to 10 feet	Grayslake Peat gp	**Organic-rich sediments** accumulated in low-lying depressions, drainageways, and on floodplains; may include small areas of open water; locally intertongued with modern alluvium, or lake sediment; commonly found around lakes and marshes and channels connecting bodies of water

WISCONSIN EPISODE (Late) (~25,000 years - 12,000 B.P.)

Description	Unit	Interpretation
Silt and clay; massive to bedded; dark gray to light gray; calcareous; soft to hard; compact; may be sticky and plastic; very fine and fine sand common along bedding planes; occasional inclusions and lenses of light gray to white silt; some wood fragments; very few clasts; generally abrupt upper and lower contacts. Typical thickness: 5 to 25 feet	Equality Formation e	**Postglacial and proglacial lake deposits** that infill low-lying areas, or depressions in drainage channels and where water was impounded along the fronts of moraines, such as between the Deerfield and Blodgett Moraines; at the surface, these sediments may interfinger or be overlain by alluvium
Sand and gravel; stratified; occasionally massive; yellowish to grayish brown; calcareous; loose; sand is very fine to very coarse, very well to poorly sorted; gravel is very fine to coarse, very well to very poorly sorted; trace to little amounts of silt and clay, frequently as thin beds. Typical thickness: 5 to 120 feet	Henry Formation (Mackinaw facies) h(m)	**Proglacial fluvial (outwash) sediments** exposed along the Des Plaines River floodplain and as terraces above present stream level; deposited as a valley train by meltwater along the glacier terminus
Diamicton; silty clay loam to silty clay; dark gray to yellowish brown; massive; calcareous; compact; firm to very hard; pebbly with occasional cobbles and boulders; commonly contains silt and sand inclusions and sand and/or gravel lenses; may contain pebble-free, silty and clayey zones with strongly expressed laminations that may be interbedded with the diamicton; lenses of saturated silt and very fine sand are not cohesive. Typical thickness: 50 to 200 feet	Wadsworth Formation w	**Subglacial and ice-marginal sediments (till)** deposited from Wadsworth glacial ice; sediment that melted out on top of the glacier or along the ice margin was reworked by slope processes and water; laminated sequences may be more than 40 feet thick, but their areal extent is irregular and difficult to delineate
Sand and gravel; massive or stratified; light yellowish brown to grayish brown; calcareous; sand is typically fine-grained with trace fine gravel; contains some silt beds; moderately well sorted; sometimes water-bearing. Typical thickness: 3 to 60 feet	Henry Formation unnamed tongue (cross section only) h-u	**Proglacial fluvial (outwash) sediments** deposited in front of advancing Wadsworth glacial ice; individual beds are irregular and discontinuous; more frequent near moraine fronts
Diamicton; commonly very cobbly sandy loam to silty loam but quite variable; beds of sand, silt, and clay; yellowish brown to brown; calcareous; hard. Typical thickness: 10 to 50 feet	Haeger Member, Lemont Formation (cross section only) l-h	**Subglacial and ice-marginal sediment** (till and reworked sediment) deposited during the advance of Haeger glacial ice; often difficult to distinguish from adjacent outwash of the Henry Formation; locally eroded
Diamicton; pebbly loam to clay loam; light reddish brown to dark gray; calcareous; hard to extremely hard; some cobbles and boulders; contains discontinuous beds of stratified sand, silt, or clay. Typical thickness: 5 to 45 feet	Tiskilwa Formation (cross section only) t	**Subglacial and ice-marginal sediments** (till and reworked sediment) deposited from Tiskilwa glacial ice; discontinuous unit in the subsurface; where present, it lies either directly on bedrock or older sediments

PRE-WISCONSIN EPISODE (Late) (~>25,000 years B.P.)

Description	Unit	Interpretation
Sand, gravel, diamicton, and silt; pebbly to cobbly sandy loam to silty clay loam; light reddish brown to grayish brown; calcareous; composite unit quite variable in texture and character; compact; hard to extremely hard; silt is massive to crudely stratified with some pebbles; sand and gravel is mostly composed of dolomite clasts with some igneous pebbles and cobbles. Typical thickness: 5 to 25 feet	Older sediment undifferentiated (cross section only) os	**Stratified glacial lake sediments, older diamicton and outwash, and weathered bedrock** widespread, but variable thickness and texture makes it difficult to differentiate sediment type using drillers' descriptions

PRE-QUATERNARY DEPOSITS

SILURIAN PERIOD (~443 to 416 million years B.P.)

