# Illinois Water 2006

## "Preparing for the Future"

October 4 - 5, 2005

Holiday Inn

Urbana, Illinois

*Proceedings*

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The organizers wish to thank these organizations for helping make this conference possible with their generous donations.

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Illinois Soil and Water
Illinois State Water Survey
U.S. Geological Survey

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Metropolitan Water Reclamation District of Greater Chicago

**Contributing**
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**General**
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# Planning Committee Members and Organizations

Representatives of these organizations committed hours of work to develop and execute this biennial conference. The Illinois Water Resources Center thanks them for their efforts.

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**Nancy Erickson** - Illinois Farm Bureau
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**Al Valocchi** - Department of Civil and Environmental Engineering, University of Illinois
**Dick Warner** - Illinois Water Resources Center
**Karl Williard** - Southern Illinois University
**Bill White** - Illinois State Water Survey

Thank you..... members of the planning committee, moderators and speakers.

# Staff

Water 2006 is coordinated by the Illinois Water Resources Center with Guidance from organizations and agencies in Illinois.

Director.....Richard E. Warner
Research Coordinator .....Phil Mankin
Program Coordinator.....Lisa Merrifield
Program Specialist .....Jennifer Fackler
Administrative Secretary.....Stephanie Lage

# Agenda


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# Agenda Summary

## Wednesday, October 4

| | |
|---|---|
| 8:00-9:00 a.m. | Registration (Conference Center Foyer) |
| 9:00-9:10 a.m. | Welcome and Opening Comments (Salon E and F) |
| 9:10-10:00 a.m. | Featured Speaker: *Sharing Western Water Lessons with the Midwest: Experiences and Institutions* – Charles Howe (Salon E and F) |
| 10:00-10:15 a.m. | Break and Exhibits |
| 10:15-12:15 p.m. | Themed Session I: *(concurrent sessions)*<br>- Water Supply Planning "The Governor's Water Supply Planning Initiative" (Salon A)<br>- Emerging Issues in Human Health and Aquatic Ecosystems (Salon C) |
| 12:15-1:30 p.m. | Lunch (Atrium) |
| 1:30-3:00 p.m. | Technical Session I: *(concurrent sessions)*<br>- Watershed Management (Salon A)<br>- Data and Models (Salon C)<br>- Stakeholders Perspectives on the Great Lakes Water Resources Compact (Salon E) |
| 3:00-3:30 p.m. | Break and Exhibits |
| 3:30-5:00 p.m. | Technical Session II: *(concurrent sessions)*<br>- Watershed Management II (Salon A)<br>- Water Quality Issues (Salon E) |
| 5:15-7:30 p.m. | Reception (Salon F)<br>- Poster Session 5:15-6:15 p.m. |
| 6:30-7:30 p.m. | Student Career Panel (Salon C) |

# Agenda Summary

## Thursday, October 5

| | |
|---|---|
| 7:30-8:30 a.m. | Illinois Section of the American Water Resources Association Meeting (Salon C) |
| 8:00-8:30 a.m. | Registration (Conference Center Foyer) |
| 8:30-10:30 a.m. | Themed Sessions II: *(concurrent sessions)*<br>- Challenges Facing Lake Michigan Water Management (Salon A)<br>- Data Needs for Water Planning (Salon E) |
| 10:30-10:45 a.m. | Break and Exhibits |
| 10:45-12:15 p.m. | Technical Session III: *(concurrent sessions)*<br>- C-FAR Strategic Research Initiative in Water Quality (Salon A)<br>- Institutional and Economic Strategies (Salon E) |
| 12:15-1:30 p.m. | Lunch (Atrium) |
| 1:30-3:00 p.m. | Technical Session IV: *(concurrent sessions)*<br>- Land Use and Water Resources (Salon A)<br>- Drought (Salon E) |
| 3:00-3:30 p.m. | Closing Comments (Salon C) |

# Agenda

## Wednesday, October 4

8:00-9:00 a.m. Registration (Conference Center Foyer)

9:00-9:10 a.m. Welcome and Opening Comments (Salon E and F)

9:10-10:00 a.m. Featured Speaker: *Sharing Western Water Lessons with the Midwest: Experiences and Institutions* – Charles Howe (Salon E and F)

10:00-10:15 a.m. Break and Exhibits

10:15-12:15 p.m. Themed Session I *(concurrent sessions)*

**Water Supply Planning** (Salon A)
Moderator**:** Ellis Sanderson, Illinois Department of Natural Resources

*A Framework for Statewide Water Supply Planning* - Derek Winstanley, Illinois State Water Survey

*Regionally Based Water Quantity Planning Process* - Gary R. Clark, Illinois Department of Natural Resources

*Water-Supply Planning in Illinois Under the Governor's Executive Order 2006-01* - Al Wehrmann, Illinois State Water Survey and Don Keefer, Illinois State Geological Survey

*Surface Water Resource Evaluation for Use in Regional Planning* - Vern Knapp, Illinois State Water Survey

**Emerging Issues in Human Health and Aquatic Ecosystems** (Salon C)
Moderator**:** Beth Hinchey Malloy, Illinois-Indiana Sea Grant

*Natural Stream Restoration and Biological Response* - Don Roseboom, Illinois Water Science Center District, U.S. Geological Survey

*Endocrine Disruption in Wastewater Impacted Aquatic Ecosystems* - Larry Barber, U.S. Geological Survey

*Characterization and Development of Pheromones to Control Invasive Bighead and Silver Carp* - Ed Little, US Geological Survey, Columbia Environmental Research Center

12:15-1:30 p.m. Lunch (Atrium)

## Wednesday, October 4 (cont.)

1:30-3:00 p.m. Technical Session I *(concurrent sessions)*

**Watershed Management** (Salon A)
Moderator**:** Bill White, Illinois State Water Survey

*Summarization of Historical Water Quality in the Kaskaskia River Watershed* - Ryan Pankau, Southern Illinois University

*Assessing the Impacts of Trail Use on Water Quality in the Lusk Creek Wilderness* - Justin Fenton, Southern Illinois University

*Watershed Modeling to Evaluate Water Quantities and Qualities at Intakes of Surface Water Supplies* - Deva Borah, Illinois State Water Survey

*Effects of Stormwater Detention on Flood Peaks and Frequency, Case Study: Blackberry Creek Watershed, Kane County* - Elizabeth Murphy, U.S. Geological Survey

**Data and Models** (Salon C)
Moderator**:** Phil Mankin, Illinois-Indiana Sea Grant

*Real-time Precipitation Data Collection and Dissemination for Operational Stormwater Management* - David Fazio, U.S. Geological Survey

*Demonstration of the Effect Particle Size Has on BMPs* - Fabio Tonto, Imbrium Systems Corporation

*Discrepancies Between Computed and Digitized Hydraulic Parameters and Implications in Hydraulic and Hydrologic* - David Soong, U.S. Geological Survey

*Feasibility Study for Energy Extraction from Treated Effluent* - Pallav Dhabalia, Institute of Technology Chicago

**Stakeholders Perspectives on the Great Lakes Water Resources Compact** (Salon E)
Moderator**:** Timothy Feather, CDM Federal Programs

*Compact Negotiation Process and Results* - Dave Naftzger, Council of Great Lakes Governors

*Status of State Ratification Process* - Molly Flanagan, National Wildlife Federation

## Wednesday, October 4 (cont.)

*Environmental Organization Perspectives* - Cheryl Mendoza, Alliance for the Great Lakes *Business and Industry Perspectives* - John Allan, Consumers Energy Company

*Illinois, The Chicago Diversion and the Compact* - Mary Ericson, National Wildlife Federation

3:00 - 3:30 p.m. Break and Exhibits

3:30 - 5:00 p.m. Technical Session II *(concurrent sessions)*

**Watershed Management II** (Salon A)
Moderator**:** Sam Dennison, Metropolitan Water Reclamation District of Greater Chicago

*Estimating Industrial Hydrologic Footprints* - Sachin Pradhan, Illinois Institute of Technology

*Agent-Based Model for the Big Creek Watershed in Southern Illinois* - Seth Soman, Southern Illinois University

*Connecting Scientists and Educators Through Great Lake and Ocean Science* - Julie Murphy, Illinois-Indiana Sea Grant

*Aerial Imagery for Long Term Watershed Evolution Assessement*, Andrew Phillips, Illinois State Geological Survey

*Using Agent-Based Models to Inform Policies for Sustainable Groundwater Use in Complex Scenarios* - Moira Zellner, University of Illinois at Chicago

**Water Quality Issues** (Salon E)
Moderator**:** Gregg Good, Illinois EPA, Bureau of Water

*Effect of Temperature on Toxicity of Heavy Metals to Aquatic Invertebrates* - Mohammed Kan, University of Illinois at Chicago

*Canopy Water Use of Soybean Grown in Future Predicted Atmospheric Concentrations of Carbon Dioxide and Tropospheric Ozone* - Carl Bernacchi, Illinois State Water Survey

*An Optimization Model for Planning Wastewater Reuse in the Chicago Area* - Yi Meng, Illinois Institute of Technology

*Nitrogen Dynamics Associated with Autumn-olive Stands at Field and Watershed Scales* - Christine Goldstein, Southern Illinois Unversity

## Wednesday, October 4 (cont.)

5:15 - 7:30 p.m. Reception (Salon F)

5:15 - 6:15 p.m. Poster Session

*Agent-Based Model for the Big Creek Watershed in Southern Ilinois,* Seth Soman, Southern Illinois University

*Development of an Image-Processing Tool for Groundwater Recharge and Discharge Estimation,* Jihua Wang, University of Illinois

*DNAzyme Biosensors For Detection of Toxic Metal Ions,* Heekyung Kim, University of Illinois

*Illinois Watershed Association*, Susan Meeker, University of Illinois Extension

*Sediment Controls on Phosphorus in East-Central Illinois,* Marshall McDaniel, University of Illinois

*Web Based Youth Programs*, Duane Friend, University of Illinois Extension

6:30 - 7:30 p.m. Student Career Panel (Salon C)

# Agenda

## Thursday, October 5

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| 7:30 - 8:30 | Illinois Section of the American Water Resources Association meeting (Salon A) |
| 8:00-8:30 a.m. | Registration (Conference Center Foyer) |
| 8:30 - 10:30 a.m. | Themed Session II *(concurrent sessions)* |

**Challenges Facing Lake Michigan Water Management**
(Salon A)
Moderator**:** Phil Mankin, Illinois-Indiana Sea Grant

*Beach Issues and Flashy, Degraded Streams* - Mark Pfister, Lake County Health Department

*Lake Michigan Open Water Monitoring Program* - Paul Horvatin, U.S. EPA Great Lakes National Program Office

*Lake Michigan Water Allocation Update: Can Illinois Remain in Compliance with the U.S. Supreme Court Decree?* - Dan Injerd, IDNR Office of Water Resources

**Data Needs For Water Planning** (Salon E)
Moderator**:** Robert Holmes Jr., US Geological Survey

*The Value of Surface Water Flow Data - - The Cost of Inadequate Surface Water Flow Data* - Arian Juhl, Illinois Department of Natural Resources Office of Water Resources

*The Value of Water Quality Data - - What is the Toll on Human and Ecosystem Health When Water Quality Data is Inadequate* - Glynnis Collins, Prairie Rivers Network

*The Value of Groundwater Quantity Data in Groundwater Planning and Management -- What are the Problems with Inadequate Data?* - Paul Schuch, Kane County Development Department

| | |
|---|---|
| 10:30 - 10:45 a.m. | Break and Exhibits |
| 10:45 - 12:15 p.m. | Technical Session III *(concurrent sessions)* |

**C-FAR Strategic Research Initiative in Water Quality** (Salon A)
Moderator**:** George Czapar, University of Illinois Extension

*Spatial and Temporal Relationships Between Biotic Integrity of Illinois Streams, Dissolved Oxygen, and Nutrients* - Mark David, University of Illinois

## Thursday, October 5 (cont.)

*Effects of Phosphorus Mediated Through Algal Biomass in Illinois Streams* - Timothy Hill, Illinois Natural History Survey

*Headwater Stream Primary Production Dynamics – Nutrient Limitation and the Potential Role of Sediment Derived Nutrients* - Bill Perry, Illinois State University

*The Impacts of Sediments on the Potential Bioavailability of Phosphorus in Illinois Streams* - Micheal Machesky, Illinois State Water Survey

**Institutional and Economic Strategies** (Salon E)
Moderator**:** Martin Jaffe, Illinois-Indiana Sea Grant

*Water Rate Making Practices in Illinois Public water Systems: Current Practices, Historical Trends, and Future Possibilities* - Jack Kiefer, CDM, Inc.

*Beyond Privatization: Restructuring Water Systems to Improve Performance* - Truegary Wolff, The Pacific Institute

*Green Lands, Blue Waters: How Protecting Your Watershed Can Help to Protect the Planet* - Stephen John, Agricultural Watershed Institute

*Institutional Innovation as a Compliance Strategy: Small Water Systems and The Safe Drinking Water Act* - Min-Yang Lee, University of Illinois

*Agriculture-Utility Coooperative Agreements for Protecting Source Water Quality in Illinois: An Analysis of the Opportunities* - Stephen Gasteyer, University of Illinois

12:15 - 1:30 p.m. Lunch (Atrium)

1:30 - 3:00 p.m. Technical Session IV *(concurrent sessions)*

**Land Use and Water Resources** (Salon A)
Moderator**:** Bev Herzog, Illinois State Geological Survey

*Institute for Sustainability of Intensively Managed Landscapes* - Praveen Kumar, University of Illinois

*Linking Land Use and Lake Erie: A Watershed Planning Framework For Achieving Balanced Growth* - Joseph Lucente, Ohio State University Extension/Ohio Sea Grant

# Agenda

## Thursday, October 5 (cont.)

*Towards Modeling for Real-time Control of Combined-Sewer-Overflow Systems: Application to the Calumet TARP System in Chicago, IL* - Arturo Leon, University of Illinois

*Urbanization Effects on Ground-Water Quality - St. Louis Area* - William Morrow, U.S. Geological Survey, Illinois Water Science Center

**Drought** (Salon E)
Moderator**:** Martin Jaffe, Illinois-Indiana Sea Grant

*Water Resource Protection and Conservation Toolkit* - Reggie Korthals, Northwestern Indiana Regional Planning Commission

*Future Projections of Drought for Water Supply Planning* - Kenneth Kunkel, Illinois State Water Survey

*The 2005 Drought and Drought Preparedness in Illinois* - Jim Angel, Illinois State Water Survey

*Indicators and Indices of Surface Water Availability* - Robert Holmes, U.S. Geological Survey, Illinois Water Science Center

3:00 - 3:30 p.m. Closing Comments (Salon C)

# Student Competition

The following students will be competing for best paper and best poster awards. The paper awards are $200 and the poster awards are $175. Awards will be made during the closing session on Thursday, October 5, 2006

Please visit our poster session and the presentations to support these students.

**Presenting Papers**
*(please see agenda for presentation times and topics)*

Dhabalia, Pallav, Institute of Technology Chicago
Fenton, Justin, Southern Illinois University
Goldstein, Christine, Southern Illinois Unversity
Lee, Min-Yang, University of Illinois
Leon, Arturo, University of Illinois
McKay, Kyle, University of Illinois
Meng, Yi, Illinois Institute of Technology
Pradhan, Sachin, Illinois Institute of Technology
Soman, Seth, Southern Illinois Unversity
Tonto, Fabio, Imbrium Systems Inc.

**Presenting Posters**
*(posters will be presented from 5:15-6:15 p.m. Wednesday, October 4)*

Kim, Heekyung, University of Illinois
McDaniel, Marshall, University of Illinois
Soman, Seth, Southern Illinois University
Wang, Jihua, University of Illinois

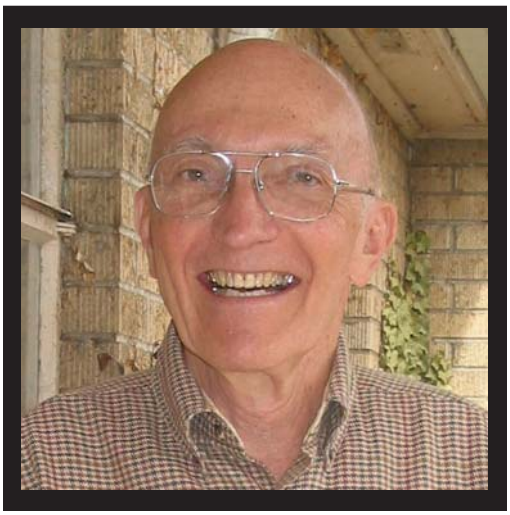
# Speakers


| | |
|---|---|
| Featured Speaker | 16 |
| Themed Session Speakers and Abstracts | 17 - 25 |

# Featured Speaker

## Charles Howe

Charles Howe, Ph.D., Stanford University, 1959, is a retired professor of economics at the University of Colorado - Bolder. He was the Chair for the National Research Council Committee on Privatization of Urban Water Services for three years and President for the Association of Environmental and Resource Economists for two years. He received the Warren A. Hall Medal of the Universities' Council on Water Resources for Distinguished Contributions to the Field of Water Resources in 2003 and Friends of UCOWR Award in 2000 along with many other awards. Some of his publications have appeared in *Journal of Contemporary Water Research and Education*, *International Journal of Water Resources Development*, *Journal of the American Water Resources*, and *American Journal of Agricultural Economics.*



## "Sharing Western Water Lessons with the Midwest: Experiences and Institutions"

While Illinois and the Midwest are subject to occasional drought conditions, the western U.S. has experienced more frequent and more severe droughts (1930's, 1950's,1970's and the current 2000-2006 drought in the Southwest). Consequently, the western states have identified water management techniques and institutional innovations that may have value for the Midwest, especially in the face of increasing climate variability and climate change. These include water banking arrangements, conjunctive groundwater-surface water management procedures, more highly integrated river basin management, concerns with equity in rural and urban water allocation as scarcity increases, intensive urban water conservation and attempts at state water planning. These experiences will be described and their possible utility to the Midwest will be discussed.

# Water Supply Plannning, "The Governor's Water Supply Planning Initiative"

The executive Order for the Development of State and Regional Water Supply Plans issued by Governor Blagojevich in January of 2006 has initiated a significant planning program for identifying the State's long range water supply needs. A program for the integration of groundwater and surface water supply source evaluations directed towards meeting regional water supply demands will be the focus of activities in two pilot areas for locally based, regional water supply planning committees. This three year $5 million program will establish the scientific basis and administrative framework for long-range water supply planning in the State of Illinois.

Moderator: Ellis Sanderson, Illinois Department of Natural Resources

## *A Framework for Statewide Water Supply Planning*

Derek Winstanley, Illinois State Water Survey

Executive Order 2006-01 calls for the Illinois State Water Survey in cooperation with the Office of Water Resources to:

1. Define a comprehensive program for state and regional water supply planning and management and develop a strategic plan for its implementation consistent with existing laws, regulations and property rights,
2. Provide for public review of the draft strategic plan for a water supply planning and management program;
3. Establish a scientific basis and an administrative framework for implementing state and regional water supply planning and management;
4. Develop a package of financial and technical support for, and encouragement of, locally based regional water supply planning committees. These committees, whether existing or new entities, shall be organized for participation in the development and approval of regional plans in the Priority Water Quantity Planning areas;
5. By December 31, 2006, ensure that Regional Water Quantity Plans are in process for at least two Priority Water Quantity Planning Areas.

I will describe a framework for state and regional water supply planning and management. The framework will include the hydrologic cycle and water budgets in Illinois, temporal variations in climate and water supply, increasing water demand and withdrawals, water conservation and reuse, identification of at-risk water supplies, and priority watersheds and aquifers.

# Themed Session 1

## Water Supply Plannning, "The Governor's Water Supply Planning Initiative" (continued)

### *Regionally Based Water Quality Planning Process*

Gary R. Clark, Illinois Department of Natural Resources

The Governor's Water Supply Planning Initiative, E.O. 2006-01 calls for the development of a regional water supply planning process led through the formation of locally based regional water supply planning committees. This regional planning process will be a grass-roots effort through which local representatives will develop strategies to meet water supply needs over a 30 year period. The successful integration and evaluation of water supply source evaluations conducted by the DNR Scientific Surveys with water supply demand projection developed by the regional planning groups will be the key to selecting strategies for avoiding conflicts and meeting the long range management needs for the State's water supply sources.

