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2004 Fall Meeting

November 17, 2004
Fermi National Accelerator Laboratory
Batavia, Illinois

Agenda and Abstracts

AGENDA

Illinois Groundwater Association
2004 Fall Meeting
November 17, 2004
Fermi National Accelerator Laboratory, Batavia, Illinois

8:15-9:00 Registration with refreshments

9:00-9:15 Opening Remarks: **Randy Locke**, IGA Chair

Morning Session

9:15-9:35 **Darin St. Germain**, USFilter WTC, *Treatment Options for Drinking Water Supplies to Comply with the New Stricter Arsenic Standard*

9:35-9:55 **Timothy P. Farrell,** Engineering Enterprises, Inc., *Water Works System Improvements, United City of Yorkville, Illinois*

9:55-10:15 **Gerald J. Dalsin**, Illinois Department of Public Health, *Updates on the Illinois Water Well Code, the Water Well and Pump Installation Contractor's License Act and Closed Loop Wells*

10:15-10:30 **Break**

10:30-10:50 **Business meeting and time for announcements**

10:50-11:10 **William Morrow**, United States Geological Survey, *Anthropogenic Constituents in Shallow Groundwater in the Upper Illinois River Basin*

11:10-11:30 **Walton R Kelly, Steven Wilson**, and **George Roadcap**, Illinois State Water Survey, *Effects of Urban Activities on Shallow Groundwater Quality in the Chicago Metropolitan Area*

11:30-1:00 **Lunch**

Afternoon Session

1:00-1:30 **Richard P. Cobb**, Illinois Environmental Protection Agency, *Groundwater Protection Regulatory Amendments and Other Regulatory Updates*

1:30-1:50 **Van C. Bowersox**, Illinois State Water Survey, *Monitoring Chemical Climate Change in America*

1:50-2:10 **Steven Wilson, H. Allen Wehnmann, Jonathan Foote**, and **Kingsley Allan,** Illinois State Water Survey, *GWINFO and ArcIMS - Development of the ISWS Groundwater Databases for Staff Accessibility and the Web*

2:10-2:30 **Break**

2:30-3:00 **Chris Cahnovsky** and **Gina Search**, Illinois Environmental Protection Agency, *Groundwater Investigation and Vapor Mitigation in Hartford, Illinois*

3:00-3:20 **Norbert W. Golchert**, Argonne National Laboratory, *Phytoremediation at Argonne National Laboratory*

3:20-3:40 **Diane M. Lamb**, Illinois State University, *Nitrate Transport in the Vadose and Shallow Saturated Zones under a Tiled Bloomington, Illinois Research Farm*

3:40 Informal Presentation and Tour of Fermi

4:00 Adjourn and IGA Executive Committee Meeting

Treatment Options for Drinking Water Supplies to Comply with the New Stricter Arsenic Standard

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On January 23, 2006 the new Arsenic Rule will be in effect which reduces the Maximum Contaminant Level from 50 parts per billion (ppb) to 10 ppb. By comparison, few water treatment regulations have affected the number and size of systems. Over 3,000 systems total are affected by the revised rule with the majority of these being very small systems of 25-500 population served.

A multitude of arsenic removal treatment options exist to address this new regulation. Most of the treatment techniques are well established and have been in full scale practice for decades. These treatment options include anion exchange, activated alumina, reverse osmosis and iron co-precipitation with filtration. As a result of tightening European Union and US regulations adsorption media have also been developed specifically for the removal of arsenic. Adsorption media offer the advantage of chemical feed treatment, simplified operating requirements and minimal liquid waste.

The practicality of treatment options for full-scale treatment requires a careful examination of site conditions and influent water quality to determine the most economical approach for a specific plant. While some treatment alternatives offer simplified operation and low waste disposal, they may not be applicable to a given system due to other constraints.

This presentation describes the widespread effect the new arsenic rule has on water systems. A review of applicable technologies from a practical implementation standpoint and description of application guidelines for a given process is included along with a discussion on the most commonly used processes.

Water Works System Improvements, United City of Yorkville, Kendall County, Illinois

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The United City of Yorkville has taken a proactive approach to properly plan and execute improvements to their Water Works System in light of the recently promulgated radium regulations and the significant amount of controlled growth currently underway in the City. In November 1999, Engineering Enterprises, Inc. (EEI), Sugar Grove, IL was commissioned by the City to prepare a study entitled “Water Works System Needs Assessment and Project Plan.” The original goal of the study was to develop a strategy to meet the rules for the Maximum Contaminant Level (MCL) for combined Radium 226 and 228. However, because of the recent and expected continued surge in residential and commercial growth in the City, the study was expanded to include a needs assessment to evaluate potential water supply, treatment, distribution, storage and SCADA improvements necessary to keep pace with development.

