BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

RECEIVED
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APR 04 2006
STATE OF ILLINOIS
Pollution Control Board

IN THE MATTER OF:	)	
PROPOSED AMENDMENTS TO	)	R04-25
DISSOLVED OXYGEN STANDARD	)	
35 IILL. ADM. CODE 302.206	)	

NOTICE

TO: Dorothy Gunn, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph Street 11-500
Chicago, Illinois 60601
(OVERNIGHT VIA MAIL)

Richard McGill, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph Street, Suite 11-500
Chicago, Illinois 60601
(OVERNIGHT VIA MAIL)

SEE ATTACHED SERVICE LIST
Regular Mail

PLEASE TAKE NOTICE that we have filed with the Office of the Clerk of the Pollution Control Board the Illinois Environmental Protection Agency's Pre-filed Testimony of Toby Frevert and Roy Smogor and the Illinois Department of Natural Resources' Pre-filed Testimony of Joel Cross, a copy of which is herewith served upon you.

Dated: April 3, 2006

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

By: ______________________
Stefanie N. Diers
Assistant Counsel
Division of Legal Counsel

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

By: ______________________
Stanley Yonkauski, Jr.
One of Its Attorneys

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1021 North Grand Avenue East
Springfield, Illinois 62794-9276
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One Natural Resources Way
Springfield, Illinois 62702-1271

THIS FILING IS SUBMITTED ON RECYCLED PAPER

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35 Ill. Adm. Code 302.206	)	

PRE-FILED TESTIMONY OF TOBY FREVERT

I am Toby Frevert, Manager of the Division of Water Pollution Control for the Illinois Environmental Protection Agency ("Illinois EPA"). I thank the Board for hearing my testimony today and allowing Illinois EPA and the Illinois Department of Natural Resources ("IDNR") additional time to work on a joint recommendation.

Since the last hearing in August 2005, Illinois EPA and IDNR have continued work to develop a joint recommendation on modification and updates to Illinois' current dissolved oxygen standard. Illinois EPA and IDNR staff reviewed and analyzed General Use water data to determine what waters warrant a dissolved oxygen standard incrementally higher than a base level deemed generally protective of most general use waters. This process proved to be complex and time consuming. Joel Cross and Roy Smogor will present a brief overview of the process used to develop our recommendation, and other personnel of the Agency and Department will be available to respond to questions and provide more specificity as desired.

Our recommendation to the Board establishes a two leveled dissolved oxygen standard. Level One is a base condition patterned after the structure recommended in USEPA's National Criteria document and generally protective of a full and diverse aquatic community. Level Two sets incrementally higher dissolved oxygen levels for those systems supporting species believed to associate with higher ambient dissolved oxygen concentrations. Specific language of our recommended dissolved oxygen standard is contained in Attachment 1 of this testimony for the Board's consideration. Significant components of that recommendation include:

1) Incorporation of a narrative provision supplementing the numeric provisions of the standard to assure environmentally acceptable conditions are provided throughout the full spectrum of General Use waters. Illinois EPA and IDNR are recommending that General Use waters at all locations maintain sufficient dissolved oxygen concentrations to prevent offensive conditions, as required in Section 302.203 of the Illinois Administrative Code. Quiescent and isolated sectors of General Use waters including wetlands, sloughs, backwaters, and lakes and reservoirs below the thermocline shall be maintained at sufficient dissolved oxygen concentrations to support their natural ecological functions and resident aquatic communities.

2) Average concentration and average daily-minimum concentration: The Illinois EPA and IDNR recommend the inclusion of 5.0 mg/L as a daily minimum and 6.0 mg/l as a daily mean averaged over 7 days during the months when early life stages are present. For the rest of the year, Illinois EPA and IDNR support 3.5 mg/l as a daily minimum, 4.0 mg/l as a daily minimum averaged over 7 days and 5.5 mg/l as a daily mean averaged over 30 days for those waters not listed as needing a higher dissolved oxygen concentration. The Agency and Department believe these concepts recognize the importance of

maintaining sufficiently high levels of dissolved oxygen that ensure long-term support of healthy aquatic life communities.

3) Enhanced waters: The Agency and Department have identified several segments (about 6% of the stream segments in the State) that warrant an enhanced level of protection. These higher dissolved oxygen standards include a daily minimum of 4.0 mg/l which is 0.5 mg/l higher than our base recommendation, daily mean value averaged over a 7-day period of 6.25 mg/l which is 0.25 mg/l higher than the base recommendation and a daily mean averaged over 30 days of 6.0 mg/l, which is 0.5 mg/l higher than the base recommendation.

Our recommendation also includes provisions regarding applicability and implementation considerations. Much of the testimony and discussion during this proceeding relate to the dynamic and variable nature of oxygen concentrations in both the spatial and temporal realm of any specific resource. To address this natural variation in dissolved oxygen concentrations, subparagraph (d) of our proposed regulatory language includes provisions on measurement and calculation of values to assess attainment of the standard. Language has been included within the numeric limits of subparagraphs (b) and (c) specifying that those numeric values apply in the main body of a stream. In other words, we are not restricting applicability of these values to either pool or riffle stretches; rather it applies throughout. The obvious departure from this uniform application applies to isolated areas such as backwater sloughs, and portions of lakes and reservoirs below the thermocline, where lower oxygen concentrations can be expected to occur naturally.

Finally, I would again like to thank the Board for the opportunity to submit pre-filed testimony and I would be happy to answer any of the Board's questions at the conclusion of the presentation of testimony from the Agency and the Department.

Toby Frevert

ATTACHMENT 1

ATTACHMENT 1

302.100 Definitions

"thermocline" means the plane of maximum rate of decrease of temperature with respect to depth in a thermally stratified body of water.

Section 302.206 Dissolved Oxygen

General use waters shall maintain dissolved oxygen concentrations at or above the minimum values contained in subsections (a), (b) and (c) of this Section.

(a) General use waters at all locations shall maintain sufficient dissolved oxygen concentrations to prevent offensive conditions as required in Section 302.203 of this Part. Quiescent and isolated sectors of General Use waters including but not limited to wetlands, sloughs, backwaters and lakes and reservoirs below the thermocline shall be maintained at sufficient dissolved oxygen concentrations to support their natural ecological functions and resident aquatic communities.

(b) Except for those waters identified in Appendix D of this Part, the main body of all streams, the water above the thermocline of thermally stratified lakes and reservoirs, and the entire water column of unstratified lakes and reservoirs shall not be less than the following:

(1) During the period of March through July a dissolved concentration of:

(A) 5.0 mg/l at any time; and
(B) 6.0 mg/l as a daily mean averaged over 7 days.

(2) During the period of August through February a dissolved oxygen concentration of:

(A) 3.5 mg/l at any time;
(B) 4.0 mg/l as a daily minimum averaged over 7 days and;
(C) 5.5 mg/l as a daily mean averaged over 30 days.

(c) All sectors within the main body of all streams and rivers identified in Appendix D of this Part shall not be less than:

(1) During the period of March through July a dissolved oxygen concentration of:

(A) 5.0 mg/l at any time; and
(B) 6.25 mg/l as a daily mean averaged over 7 days.

(2) During the period of August through February a dissolved concentration of:

(A) 4.0 mg/l at any time;
(B) 4.5 mg/l as a daily minimum averages over 7 days; and
(C) 6.0 mg/l as a daily mean averaged over 30 days.

(d) Assessing attainment of dissolved oxygen mean and minimum values.

(1) Daily mean is the arithmetic mean of dissolved oxygen value measured in a single 24-hour calendar day.

(2) Daily minimum is the dissolved oxygen value as measured in a single 24-hour calendar day.

(3) The measurements of dissolved oxygen used to determine attainment or lack of attainment with any of the dissolved oxygen standards in this Section must assure daily minima and daily means that represent the true daily minima and daily means.

(4) The dissolved oxygen value used in calculating or determining any daily mean or daily minimum should not exceed the 100% air-saturation value.

~~Dissolved oxygen (STORET number 00300) shall not be less than 6.0 mg/l during at least 16 hours of any 24 hour period, nor less that 5.0 mg/l at any time.~~

Section 302.APPENDIX D

List of Streams Segments for Enhanced Dissolved Oxygen Protection

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PROPOSED AMENDMENTS TO	)	R04-25
DISSOLVED OXYGEN STANDARD	)	
35 Ill. Adm. Code 302.206	)	

PRE-FILED TESTIMONY OF ROY SMOGOR

Good morning. My name is Roy Smogor; I have been employed by the Illinois Environmental Protection Agency ("Illinois EPA") for about 6 years. I am a stream biologist with a Master of Science degree in Fisheries and Wildlife Sciences from Virginia Polytechnic Institute and State University. I also have a Bachelor of Science degree in Biology from University of Illinois at Champaign-Urbana. I have several years of experience, in the states of Virginia and Illinois, in developing ways to use information about fish and other aquatic life to determine the overall condition, or health, of streams. Currently I am a Public Service Administrator in the Surface Water Section of the Bureau of Water. The Surface Water Section is responsible for monitoring the resource quality of Illinois streams and lakes. Specifically, we collect biological, chemical, and physical information from waters throughout the state and then interpret and report on this information. Our activities help guide the protection, management, and regulation of Illinois' aquatic natural resources. My pre-filed testimony in this matter provides an overview of the Technical Support Document that explains the joint recommendations, of Illinois EPA and the Illinois Department of Natural Resources ("Illinois DNR"), for the General Use water quality standard for dissolved oxygen.

Since the August 2005 Board hearing in this matter, Illinois EPA has participated in developing a final joint recommendation in response to proposed changes in the dissolved oxygen water quality standard made by the Illinois Association of Wastewater

Agencies ("IAWA"). Illinois EPA believes the current dissolved oxygen standard for Illinois General Use waters is too simplistic. The current standard inadequately accounts for the varied dissolved oxygen requirements of aquatic life in these waters. Moreover, the current standard does not account for how dissolved oxygen concentrations vary across a broad range of natural aquatic conditions in Illinois.

The revisions to the current dissolved oxygen General Use water quality standard being recommended today by Illinois EPA and Illinois DNR are based primarily on the U. S. Environmental Protection Agency's (U.S. EPA) 1986 national-criteria document for dissolved oxygen. Illinois EPA and Illinois DNR used this 1986 document as a foundation from which to interpret and incorporate more-recent information specifically applicable to the dissolved oxygen needs of aquatic life in Illinois waters. Although revisions to the current dissolved oxygen standard proposed by IAWA in April 2004 are also based on U.S. EPA's national-criteria document, Illinois EPA's recommendations differ from those of IAWA in the four following ways:

1) Illinois EPA recommends two levels of numeric standards, with an enhanced level of protection for waters inhabited by organisms especially sensitive to low dissolved oxygen levels. For a small subset of General Use waters—about 8% of the total General Use stream miles—Illinois EPA recommends a higher level of dissolved oxygen protection than proposed by IAWA. This higher level is intermediate between the "coldwater" criteria and "warmwater" criteria recommended in U.S. USEPA's national-criteria document. Some Illinois waters require dissolved oxygen levels higher than U.S. EPA's "warmwater" criteria because of the presence of a meaningful amount of fish

or macroinvertebrates that are more sensitive to low dissolved oxygen than the relatively few organisms on which U.S EPA's "warmwater" criteria are primarily based.

2) Illinois EPA recommends a narrative dissolved oxygen standard for waters that naturally cannot achieve consistently higher levels of dissolved oxygen, such as wetlands, sloughs, river backwaters, and portions of lakes and reservoirs below the thermocline.

3) llinois EPA recommends an annual period one month longer than that proposed by IAWA for the protection of sensitive life stages of fish. Namely, March through July rather than March through June.

4) Consistent with the U.S. EPA national-criteria document, Illinois EPA recommends a 30-day chronic dissolved oxygen standard in the form of a daily mean averaged over 30 days; this 30-day mean is not included in the IAWA proposal.

These recommendations are reflected in the language filed with the Board as Attachment 1 to the Pre-Filed testimony of Toby Frevert.

I participated in several aspects of the development of the Technical Support Document and joint Illinois EPA and Illinois DNR recommendations in this proceeding. Also, I am Illinois EPA's primary author for the joint Technical Support Document that was pre-filed with the Board with this testimony. In January 2006, I talked with Edward T. Rankin about his research on relations between stream fishes and dissolved oxygen in Ohio. We discussed how Illinois EPA and Illinois DNR were using his results to help identify Illinois fish species that are especially sensitive to low dissolved oxygen and thus potentially deserving of higher dissolved oxygen standards. I worked with Illinois EPA and Illinois DNR biologists and natural-resource managers to determine how to identify which streams in Illinois need higher minimum dissolved oxygen concentrations than those represented by the U.S. EPA "warmwater" criteria. After the two agencies co-developed an approach, Illinois DNR took the lead in identifying the Illinois stream-fish and mussel species that are most sensitive to low dissolved oxygen. Illinois EPA led the effort to determine an analogous list of most-sensitive stream macroinvertebrates, excluding mussels. After the two agencies analyzed biological information to determine which stream sites had meaningful amounts of sensitive organisms, I extrapolated this site-specific information to identify the stream segments that require the higher recommended level of dissolved oxygen standards. I am available to answer questions about or to provide examples of this extrapolation process.

