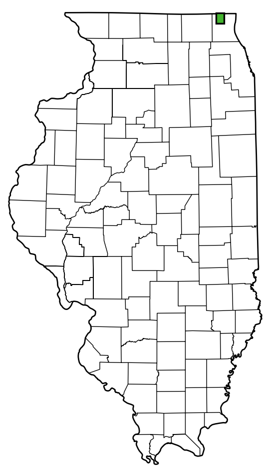
Illinois Preliminary Geologic Map
IPGM Antioch-WL

Well Locations of Antioch Quadrangle

Lake County, Illinois and Kenosha County, Wisconsin

Compiled by Barbara J. Stiff and Michael L. Barnhardt

2005



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Methodology

The value of a borehole is related to its location within the project area, the quality of its geologic information, and the accuracy with which it can be positioned. Specifically, the type of map or product (e.g., surficial geology, bedrock topography, 3-D stratigraphic model) will determine the level of positional accuracy and the quality of geologic information that is acceptable. The majority of the boreholes in the study area are residential water wells, which are usually located to a 10-acre or greater plot of land (i.e., quarter-quarter-quarter location using the Public Land Survey System (PLSS)). Generally, this level of accuracy is not sufficient for our mapping objectives because elevation and materials described at a point are used to calculate top and bottom elevations for subsurface geologic units. For this reason, we developed and refined a protocol for verifying the location of each borehole used for mapping and modeling in this project.

Data Sources

Where and How the Information is Stored

Borehole information is housed in the Geologic Records Unit (GRU) and the Geologic Samples Library (GSL) at the Illinois State Geological Survey. The GRU contains both digital and hard-copy descriptive logs and other information for boreholes made for water wells, engineering and commercial construction projects, highway and bridge construction, resource exploration such as coal, oil and gas, and building aggregate, and geologic mapping and research. The GSL stores individual samples and cores from some of these boreholes, in addition to samples collected during fieldwork by geologists working on past projects. The records for any chemical, mineralogical, or other laboratory and engineering data, descriptive logs and the physical samples are linked using a unique identifier (API number) assigned to each borehole record. Depending on the type of borehole, data pertaining to well diameter, pump capacity, ownership, etc. may also be available in the database. The digital records are managed within a relational Oracle database and can be retrieved using queries based on specific attributes such as location, type of borehole, total depth of boring, property owner, etc. We created a working database comprised of all boreholes that were located within the boundaries of the Antioch, IL-WI 7.5-minute quadrangle, plus a one-mile-wide buffer (in total, approximately 7000 boreholes).

Verifying the Data

A variety of sources and techniques were used to verify the location and other information associated with a particular borehole, including archived data; field observation, personal communication with landowners and drillers; plat book and digital tax parcel record searches; proprietary records from drilling companies and engineering consulting companies, reviewing historical aerial and/or ground photographs; digital orthophoto quadrangles; topographic maps; telephone directories; and web-based tools. Most often, we used a combination of the above to locate wells, reposition them when necessary, and assign them a verification rank (Table 1).

The Oracle database (digital) and original paper drillers' records were searched for particular borehole types, e.g., ISGS project boreholes or engineering boreholes. Our goal was to prioritize higher quality or more complete descriptive data including 1) ISGS boreholes, 2) boreholes to bedrock, 3) engineering boreholes, 4) boreholes with good descriptive geologic logs, and 5) boreholes located in areas with few others (i.e., located where "gaps" in data occur). Various combinations of these boreholes were used to develop the different maps and model.

Table 1 Verification Ranks for Coalition Pilot Study Boreholes.

