

ILLINOIS STATE WATER SURVEY



SUMMARY REPORT



The Illinois State Water Survey has been a leader in the study of water and atmospheric resources in Illinois for more than a century. Today, our scientists are engaged in new and continuing projects throughout the state, from the Fox River Watershed in northern Illinois, where they are working to improve water quality, to the Cache River Watershed in southern Illinois where scientists are helping to restore internationally-recognized ecosystems. In the Chicago region, researchers provide data for Lake Michigan diversion accounting and investigate how the Great Lakes affect the complex weather of large coastal cities. Water supply planning, which is vital in light of vigorous population growth and urban development, is a major commitment for ISWS. Our commitment to Illinois communities continues until we develop the scientific data and information for sustainable water resources planning for the entire state. Recent efforts focus on northeastern Illinois, east-central Illinois, and the Kaskaskia River basin. In addition, we continue to attract strong support from federal agencies for the Coordinated Hazard Assessment and Mapping Program, the Midwest Climate Center, and the National Atmospheric Deposition Program. It is our mission to continue to provide strong leadership in research, information dissemination, and outreach in addressing the topics that are important to the well-being of Illinois and the nation. The following are a few major projects underway at the ISWS in 2010

## Center for Atmospheric Science

### Center Research Targets Severe Weather Forecasting Near Lake Michigan

The Center for Atmospheric Science Mesoscale/Boundary Layer Meteorology (M/BLM) group research findings have resulted in improved understanding of the physical processes dictating Great Lakes climate and improvements in knowledge that can help weather forecasters. Large coastal cities such as Chicago have highly complex climates. Air masses come from both the nearby land and water, severe weather can be generated by the interaction of the two air masses, and the urban area itself modifies the atmosphere. With such a large population of Illinois affected by this complex weather, increased knowledge can have a significant impact on lives and property.

Recent intensive observations by M/BLM staff using instrumented aircraft have indicated that methods of incorporating ice cover in current numerical model forecasts can systematically underestimate lake-effect snow intensity. It is common for northeastern Illinois to receive heavy lake-effect snow behind a departing cyclone, as the winds can flow toward the west across Lake Michigan, adding heat and moisture to the atmosphere. How the bands are organized over the lake, which determine the intensity of the snow, and which communities are affected also have been extensively investigated by M/BLM staff. All of these findings have been shared through scientific publications and public presentations, as well as through meetings at regional National Weather Service offices.

Forecasts of severe weather conditions are perhaps more difficult during warm seasons. M/BLM staff have found that the inland movement of the afternoon lake breeze is strongly linked to the Chicago heat island intensity the night before, providing the possibility for more accurate local forecasts of coastal urban afternoon temperatures. Staff have been conducting novel climatological analyses of thunderstorm system interactions with the lakes as well as seeking ways to obtain over-lake observations. With funding from the IL-IN Sea Grant Program and the U.S. National Science Foundation, atmospheric profiles over and near Lake Michigan were obtained using a unique, mobile weather balloon system. These data should provide an opportunity to develop a more complete model of how storms react to moving over the lakes.

### Midwestern Regional Climate Center Provides Data to Improve Monitoring and Forecasting

With the support of the State Climatologists, the Midwestern Regional Climate Center (MRCC) assesses the impacts of weather and climate events in the nine-state region and makes this information available on the Midwest Climate Watch web page. Maps of temperature, precipitation, soil moisture, and other climate parameters are updated automatically each day, providing a near real-time assessment of the climate of the Midwest. The MRCC is able to respond quickly to requests for specialized products and information needed to assess conditions for various sectors, including agribusiness, energy, risk management, health, transportation, and water resources. For example, there was considerable attention in 2009 on the potential for a freeze in Illinois and the corn

and soybean belt. In some areas the corn crop was four weeks behind schedule and the soybean crop was one to two weeks behind. An early freeze (or in case of 2009, a normal freeze) would have resulted in significant yield losses. At the request of a local National Weather Service office in fall 2009, the MRCC created and made available a First Fall Freeze map on the Midwest Climate Watch web page. This map shows the locations where 32°F and 28°F have been recorded in the Midwest so far in the season. The map was upgraded for fall 2010, and plans are to provide a comparable spring freeze map in 2011.

In December 2009 the MRCC launched a new online climate data and information distribution system on its website. The MRCC Applied Climate System (MACS) provides users with a variety of climate data and information products to use in decision support. Data and products are aggregated by station, county, climate division, and state, and on time scales from hourly to annually, depending on the data available. Most products are configurable by the user, allowing users to tailor products for their specific needs.

For the seventh consecutive year the MRCC participated in the Climate Data Modernization Program (CDMP), a project to digitize and quality control climate data collected as far back as the mid-1800s. The MRCC developed the quality assurance techniques and software for this project. MRCC climatologists continue to use these techniques to process the digitized data, document required corrections, and produce a final, quality-assured data set for the National Climatic Data Center. The processes to quality control the temperature, precipitation, snowfall, and snow depth data have largely been completed, effectively allowing researchers to study the U.S. instrumented climate dataset extended back many decades. This increase in quality and quantity of historical data is helping researchers worldwide to improve real-time monitoring and forecasting of environmental events and in climate change research.