### *Water-Supply Planning in Illinois Under the Governor's Executive Order 2006-01*

Al Wehrmann, Illinois State Water Survey and Don Keefer, Illinois State Geological Survey

On January 9, 2006, Governor Blagojevich issued Executive Order 2006-01 for development of state and regional water-supply plans. The Executive Order (EO) is the culmination of years of discussions between scientists at the Illinois State Water Survey (ISWS) and other agencies, and concerned stakeholders on the need for comprehensive water-supply planning in Illinois. The EO sets out a three-year process to initiate water supply planning by a) establishing a scientific basis and an administrative framework for water supply planning and management, and b) developing a package of financial and technical support for locally-based regional water supply planning committees. By the end of 2006, regional water supply committees will have been created in two priority water quantity planning areas, an 11-county area of northeast Illinois delineated, in part, on the groundwater resources of the deep bedrock aquifers of northeast Illinois and overlying watersheds, and a 15-county area of east-central Illinois delineated on the basis of the Mahomet aquifer and overlying watersheds. The State Surveys will be conducting geologic mapping and water resource supply analyses as well as providing technical support to the regional committees.

# Water Supply Plannning, "The Governor's Water Supply Planning Initiative"

*(continued)*

## *Surface Water Resource Evaluation for Use in Regional Planning*

H. Vern Knapp, Illinois State Water Survey

In preparation for regional water supply planning activities, five major Illinois watersheds were designated as priority watersheds: the Fox, Kaskaskia, Sangamon, Kankakee, and Kishwaukee River watersheds. These watersheds are characterized by: 1) high projected growth in water use, and/or 2) shortages in the capacity of major surface water supply sources to meet future growth. Another factor with some of these priority watersheds is the existence of significant interconnections between shallow groundwater and surface water, such that increased groundwater use has the potential to impact low streamflows in the watershed. The protection of instream flows in Illinois' public waters is considered a primary recommended practice with regard to surface water supply planning and management.

An initial step in local and regional planning is an evaluation of the existing surface water resources. Surface water supplies generally appear to be well-defined quantities; nonetheless there are considerable approximations in the hydrologic methods and gaps in data used to define surface water supply yields. The source of greatest uncertainty can also vary considerably from one water supply system to another. This presentation characterizes uncertainties and data needs in evaluating the adequacy of surface water supplies, including issues of drought frequency and risk of shortages.

# Themed Session 1

## Emerging Issues in Human Health and Aquatic Ecosystems

This session will provide an overview of current knowledge and highlight new information on the emerging issues of endocrine disruption in aquatic systems, aquatic invasive species and their control, and advances in stream restoration. The three speakers in the session were invited based on their interdisciplinary research experience in aquatic ecosystems. The goal of this session is to explore these emerging issues to gain insight on research areas that will improve our understanding of these complex issues, ultimately leading to protection and restoration of impacted aquatic ecosystems and processes.

Moderator: Beth Hinchey-Malloy, Illinois-Indiana Sea Grant

### *Natural Stream Restoration and Biological Response*

Don Roseboom, U.S. Geological Survey, Illinois Water Science Center

The importance of bankfull floods in the formation of natural riffle pool complexes is broadly understood in stream fishery science. Less well understood is the interaction of the bankfull floods and channel dimensions to create the high quality instream habitat, which is characteristic of natural streams in dynamic balance. While stream staff from environmental agencies routinely document baseflow channel dimensions and instream habitat, the bankfull channel dimensions and bankfull floods that created such baseflow habitat is not often considered.

Stream restoration projects frequently attempt to recreate or enhance stream habitats by a mimic of the geomorphology of stable natural channels during construction. Often such constructs are not maintained by the stream floods over time.

The energy of bankfull flood creates the instream habitat and stream geomorphology of natural streams and should be a major consideration in the stream restoration design. The analysis of stream habitat and channel form should include how the modulations of specific energy (depth and velocity) in the bankfull floods constantly recreates habitat (riffles, pools, runs) by alternately modifying the bankfull stream channel dimensions of depth and width. One example is riffle recreation in unstable channels.

In stream restoration/stabilization, riffles can serve as grade control or check dams or both depending on the design flood discharge encountered for given channel dimensions. The success of such efforts is dependant upon not only the stability of the structures but their effect on bedload continuity and the constant recreations of form and habitat inchannel. In both riffle design and natural channel design, a central theme is modifying the bankfull flood so that the bankfull floods recreate a relatively stable dynamic channel.and instream habitat over time. This paper will illustrate this principle with stream restoration projects.

# Emerging Issues in Human Health and Aquatic Ecosystems *(continued)*

## *Endocrine Disruption in Wastewater Impacted Aquatic Ecosystems*

Larry Barber, United State Geological Survey

The occurrence of natural and synthetic organic chemicals in wastewater treatment plant (WWTP) effluents and receiving streams is a topic of increasing public interest. A primary concern is the potential for certain compounds to interfere with the chemical signaling of the endocrine system of a variety of vertebrate organisms. In this investigation we determined the occurrence of potential endocrine disrupting organic wastewater contaminants (OWCs) in surface waters (Mississippi River, Cuyahoga River, Calumet River, Chicago Sanitary and Ship Canal) and WWTP influents and effluents (Akron, Chicago, Detroit, Duluth, Indianapolis, Minneapolis) in the Great Lakes Region. The dominant OWCs (>100 µg/L) detected in the WWTP effluents and receiving streams were ethylenediaminetetraacetic acid and nonylphenolethoxycarboxylates, with lower concentrations (1-10 µg/L) of 4-nonylphenol, nonylphenolethoxylates, triclosan, bisphenol A, caffeine, and several other compounds. Concentrations of hormones in the WWTP effluents and surface waters were much lower (<0.01 µg/L) and their detection was more sporadic. Field and laboratory experiments with fathead minnows show that the mixture of OWCs in WWTP effluents can elicit endocrine disruption in fish residing in receiving waters.

## *Characterization and Development of Pheromones to Control Invasive Bighead and Silver Carp*

Presenting Author: Edward E. Little, US Geological Survey, Columbia Environmental Research Center

Authors: Edward E. Little and Robin D. Calfee

Species specific chemical signals, pheromones, maybe useful in attracting or repelling invasive carp and in this manner may be effective in controlling them. Our research has confirmed the presence of alarm substance in skin extracts of big head and silver carp. This alarm pheromone is released when the skin is injured as during an attack by a predator. Controlled laboratory studies with aqueous skin extracts indicate that bighead carp form tight schools in the presence of the extract, whereas explosive random movements are often induced in silver carp. Avoidance chamber studies demonstrate that both species strongly avoid areas where the extract is released. Extracts that have been aged for 24 hours or that have been frozen retain their effectiveness in inducing significant avoidance reactions. In preliminary studies adult fish also appear to avoid pond areas that have been treated with skin extract solutions. Studies are presently underway to determine the existence of an aggregating pheromone that could be used as an attractive lure.

# Themed Session 2

## Challenges Facing Lake Michigan Water Management

Home to over 8 million people, the 6-county greater Chicago metropolitan area is the most densely populated, urbanized and engineered coastal area in the Great Lakes Region. By 2030, the population is expected to increase to over 10 million people. Lake Michigan provides water supply to over 6 million people in northeastern Illinois. This session will provide an overview of the issues and planning challenges ahead due to projected increases in demands for Lake Michigan water supply and water-related recreational resources, and in improving or preserving water quality.

Moderator: Phil Mankin, Illinois-Indiana Sea Grant College Program

### *Beach Issues and Flashy, Degraded Streams*

Mark A. Phister, Lake County Health Department and Community Health Center

Conceptually, E. coli bacteria concentration is meant to be a surrogate and indicator of fecal contamination, presumably from human sewage. Studies by the US EPA indicate that the introduction of human sewage as measured by E. coli or enterococci bacteria correlated with swimmer illness. However, sources and variations of E. coli in swimming water have turned out to be more complex than originally envisioned. Our recent ribotyping research of E. coli isolates (collected from Lake County beaches) indicates that gulls are the primary source of E. coli and human/sewage is the secondary source of E. coli in Lake Michigan beach water in Lake County. Additionally, our and other recent Lake Michigan studies have linked hydrometerological conditions (such as wind direction, rainfall, insolation (sunlight)) to E. coli concentrations with strong positive and negative correlations. Based on these correlations, we have created “SwimCast” predictive models to allow beach managers to predict hourly (at 89 and 95% accuracy) what the E. coli concentrations may be rather than waiting 18-24 hours for the E. coli assays to make a decision for beach swim bans. Basing a swim ban on yesterday’s sample is inadequate and typically results in human exposure during high-risk periods and can cause a beach to be closed when it should be open. Additionally, the majority of Lake County tributaries to Lake Michigan have degraded water quality and flashy flow dynamics due to urbanized land uses and large impervious areas within their watershed. While desirable to attempt to improve habitat within these degraded tributaries, current water quality and hydrologic conditions may dramatically inhibit future restoration projects. Diurnal studies of beach water E. coli and Lake Michigan tributary water quality and hydrologic conditions will also be discussed.

### *Lake Michigan Open Water Monitoring Programs*

Paul Horvatin, U.S. EPA Great Lakes National Program Office

In the Great Lakes basin, cultural eutrophication, chemical contamination, overfishing, habitat destruction, and the introduction of non-native species represent just some of the problems affecting both ecosystem function and human health. Assessing the condition of the Great Lakes basin ecosystem is extremely important, yet it is a monumental challenge. The Great Lakes contain one-fifth of the world’s liquid fresh water and they provide drinking water, food, recreational opportunities and

# Challenges Facing Lake Michigan Water Management
*(continued)*

other support services to about 33.5 million people across two nations, eight states, two provinces, and hundreds of local and municipal communities. Lake Michigan, the second largest Great Lake by volume, supports about 10 million people in its basin, including Milwaukee and Chicago, the third largest city in the United States.

Periodic evaluation Lake Michigan ecosystem components remains vital for making informed decisions about environmental management activities, measuring progress toward restoration goals, documenting successes or failures of specific management efforts, and guiding future environmental programs. This presentation will report on the state of Lake Michigan using ecosystem indicators derived through processes associated with the State of the Lakes Ecosystem Conferences (SOLEC) and though activities supporting the Lake Michigan Lakewide Management Plan. Trends in Lake Michigan water quality data collected by U.S. EPA Great Lakes National Program Office open water monitoring program will be highlighted, and emerging lake issues will also be discussed.

## *Lake Michigan Water Allocation Update: Can Illinois Remain in Compliance with the U.S. Supreme Court Decree?*

Dan Injerd, Illinois Department of Natural Resources

From 1980 through 1993, Illinois' accumulated a substantial water debt under the U.S. Supreme Court Decree. This debt exceeded the amount of water Illinois would divert over an entire year. As a result of the U.S. Department of Justice mediation that occurred between Illinois and the other Great Lakes states in 1996, Illinois agreed to reduce its diversion and repay the water debt by the end of water year 2019.

Though still unofficial, a combination of water efficiency improvements and favorable climatic conditions has allowed Illinois to repay the entire water debt way ahead of schedule. This presentation will provide an update on Illinois' compliance with the Decree, a review of Illinois' Lake Michigan water allocation program, and a discussion of the potential role that Lake Michigan water allocations may play in meeting the future water supply demands in the Northeastern Illinois area.

# Themed Session 2

## Data Needs for Water Planning

Good water planning requires spatially and temporally adequate water resources data. In this session we will examine the value of surface-water quantity, ground-water quantity, and ground and surface-water quality data to water resources planners. Our speakers represent state and local agency perspectives as well as that of a non-governmental organization. Their resource management perspectives will range from managing floods to meeting water-supply demands to assessing how we meet the goals of the Clean Water Act.

Moderator: Robert R. Holmes, Jr., PhD, P.E., U.S. Geological Survey Illinois Water Science Center

### *The Value of Surface Water Flow Data -- "The Cost of Inadequate Surface Water Flow Data"*

Arlan Juhl, P.E., Illinois Department of Natural Resources Office of Water Resources

Surface-water quantity has been measured in Illinois for over a century. The number of people and organizations which rely on this data has grown significantly over this time as they each realize the value of the information. The funding to support this data collection has been the target of local, state and federal budget negotiators. What is the cost to you, a data user, if this data is not available to you? How are you affected by the loss of surface water flow data? How are you benefited by the collection of the data? Groundwater quantity and municipal water supplies rely on surface water data to project future supplies. Illinois needs good surface water flow data to help characterize these issues.

### *The Value of Groundwater Quantity Data in Groundwater Planning and Management --"What are the Problems with Inadequate Data?*

Paul M. Schuch, Kane County Development and Resource Management Department

Kane, along with Lake, McHenry and Will, is one of four, fast growing, "Edge Counties" in Illinois. "Edge Counties", also know as "Metropolitan Growth Engines", range from 200,000 to 800,000 in population, are located in one of the 50 largest metropolitan areas of the United States, and have been growing at double-digit rates in each decennial census since 1950. The County's 2005 estimate of population was 482,113, and it is projected to reach 717,334 people by the year 2030. The current average annual growth rate is about 16,000 people per year. Kane County's population grew by 19.3 percent in the last 5 years. Providing a sustainable potable water supply for this metropolitan growth engine is a priority planning policy of the Kane County Board. Until 2002, some of the most recent water quantity and quality data and studies prepared by the Illinois State Water Survey to project water supply needs for northeastern Illinois and Kane County were prepared during the1950s through the 1980s and were kept in paper files and reports that were not able to be used in modern computer data based methods to summarize and analyze the data and computerized scientific models to work and plan for future water supply needs with the data.
Protecting and planning for the sustainable water supply of Kane County is called for in the Coun-

# Data Needs for Water Planning
*(continued)*

ty's recently adopted 2030 Land Resource Management Plan. The Planning Issues section identifies certain Water Resource objectives including recognition of the interaction between land and water resources, protection and enhancement of the quantity and quality of ground and surface waters for drinking water supplies, reduction of pollutants that may affect water supplies, and encourages watershed planning that fosters understanding of the finite and irreplaceable water resources. The Planning Policies section identifies certain water resource policies that include the protection of groundwater, the principal source of potable water in Kane County; encourages water conservation programs; calls for state legislation that would allow the six Counties in the NIPC region to create countywide water authorities, but not the authority to regulate the agricultural use of water; calls for the development of a countywide source water protection plan; and calls for the development of a comprehensive set of countywide water resource management regulations to preserve and protect watersheds, stream banks, floodplains, wetlands, groundwater recharge and water supply.

In 2002, the County entered into a five (5) year agreement with the ISWS/ISGS to gather and study existing and new geologic and hydrogeologic data for both the shallow and deep aquifer systems underlying the County and to enter the data into a Geographic Information System database. The ISWS/ISGS will create both geologic and hydrogeologic models to assist in future planning for the County under the new 2030 Land Resource Management Plan. In the future, water regulatory measures using the data and models from the ISWS/ISGS study as the scientific basis, will need to be enacted within the County to ensure a long-term, sustainable water supply.

## *The Value of Water Quality Data -- "What is the Toll on Human and Ecosystem Health When Water Quality Data is Inadequate?"*

Glynnis Collins, Prairie Rivers Network

The environmental regulatory process is often driven by legal requirements for agency action. Thus, the setting of water quality standards, discharge permit effluent limits, and assessing attainment with standards and limits must often proceed in spite of important data gaps. I will present an overview of how data enter the regulatory process and discuss implications for human health and aquatic habitat integrity. The presentation will use recent case studies of standards and effluent limit setting from Illinois.

# Abstracts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# Technical Session 1

## Watershed Management

Moderator: Bill White, Illinois State Water Survey

### *Summarization of Historical Water Quality in the Kaskaskia River Watershed*

Presenting Author: Ryan Pankau, Southern Illinois University

Authors: Ryan Pankau, Karl Williard and Jon Schoonover

The Kaskaskia River watershed spans 22 counties in southwestern Illinois and drains approximately 5,700 square miles. The Kaskaskia River watershed is drained by the second longest river in the state and contains the largest contiguous tract of forest land in Illinois, providing valuable stopover and breeding habitat for neotropical migratory birds. A mosaic of agricultural, urban and forest land covers dominate the landscape. In recent years, expanding urban development and intensification of agriculture have added an increased risk of water pollution throughout the watershed. This rising threat to valuable natural resources within the Kaskaskia River basin has spawned an interest in restoration and afforestation of existing agricultural land. This project is aimed at identifying areas within the watershed that are significant contributors to water quality impairment, which will ensure that conservation efforts are implemented in areas highly susceptible to contamination. Preexisting water quality and quantity data were analyzed for 26 ambient water quality monitoring stations throughout the Kaskaskia River watershed. Historic nutrient data were used to develop flow-weighted loadings in order to rank tributaries based on their relative contributions of N and P, which are primary contributors to hypoxia in the Gulf of Mexico. Trend analysis and rankings of tributaries was also conducted for contaminants commonly associated with urban development and agriculture land covers (i.e. fecal coliform, heavy metals, and pesticides). This project will establish relationships between stream biota, water quality parameters, and habitat quality to identify the most susceptible areas within the Kaskaskia watershed for implementation of future restoration programs.

### *Assessing the Impacts of Trail Use on Water Quality in the Lusk Creek Wilderness Area*

Presenting Author: Justin Fenton, Department of Forestry, Southern Illinois University

Authors: Justin Fenton and Karl W. J. Williard

Historically, the Lusk Creek Watershed in southern Illinois has been one of the most pristine watersheds in the state in terms of water quality and is home to several threatened and endangered aquatic and terrestrial species. Over the past two decades, equestrian trail use within the watershed has greatly increased. There is a growing controversy concerning the potential effects of this recreational use on terrestrial habitat quality and water quality within the watershed. Our overall study objective is to assess whether trail use is impacting water quality within the Lusk Creek Wilderness Area. Specifically we aim to: 1) analyze the effects of trail use on soil physical properties, 2) compare stream total suspended solid (TSS) concentrations to the surface area of exposed mineral soil within 60 meters of Lusk Creek, and 3) relate seasonal recreation use intensity to stream

## Watershed Management *(continued)*

TSS concentrations. Twelve trail plots representing ridgetop, midslope, and riparian topographic positions were installed on two main trail systems in Lusk Creek Wilderness Area in June, 2005. Measurements of trail width, incision, slope, surface penetration resistance, hydraulic conductivity, infiltration rate, and bulk density will be taken in the trail plots and 3m adjacent to the trails. Ten stacked-pole water samplers were installed in July 2005 to sample storm event TSS concentrations above and below heavy use sections of the riparian area. These samplers are set to collect water at integrated depths from 5cm to 147cm. Data from the recent Recreation Visitor Inventory of Lusk Creek Wilderness (Chilman, 2004) will be used to compare the level of recreation use to stream TSS concentrations on a seasonal basis. TSS, bulk density, and hydraulic conductivity will be analyzed in the Department of Forestry's Water Quality Laboratory at Southern Illinois University Carbondale and all other measurements will be conducted in the field. Preliminary results will be presented at the conference in October 2006.

### *Watershed Modeling to Evaluate Water Quantities and Qualities at Intakes of Surface Water Supplies*

Presenting Author: Deva Borah, Illinois State Water Survey, IDNR-UIUC

Authors: Deva Borah, Edward C. Krug, Maitreyee Bera, and Xin-Zhong Liang

As part of a Midwest Technology Assistance Center supported project, a watershed-scale hydrologic and nonpoint-source pollution model was selected and applied to a watershed in Illinois to test its performance, enhance it, and demonstrate its usefulness to the small public water supply systems located within the watershed. Based on recent reviews of leading models, the SWAT (Soil and Water Assessment Tool), developed by the U.S. Department of Agriculture – Agricultural Research Service, and adopted in the U.S. Environmental Protection Agency's BASINS (Better Assessment Science Integrating point and Nonpoint Sources) modeling system, was selected. The model is continuous and intended for long term yield predictions and not for detailed storm event flood simulations. Therefore, the goal is to expand the model with storm event components to simulate hydrology, soil erosion, and transport of sediment and agrochemicals during storm events with short time intervals (minutes to hours) to capture rapid changes, especially during severe storms causing most of the environmental damages, in addition to long-term simulations with longer time intervals (days, months, and years) while studying long-term impacts. In this study, a storm event hydrology model was selected, tested, and investigated its enhancement potential of SWAT. The 8,400 km2 Little Wabash River watershed in Illinois was selected for this study because of its favorable small drinking water supplies and watershed attributes. Using multi-year period (1995-2002) of observed precipitation, stream flow, and concentrations of sediment, nitrate-nitrogen, ammonia-nitrogen, total Kjeldahl nitrogen, and total phosphorous, the continuous model (SWAT) was calibrated and validated. Using storm event rainfall and flow data at smaller (15 minute) time intervals, the storm event hydrologic model was also calibrated, validated, and compared its results with SWAT. The calibrated and validated SWAT was used for long-term water quantity and quality evaluations throughout the watershed, including at intakes of small public surface water supply systems. The model can be used to evaluate alternative land use and management practices. The storm event hydrology model showed promise for enhancing SWAT's storm event hydrologic simulations during intense storms.