Description	Unit	Interpretation
Rock; predominantly dolomite overlain locally by shale; upper surface is commonly fractured with crevices and solution cavities; some oil staining	Bedrock (cross section only)	**Bedrock** buried by ~140 to 250 feet of Quaternary sediments

Data Type

49180 Stratigraphic boring (ISGS)
32121 Water well
45848 Engineering boring
SG Boring with samples (S) or geophysical log (G); dot indicates to bedrock.

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

Contact
Moraine leading edge
A—A′ Line of cross section

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography compiled 1988. Planimetry derived from imagery taken 1998 and other sources. Public Land Survey System and survey control current as of 1991. Boundaries current as of 2002.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, east zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

Recommended citation:
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SCALE 1:24 000
1 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

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

Released by the authority of the State of Illinois: 2005

Geology based on field work by M. Barnhardt, 2004–2005.

Digital cartography by J. Carrell and M. Jefferson, Illinois State Geological Survey.

This Illinois Preliminary Geologic Map (IPGM) is a lightly edited product, subject to less scientific and cartographic review than our Illinois Geological Quadrangle (IGQ) series. It will not necessarily correspond to the format of IGQ series maps, or to those of other IPGM series maps. Whether or when this map will be upgraded depends on the resources and priorities of the ISGS.

ILLINOIS
DEPARTMENT OF NATURAL RESOURCES

1905-2005 ISGS Illinois State Geological Survey

For more information contact:
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.uiuc.edu

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ADJOINING QUADRANGLES
1 Antioch
2 Wadsworth
3 Zion
4 Grayslake
5 Waukegan
6 Lake Zurich
7 Wheeling
8 Highland Park

APPROXIMATE MEAN DECLINATION, 2005

ROAD CLASSIFICATION

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route
U.S. Route
State Route

Introduction

Most of the counties in northeastern Illinois are among the most rapidly growing areas of population in the state and some communities are among the most rapidly growing in the country. Although some of this region draws the majority of its drinking water from Lake Michigan, a significant portion, including most of the rapidly-growing areas, relies upon groundwater from Quaternary sand and gravel deposits or from shallow bedrock. The Illinois State Geological Survey (ISGS) has implemented a mapping program to develop three-dimensional maps of the glacial geology from land surface to the top of bedrock. The thickness of glacial sediments in Lake County ranges from about 120 to 350 feet.

Funding for mapping the surficial geology of the Libertyville Quadrangle was provided in part by a grant from the USGS National Cooperative Geologic Mapping Program (STATEMAP). These funds were used to develop the detailed map of the surficial geology, the cross section, and the extensive database that is required to accomplish the planned three-dimensional mapping, which will be funded by a separate cooperative agreement with the USGS Central Great Lakes Geologic Mapping Coalition (CGLGMC) and additional funding from the General Revenue Fund of the State of Illinois. Map and digital products that will be developed include three-dimensional models of the material (sediment) and aquifer-bearing units, and maps of the surficial geology, aquifer conductivity, aquifer sensitivity, recharge, aquifer geometry, and susceptibility to contamination. These maps and products can be used by county and municipal agencies and the public for a variety of projects including water utilization, land use, transportation network planning, and open space and environmental issues.

Regional Setting

The Quaternary geology of the Libertyville Quadrangle is predominantly the result of continental glaciers and glacial meltwaters of the last (Wisconsin Episode) glaciation. The Quaternary deposits, which are about 120 to 270 feet thick, represent at least three major glacial events that occurred between about 25,000 and 14,000 radiocarbon years before present. Lithologically distinct till units (classified as the Tiskilwa, Lemont (Haeger Member), and Wadsworth Formations) were deposited by the Lake Michigan lobe during these events (fig. 1). The majority of the diamicton found on this quadrangle is Wadsworth till and it comprises much of the volume of each of the distinct moraines that occurs on the quadrangle (fig. 2 and cross section). Locally, glacial meltwater and lake deposits are present within and between the tills of the three events and are