Illinois EPA and Illinois DNR collaborated extensively to develop the technical scientific basis and to perform the analyses that culminated in the joint recommended revisions to the dissolved oxygen standard. The experience and expertise of several Illinois natural-resource managers and biologists were invaluable to this process. In addition to Illinois DNR colleagues, the following Illinois EPA staff provided valuable technical input: Matt Short, Mark Joseph, Howard Essig, Gregg Good, Bob Mosher, and Toby Frevert. Matt Short is also available to answer questions about how the Illinois EPA macroinvertebrate information was used or about Illinois EPA's stream monitoring program, in general. In addition to relying on Illinois-based expertise, the Technical Support Document cites several published scientific books and papers; copies of the relvant portions of these works can be provided as necessary.

Illinois EPA believes that these recommendations to the Board are scientifically sound and defensible in light of the currently available information on the dissolved oxygen needs of aquatic life in Illinois. Inevitably, in the future, additional information will become available that will allow Illinois EPA to evaluate and possibly improve these current recommendations to the Board.

Finally, I would like to thank the Board for the opportunity to provide this pre-filed testimony and the accompanying Technical Support Document. Illinois EPA hopes this document sheds some light on the varied dissolved oxygen needs of Illinois aquatic life and helps the Board in its determination in this difficult proceeding. I will be happy to answer questions from the Board at the conclusion of the presentation of testimony from the Agency and the Department.

By: Roy Smogor
Roy Smogor

April 3, 2006

Illinois Environmental Protection Agency
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Springfield, Illinois 62794-9276

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IN THE MATTER OF:	)	
	)	
PROPOSED AMENDMENTS TO	)	**R 04-25**
DISSOLVED OXYGEN STANDARD	)	**(Rulemaking – Water)**
35 ILL. ADM. CODE 302.206	)	

PRE-FILED TESTIMONY OF JOEL CROSS

My name is Joel Cross and I have been employed by the Illinois Department of Natural Resources (Illinois DNR) for 7 and one half years. I am currently the Acting Manager of the Watershed Protection Section within the Office of Resource Conservation. The Watershed Protection Section has the responsibility of coordinating the implementation of the Illinois Wildlife Action Plan, statewide watershed-based scientific investigations, and Geographical Information Systems for the Office of Resource Conservation. I was formerly employed by the Illinois Environmental Protection Agency (Illinois EPA) for 19 years. During my last 9 years at the Illinois EPA, I was the Manager of the Surface Water Section and the Planning Section in the Division of Water Pollution Control. My duties included daily administration of several water resource programs including surface water monitoring and assessment, watershed management initiatives, federal non-point source programs, federal and state clean lakes programs, Total Maximum Daily Load (TMDL) development, Geographical Information Systems, and state water quality standards programs. I hold a Bachelor's degree in Zoology from Southern Illinois University at Carbondale, Illinois.

My testimony in this matter will include a general overview of the Illinois DNR's role, contribution and background history in developing the Illinois DNR and Illinois EPA joint recommendations for dissolved oxygen water quality standards. A jointly written Technical Support Document supplements the testimony provided by both Illinois DNR and Illinois EPA, and provides detailed information regarding the two agencies recommendations. I will refer to the Technical Support Document throughout my testimony.

Since the August 25, 2005 hearing, the Illinois DNR and Illinois EPA jointly developed a coordinated position that defines two levels of numeric standards for dissolved oxygen. A fundamental aspect of this position is that dissolved oxygen profiles naturally vary within general use waters throughout Illinois; therefore a single uniform standard is not appropriate given the available science today. Illinois DNR and Illinois EPA propose the establishment of two levels of numeric standards for dissolved oxygen for Illinois Pollution Control Board consideration: one level is generally protective of a full and diverse aquatic community (identified as level 2 in the Technical Support Document), and the other level sets incrementally higher dissolved oxygen concentrations to protect Illinois' most sensitive types of aquatic life (identified as level 1 in the Technical Support Document). The Illinois DNR became involved in this proceeding because State law provides that Illinois owns all aquatic life within our state boundaries and the Illinois DNR is specifically responsible for regulating and managing these natural resources.

Illinois DNR and Illinois EPA established a process for identifying a subset of waters that warrant an incrementally higher dissolved oxygen standard. A general description of this process follows. Our initial effort identified fish, macroinvertebrates, and mussels that are sensitive to dissolved oxygen. Next, Illinois DNR and Illinois EPA investigated fish and macroinvertebrate communities to determine four biological measures: number of sensitive fish species, proportion of individual fish that are sensitive, number of sensitive macroinvertebrate taxa, and the proportion of individual macroinvertebrates that are sensitive. Because the available mussel data did not comprise community assessments, number of sensitive species and proportion of sensitive individuals could not be calculated. The use of mussel data will be described later in my testimony. The third step in our process was to identify a threshold value for each of the four biological measures listed previously. Illinois DNR and Illinois EPA selected a threshold value that represented the typical amount known from healthy streams. Threshold values for each of the biological measures were determined by calculating the median value from sampling sites that were identified as attaining the Clean Water Act goal for aquatic life, referred to as full support. The calculation of the median was limited to full support waters in an attempt to limit the influence of environmental stresses, including habitat and chemicals. The fourth step of the joint process was to identify sites that had a meaningful amount of dissolved oxygen sensitive organisms. For each site, values for each of the four biological measures were compared to established threshold values. Sites were selected as having a meaningful amount of sensitive organisms if at least two of the four biological measures considered equaled or exceeded the established threshold value.

We had sampling results from 1,110 locations available for our analysis and found that 374 of the total sampling sites were identified as candidates for enhanced dissolved oxygen protection. Detailed information regarding the methods and procedures, rationale, and supporting scientific literature used in the four-step process is provided in the Technical Support Document on pages 33 through 37. Having identified these 374 sampling sites in need of enhanced dissolved oxygen protection, extrapolation of these sites to stream segments was conducted. Detailed information regarding the methods, procedures, and rationale for the extrapolation to stream segments is provided in the Technical Support Document on pages 38 through 44.

As mentioned previously, the number of sensitive species and proportion of sensitive individuals could not be calculated for mussels because of limitations in sampling methods. However, the locations of two sensitive mussel species were overlain on the stream segments that were identified as needing an incrementally higher dissolved oxygen standard based on fish and macroinvertebrate analysis. In essence, the mussel data verified the effort to identify stream segments needing protection based on the fish and macroinvertebrate data. Additional stream segments were selected for enhanced protection for dissolved oxygen based on the presence of these two dissolved oxygen sensitive mussels. The list of stream segments, and the applicable dissolved oxygen standards recommended, is described in the draft regulations provided by Toby Frevert, Illinois EPA, pre-filed testimony attachment 1. To facilitate the Illinois Pollution Control Board and interested members of the public's review of identified stream segments in need of incrementally higher dissolved oxygen standards, the Illinois DNR provided geographically referenced data layers and associated software in compact disc format (CD).

In addition to recommending two levels of numeric standards for dissolved oxygen, the Illinois DNR and Illinois EPA are also recommending an additional 30-day period as a statewide date (July 31) for protecting early life stages of fish. This is in contrast to the Illinois Association of Wastewater Agencies (IAWA's) recommended date of June 30. The Illinois DNR believes that, based on the scientific literature presented in the Technical Support Document, an additional 30-day period is necessary to protect early life stages of fish. While the IAWA's proposed date of June 30 protects the majority of spring season spawns, it neglects to include the spawning period of the summer season spawns, and neglects to include a 30-day period for protection of post-hatch embryonic and yolk-sac fry development. In general, by July 31, all late spawning fish species will have a substantial majority of their spawning and fry development into dates when higher dissolved oxygen standards will be in effect. Even though some larvae will be present into August, Illinois DNR fisheries managers believe the July 31 date should not be detrimental to the overall recruitment of a year class for fish species. A full discussion of the data supporting the selection of July 31 for protection of early life stages is provided in the Technical Support Document on pages 23 through 31.

The Illinois DNR and Illinois EPA developed these joint recommendations with input from stakeholder groups. Scheduled stakeholder meetings were held on October 19, 2005 in Chicago, and November 15, 2005 in Springfield. These meetings were attended by Illinois DNR, Illinois EPA, IAWA, Illinois Environmental Regulatory Group, Sierra Club, Prairie Rivers Network, USEPA, and Friends of the Chicago River. The Illinois DNR and Illinois EPA hosted additional meetings with IAWA on February 24, 2006 and with the Sierra Club and Prairie Rivers Network on March 1, 2006. The stakeholder process provided valuable input to the Illinois DNR and Illinois EPA in developing these recommendations for dissolved oxygen standards.

The Illinois DNR believes these joint recommendations provided through testimony and the Technical Support Document, significantly enhance protection for aquatic life in comparison to the dissolved oxygen standard currently in place. Specifically, these joint recommendations improve the current standard by identifying a season that protects for early life stages of fishes, providing dissolved oxygen standards more consistent with the USEPA National Criteria Document for Dissolved Oxygen

(1986), and attempting to account for the seasonal and natural variability of dissolved oxygen.

The Illinois DNR believes the two agencies recommendations build upon and enhances the proposed amendments to the current dissolved oxygen standards presented by IAWA by including two levels of numeric standards for protection of identified dissolved oxygen sensitive organisms in Illinois; a narrative standard for waters that naturally cannot achieve consistently higher levels of dissolved oxygen such as wetlands, sloughs, river backwaters, and lakes and reservoirs below the thermocline; the addition of the 30-day chronic standards consistent with the USEPA National Criteria Document applicable to both levels of numeric standards for dissolved oxygen; and an additional 30-day period necessary to protect early life stages of fish. The Illinois DNR does not view these joint recommendations as a lowering of dissolved oxygen standards within some waters during certain times of the year, but rather as focusing needed protection for most sensitive types and life stages of aquatic life where required. At the same time, the Illinois DNR and Illinois EPA recommendations are not unnecessarily over protective elsewhere. Therefore, the Illinois DNR further believes these joint recommendations will allow targeting of limited State resources to the most critical waters impacted by low dissolved oxygen concentrations.

Staff from the Illinois DNR has testified at both the August 12, 2004 and the August 25, 2005 hearings. Testimony for the August 25, 2005 hearing was pre-filed by

Dr. David L. Thomas, Chief of the Illinois Natural History Survey, on behalf of the Illinois DNR. During that hearing, Mr. Stanley Yonkauski, Illinois DNR attorney, moved to withdraw the Illinois DNR pre-filed testimony in order to allow the development of a joint position between Illinois DNR and Illinois EPA regarding dissolved oxygen standards (R 18-22). In addition, testimony was also provided by Dr. Thomas during the August 12, 2004 hearing. This Illinois DNR testimony, currently on the record, was provided in response to a June 24, 2004 letter from the Lieutenant Governor's Office regarding questions related to the dissolved oxygen issue (R 117-148, 155-158). Dr. Thomas' testimony was provided in the form of a response letter to the Lieutenant Governor's Office. The Illinois DNR testimony of August 12, 2004 identified two issues regarding dissolved oxygen that need to be referenced in context of the recommendations provided by the Illinois DNR and Illinois EPA today. Dr. Thomas stated that "the one-day minimum concentration of 3.5 milligrams per liter and the seven-day mean minimum of 4.0 milligrams per liter as not being conservative enough, and potentially endangering some aquatic life in the state." The 3.5 and 4.0 milligrams per liter dissolved oxygen standards proposed by IAWA are also, in part, contained in these joint recommendations provided by Illinois DNR and Illinois EPA. The Illinois DNR believes these joint recommendations address Dr. Thomas' concern expressed in previous Illinois DNR testimony by the addition of two levels of numeric standards (described in the Technical Support Document on pages 1 through 4). In these joint recommendations, the one-day minimum concentration of 3.5 milligram per liter and the seven-day mean minimum of 4.0 milligrams per liter are applicable only to juvenile and adult life stages within level 2 waters. Applicable dissolved oxygen standards for juvenile and adult life stages in level 1 waters and for early life stages within both level 1 and 2 waters are incrementally higher. The second issue stated in previous Illinois DNR testimony identifies the need to maintain a 5.0 milligrams per liter minimum at all times, which is consistent with the existing dissolved oxygen standards. Dr. Thomas further stated "that there are species that probably would not be protected at lower levels." In developing these joint recommendations, Illinois DNR and Illinois EPA investigated extensively dissolved oxygen sensitivity to fish, macroinvertebrates, and mussels during various life stages (described in the Technical Support Document on pages 10 through 22). Based on this further scientific analysis, a 5.0 milligram per liter acute dissolved oxygen standard is only necessary for protection of early life stages within level 1 and 2 waters. For juvenile and adult life stages, protective acute dissolved oxygen standards include 4.0 milligrams per liter for level 1 waters and 3.5 milligrams per liter for level 2 waters.

