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Water Resources Update

USGS Illinois Water Science Center Newsletter

Spring/Summer 2008

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U.S. Geological Survey
Illinois Water Science Center
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Message from the Former Director
Robert R. Holmes, Jr., PhD, P.E.

If you were paying attention to the title, you will note I am now the "former Director". I was trying to come up with some witty introduction to this message, but given that I already used Shakespeare once in this space (May 2005), I figured that to be my limit. As of January 4, 2008, I began work for the U.S. Geological Survey (USGS) Office of Surface Water (OSW) as the National Flood Specialist. The new position involves a number of things, but one of the high priority duties includes serving as senior advisor to the OSW Chief and the USGS Associate Director for Water on flood science. In addition, I will spend some time coordinating USGS activities during major floods. Normally, positions for our headquarters (OSW is part of our headquarters operation) would be located in our Reston, Virginia offices. However, this position is allowed to be located at a USGS field office. For the present, I will remain in Urbana, but will soon be relocating to the USGS office in Rolla, Missouri.

Gary Johnson, the Chief of the Hydrologic Data Collection and Analysis Section, has been ably filling the role of Acting Director, while the USGS undergoes a nationwide search for my replacement. A new Director will hopefully be on board by early summer.

It was not easy to lay down the reins of this Center, but after nine years as the Director, I felt something different was in order and the new position was just the right challenge that suited my technical background and interests. The staff here is dedicated, capable, and motivated and will continue to carry on outstanding water science data collection, investigations, and research. I will miss working with them and many of you who have been our partners as we endeavor to help monitor and understand the distribution and quality of water resources in Illinois. It has truly been a great run for me—I have had a lot of fun participating in some really interesting and challenging water science issues. I want to thank many of you for the friendship and collaboration during my nearly 14 years in the USGS Illinois Water Science Center. It has been my pleasure.

Stream and Wetland Monitoring at The Grove Residential Development near Bloomington, Illinois

by

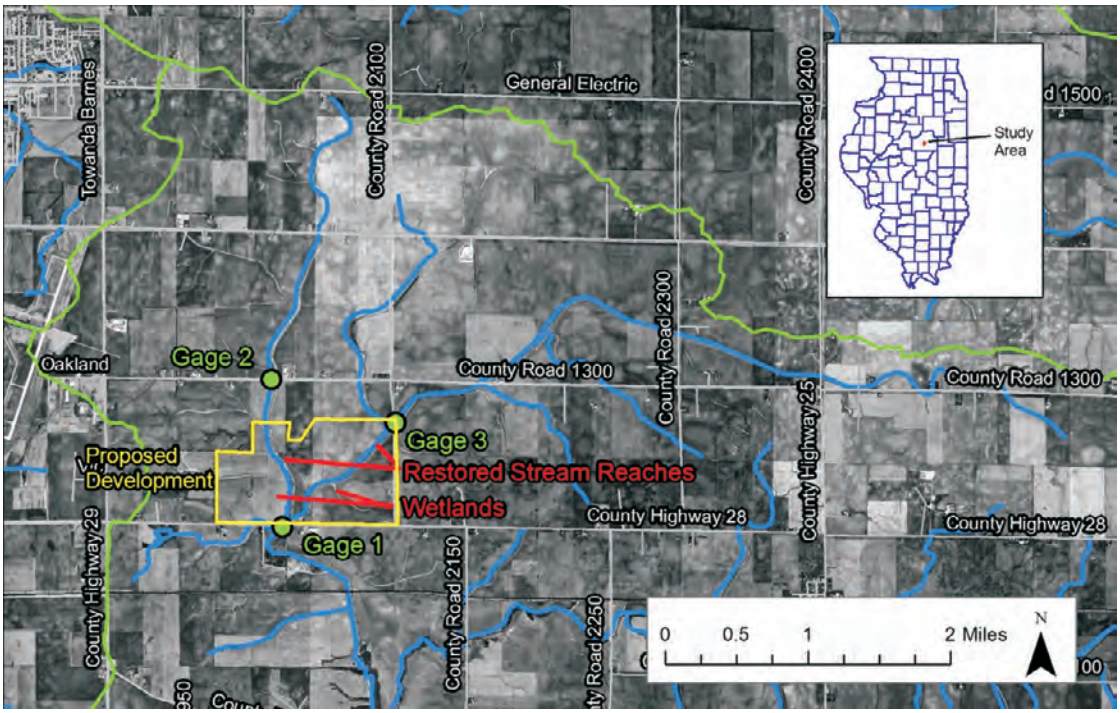
Tim Straub and Don Roseboom, Hydrologists