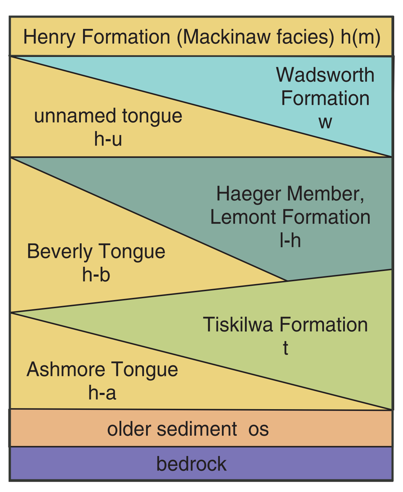

Figure 1 Intertonguing between Henry Formation outwash (gold) and Wisconsin episode till units (green). After Hansel and Johnson 1996.

classified as tongues of the Henry and Equality Formations, respectively (Hansel and Johnson 1996). In addition, an undifferentiated (early Wisconsin or older in age) and highly variable unit composed either of sand and gravel, silt, diamicton (older drift?), and/or weathered bedrock directly overlies bedrock throughout much of the quadrangle (see cross section, os).

Tiskilwa diamicton occurs sporadically in the subsurface across the quadrangle (see cross section, t). It commonly displays a distinctive reddish-brown color and loamy texture but may include thick beds of pebble-free clay and silt, most likely deposited in a lacustrine environment. The Haeger till also is found infrequently in this area (see cross section, l-h). In some places it may exhibit a reddish color where the glacier incorporated Tiskilwa diamicton and redeposited it. The upper surfaces of these units, as well as the undifferentiated unit, are interpreted to be erosion surfaces.

The Wadsworth diamicton, the only till exposed at land surface in the Libertyville Quadrangle, is predominantly a dark grayish brown, silty clay to silty clay loam diamicton (a massive to poorly sorted mixture of clay, silt, sand, and gravel), but it also contains lenses and thick beds of sorted sediment, especially silty clay, silt, and fine sand. Near a moraine front, the Wadsworth diamicton exhibits a coarser texture and an increase in the number and thickness of lenses and beds of sand and/or gravel (see cross section, w and h-u). The more uniform diamicton likely was deposited subglacially, whereas the more variable (bedded and coarser) diamicton may represent material that melted out near the ice margin or on top of the glacier and was reworked by slope processes and water.

As the Wadsworth ice was generally melting back toward the Lake Michigan basin, several moraines formed at ice margins (see cross section A–A′ and figures 2 and 3). Locally, along the western margin of the quadrangle, segments of the Valparaiso Morainic System are present. This moraine forms a hummocky, upland surface west of the Libertyville Quadrangle. Immediately to the east of the Valparaiso Morainic System lies the Tinley Moraine. The Tinley Moraine represents a readvance of the ice margin based on the presence of proglacial sorted sediment (outwash sand and gravel), and laminated silt and clay (lake sediment) regionally found between the Wadsworth till of the Tinley Moraine and Wadsworth

