Illinois Groundwater Association

Advancing Groundwater Knowledge Since 1983

www.iga.uiuc.edu

2006 Fall Meeting

Northern Illinois University, DeKalb, IL
October 10, 2006

Program with Abstracts

Agenda
Illinois Groundwater Association
2006 Fall Meeting
October 10, 2006

Northern Illinois University, DeKalb, Illinois

8:30–9:15	Registration
9:15–9:30	Opening Remarks: **Steve van der Hoven**, IGA Chair
	Morning Session
9:30- 10:00	**Walt Kelly**, *Illinois State Water Survey*, South Africa experiences
10:00-10:30	**Steve van der Hoven, Melissa Lenczewski**, *Illinois State University, Northern Illinois University*, Environmental Geology Field Camp – Training the next generation of Illinois Hydrogeologists to Collect and Interpret Field Data.
10:30-11:00	**BREAK**
11:00-11:30	**Jack Wittman, Theresa Landewe**, *Wittman HydroPlanning Associates, Inc.*, Regional Groundwater Demands in the Mahomet Aquifer
11:30-12:00	**Larry Lyons,** *Lyons Well Drilling and Illinois Association of Groundwater Professionals*, Who's Monitoring Monitoring Wells…and More
12:00-1:30	**Lunch**
	Afternoon Session
1:30-2:00	**Colin Booth**, *Northern Illinois University*, Overview of Hydrogeological Studies of the Buried Troy Valley and Related Shallow Aquifer System, DeKalb County
2:00-2:30	**Samuel Gillet**, *Northern Illinois University*, Field-based Estimation and Characterization of Shallow Aquifer Recharge in the Owens Creek Watershed, DeKalb County
2:30-3:00	**Alka Singhal**, *Northern Illinois University*, Temporal and Spatial Variability of Groundwater Recharge: A GIS-based Study in the Upper South Branch Kishwaukee River Watershed, DeKalb County
3:00-3:30	To Be Determined
3:30-3:45	Agency Report, Open Michrophone
3:45-3:50	Closing Remarks: **Steve van der Hoven**, IGA Chair
30 minutes	IGA Executive Committee Meeting

ABSTRACTS

(In order of presentation)

Water Resources in South Africa

Walton R. Kelly
Illinois State Water Survey
kelly@sws.uiuc.edu

I recently spent a six month sabbatical from the Illinois State Water Survey in South Africa, where I taught and did research at two universities, the University of Fort Hare and the University of the Western Cape. South Africa is a water poor country, ranking in the bottom 20% worldwide in water availability. Truly perennial rivers are only found in about one quarter of the country, and the combined annual runoff of all rivers in the country is only about 13% of the Mississippi River. A further stress on water resources is climate change; a recent study suggested southern Africa will become even drier, with some rivers losing up to 70% of their flow in the next century. Most drinking water in South Africa comes from surface water sources; only about 13% of bulk water use comes from groundwater. There are probably fewer than 400 groundwater professionals at all levels in South Africa, and these individuals probably represent the majority of groundwater professionals in all of southern Africa.

The South African government has promised that all citizens will have access to a clean source of drinking water by 2010, and access to clean water is considered to be a fundamental human right that has been written into the South African constitution. Unfortunately, it is highly unlikely this goal will be met by 2010. South Africa has many of the same sources of groundwater contamination as the United States, but the number one priority in on-site sanitation. Water-borne diseases are estimated to kill 25,000 people worldwide per day, and sub-Saharan Africa is one of the most vulnerable regions. The most stressed areas are informal settlements, shanty towns that are found in most major metropolitan areas in sub-Saharan Africa, which typically rely on shallow groundwater but have seriously inadequate sanitation.

While at the University of Fort Hare in the Eastern Cape Province, a poor, rural region of South Africa, I participated in a research project with a microbiologist and geologist on the quality of groundwater, with an emphasis on bacterial quality. Groundwater is typically pumped from the well to a storage reservoir, from which it is gravity-fed to taps in villages or farms. Preliminary results indicated that > 60% of the sampled wells and reservoirs had detectable *E. coli*, and 20% had *Salmonella*. Reservoirs generally had worse quality than the wells, most likely due to the existence of biofilms in the distribution systems. Current research is assessing a silver filter technology developed at the University of Illinois Department of Materials Science to kill pathogenic organisms.

Environmental Geology Field Camp -- Training the Next Generation of Illinois Hydrogeologists to Collect and Interpret Field Data

Stephen J. Van der Hoven
Illinois State University

Melissa Lenczewski
Northern Illinois University

Many geologists today find employment in the environmental field. While the skills taught at traditional geology field camp are still relevant and useful, geologists working in the environmental field also require other field skills. Northern Illinois University and Illinois State University jointly run a field camp that teaches aspects of both a traditional field camp, a hydrogeology field camp with topics unique to an environmental field camp. This four week long field camp draws on the expertise, equipment, and facilities of both universities. Exercises are designed so that the students are directly involved with data collection, reduction, and interpretation. A strong emphasis is placed on quantitative aspects of data interpretation and the use of software to manipulate and display the field data.

