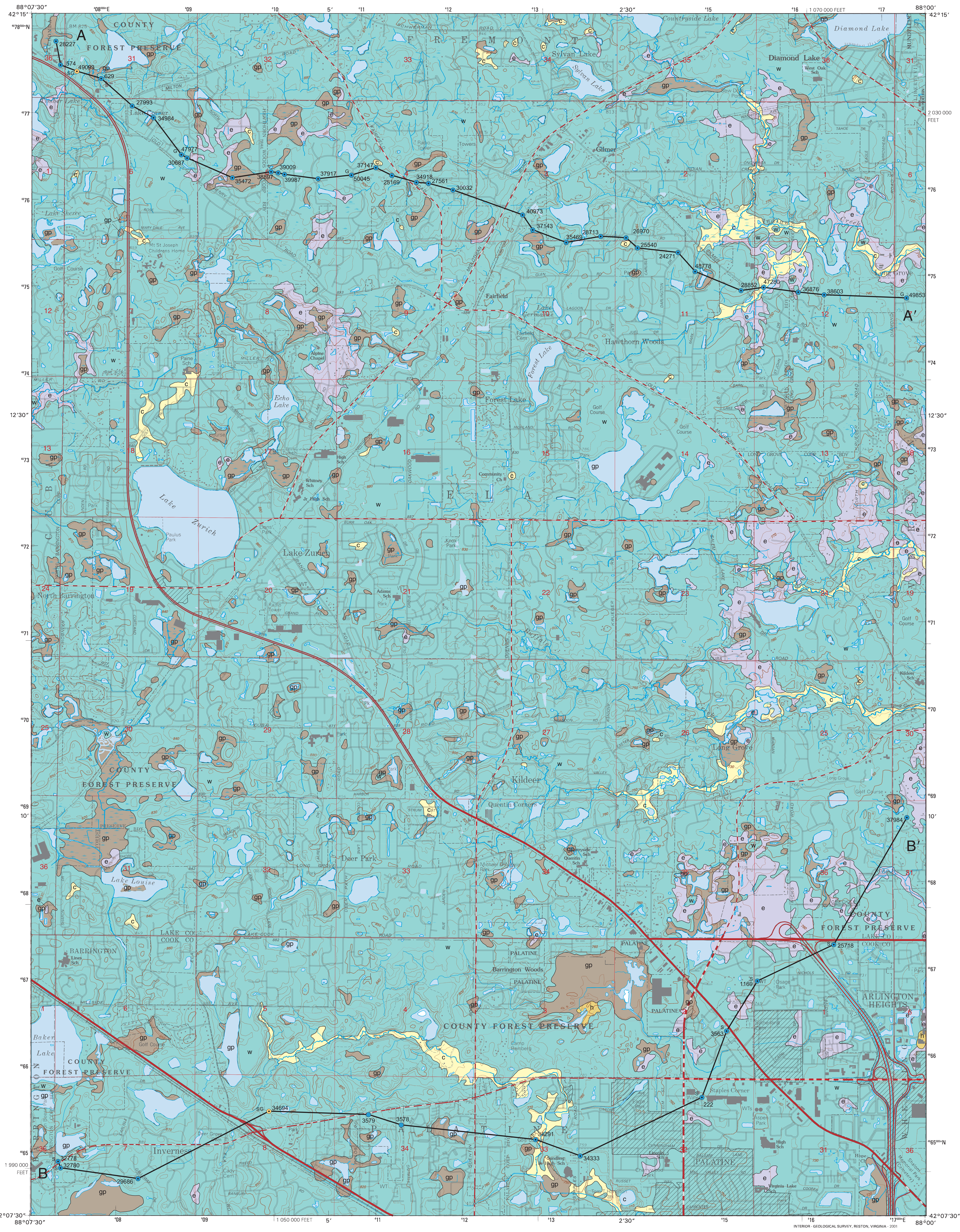
Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