## Watershed Management *(continued)*

### *Effects of Stormwater Detention on Flood Peaks and Frequency Case Study: Blackberry Creek Watershed, Kane County, Illinois*

Presenting Author: Elizabeth Murphy, U.S. Geological Survey

Authors: Elizabeth Murphy, Tim Straub, David Soong, and Tim Harbaugh

Urbanization modifies the hydrologic response to rainfall by increasing flood peaks and volumes throughout the watershed, and the frequency of smaller floods (for example, floods occurring once every 5 years or less). Modified drainage patterns, increased impervious surface areas, and reduced natural storage areas as a result of urbanization are major factors affecting hydrologic response. Modifications of the hydrologic response result in increased flood damages, water-quality degradation, and channel instability for downstream areas in the watershed. Stormwater detention basins are widely used in urbanized areas to reduce flood peaks.

A calibrated, continuous-simulation watershed model (Hydrological Simulation Program-FORTRAN) was used to generate a 50-year simulated flow time series and flood peaks at selected locations throughout the watershed. Simulated effects of stormwater detention (utilizing various release rates) on flood peaks and volumes, and the frequency of smaller floods in Blackberry Creek were determined. The simulated stormwater detention was found to successfully reduce the flood volumes from urbanized areas but was more effective on low-frequency floods than high-frequency floods.

### *Five New Low-Cost Techniques for Streambank Stabilization*

Presenting Author: Robert Frazee, University of Illinois Extension

Streambank erosion is increasing in severity along many rivers and streams throughout our nation due to greater volumes and velocities of water runoff. Besides loss of land and flooding, streambank erosion may contribute to as much as 30 to 50 percent of the downstream sediment load.

The following five, low-cost stabilization methods have recently been developed in Illinois and installed on over 500 severely eroding sites to effectively control streambank erosion: Willow-Post, Bendway Weirs, Stone Toe Protection, Rock Riffles, and Stream Barbs.

The Willow-Post Method utilizes dormant, native willow cuttings to stabilize eroding streambanks in watershed areas of 25,000 acres or less.

Bendway Weirs utilize rock structures called weirs that are built to extend out into the stream to deflect the current away from the eroding bank.

Stone Toe Protection is a continuous stone dike placed longitudinally along the toe of the eroding bank that prevents the toe from being eroded away and allowing the top bank to collapse.

## Watershed Management *(continued)*

Rock Riffles attempt to simulate normal streamflow through the construction of alternating, regularly spaced, deep and shallow areas called pools and riffles. Rock riffles provide for grade stabilization and pools dissipate the energy from the flowing water.

Stream Barbs utilize rock structures that are larger in size than Bendway Weirs and are typically installed in bends of streams that are too sharp for weirs to be used.

In September 2004, a new publication entitled Streambank Stabilization in Illinois: Protecting Land, Property, and Water Quality was produced by the Illinois Department of Agriculture, Association of Illinois Soil and Water Conservation Districts, and University of Illinois Extension. Over 25 state and national agricultural magazines published articles showcasing these new streambank stabilization practices. Over 2,500 printed copies have been requested, with requests originating from 5 different countries and 32 states within the United States. An electronic copy is also available on the University of Illinois Water Quality Website www.wq.uiuc.edu . I will provide printed copies of this new brochure as part of my presentation.

My PowerPoint presentation will highlight these five effective stabilization methods which provide landowners an economical way for protecting the land and water resources throughout the watershed. Due to strong, innovative leadership and substantial state funding, Illinois is leading all other states in providing educational programs and funding to address streambank erosion problems.

# Technical Session 1

## Data and Models

**Moderator:** Phil Mankin, Illinois-Indiana Sea Grant

### *Discrepancies Between Computed and Digitized Hydraulic Parameters and Implications in Hydraulic and Hydrologic Analysis*

Presenting Author: David Soong, U.S. Geological Survey

Author: David Soong and Christopher Hamblen

The applications of Digital Elevation Model (DEM) and Geographic Information System (GIS) in water-resources engineering are increasingly widespread. However, errors associated with the DEM and GIS interpolations have not been investigated in detail to date.

For a cooperative study with Kane County Division of Environmental Management, the U.S. Geological Survey (USGS) used interpolated data from a detailed DEM in hydraulic and hydrologic analysis and also in the mapping of flood plains and floodway using GIS procedures for the Blackberry Creek in Kane County. It was found that the automated GIS procedures for floodplain delineation produced discrepancies from manual method. Judgment was needed in determining the correctness of the digitally determined boundaries.

With either manual or digital mapping, elevation and corresponding width of the estimated water-surface at each cross section are the basic parameters used for determining the flood-plain and floodway boundaries. When determined manually by interpreting specific topographic contour intervals between two cross sections, the distance between the cross sections generally is not a concern. When the flood-plain or floodway boundaries are determined digitally using the triangulated irregular network (TIN) interception method, elevation is preserved on the flood-plain boundary but the width at cross sections may not be preserved. Results using the TIN are affected by factors including differences in topographic features between cross sections, accuracy of the channel centerline, placement and extent of the cross sections, the distance between cross sections, and the accuracy and resolution of the topographic data. Therefore, discrepancies may exist between hand- and digitally delineated maps as well as computed hydraulic parameters.

The presentation will discuss analyses of the discrepancies between computed and digitized hydraulic parameters, their effects on routing functions, and consequently on the mapped floodplains.

### *Real-time Precipitation Data Collection and Dissemination for Operational Stormwater Management.*

Presenting Author: David Fazio, U.S. Geological Survey Illinois Water Science Center

Author: David Fazio and Terry Ortel

The value of real-time hydrologic data collection and dissemination including river stage, streamflow, and precipitation data for operational stormwater management efforts at the local level is particularly high where flash flooding is common and costly.  Predicted stream response to precipitation

## Data and Models *(continued)*

and antecedent streamflow and/or moisture conditions can be produced through the use of real-time simulation, historic data, or simulation analyses. The stream-response information lead-time can then be used to activate flood plans and evaluate or operate reservoirs or other flood defense structures for active stormwater management.

The U.S. Geological Survey in cooperation with various local, county, state, and federal agencies collects and processes real-time hydrologic data. The processed data are utilized to interpret current and expected hydrologic conditions and plan for reservoir operations. For precipitation, data processing is based on the analysis of gaged precipitation, National Weather Service (NWS) NEXRAD information, and the NWS Quantitative Precipitation Forecast (QPF). Displays provide a dynamic picture of the overall precipitation patterns, and continuous-simulation rainfall-runoff models linked with dynamic-wave routing models provide the expected peak elevations at critical locations, as well as the simulated effects of operational actions. The rain-gage network data transmission is provided by radio telemetry, telephone line, satellite, and the Internet. Radio data are routed to the DuPage County Division of Stormwater Mangement Supervisory Control and Data Acquisition (SCADA) system and to the USGS Internet servers. Real-time data for selected sites are also sent to the National Weather Service for display, analysis, utilization in models and algorithms. The streamflow and rainfall data for the current water year and historical record are archived and published annually.

### *Demonstration of the Effect Particle Size Has on BMPs*

Presenting Author: Fabio Tonto, Imbrium Sytems Corporation

Author: Fabio Tonto

Current industry practice relies on evaluation of total suspended solids (TSS) removal to assess and select storm water best management practices (BMPs). TSS is widely used as a surrogate for trace element pollutants found in storm water runoff. While particles in storm water vary in size and typically include clay, silt, sand and gravel, references to particle size distribution (PSD) in relation to the common performance requirement of 80 percent TSS removal is often neglected. The interpretation of percent TSS removal becomes subjective in the absence of a PSD reference.

Consideration of the size and characteristics of particles in storm water provide a better assessment of BMP performance. This paper examines the effect of PSD on the design and performance of a Stormceptor System using full scale laboratory testing and a numerical model. While numerous studies have and continue to emerge with respect to particle size and associated pollutants, this paper emphasizes the importance of defining storm water characteristics including PSD in a treatment criteria.

## Data and Models *(continued)*

### *Feasibility Study for Energy Extraction from Treated Effluent*

Presenting Author: Pallav Dhabalia, Illinois Institute of Technology, Chicago

Author: Pallav Dhabalia and Paul R. Anderson

Treated effluent from wastewater treatment plants, which is normally released into water bodies, has a considerable amount of thermal energy. This heat energy can be extracted by the medium of water-source heat pumps and used to provide building heat for the treatment plant.

Heat pump is a reversible-cycle refrigeration system that can provide heating and cooling simultaneously or separately, as required. The efficiency of a heat pump, or coefficient of performance (COP), is inversely proportional to the temperature difference between the heat source and heat sink. Conventional heat pumps are air-source heat pumps that use air as a source of heat. Because the air temperature is very low during winter months, these heat pumps require supplemental heat and have to be defrosted regularly to get rid of ice deposit on outdoor coils.

Treated effluent is at a much higher temperature than ambient air except during the peak summer months. It can thus be used as a source of heat for heat pumps. High effluent temperature results in a small temperature difference between the heat source and sink and thereby ensures a very high efficiency for the water-source heat pumps. Heat from the treated effluent is extracted by means of a refrigerant which gets evaporated in the process. The building's heating system water or air then acts as a condensing medium, absorbing heat from the refrigerant and circulating it in a closed loop to heating units. During summer months, by reversing the flow direction of the refrigerant, the heat pumps can be used as air-conditioning units. Because water has a very high heat capacity, even at a small wastewater treatment plant, a considerable amount of potential heat is available from wastewater. At larger facilities, the excess heat available can be supplied to nearby establishments, at a cost.

A large amount of warm treated effluent released into water bodies is harmful for aquatic life. Using water-source heat pumps not only helps to overcome the limitations of air-source heat pumps but also reduces the effluent temperature by extracting heat from it and thereby reducing thermal pollution of water bodies.

In this paper, we compare air-source and water-source heat pumps, study the technical and economic feasibility of using water-source heat pumps that use treated wastewater as a source of heat, and consider the limitations that such an arrangement might have in a wastewater treatment facility.

## Data and Models *(continued)*

### *Lateral Prediction of Depth-Averaged Velocities in Compound Channels*

Presenting Author: S. Kyle McKay, University of Illinois

Authors: S. Kyle McKay, Gregory V. Wilkerson, and Arthur R. Schmidt

Although flow in compound channels is three-dimensional, most engineering applications treat the flow as one-dimensional to account for the non-uniform distribution of velocity in the cross section. If two-dimensional effects are accounted for, it is by using correction coefficients (e.g., the Boussinesq and Coriolis coefficients beta and alpha), which are not easily quantified. Two-dimensional depth-averaged models for compound channels (developed using the continuity and momentum equations), while available, are not practicable for widespread use. Therefore, a model for predicting the depth-averaged velocity distributions that is simple to use would be beneficial to many aspects of science and engineering (e.g., flow measurement; sediment transport; stream restoration; etc.). In this paper we describe the approach (dimensional analysis) that we are using to develop a model for predicting the depth-averaged velocity distribution across the width of straight, compound channels with uniform roughness. While the range of applications to which this model applies is limited, we believe the potential benefits (accuracy and ease of use) will prove its merit. To predict the depth-averaged velocity distribution, the model will utilize the cross-section averaged velocity, flow depth, and channel geometry. The data that will be used in our analyses are from large-scale laboratory studies. Preliminary analyses indicate that an appropriate function for predicting the depth-averaged velocity is: $Ud(z)/U0 = C1 + C2 \exp(C3\ z) + C4/(1+ C5 \exp(-C6\ z))$, where Ci = constant, Ud(z) = depth-averaged velocity, U0 = mean velocity, and z = dimensionless coordinate along the transverse axis. The model's utility will be demonstrated by calculating the discharge in a compound channel from the flow depth, channel geometry, and a single velocity profile measurement. Implications to turbulence models for flow in compound channels will also be discussed.

# Technical Session 1

## Stakeholders Perspecitves on the Great Lakes Water Resources Compact (panel)

Moderator: Timothy Feather, CDM Federal Programs

Panel presentation by: Dave Naftzger, Council of Great Lakes Governors; Molly Flanagan, National Wildlife Federation; Cheryl Mendoza, Alliance for the Great Lakes; Mary Ericson, National Wildlife Federation

The Great Lakes—St. Lawrence River Basin Water Resources Compact ("Compact") and companion Great Lakes—St. Lawrence River Basin Sustainable Water Resources Agreement ("Agreement") were agreed to last December after over four years of negotiations by the governors and premiers of the Great Lakes states and provinces. In order for the Compact to become effective, each of the eight Great Lakes states will need to ratify it and the U.S. Congress will be asked for its consent. Once effective, the Compact will establish a minimum set of water resources management measures for the Great Lakes states to administer.

The negotiation process for the Compact and Agreement involved the governors' and premiers' staffs, a stakeholder advisory committee, a resource group that included technical experts, and observers. Tribes and First Nations were consulted and there was also a multi-faceted public participation process. The Council of Great Lakes Governors facilitated and assisted the governors' and premiers' negotiations, and was instrumental in keeping the negotiations process on-track and ensuring a successful completion of that process. The stakeholder advisory committee consisted of organizations representing a wide range of perspectives on Great Lakes water resources management issues. Among these organizations, the views of industry and of the environmental community tended to diverge the most. However, these groups managed to reach a compromise on many issues in the negotiation of the Compact, many of which are reflected in the final Compact. As the ratification process moves forward, many of the interests represented in the stakeholder advisory committee will be working in each state to continue to promote their concerns.

This panel will (1) present an overview of the Compact negotiation process and resulting policies, (2) provide an update on the Compact ratification process, (3) present the views of environmental and industry stakeholder groups on the substance and process of the Compact, and (4) provide an analysis of the special status of Illinois in the Compact context.

### *Compact Negotiation Process and Results*

Dave Naftzger, Council of Great Lakes Governors

Annex 2001 to the Great Lakes Charter set forth the intention of the governors and premiers of the Great Lakes states and provinces (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, Ontario and Québec) to update and enhance the water resources management system for the Great Lakes basin. In order to put the broad framework of Annex 2001 into action, the governors and premiers initiated a four-year effort to develop new agreements to protect the Great Lakes. This effort involved representatives from each governor's and premier's office and their natural resource agencies working closely with members of the scientific community, represen-

# Stakeholders Perspecitves on the Great Lakes Water Resources Compact *(continued)*

tatives of local governments, agricultural, business, environmental and other interests as well as the citizens of the basin.

The process of drafting the Compact and Agreement required bringing together a vast range of interests to agree on a common set of principles and then putting those principles in writing. Invaluable to the success of this process was the commitment of the governors, the premiers and their administrations in each state and province to see the process through to completion. The Council of Great Lakes Governors was tasked with facilitating this process and, as a result, was closely involved with all aspects of the negotiation process.

## *Status of State Ratification Process*

Molly Flanagan, National Wildlife Federation

In order to become effective in the states, the Compact must be ratified, through concurring legislation and with no material changes, by each of the eight Great Lakes states' legislatures. The ratification effort will subject the Compact to the legislative processes of each of these states. Each state legislature will approach the Compact from its unique political and policy perspective and upon the timetable that best suits the legislature's needs. The challenges for those seeking Compact ratification will be to address the concerns of each state legislature and to keep the ratification process moving forward. (Separately, the provinces will amend their statutes and regulations as appropriate to implement the terms of the Agreement.)

In the months since the Compact was agreed to by the governors, several state legislatures have taken measures to ratify the Compact and, more broadly, ready themselves for Compact implementation. The approach to ratification in each state is likely to vary. Some states may seek to ratify the Compact language alone and others may consider the adoption of additional implementing legislation. The timetables for ratification also vary greatly by state and may be influenced by legislative calendars, election cycles, politics, lobbying by interest groups and decisions about implementing language. Compact ratification in each state has been, and will continue to be, a moving target. Compact effectiveness also will depend upon approval by the U.S. Congress. This effort will entail its own set of issues and challenges. The governors have suggested that they will first seek state ratification and, then, congressional approval. Strategies for addressing Congress are under ongoing development.

# Stakeholders Perspecitves on the Great Lakes Water Resources Compact *(continued)*

## *Environmental Organization Perspectives*

Cheryl Mendoza, Alliance for the Great Lakes

Environmental and conservation organizations played an active role in the Compact negotiations process and continue to work diligently in each of the Great Lakes states as ratification proceeds. Both regional groups, such as the Alliance, and state organizations are working to ensure that ratification maintains, and, where possible, improves upon, the environmental gains represented by the Compact. While the Compact reflects many of the objectives of environmental organizations, a number of regional and state-specific concerns remain. The Compact specifically provides that it does not limit states' ability to enact any additional, or more stringent, water management measures. Thus, environmental groups are active in the legislative process to seek such additions where possible. The Alliance for the Great Lakes works throughout the Great Lakes region to support efforts to improve regional water resource management, including efforts to ensure effective and comprehensive ratification and implementation of the Compact.

## *Business and Industry Perspectives*

Jon W. Allan, Consumers Energy Company

Representatives of business and industry interests played an active role in the Compact negotiations process and continue to work in each of the Great Lakes states as ratification proceeds. Both regional and state business and industry groups are working to ensure that Compact ratification efforts effectively take into account the needs and interests of industry and recognize the importance of continued industry vitality to the economy of the Great Lakes region. The Compact provides states with considerable discretion in their implementation measures and business and industry groups are working at the legislative level to ensure that this implementation is accomplished in a way that is consistent with the ability of Great Lakes business and industry to remain competitive.

## *Illinois, the Chicago Diversion and the Compact*

Mary Ericson, National Wildlife Federation

Illinois is a full and equal party to the Compact and the Agreement. It is recognized that Illinois is in a unique position as a result of the U.S. Supreme Court consent decree governing the "Chicago Diversion." This decree represents the negotiated agreement among nearly all the Great Lakes states on Illinois' right to divert water from Lake Michigan. The Compact exempts Illinois from a number of its provisions because Illinois' use of Great Lakes water via the Chicago Diversion continues to be governed by the terms of the decree. A careful review of what the consent decree provides and how this matches up to the Compact's provisions will illustrate the nature of the deal between Illinois and the other states and provinces on Illinois' access to Great Lakes water.

# Watershed Management II

Moderator: Sam Dennison, Metropolitian Water Reclamation District of Greater Chicago

## *Estimating Industrial Hydrologic Footprints*

Presenting Author: Sachin Pradhan, Illinois Institute of Technology, Chicago

Authors: Sachin Pradhan and Paul R. Anderson

Ecological footprints have been suggested as a way to estimate the land required to absorb the wastes and support the resource demands associated with the activities of a given population. The hydrologic footprint is a similar concept that can be used to describe how water resources are influenced by human activities. A comprehensive assessment of industrial water use could include the following categories:

- Direct water use associated with industrial activity. This category includes conventional water use such as process, cooling, product, washing, maintenance, and irrigation water.
- Indirect water use associated with energy demands. Cooling water for thermoelectric plants is the greatest water use in the US. As a result, there is an indirect contribution to the hydrologic footprint based on energy consumption by the industry.
- Stormwater runoff. Water use in this category depends on precipitation, the area and type of surface, and the type of stormwater management plan the industry has in place.
- Water use associated with the product(s) use(s). Design and promotion of a product can have an effect on how the consumer uses the product and how much water is involved.
- Indirect water use associated with the hydrologic footprint of suppliers. Each member of the supply chain for a specific industry has a hydrologic footprint that includes these same categories. As a result, the number and type of suppliers an industry interacts with has an effect on the overall hydrologic footprint.

In this paper we examine the hydrologic footprint of a variety of water users in the City of Chicago, and the relative contributions from the above categories. Specifically, we assess the data that can be used to measure the footprint, limitations of the existing data, and how the footprint changes among different industries.

## *Agent-Based Model for the Big Creek Watershed in Southern Illinois*

Presenting Author: Seth Soman, Southern Illinois University

Authors: Seth Soman, John Stephen, Steven Kraft, Jeffrey Beaulieu, Christopher Lant and Raja Sengupta

Computer-based agents are stimulus-response models representing individuals that (1) function autonomously without human interaction; (2) interact with one another and with humans via an agent communication language; (3) responds to changes in their environment, and (4) exhibit goal-directed behavior (Woolridge and Jennings 1995). In this paper an agent-based model is developed to identify the most-likely land-use choices by individual landowners given various agricultural policies, commodity prices, and other components of the decision environment. Typologies of landowners will be modeled using a linear programming model called GEOLP. GEOLP is a linear programming

## Watershed Management II *(continued)*

model initially set up to identify profit maximizing farm decisions, developed by Kraft and Toohill (1984), and later enhanced with a GIS interface. Each agent will be represented by a specific stimulus response model (Kraft et al., 1989). The response of a farmer to economic and policy variables will be categorized based on his/her motivations and farm structure characteristics. The different agent typologies will be designed to identify the adoption of best management practices such as placement of riparian buffers or responses to public policies such as CRP (Esseks and Kraft, 1991). For the Big Creek watershed three types of agents (land managers) were defined (Kraft et al., 1989), a profit maximizer, a mythical farmer (conservationist) and a satisficer (rural life style). Testing the agent model will be done by running simulation (GEOLP) using randomly distributed hypothetical farms in the Big Creek watershed in southern Illinois. Historical land use data derived from reclassified satellite imagery and census of agricultural datasets will be used to calibrate and validate the model. An error matrix will be created to identify the predicted land use pattern from GEOLP runs with that of the historical land use pattern maps on a field by field basis.