Verification Rank	Level of Confidence in Borehole Location	Source/Technique Used to Locate Borehole*	Number of Boreholes (Percent of Total)
1	Highest	GPS or surveyed point; field verified	105 (2)
2	High	Individual point repositioned in land parcel using various sources	676 (13)
3	Moderate	Well located to center of parcel by automated batch processing or manually using plat books	1886 (37)
4	Unknown	Too little information to locate well to a smaller parcel within the section or the well location is no longer accessible	22 (<1)
5	Not Located	Record examined but could not be verified	67 (2)
0	Untested	Location of these boreholes not evaluated; may be useful	2304 (46)

The ISGS boreholes are those drilled during our project or previous projects and comprise the group of boreholes with the highest verification rank and with the most accurate and complete geologic information. These boreholes were used to help interpret the drilling logs of neighboring water wells. By associating (correlating) the descriptive terminology used by drillers with our more specific geologic terminology and stratigraphic correlation, we could incorporate many additional boreholes from our archival database into our mapping and modeling process.

The development of the 3-dimensional model of the glacial geology relies more heavily on the boreholes with the highest quality geologic information than the other maps because the model requires more detailed subsurface geologic data than the other maps produced in the project. Boreholes to bedrock assist in the development of the bedrock topography and drift thickness maps. These boreholes need not necessarily contain high quality descriptive geologic information, rather they need contain only reliable references to depth to bedrock.

As the development of the 3-D model and the surficial geology, drift thickness, and bedrock topography maps progresses, additional data points (boreholes) may be added to provide a more uniform coverage. Shallow engineering boreholes and water wells located in areas of sparse geologic information may then be verified and used. Even though the 3-D model and thematic maps have specific purposes they may share the use of the best boreholes, while incorporating additional boreholes very selectively to achieve their goals. The distribution and type of borehole used to produce the 3-D model (Hansel, 2003) and the surficial geology (Stumpf and Barnhardt, 2003), drift thickness (Dixon-Warren and O'Malley, 2003a), and bedrock topography (Dixon-Warren and O'Malley, 2003b) maps are presented as an inset map on each of those products. Luman (2003) and Luman et al. (2003) present, respectively, examples of the value of integrating the use of modern digital orthophoto quadrangles and historical aerial photography in locating and assessing changes in land use and land cover over a 60 year period in Lake County.

