2004 Spring Meeting

April 22, 2004
Starved Rock Lodge & Conference Center
Utica, Illinois

Agenda and Abstracts

FINAL AGENDA

ILLINOIS GROUNDWATER ASSOCIATION
2004 SPRING MEETING
APRIL 22, 2004

8:00-9:00	Registration (Coffee & Doughnuts/Muffins/Bagels served)
9:00-9:10	Opening Remarks: **Randy Locke**, IGA Chair
9:10-9:30	**Bev Herzog**, Illinois State Geological Survey, *National Perspectives on Groundwater Sustainability Issues: Results from an NGWA Survey*
9:30-9:50	**Al Wehrmann**, Illinois State Water Survey, *An Analysis of Groundwater Use to Aquifer Potential Yield in Illinois*
9:50-10:10	**George Groschen**, U.S. Geological Survey, *Highlights of the Upper Illinois River Basin NAWQA Intensive Data Collection, 1999-2001*
10:10-10:30	**Steve Kroll**, IGA Grant Recipient, Northern Illinois University, *Influence of Oxygenates on the Fate and Transport of BTEX Compounds in Fine-Grained Soils*
10:30-10:50	**Break & Networking Time**
10:50-11:10	**Erik Spande**, CH2M-Hill,Chicago, *Horizontal Drilling Mud Release Investigation at Detrana Fen, McHenry County, Illinois*
11:10-11:30	**Feng Yue**, University of Illinois, Urbana, *Web-Based Interactive Simulation of Groundwater Flow and Transport*
11:30-11:50	**John Baker**, Alan Environmental, Downers Grove, *Overview of Environmental Isotopes and Their Utilization in Gas and Groundwater Investigations for Landfills*
12:00-1:15	**Lunch** (Pasta Buffet served in Great Hall)
1:15-1:35	**Dr. Robert Gibbons**, University of Illinois at Chicago, *A Statistical Approach for Performing Water Quality Impairment Assessments*
1:35-1:55	**Business Meeting/Open Microphone**
2:00-4:00	**Field Trip** in the Park, led by **Bob Vaiden & Sallie Greenberg**, Illinois State Geological Survey
	Adjourn

Presenters are in bold type

ABSTRACTS

(In order of presentation)

National Perspectives on Groundwater Sustainability Issues:
Results from an NGWA Survey

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Groundwater sustainability was recently determined to be the issue of most importance to members of the National Ground Water Association (NGWA). State geological surveys and NGWA members were surveyed to learn what the specific issues are and what the federal role should be. The questionnaire asked if the respondent's state currently has or expects a groundwater shortage, what types of groundwater information they have and how good it is, what types of information would they concentrate on if they had more resources, and what should the federal government do to help meet information gaps. Most states have or expect at least localized urban or rural groundwater shortages within the next ten years, most have a "reasonable" estimate of the potential yield of major aquifers, but few states have met their goals in collecting any type of groundwater data. State geological surveys and NGWA members are in close agreement on both data needs and what the federal role should be. Data needs rating a high priority on both lists include: hydraulic properties of major aquifers, groundwater level monitoring network, accurate water use data, water quality for all aquifers and groundwater recharge rates. Increased funding for coop programs on groundwater quantity data collection, groundwater quality data collection, and aquifer mapping, along with increased research related to groundwater availability top both lists for the federal role.

An Analysis of Groundwater Use to Aquifer Potential Yield in Illinois

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Proper water resource planning and management requires a firm understanding of water use and water resource availability. This talk summarizes a comparison of Year 2000 groundwater withdrawals against estimated aquifer potential yields. The comparison is presented as a ratio of groundwater use (withdrawals) to groundwater yield (i.e., potential aquifer yield) on a township basis. Geographical Information System (GIS) technology was used to determine township use-to-yield ratios for three aquifer types (sand-and-gravel, shallow bedrock, and deep bedrock).