### *Connecting Scientists and Educators through Great Lake and Ocean Science*

Author: Julie Murphy, Illinois-Indiana Sea Grant

The jobs that water resource managers and research scientists perform are crucial to the health of our nation's waterways. Just as crucial, however, are outreach efforts to keep the public informed about the importance of our water resources and the urgent need to protect them. COSEE Great Lakes provides opportunities for researchers and water resource managers to partner with teachers and reach out to thousands of students in grades 4-10.

COSEE (Centers for Ocean Sciences Education Excellence) is a network of ten regional centers established along America's shores. COSEE's goals are to promote the development of effective partnerships between research scientists and educators, disseminate effective ocean sciences programs and best practices that build on existing resources, and promote a vision of ocean education as a charismatic, interdisciplinary vehicle for fostering scientific literacy. Created in 2005, the NSF-funded COSEE Great Lakes adds a critical freshwater component to COSEE education programs, examining the journey from freshwater to saltwater and from watershed to sea.

COSEE Great Lakes' objectives include facilitating collaboration between Great Lakes researchers, educators, and thousands of students in grades 4-10, assisting research scientists to gain better access to educational organizations and use appropriate pedagogy in relating the Great Lakes/ocean science story, integrating ocean and Great Lakes research into existing high quality science education materials, making current research findings about the Great Lakes available to the public to encourage public science literacy and appreciation of water resources, and helping students explore Great Lakes issues and their connection to our oceans.

In this presentation, I will discuss three compelling ways that research scientists can become involved in this Great Lakes initiative educating teachers and students:

- In Lake Exploration workshops scientists interact with teachers for a week, not through

lectures but through questioning, discussions of research and curriculum, and exchange of views across the cultures of research and education. The program invites scientists to participate in the upcoming COSEE Lake Exploration workshop on Lake Michigan in Summer 2008.

- Through educator house-calls, small groups of teachers will visit research labs in 2006 and 2008 for discussions with scientists. Teachers will be prepared to describe conditions for learning science, and to assist scientists with preparation for classroom visits and student interaction.
- In our School for Scientists, we will conduct education workshops for science researchers at the 2007 and 2009 annual meetings of the International Association for Great Lakes Research.

Scientists who engage in any of these COSEE activities will be supported to present at education conferences for science teachers.

## *Aerial Imagery for Long Term Watershed Evolution Assessement*

Presenting Author: Andrew Phillips, Illinois State Geological Survey

Authors: Andrew Phillips, Geoff Pociask, and Lisa Smith

Ongoing assessement of watersheds in the Illinois River Basin are intended to characterize their current geomorphic, ecological, and cultural conditions in order to inform ecosystem restoration activities. Current conditions developed, however, by complex interactions of physical and cultural factors over long periods. Furthermore, projects aimed at ecosystem restoration have impacts that develop over long periods. It is thus essential to characterize the rates and styles of watershed response to landscape changes in order to predict project success. Very few watersheds have long term data collected within them, but a legacy of aerial imagery provides a detailed data source of comprehensive watershed conditions over the last 65 years. From these data, we extract stream channel planform and land cover change, and interpret them in the context of available soils data and field studies. Our current focus is on the Senachwine and Partridge Creek watersheds near Peoria, Illinois.

## *Using Agent-Based Models to Inform Policies for Sustainable Groundwater Use in Complex Scenarios*

Author: Moira Zellner, University of Illinois at Chicago

Water systems are vulnerable to overexploitation due to their open-access nature: many users can tap into the resource and no one can be excluded from accessing it, diminishing its availability to others, diluting responsibilities over its management and removing any individual incentive to preserve it. Unless some institutional arrangement is enforced, water will be extracted beyond the system's ability to replenish itself, leading to the collapse of the resource and of the economic activities depending on it. The natural resource management literature provides abundant examples of

## Watershed Management II *(continued)*

the depletion of open-access resources, and no conclusive evidence exists about the most effective institutional arrangement that can prevent it. The interaction of myriad physical and socio-economic factors introduces complexity and uncertainty in the water system, obscuring the understanding of the impacts of human decision-making, and imposing the costs of these impacts on others. Yet, understanding and acknowledging the complex aspects of water resources can help planners frame the allocation problem and design better policy solutions. In this paper, I lay out the theoretical background that explains the challenges associated with water management and the limitations of traditional analytical and policy approaches. Responding to this challenge, I propose an analytical and institutional framework that explicitly represents the complexity of water systems coupled with human economic activity, examining its potential for water resource planning. The purpose is to provide guidelines for setting up a dynamic institutional learning framework, using agent-based models to support and integrate empirical exploration, policy analysis and policy implementation. This paper draws from previous experience in other areas of the Great Lakes basin, where rapidly declining groundwater levels in have raised serious concern. Hydrological studies suggest that land-use changes play a significant role in this decline. The Water-Use Land-Use Model (WULUM) is an agent-based model developed to understand how land-use decisions create the observed patterns of resource depletion, and to suggest policies to reverse the process. The land-use component includes groundwater extractors, including irrigated farms and households. The groundwater component includes the glacial deposits and the underlying bedrock aquifer. The behavior of water users is defined by simple rules that determine their location and consumption. The dynamics of groundwater are represented through diffusion rules between each cell and its immediate neighbors. Initial explorations with the model showed that land-use patterns have a non-linear relationship with groundwater levels: both low-density and high-density zoning restrictions improved aquifer conditions over medium-density development. Moreover, of all the natural and policy variables, zoning had the greatest influence on urban settlement and therefore on resource consumption. The progressing versions of WULUM were used in work meetings with county planners to understand the impact of land-use changes on groundwater levels in their jurisdiction. The discussions that emerged around the model were useful to inform not only land-use and water management policies, but also model construction and future directions of empirical research. This participatory approach to modeling generated further interest in continuous involvement and training of county planners to improve WULUM, and apply it to policy-making through discussion with municipalities, agricultural organizations, and other stakeholders.

# Water Quality Issues

Moderator: Gregg Good, Illinois EPA

## *Effect of Temperature on Toxicity of Heavy Metals to Aquatic Invertebrates.*

Presenting Author: Mohammed Khan, University of Illinois at Chicago

Authors: M.A.Q.Khan and S.A.Ahmad

Aquatic animal species differ in their sensitivity to heavy metals. For example, zebra mussels (Dreissena polymorpha) and water flea (Daphnia magna) are more sensitive to copper than cadmium, lead, and zinc while baby crayfish (Orchonectis immunis) are more sensitive to cadmium than other metals. The toxicity of these metals increases by a rise in acclimation water temperature. A 4-50C increase in acclimation water temperature can make copper become 400% and 100% more toxic to respectively mussels and daphnids (Table 1). This rise in temperature can increase the rate of aerobic metabolism (oxygen consumption) by about 100% in mussels and 30% in crayfish and daphnids. These heavy metals inhibit the rate of respiration and seem to inhibit the temperature-related increase in respiration in all these animals although to different extents. Copper can inhibit the increase in rate of oxygen consumption up to 50% at 270C in crayfish, which can be inhibited further in mussels if the concentration of copper is increased. Increase in water temperature, in addition to increasing the metabolism (increased oxygen consumption), can decrease the solubility and, thus, the concentration of dissolved oxygen in water. Temperature can also increase the concentration of heavy metals in water due to their desorption (an exothermic process). All these factors together can make sublethal/subtoxic environments become lethal to aquatic animals. Such effects indicate that the onset of global warming (climate change) can have serious effects on aquatic biota and should be extensively investigated.

## *Canopy Water Use of Soybeans Grown in Future Predicted Atmospheric Concentrations of Carbon Dioxide and Tropospheric Ozone*

Author: Carl Bernacchi, Illinois State Water Survey

Tropospheric concentrations of carbon dioxide ([CO2]) and ozone ([O3]) are increasing as a result of land-use changes and fossil fuel combustion. These changes are hypothesized to have a large effect on water use for crop species. While leaf-level responses to elevated [CO2] and [O3] are well documented for crop species, few studies have addressed canopy level responses to increases in these pollutants. Evapotransporation (ET) for soybean, one of the most important agricultural crop species, was measured using an energy balance approach. Plots of soybean were exposed to a 180 µmol mol-1 increase in [CO2], a 25% increase in ambient [O3], or both. Data collection for the elevated [CO2] and elevated [O3] treatments was started in 2002 and the elevated [CO2] X [O3] treatment was added in 2003. Measurements continued from 2002-2005, representing four complete growing seasons. Measurements of air and canopy temperature, relative humidity, net radiation, soil heat flux, and wind speed were recorded in 10 minute intervals from emergence to canopy senescence for each of the treatments. Sensible heat flux was calculated from the wind

and temperature measurements. ET was determined as a residual in the energy balance from net radiation, sensible heat flux, and soil heat flux. The results show a decrease in ET for all three treatments with the largest decrease observed for the plants grown in elevated [O3] in 2002 and 2003. When integrated over the entire growing season, plants grown in elevated [CO2] and elevated [O3] used substantially less water than the control plots. These results suggest that future atmospheric change may influence a crops response to drought conditions and may have feedback effects on atmospheric moisture, potentially altering regional precipitation patterns.

## *An Optimization Model for Planning Wastewater Reuse in the Chicago Area*

Author: Yi Meng, Illinois Institute of Technology

Almost all water use in Chicago comes from Lake Michigan, but little of the nearly 2 billion gallons of Lake Michigan water used daily is returned to the lake. Instead, it flows out of the Great Lakes basin, to the Mississippi River. Even after a 1967 Supreme Court Decree limited the diversion to 2100 MGD, the Chicago diversion is still questioned.

To meet the future public water demand in this region and obey the Decree and navigation rule in Chicago Sanitary and Ship Canal, a variety of alternatives has been analyzed, such as applying water reuse, importing water from neighbor counties, resetting the water rate, and increasing groundwater withdrawal. In this paper we examine one of the most promising alternatives, treated wastewater reuse.

Seven wastewater treatment plants (WWTPs) of the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) have 1400 million gallons of treated effluent production. The majority of the effluent (98 %) is flushed down to rivers and canals without reuse. The high quality of treated wastewater makes it an excellent source for different kinds of reuse application, ranging from industrial processes that need high water quality to land irrigation applications that can get by with lower water quality.

The purpose of this project was to explore the potential for reusing municipal wastewater in the Chicago metropolitan area. We selected 475 industrial users, 614 parks, 108 golf courses, and 313 property owners along Chicago River and the Sanitary & Ship Canal for prescreening purposes. A Geographic Information System was used to explore the distances between potential treated wastewater users with the seven WWTPs. To explore incentives and barriers to treated wastewater reuse we considered the following four issues: Regulation and policy, health risk, technology, and economics. Results show water use in Chicago is inefficient and there are many opportunities for treated wastewater reuse.

This project explores the different interests of different entities who are related to water use practices. From perspectives of those different entities, such as Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), the City of Chicago, industries, residents and Non-governmental

organizations (NGOs), under the economic, regulatory, and technical constraints, to build a decision support system for maximizing the welfare for the whole local society.

This multi-objective decision model is able to identify water reuse opportunities, prioritize these water reuse opportunities by cost factor, and optimize the allocation of urban water resources. This model include opinions from most concerned stakeholders, thus can provide essential information to decision makers in planning and managing urban water resources to a sustainable approach.

## *Nitrogen Dynamics Associated with Autumn-olive Stands at Field and Watershed Scales*

Presenting Author: Christine Goldstein, Department of Forestry, Southern Illinois University

Authors: Christine L. Goldstein, Karl W. J. Williard and Sara G. Baer

Autumn-olive (Elaeagnus umbellata Thunb.) is a nitrogen (N) fixing invasive, exotic shrub that has become naturalized in the eastern United States. The fixed nitrogen could potentially contribute to the non-point source pollution of groundwater and surface waters, and ultimately contribute to the eutrophication and subsequent hypoxia of downstream water bodies such as the Gulf of Mexico. Our study objective was to assess the nitrogen dynamics and nitrogen leaching in autumn-olive stands at field and watershed scales. To achieve this objective we will 1.) determine whether soil net nitrogen mineralization rates, soil water nitrogen (nitrate and ammonium) concentrations, and groundwater nitrogen concentrations are greater under autumn-olive stands compared to open field conditions and 2.) determine whether stream nitrate and ammonium concentrations are related to the percent cover of autumn-olive in a watershed.

To sample soil water, six tension lysimeters were installed in both autumn-olive and open field plots at three riparian sites in southern Illinois. Soil water samples were collected at least monthly from February 2004 to present and analyzed for dissolved nitrate-N (NO3-N), ammonium-N (NH4-N), pH, and specific conductivity in the Department of Forestry's Water Quality Research Laboratory. In addition, twelve groundwater wells were installed in January 2006 at the three riparian sites. Groundwater was sampled every two weeks from April 2006 to present and analyzed for dissolved NO3-N, NH4-N, pH, and specific conductivity. Also, in-situ measurements of soil net N mineralization and net nitrification were made at each of the three riparian sites. Twelve ephemeral streams in the Indian Creek watershed in southern Illinois were sampled for dissolved NO3-N, NH4-N, pH, and specific conductivity following significant (>1.2 cm) precipitation events. The twelve watersheds will be surveyed in summer 2006 to determine percent cover of autumn-olive in each watershed. Soil water NO3-N concentrations were significantly greater ($p=0.003$) under riparian autumn-olive plots ($3.06 \pm 0.44$ mg L-1) compared to nearby open field plots ($0.07 \pm 0.01$ mg L-1). However, soil water NH4-N concentrations were similar ($p=0.530$) between autumn-olive ($0.11 \pm 0.01$ mg L-1) and open field ($0.09 \pm 0.01$ mg L-1) plots. These results indicate that the ammonium fixed by autumn-olive may be rapidly converted to nitrate and leached via soil water. Soil net nitrogen mineralization and net nitrification rates, groundwater nitrogen, and stream nitrogen results will be presented at the meeting in October 2006. Preliminary soil water results indicate that autumn-olive may be converting riparian areas from net nitrogen sinks to net nitrogen sources.

## C-Far Strategic Research Initiative in Water Quality

Moderator: George Czapar, University of Illinois Extension

### *Spatial and Temporal Relationships Between Biotic Integrity of Illinois Streams, Dissolved Oxygen, and Nutrients (Including Controls on Dissolved Reactive and Particulate Phosphorus).*

Presenting Author: Mark B. David, University of Illinois

Authors: Mark .B. David, T.V. Royer, A.R. Childers, M.R. Whiles, C.A. Mitchell, K.M. Starks, M. McDaniel, and T.N. Heatherly

Nutrient enrichment in streams and rivers can increase productivity and the occurrence of nuisance algal blooms. We are evaluating the model that increased nutrient loading (particularly phosphorus) to Illinois streams leads to increased chlorophyll-a, which causes large diel fluctuations in dissolved oxygen and concomitantly impairs biota. How well this model applies to streams and rivers of Illinois is unknown. Our first objective has been to determine relationships among nutrients, chlorophyll-a (including both sestonic and benthic chlorophyll), dissolved oxygen patterns and biotic integrity, as indicated by stream macroinvertebrate communities. Our second objective was to quantify controls on P forms and amounts in Illinois streams and explore relationships to chlorophyll-a. Last, we have examined the role of landscape and anthropogenic factors on these relationships, including shading, sewage effluent discharges, and sedimentation. We have conducted extensive state-wide sampling of approximately 140 sites to encompass the variability in stream and land use types that occur in Illinois during both late spring (high flow) and late summer (low flow) conditions. At a state-wide scale, it does not appear that dissolved nutrients are strongly related to the abundance of chlorophyll-a. Intensive work was also conducted at selected sites to gain a finer temporal resolution of nutrient-chlorophyll-oxygen relationships. Our results show that light availability, temperature, and hydrology modify the cause-and-effect relationship implied in the above model. Our recent focus has been to obtain dissolved oxygen measurements (continuously for a minimum of 72 hours) at as many sites as possible to expand on our previous site-specific results. These dissolved oxygen concentrations have been related to chemical and biological conditions in each stream, as well as physical habitat. Studies also have evaluated P forms and controls (chemical, physical, and biological) on concentrations in a range of streams. From these data we hope to determine controls on P concentrations in Illinois waters, along with the resultant impact on chlorophyll-a, dissolved oxygen, and biota, providing needed data for IL EPA to develop nutrient criteria.

## C-Far Strategic Research Initiative in Water Quality *(continued)*

### *Effects of Phosphorus Mediated Through Algal Biomass in Illinois Streams*

Presenting Author: Timothy Smith, Center for Aquatic Ecology and Conservation, Illinois Natural History Survey

Authors: Timothy Smith, Walter Hill and Shari Fanta

To quantify the effect of phosphorus on algae, dissolved oxygen and fish biodiversity in wadeable Illinois streams, we used an integrated research approach with data from highly controlled lab experiments, large scale natural experiments and statistical modeling from long term and contemporary observations. By testing and cross checking our conclusions and hypotheses we were able to provide integrated scientific support for TMDL regulation of phosphorus in the state of Illinois. Phosphorus frequently limits algae growth in aquatic systems. Growth rates of algae generally increase in a type II or type III dose-response curve as P is added to systems. At high P concentrations, algae growth rates reach a plateau. Some additional absorption of P may occur at these high concentrations, but further additions of P do not increase algal growth rate. Efforts to reduce algal growth in streams will not be effective unless P concentrations are reduced below the dose-response plateau.

Experiments in controlled laboratory streams showed a clear dose-response relationship between algae accrual and TP and SRP concentrations. Algae accrual reached maximum levels at 75ug/l TP and did not increase further in systems with higher TP concentrations. A BACI experiment in Little Kickapoo Creek showed that start-up operations of a sewage treatment plant increased algae growth relative to pre-treatment and upstream growth rates. Responses to TP and SRP additions were much greater in the absence of riparian canopy. Prior to plant operations, stream TP averaged 60 ug/l. Subsequent to plant effluent release, P levels increased to 1569-260 ug/l at affected sites. In statewide surveys, no general dose-response relationship between periphyton accrual and P concentrations was observed. However, all sites sampled contained average TP well in excess of 75 ug/l. Several covariates also strongly affected algae accrual. Light and flow rates most strongly affected periphyton biomass across experimental and natural systems. Sites without canopy and low turbidity experienced the highest algal growth rates regardless of TP or SRP concentrations. Algae growth also declined during periods of high flow and at sites with high point velocities. Normal mechanisms of eutrophication were supported by analysis of dissolved oxygen and animal diversity. Dissolved oxygen cycled more widely and experienced lower minima at sites with highest algae accrual. Fish and mussel diversity was lower in drainage basins with high TP and total ammonia ammonium concentrations but not in large rivers.

## C-Far Strategic Research Initiative in Water Quality *(continued)*

From our data we conclude that significant reductions in ambient Illinois P concentrations would be required to reduce algae growth in most Illinois streams. The plateau for algae growth occurs at levels at or below 75 ug/ml. Reduction of P to the EPA standard of 75 ug/ would not be likely to reduce algae growth and eutrophication in Illinois streams. Canopy cover strongly affected algae accrual across the full spectrum of nutrient concentrations. Restoration and maintenance of riparian canopy in wadeable streams would provide a buffer against nutrient effects in moderate sized streams. Riparian shading also contributes habitat complexity to streams, a factor known to strongly limit animal diversity in Illinois.

### *Headwater Stream Primary Production Dynamics – Nutrient Limitation and the Potential Role of Sediment Derived Nutrients*

Presenting Author: Bill Perry, Department of Biological Sciences, Illinois State University

Authors: William L. Perry, Krista Kirkham, Kelly Slattery, and Katie Kizer

The goal of this project was to examine the relationships between nutrients, algal production, and dissolved oxygen in first and second order agricultural headwater streams of Central Illinois. Excess nutrient inputs into streams can lead to decreased water quality and biodiversity. Agricultural streams are often channelized with simplified riparian zones and high nutrient loading rates. The degraded conditions of these streams may affect downstream systems.

To examine the link between nutrients and algal production, we have focused on 6 headwater streams of the Mackinaw River with similar geology, hydrology and watershed size. Previously, we documented annual variations in dissolved nutrient concentrations (ammonia, nitrate, dissolved reactive phosphorus, and total phosphorus) which we hypothesized would lead to nitrogen limitation of periphyton during late summer early fall months. We tested this hypothesis using nutrient diffusing substrata and found that periphyton were nitrogen limited during late summer and early fall. Phosphorus was rarely limiting even though dissolved reactive phosphorus levels were near detection during these times. These experiments, however, used artificial substrata to mimic hard substrata, but soft sediments dominate the benthos of agriculture streams.

