Illinois Groundwater Association

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2007 Spring Meeting

Levis Faculty Center, University of Illinois, Urbana, Illinois
March 28, 2007

Program with Abstracts

Agenda
Illinois Groundwater Association
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8:30–9:15 Registration
9:15–9:45 Opening Remarks, **Don Keefer**, IGA Chair

Morning Session

9:45- 10:15 **Kristine Karuhn**, *Northern Illinois University*, Impacts of High-Density Septic Systems on Surface and Groundwater Quality and Quantity

10:15-10:45 **Carol Fuller**, *Illinois EPA*, Review and Summary of Illinois Community Right-to-Know Legislation

10:45-11:15 **BREAK**

11:15-11:45 **Rick Cobb**, *Illinois EPA*, Demonstration of Illinois EPA Source Water Assessment Program On-Line Interactive Database

11:45-12:15 **Presentation of the 2007 Illinois Groundwater Science Achievement Awards** ***to Bill Dixon and Bob Sasman***

12:15-1:45 **Lunch**

Afternoon Session

1:45-2:15 **Keith Hackley, Sam Panno,** *Illinois State Geological Survey and* **Thomas Anderson,** *Department of Geology, University of Illinois,* Groundwater Evolution in the Mahomet Aquifer: Implications for Recharge, Rock-Water Interactions and Mixing

2:14-2:45 **Ed Glatfelter**, *Illinois State Water Survey*, Governor's Executive Order 2006-01 and the Status of the Regional Water Supply Planning Groups

2:45-3:15 **Anirban Basu**, *Illinois State University*, Quantification of Flux of Nitrogen between Surface Water and Groundwater

3:15-3:45 Agency Report, Open Microphone

3:45-3:50 Closing Remarks: **Don Keefer**, IGA Chair

3:50 IGA Executive Committee Meeting

ABSTRACTS

(In order of presentation)

High-Density Septic Systems and Ground/Surface Water Quality and Quantity

Kristine Karuhn
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Septic systems are widely used throughout the country as a source of wastewater disposal. While generally convenient and cost effective, particularly in rural areas, the effects of septic systems on the surrounding environment becomes more complicated in high density areas. This study utilized a lake community dependent on septic systems of approximately 1,700 homes in northern Illinois occupying approximately 7 square kilometers (2.7 square miles). The dammed lake occupies 1.3 square kilometers (0.5 square miles) and is at an elevation of 193.2 meters (634 feet) above mean sea level (AMS) and is located downstream from agricultural land, horse farms, and golf courses. The lake suffers from algae problems which results in an unpleasant smell and increased sediment buildup on the bottom of the lake as the algae die. The algae problem is likely due to eutrophication of the lake. Excess nutrients are likely from multiple sources including upstream farmland and golf courses as wells as locally from the home septic systems.

The purpose of this study was to determine the effects high density septic systems have on groundwater and surface water quality and quantity. This was to be done in four ways: 1) analyze water samples for inorganic compounds such as ammonia, nitrates, and phosphates; 2) analyze water samples for fecal coliform bacteria; 3) use pharmaceuticals as tracers of septic system contamination; 4) model the groundwater flow of the area using MODFLOW.

For this study four shallow monitoring wells (P1-P4) were installed around the lake. The four wells and two lake locations were monitored every two weeks between October 2005 and October 2006. Ammonia, nitrates, alkalinity, chlorine, dissolved oxygen, and phosphates were tested for using a Hach chemistry test kit. Nitrates, phosphates, chloride, and fluorine were tested for using a Dionex HPLC. Over the course of the year well P2 consistently demonstrated higher levels of the parameters, including ammonia and nitrate. The reason for the elevated levels at P2 compared to the other wells is suspected to be the location of the well which is in the direct vicinity of septic systems, whereas the other three wells are located in more open community green areas. The elevated levels of nutrients in the groundwater near septic systems are cause for concern, as it is likely the septic systems are also contributing to the lake water. The next step in this process is to examine the ground and surface water for the presence of pharmaceuticals, which would show definitively that there is an anthropogenic source contributing to the lake quality issues.

Community Right-to-Know Overview

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Overview of Right to Know Law (PA 094-314), Background and Implementation - Illinois EPA will present background regarding the need for this law, which came about due to discovering groundwater contamination from an industrial area that affected hundreds of private wells in several areas of DuPage County. The law compels the Agency to provide timely notification to private property owners, particularly those with private wells, about contamination in groundwater or soil that may pose a threat to human health. The presentation will include information about implementation of the rules for notification.

Demonstration of Illinois EPA Source Water Assessment Program On-Line Interactive Database

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Illinois EPA worked with the USGS, ISWS, and ISGS to develop the Source Water Protection (SWAP) Internet GIS. Illinois EPA has been working on enhancing the database engine for the SWAP Internet GIS. A live Internet demonstration will be presented that will provide a preview of the new system before going public.

Groundwater Geochemistry in the Mahomet Aquifer: Implications for Recharge, Rock-Water Interactions and Mixing

K. C. Hackley, *Geochemist, Illinois State Geological Survey,*
S.V. Panno, *Geochemist, Illinois State Geological Survey,*
and **T. F. Anderson,** *Emeritus Professor, Geology Department, University of Illinois*
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The Mahomet aquifer (MA) is a major resource of drinking water for about 800,000 people in east-central Illinois. The aquifer is made up of sands and gravels from glacial outwash deposits which fill the basal portion of the Mahomet Bedrock Valley extending from western Indiana to central Illinois. The MA intersects the north-south trending Mackinaw Bedrock Valley forming a large confluence area with the Sankoty-Mahomet aquifer (SMA) in Tazewell Co. The basal sands are buried by less permeable clay rich glacial tills which are intercalated with smaller, less extensive sands and gravel that make up shallow locally important aquifers.