A high use-to-yield ratio (e.g., >0.9) suggests an area where groundwater availability problems exist or could be impending. The area of influence of a well or well field often may extend beyond the township boundaries in which the pumpage is occurring. In such cases, township aquifer potential yields may appear to be approached or exceeded even though the withdrawal does not exceed total aquifer potential yield. Therefore, the delineation of high groundwater use-to-yield areas by this method should be considered simply as a means for calling attention to areas to prioritize on a statewide basis for water resources planning and management.

Comparing groundwater withdrawals to potential aquifer yields in a GIS format is a useful technique for drawing attention to areas where stresses may occur (or are occurring). However, such analysis can not be substituted for local-scale investigations, particularly those that incorporate detailed information into groundwater flow models that can accurately assess local conditions. Areas may be unduly highlighted where large, relatively isolated, withdrawals occur within an extensive aquifer, such as occurs in the Mahomet aquifer near Champaign in east-central Illinois. The effects of such pumpage will be spread across a larger area than the townships where the wells are located, smoothing the use-to-yield ratio over a larger area. In at least one other area near East St. Louis, the withdrawal in one township is intentionally greater than the potential yield for purposes of dewatering to protect below-grade highway roadbeds.

However, areas where the aquifer may be confined to a narrow valley, where multiple pumping wells are located within a small area, or where withdrawals do indeed exceed the estimated recharge rate can be identified (e.g., Fox River valley, Peoria, Lewiston, Normal). Certainly, areas where multiple townships exhibiting high use-to-yield ratios are clustered together (e.g., the deep bedrock of northeastern Illinois) should signify locations where additional research, data collection, and water resource planning may be warranted.

Highlights of the Upper Illinois River Basin NAWQA Intensive Data Collection, 1999-2001

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Stream and River Highlights

During 1999-2001, water quality in upper Illinois River Basin streams and rivers largely reflected the amount of agricultural or urban land in their basins. Concentrations of chemicals in stream water occasionally exceeded guidelines for the protection of aquatic life and drinking water, such as for nitrate, phosphorus, diazinon, and organic wastewater compounds. Concentrations in the Des Plaines and Kankakee Rivers were least likely to exceed standards and guidelines. Although area streams and rivers generally are not used as drinking-water sources, elevated concentrations can affect aquatic wildlife and the quality of water for downstream Illinois River water users.

- The ammonia concentration (flow-weighted mean) at the Chicago Sanitary and Ship Canal at Romeoville was 0.64 mg/L (milligrams per liter), the highest measured in the upper Illinois River Basin and the fourth highest of 109 streams and rivers measured nationwide by the NAWQA Program during 2000-01.

- Nitrate concentrations of 12.3 mg/L (flow-weighted means) at the agricultural stream sites Sugar Creek at Milford and Iroquois River near Chebanse were the highest among 109 streams sampled during 1999-2001 for the NAWQA Program nationwide.

- Natural features (including glacial geology, soils, and hydrology) and land-management practices (including artificial drainage) affect nutrients in streams, as indicated by nitrogen in runoff at the Iroquois River near Chebanse and the Kankakee River near Momence, Ill.

- Herbicides were detected frequently in streams and rivers, particularly those draining agricultural land. For example, atrazine was detected in every sample from streams and rivers draining agricultural or mixed land-use watersheds.

Trends in Stream-Water Quality

- Ammonia concentrations decreased during 1978-97 in areas where sewage-treatment processes were enhanced, but nitrate concentrations increased. The enhancements transformed ammonia to nitrate, making effluent less toxic to fish.

- Detections of alachlor and cyanazine have decreased in streams and rivers since the early 1990s because of decreased use of these herbicides.

Ground-Water Highlights

Ground water is the largest source of drinking water in the upper Illinois River Basin (15 percent of the drinking water), except for Lake Michigan (82 percent). Commonly used herbicides and nitrate were less frequently detected in well-water samples than in stream and river samples.

- Shallow ground water in the upper Illinois River Basin generally meets drinking-water standards and guidelines; standards or guidelines have not been established for many pesticides and most breakdown products detected.