We are now testing the hypothesis that biomass and production of periphyton on soft sediments is higher than on hard sediments and may be rarely nutrient limited. To determine if sediment phosphorus concentrations differed between streams and seasonally within a stream we used a combination of sequential phosphorus extractions coupled with determination of equilibrium phosphorus concentrations. Preliminary data suggest sediments have large amounts of phosphorus potentially available to periphyton. Periphyton net primary production on hard and soft sediments was estimated using replicate acrylic chambers (20 x 7 cm). Mean net primary production, chlorophyll, and ash free dry mass was significantly higher on soft substrata compared to hard substrata (n = 6 streams). Periphyton on soft sediments is often overlooked, but may be an important contributor to diurnal dissolved oxygen fluctuations.

## C-Far Strategic Research Initiative in Water Quality *(continued)*

In the near future, we will be examining the link between algal biomass and diurnal dissolved oxygen swings in small headwater streams and the effect on downstream systems. To examine the link between algal biomass and dissolved oxygen we plan on surveying streams varying in algal biomass and assessing dissolved oxygen over 96 hours. We will also examine dissolved oxygen upstream and downstream of the confluence of the tributary streams with the larger Mackinaw River.

Our research on agricultural headwater streams suggests periphyton are rarely limited by nutrients or light. Our data suggests these extensive algal blooms may be deriving nutrients from sediment bound phosphorus and the resulting algal blooms drive diurnal dissolved oxygen fluctuations. Periphyton on soft sediments is often overlooked by stream ecologists but may be the major contributor to oxygen minima which can lead to decreased biodiversity.

## *The Impact of Sediments on the Potential Bioavailability of Phosphorus in Illinois Streams*

Presenting Author: Michael L. Machesky

Authors: Michael L. Machesky, James A. Slowikowski, Thomas R. Holm, Josh Stevens, and Kip Stevenson

In this study, funded by the Illinois Council of Food and Agricultural Research (CFAR), we are clarifying the impact of suspended and bed sediments on the potential bioavailability of phosphorus. The Spoon River watershed in West-Central Illinois, a major tributary of the Illinois River, is the focus of this effort and within this watershed we are intensively monitoring two low-order tributaries, Court and North creeks, as well as the Spoon River itself. Our efforts include intensive low flow and storm sampling of suspended and bed sediments to determine phosphorus forms and bioavailability. While these intensive data are being collected, important water quality parameters such as pH, temperature, dissolved oxygen, and chlorophyll a are also being monitored, through in situ sampling and the use of continuous water quality monitoring instrumentation.

Our presentation will summarize results from this study including phosphorus bioavailability as determined with the iron-oxide impregnated filter strip method (Fe-P), the phosphorus buffering capacity of fine-grained bed sediments, and stream productivity as estimated from our continuous dissolved oxygen monitoring data. Some major findings from our results to date are:

1) The severe drought conditions which characterized the summer of 2005 had major im pacts on water quality when compared to the more typical summer of 2004. The uninter rupted low-flow water conditions during the summer of 2005 were typified by unusually high concentrations of suspended algae, low concentrations of dissolved phosphorus, and persistently large diurnal swings in dissolved oxygen concentrations.
2) Equilibrium Phosphorus Concentration (EPCo) values (that phosphorus concentration at which sediments are neither a source nor a sink of inorganic phosphorus) of our fine-grained Court Creek, North Creek, and Spoon River sediments vary directly with mean overlying water column DRP concentrations over the relatively short term (weeks), and

## C-Far Strategic Research Initiative in Water Quality *(continued)*

EPCo values follow the order, North ≈ Court > Spoon.

3) Bioavailable phosphorus concentrations (as determined by the Fe-oxide filter strip method), were generally equal to dissolved reactive phosphorus (DRP) concentrations during the summer months of 2004, but were typically 2-5 times higher than 2005 summer DRP concentrations. Bioavailable phosphorus concentrations are also 2-5 times higher than DRP concentrations during storm events.

# Technical Session 3

## Institutional and Economic Strategies

Moderator: Martin Jaffe, Illinois-Indiana Sea Grant College Program

### *Water Rate Making Practices in Illinois Public Water Systems: Current Practices, Historical Trends, and Future Possibilities*

Author: Jack Kiefer, CDM, Inc.

The pricing of public water services plays an important role in signaling the cost of securing, treating, and distributing water supplies. Economic theory stipulates that price determines the demand for water, and, as a result, affects the allocation of the scarce resource across competing uses. Differences in how water prices are calculated and presented in the form of a rate schedule may lead to differences in customer incentives and can have broad implications for economic efficiency and social welfare.

There is a lack of information on the pricing objectives that are actually considered in water ratemaking and how ratemaking objectives affect the choice of any particular water rate structure over another. More precise information is needed on the set of instruments that water utilities use in charging for water and the degree of variation in their application. A more thorough understanding of the intricacies of water ratemaking is needed in order to predict the likely success of promoting rates that are economically efficient.

This paper examines the water pricing behaviors of a sample of 426 community water systems in the State of Illinois. The purpose of the study is to describe comprehensively how water rate structures differ across water systems to determine if variation in ratemaking practices is caused by differences in ratemaking objectives. The paper summarizes the characteristics of rates and rate structures across Illinois water systems and identifies differences in rate complexity, primary rate making objectives, and examines trends in the use of specific rate designs. In light of these factors, recommendations are provided for improving rate making practices and for further important technical assistance to Illinois water utilities.

### *Beyond Privatization: Restructuring Water Systems to Improve Performance*

Presenting Author: Truegary Wolff, The Pacific Institute

Authors: Truegary Wolff and Eric Hallstein

Water managers throughout the United States (US) face significant challenges meeting the needs of the communities they serve. Numerous documents have been written about these challenges and how to overcome them. The most controversial types of solution options involve increased reliance on the private sector.

In the US, interest in the privatization of water and wastewater utilities, and to a much lesser extent in storm water management, increased significantly during the 1990s. Private companies saw

## Institutional and Economic Strategies *(continued)*

an opportunity for profit in owning or operating water systems, and they entered or expanded their presence in many markets. In some cases they have been strongly opposed by those who feel that water is too essential and fundamental a public good to allow private ownership or even operation of publicly owned facilities. For similar reasons, some communities have purchased or attempted to purchase water system assets from investor owned utilities. This action of "municipalization" is the opposite of selling public assets to an investor owned company. By "restructuring" we mean the full range of options including and between these two extremes.

This document is unique in that it discusses the role of the private sector in water systems in the upper Midwest while arguing that "public versus private" is not the "bright line" that separates success from failure. We believe that the ideological debate over privatization has overshadowed more important determinants of success. Our essential message is that the issue of public versus private is an important "value issue" that has, unfortunately, become a distraction from other, more important determinants of success. These determinants include effective staffing, adequate and innovative funding, better asset management systems, performance measurements and rewards, and better stakeholder involvement and transparency.

This report (http://www.pacinst.org/reports/beyond_privatization/ ) provides a framework for assessing problems, identifying possible solutions, and choosing among them. It provides practical information and examples to help urban and rural municipal-level decision-makers who need to improve the effectiveness of the water, wastewater, and storm water utilities that serve them, whether public or private. To illustrate critical points, the manual offers numerous examples from the upper Midwest: the US States of Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin, and the Canadian Province of Ontario.

### *Green Lands, Blue Waters: How Protecting Your Watershed Can Help to Protect the Planet*

Author: Stephen John, Agricultural Watershed Institute

As stated in its project description document, the Green Lands, Blue Waters (GLBW) Initiative is "a long-term comprehensive effort whose mission is to support development of and transition to a new generation of agricultural systems in the Mississippi River Basin that integrate more perennial plants and other continuous living cover into the agricultural landscape. … The vision is to improve water quality in the Mississippi River Basin, increase economic options and profitability for farmers, improve wildlife habitat, reduce flooding potential, strengthen vitality and quality of life of rural communities, and enhance human health."

This paper will describe the membership and organizational framework of the GLBW Initiative, the values that guide the effort, its objectives and strategies, and its potential economic and environmental benefits. Current Illinois members of the GLBW consortium are the University of Illinois, Agricultural Watershed Institute, Illinois Stewardship Alliance, and the Upper Mississippi Basin Project of The Nature Conservancy. Iowa State University, University of Minnesota and University

of Wisconsin have also members of the Consortium.
The initiative envisions major changes over time in cropping systems and it relies on voluntary approaches to achieve change. A key objective is "to develop and promote profitable enterprises based on the products of continuous living cover systems." The development of such enterprises will suggest fruitful avenues for research and demonstration projects. Creative ideas and plans to implement promising ideas will come in part through learning groups. The project description states: "Learning groups provide a forum for learning, innovation, and integration of different types of knowledge among stakeholders. The learning groups will identify the most promising continuous living cover systems, help design and carry out research and demonstrations, identify barriers to the adoption of perennial crops and the use of cover crops in annual crop systems and propose effective means to remove them, and evaluate related Federal farm policy."

A biomass energy project currently being conducted by the Agricultural Watershed Institute will be presented as a case study illustrating the use of cross-sector learning groups to identify markets and uses for perennial crops. Participants in this biomass energy learning group include agricultural producers, electrical utilities and industries, conservation agencies and organizations, university researchers, business and economic development specialists, and other stakeholders. One of the challenges being addressed in this project is how to capture the value of air, water and habitat-related ecosystem services to bridge the gap between the coal-equivalent energy value of biomass crops and the price needed to attract farmers to grow and process the crop.

The paper will discuss the potential role that the kind of alternative cropping systems envisioned by GLBW can play in meeting local water quality goals, reducing nutrient loads throughout the Mississippi River Basin, and achieving dramatically increased soil carbon sequestration and reduced carbon dioxide emissions from fossil fuels.

## *Institutional Innovation as a Compliance Strategy: Small Water Systems and The Safe Drinking Water Act*

Presenting Author: Min-Yang Lee, University of Illinois Urbana-Champaign

Authors: Min-Yang Lee and John Braden

This study investigates the role of organizational change in response to environmental regulations with particular reference to the effects of the Safe Drinking Water Act on drinking water supply. In the United States, the drinking water industry is relatively fragmented; over 53,000 water systems provide drinking water to the 270 million people and 93% of those systems serve fewer than 10,000 people. These small water systems provide water to 20% of the population. Small systems tend to have smaller staffs, less technical expertise, more modest financial resources, and weaker management than the better-funded systems serving larger communities. They are more likely to violate drinking water standards. While much work has been done on technical innovations that help small

water systems to provide safe, reliable drinking water, little research has been conducted on the organizational innovation as a strategy for meeting environmental standards. We use a unique dataset from the USEPA and combine this with spatial data covering locations of small drinking water systems to assess and characterize the determinants of merger in the drinking water industry. We find evidence that small systems are using merger as a mechanism to comply with Safe Drinking Water Act requirements.

## *Agriculture-Utility Cooperative Agreements for Protecting Source Water Quality in Illinois: An Analysis of the Opportunities*

Presenting Author: Stephen P. Gasteyer, University of Illinois

Authors: Stephen P. Gasteyer and Jennifer Carrera

Drinking water quality is critical to quality of life. Citizens need to be confident that when they turn on their tap, the water that comes out will be safe and potable. To achieve this, for the last decade, community water systems have attempted to protect the source of their drinking water to limit the amount of treatment necessary. For many communities in Illinois located in close proximity to agriculture, this means working with agricultural producers to protect sources of drinking water. Most farmers, however, do not receive their drinking water from municipal water suppliers. Further, actions to implement source water protection may well constitute a loss of land for production. This paper will explore the institutional, financial, social, and cultural factors that influence the decision of farmers to protect drinking water for communities. The authors will discuss the results of reviews of existing literature, text analysis of existing project documents, reports and local media, and interviews with key informants throughout Illinois, and of local actors in east central Illinois. The results will include discussion of existing strategies used to protect source water by communities and agricultural producers, the varied processes of implementation of those strategies; assessment of the success of those various initiatives; assessment of their sustainability over time; and, finally, preliminary models for community/agriculture alliances to protect source water quality. All these will be exemplified using case studies from Illinois and other Midwestern states.

# Land Use and Water Resources

Moderator: Bev Herzog, Illinois State Geological Survey

## *Institute for Sustainability of Intensively Managed Landscapes*

Author: Praveen Kumar, University of Illinois

Intensively managed landscapes (IMLs) refer to extensive modification of the land for agriculture and urban use. While serving as a cradle for economic prosperity of our society, IMLs are also responsible for the unintended deterioration of our environment from the alteration of natural vegetation, modification of rivers for navigation, increased loading of fertilizers and chemicals in water bodies, decline of ground water levels, reclamation of land using levees, etc. These induce significant modification of the water cycle and the environment and as a result all the systems that are linked such as climate, biogeochemistry, and ecology. The adverse effects of these stressors are evident through the degradation of the water quality and ecosystem functions, increased erosion, loss of wetlands and biodiversity, deterioration of recreational opportunities, and ultimately the quality of human life.

With rapid growth of the world population, doubling to over 6 billion in the last 40 years, with an expected increase to 9 billion in another 40 years, the growing demand for food, water, energy, and standard of living is transforming our landscape and environment in unprecedented and unpredictable ways across the globe with local, regional and continental scale impacts. These effects are further exacerbated by the uncertainty of the changing climate. Billions of dollars are already being spent on restoration activities. Will the IMLs continue to provide the productive functions for the growing human needs, and can this be done while still reclaiming the lost environmental functions? What new scientific understandings about the web of intricate relationships in nature are required to support continued economic prosperity without further environmental degradation? Policies and management practices supported by innovations in science, planning, design, engineering, and participatory decision making are necessary to meet the needs of the future with sustainable land and water resources. We sit at the cross roads in time with challenge, necessity, and opportunity to make a careful assessment of our landscape and environment, and advocate sustainable and economically viable solutions and practices for immediate societal benefits and long term security. The recent human tragedy and economic losses brought upon by floods and droughts only serve to illustrate the urgent need for such studies.

The Institute for the Sustainability of Intensively Managed Landscapes, unique in its focus on human impact issues, will help develop a complete and comprehensive picture of environmental processes and functions through the integrated study of rivers and lakes, water cycle, agriculture, ecosystems, urban environment and climate.

## Land Use and Water Resources *(continued)*

### *Linking Land Use and Lake Erie: A Watershed Planning Framework For Achieving Balanced Growth*

Author: Joseph Lucente, Ohio Sea Grant College Program

The Ohio Lake Erie Commission recently published for review Linking Land Use and Lake Erie, a "planning framework for achieving balanced growth in the Ohio Lake Erie watershed." This report offers their recommendations for attaining a living equilibrium between a strong, diversified economy and a healthy Lake Erie ecosystem.

The plan connects balanced growth and a vital Lake Erie. Together, they impact the economic competitiveness and quality of life in Ohio. Balanced growth includes revitalizing urbanized areas, promoting efficient development, and protecting natural areas; all of which are quality-of-life strategies that are key to the retention and attraction of an educated workforce.

Linking land use issues and the health of Lake Erie maximizes the efficient use of infrastructure, conserves farmland, provides open space and recreational opportunities and promotes compact development patterns that build on the unique qualities of communities to promote greater transportation choices. The strategy will help local governments plan for economic development opportunities and streamline decision-making processes. The plan should provide consistency and predictability for private and public development decisions, thus enabling more cost-effective development.
Most pressing issues often have a regional dimension, e.g., economic development, housing supply, transportation, and environmental quality. The reality is that Ohio is a home-rule state where control of land-use decisions is at the local level of government. More effective local solutions can be realized by collaborating on a larger geographic scale.

Central to the implementation of the plan will be voluntary Watershed Planning Partnerships composed of representatives of local governments, planning agencies, councils of governments, special purpose authorities (such as metropolitan planning organizations, sewer districts, or transit authorities), and non-governmental organizations (such as watershed organizations, chambers of commerce, or land trusts). State agency representatives will assist these partnerships with coordination and state-level input.
Each partnership will develop a Watershed Balanced Growth Plan as a framework for coordinated, regional decision-making about how growth and conservation should be promoted and balanced in the watersheds. Watershed Balanced Growth Plans will not replace, but serve to augment comprehensive plans many communities create. They will be limited to the designation of two primary features:

- "Priority Conservation Areas" (PCA's) -- locally designated areas targeted for protection and restoration such as important ecological, recreational, heritage, agricultural, and/or public access areas that are significant for their contribution to Lake Erie water quality and the region's general quality of life.
- "Priority Development Areas." (PDA's) -- locally designated areas where growth and/or redevelopment is especially encouraged to maximize development potential, maximize the efficient use of infrastructure, promote the revitalization of existing cities and towns, and con tribute to the restoration of Lake Erie.

## Land Use and Water Resources *(continued)*

### *Towards Modeling for Real-Time Control of Combined-Sewer-Overflow Systems: Application to the Calumet TARP System in Chicago, Illinois*

Author: Arturo Leon, University of Illinois

Although combined-sewer-overflow (CSO) systems are generally designed based on gravity flow conditions, in practice large variations in the inflow and outflow from these systems result in flow conditions that vary from dry to gravity flow to mixed gravity-pressurized flow, to fully-pressurized flows. Thus, any realistic numerical model of CSO systems must be able to simulate all these flow conditions starting from any specified initial condition. Furthermore, if a model is intended for real-time control of CSO systems, such a model must be robust, accurate and computationally efficient. Mixed flows are traditionally simulated by one of two general approaches: (a) simulation of pressurized flows as gravity flows using the Preissman slot method and (b) separate simulation of the gravity and pressurized flows. The Preissman slot approach is computationally simpler as it only requires solution for one flow type (gravity flow); however this method may present accuracy and stability problems associated with the width and shape of the hypothetical slot and it can not simulate negative pressures. On the other hand, while the separate simulation of gravity and pressurized flows is more complex, methods based on this approach are able to simulate negative pressures in the pressurized flow regime. However, most of the available models developed using these two approaches are not robust and they cannot simulate certain flow conditions such as dry bed flow. The work described herein focuses on the application of a new model developed at the University of Illinois at Urbana-Champaign for modeling the Calumet Tunnel And Reservoir Plan (TARP) system operated by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC). This numerical model solves the 1D conservation of mass and momentum equations for gravity flows coupling a Finite Volume shock-capturing scheme with the Preissman slot method. The Calumet CSO system consists of tunnels, reservoirs, drop shafts, connecting structures, pumping stations, and other appurtenances for the capture and storage of CSOs during large storms and for conveyance of the stored CSOs to water reclamation plants for treatment after the storm has ended. In contrast to most of the models used for the modeling of mixed flows, the model developed at the University of Illinois is found to be very robust, is fully conservative, accurate, efficient, is capable of simulating the entire range of possible flows, and it can handle automatically gravity-flow bores. Furthermore, it is shown for the case of gravity flows, that to achieve a specified level of accuracy, the proposed scheme requires much less memory storage and execution time than the fixed-grid Method of Characteristics (MOC) with space-line interpolation. The model developed at the University of Illinois ultimately could allow for the implementation of real-time control of CSO systems.

## Land Use and Water Resources *(continued)*

### *Urbanization Effects on Ground-Water Quality – St. Louis Area*

Author: William Morrow, U.S. Geological Survey, Illinois Water Science Center

The St. Louis area of St. Charles County in Missouri, and Madison and St. Clair Counties in Illinois (the “Metro East”), is one of the fastest developing areas in the United States. Urban land use in these counties is expanding at a much higher rate than current population trends. This effect on water quality will become more important as ground-water consumption in the area increases.

In 2005, as part of the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program, 25 monitoring wells were installed in these three counties to assess recently recharged ground water, and water-quality samples were collected for a wide range of constituents to document the status and trends of the water quality. These shallow wells were installed in glaciofluvial deposits overlying the limestone bedrock at the first water-producing unit. Analyses included volatile organic compounds, pesticides, trace elements, and major inorganics. Age-dating of the ground-water using SF6 concentrations indicated that all samples were post-1973 with a median apparent age of 1988.

Water quality constituents indicative of urban contamination were not detected in concentrations above levels of concern. Volatile organic compounds (VOCs) were detected above the reporting level in 56 percent of the well samples and pesticides were detected in 68 percent of the well samples, however these detections were below drinking-water regulations and all were below one microgram per liter (g/L) except for a detection of chloroform and acetone. Nitrate exceeded drinking-water standards in 8 percent of the samples. Trace elements and major inorganics generally did not occur at drinking-water regulation levels of concern except for manganese. Manganese exceeded the USEPA life-time health advisory drinking-water level of 300 g/L in 48 percent of the samples, with a maximum of 11,000 g/L.

Confining clays and loess may be limiting the infiltration of anthropogenic compounds, as indicated by low concentrations of pesticides and VOCs. These wells are planned be sampled on a decennial cycle to document the changing water-quality conditions in this urban environment.