At this point, I would like to thank the Illinois Pollution Control Board for providing the Illinois DNR and Illinois EPA additional time to develop a joint position in this matter as well as all those people who fully participated in the stakeholder process. Illinois DNR staff making significant contributions to this process includes Scott Stuewe, Ann Holtrop, Dr. David L. Thomas, Dr. Kevin Cummings, Jim Mick, Mike Conlin and Illinois DNR

Deputy Director Leslie Sgro. Staff from Illinois EPA spent countless hours working directly with the Illinois DNR, including Toby Frevert, Roy Smogor, Matt Short, Mark Joseph, Gregg Good, Bob Mosher, Stefanie Diers, Deborah Williams, and Marcia Willhite. From the Sierra Club and Prairie Rivers Network, I'd like to thank Albert Ettinger, Cindy Skrukrud, and Glynnis Collins. Finally, I'd like to thank IAWA, including Dennis Streicher, Roy Harsh and Dr. James Garvey from Southern Illinois University.

In addition to myself, other Illinois DNR staff are here today and can be called upon to address specific questions related to the Technical Support Document as needed. Scott Stuewe, Acting Chief for the Division of Fisheries, can address questions related to biological data and information. Ann Holtrop, Watershed Protection Section, can address questions related to the overall process used to determine waters that warrant a higher dissolved oxygen standard.

Joel Cross

By Joel Cross, Acting Manager
Watershed Protection Section
Office of Resource Conservation

March 31, 2006
Joel Cross
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL. 62702

Section 302.APPENDIX D: Stream Segments for Enhanced Dissolved Oxygen Protection

BASIN NAME
Segment Name
Segment No.

End Points	Latitude	Longitude	COUNTY

Illinois

Aux Sable Creek
239

start	41.3982125891033	-88.3307365155966	GRUNDY
end	41.5221610266554	-88.3153074461322	KENDALL

Baker Creek
123

start	41.0993159446094	-87.833779044559	KANKAKEE
end	41.1187483257075	-87.7916507082604	KANKAKEE

Baptist Creek
160

start	40.5172643895406	-90.9781701980636	HANCOCK
end	40.5217773790395	-90.9703232423026	HANCOCK

Barker Creek
170

start	40.4730175690641	-90.3623822544051	FULTON
end	40.4505102531327	-90.423698306895	FULTON

Battle Creek
196

start	41.791467372356	-88.6440656199133	DEKALB
end	41.8454435074814	-88.6580317835588	DEKALB

Big Bureau Creek
209

start	41.2403303426443	-89.3778305139628	BUREAU
end	41.6599418992971	-89.0880711727354	LEE

Big Rock Creek
275

start	41.6325949399571	-88.5379727020413	KENDALL
end	41.7542831812644	-88.5621629654129	KANE

Blackberry Creek
271

start	41.6432480686252	-88.451129393594	KENDALL
end	41.7663693677829	-88.3855968808499	KANE

Boone Creek
284

start	42.3430701828297	-88.2604646456881	MCHENRY
end	42.3116813126792	-88.3284649937798	MCHENRY

Buck Creek
225

start	41.4305449377211	-88.7732713228626	LASALLE
end	41.4508806057478	-88.919966063547	LASALLE

403

start	40.6513984442885	-88.8660496976016	MCLEAN
end	40.6757825960266	-88.8490439132056	MCLEAN

Camp Creek
116

start	41.0119168530464	-89.7317034650143	STARK
end	41.0202988179758	-89.6817209218761	STARK

BASIN NAME

Segment Name

Segment No.

End Points	Latitude	Longitude	COUNTY

168

start	40.2936155016035	-90.7791785207262	MCDONOUGH
end	40.3985161419285	-90.5089903510732	MCDONOUGH

Camp Run

115

start	41.0119168530464	-89.7317034650143	STARK
end	41.0575944852479	-89.6822685234528	STARK

Cantway Slough

250

start	41.1654521279715	-87.6179423055771	KANKAKEE
end	41.1204910206261	-87.6018847740212	KANKAKEE

Cedar Creek

164

start	40.4187924503946	-91.0119249544251	HANCOCK
end	40.4320989747514	-90.9816512014458	HANCOCK

Central Ditch

17

start	40.2466345144431	-89.8605138200519	MASON
end	40.259146892407	-89.8331744969958	MASON

Clear Creek

70

start	40.2358631766436	-89.1715114085864	LOGAN
end	40.2817523596784	-89.2105606026356	MCLEAN

Coal Creek

173

start	40.6458316286298	-90.2773695191768	FULTON
end	40.6911917975894	-90.0990104026141	FULTON

Collins Run

243

start	41.4219631544372	-88.3508108111242	GRUNDY
end	41.4172036201222	-88.3955434158999	GRUNDY

Conover Branch

184

start	39.8376993452498	-90.1465720267561	MORGAN
end	39.8696939232648	-90.1234898871846	MORGAN

Coon Creek

60

start	40.1076562155273	-89.0130117597621	DEWITT
end	40.1755351290733	-88.8857086715202	DEWITT

Coop Branch

31

end	39.2042878811665	-90.0972130791043	MACOUPIN
end	39.1194481626997	-89.9878509202749	MACOUPIN

Coopers Defeat Creek

114

start	41.1557502062867	-89.748162019475	STARK
end	41.1485959333575	-89.6944246708098	STARK

Copperas Creek

88

start	40.4856512052475	-89.8867983078194	FULTON
end	40.549513691198	-89.9011907117391	FULTON

Court Creek

122

BASIN NAME

Segment Name / **Segment No.** / End Points	Latitude	Longitude	COUNTY
start	40.9184191403691	-90.1108008628507	KNOX
end	40.9349919352638	-90.2673514797552	KNOX
Cox Creek			
177			
start	40.0231674243157	-90.1158780774246	CASS
end	39.9657957063914	-90.0180644049351	CASS
Crane Creek			
174			
start	40.1328714038267	-89.9709414534257	MENARD
end	40.2466345144431	-89.8605138200519	MASON
Crow Creek			
102			
start	40.9323207251964	-89.4264477600798	MARSHALL
end	40.9663161180876	-89.2558617294218	MARSHALL
Deer Creek			
59			
start	40.117679723776	-89.3801215076251	LOGAN
end	40.1915602627115	-89.1582023776838	LOGAN
Des Plaines River			
245			
start	41.3923135096469	-88.2590124225285	GRUNDY
end	41.4325013563553	-88.1725611633353	WILL
Dickerson Slough			
421			
start	40.3597968706068	-88.3225685158141	CHAMPAIGN
end	40.4568389800294	-88.3442742579475	FORD
Drummer Creek			
423			
start	40.37389931547	-88.3480753423386	CHAMPAIGN
end	40.479101489993	-88.388698487066	FORD
Dry Fork			
35			
start	39.1989703827155	-89.9609795725648	MACOUPIN
end	39.1445756951412	-89.8876581181152	MACOUPIN
Du Page River			
268			
start	41.4988385272507	-88.2166248594859	WILL
end	41.7019525201778	-88.1476209409341	WILL
Eagle Creek			
392			
start	41.1360015419764	-88.8528525904771	LASALLE
end	41.1291172842462	-88.8664977236647	LASALLE
East Aux Sable Creek			
240			
start	41.5221610266554	-88.3153074461322	KENDALL
end	41.6231669397764	-88.2938779285952	KENDALL
East Branch Big Rock Creek			
277			
start	41.7542830239271	-88.5621632556731	KANE
end	41.8161922949561	-88.6002917634599	KANE
East Branch Copperas Creek			
47			
start	40.549514632509	-89.901189903351	FULTON

End Points	Latitude	Longitude	COUNTY
end	40.6583152735498	-89.8516717710553	PEORIA

East Fork La Moine River

167

start	40.3962156185095	-90.9339386121768	HANCOCK
end	40.4506930058171	-90.758703782814	MCDONOUGH

East Fork Mazon River

256

start	41.1872307009926	-88.2731640461448	GRUNDY
end	41.0815161304671	-88.3093601699244	LIVINGSTON

East Fork Spoon River

110

start	41.2158736312898	-89.6870256054763	STARK
end	41.2603216291895	-89.7311074496692	BUREAU

Easterbrook Drain

410

start	40.3687232740908	-88.5787269955356	MCLEAN
end	40.3909243275675	-88.5484031360558	MCLEAN

Exline Slough

252

start	41.1187483257075	-87.7916507082604	KANKAKEE
end	41.3377194296138	-87.674538578544	WILL

Fargo Run

94

start	40.8110626738718	-89.7625906815013	PEORIA
end	40.7936211492847	-89.7147157689809	PEORIA

Ferson Creek

281

start	41.9275380999085	-88.3177738518806	KANE
end	41.9518312998438	-88.3965138071814	KANE

Fitch Creek

131

start	41.0629732421579	-89.9929808862433	KNOX
end	41.1048465021615	-90.0171275726119	KNOX

Forked Creek

265

start	41.312634893655	-88.1518349597477	WILL
end	41.4208599921871	-87.8221168060732	WILL

Forman Creek

129

start	41.0920068762041	-90.1229512077171	KNOX
end	41.061779692349	-90.1373931430424	KNOX

Fourmile Grove Creek

232

start	41.5880621752377	-89.0154533767497	LASALLE
end	41.6281572065102	-89.0480036727754	LEE

Fox Creek

121

start	41.2158736312898	-89.6870256054763	STARK
end	41.2178841576744	-89.6378797955943	BUREAU

Fox River

270

start	41.6177003859476	-88.5558384703467	KENDALL
end	41.7665361019038	-88.3100243828453	KANE

BASIN NAME
Segment Name
Segment No.

End Points	Latitude	Longitude	COUNTY
Friends Creek			
56			
start	39.9296881580789	-88.7753341828841	MACON
end	40.0511150621524	-88.756810733868	MACON
Furrer Ditch			
175			
start	40.259146892407	-89.8331744807195	MASON
end	40.256856262248	-89.8235353908665	MASON
Gooseberry Creek			
138			
start	41.0815161304671	-88.3093601699244	LIVINGSTON
end	41.0229178273291	-88.3433997610298	LIVINGSTON
181			
start	41.2273512263311	-88.3737634512576	GRUNDY
end	41.1567969821084	-88.3954921510714	GRUNDY
Grindstone Creek			
169			
start	40.2936155016035	-90.7791785207262	MCDONOUGH
end	40.3128991202966	-90.6514786739624	MCDONOUGH
Hall Ditch			
176			
start	40.214043063866	-89.8947856138658	MASON
end	40.1996396083582	-89.8430392085184	MASON
Hallock Creek			
101			
start	40.9330251540704	-89.523027406387	PEORIA
end	40.9162496002415	-89.5368879858621	PEORIA
Haw Creek			
125			
start	40.8575772861862	-90.2335091570553	KNOX
end	40.9174343445877	-90.3387634753254	KNOX
Henline Creek			
401			
start	40.5867014223785	-88.6971328093932	MCLEAN
end	40.6247936449316	-88.6315733675586	MCLEAN
Henry Creek			
100			
start	40.932455717876	-89.5256512687818	PEORIA
end	40.9472322228041	-89.5711427004422	PEORIA
Hermon Creek			
126			
start	40.7818347201379	-90.2738699961108	KNOX
end	40.7628476930817	-90.3372052339614	KNOX
Hickory Creek			
244			
start	41.5038289458964	-88.0990240076033	WILL
end	41.4935392717868	-87.8108342251738	WILL
Hickory Grove Ditch			
87			
start	40.4870721779667	-89.7285827911466	TAZEWELL
end	40.4136575635669	-89.7349507058786	MASON
Hickory Run			
93			