SURFICIAL GEOLOGY OF LAKE ZURICH QUADRANGLE

COOK AND LAKE COUNTIES, ILLINOIS

Andrew J. Stumpf
2006



QUATERNARY DEPOSITS

Description	Unit	Interpretation
HUDSON EPISODE (~12,500 radioocarbon years before present (B.P.) to today)		
Fill, compacted land, or other disturbed material; highly variable in grain size (may range from clay to gravel), and may contain man-made construction and mining debris. Typical thickness: variable	Disturbed ground	**Human-disturbed deposits** found in gravel pits, retention ponds, earthen dams, other excavations and landfills; where possible, the original underlying sediments have been identified and mapped as one of the lithostratigraphic units described below.
Silt and clay; occasional sand lenses; brown to yellowish brown; loose to compact; may be mottled and gleyed; some bedding; organic-rich in places. Typical thickness: 5 to 20 feet.	Cahokia Formation c	**Postglacial (modern) alluvial deposits** present on active floodplains, natural levees; coarse deposits in channels, point bars, and tributary streams; derived mainly from eroded loess and diamicton; may overlie lacustrine silt and clay, and/or till; locally may include silty slopewash deposits in footslope locations.
Peat, muck and organic-rich sediment that may contain interbeds of silt, clay and some fine sand; black to dark brown; soft to firm; snail shells common. Typical thickness: 5 to 20 feet.	Grayslake Peat gp	**Organic deposits** accumulated in low-lying depressions, drainage-ways, 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; includes some areas where thin lenses of organic-rich sediments occur at shallow depths within gleyed, silty lake sediments; locally, may include slopewash deposits.
WISCONSIN EPISODE (Late) (~25,000–12,500 radiocarbon years B.P.)		
Silt or clay; massive to bedded; dark gray to light gray; calcareous; soft to hard; compact; very fine and fine sand may occur along bedding planes; occasional inclusions and lenses of light gray to white silt; very few clasts; generally abrupt upper and lower contacts. Typical thickness: 5 to 20 feet.	Equality Formation e	**Postglacial and glacial proglacial lake deposits** that infill low-lying areas, or depressions in drainage channels and on moraines; at the surface, these sediments may interfinger or be overlain by Cahokia alluvium or Grayslake peat.
Sand and gravel; massive or stratified; yellow to grayish brown; calcareous; loose; sand is fine to coarse, very well to poorly sorted; gravel is very fine to coarse, very well to very poorly sorted; minor amounts of silt and clay; locally may underlie Equality Formation. Typical thickness: 5 to 15 feet.	Henry Formation h	**Proglacial outwash deposits** exposed on the surface and found in kettled topography and deltaic fans; may delineate the margin of stagnant ice.
Diamicton; silty clay loam to silty clay; gray to yellowish brown; calcareous; compact; pebbly; lower part contains some cobbles and boulders and is more dolimitic; commonly contains silt and sand inclusions and sand and/or gravel lenses; may contain pebble-free, silty and clayey zones with strongly expressed laminations interbedded with the diamicton; lenses of saturated silt and very fine sand are loose and prone to liquifaction. Typical thickness: 50 to 160 feet.	Wadsworth Formation w	**Subglacial and ice-marginal sediment (till)** deposited from "Wadsworth" glacial ice; sediment that melted out on top of the glacier or along the ice margin was reworked by mass movements and water; laminated sequences may be more than 20 feet thick, but their areal extent is irregular and difficult to delineate; included in this mapping unit are thin and discontinuous accumulations of silty sediment deposited postglacially along ephemeral drainage ways in hummocky topography.
Sand and gravel; massive or stratified; yellowish brown to grayish brown; calcareous; often diffuse and grades into sandy diamicton or laminated sand, silt and clay. Typical thickness: 20 to 100 feet.	Henry Formation unnamed tongue (cross sections only) h(w)	**Proglacial outwash** deposited in front of "Wadsworth" glacial ice; the unit is discontinuous throughout the area.
Silt, clay, and fine sand; bedded to massive; dark gray to light brown; calcareous; compact, typically medium dense to hard; water well drillers often describe this material as “hardpan”, “hard sand”, “interlayered red clay and sand” or “sandy clay”; may contain beds of silty to loamy diamicton; some dropstones; generally abrupt upper and lower contacts. Typical thickness: 40 to 200 feet.	Equality Formation undivided (cross sections only) e-u	**Proglacial lake deposits** that were deposited in front of glacial ice; deposited in lake basins, deltas, subaqueous fans, or subaqueous debris flows; near continuous unit in the sub-surface across the quadrangle.
WISCONSIN AND SANGAMON EPISODES (~130,000– ~14,000 years B.P.)		
Sand, gravel, diamicton, and silt; sandy loam to silty clay loam; light brown to gray; calcareous; composite unit very variable in texture and other physical characteristics; compact and hard; silt is massive to crudely stratified with some pebbles; sand and gravel is mostly composed of dolomite clasts with some distally-eroded metamorphic or volcanic pebbles. Typical thickness: 5 to 50 feet.	Older sediment undifferentiated (cross sections only) os	Includes older sand and gravel, diamicton, stratified glacial lake sediments, and weathered bedrock.