## Center for Chemistry and Technology

### Institutional Water Treatment Program Conserves Resources and Saves Money

The Institutional Water Treatment Program (IWTP) provides unbiased, professional water treatment advice to more than 100 state facilities throughout Illinois. The program results in substantial annual savings in the costs of chemicals, fuel, water, and maintenance for participating facilities and the State of Illinois. Typical inquiries from state facilities about treatment concern their steam, heating, cooling, and drinking water systems.

Since 1949, IWTP services have ranged from presenting on-site training and seminars to providing chemical specifications and making recommendations concerning a comprehensive water treatment program for control of corrosion, mineral scale formation, and biological growth. Facilities receive detailed written recommendations and specifications

for recommended treatment equipment, chemicals, and corrosion-resistant materials for use in construction.

Program staff are also actively involved in an annual workshop for Illinois Institutional Chief Engineers co-sponsored by the University of Illinois and other state agencies. The workshop, now in its 62nd year, also provides information on pending regulations and water treatment developments which are relevant to supervisory and administrative staff at individual institutions.

State facilities participating in the program pay a fee to recover the costs associated with staff salaries, routine visits (three to six per year, depending on the size and complexity of the facility), recommendations, consultations, and sample analyses. During an average year, the IWTP staff respond to more than 1,000 phone requests and provide more than 1,000 written copies of detailed laboratory water analyses, recommendations for action based on analytical results, and other materials. Each year program staff also make more than 400 site visits to state facilities to evaluate the chemical treatment program, answer questions, solve emerging problems, and analyze samples.

Among the state facilities participating in the IWTP are the Departments of Corrections, Human Services, Secretary of State, Central Management Services, Transportation, Veterans Affairs, Natural Resources, and several state universities.

## Center for Groundwater Science

### ISWS Models Find Options for Water Supplies in Northeastern Illinois

Work by ISWS scientists is providing a sound scientific foundation for how the highly populated region of northeastern Illinois plans for future water supplies. Providing an adequate supply of water to northeastern Illinois has obvious environmental and societal value touching not only the lives and businesses of the region but also across the Midwest and beyond to people and interests with a connection to the greater Chicago area.

This 11-county region uses nearly 1.5 billion gallons of water each day (bgd). By 2050, that amount could rise to 2.4 bgd. The region depends on three principal water sources for water supply: Lake Michigan, the inland surface waters of the Fox and Kankakee rivers, and groundwater. Over the past four years with the assistance of the ISGS, the ISWS has been engaged in assessing the availability of these water resources to meet future water demands with an emphasis on the Fox River and the principal aquifers of the region.

A regional groundwater flow model developed by ISWS hydrologists shows the deep bedrock (Cambrian-Ordovician) aquifers are already being over-pumped along a corridor between Aurora and Joliet. As groundwater levels drop to critical levels, well yields will decrease and well water quality will likely degrade. Where can affected communities turn for water?

Greater use of shallow aquifers is possible, but unlike deep aquifers, shallow aquifers are not available everywhere in the region. Also, because shallow aquifers are much more intimately connected to surface waters and wetlands, increasing withdrawals will potentially affect shallow water levels and stream low flows and thus affect dependent aquatic ecosystems. Shallow groundwater also is more vulnerable to contamination. ISWS studies reveal an increasing trend in shallow groundwater chloride levels, a result of winter road de-icing.

ISWS modeling of the Fox River suggests the river can provide additional water for the region. Flows on the Fox continue to increase as more treated effluent is discharged to the river. ISWS investigations show the river could be tapped to meet downstream demand while also meeting low-flow requirements.

## Center for Watershed Science

### ISWS Completes Cache River Modeling and Analysis

This year, ISWS completed the second phase of modeling and analysis for restoration alternatives for the Cache River basin. The Cache River Wetlands Joint Venture Partnership now has the information and objective analyses needed to formulate restoration management plans and pursue funding to accomplish restoration goals based on detailed scientific results. The Partnership includes the Illinois Department of Natural Resources, The Nature Conservancy, U.S. Fish and Wildlife Service, Ducks Unlimited, the Natural Resources Conservation Service, and several local organizations.

The Cache River basin is located in the extreme southern tip of Illinois near the confluence of the Ohio and Mississippi rivers. Because of its unique location at the junction of major rivers and physiographic regions, the basin exhibits some of the most diverse natural wetland communities in the state with many plant and animal species on the edge of their geographic range. Some communities are relatively undisturbed. However, land use and drainage modifications have threatened the ecological integrity of the wetlands that now contain more than 100 endangered or threatened species.