This investigation examines the chemical and isotopic geochemistry of about 80 groundwater samples collected primarily from the MA and SMA as well as from the shallower less extensive aquifers in the bedrock valleys. The chemical and isotopic results show significant variations from the Indiana border westward to central Illinois. Significant chemical differences can be observed in the basal sands of the MA and SMA. The central and eastern portion of the MA (Champaign, Ford and Vermillion Co.) exhibits low chloride (Cl) concentration and ^{14}C values around 30 pMC. Further west, from Piatt to Tazewell Co., significant increases in the sodium (Na), Cl, methane and DOC concentrations occur. Isotopically, the ^{14}C values show a continuous decrease in the western portion of the MA and the $\delta^{13}C$ values become more positive. In the confluence area of Tazewell Co. there is a dramatic reversal in the chemical and isotopic trends in the basal sands. The confluence area shows a drop in the Na and Cl concentrations and a rapid increase in ^{14}C activity. The northeastern portion of the MA, in Iroquois Co., shows the largest concentrations of sulfate compared to the rest of the aquifer. This northeastern section exhibits a different pattern of chemical and isotopic characteristics with high sulfate, low ^{14}C activity, and rather negative $\delta^{13}C$ values compared to the rest of the MA.

The significant variability observed in the chemical and isotopic composition across the Mahomet and Sankoty-Mahomet aquifers are used to define the geochemical evolution of the groundwater, including the microbial processes and possible mixing of different groundwater sources. The results suggest that the central region, Champaign Co and Ford Co is an area of primary recharge. The western part of the MA (DeWitt and McLean Co.) is an area basically isolated from surficial recharge exhibiting strong reducing conditions, microbial methane production, and characteristics of bedrock saline seeps. The northeastern portion of the MA also shows influences of bedrock seepage and significant microbial reduction of sulfate. The characteristics of the SMA in the confluence area suggest mixing of groundwater flowing from the MA with significant surficial recharge. Although the MA and SMA are not structurally or mineralogically complicated, the chemical and isotopic characteristics of the groundwater is quite variable, revealing several important aspects of the groundwater evolution and recharge.

Governor's Executive Order 2006-01 and the Status of the Regional Water Supply Planning Groups

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This presentation will review the Governor's Executive Order 2006-01 calling for a statewide water supply planning and management initiative. It will discuss the history behind the Executive Order going back to the term of Governor Edgar. It will review the characteristics of the approach laid out in the Executive Order: pilot planning in two priority areas; grass-roots regional planning; science based planning; and planning within existing laws and regulations. It will also review the process used to form the two grass-roots regional planning groups, the current status of these groups, and how to keep track of the planning process.

Quantifying Nitrogen Cycling Between Surface Water and Groundwater in a Low Gradient Stream in an Agricultural Setting

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The aim of this study is to characterize stream-groundwater exchange at the fluvial plane scale in terms of mass flux of nitrogen in a low gradient agricultural setting where major non-point sources of nitrogen are nitrogen fertilizers and biodegradation. A numerical model will be combined with the concentrations of major N species (NO_3^-, NH_4^+, and dissolved organic nitrogen (DON)) to estimate mass fluxes of N into and out of the stream. Water samples have been collected from the stream and a network of wells installed to monitor major ions and concentrations of dominant nitrogen species. Stream water showed high NO_3^- concentration (10 mg N/L) during winter and spring and very low to non detectable NO_3^- concentration during summer and fall. Groundwater DON concentrations were low (around 1 mg N/L) in the floodplain samples (away from the stream) whereas it is much higher (0.9 to 2.9 mg N/L) in the meander samples during summer. Samples both from the floodplain and the meanders show considerable decrease (0.56 to 1.5 mg N/L) in DON concentrations during fall. NO_3^- is below the detection limit for most of the groundwater samples. Where detected (primarily in meander samples) NO_3^- concentrations range from 0.2 to 1.5 mg N/L. NH_4^+, detected in most groundwater samples, range from 0.01to 9.74 mg N/L. The samples collected from the meanders show the highest concentration (0.03 to 9.74 mg N/L) of NH_4^+. The highest concentrations of NH_4^+ have been observed during the summer (0.4 to 9.74 mg N/L) during the summer. The concentrations of DON and NH_4^+ decreases with the meander width owing to smaller flow path and less residence time in meanders with shorter width. Results of the present study indicate that the groundwater reservoir serves as a source or a sink for N depending on the amount of nitrate in the stream water. During winter and spring when the stream NO_3^- concentrations are high, groundwater acts as a sink due to denitrification as stream water flows beneath the meanders. And during summer and fall, when the stream NO_3^- is low, groundwater serves as a small net source due to discharge of DON and NH_4^+ to the stream. Discrete seasonal Cl^- plumes due to road salting enter the hyporheic exchange zones from the stream and flow beneath the meanders, and can be used to calibrate the numerical model. This study provides a conceptual model for a numerical model to quantify mass fluxes of dominant nitrogen species and groundwater flow where three independent parameters, hydraulic head, stream discharge and Cl^- will be used to calibrate the 3D steady state groundwater model.