Because of the unique location of the United City of Yorkville, there are three sources of water supply available including shallow consolidated and unconsolidated aquifers, deep consolidated aquifers, and surface water from the Fox River. To delineate the previously unmapped bedrock valley through the northern portion of Kendall County, the City financed a geological reconnaissance study as an integral part of the “Needs Assessment and Project Plan.” While numerous studies had previously been completed in Kane County to the north of Yorkville’s planning area, the mapping of the sand and gravel deposits in Kendall County had never been completed before. By assembling and evaluating the existing geological information, the Aurora Bedrock Valley in northern Kendall County was delineated. The information provided in the geological reconnaissance study will be used as a planning guide for acquiring land for potential future shallow groundwater well sites and to control land use in the delineated bedrock valley area to protect this important resource.

After the Aurora Bedrock Valley was delineated, the plan progressed into a cost-effective supply and treatment evaluation. By evaluating nine (9) alternatives encompassing three (3) source water options and four (4) treatment technologies, the most cost-effective viable supply and treatment option was determined. The treatment technologies evaluated included blending, lime softening, reverse osmoses and cation exchange, all recognized by the IEPA as Best Available Technologies for radium treatment.

Using the Water Works System Needs Assessment and Project Plan as a “road map” for implementing cost-effective improvements, the City selected EEI to design and oversee construction for $24.2 million of Water Works System improvements. These projects include four (4) deep sandstone wells, four (4) cation exchange treatment facilities, three (3) elevated water storage tanks, approximately 7.9 miles of water main, two booster pumping and pressure reducing valve (BP/PRV) stations, two pressure reducing valve (PRV) stations and a SCADA system.

Updates on the Illinois Water Well Construction Code, the Water Well and Pump Installation Contractor's License Act and Closed Loop Wells

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Amendments have been proposed to clarify existing requirements and establish new ones in the Illinois Water Well Construction Code. Currently, it is not clear as to what depth the annular space is to be grouted for drilled wells. The new language would specify to grout the entire annular space. Shale traps, cementing baskets, packers or other devices would not be allowed to suspend grout above an open annular space. A minimum grouting depth of 60 feet would be allowed in those situations where the contractor is unable to maintain an open annular space. Subsections were established for grouting through the casing, or Haliburton method, flowing artesian wells, and standards for bored well construction materials.

There have been discussions between the water well industry, local health departments and the Department to amend the Water Well and Pump Installation Contractor's License Act. Under the proposal, licensed water well contractors would be allowed to install pitless well adapters and pitless units; licensed water well pump installers would be allowed to extend water well casing from a maximum depth of 10 feet below the ground surface and seal abandoned private and semi-private wells; and an individual who are not a licensed water well contractor would be able to seal an unused dug well on land for which he or she is a representative of the owner. License fees for water well and pump installation contractors have been the same for over 30 years. The proposed language would double the fees for taking the contractor license examinations and essentially triple the fees for license renewals.

There have also been discussions between the above groups to amend the Illinois Water Well Construction Code, regarding closed loop wells and the water well construction permit fee. Closed loop contractors would have to be registered or certified by the Department. The construction of closed loop wells would have to be permitted at a fee of $200 for each closed loop well system. The water well construction permit fee would be increased from $100 to $200. This fee has not increased since the Groundwater Act became effective on January 1, 1988.

Anthropogenic Constituents in Shallow Groundwater in the Upper Illinois River Basin

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As part of the U.S. Geological Survey's National Water-Quality Assessment program, groundwater samples for analysis of volatile organic compounds (VOCs), pesticides, and nitrate were collected from 43 wells in shallow (175 feet deep or less) glacial deposits overlying a major bedrock aquifer in recently urbanized areas in the Chicago, Ill. and Milwaukee, Wis. metropolitan counties. Constituent detections were identified by use of two reporting levels – a laboratory reporting level (more restrictive) and an information-rich method (more restrictive). For the laboratory reporting level, the risk of a false positive or false negative detection is less than or equal to 1 percent. For the information-rich method level, estimated concentrations are identified positively and are qualified to be present on the basis of quality-control criteria, but have a higher risk of false positive detections.