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
	start	40.8217198390551	-89.7449749384213	PEORIA
	end	40.8581447502391	-89.7622130910013	PEORIA
Hillsbury Slough				
416				
	start	40.3453953438371	-88.3035309970523	CHAMPAIGN
	end	40.3928682378873	-88.2265028280313	CHAMPAIGN
Hodges Creek				
34				
	start	39.2630316914552	-90.1858200381692	GREENE
	end	39.2801974743086	-90.1528766403572	GREENE
Hurricane Creek				
44				
	start	39.449376470161	-90.5400508230403	GREENE
	end	39.4781872332274	-90.4508986197452	GREENE
Illinois River				
236				
	start	41.3255740245957	-88.9910230492306	LASALLE
	end	41.3986780470527	-88.2686499362959	GRUNDY
Indian Creek				
120				
	start	40.988610901184	-89.8221496834014	STARK
	end	41.2003389912185	-89.9349435285117	HENRY
182				
	start	39.8785447641605	-90.3782080959549	CASS
	end	39.8234731084942	-90.103743390331	MORGAN
224				
	start	41.7480730242898	-88.8741562924388	DEKALB
	end	41.7083887626958	-88.9437996894049	LEE
226				
	start	41.4400734113231	-88.7627018786422	LASALLE
	end	41.7377348577433	-88.8557728844589	DEKALB
396				
	start	40.7701181840118	-88.4858209632899	LIVINGSTON
	end	40.6469799222669	-88.4812665778082	LIVINGSTON
Iroquois River				
253				
	start	41.0739205590002	-87.8152251833303	KANKAKEE
	end	40.9614905075375	-87.8149010739444	IROQUOIS
447				
	start	40.7817769095357	-87.7532807121524	IROQUOIS
	end	40.8174648935578	-87.5342555764515	IROQUOIS
Jack Creek				
109				
	start	41.1283656948767	-89.7699479168181	STARK
	end	41.150467875432	-89.8374616586589	STARK
Jackson Creek				
246				
	start	41.4325013563553	-88.1725611633353	WILL
	end	41.4638503957577	-87.9160301224816	WILL
Joes Creek				
33				
	start	39.2801974743086	-90.1528766403572	GREENE
	end	39.3757180969001	-90.0772968234561	MACOUPIN

BASIN NAME Segment Name Segment No. End Points		Latitude	Longitude	COUNTY
Johnny Run				
258				
	start	41.2826709079541	-88.3633805819326	GRUNDY
	end	41.0807507198308	-88.5801638050665	LIVINGSTON
Jordan Creek				
266				
	start	41.3044458242397	-88.1279087273328	WILL
	end	41.3077177643453	-88.1188984685001	WILL
Judd Creek				
106				
	start	41.089645284216	-89.1847595119809	MARSHALL
	end	41.0429807674449	-89.1339049242164	MARSHALL
Kankakee River				
248				
	start	41.3923135096469	-88.2590124225285	GRUNDY
	end	41.1660752568715	-87.526360971907	KANKAKEE
Kickapoo Creek				
57				
	start	39.9932216924528	-88.8083252484687	MACON
	end	39.9987405799186	-88.8205170598483	MACON
65				
	start	40.1286520491088	-89.4532728967436	LOGAN
	end	40.4376592310728	-88.8667409562596	MCLEAN
92				
	start	40.6548826785105	-89.6134608723157	TAZEWELL
	end	40.9170471944911	-89.6577393908301	PEORIA
Kings Mill Creek				
83				
	start	40.4558745105979	-89.1642930044364	MCLEAN
	end	40.509184986927	-89.0937965002854	MCLEAN
La Harpe Creek				
159				
	start	40.4678428297867	-91.0424167497572	HANCOCK
	end	40.5172643895406	-90.9781701980636	HANCOCK
La Moine River				
158				
	start	40.3320849972693	-90.8997234923388	MCDONOUGH
	end	40.5923258750258	-91.0177293656635	HANCOCK
Lake Fork				
61				
	start	40.0837107988142	-89.3969397975165	LOGAN
	end	39.9367293000733	-89.2343282851812	LOGAN
Langan Creek				
254				
	start	40.9614905075375	-87.8149010739444	IROQUOIS
	end	40.9432018898477	-88.0465558527168	IROQUOIS
Lime Creek				
214				
	start	41.4515003790233	-89.5271752648714	BUREAU
	end	41.4951141474998	-89.456554884734	BUREAU
Little Indian Creek				
183				
	start	39.8355964564522	-90.1231971747256	MORGAN

BASIN NAME

Segment Name	**Segment No.**	End Points	Latitude	Longitude	COUNTY
		end	39.8658175367056	-90.0423591294145	MORGAN
	227				
		start	41.5091299863247	-88.7725444056074	LASALLE
		end	41.749433980972	-88.8141442269697	DEKALB
Little Kickapoo Creek					
	67				
		start	40.3336625070255	-88.9736094275975	MCLEAN
		end	40.394785197415	-88.9473142490326	MCLEAN
Little Mackinaw River					
	82				
		start	40.4423190352496	-89.4617848276975	TAZEWELL
		end	40.4481261917524	-89.4329939054056	TAZEWELL
Little Rock Creek					
	274				
		start	41.6345548769785	-88.5384723455853	KENDALL
		end	41.7895688619816	-88.6981590581244	DEKALB
Little Sandy Creek					
	107				
		start	41.0912632622075	-89.2247552498617	MARSHALL
		end	41.125352501365	-89.1758716886846	PUTNAM
Little Senachwine Creek					
	99				
		start	40.9533145540839	-89.5292433956921	PEORIA
		end	41.0084439145565	-89.5499765139822	MARSHALL
Little Vermilion River					
	233				
		start	41.3237602050852	-89.0811945323001	LASALLE
		end	41.5760289435671	-89.0829047126545	LASALLE
Lone Tree Creek					
	418				
		start	40.3750682121535	-88.3819688457729	CHAMPAIGN
		end	40.3145980401842	-88.4738655755984	MCLEAN
Long Creek					
	163				
		start	40.4466427913955	-91.0499607552846	HANCOCK
		end	40.4297652043359	-91.1507109600489	HANCOCK
Long Point Creek					
	68				
		start	40.2755311999445	-89.0786438507327	DEWITT
		end	40.2549604211821	-88.9826285651361	DEWITT
	394				
		start	41.038177645276	-88.7908409579793	LIVINGSTON
		end	41.0018214714974	-88.8534349418926	LIVINGSTON
Mackinaw River					
	397				
		start	40.5796794158534	-89.2813445945626	TAZEWELL
		end	40.5649627479232	-88.478822725546	MCLEAN
Macoupin Creek					
	32				
		start	39.1989703827155	-89.9609795725648	MACOUPIN
		start	39.2121253451487	-90.2312084410337	JERSEY
Madden Creek					
	413				

BASIN NAME
Segment Name
Segment No.

End Points		Latitude	Longitude	COUNTY
	start	40.0943580002069	-88.5400649488702	PIATT
	end	40.2109635906658	-88.4943738561926	PIATT
Masters Creek				
220				
	start	41.4976109383336	-89.4125473607076	BUREAU
	end	41.5439000049343	-89.421988392756	BUREAU
Masters Fork				
217				
	start	41.4531024225454	-89.4290492805799	BUREAU
	end	41.5702310455498	-89.3821188149649	BUREAU
Mazon River				
257				
	start	41.3086768327676	-88.3389845675056	GRUNDY
	end	41.1872307009926	-88.2731640461448	GRUNDY
Mendota Creek				
234				
	start	41.5281666288805	-89.1041764154672	LASALLE
	end	41.5282367334928	-89.1224368860589	LASALLE
Middle Branch of Copperas Creek				
90				
	start	40.549514632509	-89.901189903351	FULTON
	end	40.5980896362772	-89.9368482699851	FULTON
Middle Creek				
165				
	start	40.3957329294144	-90.9741776721721	HANCOCK
	end	40.3888894030526	-91.0072502737366	HANCOCK
Mill Creek				
494				
	start	41.8213649020421	-88.3222376599138	KANE
	end	41.9231053361497	-88.4419826012614	KANE
Mole Creek				
390				
	start	41.0193910577853	-88.8019375580673	LIVINGSTON
	end	40.9109452909954	-88.9263176124884	LIVINGSTON
Morgan Creek				
272				
	start	41.6481172046369	-88.4151168308869	KENDALL
	end	41.6530911245692	-88.3631669287476	KENDALL
Mud Creek				
449				
	start	40.637099482441	-87.5885960450541	IROQUOIS
	end	40.6100172186722	-87.5261312404789	IROQUOIS
Mud Run				
117				
	start	41.0092425694765	-89.7790957399812	STARK
	end	40.9876287937001	-89.6785472090663	STARK
Murray Slough				
259				
	start	41.2428845425989	-88.3615508333781	GRUNDY
	end	41.054741775769	-88.5825975362008	LIVINGSTON
Nettle Creek				
237				
	start	41.3559056532822	-88.4326806825019	GRUNDY

End Points		Latitude	Longitude	COUNTY
	end	41.3989525138118	-88.5519708865374	GRUNDY
Nippersink Creek				
285				
	start	42.403479031235	-88.1904263022916	LAKE
	end	42.408321560969	-88.341299199739	MCHENRY
289				
	start	42.3885864249526	-88.3641081665149	MCHENRY
	end	42.4692291197455	-88.4764236384547	MCHENRY
North Branch Crow Creek				
103				
	start	40.9663161180876	-89.2558617294218	MARSHALL
	end	41.0005549578781	-89.1943061363378	MARSHALL
North Branch Nippersink Creek				
286				
	start	42.4376632559979	-88.2872504317539	MCHENRY
	end	42.4945866793007	-88.3294075716268	MCHENRY
North Creek				
119				
	start	40.9486975483619	-89.7633680090807	PEORIA
	end	40.9421533616142	-89.7281078793964	PEORIA
North Fork Lake Fork				
62				
	start	39.9367293000733	-89.2343282851812	LOGAN
	end	40.0523211989442	-89.0999303242614	DEWITT
North Fork Salt Creek				
71				
	start	40.2675598120912	-88.7867164044023	DEWITT
	end	40.3620541452609	-88.7204600533309	MCLEAN
Otter Creek				
171				
	start	40.2161621556914	-90.164317977292	FULTON
	end	40.3182822717998	-90.3860609925548	FULTON
279				
	start	41.9619670384069	-88.3574449893747	KANE
	end	41.9903303640688	-88.3568570687618	KANE
393				
	start	41.1611802253124	-88.8310854379729	LASALLE
	end	41.1541734588026	-88.7148550047115	LASALLE
Panther Creek				
178				
	start	40.0231674243157	-90.1158780774246	CASS
	end	39.9411115612757	-90.0607356525317	CASS
405				
	start	40.6607941387838	-89.196034413193	WOODFORD
	end	40.8483817762616	-89.0003562591212	WOODFORD
Paw Paw Run				
231				
	start	41.6177945875792	-88.8847204360202	LASALLE
	end	41.6630271288718	-88.9144064528509	DEKALB
Pike Creek				
216				
	start	41.5121637096396	-89.3366888940457	BUREAU
	end	41.5707857354427	-89.2125163729316	BUREAU

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
388				
	start	40.8655185113965	-88.7090974772719	LIVINGSTON
	end	40.7989226101833	-88.7756316859923	LIVINGSTON
Pond Creek				
212				
	start	41.3494925800361	-89.5685244208084	BUREAU
	end	41.3541221673156	-89.6001721270724	BUREAU
Poplar Creek				
493				
	start	42.0127893042098	-88.2799278350546	KANE
	end	42.0604682884044	-88.151517184544	COOK
Prairie Creek				
69				
	start	40.2688606116755	-89.1209318708141	DEWITT
	end	40.3183618654781	-89.1150133167993	MCLEAN
79				
	start	40.1610672222447	-89.6159697428554	MASON
	end	40.3105388304102	-89.4819788351989	LOGAN
264				
	start	41.3410818305214	-88.1859963163497	WILL
	end	41.4048430210988	-87.9636949110551	WILL
391				
	start	41.0691920852358	-88.8106812576958	LIVINGSTON
	end	41.0162806406811	-89.0122375626521	LASALLE
Prairie Creek Ditch				
81				
	start	40.242940205103	-89.5831738921535	LOGAN
	end	40.268603376062	-89.5902703680441	LOGAN
Prince Run				
118				
	start	40.9953442805941	-89.7634490486344	STARK
	end	40.9486975483619	-89.7633680090807	PEORIA
Rob Roy Creek				
495				
	start	41.6340658591268	-88.530902327864	KENDALL
	end	41.7208669225124	-88.4449822691918	KENDALL
Rock Creek				
180				
	start	39.9533586794244	-89.7717217346798	MENARD
	end	39.9192042890665	-89.881417605895	MENARD
251				
	start	41.2029705333006	-87.9860450524621	KANKAKEE
	end	41.2416733683013	-87.9199539652218	KANKAKEE
Rocky Run				
221				
	start	41.2966432755716	-89.5031050607007	BUREAU
	end	41.2892114895079	-89.5271301009319	BUREAU
Rooks Creek				
386				
	start	40.9620056243899	-88.737743684525	LIVINGSTON
	end	40.7615433072922	-88.6752675977812	LIVINGSTON
Salt Creek				
58				