With funding from the Illinois Environmental Protection Agency (IEPA) 319 Program and the Illinois Department of Natural Resources (IDNR), the City of Bloomington is developing wetland detention within a natural stream design for The Grove residential development in central Illinois (figure below). Runoff from the 480 acre Grove is designed to be captured in large shallow wetland basins so that peak flows are reduced. Stream naturalization will convert two miles of agricultural drainages ditches in the East and West Branches of Kickapoo Creek into meandering stream channels within an 80 acre linear park. The park landscape will maximize the enhancement of native wetland, riparian, and aquatic species for the park's trail system.

To meet the design criteria for the Grove development, the naturalized stream reaches need to transport the available water and sediment supplied from the drainage ditches in the upper 8,000 acres of agricultural row crops. Also, sediment from the development process must be minimized by erosion and control practices. After development is completed, runoff, sediment, and nutrient loads from the new residential areas must be decreased by routing flow through wetlands. Lastly, throughout and after development, the dissolved oxygen in the stream must remain high enough to support aquatic life. Additional monitoring by field staff from the IEPA and IDNR will independently evaluate the response of aquatic habitat and stream fisheries to implementation of the restoration design.

The following are the four objectives of this study:

1. Assess sediment transport disposition through the naturalized stream reaches utilizing repeated cross-sectional survey data, and sediment and flow data from two gages upstream of the development and one gage downstream of the development.
2. Document construction and erosion control activities throughout the development process.
3. Evaluate the effectiveness of reducing runoff, and nutrient and sediment loads from the residential areas by routing flow through constructed wetlands. Data will be collected at the intakes and outlets of two wetlands.
4. Determine the annual minimum dissolved oxygen levels by collecting continuous dissolved oxygen data at the downstream extent of the study area.

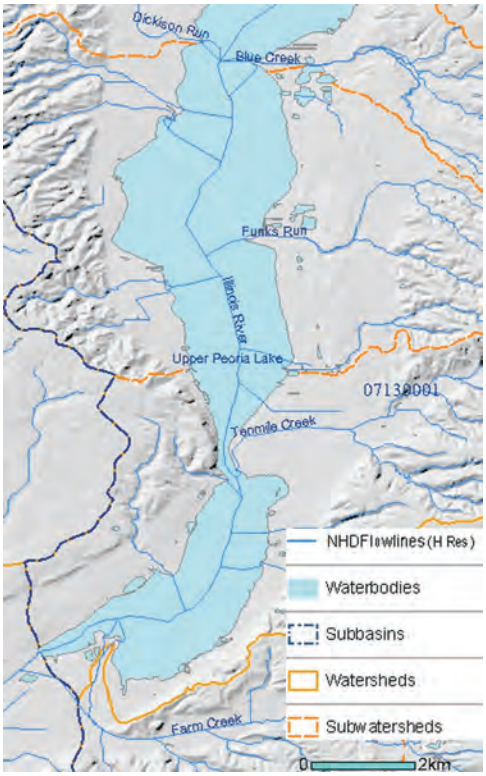


Proposed development naturalized stream reaches and wetlands. Initial USGS streamgaging stations are shown, but wetland gages are not shown. The wetland gages will be established in the development area at the inlet and outlet of the two wetland areas shown.

USGS Illinois Water Science Center Named NHD Steward for Illinois

by

Jennifer Sharpe, Geographer; Terri Arnold, Cartographer; Shelley Silch, Physical Scientist



In a Memorandum of Understanding (MOU) with the USGS National Geospatial Technical Operations Center (NGTOC), the USGS Illinois Water Science Center (IL WSC) has agreed to become the principal steward for the National Hydrography Dataset (NHD) for Illinois.

