# Developing a preliminary 3-D model of the quaternary geology of the Wauconda 7.5´ Quadrangle

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**Background.** Using data from ISGS boreholes, natural gamma logs of boreholes and water wells, water-well drillers' descriptive logs, and water-well samples, we created a preliminary 3-D model of the Quaternary geology of the Wauconda quadrangle. Because only minor deposits of postglacial sediment cover the land surface, too thin to represent on this model, only the glacial deposits are represented. The 3-D model illustrates our present understanding of relationships among Quaternary units. It also shows areas where data are sparse and future drilling, downhole geophysics, and shallow seismic reflection studies should be focused. The digital model can be easily modified as new data become available.

**Regional Stratigraphy and Stratigraphic Framework.** The Quaternary deposits and topography of the Wauconda Quadrangle resulted from cycles of erosion and deposition during Wisconsin Episode glaciation, between about 25,000 and 14,000 radiocarbon years ago in Illinois (Fig. 1) (Hansel and Johnson, 1992, 1996). The glacial drift ranges from about 100 to 250 feet thick and consists of three distinct till units of the Wedron Group (Wadsworth Formation, Haeger Member, and Tiskilwa Formation) that intertongue with proglacial fluvial and lacustrine sediments. These materials were deposited during three glacial phases of the Lake Michigan Lobe (Fig. 2) and form three distinct glacigenic sequences consisting predominantly of proglacial/ subglacial successions. These sequences offlap to the east–northeast in the up-ice direction.

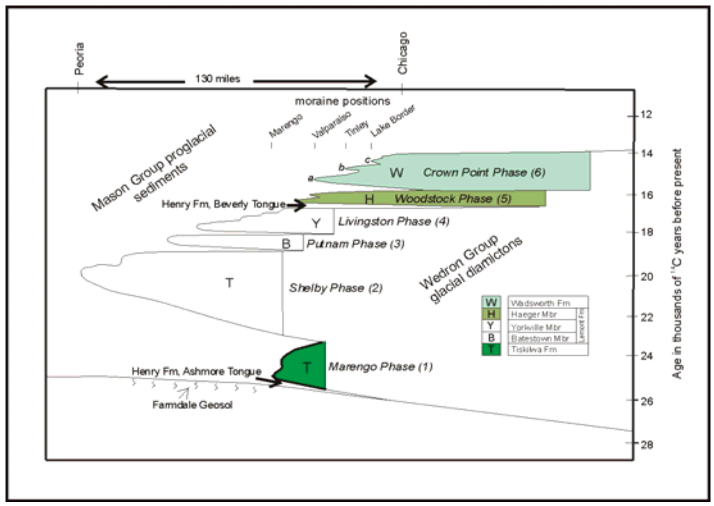


**Figure 1. Time-distance diagram from Peoria to Chicago showing glacial phases and lithostratigraphic units of the Wisconsin Episode Lake Michigan Lobe in Illinois. Only phases and units in the Wauconda quadrangle are colored. After Hansel and Johnson, 1992.**

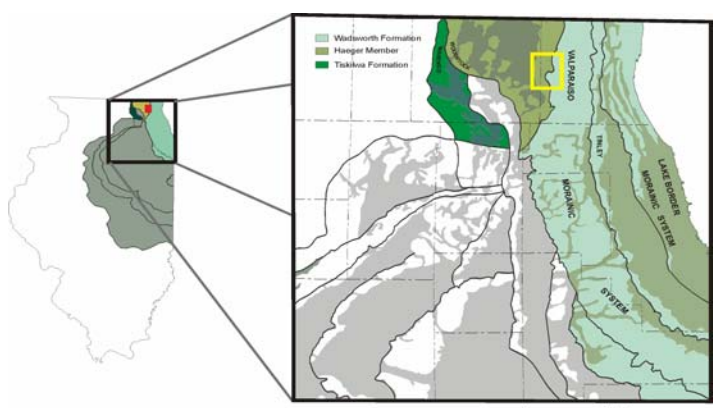


**Figure 2. End moraines and ice-margin positions of major glacial phases of the Lake Michigan lobe during the Wisconsin Episode in Illinois. Quadrangle boundary shown in red on inset map. After Hansel and Johnson, 1992.**