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
	start	40.1286520491088	-89.4532728967436	LOGAN
	end	40.1404369482862	-88.8817439726269	DEWITT
409				
	start	40.2793653821328	-88.6019348286105	DEWITT
	end	40.3687232740908	-88.5787269955356	MCLEAN
Sandy Creek				
105				
	start	41.1083947129797	-89.3471796913242	PUTNAM
	end	41.0855613697751	-89.0792291942694	MARSHALL
Sangamon River				
408				
	start	40.0056362283258	-88.6286241506431	PIATT
	end	40.4223231153926	-88.67328493366	MCLEAN
Senachwine Creek				
96				
	start	40.929825860388	-89.4632928486271	PEORIA
	end	41.0900318754938	-89.5885134178247	MARSHALL
Short Creek				
162				
	start	40.4611057719393	-91.0582083107674	HANCOCK
	end	40.4682735975769	-91.0704506789577	HANCOCK
Short Point Creek				
389				
	start	40.9883827214271	-88.7830008925065	LIVINGSTON
	end	40.8951301673701	-88.8749997260932	LIVINGSTON
Silver Creek				
111				
	start	41.2185762138697	-89.6793069447094	STARK
	end	41.2431713087936	-89.6494927441058	BUREAU
South Branch Crow Creek				
104				
	start	40.9663161180876	-89.2558617294218	MARSHALL
	end	40.9410075148431	-89.1948285503851	MARSHALL
South Branch Forked Creek				
267				
	start	41.2631372965881	-88.0315238211836	WILL
	end	41.292604367733	-87.9621751169561	KANKAKEE
South Fork Lake Fork				
63				
	start	39.9367293000733	-89.2343282851812	LOGAN
	end	39.9674631778105	-89.0884701339793	MACON
South Fork Vermilion River				
395				
	start	40.7701181840118	-88.4858209632899	LIVINGSTON
	end	40.7234241258087	-88.355790853647	LIVINGSTON
Spoon River				
3				
	start	40.883272448156	-90.0994555125119	KNOX
	end	41.2158736312898	-89.6870256054763	STARK
Spring Creek				
161				
	start	40.5838583294631	-91.0397056763892	HANCOCK
	end	40.595079516268	-91.0572149428165	HANCOCK

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
166				
	start	40.4506930058171	-90.758703782814	MCDONOUGH
	end	40.5047702003096	-90.7202911238868	MCDONOUGH
223				
	start	41.3114342012759	-89.1969933188526	BUREAU
	end	41.5341774964794	-89.1599030581214	LASALLE
Stevens Creek				
55				
	start	39.833172054334	-89.008501860042	MACON
	end	39.8725126750168	-88.9902570309468	MACON
Sugar Creek				
76				
	start	40.1505909949415	-89.6335239996087	MENARD
	end	40.3515916252906	-89.1626966142058	MCLEAN
124				
	start	40.9273148603695	-90.1168866799652	KNOX
	end	40.9407150872189	-90.126984172004	KNOX
448				
	start	40.7817769095357	-87.7532807121524	IROQUOIS
	end	40.650106664471	-87.5259225515566	IROQUOIS
Sutphens Run				
228				
	start	41.5813276727649	-88.9196815109252	LASALLE
	end	41.5940767755281	-89.0434408697488	LASALLE
Swab Run				
127				
	start	40.8043825531334	-90.0417502151246	KNOX
	end	40.8089204046364	-89.9959890937906	KNOX
Tenmile Creek				
64				
	start	40.1166122038468	-89.0605809659338	DEWITT
	end	40.1573804135529	-88.9870426654374	DEWITT
Timber Creek				
77				
	start	40.3499903738803	-89.1633832938062	MCLEAN
	end	40.3824906556377	-89.0653243216353	MCLEAN
Trim Creek				
249				
	start	41.1679695055755	-87.6275919071884	KANKAKEE
	end	41.3235679470585	-87.6273348723156	WILL
Turkey Creek				
172				
	start	40.5312633037562	-90.2784734138591	FULTON
	end	40.6100168551688	-90.1683886238592	FULTON
402				
	start	40.6346912128201	-88.8256051903746	MCLEAN
	end	40.6636296144043	-88.7848217949076	MCLEAN
Tyler Creek				
283				
	start	42.057069434075	-88.2869209701875	KANE
	end	42.0886074301339	-88.3939734393445	KANE
Unnamed Tributary				
230				

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
	start	41.6008353940091	-88.9239309686064	LASALLE
	end	41.6393800996109	-88.95237726256	LEE
406				
	start	40.8483817762616	-89.0003562591212	WOODFORD
	end	40.8446321845668	-88.9879480330159	WOODFORD

Unnamed Tributary of Big Bureau Creek

Segment No.		Latitude	Longitude	COUNTY
222				
	start	41.2923889187328	-89.4849627504116	BUREAU
	end	41.2746773653832	-89.4967232161933	BUREAU

Unnamed Tributary of Coopers Defeat Creek

Segment No.		Latitude	Longitude	COUNTY
113				
	start	41.1485959333575	-89.6944246708098	STARK
	end	41.1432423938169	-89.6549152326434	STARK

Unnamed Tributary of Dickerson Slough

Segment No.		Latitude	Longitude	COUNTY
422				
	start	40.4068214049304	-88.3388760698826	FORD
	end	40.4286849455119	-88.3118606581845	FORD

Unnamed Tributary of Drummer Creek

Segment No.		Latitude	Longitude	COUNTY
425				
	start	40.430183509928	-88.3944923485681	FORD
	end	40.4228198536222	-88.4420280012069	FORD

Unnamed Tributary of East Branch of Copperas Creek

Segment No.		Latitude	Longitude	COUNTY
89				
	start	40.59257130763	-89.8385498955685	PEORIA
	start	40.59257130763	-89.8385498955685	PEORIA

Unnamed Tributary of East Fork of Spoon River

Segment No.		Latitude	Longitude	COUNTY
112				
	start	41.1911731339471	-89.6948993736812	STARK
	end	41.1958777466981	-89.6635132189552	STARK

Unnamed Tributary of Indian Creek

Segment No.		Latitude	Longitude	COUNTY
185				
	start	39.8195431621523	-90.231206997871	MORGAN
	end	39.7997709298014	-90.2444898890822	MORGAN
229				
	start	41.5989641246871	-88.913295513256	LASALLE
	end	41.6212302072922	-88.9971274321449	LASALLE

Unnamed Tributary of Jackson Creek

Segment No.		Latitude	Longitude	COUNTY
247				
	start	41.4328713295604	-88.0777949404827	WILL
	end	41.4181859202087	-88.0389954976751	WILL

Unnamed Tributary of Johnny Run

Segment No.		Latitude	Longitude	COUNTY
261				
	start	41.1315090714299	-88.5704499691513	GRUNDY
	end	41.1211734141418	-88.5813177275807	GRUNDY

Unnamed Tributary of Kickapoo Creek

Segment No.		Latitude	Longitude	COUNTY
66				
	start	40.4376592310728	-88.8667409562596	MCLEAN
	end	40.4499435649154	-88.7941853627565	MCLEAN
95				
	start	40.843847234267	-89.6598940056171	PEORIA
	end	40.8376970553513	-89.655765678658	PEORIA

Unnamed Tributary of Lone Tree Creek

417

start	40.3145980401842	-88.4738655755984	MCLEAN
end	40.3084681821929	-88.4721825603404	MCLEAN

419

start	40.3200878690807	-88.4758169784284	MCLEAN
end	40.3246054213609	-88.502979969789	MCLEAN

420

start	40.3555955038811	-88.4486860730234	CHAMPAIGN
end	40.3553786361326	-88.4890287857383	MCLEAN

Unnamed Tributary of Mackinaw River

398

start	40.5649627479232	-88.478822725546	MCLEAN
end	40.4956570103387	-88.5106552787079	MCLEAN

399

start	40.558742486097	-88.5447290418444	MCLEAN
end	40.532461937187	-88.5550436512012	MCLEAN

400

start	40.5536214693649	-88.6155771894066	MCLEAN
end	40.5386135050112	-88.6150100834316	MCLEAN

Unnamed Tributary of Masters Creek

219

start	41.5407471962821	-89.4154110620948	BUREAU
end	41.5452528261938	-89.4136798690744	BUREAU

Unnamed Tributary of Masters Fork

218

start	41.510430587881	-89.3900507138719	BUREAU
end	41.6181398940954	-89.2965280984998	LEE

Unnamed Tributary of Nettle Creek

238

start	41.4088814108094	-88.5216683950888	GRUNDY
end	41.4186133676397	-88.5339604493093	GRUNDY

Unnamed Tributary of Nippersink Creek

255

start	42.4692291197455	-88.4764236384547	MCHENRY
end	42.4695432978934	-88.5110499918451	MCHENRY

288

start	42.4176539163554	-88.3444740410368	MCHENRY
end	42.4179067763647	-88.3502762821058	MCHENRY

290

start	42.3969278131381	-88.4109784072142	MCHENRY
end	42.3875994074602	-88.4491666706176	MCHENRY

Unnamed Tributary of North Fork of Salt Creek

72

start	40.3598944577027	-88.7302360564635	MCLEAN
end	40.3817246400667	-88.7481607936989	MCLEAN

73

start	40.3620541452609	-88.7204600533309	MCLEAN
end	40.3690272117515	-88.6961244618476	MCLEAN

75

start	40.2987649882463	-88.7603546124853	MCLEAN
end	40.3051172967471	-88.7525145171727	MCLEAN

Unnamed Tributary of Panther Creek

BASIN NAME

Segment Name

Segment No.

End Points	Latitude	Longitude	COUNTY
179			
start	39.9411115612757	-90.0607356525317	CASS
end	39.9350887523192	-90.047762075576	CASS

Unnamed Tributary of Pond Creek

End Points	Latitude	Longitude	COUNTY
211			
start	41.3541221673156	-89.6001721270724	BUREAU
end	41.3352313411595	-89.5875580793812	BUREAU

Unnamed Tributary of Prairie Creek

End Points	Latitude	Longitude	COUNTY
78			
start	40.2086608970772	-89.6103029312127	MASON
end	40.2239585519289	-89.638616348402	MASON
80			
start	40.3105388304102	-89.4819788351989	LOGAN
end	40.3114851545122	-89.4410508250634	LOGAN

Unnamed Tributary of Rooks Creek

End Points	Latitude	Longitude	COUNTY
387			
start	40.7615433072922	-88.6752675977812	LIVINGSTON
end	40.7348742139519	-88.6985073106457	MCLEAN

Unnamed Tributary of Salt Creek

End Points	Latitude	Longitude	COUNTY
412			
start	40.3090617343957	-88.6002511568763	MCLEAN
end	40.3165662374132	-88.6011454430269	MCLEAN

Unnamed Tributary of Sandy Creek

End Points	Latitude	Longitude	COUNTY
108			
start	41.0816545465891	-89.0921996326175	MARSHALL
end	41.0690044849354	-89.0872784559417	MARSHALL

Unnamed Tributary of Sangamon River

End Points	Latitude	Longitude	COUNTY
414			
start	40.2187198550443	-88.3726776422252	CHAMPAIGN
end	40.207759150969	-88.3556670563292	CHAMPAIGN
415			
start	40.2618571248343	-88.3804307110291	CHAMPAIGN
end	40.2604569179243	-88.4076966986332	CHAMPAIGN

Unnamed Tributary of Senachwine Creek

End Points	Latitude	Longitude	COUNTY
97			
start	41.0729094906046	-89.5194162172506	MARSHALL
end	41.1005615839111	-89.5247542292286	MARSHALL
98			
start	41.0008160428297	-89.5071527441621	MARSHALL
end	41.0407981005047	-89.5430844273656	MARSHALL

Unnamed Tributary of Walnut Creek

End Points	Latitude	Longitude	COUNTY
130			
start	41.0811500581416	-90.0632765005186	KNOX
end	41.0847653353348	-90.0680765817376	KNOX
132			
start	41.0602585608831	-89.9869046205873	KNOX
end	41.0721601609241	-89.9735120056073	STARK
133			
start	41.0262443553352	-89.9515238620326	STARK
end	41.0340788244836	-89.924721175772	STARK

Unnamed Tributary of West Bureau Creek

End Points	Latitude	Longitude	COUNTY
215			
start	41.4606455355906	-89.5251264675481	BUREAU

End Points		Latitude	Longitude	COUNTY
	end	41.4958522845312	-89.5472802493082	BUREAU

Unnamed Tributary of West Fork Sugar Creek

85

	start	40.3381506914873	-89.2954898975603	TAZEWELL
	end	40.3660114221746	-89.2448498120596	MCLEAN

86

	start	40.3105145326502	-89.3291625265707	LOGAN
	end	40.3299182729366	-89.3779530037535	TAZEWELL

Valley Run

241

	start	41.4172036201222	-88.3955434158999	GRUNDY
	end	41.5039796750174	-88.5041976708714	KENDALL

Vermilion Creek

235

	start	41.4768291322914	-89.0571044195371	LASALLE
	end	41.5338604103044	-89.0473804190906	LASALLE

Vermilion River

385

	start	41.3202746199326	-89.067686548398	LASALLE
	end	40.8817674383366	-88.6504671722722	LIVINGSTON

Walnut Creek

128

	start	40.9597510841493	-89.9769499175619	PEORIA
	end	41.12653217294	-90.2059192933585	KNOX

404

	start	40.6253040823561	-89.239009045057	WOODFORD
	end	40.7670065190601	-89.3054156233977	WOODFORD

Waubonsie Creek

273

	start	41.6864691774875	-88.3543291766866	KENDALL
	end	41.727653072306	-88.2817226140407	KANE

Waupecan Creek

262

	start	41.3345412028515	-88.4648617458928	GRUNDY
	end	41.1880870688571	-88.5889392759762	LASALLE

Welch Creek

278

	start	41.7390229211455	-88.5133300234389	KANE
	end	41.7542282081589	-88.4963865174814	KANE

West Branch Big Rock Creek

276

	start	41.7542830239271	-88.5621632556731	KANE
	end	41.791467372356	-88.6440656199133	DEKALB

West Branch Drummer Creek

424

	start	40.4348513301682	-88.3934764271309	FORD
	end	40.4490333768479	-88.4056995893214	FORD

West Branch Du Page River

269

	start	41.7019525201778	-88.1476209409341	WILL
	end	41.7799425869794	-88.1712650214772	DUPAGE

West Branch of Easterbrook Drain

411

BASIN NAME

Segment Name

Segment No.