The NHD was designed and substantially build by three Federal partners: USGS, USEPA, and the USDA Forest Service. It was designed to be a reliable source of data that would grow both through system-wide revisions and the contributions of its users. While the Federal agencies generally represent a National perspective, thousands of other users have used the NHD to record and analyze waterways in their local areas. The data they have developed as users are then fed back to develop and refine the NHD as a whole.

Because the data comes increasingly from local sources, there is a greater need for management and oversight by an intermediary. Those intermediaries are referred to as "data stewards." The NHD will be maintained through data stewardship, a program in which users assume more responsibility for the success of the NHD. Stewardship will be distributed across the Nation, typically on a State-by-State basis, and the principal stewards will coordinate and assume responsibility for the NHD at this level. Other organizations, which could have specific local or topical interests, may then assume further stewardship, referred to as secondary stewards, under the auspices of the principal stewards. This distributes stewardship down to the organizations that have the best available information on the hydrography in their area. These users can perform the actual enhancements with oversight and support from the principal stewards. These edits will become transactions provided to the NHD database that the USGS will maintain on behalf of the entire user community.

As Illinois' NHD steward, the USGS IL WSC responsibilities include:

- Guarantee that updated NHD data pass all validation tests.
- Assure that the core content (features, attributes and relationships identified in the NHD standards) is included.
- Keep the data current.
- Consider any change submitted and decide authoritatively if it will be accepted or not. (Some changes can have significant impacts, and it is essential that any changes made to the NHD are valid.)
- Report the decision publicly through the NHD Website (*http://nhd.usgs.gov/*).
- Respond to proposed changes within some agreed upon reasonable time.
- Provide publicly available information on status of data development and updating through the NHD Website.
- Maintain awareness of activities by other agencies and groups.