PRE-QUATERNARY DEPOSITS

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 sections only)	**Bedrock** buried by ~140 to 360 feet of Quaternary sediments.

Data Type

Stratigraphic boring

Water well boring

SG 26211 — Labels indicate samples (S) or geophysical log (G). Boring and outcrop labels indicate the county number. Dot indicates boring is to bedrock.

Contact

A—A′ Line of cross section

Note: The county number is a portion of the 12-digit API number on file at the ISGS Geological Records Unit. Most well and boring records are available online at the ISGS Web site.

Base map compiled by Illinois State Geological Survey from digital data provided by the Lake County GIS and Mapping Division, and Cook County Assessor's Office (hydrography and transportation current as of 2002). Hypsography data (current as of 1993) and PLSS data (current as of 1958) from United States Geological Survey.

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

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: 2006

Geology based on field work by A. Stumpf, M. Barnhardt and J. Thomason, 2004–2006. Less than 5% of the map area field checked.

Digital cartography by J. Carrell, J. Domier, D. Luman, J. Palmer, and S. Geegan, Illinois State Geological Survey.

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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1	2	3
4		5
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ADJOINING QUADRANGLES
1 Wauconda
2 Grayslake
3 Libertyville
4 Barrington
5 Wheeling
6 Streamwood
7 Palatine
8 Arlington Heights

$2\frac{1}{2}°$
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2006

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

Purpose

Detailed geologic mapping on the Lake Zurich Quadrangle was completed as part of an ongoing, multi-year mapping program by the Illinois State Geological Survey (ISGS) to update geological information for Lake County and the adjacent areas of Cook, Kane and McHenry counties, in northeastern Illinois. Beginning in 2000, this new mapping has provided geological information that is regularly incorporated into decision-making on a wide variety of local and countywide issues that include protecting ground water, locating new municipal water wells, designing and constructing foundations and structures, identifying potential aggregate resources, preservation of natural areas, and addressing a broad spectrum of land-use concerns. From this initial mapping, we plan to develop additional datasets and interpretive information that will be the basis for derivative geological products such as 3-D geology and hydrogeology models, analyses of aquifer-bearing strata for their conductivity and susceptibility to contamination, models of surface-groundwater interaction, and reports of material engineering properties and mineralogy and chemistry.

The Illinois State Geological Survey has implemented a mapping program to develop three-dimensional maps of the glacial geology from land surface to the top of bedrock in northeastern Illinois because this is the most rapidly growing area of population in the state, and some communities are among the most rapidly growing in the country and have or may encounter geologic hazards during development. Although some of this region draws the majority of its drinking water from Lake Michigan, a significant part, including most of the rapidly-growing areas in the Lake Zurich area, relies upon groundwater from Quaternary-age glacial sand and gravel deposits or from shallow bedrock (fig. 1).

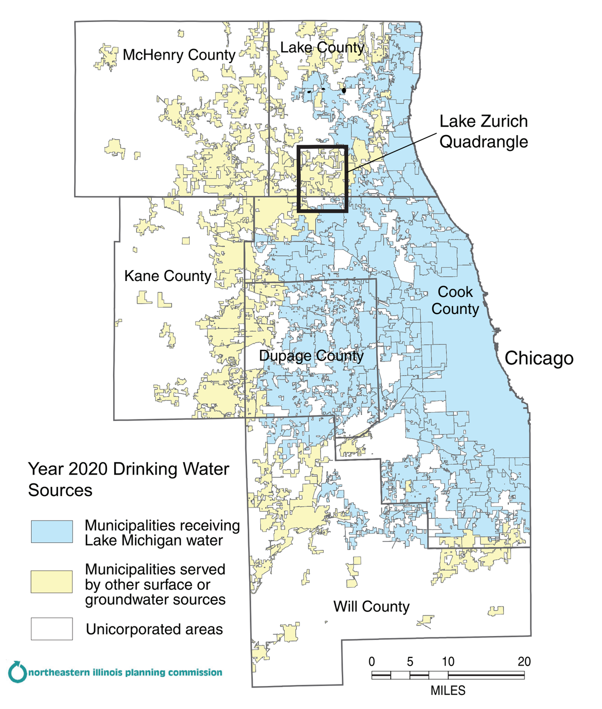

Figure 1 Year 2020 domestic water sources in northeastern Illinois.