The lowermost sequence contains proglacial sediments (predominantly fluvial sand and gravel of the Ashmore Tongue, Henry Formation) and diamictons (till and ice-marginal sediments) of the Tiskilwa Formation. The Tiskilwa diamicton is buried beneath sediments of a middle sequence, which contains a thick sand and gravel unit (Beverly Tongue of the Henry Formation) and diamicton of the Haeger Member (Lemont Formation). The Haeger diamicton is exposed at the surface over much of the western two-thirds of the quadrangle. The uppermost sequence, comprising Wadsworth diamicton that overlies a discontinuous sand and gravel (unnamed tongue, Henry Formation), is present in the eastern third of the quadrangle. Locally in this area, tongues of proglacial lacustrine sediment of the Equality Formation are present, especially at the surface, but also intertongued with diamicton of the Wadsworth Formation. Because drillers often do not differentiate between lake clays and clay-rich diamictons in their logs of water wells, lacustrine sediments are probably under-represented in the model. Sand and gravel of the Henry Formation is also present locally at the surface. Figure 3 illustrates intertonguing relationships among the diamicton units of the Wedron Group and sand and gravel units of the Henry Formation. The sand and gravel units form regional and local drift aquifers. Our geologic mapping will help define these aquifers and provide information for their utilization and protection in this area where population and water demands are both growing rapidly.

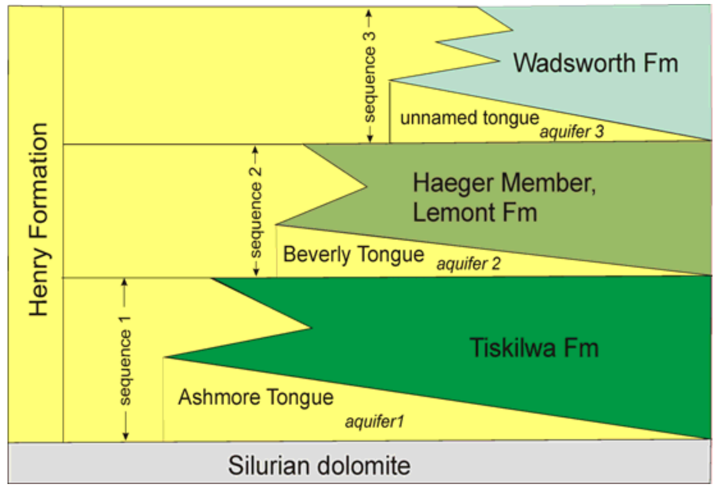


**Figure 3. Intertonguing relationships among diamicton and sand and gravel units. The materials represent three major glacigenic sequences. The sand and gravel tongues form regional or local aquifers. Locally, aquifer 1 (Ashmore Tongue, Henry Formation) may be connected to the uppermost bedrock aquifer.**

**Data and Methodology.** Because exposures are rare, the data used in the model are predominantly from descriptions of cores and drill-cuttings, natural gamma logs (some with samples), and water-well drillers' logs (some with samples). The data are of extremely varying quality. The highest quality data come from ISGS cores with associated natural gamma downhole logs. These data provide a basis for interpreting water wells in areas where previously only natural gamma logs, drill-cutting samples, or drillers' logs were available. Because we had few cores and natural gamma logs to integrate into the model, we made use of data from water-well drillers stored in the ISGS's well-log database. Drillers' descriptive logs of drill holes provide geological information that is extremely variable in quality. Most water wells are clustered on commercial properties and in subdivisions. Initially, we examined several thousand available water-well logs, but selected only the best ones for each section. We then attempted to verify their locations using tax-parcel data, street address information, and plat-books; several hundred water well locations were verified for the model. During model development, many records were eliminated either to reduce data clustering or because their descriptions could not be correlated with adjacent wells. In the end, records from 350 wells were used to construct the model. Wells located in an a buffer zone, 1 mile wide around the quadrangle, were also used to define the edges of the model more accurately.

We used RockWorks99 software to make stratigraphic picks and generate the model. The process involved constructing hundreds of cross sections to make well-to-well correlations in multiple directions. Many of the higher-quality data points were used first to model a larger area of northeastern Illinois (6-quadrangle area), which helped to put the Quaternary units in a regional perspective. In this project we elected to present our preliminary model in the RockWorks99 software because our present databases are set up to link with the software. Also, RockWorks99 was better at modeling pinch outs of units between data points. In the future, as our databases are updated, we are planning to use RockWorks2002 software to further develop the model. This software will provide us improved graphical representation and manipulation (ability to view the model from any perspective) and better vertical slicing capabilities.

**Stratigraphic Model.** In the model the main Quaternary lithostratigraphic units of the Wauconda quadrangle are illustrated as individual sediment layers overlying the bedrock surface (Fig. 4). The proglacial sand and gravel units of the Henry Formation constitute important drift aquifers in the region (Fig. 3). The lowermost aquifer, the Ashmore Tongue, is present locally beneath the Tiskilwa Formation and is connected to the uppermost bedrock aquifer (Silurian dolomite). In many places, the Beverly Tongue is a major regional drift aquifer; many municipal and private wells in the Wauconda quadrangle pump water from this unit. An unnamed, noncontiguous tongue of the Henry Formation lies beneath the Wadsworth Formation, and locally, where the sand is clean (well sorted), this unit is an important water-bearing unit. Because the intertonguing diamictons are not present everywhere, the aquifers may be connected.