One half of the camp focuses on measuring and monitoring water on and beneath the land surface. Activities include conducting aquifer and slug tests, infiltration tests, tracer tests, stream flow measurements, organic and inorganic water sampling techniques, and field measurement of water quality parameters. The other half of the camp covers Quaternary stratigraphy and soils, borehole logging and drilling techniques, and shallow geophysical techniques. The Quaternary and soils section includes field trips to familiarize the students with the regional geologic units and landforms. The final project for this section was mapping the surficial geology of a 7.5 minute quadrangle based on topography and drilling and analysis shallow cores. Techniques covered in the geophysics section included resistivity, conductivity, magnetics, and seismic refraction. The geophysical techniques are used to identify karst features, the water table, and buried anthropogenic features. We also include an exercise on stream ecology which compares the diversity of aquatic organisms in streams that receive wastewater effluent to streams receiving no effluent.

Overall, we believe that the students gain first hand experience with many of the major skills that a practicing environmental geologist uses today. While we do not expect that the students will be experts in any one technique, they will at least have some familiarity with the field techniques and how to organize and interpret hydrogeologic data.

Regional Groundwater Demands in the Mahomet Aquifer

Jack Wittman, PhD
Theresa Landewe
WHPA, Inc.
www.wittmanhydro.com

Central Illinois has relatively few major surface waters. As a result, much of the municipal, agricultural, and industrial water supply depends on high-capacity wells that extract water from the Mahomet Aquifer. The Mahomet Aquifer is a deep sand-and-gravel formation that is the downstream expression of a buried pre-glacial valley known as the Teays Valley in Indiana and Ohio. Currently, municipal water utilities, farmers, and ethanol plants are proposing new wellfields that would use this system. Declining groundwater levels in the region dictate that in the future, new wellfields must be developed in a way that does not damage existing users while expanding the sustainable supply. Because the Mahomet Aquifer is such an important water resource in Illinois, all water users are affected by regional trends in water demand. Similarly, new demands by any sector could affect the neighbors. This presentation describes why it is necessary to understand the increasing regional demand for drinking water, irrigation, and industrial supply in order to evaluate the long-term sustainability of the system. In light of the recent governors initiative it is critical that management and development of the Mahomet Aquifer is accompanied by a thorough understanding of regional hydrogeology, groundwater flow, and the continuing increase in water demand.

Overview of Hydrogeological Studies of the Buried Troy Valley and Related Shallow Aquifer Systems

Colin J. Booth
Department of Geology & Environmental Geosciences
Northern Illinois University

The Troy Bedrock Valley (TBV) is a major pre-Pleistocene drainage feature that enters Illinois from Wisconsin and swings southeast then southwest through western DeKalb County. During the Pleistocene, the valley was filled with outwash, till, and alluvial deposits, including sand and gravel aquifers that are now used for domestic, farm and city supplies. In DeKalb County, the Troy has little surface expression, but in the bedrock surface it is a steep-sided gorge with a fairly flat floor, some 1-2 miles wide and around 300 feet deeper than the adjacent Galena-Platteville Dolomite buried upland. Locally, the TBV cuts through to the underlying Ancell regional sandstone aquifer. Hydrogeological issues relating to the TBV include the glacial aquifer as a local water supply, the hydraulic relationship with the Galena-Platteville, recharge to the regional bedrock aquifer, the shallow recharge behavior, and the effects of urbanization on the overlying watersheds.

In addition to studies that have delineated the bedrock surface, hydrogeological studies of the TBV include those for the City of DeKalb's recent TBV well development (Baxter & Woodman, 1998-1999), a related ISGS aquifer and mapping study by Vaiden et al. (2004), and several NIU student theses. DeKalb's water supply is mostly obtained from the deep regional bedrock aquifer, but to provide for future demands, and to dilute the radium content in the bedrock water, the city constructed two wells into sand and gravel aquifers in the TBV. Vaiden et al. (2004) combined existing and new well data and geophysical data to produce new digitized maps of the TBV geology. They identified three principal sand and gravel aquifers: the thick, continuous basal Troy Valley Aquifer; a thinner middle aquifer in the upper Illinoian deposits; and an upper aquifer of Wisconsinan outwash extending beyond the TBV. All aquifers are used for rural domestic supplies; the middle and basal aquifers are locally in contact and are tapped by the DeKalb wells. A thesis study made in conjunction with the DeKalb well development (Boehmke-Zimmer) included modeling of the glacial aquifer and indicated that the watersheds and the TBV in this area west of DeKalb are local and regional recharge areas.