# Drought

Moderator: Martin Jaffe, Illinois-Indiana Sea Grant

## *Water Resources Protection and Conservation Toolkit*

Presenting Author: Reggie Korthals, Northwestern Indiana Regional Planning Commission

Authors: Reggie Korthals and Sarah B. Nerenberg

The three counties in Northwestern Indiana are predicted to see greater growth in areas not currently receiving Lake Michigan water as the population declines in the urban core along the Lake Michigan shoreline. Because of this change and the unknowns in future water quality and quantity in the three-county region, Northwestern Indiana Regional Planning Commission (NIRPC) is taking the lead in the region to educate local governments on the availability, protection, and conservation of its water resources.

Under a grant from the Joyce Foundation, NIRPC produced a Water Resources Protection and Conservation Toolkit. The toolkit provides background on water resources and methods to best protect critical water resources in and near the Great Lakes watershed.

These tools are intended to help communities in these areas to most effectively protect and conserve water resources and protect the natural water cycle. The toolkit is intended to assist communities meet part of the major goal of the Great Lakes Compact - to protect, conserve, restore, and improve the water and water dependent natural resources of the Great Lakes.

The toolkit consists of a series of fact sheets that provide overviews of the key issues and identify a series of resources saved on a CD that will assists homeowners, local governments, water utilities, and developers in making choices that better protect, conserve, and sustain local water resources. To-date, 500 toolkits and 1000 CDs have been distributed throughout the Lake Michigan Watershed. Currently, NIRPC is assessing the future water supply planning needs of the region and strategizing on an approach.

This presentation will frame the water resources issues in Northwestern Indiana and relate them to the overall Greats Lakes watershed, present the challenges, provide an overview of the key players, and summarize the content and intention of the toolkit.

## Drought *(continued)*

### *Future Projections of Drought for Water Supply Planning*

Presenting Author: Kenneth Kunkel, Illinois State Water Survey

Authors: Kenneth E. Kunkel, Derek Winstanley, James Angel, Xin-Zhong Liang, and Michael Palecki

One of the most important factors to be considered in water-supply planning and management is the occurrence of drought, which can decrease water availability and increase water demand. During the drought of 2005, water system capacities were strained to supply adequate water amounts at some places and times, but there were only isolated water shortages. Water supplies in Illinois are impacted generally by more intense and longer lasting low precipitation events. Thus, an essential component of water supply planning is a scientifically-sound assessment of the future intensity and frequency of droughts. This must consider 3 factors. One, water systems will respond at a variety of time scales to drought. Some surface water systems or shallow groundwater systems will be impacted by intense but short lasting droughts like in 1988-89, while deep groundwater supplies may take many years to decline. Two, the past history of climate provides a minimum envelope for the future. Water supply planners must assume that the most severe drought of the recent past at a given time scale can occur again in the future. Three, anthropogenic influences, particularly increasing concentrations of greenhouse gases, are affecting the climate system and this may change the probability that a future drought may be more severe than any of the recent past.
An assessment of the worst-case long and intense drought was made, based on 2 sources of the recent climate history. Tree-ring information provided an estimate based on the past several hundred years; the advantage of this estimate is the long period available for analysis but the estimates are somewhat uncertain because of the inexact linkage between precipitation and tree-ring width. A second estimate was provided by 110 years of observational data, a highly accurate source but the relatively short period available limits the number of severe droughts in the sample.
The worst-case drought scenario based on tree-ring data is a 10-year period with precipitation 12% below normal statewide. As there is considerable uncertainty in translating tree-ring data into precipitation values, the 10-year worst-case drought scenario should be at least 15% below normal. Interestingly, the observational data give a similar value of 15% below normal for the 10-year worst-cast drought.

The potential impacts of anthropogenic influences on the future climate is being explored through an analysis of very recent climate model simulations which were generated for the upcoming Fourth Assessment Report of the Intergovernmental Panel on Climate Change is underway. In addition, regional climate model simulations, which provide a more accurate assessment of conditions at the spatial scale of Illinois, also are being produced and analyzed. Results from these analyses will be presented.

## Drought *(continued)*

### *The 2005 Drought and Drought Preparedness in Illinois*

Presenting Author: James Angel

Authors: James Angel, Michael Palecki, Kenneth Kunkel, and Derek Winstanley

Although drought is a natural and recurring feature of climate, the dry conditions in 2005 reached a historic level of severity in northern and western Illinois, ranking it as one of the 3 most severe droughts in 112 years of record in that region. The timing of the dryness, occurring in the spring and summer when water demand and use is high, produced substantial impacts on agriculture and other sectors in 2005. There were several unique aspects to this drought. First, while severe droughts have historically impacted large areas in the Midwest, by the summer of 2005 severe drought was largely confined to northern and western Illinois. Since many of the surrounding states did not experience severe drought, corn and soybean prices remained relatively low, causing additional financial hardship for Illinois farmers. Second, southern and central Illinois benefited from the unprecedented passage of four tropical systems as they tracked up the Ohio River Valley from the Gulf of Mexico. Third, corn and soybean yields were surprisingly high in some parts of the state, suggesting that the response of crops to drought has changed with time due to plant genetics and field practices. For example, there is evidence that vigorous crop root systems were able to take advantage of deeper soil moisture.

The Illinois State Water Survey is the primary agency in Illinois for monitoring and studying the water resources of the state. As a result, Water Survey scientist provided considerable data and expertise on the 2005 drought to the Illinois Drought Response Task Force (DRTF). The DRTF is the primary state-level response to any drought in Illinois. Participants in the DRTF included representatives from the Governor's office, Illinois Department of Natural Resources (IDNR), Illinois Department of Agriculture, Illinois Department of Public Health, Illinois Environmental Protection Agency (IEPA), Central Management Services, and the Illinois Commerce Commission. The Governor activated the DRTF on June 26, 2005 following a recommendation by the DRTF co-chairs, Gary Clark (IDNR) and Roger Selburg (IEPA). Water Survey scientists also provided guidance on the drought to the U.S. Drought Monitor.

At the conference, key aspects of the 2005 drought will be discussed. Particular actions and responsibilities of the DRTF will be described and plans to update the Illinois drought plan will be covered.

## Drought *(continued)*

### *Indicators and Indices of Surface Water Availability*

Presenting Author: Robert Holmes, USGS Illinois Water Science Center

Indicators are defined as performance measures that combine information into a usable form for water managers and private citizens. Indices are defined as higher-order indicators which provide either a summary of or a
weighted set of indicators. Because of the relatively rapid changes in rivers, indicators for surface water are more beneficial if they can be updated in near-real time. The importance of adequate spatially distributed data, which are long-term and utilize regionally (or nationally) consistent data-collection and reporting techniques, cannot be overemphasized in the determination of indicators and indices for use in the analysis of important water issues. Consider the following quote from the report by Hudson and Roberts (1955) discussing the drought the State of Illinois faced in the early 1950's:

"Deficiencies in hydrologic data appear to have had an important role in the failure of public water-supply sources. At the time of design of most of the reservoirs now in use, there were few stream-flow data available."

Examples of indicators and indices of importance for assessing surface water availability include:

- Annual mean streamflow.
- Mean annual streamflow.
- Annual 7-day low streamflow.
- Trend analysis of streamflow characteristics over time.
- Percentiles of various streamflow characteristics (daily flow, 7-day flow, 28-day flow, etc.).
- 7- day 10-year low streamflow frequency (7Q10).
- Storage ratio index (reservoir and lake storage available divided by the mean annual streamflow).
- Storage vulnerability index (based on the regional reservoir storage and the regional reservoir yield estimated by the consumptive demand).

Of the above indicators and indices, all but one depend on streamflow data. Of the USGS stream-flow gages operational in Illinois, 99 percent are real-time gages and provide the ability to update many indicators and indices in a timely manner. Selected surface-water indicators can be found on the Web at http://water.usgs.gov/waterwatch/

Hudson, H.E. and Roberts, W.J., 1953, 1952-1955 Illinois drought with special reference to impounding reservoir design, Illinois State Water Survey Bulletin 43, 52 p.

# Poster Session

## *Web Based Youth Programs*

Author: Duane Friend, University of Illinois Extension

The use of Extension web based education materials for youth has expanded dramatically in the last few years. Teachers and students are given a trustworthy resource that can be used as a supplement to textbook material or as a stand alone project.

University of Illinois Extension has developed a series of web based natural resource programs, which has proved to be enormously popular.

The All Star River Explorers is a newly created website designed to introduce students to the basics of hydrology and increase their understanding of how rivers are formed and their importance in our lives. The site may be used by both teachers and students, and targets grade levels 4-6.

Sections within the site include:

River Basics- how rivers form and change, and how people affect these processes.
River Dollars and Sense- the economic importance of rivers.
Ooze, Goo, and Other Nasty Things- how pollution and invasive species affect rivers.
Hall of Fame- Brief biographies of famous North American river explorers
Teachers guide- activities and resources for teachers to use in class

## *DNAzyme Biosensors For Detection of Toxic Metal ions*

Presenting Author: Heekyung Kim, University of Illinois

Authors: Heekyung Kim, Juewen Liu, Daryl P. Wernette, Debapriya Mazumdar, Geng Lu, and Yi Lu

A new class of fluorescent and colorimetric biosensors has been developed for simple and fast detection of trace contaminants. A DNAzyme with high specificity for Pb<sup>2+</sup> has been isolated using an  in vitro  selection method and converted to sensors by coupling with flurophore/quencher or gold nanoparticles. The fluorescent biosensors are highly sensitive with a detection limit of 2 ppb for Pb<sup>2+</sup>, below that of EPA drinking water limit of 15 ppb. The immobilization of the sensor on gold coated surfaces has made possible dry storage and regeneration for long term use. The detection of Pb<sup>2+</sup> in water with various hardness has been achieved using a portable fluorometer, showing on-site and real time detection is possible. The detection of Pb<sup>2+</sup> in leaded paint has been demonstrated using the colorimetric sensor below the federal threshold of 1 mg/cm<sup>2</sup>. Our approach is general enough so that sensors for other metal ions such as Cd<sup>2+</sup>, Hg<sup>2+</sup>, Co<sup>2+</sup> and U<sup>6+</sup> have been or are being obtained.

## Poster Session *(continued)*

### *Sediment Controls on Phosphorus in East-Central Illinois*

Author: Marshall McDaniel, University of Illinois

Concerns about eutrophication in freshwater systems have lead to an interest in sedimentary controls on phosphorus (P) cycling. Within the body of research on P cycling in lotic sediments it has been well established that sediment minerals can adsorb P, but the microbial processing of P in these sediments is poorly understood. In this study alkaline phosphatase activity (APA), a metric of P limitation and microbial activity, was measured biweekly over an approximate one year period in the benthic sediments of four east-central Illinois streams. Benthic sediments were also measured for texture, organic matter content, extractable P, and equilibrium P concentrations (EPC0). Water samples were collected in coordination with biweekly benthic sediment samples and measured for dissolved reactive phosphorus (DRP) and total phosphorus (TP). In addition the automated ribosomal intergenic spacer analysis (ARISA) method, a molecular method that involves isolating the intergenic spacer between the 16S-rRNA and 23S-rRNA gene from microbial communities, was used to observe temporal, spatial, and environmental changes in the sediment microbial community composition (MCC). In stream TP and DRP ranged from 0.001 to 1.67 and 0.010 to 1.755 mg/L respectively. Salt fork, a stream receiving wastewater effluent, showed the highest TP, DRP, and EPC0 values. Inorganic P sorption, as assessed by EPC0, was relatively constant during the year and didn't seem to be controlling stream water P concentration. Sediment APAs at three of the four sites were correlated with in-stream DRP, and increases in DRP were accompanied by decreases in sediment APA. This suggests a hydraulic connectivity between P in the water column and processing of P by microbes in the benthic sediment. However, this connectivity could vary due to stream morphological and hydrological characteristics as well as sediment characteristics such as texture and organic matter. In order to completely evaluate the benthic microbial community's contribution to P within the stream a method of measuring fluxes of P out of the sediment must be conducted. However, according to the results in this study microbial populations within the benthic sediments of streams play a significant role in the P cycling within these streams.

### *Illinois Watershed Association*

Author: Susan Meeker, University of Illinois Extension

The newly forming Illinois Watershed Association allows for an amplified voice for Illinois watershed groups. In a survey conducted by University of Illinois Extension in late 2003, over 160 watershed groups were identified in Illinois. It became evident that coordination among Illinois watershed associations would be beneficial as they are a large and diverse group. In preliminary discussions with federal, state, regional, non-governmental organizations, universities and watershed group representatives, interest in developing a statewide watershed association was expressed.

In February of 2004, at the Connecting Illinois Watersheds conference, an informational meeting was held to discuss formation of a statewide watershed association. It was suggested that answers to common questions and a survey be provided so watershed organizations and concerned individuals could express their opinion in forming a statewide organization. In the summer of 2004 a

## Poster Session *(continued)*

survey was conducted by the University of Illinois Extension, 87 people replied, of which 77% were in favor of forming a statewide association.

In the spring of 2005 an informational meeting was held and a steering committee was formed. The steering committee developed marketing materials outlining proposed benefits, goals, and a mission. The Steering Committee also selected the interim Board of Directors with representation from watershed groups in the major river basins throughout Illinois. The interim board members started their term in January 2006.

The mission of the Illinois Watershed Association is to improve information sharing and technical support among watershed organizations, advocate sound watershed management practices and programs, and amplify local watershed group's public outreach and educational efforts.

### *Agent-Based Model for the Big Creek Watershed in Southern Illinois*

Presenting Author: Seth Soman, Southern Illinois University

Authors: Seth Soman and John Stephen

Computer-based agents are stimulus-response models representing individuals that (1) function autonomously without human interaction; (2) interact with one another and with humans via an agent communication language; (3) responds to changes in their environment, and (4) exhibit goal-directed behavior (Woolridge and Jennings 1995). In this paper an agent-based model is developed to identify the most-likely land-use choices by individual landowners given various agricultural policies, commodity prices, and other components of the decision environment. Typologies of landowners will be modeled using a linear programming model called GEOLP. GEOLP is a linear programming model initially set up to identify profit maximizing farm decisions, developed by Kraft and Toohill (1984), and later enhanced with a GIS interface. Each agent will be represented by a specific stimulus response model (Kraft et al., 1989). The response of a farmer to economic and policy variables will be categorized based on his/her motivations and farm structure characteristics. The different agent typologies will be designed to identify the adoption of best management practices such as placement of riparian buffers or responses to public policies such as CRP (Esseks and Kraft, 1991). For the Big Creek watershed three types of agents (land managers) were defined (Kraft et al., 1989), a profit maximizer, a mythical farmer (conservationist) and a satisficer (rural life style). Testing the agent model will be done by running simulation (GEOLP) using randomly distributed hypothetical farms in the Big Creek watershed in southern Illinois. Historical land use data derived from reclassified satellite imagery and census of agricultural datasets will be used to calibrate and validate the model. An error matrix will be created to identify the predicted land use pattern from GEOLP runs with that of the historical land use pattern maps on a field by field basis.

## Poster Session *(continued)*

### *Development of an Image-Processing Tool for Groundwater Recharge and Discharge Estimation*

Author: Jihua Wang, University of Illinois

Recharge and discharge define the relationships between groundwater, precipitation, and surface water and thus can strongly influence water supply management options. Groundwater recharge and discharge result from of a set of complex, uncertain processes that generally are challenging to study. Conventional recharge and discharge estimation methods require time-consuming field experiments or data collection. We are developing a Geographic Information System (GIS) software package to estimate shallow recharge and discharge patterns and rates. The software is programmed in Visual Basic using the ArcObjects environment, including a recently developed image-processing algorithm, TV+L1. The scale-dependent character of this algorithm offers users the flexibility to extract variable degrees of spatial detail according to their needs. This new recharge and discharge estimation method requires relatively short preparation time and uses readily available hydrogeologic data. The software has been tested on a field site in Wisconsin which has been well-studied by the USGS. Preliminary results show that this method can provide an efficient recharge and discharge estimation tool that allows the user to select variable degrees of resolution and zonation. After the initial development stage, this GIS-based software will be integrated with the existing groundwater modeling code, MODFLOW, and parameter estimation code, PEST, for a linked recharge and discharge analysis and calibration procedure. The procedure design is modular, allowing the incorporation of additional image processing algorithms, recharge and discharge estimation methods, and parameter estimation methods as they become available. The final version of this software will be applied to ongoing ISWS studies of groundwater in Illinois.

# Speaker Biographies

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Dr. Angel holds a Ph.D. (1996) from the University of Illinois in the Department of Geography. His Ph.D. research was on the frequency and intensity of Great Lakes storms. Since 1984, he has worked at the Illinois State Water Survey as a researcher on projects that examined droughts, floods, rainfall patterns, extreme rainfall events, storms, and climate change. He was the co-author, along with Floyd Huff, on a rainfall frequency study (for example, the 100-year storm) that became the new standard for designing water-handling structures in Illinois. He has published several Water Survey publications, and journal articles in scientific publications such as Monthly Weather Review, Journal of Climate, and Journal of Applied Meteorology. He became the Illinois State Climatologist in 1997, replacing Wayne Wendland, who retired.

## *Barber, Larry*

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Dr. Larry Barber is a geochemist with the United States Geological Survey in Boulder, Colorado and has been conducting research on the fate of organic and inorganic contaminants in natural waters for more than 30 years. He received his B.S. in geology from the University of Arkansas, and his M.S. and Ph.D. in geology from the University of Colorado. His current research focuses on the aqueous chemistry and effects of emerging contaminants during water reclamation and reuse.

# Speaker Biographies

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I received my B.S. and M.S. degrees at Bradley University and a Ph.D. from the University of Illinois. After completing my Ph.D., I worked two years for the USDA Agricultural Research Service where I conducted experiments on the response of canopy-scale water use of corn and soybean to atmospheric change. Currently, I am a Scientist with the Illinois State Water Survey with an adjunct Assistant Professor position in the Department of Plant Biology at the University of Illinois, Urbana-Champaign. The main foci of my research is on physiological responses of crops to pollution and atmospheric change, the effects of tillage on carbon sequestration and the feedbacks between crops and their environment specifically related to water use.

## *Borah, Deva K.*

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Dr. Deva K. Borah is currently a Research Hydrologic Engineer at the Illinois State Water Survey, Champaign, Illinois. Dr. Borah earned his Ph.D. degree in Engineering Science from the University of Mississippi and through collaborative research with the USDA-ARS National Sedimentation Laboratory, Oxford, Mississippi in 1979 and has 27 years of professional experience, including at the Illinois State Water Survey, Rutgers University, University of Mississippi, TAMS Consultants, Inc. in New York, New York and OMNI Environmental Corporation in Princeton, New Jersey. He has over 150 publications published in peer-reviewed journals, conference proceedings, and as book chapters and research/project reports.

# Speaker Biographies

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Speaker: Water Supply Planning, "The Governor's Water Supply Planning Initiative"

Mr. Clark started his career as a civil engineer with the State of Illinois Department of Natural Resources, Office of Water Resources in 1974. On July 1, 2003, Mr. Clark was appointed as the Director of the Office of Water Resources. During his career with the Office of Water Resources, Mr. Clark has served as the Chief of the Planning and Research Section and as manager of the Division of Program Development. During his career, his areas of professional responsibilities included the administration and conduct of research and planning in the areas of instream flow protection, statewide water supply management, groundwater modeling, drought management, groundwater and surface water law and state water planning. Mr. Clark is a graduate of the University of Wisconsin, with a B.S. Civil Engineering in 1972, and a M.S. in Civil and Environmental Engineering in 1974. He is a licensed Professional Engineer in the State of Illinois and Wisconsin. In June of 2005 Mr. Clark was credentialed as a Diplomate, Water Resources Engineer by the American Academy of Water Resources Engineers.

## *Collins, Glynnis*

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Speaker: Data Needs for Water Planning

## *Czapar, George*

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Moderator: C-FAR Strategic Research Initiative in Water Quality

Dr. George Czapar is an Extension Educator, Integrated Pest Management, for the University of Illinois. He also serves as the leader of the Strategic Research Initiative (SRI) in Water Quality for the Illinois Council on Food and Agricultural Research (C-FAR). He received his B.S. and M.S. degrees in Agronomy from the University of Illinois, and a Ph.D. in Weed Science from Iowa State University.

# Speaker Biographies

## *David, Mark*

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Speaker: C-FAR Strategic Research Inititative in Water Quality

Mark David is a Professor in the Department of Natural Resources and Environmental Sciences at the University of Illinois at Urbana-Champaign, where he has been on the faculty since 1985. Dr. David earned his B.S. degree from the Pennsylvania State University, M.S. degree from the University of Maine, and his Ph.D. degree from the State University of New York, College of Environmental Science and Forestry.