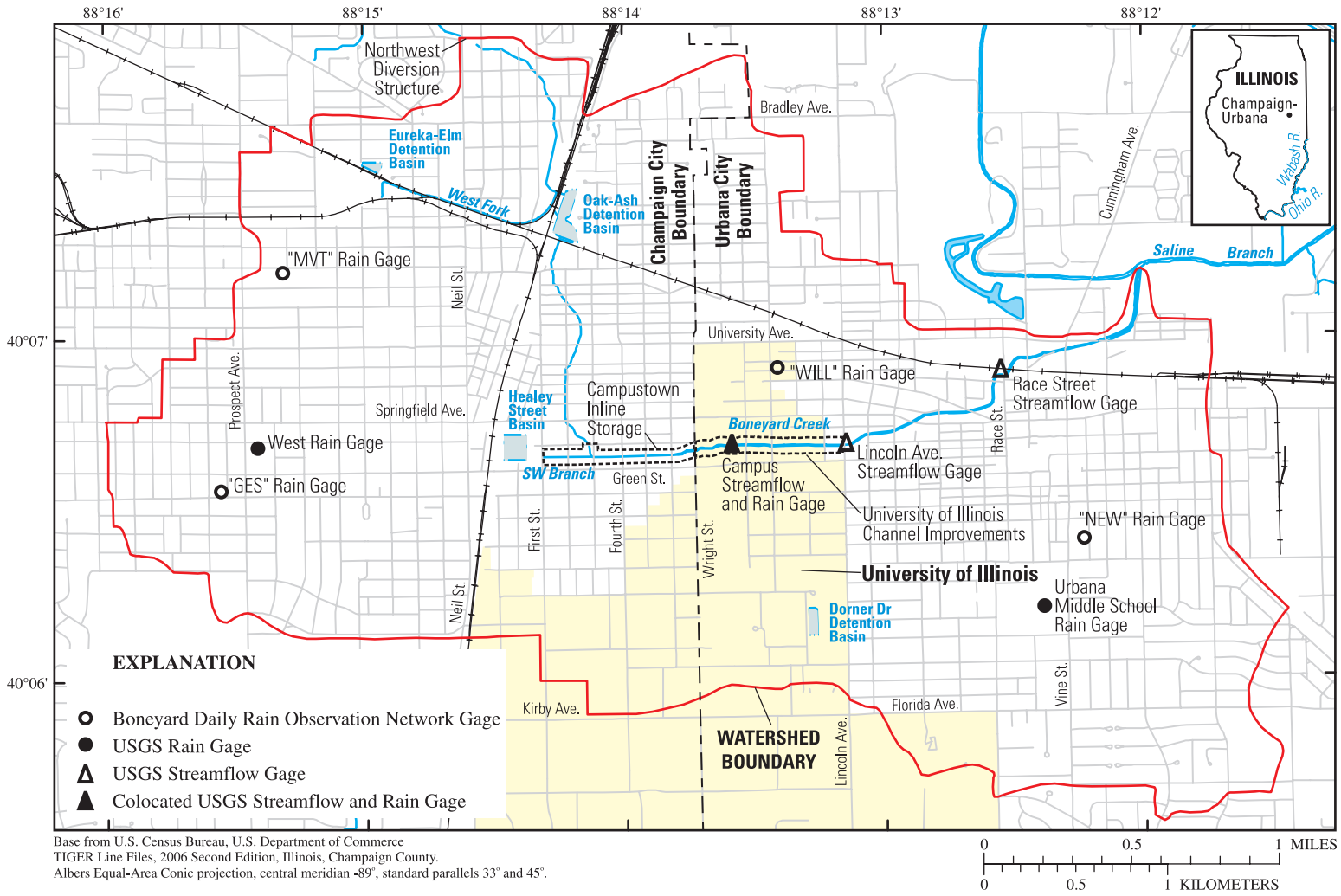
Currently, several State agencies have expressed interest in participating as secondary stewards. If your agency would like to participate, please contact Jennifer Sharpe by e-mail at *il.nhd@usgs.gov* or phone 217.344.0037, extension 3048. Learn more about the National Hydrography Dataset at *http://nhd.usgs.gov/.*

Assessment of Flood Remediation Impact with Minimal Historic Hydrologic Data: Boneyard Creek

by
Robert R. Holmes, Jr., PhD, P.E., Hydrologist

Boneyard Creek (figure below) drains a highly urbanized watershed of approximately 19.3 km^2 to its confluence with the Saline Branch and flows, in upstream-to-downstream order, through the City of Champaign, Illinois, the University of Illinois, and the City of Urbana, Illinois. The Creek has had recurrent over bank and drainage system backwater flooding for decades. A storm sewer system drains much of the Boneyard Creek watershed. In the late 1950s and early 1960s, the Boneyard Creek channel was deepened by up to 1.5 m and lined with sheet piling walls and a concrete floor in Urbana from near Race Street to the upstream side of Lincoln Avenue. These improvements resulted in a hydraulic drop in the channel bottom of approximately 1.2 m at Lincoln Avenue. The Northwest Diversion Structure was completed in August 1960, resulting in the upper 2.90 km^2 of watershed being diverted directly into the Saline Branch. This diversion decreased the contributing watershed area at the mouth of the Boneyard to approximately 16.4 km^2. In the 1980s, three stormwater detention facilities were constructed in the Boneyard watershed, with two of them totaling 9.07 ha-m of detention storage in Champaign and one having 1.48 ha-m of storage in the University campus (Berns, Clancy, and Associates, 1998).

Even with the flood-control improvements described above, recurrent flooding problems remained along Boneyard Creek and resulted in the two entities, Champaign and the University, proposing and implementing a series of remediation projects (remediation) to limit flood damages. The remediation projects, consisting of channel improvements, expansion and construction of detention facilities, and various storm-sewer improvements,



Boneyard Creek watershed, Champaign-Urbana, Illinois.

were designed by the engineering firms Camp, Dresser, and McKee and Berns, Clancy, and Associates to have no detrimental downstream hydrologic impact (Camp, Dresser and McKee, 1997). The engineering analysis and design was conducted by the consultants using the Stormwater Management Model (SWMM) (U. S. Environmental Protection Agency, 1997). The remediation, when originally proposed, met with public controversy downstream in Urbana. The U.S. Geological Survey (USGS) is sometimes called upon to provide data or results that are useful to multiple parties in potentially contentious interjurisdictional conflicts in water resources. A study by the USGS in cooperation with Champaign, the University, and Urbana, was undertaken to determine the effects of the remediation on the downstream reaches of the Boneyard Creek.