For the past 30 years, concerned citizens, nongovernmental organizations, and state and federal agencies have been collaborating to protect and restore these valuable natural resources. The scale and complexity associated with successful restoration, preservation, and management resulted in the formation of the Partnership. With the common goal of restoring as much of the Cache River system's natural hydrology as possible, the ISWS was contracted to develop the necessary hydrologic and hydraulic models to objectively evaluate the benefits and potential impacts of proposed restoration alternatives from both ecological and regulatory perspectives. ISWS produced detailed models that determined water levels associated with various combinations of flow conditions and control structures as compared to a reference condition to address regulations.

### ISWS Scientists Analyze Impaired Fox River

The Fox River Study Group, Inc. is a coalition of municipalities, environmental organizations, and government agencies working together to improve water quality in the Fox River watershed. They are funding the Illinois State Water Survey to conduct a multi-year, four-phase study in response to the Illinois Environmental Protection Agency (IEPA) designation of the entire Fox River as impaired. Phase Three, which focuses on monitoring and detailed calibration of watershed and water quality models using the newly collected precipitation, stream discharge, and water quality data, was initiated this year.

Science-based planning tools developed in this study will provide all stakeholders interested in economic and environmental planning a comparison of different watershed development scenarios and assessment of their expected impacts on Fox River water quality. This integrated research approach is already providing benefits not only to scientists but also to citizens in the Fox River watershed. Data and results from this study have been used in water quality assessments such as IEPA's bi-annual water quality report and watershed planning by the Chicago Metropolitan Agency for Planning (CMAP). Currently, CMAP is working with four watershed planning groups to develop watershed plans based in part on the data and models developed through this project. In addition, entities within the watershed are using information developed through this project for the National Pollutant Discharge Elimination System's permitting and other planning efforts. This year alone there have been more than 8,400 individual downloads of data from the project website. ISWS researchers continue this integrated research and close collaboration with local stakeholders in order to provide citizens with cost-effective, science-based tools that will help promote and maintain our water resources.

### CHAMP Team Identifies Flood Hazards

Flooding is the most predictable natural hazard, yet Illinois continues to suffer economic losses due to flooding. The first step to reduce economic and personal losses is to accurately show where flooding is likely to occur. Coordinated Hazard Assessment and Mapping Program (CHAMP) staff in cooperation with the Federal Emergency Management Agency (FEMA) and the Illinois Department of Natural Resources, Office of Water Resources, have produced updated digital maps showing areas prone to flooding in 75 Illinois counties which will be finalized by 2012. These Flood Insurance Rate Maps show the areas that have a 1 percent chance of inundation in any given year. Communities can use these maps to avoid putting citizens at risk by steering development away from high flood-risk areas.

The CHAMP team takes the message a step further. Working with University of Illinois Extension, the team has provided data for mitigation planning in four counties. Mitigation plans are the basis for FEMA funding for community projects that reduce exposure to flood losses. The CHAMP staff will continue to partner with FEMA in

the five-year Risk MAP program, which includes extensive outreach initiatives on a watershed basis. CHAMP staff will collaborate with Extension on these outreach efforts to inform the public about flood hazards and alternatives for mitigating risk with the ultimate goal of saving lives, reducing property loss, and minimizing economic disruption.

Since 2004, FEMA has provided more than 13 million dollars to the ISWS CHAMP program to prepare maps and technical data, creating over 25 jobs in Illinois.

## National Atmospheric Deposition Program

NADP is a long-term monitoring program in support of research on the effects of atmospheric chemical deposition on agricultural crops, forests, rangelands, surface waters, and other natural and cultural resources. The NADP operates four networks that monitor precipitation chemistry and atmospheric mercury fractions at more than 300 sites.

### National Trends Network (NTN)

NTN is the only network providing a long-term record of precipitation chemistry across the United States. Its purpose is to provide data on the amounts, trends, and geographic distributions of the atmospheric deposition of acids, nutrients, and base cations. NTN collects about 13,000 samples each year.

### Atmospheric Integrated Research Monitoring Network (AIRMoN)

AIRMoN sites collect precipitation samples daily (1,100 observations annually) to provide data for studying atmospheric processes and for developing and testing models that simulate these processes.

### Mercury Deposition Network (MDN)

MDN sites collect precipitation samples for total mercury analysis across North America (6,000 observations annually). The objective of the MDN is to provide data on the geographic distributions and trends of mercury deposition, information that may help scientists better understand the link between mercury deposition and mercury-contaminated fish.

### Atmospheric Mercury Network (AMNet)

AMNet sites collect atmospheric mercury concentrations of elemental, oxidized mercury and mercury associated with particulates to enable the estimation of mercury dry deposition. While the MDN analyzes wet deposition of mercury, or mercury washed out of the atmosphere by rain and snow, the AMNet determines deposition that moves from the atmosphere to the ground under natural processes, deposited without precipitation (dry deposition). This network is just beginning and is operating at 20 sites in North America.

Federal and state agencies and universities are the primary users of data for research purposes. Teachers also use the

information to educate elementary and high school students on pollutants in the atmosphere.