Funding

This mapping was completed for the STATEMAP component of the National Cooperative Geologic Mapping Program (NCGMP), which is administered by the United States Geological Survey (USGS). STATEMAP is a matching-funds grants program with state geological surveys and the USGS to develop digital geologic maps for areas where information is needed to solve critical earth science problems that will eventually become part of the state's database and the National Geologic Map Database component of the NCGMP.

For the FY05 mapping, the matching funds were allocated to develop a detailed map of the surficial geology, interpretative cross sections, informational text, and an accompanying database for the Lake Zurich Quadrangle. Planned additional work includes development of derivative geologic and hydrogeologic map products.

Introduction

The Lake Zurich Quadrangle is located in northeastern Illinois and encompasses parts of Lake and Cook counties that include the cities of Mundelein and Palatine, the villages of Arlington Heights, Barrington, Lake Zurich, Hawthorne Woods and Long Grove, and also unincorporated areas. The map area is located within the watersheds of the Des Plaines and Fox Rivers. The land surface ranges in elevation (above mean sea level) from a minimum of 710 feet along Indian Creek at Long Grove to greater than 920 feet northwest of Hawthorne Woods. A broad linear ridge dissects the map area trending approximately in a southwest to northeast direction from Barrington to Sylvan Lake.

The surficial geology map and accompanying cross sections delineate geologic materials (formally called lithostratigraphic units) that are classified by their lithology (sediment type or rock type) and stratigraphy position. The stratigraphic nomenclature used here is from Willman and Frye (1970) and Hansel and Johnson (1996). Lithostratigraphic units in northeastern Illinois have a complex but mappable pattern of occurrence. The surficial geology map shows the distribution of geologic units at the land surface that are present in a specific, or stratigraphic, succession in the subsurface.

The surficial geology map, together with information on the subsurface distribution of geologic materials is necessary to identify opportunities and limitations for future development as well as determining likely consequences of past and future land-use decisions. The unique value of a surficial geology map springs from the wide variety of relevant interpretations that it supports for addressing societal and scientific issues. The surficial geology map is a basis upon which other derivative maps are produced for specific purposes such as assessment of groundwater resource potential, mineral resources, and geologic hazards.

Regional Setting

The surficial geology of northeastern Illinois is predominantly the result of continental glaciers and glacial meltwater of the last (Wisconsin Episode) glaciation that occurred between about 25,000 and 12,500 yr. B.P. (radiocarbon years before present). In the region during this Wisconsin Episode, the Lake Michigan lobe advanced at least three times depositing lithologically distinct diamictons interpreted to be tills that comprise units of the Tiskilwa, Lemont (Haeger Member), and Wadsworth Formations (Hansel and Johnson 1996). Meltwater generated from the glaciers drained through subglacial channels or in rivers flowing away from the ice. Where glaciers or sediment blocked drainage in front of and on top of the ice, the meltwater was ponded forming lakes.

In the Lake Zurich Quadrangle, the sediments deposited during the last glaciation range in thickness from 130 to 370 feet above bedrock. Only a single diamicton unit, the Wadsworth Formation till, has been differentiated in the map area and forms hummocky morainal upland comprising segments of the Valparaiso Morainic System and the Tinley Moraine west of Lake Michigan (fig. 2). Meltwater stream and river sediments infill channels and low-lying areas on the land surface. In the subsurface, these sediments form tongues of proglacial sediment (Hansel and Johnson 1996) that are remnants of former channel and lake deposits. Modern river, lake and organic-rich sediments are present at the surface on floodplains and in depressions.