- Detections of synthetic chemicals were frequent in samples collected from monitoring wells and domestic-supply wells in recently urbanized areas. For example, volatile organic compounds (VOCs) were detected in 75 percent of the well samples. At least one pesticide, pesticide breakdown product, or VOC was detected in 90 percent of the wells. However, concentrations were near the laboratory method detection limit, and none of these constituents exceeded drinking-water standards or guidelines.

- Ground-water recharge is reduced in urban areas because of widespread impervious surfaces, such as roads and parking lots. Urbanization effects on potential recharge, along with droughts, could affect ground-water supplies.

- Shallow ground water collected from monitoring wells and domestic-supply wells exceeded the drinking-water standard for nitrate in only two wells.

- Breakdown products of pesticides were detected in 60 percent of these agricultural-area wells; however, no pesticide or breakdown product exceeded drinking-water standards or guidelines. Breakdown products of acetochlor, alachlor, and metolachlor were detected more frequently and at higher concentrations than were their parent compounds.

Influence of Oxygenates on the Fate and Transport of BTEX Compounds in Fine-Grained Soils

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The use of methyl tert-butyl ether (MTBE) as a fuel oxygenate is currently being phased out with ethanol being the most likely replacement in most areas. Ethanol has been shown to have an influence on the biodegradation of petroleum hydrocarbons in the environment with the possibility of increased plume lengths. An experiment was conducted to determine the influence of ethanol on the biodegradation of benzene, toluene, ethylbenzene, and xylene (BTEX) in fine-grained material (loess) from northern Illinois. Three undisturbed columns (0.3 m in diameter by 0.4 m long) of loess were collected from approximately 1.7 to 2 m depth at an uncontaminated site at Northern Illinois University, DeKalb, Illinois. Natural, uncontaminated groundwater was spiked with either a mixture of BTEX or BTEX and ethanol and continuously pumped through two of the columns. A third column was continuously fed uncontaminated groundwater. Effluent concentrations of BTEX were significantly higher in the ethanol-amended column. Ethanol biodegradation lowered the pH, increased the conductivity, and altered the redox conditions compared to the two columns without ethanol. The biodegradation rates of benzene in the two experimental columns were determined. Benzene was biodegraded in the presence of ethanol, but at a substantially lower rate than benzene without ethanol addition. This effect was only noted for the first 60 days of the experiment and by day 90 the biodegradation rates of benzene were similar in both columns. The biodegradation rates of benzene were used to model the possible increase in benzene plume length due to the addition of ethanol to gasoline. Transport modeling indicated an increase in plume length between 34% and 68%. Although ethanol hinders the biodegradation of BTEX, it is still an environmentally sound replacement for MTBE.

Horizontal Drilling Mud Release Investigation at Detrana Fen, McHenry County, Illinois

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Drilling mud was released under the Detrana Fen during horizontal directional drilling operations conducted during the installation of a 36-inch natural gas pipeline in November of 2001. Bentonite-based drilling mud emerged at ground surface at three locations within the fen in a 50-ft by 50-ft area. The effects of the release were surveyed and bentonite was recovered, and an initial assessment was conducted in early 2002 that evaluated the surficial hydrogeology and makeup of the suspected bentonite-impacted soils. A follow-up investigation performed in January 2003 refined the understanding of the shallow hydrogeology, and assessed the deep hydrogeology, hydraulic responses at the fen at the study area over time, and groundwater chemistry to determine if the fen had been impacted by the bentonite release.

The hydrogeological characterization shows that the site has 10 to 20 ft of organic-rich and fine grained (silts and clay) soils at the ground surface with an intermittently present peat layer within the fine-grained soil that is up to 2.5 ft thick. Fine-grained soils and peat are underlain by over 40 feet of sand and gravel glacial outwash. High ground covered in grass, shrubs, or mature oak trees surround the Dentrana Fen area. Groundwater levels in piezometers screened above the peat and wells below the peat are occasionally artesian, and the deep well screened near the pipeline (approximately 50-ft below ground surface) is consistently artesian. Vertical gradients were consistently upward during the monitoring period. Horizontal groundwater flows were toward local streams and open surface water bodies.