Dr. David's research is focused on the biogeochemistry of nutrients in agricultural, forested, and aquatic ecosystems. He has conducted interdisciplinary research to study complex systems from a variety of approaches. Using field research, Dr. David examines the transformation, transport, and effects of nutrients in agricultural and forested landscapes, including aquatic systems. Dr. David's research areas include nitrogen and phosphorus biogeochemistry in agricultural ecosystems, including transport to surface waters at scales ranging from fields to regions; fate and effects of nutrients in aquatic systems; use of constructed wetlands to reduce agricultural nutrient losses to surface waters; acidic deposition effects on soils, including sulfur biogeochemistry; forest nutrient cycling; sewage waste disposal; and herbicide transport.

Results of Dr. David's research have been presented at national and international meetings, as well as at the local and state levels. He has authored or co-authored 99 refereed journal articles, many oral and poster presentations at national meetings, along with other technical and non-technical publications. Dr. David's research is highly cited: he was named in 2003 as an ISI Highly Cited Researcher in Ecology and Environment, which includes soil science. He was named a fellow of the Soil Science Society of America in 2005 and a fellow of the American Society of Agronomy in 2006.

Dr. David served as an associate editor for the Soil Science Society of America Journal, is currently as associate editor for the Journal of Environmental Quality, and has frequently served as a proposal panel member for the USDA and NSF.

## *Dennison, Sam*

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Moderator: Watershed Management II

Sam Dennison is a biologist and the head of the Aquatic Ecology and Water Quality Section in the R&D Department of the Metropolitan Water Reclamation District of Greater Chicago. His education includes a B.A. in biology, an M.S. in fisheries biology and a Ph.D. in biology. He is a certified fisheries professional and a past president of the Illinois Chapter of the American Fisheries Society.

## *Dhabalia, Pallav*

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Speaker: Data and Models

Pallav Dhabalia was born in Raipur, India. He received his Bachelors degree from the National Institute of Technology, Raipur. Pallav worked for one year as an Engineer at Sterlite Industries India Ltd. and is now studying for his masters degree in Chemical Engineering from the Illinois Institute of Technology Chicago.

## *Ericson, Mary*

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Speaker: Stakeholders Perspectives on the Great Lakes Water Resources Compact

Mary C. Ericson is the Great Lakes Water Resources Attorney & Advocate at the National Wildlife Federation. She works on water management issues throughout the Great Lakes region. She is also an Adjunct Clinical Assistant Professor in the Environmental Law Practicum at the University of Michigan Law School. She has a B.A. in Philosophy and in Music from Ripon College and a J.D. from Cornell University. Before joining NWF, Mary practiced environmental law in-house at DaimlerChrysler Corporation, specializing in superfund and remediation matters. Prior to that, she practiced in Washington D.C., specializing in transactional environmental issues at Milbank Tweed Hadley & McCloy and in regulatory environmental matters at Pillsbury, Madison & Sutro. She has also worked as a research assistant for the Environmental Law Faculty at the National University of Singapore, where she undertook extensive research and writing on integrated coastal management.

# Speaker Biographies

## *Fazio, David*

Geographer/GIS Specialist
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Speaker: Data and Models

David Fazio contracted with Motorola (Cleveland, Ohio) in 1994. Mapped state communications antenna network. From 1995 to 1998 contracted work with the U.S. Geological Survey, Illinois Water Science Center (Urbana, Illinois). Primary responsibilities were mapping and GIS for the National Water Quality Assessment program - Lower Illinois River Basin (NAWQA - LIRB). Other work for NAWQA - LIRB included surveying and characterizing stream habitat, and collection of fish, benthic macroinvertebrates and algae surveys. In 1998 joined the U.S. Geological Survey, Illinois Water Science Center. From 1998 to the present, work responsibilities have expanded to include surveying for the district, and operating and maintaining a real-time network of 28 rain gages for operational stormwater management in DuPage County, Illinois. He received a B.A. from Wittenberg University and a masters from Miami University.

## *Feather, Timothy*

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Moderator: Stakeholders Perspectives on the Great Lakes Water Resources Compact

Dr. Feather is employed by CDM Federal Programs and oversees water resources strategic initiatives involving the U.S. Army Corps of Engineers. Technically, his focus has been on the development of interdisciplinary solutions to environmental challenges and has been involved in projects nationwide servicing federal and state water resource agencies with special planning and policy studies. Recently, Dr. Feather published an ASCE committee report entitled “State Water Resources Planning in the United States”. As part of the Corps of Engineers Evaluation of Environmental Investments Research Program, Dr. Feather has researched methods for monetary and nonmonetary valuation of environmental project features and developed an overall evaluation framework for environmental plan formulation. Environmental planning tools that Dr. Feather has supervised and/or developed include environmental resource valuation, environmental law review/assessment, outdoor recreation analysis, water demand and conservation analysis, economic base analysis, water and wastewater quality analysis, survey and statistical evaluation and group process design and facilitation.

## *Fenton, Justin*

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Speaker: Watershed Management I

I received an Associate Degree in science from Lewis and Clark Community College, Godfrey Illinois. I continued my undergraduate studies at Southern Illinois University Carbondale and received my Bachelors Degree in Forest Natural Resource Management. Currently I am in my second year of Master's graduate work specializing in Forest Hydrology.

## *Flanagan, Molly*

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Speaker: Stakeholders Perspectives on the Great Lakes Water Resources Compact

Molly Flanagan is the Great Lakes Water Resources Advocate for the National Wildlife Federation (NWF). Molly directs NWF's water resources campaign working to ensure strong natural resource protections for the waters of the Great Lakes region. In her work, Molly designs and implements advocacy and political strategies to forward NWF's efforts to reform water resource policies in the Great Lakes, including efforts to pass the Great Lakes-St. Lawrence River Water Resources Compact into law. To this end, Molly leads a coalition of conservation organizations in Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York and works closely with agency and elected officials across the basin.

Prior to joining NWF, Molly was the Director of Lake Erie Programs for the Ohio Environmental Council (OEC). She was responsible for developing and executing statewide advocacy efforts on critical issues pertaining to the Lake Erie basin as well as throughout the Great Lakes including work on the Annex Implementing Agreements, Great Lakes Restoration, aquatic invasive species, and assisting grassroots activists in their work on local water quality and water quantity concerns.

Molly is an accomplished speaker and has given presentations at a number of conferences and meetings throughout the Great Lakes Basin on water resource issues and other issues affecting the Great Lakes. In addition, she currently serves on the Advisory Panel for the Great Lakes Aquatic Habitat Network and Fund and is a member of the Board of Directors of Great Lakes United as the Lake Erie Director. Molly graduated Summa Cum Laude with a BA in Environmental Studies from Denison University. She is a 2003 graduate of the League of Conservation Voter's Environmental Leadership Institute.

# Speaker Biographies

## *Frazee, Robert*

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Speaker: Watershed Management I

Bob Frazee works with farmers, elected officials, organizations, and other agencies in addressing issues impacting soil and water conservation, streambank erosion, no-till systems, and management of the Illinois River System. He is the recipient of numerous state and national awards for innovative programming. At ceremonies in Washington, D.C., Bob was presented the USDA Superior Service Award by Secretary of Agriculture Mike Espy for outstanding leadership and programming associated with management of the Illinois River System. Mr. Frazee holds a B.S. degree in Agronomy from Western Illinois University and a M.S. degree from University of Illinois.

## *Gasteyer, Stephen*

Assistant Professor
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Department of Human and Community Development
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Speaker: Institutional and Economic Strategies

Stephen Gasteyer joined the faculty of University of Illinois as a professor of Human and Community Development and Leadership in August 2005. Prior to this appointment, he served as the Director of Applied Research and Policy Development at the Rural Community Assistance Partnership (RCAP, Inc.) in Washington, DC from April 2002-August 2005. He continues to work closely with RCAP. His areas of research include a range a range of water and community development issues such as infrastructure financing, governance of water infrastructure systems, enabling access to water services, assessing the impacts of community infrastructure and capacity development training and technical assistance, and organizational structures in watershed and source water protection. He has written extensively and made presentations on, among other things, community participation and action, water infrastructure development, community organization and water issues, water privatization, regionalization of water systems, and water governance and management in the US, OECD, and developing countries. Other experience includes work as a Peace Corps Volunteer in Mali for June 1987-December 1990; work as a program associate for the Committee on Sustainable Agriculture for Developing Countries—which advocated for increased international support of sustainable agriculture practices, work on environment and sustainable development in West Bank and Gaza (Palestinian territories) from 1993-1996. He received a M.Sc. in 1998 and Ph.D. in Sociology from Iowa State University 2001. His dissertation looked at community organization and water quality protection.

## *Goldstein, Christine*

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Speaker: Water Quality Issues

I attended Lake Land Community College and completed an Associate's degree in General Agriculture in May 2003. I transferred to Southern Illinois University Carbondale where I completed my bachelor's degree in Forest Resource Management, Watershed Management in May 2005. I am currently in my second year of my Master's program in Forest Hydrology.

## *Good, Gregg*

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Moderator: Water Quality Issues

Gregg Good is the manager of Illinois EPA's Bureau of Water, Surface Water Section. He has been employed with the Agency for 21 years, and oversees the development and implementation of the Agency's inland lake, river/stream and Lake Michigan Clean Water Act related monitoring and assessment activities.

## *Hinchey-Malloy, Beth*

U.S. EPA Great Lakes National Program Office
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Moderator: Emerging Issues in Human Health and Aquatic Ecosystems

Elizabeth Hinchey-Malloy is a Great Lakes Ecosystem Extension Specialist with Illinois-Indiana Sea Grant. Her major focus is on ecosystem issues of all five Great Lakes and their connecting waterways.

As a liaison to the U.S. EPA Great Lakes National Program Office, Beth works with EPA staff to: develop outreach products and programs related to Great Lakes ecosystem research and monitoring; work with end users to interpret and apply project results to policy and management decisions at the local level that result in proper management of Great Lakes ecosystems; conduct

outreach events onboard the U.S. EPA research vessel, the R/V Lake Guardian.

Beth holds a Ph.D. and M.S. in Marine Science from the College of William & Mary, Virginia Institute of Marine Science, and a B.S. in Biology from the University of Notre Dame.

## *Holmes, Dr. Robert R., Jr., PhD, P.E.*

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Moderator: Data Needs for Water Planning
Speaker: Drough

A native of Harrisburg, Illinois, Robert Holmes is the Director of the U.S. Geological Survey Illinois Water Science Center (USGS-IWSC) and an Adjunct Assistant Professor of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign. In his capacity as Director of the USGS-IWSC, Dr. Holmes manages and directs all USGS Water Resources field operations and research in Illinois. Before becoming Director in 1999, Dr. Holmes served in various positions in Missouri and Illinois with USGS including: staff hydrologist, Surface-Water Specialist, and Chief of the Hydrologic Data and Analysis Section. Dr. Holmes has taught undergraduate, graduate, and short courses in sediment transport, open-channel hydraulics, water availability, and field data collection techniques.

Dr. Holmes has research interests in the areas of geomorphology, surface-water hydrologic processes, river hydraulics, sediment transport, and stream restoration. He has authored or co-authored numerous papers and reports on these topics.

Dr. Holmes has BS and MS degrees in Civil Engineering from the University of Missouri-Rolla, and a PhD in Civil and Environmental Engineering from the University of Illinois at Urbana-Champaign. He is a licensed professional engineer in Illinois and Missouri and holds memberships in Sigma Xi Research Society, the American Society of Civil Engineers (ASCE), the American Geophysical Union, the International Hydrological Science Association, and the Illinois Association of Floodplain and Stormwater Managers. Dr. Holmes has and is serving on numerous science advisory committees including the Illinois River Coordinating Council, Salt Fork Watershed Technical Advisory Group, Illinois River Science Advisory Council, Illinois State Water Plan Task Force, Illinois Drought Response Task Force, Corps of Engineers Illinois River Basin Restoration Study Steering Committee, and the USGS Representative to National Research Council Workshop on Stream Restoration. Dr. Holmes has served as President of the Mid-Missouri Section of ASCE and Water Master for the Champaign-Urbana Hydraulic Engineering Luncheon Series and has received the Department of the Interior's Superior Service Award.

## *Horvatin, Paul*

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Speaker: Challenges Facing Lake Michigan Water Management

Paul Horvatin is the Program Manager for the Great Lakes National Program Office. He is responsible for indicator development and monitoring program for USEPA in the Great Lakes inlcuding: open lakes monitoring, Integrated Atmospheric Deposition Network (IADN), contaminated fish monitoring, biological monitoring, Research Vessel Lake Guardian management, and health and safety management for GLNPO. Paul also serves as the U.S. Co-Chair for State of the lakes Ecosystem Conference and Program Manager for the Lake Michigan Mass Balance Project. He earned his Bachelor of Science and Masters degrees at the University of Illinois.

## *Herzog, Beverly*

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Moderator: Land Use and Water Resources

Beverly L. Herzog is a senior hydrogeologist and Assistant to the Chief for Environmental Initiatives at the Illinois State Geological Survey. She is also currently serving as the chairman of the Association of Ground Water Scientists and Engineers, a division of the National Ground Water Association. Herzog has a B.S. degree in geology from the UW-Oshkosh, an M.S. degree in hydrology from Stanford University, more than 25 years of experience in groundwater research. She is a Certified Ground Water Professional and a Registered Professional Geologist in Illinois.

# Speaker Biographies

## *Injerd, Dan*

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Illinois Department of Natural Resources
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Speaker: Challenges Facing Lake Michigan Water Management

Daniel Injerd is the Chief of the Lake Michigan Management Section for the Office of Water Resources, Illinois Department of Natural Resources. In this position, Mr. Injerd is responsible for the management of Illinois= Lake Michigan diversion as allowed under a U.S. Supreme Court decree and the allocation of Lake Michigan water to 200 public water supplies serving over 6.8 million people in northeastern Illinois. The Section also reviews and issues permits for construction activities in Lake Michigan. Mr. Injerd is active in representing Illinois on Great Lakes issues, and was a member of Illinois= team throughout the mediation process that successfully resolved the interstate dispute concerning Illinois= Lake Michigan diversion. He also serves as an Alternate Commissioner on the Great Lakes Commission and was recently appointed by Governor Rod Blagojevich to represent Illinois on the Council of Great Lakes Governors' Great Lakes-St. Lawrence River Water Resources Regional Body.

Mr. Injerd has been involved with the Great Lakes for 29 years. His educational background includes a Master of Science in Resource Management from Michigan State University, with a minor in Sanitary Engineering.

## *Jaffe, Martin*

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Moderator: Institutional and Economic Strategies and Drought

Martin Jaffe is the Director of the Urban Planning and Policy Program and an Associate Professor at the University of Illinois at Chicago. Marty currently holds an appointment as a specialist with the Illinois-Indiana Sea Grant College Program, where he has been involved in water supply planning and water resources management in both northeastern Illinois and in northwestern Indiana, and also directs the Metropolitan Sustainability Initiative at UIC's Great Cities Institute. Marty's degrees are from both Wayne State University (JD) and DePaul University (LL.M.) law schools.

## *John, Steve*

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Speaker: Institutional and Economic Strategies

Steve John is the executive director of the Agricultural Watershed Institute, a nonprofit research and educational institute established in 2003 located in Decatur, Illinois. Prior to formation of AWI, Mr. John was an environmental planning consultant specializing in watershed management and de-centralized wastewater systems. He served on the Decatur City Council from 1987 to 1995 and, as a councilmember, was a founder and co-chair of the Upper Sangamon Watershed Committee. He has a B.A. in sociology from the University of Notre Dame.

## *Juhl, Arlan*

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Speaker: Data Needs for Water Planning

Arlan R. Juhl is a 1973 graduate of Iowa State University in Ames, Iowa with a Bachelor of Science Degree in Agricultural Engineering, and is a Registered Professional Engineer in Illinois. He began his water resource carreer with the Division of Waterways (now the Office of Water Resources) in the Sterling field office, later moving to the Springfield headquarters office. He has worked on floodplain management issues, he has performed flood control project planning and design, he is actively involved with state and Corps of Engineers cooperative projects, and he strongly supports the surface water data collection network. He is currently the Manager of the Division of Planning for the Office of Water Resources.

# Speaker Biographies

## *Keefer, Don*

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Speaker: Water Supply Planning

Don Keefer is a Geologist and the Director for the Geologic Mapping and Hydrogeology Center at the Illinois State Geological Survey. He is a Licensed Professional Geologist in Illinois, with a BS and MS from the University of Illinois at Urbana. Since working for the ISGS in 1985, his research interests have focused on the characterization of subsurface contaminant fate and transport, the characterization of heterogeneity within geologic deposits, and the application of geologic information to groundwater resource protection. Don's current research interests also include geostatistical modeling of complex geologic systems and the development of advanced 3-D mapping technologies.

## *Khan, Mohammed Abdu Quddus*

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Speaker: Water Quality Issues

Mohammed Khan received his Ph.D. in zoology from University of Western Ontario and a M.D from the Universidad Autonoma de Ciudad Juarez, Mexico. He is currently a professor emeritus in Biological Science at the University of Illinois-Chicago. Dr. Khan received the Senior Fulbright Fellowship and the University of Wageningen Fellowship.

## *Kiefer, Jack C.*

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Speaker: Institutional and Economic Strategies

Dr. Jack C. Kiefer is an economist and geographer specializing in multiple consulting areas of resource economics and planning, econometrics, and integrated water demand and supply planning and management. Dr. Kiefer has 15 years of consulting experience in the water utility industry and has led water resources studies for some of the largest water utilities in the United States. Dr. Kiefer is an expert in conducting empirical studies related to water demand forecasting and evaluation of water conservation programs. Dr. Kiefer also applies his broad expertise in the areas of economics, risk analysis, and multi-criteria decision-support techniques for the U.S. Army Corps of Engineers, as well as for other U.S. and international water management agencies.

Prior to joining CDM, Dr. Kiefer led Planning and Management Consultants, Ltd.'s (PMCL's) Water Resources Research program and its five business service lines of Integrated Water Demand and Supply Planning, Resource Economics and Quantitative Analysis, Navigation Analysis, Military Resources Planning and Environmental Planning. He currently serves as Principal Economist and Lead Practitioner for CDM's Water Services Division and heads CDM's Water Economics Group located in Carbondale, Illinois.

## *Knapp, Vern*

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Speaker: Water Supply Planning, "The Governor's Water Supply Planning Initiative"

Vern Knapp is a Senior Hydrologist and Assistant Head in the Center for Watershed Science at the Illinois State Water Survey. He has over 25 years of experience at the Water Survey and has produced over 50 publications addressing various water resources issues in Illinois. His current projects focus on analyzing drought impacts on surface water supplies, determining streamflow trends affected by climate variability and water use activities, and developing streamflow and water accounting models for use in planning.

# Speaker Biographies

## *Korthals, Reggie*

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Speaker: Drought

Reggie Korthals is Director of Environmental Management Planning for the Northwestern Indiana Regional Planning Commission (NIRPC). Ms. Korthals has worked for NIRPC for seven years and has been involved in environmental issues in government and agriculture for twenty-five years. She directs a staff that is responsible for the development, implementation, and management of air quality programming, watershed planning, water resource protection, natural resource conservation and regional land use planning.

Ms. Korthals is the 2005 recipient of the Indiana Quality of Life Council Award for outstand contributions to environmental protection. Her background includes agriculture, secondary education, political speech writing, environmental planning and public administration.

Reggie also serves as an adjunct professor at Indiana University Northwest teaching environmental law and policy, she is a past member of the Porter County Park Board, currently serves on the Porter County Solid Waste Advisory Board, and is active in the IU and Purdue Alumni Associations. Reggie is on the Board of Directors for the Northwest Indiana Consortium for the Environment (NICE), the Center for Regional Sustainable Vitality, Indiana Watershed Leadership Program at Purdue University, and the Purdue University Calumet-Argonne National Laboratories Water Institute.

Ms. Korthals is a nationally recognized presenter on air quality and water resource planning and has presented to the National Association of Regional Councils, Federal Highway Administration, United States Environmental Protection Agency, American Planning Association, National Association of Public Administrators, The Council of State Governments, and many local and regional organizations. Reggie has been a contributing author on numerous air quality, water quality, and Brownfield's redevelopment publications.

Reggie received her Bachelors degree with highest honors from Purdue University and from Indiana University's School of Public and Environmental Affairs (SPEA) she received a Masters in Public Administration (MPA) with high honors. She lives in Chesterton Indiana.

# Speaker Biographies

## *Kunkel, Kenneth*

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Speaker: Drought

Kenneth E. Kunkel is the director of the Center for Atmospheric Sciences at the Illinois State Water Survey (ISWS) and has been with the ISWS since 1988. He holds a Ph.D. in meteorology from the University of Wisconsin-Madison. His recent research and publications have focused on climate variability, extremes, and change.