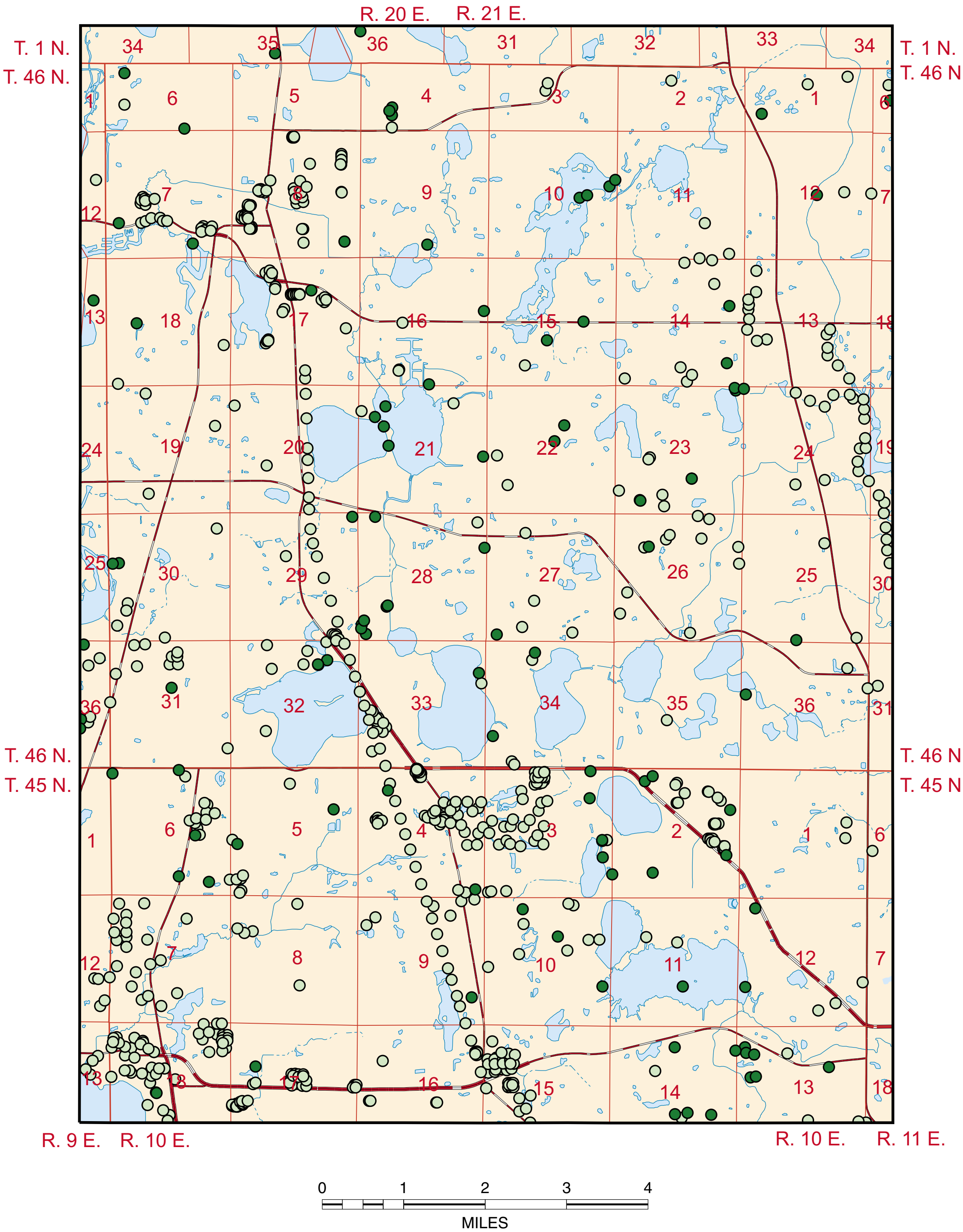

Figure 1 Boreholes with verification ranks 1 (dark green), and 2 (light green).

Verification Ranks for Data Point Locations

We developed a numerical ranking system to summarize the confidence we have in the accuracy of locations for each data point (Table 1). The numerical code is included in the database to enable users to identify and select the level of confidence they desire. The well data map (at left) displays approximately 5250 boreholes located within the quadrangle boundaries. Verified wells (green) are further displayed based on their rank in figures 1, 2, and 3 (at left). Unverified wells (red) are Rank 0.