Western expansion of the city of DeKalb is now extending over part of the TBV and its watersheds. We are studying the effects of urbanization on recharge to the shallow aquifers and system. Research includes field budget and recharge studies of the Owens Creek watershed (Gillet) and GIS-based studies of shallow recharge, controlled by land use and type, in the Upper South Branch Kishwaukee System (Singhal). The Galena-Platteville dolomite, into which the TBV cuts, is a minor aquifer used by residential and farm wells. It was studied by Morrison (1996), who measured potentiometric heads and groundwater chemistry and showed that water flows from both the weathered upper bedrock zone and permeable horizons in the dolomite into the TBV. Future work (Greer) will focus on modeling the entire TBV system and the recharge through it into the Ancell regional aquifer.

Characterization and Estimation of Recharge to a Near Surface Glacial Aquifer in Owens Creek Watershed

Samuel Gillet
Department of Geology & Environmental Geosciences
Northern Illinois University

Owens Creek watershed overlies a section of the buried Troy Bedrock Valley west and northwest of DeKalb, Illinois. Generally northeast-southwest trending ridges of the Bloomington Moraine System dominate the landscape in this predominantly agricultural watershed. The Creek flows north to its confluence with the South Branch of the Kishwaukee River approximately 1.5 miles west of Kirkland, Illinois. Three sedimentary units (basal, middle, and upper), classified based on depositional environment, have previously been described within the glacially derived sediments that fill the Troy bedrock valley. Spatially variable sand and gravel deposits within each of these units comprise the basal, middle, and upper aquifers. Previous numerical modeling efforts suggest that the area west of DeKalb may constitute a recharge area for the glacial aquifers within the Troy Valley, and that flow directions diverge to the north and south along the valley from this area.

The current study combines hydrologic field data including well water levels, soil moisture, streamflow, and rainfall data collected from July 2005 to September 2006 with previous field measurements to characterize the groundwater flow system in the upper aquifer unit. Wells in this study are differentiated based on whether they reflect the water levels within the surficial water table system or the upper glacial aquifer unit. Differences in how the water table wells respond to seasonal spring recharge are believed to reflect the textural heterogeneities, and thus range of specific yield values, exhibited by the uppermost glacial sediments. Glacial aquifer water levels exhibit an apparent northerly decrease in potential within the upper aquifer unit, as well as more responsiveness to seasonal recharge in the southern part of the study area. This suggests a recharge zone to the south with possible discharge locations at the South Branch Kishwaukee River or the underlying middle unit aquifer in the vicinity of Kirkland. Hydrologic data collected during this investigation are currently being incorporated into a water balance model for the upper unit aquifer in order to estimate local recharge rates for the Owens Creek Watershed area.

Temporal and Spatial Variability of Groundwater Recharge: A GIS Based Study in the Upper S. Branch Kishwaukee Watershed, DeKalb County, IL

Alka Singhal
Department of Geology & Environmental Geosciences
Northern Illinois University
asinghal@niu.edu

Effective groundwater management requires the reliable estimation of the hydrologic budget and groundwater recharge at local, sub-watershed scales. Using a soil-water balance model combined with Geographic Information System (GIS) methods to delineate spatial data, annual recharge rates in a sub-watershed of the Kishwaukee River in DeKalb County, IL, were estimated for three different years (1996, 2000 and 2005). These years were chosen to represent both extreme and average weather conditions. The input parameters include basic soil characteristics, land cover, daily precipitation, potential evapotranspiration and plant moisture availability. The calculated output includes actual evapotranspiration, runoff and infiltration rates. Actual ET was calculated using a two-parameter model (Zhang et al. 1999) and the run-off was calculated using the NRCS (SCS) curve number method. As spatially variable phenomena, the hydrologic parameters are best characterized using GIS techniques, which are also being used to identify combinations of soil type and land use for recharge estimates.

Although the bulk of the watershed is still largely rural, the area is undergoing rapid urbanization and in the north is largely urban. Urban development as delineated through GIS and used as a factor in estimating spatially variable recharge rates. The calculated areal recharge is, as expected, a function of soil type and land-cover. In forest or agricultural areas, recharge rates are high on sandy soil and low on clayey loamy soil; they are also low on urban land-cover. The spatial variation is large, with calculated recharge rates ranging from 0.2 to 13 inches per year. Temporal variation results from changing weather parameters like precipitation and temperature. The recharge estimates determined by GIS are being used as an input parameter for a groundwater flow model of the area. To make the calculations more reliable and efficient, the model is automated using the ArcGIS 9.1 model building tool and Python script.