End Points	Latitude	Longitude	COUNTY
start	40.3633709579832	-88.5816306009141	MCLEAN
end	40.3762064931712	-88.5843753634505	MCLEAN

West Branch of Horse Creek

263

start	41.2492485076225	-88.1312055809841	WILL
end	41.0019131557324	-88.1364114459172	KANKAKEE

West Branch of Lamarsh Creek

91

start	40.5615978513207	-89.6991824445749	PEORIA
end	40.640281675188	-89.7388615248892	PEORIA

West Branch Panther Creek

407

start	40.7528335084236	-89.1030067348099	WOODFORD
end	40.7954060105963	-89.1900600098668	WOODFORD

West Bureau Creek

213

start	41.3209910742583	-89.5195916727401	BUREAU
end	41.478267808168	-89.5152211006131	BUREAU

West Fork Mazon River

260

start	41.2530670781541	-88.3508667933585	GRUNDY
end	41.0302502359071	-88.5226194555857	LIVINGSTON

West Fork Salt Creek

74

start	40.317360196629	-88.7559599297755	MCLEAN
end	40.3372561693307	-88.8039670869984	MCLEAN

West Fork Sugar Creek

84

start	40.2844404292499	-89.332075650855	LOGAN
end	40.4558745105979	-89.1642930044364	MCLEAN

Wolf Creek

497

start	41.1540042913791	-88.8612912917747	LASALLE
end	41.1611802253124	-88.8310854379729	LASALLE

Kaskaskia

Bearcat Creek

37

start	39.0121682814832	-89.5317265036074	BOND
end	39.0568357269204	-89.4889786056249	MONTGOMERY

Becks Creek

45

start	39.1565938305703	-88.9491156388975	FAYETTE
end	39.3602481794208	-89.0227919838743	SHELBY

Brush Creek

39

start	39.1385354787129	-89.5805305687638	MONTGOMERY
end	39.1539913389194	-89.561368040102	MONTGOMERY

Cress Creek

41

start	39.1652709439739	-89.5012992382647	MONTGOMERY
end	39.1962551507602	-89.5131844155481	MONTGOMERY

Dry Fork

BASIN NAME

Segment Name

Segment No.

End Points	Latitude	Longitude	COUNTY
43			
start	39.036113738887	-89.2488135289512	FAYETTE
end	39.1033131262537	-89.2984242244004	MONTGOMERY

East Fork Shoal Creek

23			
start	38.8310032253066	-89.4990300331039	BOND
end	38.9226451880864	-89.4117554251748	BOND

Gerhardt Creek

27			
start	38.3445550793694	-90.0600653224456	ST. CLAIR
end	38.367857922464	-90.0997565611344	MONROE

Hurricane Creek

42			
start	38.9180334233238	-89.2472989134191	FAYETTE
end	39.2167946546678	-89.2767284135051	MONTGOMERY

Loop Creek

21			
start	38.4738791704891	-89.8286629587977	ST. CLAIR
end	38.4996759642082	-89.9058988238884	ST. CLAIR

Middle Fork Shoal Creek

40			
start	39.0848984732588	-89.5438724131899	MONTGOMERY
end	39.1868483992515	-89.4798528829252	MONTGOMERY

Mitchell Creek

48			
start	39.1565938305703	-88.9491156388975	FAYETTE
end	39.3191569074355	-88.9291931738519	SHELBY

Mud Creek

51			
start	39.4078984061571	-88.8964126852371	SHELBY
end	39.4786612118046	-88.9523280946578	SHELBY

Ninemile Creek

30			
start	38.0441291788376	-89.9112042263573	RANDOLPH
end	38.0507383485977	-89.8278402421236	RANDOLPH

Opossum Creek

46			
start	39.2718719283603	-89.006345202583	SHELBY
end	39.2833737967471	-89.0555186821259	SHELBY

Prairie du Long Creek

24			
start	38.2583950460692	-89.9674114204896	MONROE
end	38.3425597902873	-90.0517323138269	ST. CLAIR

Robinson Creek

50			
start	39.3519556417502	-88.8434641389225	SHELBY
end	39.5215530679793	-88.8331635597113	SHELBY

Rockhouse Creek

25			
start	38.279441694169	-90.0367398173562	MONROE
end	38.2999005789932	-90.1039357731424	MONROE

Section Creek

49

End Points		Latitude	Longitude	COUNTY
	start	39.1835497280833	-88.9455894742885	FAYETTE
	end	39.1959160048126	-88.961892707007	FAYETTE

Shoal Creek

22

	start	38.4831106563982	-89.5775456200079	WASHINGTON
	end	38.5557239981111	-89.4968640710432	CLINTON

36

	start	38.8310032008922	-89.4990300493802	BOND
	end	39.0848755752581	-89.5439018081354	MONTGOMERY

Silver Creek

20

	start	38.3369025707936	-89.8753691916515	ST. CLAIR
	end	38.5568068204478	-89.8305698867169	ST. CLAIR

Stringtown Branch

53

	start	39.7138824796477	-88.6677549810426	MOULTRIE
	end	39.7363136714592	-88.6944718913546	MOULTRIE

Unnamed Tributary of Gerhardt Creek

26

	start	38.367857922464	-90.0997565611344	MONROE
	end	38.3742880966457	-90.1107074126403	MONROE

Unnamed Tributary of Okaw River

54

	start	39.734248747064	-88.6620801587617	MOULTRIE
	end	39.80990395294	-88.6969360645412	PIATT

Walters Creek

28

	start	38.3425597902873	-90.0517323138269	ST. CLAIR
	end	38.3445550793694	-90.0600653224456	ST. CLAIR

West Fork Shoal Creek

38

	start	39.1385354787129	-89.5805305687638	MONTGOMERY
	end	39.1877434015581	-89.6041666305308	MONTGOMERY

West Okaw River

52

	start	39.6158126349278	-88.7105522558061	MOULTRIE
	end	39.7564321977535	-88.630211952428	MOULTRIE

Mississippi River

Apple River

372

	start	42.3210892387922	-90.2520915343109	JO DAVIESS
	end	42.5078007598632	-90.1320538371008	JO DAVIESS

Bear Creek

199

	start	40.1421908412793	-91.322057103417	ADAMS
	end	40.3507607406412	-91.1831593883194	HANCOCK

Bigneck Creek

205

	start	40.1189668648562	-91.2247381726013	ADAMS
	end	40.118891177483	-91.1409739765636	ADAMS

Burton Creek

192

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
	start	39.8643091712617	-91.343323220756	ADAMS
	end	39.92393403238	-91.2381482737218	ADAMS
Camp Creek				
140				
	start	41.2607621817314	-90.514303172809	MERCER
	end	41.3114464274682	-90.2476056448033	HENRY
142				
	start	41.2202380211465	-90.895164796358	MERCER
	end	41.2787933006746	-90.6950345992843	MERCER
Carroll Creek				
349				
	start	42.1027782814517	-90.0265311556732	CARROLL
	end	42.0906369943302	-89.8985337135691	CARROLL
Clear Creek				
6				
	start	37.4821139304798	-89.377768200259	UNION
	end	37.5377402977406	-89.331689550578	UNION
381				
	start	42.4468385101031	-90.0472460146999	JO DAVIESS
	end	42.4780763391708	-90.035127804618	JO DAVIESS
Coon Creek				
376				
	start	42.4035528739642	-90.1272819897867	JO DAVIESS
	end	42.4347098804951	-90.1169407822902	JO DAVIESS
Copperas Creek				
148				
	start	41.3717279574558	-90.901871458269	ROCK ISLAND
	end	41.3616090539824	-90.7468725613692	ROCK ISLAND
Deep Run				
155				
	start	40.7779166934519	-90.9639489255706	HENDERSON
	end	40.794076798068	-90.9474772904134	HENDERSON
Dixson Creek				
154				
	start	40.7684181600505	-90.9376123103323	HENDERSON
	end	40.7650613473293	-90.9262679175808	HENDERSON
Dutch Creek				
4				
	start	37.4593003249666	-89.3688365937935	UNION
	end	37.4147572383786	-89.2744790735331	UNION
East Fork Galena River				
383				
	start	42.450241615252	-90.3876497193745	JO DAVIESS
	end	42.4876693698893	-90.286894403861	JO DAVIESS
Edwards River				
145				
	start	41.1459068953479	-90.9832855425151	MERCER
	end	41.2835429634312	-90.1022166001482	HENRY
Eliza Creek				
146				
	start	41.2754465656779	-90.9740195834639	MERCER
	end	41.2948140261561	-90.8870757880317	MERCER
Ellison Creek				

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
153				
	start	40.7615810139869	-91.0723400800456	HENDERSON
	end	40.7295594797542	-90.7480413061409	WARREN
Galena River				
382				
	start	42.450241615252	-90.3876497193745	JO DAVIESS
	end	42.5068721036534	-90.390459616835	JO DAVIESS
Green Creek				
5				
	start	37.4514943718452	-89.3379244013686	UNION
	end	37.4666314694209	-89.3048476846202	UNION
Hadley Creek				
188				
	start	39.7025380326419	-91.1396851101986	PIKE
	end	39.7351716794518	-90.9664567571417	PIKE
Hells Branch				
378				
	start	42.3582317355027	-90.185076448587	JO DAVIESS
	end	42.4166702490621	-90.1660286242329	JO DAVIESS
Henderson Creek				
134				
	start	41.0518601460692	-90.652709618504	WARREN
	end	41.0728998007979	-90.3331881878676	KNOX
150				
	start	40.8788582366336	-90.9641994146698	HENDERSON
	end	40.989888583038	-90.8698875032336	HENDERSON
Hillery Creek				
144				
	start	41.2699394405307	-90.2020116075301	HENRY
	end	41.2553101029329	-90.1954503442612	HENRY
Honey Creek				
157				
	start	40.7000823335975	-91.0347691132118	HENDERSON
	end	40.7064734203141	-90.8589436695132	HENDERSON
186				
	start	39.4871465283426	-90.7799240715991	PIKE
	end	39.5633421986505	-90.8011460205638	PIKE
207				
	start	40.1052246871151	-91.2149469620062	ADAMS
	end	40.0689996865178	-91.2253825583113	ADAMS
Hutchins Creek				
7				
	start	37.5043385818368	-89.3755380391598	UNION
	end	37.58788138261	-89.3917584202331	UNION
Little Bear Creek				
194				
	start	40.3213003292038	-91.2390256840921	HANCOCK
	end	40.302753021887	-91.3102530307924	HANCOCK
Little Creek				
200				
	start	40.1807360433073	-91.2803860136891	ADAMS
	end	40.230127123031	-91.3051461065984	HANCOCK