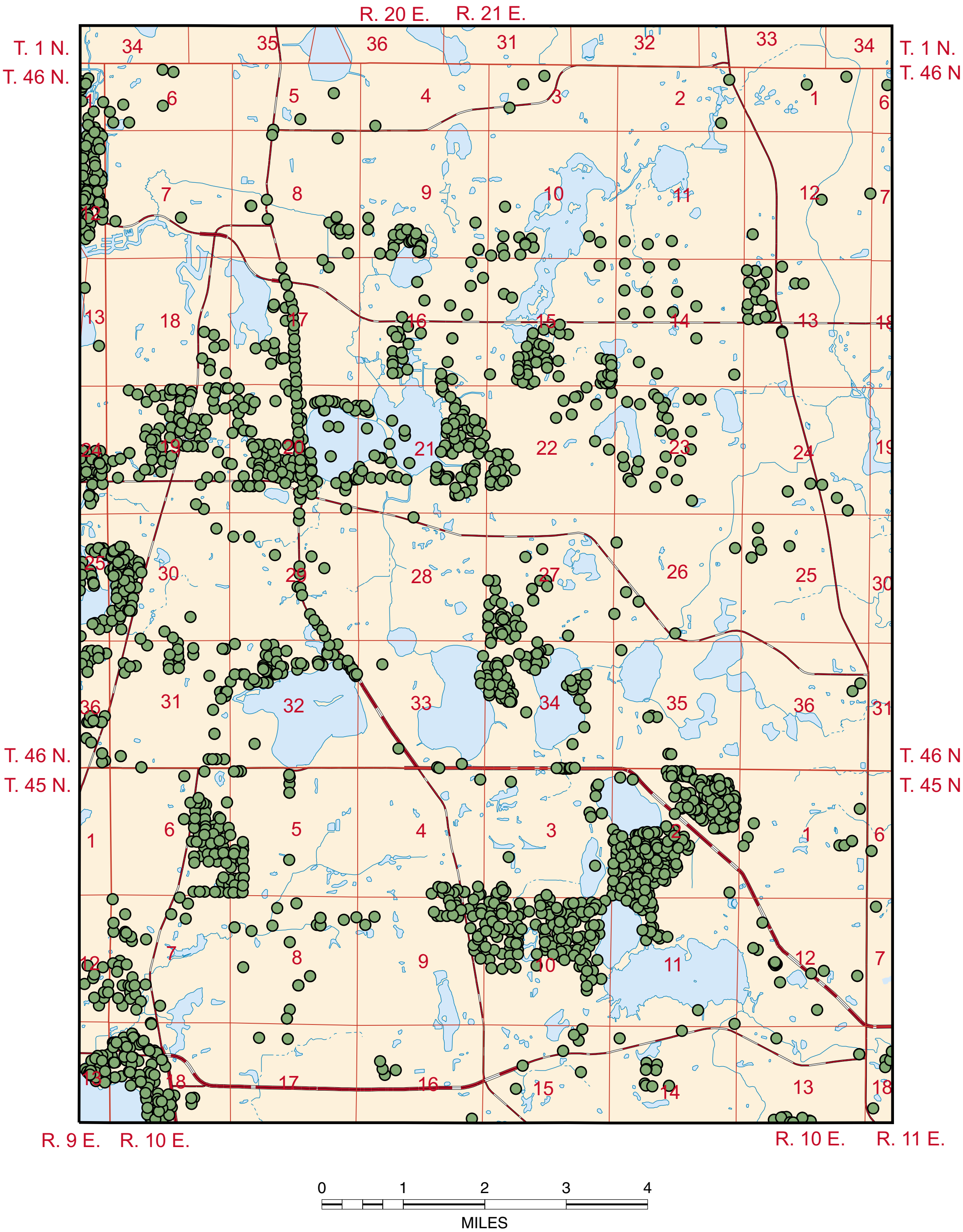

Figure 2 Boreholes with verification rank 3.

Rank 1 (highest) is reserved for boreholes that have been located in the field by surveying or by using a Global Positioning System (GPS). These points are often located within 40 feet (generally much closer) of their true horizontal position. This rank contains borehole locations in which we have the highest confidence (fig. 1). It includes ISGS boreholes with downhole geophysics, new water wells that we have gamma-logged, and other selected boreholes that have been field-verified with a GPS unit or have been obtained from engineering companies or various agencies.