All three political entities recognized the likelihood of continued controversy after construction of these remediation improvements. Therefore an agreement was developed among Champaign, the University, and Urbana to collect data at additional sites and have a study plan in place to analyze the effects scientifically, rather than to allow the controversy to grow and possibly result in litigation. As part of that agreement, it was established that the study would assist the political entities in assessing the hydrology/hydraulics of the watershed in the post-remediation configuration, specifically to ascertain if the Boneyard SWMM model, used for design of the remediation improvements, is a reliable method for predicting flows and stages at Lincoln Avenue. The ultimate objective is to to answer the question—*"Have the remediation improvements resulted in a higher water surface elevation profile downstream in Urbana than existed prior to the remediation improvements?"*

Ideally, determination of effects of hydrologic changes from flood-remediation projects in a watershed would be conducted with adequate data from both before and after remediation time periods. In addition, precipitation, soil moisture, and streamflow data at strategic locations would be available. Ideally, one could either select various similar storm events from the before and after time periods for comparison (similar storm flows would be defined as having similar precipitation amounts and antecedent soil moisture conditions) or determine the streamflow frequency statistics from both periods and compare the streamflow peaks for selected frequencies, such as the 2-year, 25-year, and 100-year flood.

There are sparse data to do a rigorous comparison of before and after hydrologic effects for Boneyard Creek. This data gap is a paucity of spatially-distributed incremental rainfall gages and the result of the cumulative effect of numerous hydrologic alterations of the Boneyard watershed through time, eliminating homogeneity of the controls on streamflow at the USGS Boneyard Creek campus gage, which has been operated since 1948.

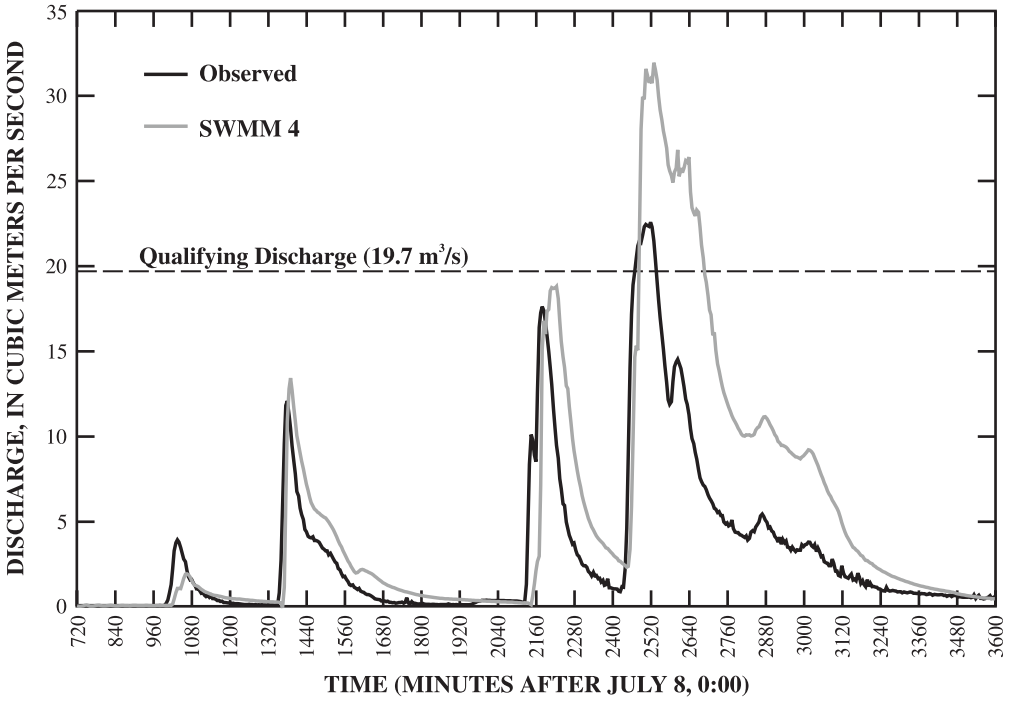
An alternative approach to determine any adverse effects of the remediation downstream in Urbana (downstream of Lincoln Avenue) is being undertaken. The entire design (and permitting) of the Boneyard post-remediation flood control was based on the assumption that the consultants SWMM model results are either a correct or conservative estimate of peak streamflow for a given rainfall input. The present approach is based on the determination of the accuracy of the SWMM model in simulating post-remediation storm flows. This approach necessitates the collection of additional rainfall data to properly characterize the spatial and temporal distribution of rainfall on the Boneyard watershed and accurately monitor the streamflow as it enters Urbana at Lincoln Avenue, where an additional USGS streamflow gage was established.