McCraney Creek

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
189				
	start	39.7167396162723	-91.1729844320811	PIKE
	end	39.8572624790589	-91.0907175471865	ADAMS
Mill Creek				
191				
	start	39.8643091712617	-91.343323220756	ADAMS
	end	39.9675786362521	-91.2477003180771	ADAMS
377				
	start	42.3539782358808	-90.1879698650198	JO DAVIESS
	end	42.4518923573772	-90.2485882677025	JO DAVIESS
496				
	start	38.9472270910927	-90.2956721236088	JERSEY
	end	38.9871246152411	-90.3431576290565	JERSEY
Mississippi River				
2				
	end	37.1887629940337	-89.4576720472899	ALEXANDER
29				
	start	38.8664117755941	-90.1477786925267	MADISON
	end	38.327795025976	-90.3709302644266	MONROE
384				
	start	42.5079432477656	-90.6430378486115	JO DAVIESS
	end	41.5746193723759	-90.392321397091	ROCK ISLAND
440				
	start	39.326689248302	-90.8243988873681	CALHOUN
	end	39.8935238218567	-91.4437639810547	ADAMS
Mud Creek				
202				
	start	40.1812148450863	-91.2785060826782	ADAMS
	end	40.1852755387137	-91.2660018265735	ADAMS
Nichols Run				
156				
	start	40.7735451176215	-90.9672827833242	HENDERSON
	end	40.7648298879037	-90.9675416302885	HENDERSON
North Henderson Creek				
136				
	start	41.0973619647032	-90.7191141378965	MERCER
	end	41.119743833988	-90.4494190524502	MERCER
Parker Run				
141				
	start	41.2623500459087	-90.4891341819923	MERCER
	end	41.2260011828886	-90.4145431241447	HENRY
Pigeon Creek				
190				
	start	39.7143204171354	-91.2372670411405	PIKE
	end	39.8220301600964	-91.2087922935523	ADAMS
Pope Creek				
137				
	start	41.1401437091914	-90.8116816399802	MERCER
	end	41.1394137238591	-90.2877112230995	KNOX
Sixmile Creek				
187				
	start	39.4592604039597	-90.8902507134236	PIKE
	end	39.5431657559583	-90.8891598316201	PIKE

BASIN NAME

Segment Name

Segment No.

End Points	Latitude	Longitude	COUNTY
Slater Creek			
198			
start	40.291601584329	-91.2423526162923	HANCOCK
end	40.2822885732908	-91.2189777154329	HANCOCK
Smith Creek			
152			
start	40.9297989285848	-90.9146232873076	HENDERSON
end	40.9291958384872	-90.7919464822621	HENDERSON
South Edwards River			
139			
start	41.2656645104853	-90.2611866223557	HENRY
end	41.1927071399434	-90.0393078982573	HENRY
South Fork Apple River			
380			
start	42.4468385101031	-90.0472460146999	JO DAVIESS
end	42.4176188464167	-89.9845802036023	JO DAVIESS
South Fork Bear Creek			
203			
start	40.1677973436879	-91.2933473698779	ADAMS
end	40.0950329934447	-91.0607522810856	ADAMS
South Henderson Creek			
135			
start	41.0188478643653	-90.4811337762604	WARREN
end	41.0121123609019	-90.4338464913801	KNOX
151			
start	40.8788582366336	-90.9641994146698	HENDERSON
end	40.8534764362853	-90.8707263659685	HENDERSON
Straddle Creek			
301			
start	42.0906369943302	-89.8985337135691	CARROLL
end	42.1316680929413	-89.783599495409	CARROLL
Thurman Creek			
204			
start	40.1277667094818	-91.234525810555	ADAMS
end	40.1580795200863	-91.1501036788115	ADAMS
Tournear Creek			
193			
start	39.9042285951329	-91.2447718289928	ADAMS
end	39.8738503674823	-91.1658282439773	ADAMS
Unnamed Tributary of Apple River			
375			
start	42.3613497834653	-90.1603277978963	JO DAVIESS
end	42.3651703478401	-90.1182227692179	JO DAVIESS
Unnamed Tributary of Bear Creek			
197			
start	40.3187160045841	-91.2379753573306	HANCOCK
end	40.3220475782343	-91.2218711128768	HANCOCK
201			
start	40.2483484763178	-91.2634157983708	HANCOCK
end	40.2576281291385	-91.2420554576986	HANCOCK
Unnamed Tributary of Copperas Creek			
149			
start	41.3759130587612	-90.8569366994939	ROCK ISLAND

End Points	Latitude	Longitude	COUNTY
end	41.3735944469795	-90.829794872711	ROCK ISLAND

Unnamed Tributary of Furnace Creek

373

End Points	Latitude	Longitude	COUNTY
start	42.3419228115146	-90.2583358633166	JO DAVIESS
end	42.3737126096251	-90.2971522307335	JO DAVIESS

374

End Points	Latitude	Longitude	COUNTY
start	42.3419228115146	-90.2583358633166	JO DAVIESS
end	42.3615209718591	-90.24931703774	JO DAVIESS

Unnamed Tributary of South Edwards River

143

End Points	Latitude	Longitude	COUNTY
start	41.2011516193172	-90.1850818577344	HENRY
end	41.1943841818099	-90.1839265246101	HENRY

Unnamed Tributary of South Fork of Bear Creek

206

End Points	Latitude	Longitude	COUNTY
start	40.0797919556019	-91.1461193615862	ADAMS
end	40.0587441356106	-91.1467388825794	ADAMS

West Fork Apple River

379

End Points	Latitude	Longitude	COUNTY
start	42.4777531846594	-90.1103501186504	JO DAVIESS
end	42.4739843218597	-90.1321517307332	JO DAVIESS

West Fork of Bear Creek

195

End Points	Latitude	Longitude	COUNTY
start	40.3385207135212	-91.2203393068898	HANCOCK
end	40.3592824400704	-91.2334357995319	HANCOCK

Yankee Branch

147

End Points	Latitude	Longitude	COUNTY
start	41.2850778212191	-90.9379823025264	MERCER
end	41.2926277702981	-90.9335620769218	MERCER

Ohio

Big Creek

16

End Points	Latitude	Longitude	COUNTY
start	37.4366764302436	-88.3127424957005	HARDIN
end	37.5591274535694	-88.3148730216063	HARDIN

Big Grand Pierre Creek

13

End Points	Latitude	Longitude	COUNTY
start	37.4163002207384	-88.4338876873615	POPE
end	37.5702304746463	-88.4292613661871	POPE

Hayes Creek

10

End Points	Latitude	Longitude	COUNTY
start	37.4452331751972	-88.7114120959417	JOHNSON
end	37.4559134065693	-88.6286228702431	POPE

Hicks Branch

14

End Points	Latitude	Longitude	COUNTY
start	37.5432903813926	-88.4245265989312	POPE
end	37.5391971894773	-88.4135144509885	HARDIN

Little Lusk Creek

12

End Points	Latitude	Longitude	COUNTY
start	37.4991426291527	-88.5277357332102	POPE
end	37.5247950767618	-88.5017934865946	POPE

Little Saline River

9

End Points	Latitude	Longitude	COUNTY
start	37.6429893859023	-88.6229273282692	SALINE

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
	end	37.5783125058777	-88.7169929932876	JOHNSON

Lusk Creek

11

	start	37.3685952948804	-88.4926140087969	POPE
	end	37.5649232438096	-88.5644984122843	POPE

Miss River

2

	start	36.9810279805712	-89.1311552055554	ALEXANDER

Ohio River

1

	start	36.9810279805712	-89.1311552055554	ALEXANDER
	end	37.7995447392016	-88.0255709974801	GALLATIN

Simmons Creek

15

	start	37.4274681380208	-88.4392381154217	POPE
	end	37.4644921054999	-88.4850750109356	POPE

South Fork Saline River

8

	start	37.6372646144582	-88.6447143188352	SALINE
	end	37.6650992000287	-88.7471054185807	WILLIAMSON

Unnamed Tributary of Big Creek

18

	start	37.4816237108967	-88.3412279259479	HARDIN
	end	37.4836843600581	-88.3434390004066	HARDIN

Wabash River

488

	start	37.7995447392016	-88.0255709974801	GALLATIN

Rock

Beach Creek

302

	start	41.8989215290323	-89.121081932608	OGLE
	end	41.8637759544565	-89.185844184387	LEE

Beaver Creek

322

	start	42.2551087433884	-88.9247700103803	BOONE
	end	42.4341346635117	-88.7603784300954	BOONE

Black Walnut Creek

341

	start	42.1132080942552	-89.2141520188153	OGLE
	end	42.061557908797	-89.2316600156935	OGLE

Brown Creek

335

	start	42.3568412672282	-89.4493817584574	STEPHENSON
	end	42.3697340053709	-89.4802304815634	STEPHENSON

Buffalo Creek

358

	start	41.9242552302868	-89.6809355972221	WHITESIDE
	end	41.9752373833258	-89.6243677263482	OGLE

Cedar Creek

337

	start	42.3709196286357	-89.670256711355	STEPHENSON
	end	42.3896058186609	-89.5870343171161	STEPHENSON

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
Coal Creek				
208				
	start	41.3941767873198	-89.8287586795479	BUREAU
	end	41.2930847238959	-89.6659810678663	BUREAU
Coon Creek				
304				
	start	42.0365871032824	-89.489365571257	OGLE
	end	42.0550520228278	-89.4762995939105	OGLE
326				
	start	42.254519734978	-88.7945563884938	BOONE
	end	42.1336677087989	-88.6039205825106	DEKALB
Crane Grove Creek				
371				
	start	42.2656461748962	-89.6058461735176	STEPHENSON
	end	42.2317224844045	-89.5804359629382	STEPHENSON
Deer Creek				
307				
	start	42.1046195671697	-88.7267155451459	DEKALB
	end	42.1076541965304	-88.6684575625598	DEKALB
Dry Creek				
332				
	start	42.4322162336943	-89.0509181181504	WINNEBAGO
	end	42.4892211712754	-88.9789486331688	WINNEBAGO
East Branch South Branch of Kishwaukee River				
306				
	start	42.0108038948242	-88.7236807475971	DEKALB
	end	41.9822037358546	-88.5449399063616	KANE
East Fork Mill Creek				
343				
	start	42.1402053009442	-89.2945061380348	OGLE
	end	42.1744627607887	-89.268245093523	OGLE
Elkhorn Creek				
350				
	start	41.8392614813286	-89.6956810578758	WHITESIDE
	end	42.0864514128748	-89.636841111792	OGLE
Franklin Creek				
303				
	start	41.8885909580789	-89.4120344682789	OGLE
	end	41.830393186845	-89.3092915487959	LEE
Goose Creek				
356				
	start	41.9282951879448	-89.692114617634	WHITESIDE
	end	41.9476422569681	-89.6849104470831	OGLE
Green River				
359				
	start	41.6266589513433	-89.5688644755145	LEE
	end	41.8177589430141	-89.1263088319088	LEE
Kilbuck Creek				
312				
	start	42.1838622639314	-89.1301689015062	WINNEBAGO
	end	41.9181917577798	-88.9212387567239	DEKALB
Kingsbury Creek				
311				

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
	start	42.1077794424363	-88.8726630666396	DEKALB
	end	42.1579325310556	-88.8548684690422	BOONE
Kishwaukee River				
318				
	start	42.1866384939252	-89.1320796977525	WINNEBAGO
	end	42.2666635150817	-88.5250450377336	MCHENRY
Kyte River				
295				
	start	41.9881250432719	-89.3232327202272	OGLE
	end	41.9206998470585	-89.0576692414087	OGLE
Leaf River				
345				
	start	42.093677393629	-89.3249228482157	OGLE
	end	42.1545774626081	-89.5725820219443	OGLE
Lost Creek				
368				
	start	42.245723132043	-89.7807765552299	STEPHENSON
	end	42.2314500223394	-89.7709518073782	STEPHENSON
Middle Creek				
344				
	start	42.1559584011258	-89.2911997709031	OGLE
	end	42.1737499306461	-89.2931763612625	OGLE
Mill Creek				
342				
	start	42.1206847838382	-89.2792143996076	OGLE
	end	42.2092574596508	-89.3358557551327	WINNEBAGO
Mosquito Creek				
323				
	start	42.3066628798583	-88.9047855300292	BOONE
	end	42.3100003482313	-88.9099328193755	BOONE
327				
	start	42.246521748985	-88.7802719043895	BOONE
	end	42.1906300595167	-88.7849304281662	BOONE
Mud Creek				
325				
	start	42.2592878387497	-88.7503449689069	BOONE
	end	42.2805097009077	-88.7381130663589	BOONE
346				
	start	42.1301628959448	-89.4043328758949	OGLE
	end	42.1639762007661	-89.4554911246235	OGLE
North Branch Kishwaukee River				
320				
	start	42.2655855837644	-88.5514660318739	MCHENRY
	end	42.4163330454161	-88.5232715616737	MCHENRY
North Branch Otter Creek				
292				
	start	42.4412940471901	-89.3074016078782	WINNEBAGO
	end	42.4570625094589	-89.356265092275	WINNEBAGO
North Fork Kent Creek				
333				
	start	42.2621663352674	-89.0944316410734	WINNEBAGO
	end	42.310438304708	-89.1651357273603	WINNEBAGO
Otter Creek				