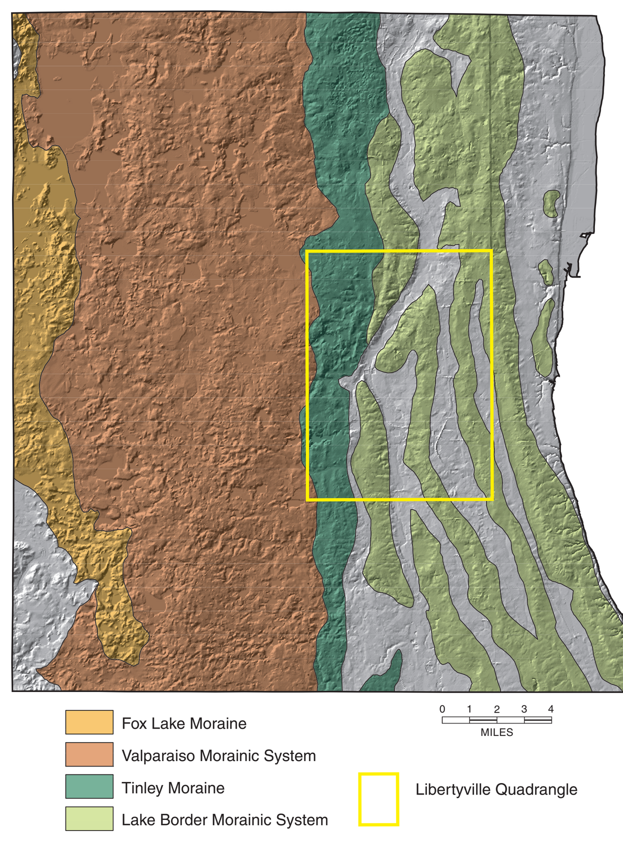

Figure 2 Surface topography and moraines of Lake County. After Willman and Frye 1970; Willman and Lineback 1970; Surface topography after Luman et al., 2003.

till in the subsurface (on cross section see Tinley Moraine segment, h-u). North-south trending ridges of the Lake Border Morainic System are present in the central and eastern part of the quadrangle. These moraines likely formed during short-lived readvances or still-stands of the retreating glacier. In the central part of the quadrangle, the Lake Border moraines (Park Ridge, Deerfield, Blodgett) are bisected by the Des Plaines River and its tributaries (Willman and Lineback 1970, Willman 1971). South of the Libertyville Quadrangle, the Des Plaines River carried glacial meltwater between the Tinley and Lake Border moraines toward glacial Lake Chicago, which had an outlet through the Tinley and Valparaiso moraines west of Chicago.

The Wadsworth Formation ranges from about 100 to 220 feet in thickness, with the thicker accumulations occurring near moraine fronts. Along the Des Plaines River and its tributaries, the Wadsworth Formation is overlain by outwash (Henry Formation) and modern stream sediment (Cahokia Formation). Locally, fine-grained lake sediment (Equality Formation) and muck or peat (Grayslake Peat) occurs in depressions in both upland and floodplain locations. An extensive area of lake sediment occurs between the Deerfield and Blodgett moraines and probably represents an area where meltwater was impounded during the formation of the Blodgett Moraine (figures 3, 4, and 5).

Mapping Techniques

The map of surficial geology is based largely on digitized soils maps (scale 1:15,840) from the Soil Survey of Lake County, Illinois (Paschke and Alexander 1970, USDA 2004). Initially, individual soil series were grouped by their parent material following 1) the classification key in Soils of Illinois (Fehrenbacher et al. 1984), 2) profile descriptions in the survey report, 3) NRCS field notes, 4) discussions with NRCS soil mappers, and 5) updated individual Soil Series Description sheets acquired either directly from the USDA-NRCS or downloaded from their web site. These parent material classes then were grouped into more general geologic material classes comprising the mapping units used for this map, following Hansel and Johnson (1996) and Willman and Frye (1970).

The parent material (geologic material) classes were generalized for the surficial geology map because the soil-based data layer created a very complex map with polygons that were too small for incorporation into cross sections. It is assumed the thickness of each surficial unit is at least 6 to 10 feet or more based upon the depth to which soil mappers sample during their mapping. The thickness of specific units was adjusted where our drilling, field observations, or records suggested otherwise. Selected soil series, or in some cases individual polygons in various soil series, were regrouped into different geologic material classes following extensive fieldwork and data analysis for the Libertyville and the adjacent Wadsworth, Grayslake, and Antioch quadrangles (Barnhardt et al. 2001, Stumpf 2004, Hansel 2005). The sediment at land surface (parent material for the soils) was examined and associated with its geomorphic (landscape) position to develop a sediment-landscape model. This model was used to interpret the sediment description for every water well, stratigraphic, or engineering boring used in the mapping.

Two boreholes were drilled to bedrock and continuously sampled using the ISGS drill rig to acquire high quality samples. Natural gamma logs were collected for each and a monitoring well was installed in one where sand and gravel was encountered. The cores from these two boreholes were described in detail and compared to their gamma logs to better understand and interpret the descriptive records from adjacent water wells. Geologic information for subsurface units depicted on the cross section was obtained from core descriptions for the above-mentioned boreholes and several dozen sample sets obtained from water wells and engineering boreholes, which are available in databases at the ISGS. Of a total of 2715 water well and engineering boreholes located on the quadrangle, the locations of 1897 were verified to tax parcel size and repositioned as needed (fig. 6). The quality of the geologic information was evaluated as individual boreholes were selected for developing and validating the surficial geology map and cross section. The legend of map units provides additional discussion on the variability of sediments and their occurrence on the landscape.