The assessment method calls for the observed rainfall data to be entered into the SWMM model in the "as-built" state and run it to predict the streamflow at Lincoln Avenue. If the model predicts flow equal to or larger than the

University of Illinois channel improvements (photo courtesy of Aerial Mapping Services, Inc. and Berns, Clancy and Associates).

observed flow, this prediction provides evidence that the design model is accurate or conservative, and thus much more likely that there has been no adverse impact downstream in Urbana from the remediation project.

The floods selected for simulation as part of the assessment will have peak streamflows at the Lincoln Avenue gage of at least 19.7 m^3/s, and flood peaks at or exceeding this value will be selected as "qualifying" storm events. Streamflow of 19.7 m^3/s, estimated to be the five-year recurrence [likelihood] flood at Lincoln Avenue, was selected because it was expected that at least three such floods of this magnitude would occur in the five to ten years slated for the data collection, and it was thought to be of sufficient magnitude to be in the range of flows for which the SWMM model was calibrated.



Observed and simulated streamflow for the Boneyard Creek at the Lincoln Avenue gage, July 8-10, 2003.

Data collection began in late 2001. The first "qualifying" storm event occurred on July 9, 2003, with a peak observed streamflow of 22.6 m^3/s. Preliminary modeling of the July 9, 2003 storm event was conducted by distributing the observed rainfall for each sub-watershed within the SWMM model using the Thiessen polygon method. The SWMM model estimated a peak streamflow of 33 m^3/s (figure above), which is a significant over prediction of the observed peak streamflow. With the preliminary model estimate of an over prediction of the observed peak flow, for this event, a preliminary finding would be that the remediation had no adverse impact on Urbana for this event. Final determination of the impacts will not be made until a more thorough analysis of this event along with analysis of additional events. Another qualifying storm event has occurred but no analysis has been completed.

Boneyard Creek looking east towards Lincoln Avenue on the University of Illinois campus in Urbana.