Mapping Techniques

The surficial geology map is based largely on digital soils data for Lake and Cook Counties from the United States Department of Agriculture (USDA) and its Natural Resources Conservation Service (NRCS) (USDA 2003, 2005) that was compiled by digitizing Paschke and Alexander

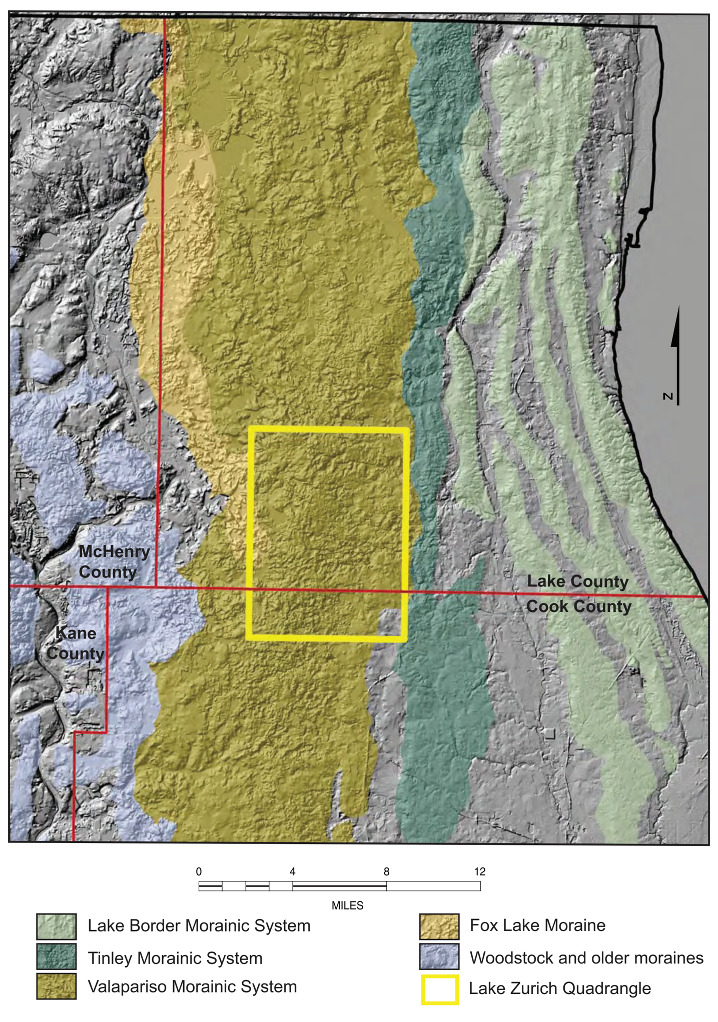

Figure 2 Surface topography and moraines of northeastern Illinois

(1970) and Mapes (1979) 1:15,840-scale soil maps of the counties. Initially for this mapping, 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 or downloaded from their web site <url: http://soildata mart.nrcs. usda.gov/County.aspx?State=IL.

Following fieldwork and data analysis, the parent material classes were then grouped into more general geologic material classes, comprising five surficial geology mapping units, following the classification of deposits of Hansel and Johnson (1996). This process reduced the number of map units to a level that would be discernable on a 1:24,000-scale map (greater than 5 acres in size). The thickness of each surficial geologic unit is assumed to be at least 5 feet (the minimum depth that these mappers take soil cores), unless drilling or geophysics logging suggest otherwise. The legend of map units provides additional information on the character, thickness, and occurrence of materials encountered in different geologic mapping units.

Fieldwork undertaken for this mapping included drilling of test stratigraphic boreholes and undertaking geophysical (natural gamma-ray) downhole logging. Continuous cores to depths ranging from 250 to 300 feet were acquired at three sites on a variety of geomorphic positions. The cores were described in detail and compared to geophysical (natural gamma-ray) data obtained from the boreholes (see below) to better understand and interpret the descriptive records from adjacent water wells.

Natural gamma-ray logs collected in fifty-four drill holes (including stratigraphic boreholes, groundwater test borings, and private water wells) provide a semi-quantitative measure of the texture and mineralogy of unconsolidated sediments lying above bedrock. These data were augmented with geologic information from drilling logs of engineering and water-well borings, previously completed maps, LIDAR elevation data, wetland surveys, and aerial photographs to validate the surficial mapping units.

Forty-nine sets of sediment samples obtained from water wells and engineering boreholes drilled previously in the map area for other projects were studied to further define unit contacts. Of a total of 4647 water well and engineering borehole records available, 787 were used to compile this map. The locations of most borings were verified using tax parcel data, but for a few borings, their locations were measured in the field using hand-held GPS units. The quality of the geologic information was evaluated as individual boreholes were selected for developing and validating the surficial geology map and cross section.