Acknowledgments

Funding for this project was provided in part through a contract grant from the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS contract number 04HQAG0046 (STATEMAP), a cooperative agreement with the U.S. Geological Survey, 04ERAG0052 (Central Great Lakes Geologic Mapping Program), and the General Revenue Fund from the State of Illinois. The views and conclusions in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government or the State of Illinois. This map is based on the most reliable information available at the time mapping was completed. However, because of project objectives and the scale of the map, interpretations from it should not preclude more detailed site investigations specific to any other project.

Many individuals assisted in this project by providing information and services including field assistance and drilling support, database management and development, data entry, cartographic and graphic production, technical review, and discussions on geology. ISGS staff A. Hansel and A. Stumpf (geology), V. Amacher and B. Stiff (data entry/database/GIS), J. Aud, J. Hutmacher, S. Wildman, and C. Wilson (drilling), J. Domier and J. Carrell (cartography/graphics), C. Stohr (borehole logging), D. Luman (imagery), and undergraduate intern, M. Jefferson (GIS, database development) provided invaluable assistance to the author. Several Lake County departments provided assistance and information: the Department of Information and Technology, GIS and Mapping Division provided updates for various GIS layers, the Forest Preserve District provided access to their property and permission for drilling and monitoring well installation, and the Public Works Department provided easy access to water for drilling.

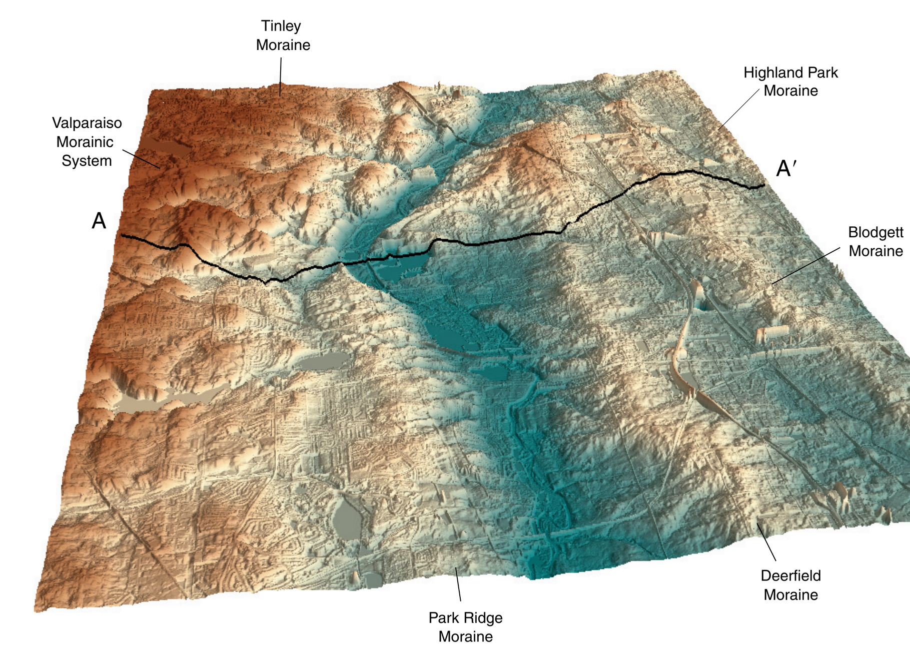

Figure 3 Surface topography of Libertyville Quadrangle with cross section A–A′. Digital elevation model generated from 2-foot resolution LIDAR, courtesy Lake County, Illinois GIS (2004).