VOCs were detected in 32 percent (12 of 38) of the well samples with 15 detections of 7 VOCs, based on laboratory reporting levels. Concentrations ranged up to 4.6 micrograms per liter (µg/L), with a median concentration of 0.13 µg/L. Methyl *tert*-butyl ether (MTBE) and chloroform were the most common with detections in 10 percent (4 of 38) of the samples. Using information-rich method reporting levels, VOCs were detected in 74 percent of the samples with 37 detections of 15 VOCs. Chloroform was most common with detections in 24 percent (9 of 38) of the samples.

Pesticides and/or pesticide transformation products were detected in 62 percent (26 of 42) of the samples with 83 detections of 20 pesticides, based on laboratory reporting levels for the respective constituent. Concentrations ranged up to 3.6 µg/L, with a median concentration of 0.06 µg/L. Deethylatrazine was most common with detections in 43 percent (18 of 42) of the samples. Using information-rich method reporting levels, pesticides were detected in 74 percent (31 of 42) of the samples with 134 detections of 29 pesticides. Deethylatrazine was most common with detections in 45 percent (19 of 42) of the samples.

Nitrate concentrations ranged up to 12.5 milligrams per liter (mg/L) with a median concentration of 0.068 mg/L. Nitrate concentrations were greater than 2 mg/L in 30 percent (13 of 43) of the samples. One sample (of 43) exceeded 10 mg/L.

Total VOC detections did not correlate with well depth, apparent recharge date, or dissolved oxygen. Total pesticide detections did correlate with dissolved oxygen and negatively correlated with well depth. Nitrate concentrations correlated with dissolved oxygen and apparent recharge date.

Of the 43 wells sampled for VOCs or pesticides using information-rich method reporting levels, or nitrate at laboratory reporting levels, 40 of 43 (93 percent) samples had at least one detection of a VOC or pesticide, or a detection of nitrate above 2.0 mg/L. This indicates that most of these wells are anthropogenically affected, but not at drinking-water levels of concern as established by the U.S. Environmental Protection Agency.

Effects of Urban Activities on Shallow Groundwater Quality in the Chicago Metropolitan Area

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The Chicago metropolitan area is one of the most rapidly expanding metropolitan areas in the USA, with a projected population increase of greater than 20% by 2020. Water use increased about 27% from 1980 to 1992 and demand is expected to continue to grow as the population of the region increases. The principal sources of water in the area, Lake Michigan and deep bedrock aquifers, are being used at their legislated and sustainable limits, respectively. The main sources of water that will be used to meet the increases in water demand are the shallow bedrock and overlying sand and gravel aquifers.

Results from several studies suggest that urbanization is degrading shallow groundwater quality in the Chicago region. Groundwater quality in the industrial Lake Calumet area of south Chicago is extremely degraded. Recent sampling in Kane County indicates that groundwater quality in the eastern urban corridor is significantly worse than in the rest of the county.

In another study, temporal changes in water quality in shallow unconfined aquifers are being evaluated using archived and published data. Several hundred shallow (< 200 ft) municipal wells have been periodically sampled in northeastern Illinois in the last 25 years, and some of these have been sampled for decades before that. Concentrations of total dissolved solids and several of the major ions, especially chloride, have increased in the last 25 years, especially in the shallowest wells (< 100 ft).

Linear regressions were performed on 184 municipal wells that have been sampled three or more times over at least an 8 year period. Over 80% of these wells had positive trends for chloride concentrations, with rates varying between 0.1 and 21.1 mg/L/yr, with a median value of 1.2 mg/L/yr. The increase in chloride concentrations began in the 1960s, when road salt began being used in large amounts. Prior to 1960, about one-third of samples had chloride concentrations < 10 mg/L and less than 10% had concentrations > 40 mg/L. By the 1990s, 80% of samples were > 10 mg/L, almost 50% > 40 mg/L, and 16% > 100 mg/L. The increases in chloride concentrations are most pronounced in the counties west of Chicago, where land use changes are most rapid and aquifer material is closer to the land surface.

Groundwater Protection Regulatory Protection Amendments and Other Program Updates

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The Illinois Environmental Protection Agency (Illinois EPA) is working on several initiatives to protect and restore groundwater in Illinois. The Illinois EPA Bureau of water is working on the following regulatory proposals: Marquette Heights Maximum Setback Zone R2005-009; Class III groundwater designation of Boone Creek Fen, Spring Hollow, Lee Miglin Savanna and Amberin Ash Ridge; wellhead protection amendments to the Leaking Underground Storage Tank, and the Tiered Approach for Corrective Action Objectives regulations; amendments to the Board's groundwater standards; and amendments to the Board's drinking water regulations to include source water protection planning requirements. Further, the Illinois EPA is actively working on developing and implementing a right-to-know strategic plan in response to House Resolution 1010, and continues to implement the current potential groundwater contamination to private well program (55ILCS 5/9.1). Further the Director Cipriano has established a new Contaminant Evaluation Group to use the Source Water Assessment and Protection Internet geographic information system to screen facilities or sites suspected or know to impact off-site potable wells.