Unit Characterization and Stratigraphic Relationships

The diamicton of the Wadsworth Formation comprises the majority of sediments found at land surface on the quadrangle (see geology map and cross sections). The diamicton is fairly uniform, however, it can also be comprised of interbeds of sorted material (glacial river and lake sediments), suggesting that materials deposited by debris-rich ice were significantly reworked at the margin and under the ice sheet. Although predominantly fine-grained, the upper part of the diamicton may have a sandier texture, especially at the base of slopes or in depressions on the uplands, where it has been modified by mass movements or water. The lower part can also be coarser textured, containing more gravel and rock fragments (clasts), up to boulder-size. The clasts are predominantly dolomite and its matrix is highly dolomitic.

Glacial meltwater stream or river sediments (outwash) sand and gravel (Henry Formation) and modern river and stream sediments (Cahokia Formation) comprise the terraces and floodplains deposits along some of the larger streams in the county, but river deposits are generally sparse on this quadrangle. Discontinuous outwash deposits present below the Wadsworth Formation diamicton that are remnants of former fluvial deposits are classified as a tongue of the Henry Formation. Although locally thick, these deposits have not been widely utilized as groundwater resource.

Stratified silt or silty clay sediments are found widely in the quadrangle both at land surface and in subsurface. At the land surface, these sediments occupy broad low-lying areas along active/inactive drainage-ways connecting many of the lakes, and locally in shallow depressions or drainage channels on the morainal uplands. These laminated and bedded deposits, classified to the Equality Formation, are representative of sediments deposited in glacial lakes that developed during late glacial and postglacial times.

Fine-grained sediments similar in character to those at the surface were mapped in the subsurface below Wadsworth Formation diamicton (see cross sections). These sediments in some places are extremely thick, in excess of 200 feet, and comprise the core of a ridge that dissects the quadrangle (see above). This deposit is composed of fine to very fine sand, silt, and clay, but locally may contain beds of diamicton or sand and gravel. Because these sediments have been overridden by glaciers of the Wadsworth advance, they have been consolidated, and therefore usually harder and more difficult to drill through. Generally these sediments are dry, locally moist or saturated, but have not widely been tapped by water well drillers for a public water supply.

Due to the absence of intervening tills, deposits of sorted sediment, or datable organic-material, the precise age of these sediments is not known, and therefore are classified as an undivided tongue of the Equality Formation. These sediments were likely deposited during either the advance of Haegar ice or the melting of Tiskilwa ice when the drainage was blocked and meltwater ponded. These sediments likely compose a system of ice-marginal fans, deltas and lake plains, their areal extent regionally is not precisely known. Drainage and mass movements off debris-rich glaciers or the melting icebergs in the lake are sources of diamicton and sorted sediment within this glacial lake deposit.

Occupying similar positions on the landscape as deposits of the Equality Formation are peat, muck, and organic-rich silt (Grayslake Peat). These deposits often compose thin lenses of organic material that lie above or are interfingered with gleyed silt and clay deposits of the Equality Formation. The Grayslake Peat also is present on morainal uplands adjacent to lakes and in deeper depressions where sediment and organic material have accumulated.

Throughout much of the quadrangle lying below the Equality Formation deposits, an undifferentiated (early Wisconsin or older in age) and highly variable unit composed either of sand and gravel, silt, and/or diamicton (older drift?) was encountered (see cross section). This unit directly overlies bedrock. The bedrock has a surface that is locally fractured and/or weathered.

Acknowledgments

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Many individuals and agencies associated with this and other mapping projects in northeastern Illinois provided important information and services to the author. Assistance with drilling and core description was provided by J. Aud, J. Hutmacher, C. Wilson, M. Barnhardt and J. Thomason. Cartographic and GIS support was provided by J. Domier, J. Carrell, B. Stiff, V. Amacher, J. Palmer and D. Luman, and geophysical logging was provided by D. Walgren, C. Stohr, and C. Blakley. Agencies that collaborated with the Lake Zurich mapping project included various agencies in the governments of Lake County and Cook County, USDA-NRCS in Illinois, City of Palatine, Village of Lake Zurich, Village of Hawthorn Woods, Village of Long Grove, Barrington Council of Governments, and private water-well drilling companies.

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