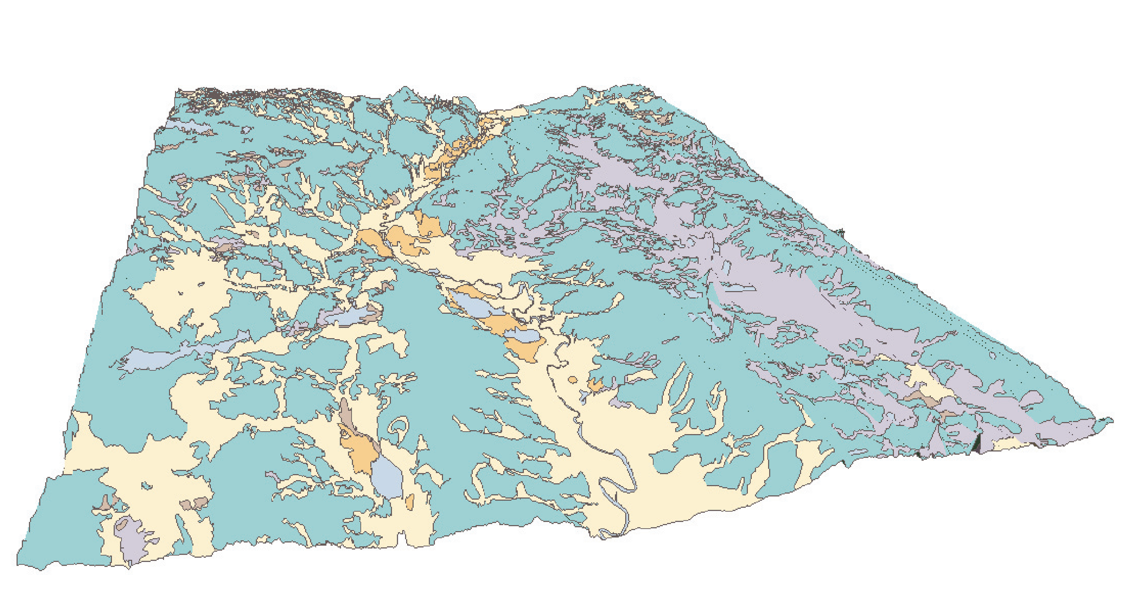

Figure 4 Surficial geology over topography of Libertyville Quadrangle.

Figure 5 Land cover over topography of Libertyville Quadrangle.

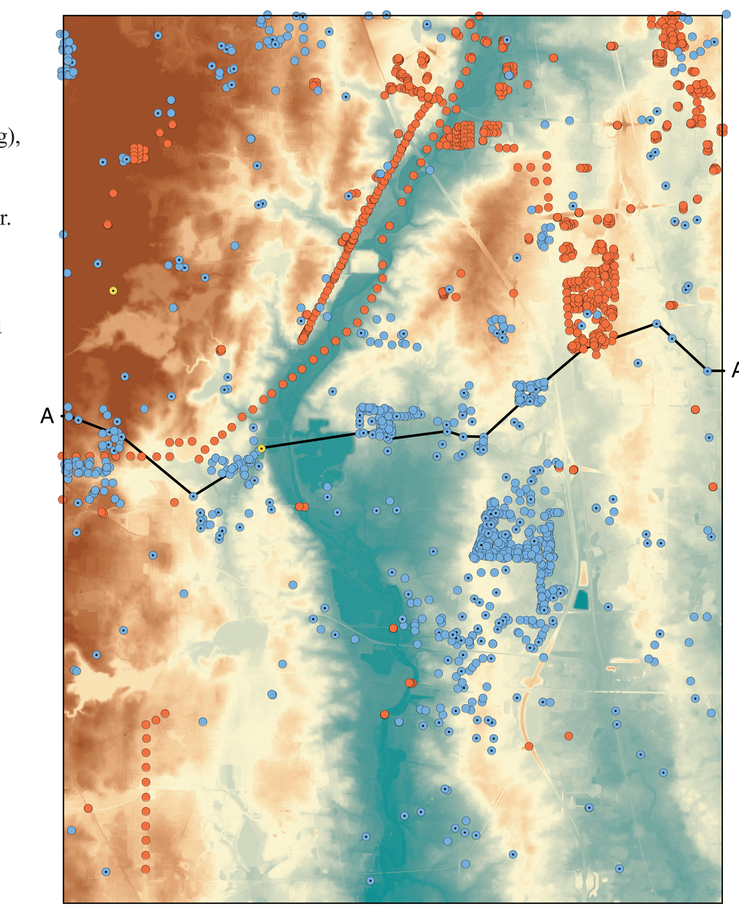

Figure 6 Locations of boreholes and cross section. Red circles are engineering boreholes; blue are water wells; and yellow are stratigraphic. Black dot in circle indicates borehole penetrated bedrock.

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