The 3-D stratigraphic model is preliminary and further data collection and field-checking are planned. Overall, the model is less reliable with depth, because many wells are set into the first viable water-bearing unit in the drift and do not penetrate through all the Quaternary materials lying above bedrock. The top-most layers in the model are not always coincident with surficial sediments mapped within 6 feet of the ground surface in the quadrangle. The databases used to construct the model did not include detailed information collected by soil scientists, engineers and field geologists, and therefore should not be considered reliable for mapping surficial materials at small scales.

## References

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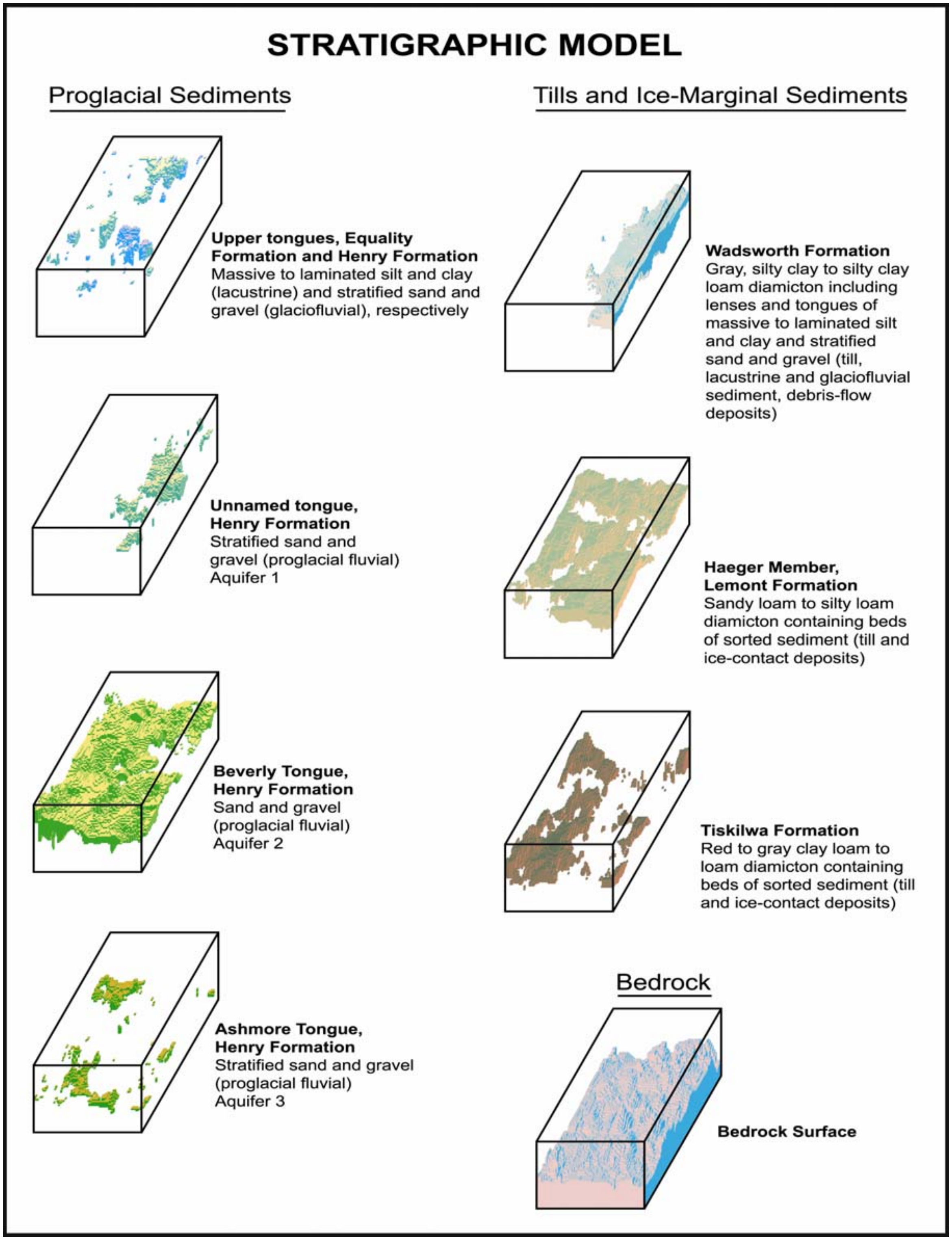


**Figure 4. Individual layers representing the lithostratigraphic units in the 3-D model for the Wauconda Quadrangle.**