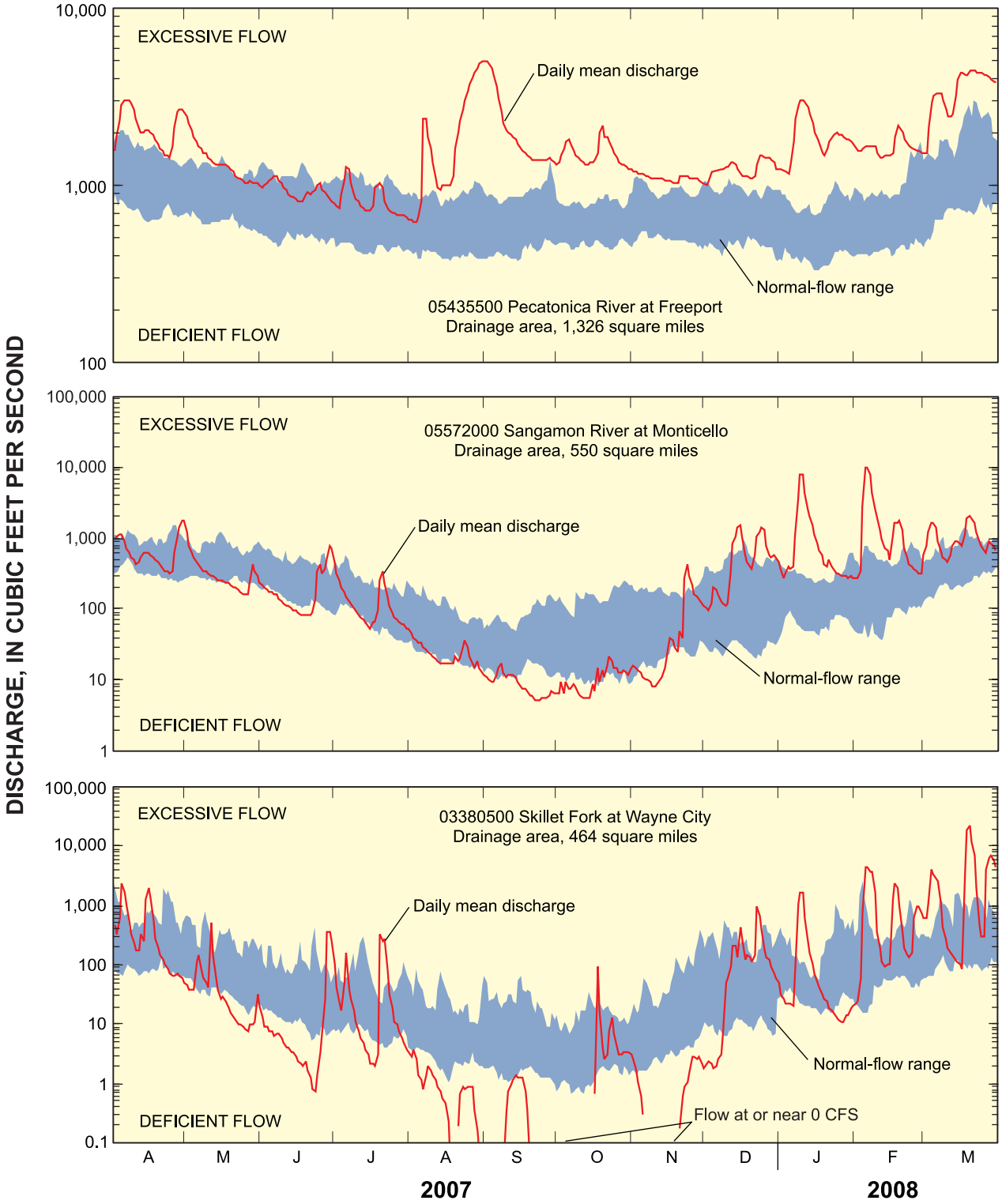
References

Berns, Clancy, and Associates, 1998, Joint Agency Permit Application Boneyard Creek Flood Control, Permit Application Package Phase 1C.

Camp, Dresser, and McKee Inc., 1997, Permit Application Package Phase I Improvements Boneyard Creek Improvement Plan, City of Champaign, Illinois.

U. S. Environmental Protection Agency, Environmental Research Laboratory, 1997, Storm Water Management Model, Version 4.4 beta, Users Manual.

Illinois Streamflow Conditions for April 2007 through March 2008



Daily mean discharge from April 1, 2007 through March 31, 2008 compared with percentile distribution of mean daily discharged for the 30-year period, 1961-90, for 3 representative streamgaging stations. A daily mean discharge is in the deficient-flow if its value is less than or equal to the 25th percentile, in the normal-flow range if its value is between 25th and 75th percentiles, and in the excessive-flow range if its value is equal to or greater than the 75th percentile.