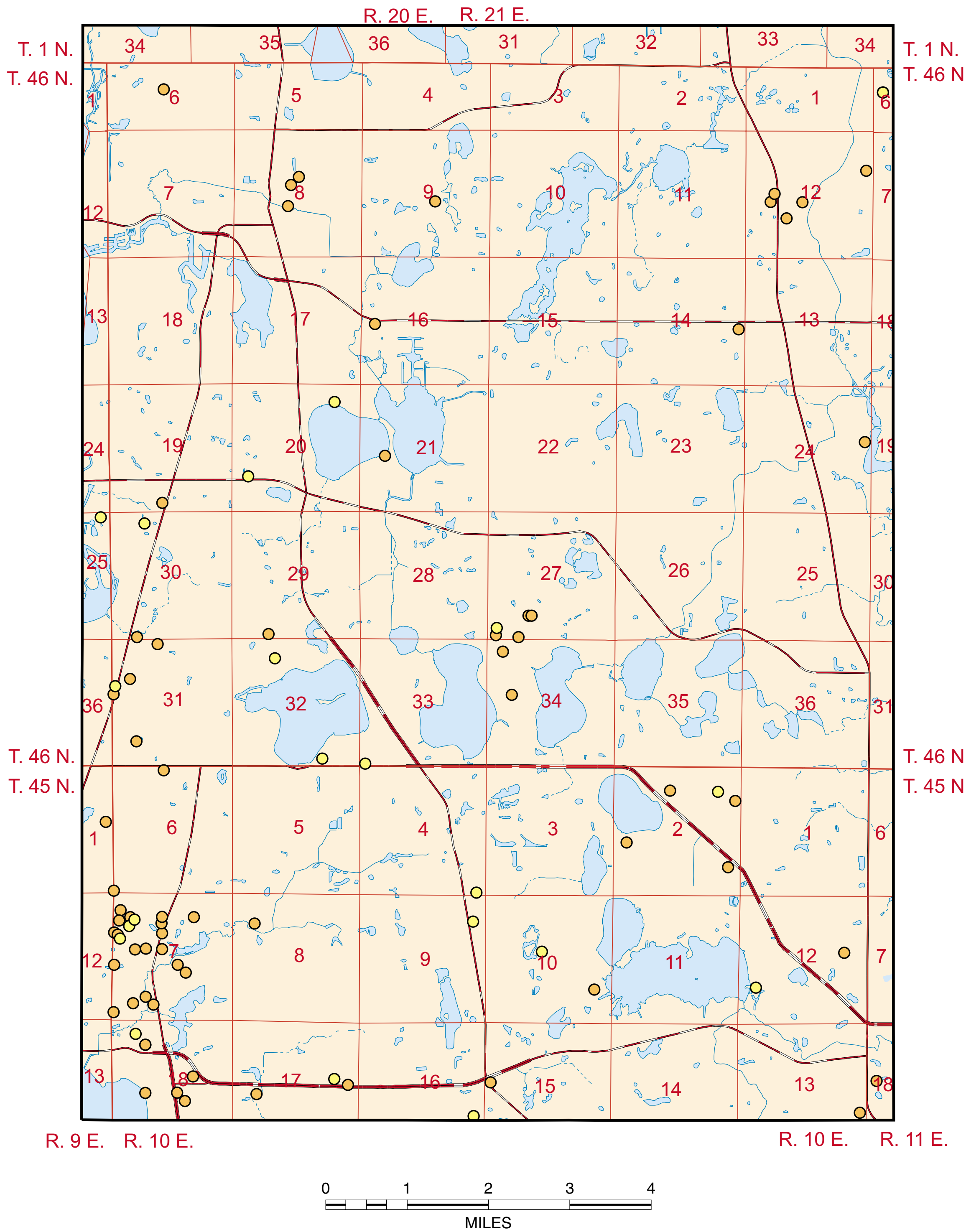

Figure 3 Boreholes with verification ranks 4 (yellow), and 5 (orange).

Rank 2 level of confidence is assigned after we verify the address of the parcel of land and its ownership, as above, and manually reposition the location of the wellhead on a digital imagery base (fig. 1).

Rank 3 includes those wells that have been matched to a location either by automated batch processing using digital tax parcel records and TIGER files, or manually using plat books (fig. 2). This method produces a subset of wells whose location accuracy can be readily upgraded to Rank 1 or 2 if needed. For example, if the parcel of land is quite large, the well may be relocated to buildings or a wellhead visible on aerial photography. Initially, however, wells in Rank 3 are positioned automatically in the middle of the parcel, which may result in them being located in a body of water if the parcel contains a lake or pond.

Rank 4 identifies wells for which a confidence level is undetermined because there is not enough information in the record to locate the site to the confidence levels described above (fig. 3).

Rank 5 contains wells that we attempted to locate using the above sources but were unsuccessful. This ranking separates wells that we attempted to locate from those in rank 0, which we did not attempt to locate (fig. 3).

Rank 0 (lowest) is reserved for wells that we did not attempt to locate and therefore the confidence level is untested. Wells in this category are those that occur in close proximity to each other or were not selected because neighboring wells had better descriptive geologic information and/or were positioned in slightly better locations. Some wells in Rank 0 may be at equal confidence levels as neighboring wells which were selected.

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