## *Lee, Min-Yang*

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Speaker: Institutional and Economic Strategies

Min-Yang Lee is a graduate student in the Department of Agriculture and Consumer Economics at the University of Illinois Urbana-Champaign. He is interested in both organizational behavior as it relates to environmental quality and valuation of water based resources.

## *León, Arturo S.*

University of Illinois
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Speaker: Land Use and Water Resources

Arturo S. León graduated from the National University of San Cristobal de Huamanga (Peru) in 1996 with a Batchelor degree in Civil Engineering. Then, he got the title of Civil Engineer of the same university in 1998. Later, he obtained the degree of Master of Science in Hydraulic Engineering from the National University of Engineering (Lima-Peru) in 2000. Since 1996 and before he moved to the USA in 2002, Mr. León worked as an assistant engineer, teaching assistant and as a hydraulic engineer. He has theoretical (research) and practical (design and construction) experience in hydrology and hydraulic engineering. His practical experience includes flood routing, design of

channels, culverts, intakes, dams, drop structures, energy dissipators, tunnels, deflectors, channel controls, road drainage, pumping stations, erosion and sediment control structures, as well as, planning of water resources. As an investigator, he has worked intensively in local scour around cylindrical piers (Master thesis) and currently (Ph.D thesis), he is working on developing a two-phase (air-water mixture) transient mixed flow (simultaneous occurrence of free surface and pressurized flows) model. In the USA, at the University of Illinois he has worked as Teaching Assistant of two courses “Hydraulic Analysis and Design of Engineering Systems” and “Open Channel Hydraulics” during 2004 and 2005. He is also author of two books (in Spanish), as well as of one book chapter and several Journal and conference papers.

## *Little, Ed*

Chief
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Speaker: Emerging Issues in Human Health and Aquatic Ecosystems

Edward Little is a biologist with USGS and conduct investigations concerning the impacts of physical, chemical, and biotic habitat alterations on aquatic organisms. Much of my career has been focused on the impact of environmental stressors, particularly contaminants on the behavioral responses of aquatic organisms. I began doctoral and post doc research was on the chemical senses and response to pheromones, so this project has brought me full-circle.

## *Lucente, Joe*

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Speaker: Land Use and Water Resources

Joe Lucente is an Extension Educator in Community and Economic Development with The Ohio State University Extension/Ohio Sea Grant College Program. Located at the OSU Extension Office in Lucas County Ohio, he is responsible for research, education and technology transfer of information concerning Lake Erie and the Great Lakes. His main responsibilities include developing and conducting an outreach education program on leadership development, urban redevelopment, business retention and expansion, and related environmental issues designed to improve the economic and environmental climate of the Toledo and Maumee Bay area.

Joe obtained a Masters of Public Administration degree from the University of Akron in 1995. He received his Bachelor of Science in Applied Science degree from Youngstown State University in 1994 with a major in Criminal Justice and minor in Political Science.

Joe has been with the Ohio State University Extension/Ohio Sea Grant College Program since February 2001.

## *Machesky, Mike*

Professional Scientist
Center for Watershed Science
Illinois State Water Survey
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Speaker: C-FAR Strategic Research Initiative in Water Quality

Dr. Machesky is a Professional Scientist for the Illinois State Water Survey, Center for Watershed Science. His research interests include fate and transport of nutrient and contaminants in surface waters and sediments, and solid-liquid interfacial processes. He received his Ph.D. from the University of Wisconsin-Madison in Water Chemistry.

## *Mankin, Phil*

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University of Illinois
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Phone: 217-244-6916
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Moderator: Challenges Facing Lake Michigan Water Management

Dr. Mankin is the Research Coordinator for the Illinois-Indiana Sea Grant College Program, located at the University of Illinois, Urbana, Illinois. As a researcher for many years with the University of Illinois, Dr. Mankin has studied the interaction of human activity and wildlife from many perspectives. In urban and agricultural settings, he explores relationships between ecosystems and land use management. In his role as Research Coordinator, Mankin develops research partnerships and collaborative funding opportunities, as well as optimize impacts from research projects.

# Speaker Biographies

## *McKay, Kyle*

University of Illinois
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Speaker: Data and Modeling

Steven Kyle McKay is a research assistant in the Ven Te Chow Hydrosystems Laboratory at the University of Illinois. Since joining the department, Kyle has worked on modeling the Tunnel and Reservoir Project for the Metropolitan Water Reclamation District of Greater Chicago. His current research interests involve describing lateral velocity distributions in compound channels. In 2005, he received his B.S. in Environmental Engineering from the Department of Civil Engineering at Colorado State University. Throughout his undergraduate education, he served as a student technician in the Hydraulics Laboratory of the Engineering Research Center at Colorado State University. Following graduation, Kyle spent a summer working in the Environmental Laboratory of the Engineering Research and Development Center (ERDC) at Waterways Experiment Station.

## *Mendoza, Cheryl*

Alliance for the Great Lakes
700 Fulton Ave., STE A
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Phone: (616) 850-0745
e-mail: CMendoza@greatlakes.org
web site: www.greatlakes.org
Speaker: Stakeholders Perspectives on the Great Lakes Water Resources Compact

Cheryl Mendoza serves as Manager of Water Conservation Programs for the Alliance for the Great Lakes, formerly Lake Michigan Federation. She has been with the Alliance for 6 years, and as a manager, she advocates for sound water withdrawal policies with respect to diversions, bulk water sales, and other forms of water removals. Cheryl is on the Governor's and Premier's Advisory Group with respect to the development of regional policies to better manage and protect Great Lakes waters.

Cheryl graduated from Michigan State University in December of 1997 with a degree in Natural Resources Management. During her time at MSU, she taught Ecology laboratories, was a volunteer conservation officer, and worked at various nature centers in the area. After graduation she worked at the Michigan United Conservation Clubs as an Education Specialist and assisted in lobbying efforts.

## *Meng, Yi*

Illinois Institute of Technology
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Speaker: Water Quality Issues

Yi Meng is a PhD candidate in the chemical and environmental department at the Illinois Institute of Technology. He received his bachelor degree in civil engineering and has five years work experience in water works planning and industrial wastewater treatment. His current research is to build an optimization model for planning water reuse in Chicago area which is funded by USEPA.

## *Morrow, William*

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Urbana, IL 61801
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e-mail: wsmorrow@usgs.gov
web site: http://il.water.usgs.gov
Speaker: Land Use and Water Resources

William Morrow works for the U.S. Geological Survey in Urbana, Illinois. He received his Bachelors and Masters from Northern Illinois University.

## *Murphy, Elizabeth*

U.S. Geological Survey-Illinois Water Science Center
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Speaker: Watershed Management I

Elizabeth Murphy is a hydrologist with the U.S. Geological Survey-Illinois Water Science Center. She received her BS in Civil Engineering and MS in Environmental Engineering from the University of Illinois.  Her current projects include flood-hazard studies in Kane and Kendall counties and the near real-time flood forecasting system in DuPage county.

# Speaker Biographies

## *Murphy, Julie*

Illinois-Indiana Sea Grant
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Speaker: Watershed Management II

Julie Murphy earned a B.S. in Physics and an M.S. in Curriculum and Instruction from Illinois State University. She taught high school Physics and Chemistry for five years, and is currently the Education Assistant for Illinois-Indiana Sea Grant.

## *Naftzger, David*

Executive Director
Council of Great Lakes Governors
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Chicago, IL 60601
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e-mail: dnaftzger@cglg.org
Speaker: Stakeholders Perspectives on the Great Lakes Water Resources Compact

David Naftzger serves as the Executive Director of the Council of Great Lakes Governors. He coordinates the Governors' and Premiers' shared efforts to manage the Great Lakes. In this role, David facilitated the negotiation of the Great Lakes—St. Lawrence River Basin Sustainable Water Resources Agreement and the companion interstate compact; historic agreements to cooperatively manage future water use in the Basin. He also coordinates the Governors' broader regional efforts to protect and restore the Great Lakes including their participation in the Great Lakes Regional Collaboration. In addition, he manages the Council's shared foreign trade offices in Australia, Brazil, Canada, Chile, China and South Africa.

Previously, David was the National Conference of State Legislatures' director for agriculture and international trade in Washington, D.C. He represented the legislatures before Congress, the Administration and foreign audiences on issues including international trade and investment agreements, land use and economic development.

David earned a Master's degree in Government from the London School of Economics. He holds a Bachelor's degree in Political Science from DePauw University and studied at Albert Ludwigs University in Freiburg, Germany.

## *Pankau, Ryan*

Southern Illinois University
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Speaker: Watershed Management I

Ryan Pankau is a 2006 graduate of Southern Illinois University at Carbondale with a BS in Forest Resource Management. Currently, he is pursing a MS in Forest Hydrology at SIU. His research interests include: land use impacts on water chemistry, riparian zone management and stream channel morphology.

## *Perry, Bill*

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Speaker: C-FAR Strategic Research Initiative in Water Quality

Bill Perry is an aquatic ecologist interested in forces structuring stream and lake communities. I obtained my masters degree at the University of Cincinnati working at the Northern Alaska Long Term Ecological Research Site studying the effects of eutrophication and
global change. I then obtained my doctoral degree from Notre Dame studying invasive species and the role of hybridization as a mechanism of invasion of the rusty crayfish in northern Wisconsin. I was hired at Illinois State University in 2000. Since then, I have been examining the structure and function of agricultural headwater streams with an
emphasis on eutrophication and periphyton dynamics.

## *Pfister, Mark*

Associate Director
Environmental Health Services
Lake County Health Department and Community Health Center
3010 Grand Avenue
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Speaker: Challenges Facing Lake Michigan Water Management

As the Associate Director, Mark's primary responsibility is managing the Environmental Health Services Engineering section that includes Lakes Management, Solid Waste, General Engineering and the Environmental Laboratory. He was previously the Supervisor of the Lakes Management Unit for

14 years. He has coordinated and conducted numerous lake and stream assessments and bacterial monitoring of 95 beaches (which includes daily monitoring of 11 Lake Michigan beaches). Mark is also responsible for directing GIS and GPS mapping for the service area. Mark is an active member of the North American Lake Management Society, the Illinois Lake Management Association, the Illinois Environmental Health Association, the Illinois Public Health Association and the Great Lakes Beach Association. Mark completed a BA program with a major in Biology, Psychology and Environmental Science at Augustana College in Rock Island, IL and a MSES in Water Resources (Limnology) at Indiana University in Bloomington, IN. In the fall of 2006, Mark began his Doctorate program in Public Health at the University of Illinois – Chicago, School of Public Health.

## *Roseboom, Don*

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Speaker: Emerging Issues in Human Health and Aquatic Ecosystem

Don Roseboom is a stream restoration specialist for the United States Geological Survey in the Illinois Water Science Center, Champaign, IL. Don is a member of recently formed USGS team to develop watershed criteria for stream restoration in variable geologic regions of the Midwest. Don also has a joint appointment with Colorado State University where he works with Dr. Chester Watson on stream restoration designs and project implementation.

## *Pradhan, Sachin*

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Speaker - Watershed Management II

I did my undergrad in Construction Engineering from University of Mumbai, India. I did my Masters in Environmental Engineering from Illinois Institute of Technology, Chicago. I am currently working as civil/environmental engineer with American Water, St. Louis, MO.

## *Sanderson, Ellis*

Department of Natural Resources
Office of Water Resources
One Natural Resources Way
Springfield, IL 62702.
Phone: 217-782-2457
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Moderator: Water Supply Planning, "The Governor's Water Supply Planning Initiative"

Ellis W. Sanderson received his Bachelor of Science in Civil Engineering from the University of Illinois in January, 1963. Following service in the U.S. Army for 2 years, he worked at the Illinois State Water Survey as an engineer for 33 years in progressively responsible technical and management positions until retirement in March, 1998. His responsibilities included development and conduct of projects investigating ground-water resources, municipal water supply source evaluations (including assessment of well field performance), focused project work investigating causes of well deterioration and methods of well rehabilitation, and responding to requests for information and assistance in solving ground-water supply problems.
He then worked for the E J Water Corporation until December, 2001, as the Assistant Manager of this large rural water system with more than 600 miles of water main serving more than 3000 rural customers in Effingham, Jasper, Cumberland, and Clay Counties. He fulfilled the role of interim Manager for one year being responsible for the overall direction of company staff with special emphasis on the planning and coordination of distribution system and water source expansion.

Since May, 2006, he has worked part-time for the DNR Office of Water Resources assisting with the launch of the water supply planning initiative called for in Executive Order 2006-01.

He is a Life Member of the American Water Works Association and previously served on the Board of Directors of the Mahomet Aquifer Consortium.

## *Schuch, Paul M.*

Director Water Resources
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Speaker: Data Needs for Water Planning

Paul Schuch received his Bachelor of Science and Master of Science Degrees in Civil Engineering from the University of Illinois in 1971 and 1973. He is a Licensed Professional Engineer in the State of Illinois and a Certified Floodplain Manager with the Association of State Floodplain Managers.

Mr. Schuch has practiced in the field of Civil Engineering for 33 years in both the private and public sector. He has been employed by Kane County, Illinois for 17 years, the last 15 of which he has served as the Director Water Resources. His Division's primary duties include enforcement of the Countywide Stormwater Ordinance in unincorporated Kane County and the oversight of a 5-Year Scientific Research Contract with the Illinois State Water Survey and Illinois State Geological Survey on scientific Water Supply Investigations for Kane County. His most recent assignment with the County is to create a strategy and framework for the creation of a Countywide Water Supply Plan. He is a member of the American Public Works Association, the American Society of Civil Engineers, American Water Resources Association, and Association of State Flood Plain Managers. He has been married for thirty-one years to his wife Patricia and they have one son Matthew.

## *Smith, Tim*

Illinois Natural History Survey
Center for Aquatic Ecology
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Speaker: C-FAR Strategic Research Initiative in Water Quality

Tim Smith is biologist with the Illinois Natural History Survey. He has worked as an aquatic ecologist as a graduate student or a post-graduate researcher since beginning an MS in the department of Biology at the University of Illinois in 1990. There he was the charter president of the AFS student subsection at the University of Illinois and his work was selected as best student poster at the AFS national meeting in 1998. Tim's research has focused on living and non-living control of productivity in aquatic ecosystems, spanning a wide range of topics and research approaches. During his MS work he studied anaerobic digestion in omnivorous fish and produced a model predicting annual abundance of gizzard shad in Lake Shelbyville Illinois based on productivity derived from nutrient loading during floods in the Kaskaskia River. He has studied effects of large fish predators on pond community structure and during a stint at the John Muir Institute for the Environment at the University of California at Davis, he helped design and implement a multi-disciplinary study quantifying the effects of sediment and heat on coastal streams in Northern California. As a part of that project he helped delineate a quantitative response of heat shock proteins in steelhead parr to sediment and heat. Current projects include studies of effects of anthropogenic nutrients on subtropical lagoons in Belize, Central America. Work there has used stable isotopes to trace nitrogen from shrimp farms and septic systems and he is currently involved in an effort to quantify the amount of movement of fish from inland estuaries to the MesoAmerican Reef offshore using otolith microchemistry and stable isotopes. He is currently working out of Walter Hill's lab in the Center for Aquatic Ecology and Conservation with Walter and Shari Fanta researching phosphorus effects on Illinois streams. Tim has coordinated field studies and large scale experiments designed to compliment laboratory trials of phosphorus effects and has been engaged in the analysis of those results. In addition to numerous professional presentations and technical reports he is also published in Fish Biology, Copeia and Transactions of the American Fisheries Society.

## *Soman, Seth*

Southern Illinois University
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Speaker: Watershed Management II

I am a PhD candidate for environmental resources and policy. I got my masters in agribusiness economics from SIUC. I am from India.

## *Soong, David*

USGS - Illinois Water Science Center
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Speaker: Data and Models

David Soong is a hydrologist with the United States Geological Survey Water Science Center in Urbana, Illinois. He joined the USGS in 2000 and has been working on hydrologic and hydraulic analysis, including updating the statewide flood frequencies and stormwater issues for the Blackberry Creek watershed in Kane County. Before joining the USGS, he was with the Illinois State Water Survey and had worked there for more than 15 years. David Soong received his MS and PhD from the University of Illinois - Urbana and Champaign and is a registered engineer in Illinois.

# Speaker Biographies

## *Tonto, Fabio*

National Engineering Manager
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Speaker: Data and Models

Fabio Tonto. P.Eng. is the National Engineering Manger for Imbrium Systems Inc. overseeing Canadian and International markets. Mr. Tonto has been contributing his technical, marketing and product research and development expertise to Imbrium Systems since 2001.

As senior stormwater specialist, Mr. Tonto has a sound knowledge of stormwater industry, and regulations. He is a professional engineer, and graduated from the Environmental Engineering program at the University of Guelph. Upon completion of his degree, Mr. Tonto spent three years working as an environmental consultant conducting environmental site assessments.

## *Wehrmann, Al*

Director, Center for Groundwater Science
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Speaker: Water Supply Planning, “The Governor’s Water Supply Planning Initiative”

Allen Wehrmann began his professional career at the Illinois State Water Survey in 1977. His 28+ years at the Survey have been directed toward a variety of groundwater resource development and contamination investigations across Illinois. During the early to mid-1990s, he was involved with developing groundwater-related criteria for the siting of a low-level radioactive waste disposal facility in Illinois (he was co-author of the 1991 John C. Frye Award winner from the Geological Society of America, Geologic and Hydrologic Factors for Siting Hazardous or Low-Level Radioactive Waste Disposal Facilities). In 1997-98, he served on Governor Edgar’s Blasting Task Force to examine mine blasting impacts on wells and landfills. In 2002, Allen was promoted to Head of the Survey’s Groundwater Section, now called the Center for Groundwater Science. As Center Director, Mr. Wehrmann oversees the research, data collection, and public service activities of approximately 20 scientists, engineers, and technical support staff, including major staff efforts to assess long-term groundwater availability in Illinois. Allen serves as a Technical Advisor to the Mahomet Aquifer Consortium, is a member of the State’s Integrated Water Quantity Planning & Management Committee, the State Water Plan Task Force, the Intergovernmental Coordinating Committee on Groundwater, and the Illinois EPA Right-to-Know Committee. Mr. Wehrmann earned a B.S. in Civil Engineering from Iowa State University, is a registered Professional Engineer in Illinois, and is certified as a Professional Groundwater Hydrologist by the American Institute of Hydrology. He is a past Chair of the Illinois Groundwater Association (1990) and recently co-chaired the 50th Midwest Ground Water Conference held in Urbana last fall.

# Speaker Biographies

## *White, Bill*

Illinios State Water Survey
Illinois Water Science Center
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Moderator: Watershed Management I

Bill White is a Professional Scientist in the Center for Watershed Science at the Illinois State Water Survey (ISWS); a Division in the Scientific Office of the Illinois Department of Natural Resources. Bill currently manages the Peoria Office for the ISWS and oversees the well known field based Stream and Watershed Assessment & Restoration Program. Bill also oversees staff working in analytical laboratories assessing water quality and other environmental conditions. Mr. White previously served as Science Advisor to the Director of the Office of Realty & Environmental Planning in the Illinois Department of Natural Resources. He directed the Science & Planning Section of the Ecosystems Division at IDNR, coordinated planning and science issues for the Conservation 2000 Program, and directed programs associated with watershed, floodplain, and greenways planning. Memberships and recent involvements include nominated and appointed full member of Sigma Xi (The National Scientific Research Society), Illinois State Academy of Sciences, Adjunct Appointment with the Illinois Natural History Survey, Illinois Geological Mapping Advisory Committee, IDNR Dam Task Force, and Illinois River Restoration Project Technical Committee to name just a few.

## *Winstanely, Derek*

Cheif
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Speaker: Water Supply Planning, “The Governor’s Water Supply Planning Initiative”

Derek Winstanley is the Cheif at the Illinois State Water Survey (Illinois Department of Natural Resources and Adjunct Professor of Geography, University of Illinois. He received his B.A., M.A. and Ph.D. from Oxford University.

# Speaker Biographies

## *Zellner, Moira*

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Speaker: Watershed Management II

Moira Zellner is an assistant professor in the Urban Planning and Policy at University of Illinois at Chicago (UIC) and an affiliated researcher with the Institute for Environmental Science and Policy (IESP) at UIC. Born and raised in Buenos Aires, Argentina, Dr. Zellner earned her undergraduate degree in ecology at the Centro de Altos Estudios en Ciencias Exactas, and pursued doctoral studies in urban and regional planning and in complex systems at the University of Michigan. Before coming to the US, she worked in Argentina as a consultant on environmental issues for local and international environmental engineering firms and for the undersecretary of Environment in the City of Buenos Aires. In the US, her professional and academic work includes greenway development and river restoration projects in Miami Beach and in California, transportation surveys, and more recently, agent-based modeling of land-use change and its ecological impacts. Her current work focuses on using such models as exploratory tools for policy analysis and implementation, addressing the complexity of urban and regional processes and their environmental impacts.


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