EMPLOYEE SPOTLIGHT

P. Ryan Jackson
(Hydrologist)

Ryan Jackson joined the staff of the USGS Illinois Water Science Center in Urbana as a hydrologist in late February 2008. Ryan is currently dividing his time between the Office of Surface Water (hydroacoustics), the Hydrologic Data Collection and Analysis Section, and the Surface Water Investigations Section. Ryan became interested in working for the USGS after successful collaborations with Illinois Water Science Center and OSW personnel beginning in 2005.

Ryan holds M.S. and Ph.D. degrees in Civil Engineering from the University of Illinois at Urbana-Champaign and a B.S. in Civil Engineering from the University of New Mexico. During his undergraduate studies, Ryan worked at Sandia National Laboratories as a research assistant in the Microelectronics Development Laboratory completing routine testing of microelectronic devices and helping to maintain a 300-user computer network. Ryan also spent a year studying abroad at the Royal Melbourne Institute of Technology in Melbourne, Australia. As a graduate student, Ryan studied environmental fluid mechanics, specializing in mixing in stratified turbulence. His research included theoretical and laboratory analyses of small-scale turbulent mixing, dye experiments on the Hudson River to investigate the dispersion of Zebra Mussel larvae, dye experiments on the Kissimmee and Loxahatchee Rivers to estimate dispersion coefficients for comparison with estimates from acoustic Doppler current profiler (ADCP) transects, tracking intrusions generated by boundary mixing in lakes, and characterization of density currents in the Chicago River using both a physical model and field measurements. While at UIUC, Ryan received the National Defense Science and Engineering Graduate Fellowship and the National Science Foundation GK-12 Teaching Fellowship. The latter fellowship allowed Ryan to spend two years teaching science part time at Danville High School and Urbana Middle School.

Prior to joining the USGS, Ryan was a postdoctoral fellow at Woods Hole Oceanographic Institution where he studied mixing in the deep sea. As a part of a larger project, Ryan and his colleagues used the submarine ALVIN to inject tracer (sulfur hexaflouride) along the East Pacific Rise (8500 ft deep) near high temperature (400°C) hydrothermal vents. By measuring local currents and the dispersion of the tracer over approximately 50 days using R/V Atlantis and ALVIN, Ryan and his colleagues were able to build a data set that allows vent biologists to predict dispersal of larvae from hydrothermal vent fauna. Ryan's experiences at WHOI and his time at sea taught him a great deal about the planning, preparation, and resources required to execute large-scale field experiments. Ryan has published his research in several peer-reviewed journals including the Journal of Physical Oceanography, Geophysical Research Letters, Experiments in Fluids, and Science of the Total Environment and he currently has articles submitted to the Journal of Fluid Mechanics and Deep Sea Research.

Ryan was raised in New Mexico and Colorado. He spent several years on the Cibola Search and Rescue team in Albuquerque before trading the Rocky Mountains for the corn fields of Illinois. Ryan enjoys woodworking, hiking, kayaking, fishing, and working in the yard. Ryan spends most of his free time with his wife, Heather, and his children, Kylie (3) and Colin (5 months).

USGS Illinois Water Science Center Publications

Listed below are publications that were published recently. Federal Fiscal Year (FY) covers October 1 through September 30. Our policy is to provide copies of our publications to requestors at no cost as long as the publication is in stock in the USGS Illinois Water Science Center. To obtain copies of the following, or any other USGS Illinois Water Science Center publication, you may contact Donna Ayers at (217) 344-0037, extension 3053 or by e-mail at *dmayers@usgs.gov*.

Reports also can be found at the USGS Publications Warehouse at: *http://infotrek.er.usgs.gov/pubs/*

FY 2007

SIR 2007-5141, Hydrologic, Hydraulic, and Flood Analyses of the Blackberry Creek Watershed, Kendall County, Illinois, by E.A. Murphy, T.D. Straub, D.T. Soong, and C.S. Hamblen (http://pubs.usgs.gov/sir/2007/5141)

SIR 2007-5184, Ground-Water Quality in the Vicinity of Coal-Refuse Areas Reclaimed with Biosolids in Fulton County, Illinois, by W.S. Morrow (http://pubs.usgs.gov/sir/2007/5184)