Monitoring Chemical Climate Change in America

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The National Atmospheric Deposition Program – National Trends Network (NTN) has measured the acids, nutrients, and base cations in U.S. precipitation for more than two decades, long enough to identify a “chemical climate” and observe its changes. Much as climatologists describe the physical characteristics of our average weather (i.e., climate) and use long-term temperature records to evaluate climate change, NTN scientists compute mean chemical concentrations and deposition fluxes to evaluate chemical climate changes. Precipitation chemistry is an indicator of chemical climate, since precipitation scavenges airborne gases and particles, which are affected by emissions, chemical transformations, and weather. NTN data indicate that significant changes have occurred in precipitation chemistry over the last 25 years.

This presentation will focus on trends in the sulfate and nitrogen concentrations in precipitation. Sulfate concentrations have decreased, especially in the last decade. These decreases were anticipated because of deep reductions in sulfur dioxide emissions, mostly at coal-fired power plants in the eastern United States. As sulfate concentrations decreased, there has been an unanticipated increase in ammonium concentrations. The ammonium increases in rain and snow appear to be substantially larger than potential increases in airborne ammonia emissions. The relative amounts of sulfur and nitrogen in precipitation have changed markedly, signaling a shift in our chemical climate. Results such as these from the National Atmospheric Deposition Program attest to the value of long-term monitoring of the physical and chemical properties of our water resources.

GWINFO and ArcIMS - Development of the ISWS Groundwater Databases for Staff Accessibility and the Web

Steven Wilson, H. Allen Wehrmann, **Jonathon Foote** and **Kingsley Allan**

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The Groundwater Section of the Illinois State Water Survey maintains groundwater-related databases to provide basic data and information to the general public and to support applied groundwater research activities. Data types include groundwater quality, water use (withdrawals), aquifer hydraulic properties, groundwater levels, and drillers records for private, public, industrial/commercial, and irrigation wells. These data, which span more than 100 years, were stored in separate databases, independent of each other.

The databases have been integrated into a SQL-structured system that will link information by well and location. GWInfo, is a VB.net application that has been developed in-house to complete this integration. The current version of GWInfo allows a user to view, report, download, or chart data for a well, or in an area, for a variety of data types. This powerful advancement allows a user to create datasets in minutes that previously would have taken hours or even days to produce. A key feature of database development is the addition of spatial location information for all data, allowing the data to be imported into ArcSDE and ArcIMS, so that public information can be shared dynamically over the web within a GIS environment.

The first implementation of this new data structure/integration will link selected sets of the ISWS data to the Illinois Environmental Protection Agency's (IEPA) Source Water Assessment and Protection (SWAP) Program website. SWAP-linked data include annual water withdrawals from Illinois community and self-supplied industries, ambient groundwater quality data, and aquifer hydraulic properties data from hundreds of aquifer tests performed throughout Illinois over the past 50+ years. These data are now available to SWAP users, which includes local, county, and state units of government, as well as the USGS, allowing scientists and agency personnel access to the wealth of groundwater information stored at the ISWS. This has led to efforts to share new research findings and results with ISWS scientists and help promote collaboration between agencies in evaluating and analyzing groundwater quality conditions in Illinois.

Groundwater Investigation and Vapor Mitigation in Hartford, Illinois

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The Village of Hartford in Madison County, Illinois sits over a large plume of free phase hydrocarbons. The source of these hydrocarbons is decades of releases from refining and pipeline operations. The Hartford area has been the site of refining and pipeline operations since around 1908. Hydrocarbon releases have occurred at numerous sites around Hartford, most notably are the pipelines that intersect North Hartford and the pipelines that run parallel to the Village.

Vapors from the hydrocarbon plume migrate through the soil or through utility corridors or the utilities themselves. These migrating vapors enter the homes and cause odor complaints and in some cases caused house fires. Two remediation efforts were under taken to address this vapor intrusion problem. In 1978 free product recovery wells were installed in the Village and in 1993 a soil vapor extraction system was installed. Through the 1990's the hydrocarbon complaints decreased. In May 2002, several homes experienced vapor odors and high LEL levels were detected in the homes. Several residents were evacuated from their homes.