Results from these investigations show that the fen had not been measurably impacted by the bentonite release. No evidence of bentonite drilling mud was identified in the 16 borings completed in the 50-ft by 50-ft study area, indicating that the areas where bentonite did emerge at ground surface were vertical features and that the extent of bentonite is not likely to be widespread. Wells inside and outside the release area showed hydraulic responses consistent with upwelling groundwater typical of fens, and all wells behaved in a similar manner indicating that the hydraulic connection at the site had not been effected by the release. Groundwater parameters and analytical results for all wells were within expected ranges for Midwestern temperate zone fens, showing that bentonite, which does not typically impact groundwater chemistry, had not impacted the study area's groundwater character.

Web-Based Interactive Simulation of Groundwater Flow and Transport

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A series of interactive web simulation models were developed to help students understand the subject of groundwater flow and solute transport that includes physical, chemical, and biological processes. Conventional mathematical models that simulate groundwater systems are often too complex to serve as a readily learning tool. Commercially available simulation codes are cumbersome because they have awkward user interfaces and require installation on local computers. Web-based technology has the potential to overcome these difficulties. Users can remotely access our interactive simulation models programmed as Java applets through web browsers. They can rapidly visualize the moving path and pattern of groundwater and chemical particles and the impact of changes to parameter values and boundary and initial conditions for different types of reaction processes. Presently, our online models include: non-reactive and reactive diffusive transport, 1D and multidimensional non-reactive and reactive solute transport, and 2D steady flow in homogeneous and heterogeneous aquifers. In this presentation, several examples will be illustrated to show the effectiveness of these interactive web models as an innovative instructional tool for study of groundwater.

URL: http://www.cee.uiuc.edu/transport/
Web browser must be Java-enabled

Overview of Environmental Isotopes and Their Utilization In Gas and Groundwater Investigations for Landfills

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Environmental isotopes have been used over the last 30 years for environmental and hydrogeologic studies. The isotopes of Hydrogen- deuterium and tritium, Carbon-C-13 and C-14, and Oxygen-O-18 are the most commonly used. Isotopes, along with geochemical data can be used for demonstrating if hydraulic connection occurs, especially with a landfill and groundwater and for determining sources of contamination. Studies done at many Waste Management, Inc. landfills have shown that alternate sources of VOCs, for example, can be determined. Early work with Dennis Coleman, owner of Isotech Labs, Urbana, Illinois, and the IGS and IWS have shown unique characteristics of MSW landfill leachate that are unique to industrial sources. Also landfill gas is found to have unique isotopic fingerprints. Using these methods, a case study will show that most VOCs found in groundwater near MSW landfills are from landfill gas, not leachate.

Coleman has also shown methods of determining sources of methane migration using fingerprints of thousands of samples of methane from thermogenic, microbrial, and fermentation sources. Also, sources within a large landfill or nearby landfills can show unique isotopic signatures that can determine sources of methane in the vadose zone. A case study will be presented that shows how to determine which landfill had the methane release.

A Statistical Approach for Performing Water Quality Impairment Assessments

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A statistical approach for making Total Maximum Daily Load (TMDL) impairment decisions is developed as an alternative to the simple tally of the number of measurements which happen to exceed the standard. The method insures that no more than a small (e.g., 10%) percentage of water quality samples will exceed a regulatory standard with a high level of confidence (e.g., 95%). The method is based on the 100(1-alpha) percent lower confidence limit on an upper percentile of the concentration distribution. Advantages of the method include: (1) it provides a direct test of the hypothesis that a pre-specified percentage of the true concentration distribution exceeds a regulatory standard, (2) it is applicable to a wide variety of different statistical concentration distributions, (3) it directly incorporates the magnitude of the measured concentrations unlike traditional approaches, and (4) it has explicit statistical power characteristics (i.e., what is the probability of missing an environmental impact). Detailed study of the simple tally approach reveals that it achieves high statistical power at the expense of unacceptably high false positive rates (30% to 40% false positive results). By contrast, the statistical approach results in similar statistical power while achieving a nominal false positive rate of 5%.

Geologic Field Trip in Starved Rock State Park

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