The Illinois Environmental Protection Agency (IEPA) referred the Premcor Refining Group and Apex Oil Company to the Office of the Illinois Attorney Generals Office (IAGO) to force these pipeline owners and former owners to fix the problem. The IEPA and IAGO asked the United States Environmental Protection Agency to assist in the enforcement process.

In March 2004, the USEPA entered into an Administrative Order on Consent (AOC) with the Premcor Refining Group, Atlantic Richfield Oil Company and Equilon LLC dba Shell Oil Products US. The oil companies formed a group called the Hartford Working Group. The AOC required the Hartford Working Group to conduct a soil vapor extraction pilot test and free product hydrocarbon recovery pilot test the results were to be used to expand the currently operating soil vapor extraction system; conduct a vapor intrusion mitigation pilot test (sub slab depressurization system); Site investigation plan; Interim Measures Work Plan, Sentinal Wells Work Plan to protect the Village's public water supply; implement a contingency plan to respond to vapor complaints and provide alternate house to residents; Free Phase Hydrocarbon Monitoring Well and Soil Sampling Work Plan; Dissolved Phase Groundwater Investigation, Utility and Pipeline Investigation Work Plan and a proposal for an Active Recovery System (90% design plan). The Hartford Working Group began work on many of these plans prior to the signing of the Order.

Phytoremediation at Argonne National Laboratory

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In the 1950s and 1960s, Argonne disposed of various waste chemicals into 'French Drains' in the 317/319 Area. Although these materials were not considered hazardous at the time, some are now classified as hazardous waste. As such, these areas were identified as Solid Waste Management Units (SWMUs) and required remediation under RCRA. The contaminants of concern were various volatile organic compounds, heavy metals, and some radionuclides. The bulk of these contaminants were removed in the late 1990s by utilizing a process of soil mixing using zero valent iron. To complete the cleanup, phytoremediation was applied to this area. Phytoremediation involves the use of trees and other plants to remove contamination from soil and groundwater. In 1999, 800 poplar trees were planted utilizing patented technique to have the tree roots reach the top of the water table. The function of the trees was to decompose the volatile organic compounds, sequester the metals, and evapotranspire the tritiated water. The progress on the cleanup has been monitored by conducting sampling of a number of monitoring wells within the phytoremediation plantation and by collecting leaf and tree samples to follow the fate of the volatile organic compounds in several compartments of the trees. In general, the groundwater concentrations of the parameters of interest have declined steadily over the past few years. Studies of tree tissue samples indicate the increasing presence of decomposition products of the major volatile organic compounds. These studies will continue for a number of years as part of the Argonne Long-Term Stewardship program.

Nitrate Transport in the Vadose and Shallow Saturated Zones under a Tiled Bloomington, Illinois Research Farm

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Lake Bloomington, a major water reservoir for Bloomington, Illinois, has a watershed land-use of 90.3% agricultural (IDNR, 1998). Periodically, the lake's nitrate (NO_3-N) level exceeds EPA's legal standard. To investigate, the city has established a research farm adjacent to the lake and has been working with different fertilizer application methods. Unknown is the related vadose and shallow saturated zone activity.

Research objectives were to enhance understanding of dissolved NO_3-N in vadose and shallow saturated zones and to create a conceptual model of transport and storage. The investigation included: monitoring dissolved NO_3-N through time; measuring shallow subsurface physical properties; determining preferential pathways; using measured and regional parameters to quantify nitrate with a simplified mass balance; and use the study data with a groundwater flow model. Vadose zone apparatuses were installed and used along with the city's groundwater equipment. Water samples were regularly collected and analyzed. Land surface was surveyed and water levels were monitored. Field saturated hydraulic conductivity was measured at four soil-sites, for three depths each. Beans grown for half of the 1-year study period had no fertilizers, while the second half had added fertilizers for corn.

NO_3-N concentrations increased seasonally with water availability, crop N-fixation, and N-fertilizer. Levels decreased through dry periods and at harvest. Soil hydraulic conductivity affected storage potential and inhibited transport. The vadose zone was found to store more dissolved NO_3-N mass than the shallow saturated zone. Tile drains transported 99% of the total dissolved NO_3-N output. The N-mass balance was shown to be a viable means to quantify the NO_3-N. Preferential pathways did not enhance flow at the farm. A groundwater flow model for the watershed was utilized, calibrated by study data. Understanding of shallow subsurface nitrate activity was acquired through this investigation that subsequently related to the larger watershed.