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
291				
	start	42.4565457866811	-89.2410171137247	WINNEBAGO
	end	42.4412940471901	-89.3074016078782	WINNEBAGO
348				
	start	42.1345277930786	-89.411492883497	OGLE
	end	42.1911608097275	-89.4222625773931	OGLE
Owens Creek				
310				
	start	42.1012605056104	-88.8850996053184	DEKALB
	end	41.994362186304	-88.8506687869106	DEKALB
Pine Creek				
305				
	start	41.9113031895505	-89.452879176459	OGLE
	end	42.0376146514025	-89.4909007464322	OGLE
Piscasaw Creek				
324				
	start	42.2618063936707	-88.8176068924198	BOONE
	end	42.3916885547221	-88.7041339551642	MCHENRY
Raccoon Creek				
328				
	start	42.4479288873423	-89.098286193015	WINNEBAGO
	end	42.4829761640917	-89.1400856130022	WINNEBAGO
Reid Creek				
353				
	start	41.8644109921615	-89.5919014348703	LEE
	end	41.9135187969506	-89.5728723309406	OGLE
Richland Creek				
336				
	start	42.3456275295301	-89.6832413426115	STEPHENSON
	end	42.5047442687577	-89.6477619118761	STEPHENSON
Rock River				
294				
	start	41.9881250432719	-89.3232327202272	OGLE
	end	42.4962174640048	-89.0418910839077	WINNEBAGO
Rock Run				
490				
	start	42.3211872463585	-89.4237342452712	STEPHENSON
	end	42.4281098959774	-89.4483616268915	STEPHENSON
Rush Creek				
321				
	start	42.2560676137827	-88.7031592940742	MCHENRY
	end	42.4031741332744	-88.5930626223964	MCHENRY
Silver Creek				
338				
	start	42.0611717976691	-89.335901928201	OGLE
	end	42.0866765435436	-89.3839889015445	OGLE
Skunk Creek				
354				
	start	41.8794703976699	-89.7072621672884	WHITESIDE
	end	41.897582187238	-89.7290746844729	WHITESIDE
South Branch Kishwaukee River				
308				
	start	42.2001609257306	-88.9840657029051	WINNEBAGO

end	41.9015798699947	-88.7706697182685	DEKALB

315

start	42.2627093767756	-88.5609522875415	MCHENRY
end	42.1066209842679	-88.4620443477841	KANE

South Branch of Otter Creek

280

start	42.4412940471901	-89.3074016078782	WINNEBAGO
end	42.4343122756071	-89.3600650183381	WINNEBAGO

South Fork of Leaf River

347

start	42.1296104494647	-89.4546456401589	OGLE
end	42.1085718337046	-89.5037134270228	OGLE

South Kinnikinnick Creek

330

start	42.419961259532	-89.018119476068	WINNEBAGO
end	42.4190921988888	-88.8710507717794	BOONE

Spring Creek

339

start	42.0709215390383	-89.325546679708	OGLE
end	42.0590157098796	-89.3110803788049	OGLE

Spring Run

313

start	42.0402370001041	-89.0065478421579	OGLE
end	42.0507770466662	-88.9858854279893	OGLE

Steward Creek

297

start	41.8903673258897	-89.1021064698423	OGLE
end	41.8259979751563	-88.9624738458404	LEE

Stillman Creek

340

start	42.1259475370515	-89.2319193482332	OGLE
end	42.0372051268587	-89.1542573242497	OGLE

Sugar Creek

352

start	41.8392614813286	-89.6956810578758	WHITESIDE
end	41.8644109921615	-89.5919014348703	LEE

Sugar River

293

start	42.4357992567436	-89.1971727593158	WINNEBAGO
end	42.4982890047043	-89.2624235677856	WINNEBAGO

Sumner Creek

334

start	42.3227762010459	-89.3830042631004	WINNEBAGO
end	42.25195988987	-89.3997975146614	STEPHENSON

Turtle Creek

329

start	42.4929910323531	-89.0439958173493	WINNEBAGO
end	42.4961371053418	-89.0246519221989	WINNEBAGO

Unnamed Tributary

361

start	41.6608316904842	-89.4728200038511	LEE
end	41.6425311558513	-89.4137140926471	LEE

365

BASIN NAME			
Segment Name			
Segment No.			
End Points	Latitude	Longitude	COUNTY
start	41.7443681625006	-89.168951821186	LEE
end	41.738182745458	-89.1042187039322	LEE
492			
start	42.1246069284208	-88.5882544654343	DEKALB
end	42.1028295788327	-88.5105326912596	KANE
Unnamed Tributary of Buffalo Creek			
357			
start	41.9332348110612	-89.6342816030603	OGLE
end	41.93890647032	-89.6092042883405	OGLE
Unnamed Tributary of Coon Creek			
282			
start	42.1336677087989	-88.6039205825106	DEKALB
end	42.0754334787177	-88.5442273447775	KANE
491			
start	42.150113155436	-88.6091713292612	DEKALB
end	42.1691790844289	-88.5070973943593	MCHENRY
Unnamed Tributary of Elkhorn Creek			
355			
start	41.9378871254405	-89.7318712136894	CARROLL
end	41.9525180771018	-89.7332762139612	CARROLL
Unnamed Tributary of Green River			
360			
start	41.8177589430141	-89.1263088319088	LEE
end	41.8012094828667	-89.0296681468724	LEE
362			
start	41.66455888603	-89.4729486542104	LEE
end	41.650155479351	-89.4398464027055	LEE
364			
start	41.750735979575	-89.2189268880904	LEE
end	41.7278383993539	-89.1577958588247	LEE
366			
start	41.7304138832457	-89.2547363744761	LEE
end	41.7421804770435	-89.2683034846455	LEE
367			
start	41.7336722733557	-89.2459381167869	LEE
end	41.6996843512729	-89.2025409068097	LEE
489			
start	41.7765356433433	-89.1781811586274	LEE
end	41.791148742648	-89.1782543204659	LEE
Unnamed Tributary of Kyte River			
298			
start	41.969037423435	-89.2727932207785	OGLE
end	41.9423468128644	-89.2676252361535	OGLE
299			
start	41.9474122868214	-89.1742920304606	OGLE
end	41.9511979792854	-89.1378721025283	OGLE
Unnamed Tributary of North Branch Kishwaukee River			
319			
start	42.4163330454161	-88.5232715616737	MCHENRY
end	42.4218523642031	-88.5063783493938	MCHENRY
Unnamed Tributary of Rock River			
331			
start	42.3730089457359	-89.0581319432428	WINNEBAGO

end	42.382841503485	-89.0950184603254	WINNEBAGO

Unnamed Tributary of South Branch Kishwaukee River

309

start	42.1219922946716	-88.9236557341498	DEKALB
end	42.1138208388943	-88.9372243118963	DEKALB

316

start	42.1565644453666	-88.4449935784875	MCHENRY
end	42.1594149792506	-88.4178533576301	MCHENRY

317

start	42.234010247227	-88.5199093723576	MCHENRY
end	42.2225793216803	-88.5259266256801	MCHENRY

Unnamed Tributary of Spring Run

314

start	42.0401565844742	-88.9948863767949	OGLE
end	42.0116835703089	-88.9710672286801	OGLE

Unnamed Tributary of Steward Creek

296

start	41.8444592840822	-89.0070046248547	LEE
end	41.8601589546913	-88.9714244440014	LEE

300

start	41.871719116543	-89.069434926448	LEE
end	41.8792477545579	-89.037635229652	LEE

Unnamed Tributary of Yellow Creek

369

start	42.3067615221991	-89.8535571166391	STEPHENSON
end	42.3493669268537	-89.8275355259147	STEPHENSON

West Fork Elkhorn Creek

351

start	42.0864514128748	-89.636841111792	OGLE
end	42.0924853439498	-89.6474944357754	OGLE

Willow Creek

363

start	41.7653209616214	-89.1943294683724	LEE
end	41.7141851660088	-89.032161004274	LEE

Yellow Creek

370

start	42.2899156684427	-89.5696276563017	STEPHENSON
end	42.3796215769162	-89.9350879560031	JO DAVIESS

Wabash

Bean Creek

437

start	40.2950579779894	-87.7823902126108	VERMILION
end	40.3344744135429	-87.7494458762005	VERMILION

Big Creek

457

start	39.3351439545995	-87.5878012286214	CLARK
start	39.436126036547	-87.7023848396263	CLARK

Bluegrass Creek

436

start	40.301292752824	-87.7969361668719	VERMILION
end	40.381268589802	-87.8562389558508	VERMILION

Brouilletts Creek

BASIN NAME

Segment Name

Segment No.

End Points	Latitude	Longitude	COUNTY
450			
start	39.7057649552945	-87.5509615193818	EDGAR
end	39.797449971524	-87.7178559181463	EDGAR
Brush Creek			
468			
start	38.993072718826	-88.1273817532169	JASPER
end	38.9675510537677	-88.1471375817992	JASPER
Brushy Fork			
484			
start	39.7161188745587	-88.0853294840712	DOUGLAS
end	39.8111289403664	-87.8839288887749	EDGAR
Buck Creek			
435			
start	40.3115126234324	-87.9255710854089	VERMILION
end	40.2862675329103	-87.9704593374522	CHAMPAIGN
Cassell Creek			
473			
start	39.4866434423672	-88.2094970436354	COLES
end	39.4909698054293	-88.207848854172	COLES
Catfish Creek			
477			
start	39.680891264864	-87.9341744320393	EDGAR
end	39.6581354970801	-87.8937116601235	EDGAR
Clark Branch			
483			
start	39.8111289403664	-87.8839288887749	EDGAR
end	39.8226610039489	-87.8513747624001	EDGAR
Collison Branch			
439			
start	40.2351860050982	-87.7725365689525	VERMILION
end	40.2197161120333	-87.803155121171	VERMILION
Cottonwood Creek			
469			
start	39.2033657707304	-88.2765033266093	CUMBERLAND
end	39.3142137713574	-88.229342077034	CUMBERLAND
Crabapple Creek			
452			
start	39.7057649552945	-87.5509615193818	EDGAR
end	39.8065708276187	-87.6467768455628	EDGAR
Crooked Creek			
465			
start	38.9817031629594	-88.066438923761	JASPER
end	39.0356467346919	-88.0923368283887	JASPER
Deer Creek			
485			
start	39.7053403128076	-88.0850387247647	DOUGLAS
end	39.7025679945443	-88.2058470030399	DOUGLAS
Donica Creek			
479			
start	39.6453315324326	-87.9892294370803	COLES
end	39.6172623271272	-87.9782640861296	COLES
Dudley Branch			
475			

End Points	Latitude	Longitude	COUNTY
start	39.5115642227627	-88.0564563693231	COLES
end	39.5068188298145	-88.043669581567	COLES

East Crooked Creek

287

End Points	Latitude	Longitude	COUNTY
start	39.0356467346919	-88.0923368283887	JASPER
end	39.1659729856615	-88.0610310241876	JASPER

East Fork Big Creek

458

End Points	Latitude	Longitude	COUNTY
start	39.436126036547	-87.7023848396263	CLARK
end	39.5471103780713	-87.760040304497	EDGAR

Embarras River

460

End Points	Latitude	Longitude	COUNTY
start	38.9148628762488	-87.9834798036322	JASPER
end	39.7161188745587	-88.0853294840712	DOUGLAS

Feather Creek

432

End Points	Latitude	Longitude	COUNTY
start	40.1172818042134	-87.8342855159987	VERMILION
end	40.1416543211304	-87.8399367268356	VERMILION

Greasy Creek

480

End Points	Latitude	Longitude	COUNTY
start	39.6325904592965	-88.0822649850404	COLES
end	39.6182255297223	-88.1320998047424	COLES

Hickory Creek

464

End Points	Latitude	Longitude	COUNTY
start	38.9714278418083	-87.972721454297	JASPER
end	38.99191464315	-87.989292523907	JASPER

Hickory Grove Creek

478

End Points	Latitude	Longitude	COUNTY
start	39.6581354970801	-87.8937116601235	EDGAR
end	39.5712873627184	-87.8825676201308	EDGAR

Hurricane Creek

470

End Points	Latitude	Longitude	COUNTY
start	39.2889007816578	-88.1544749600653	CUMBERLAND
end	39.3793118297358	-88.0668208708762	COLES

Jordan Creek

433

End Points	Latitude	Longitude	COUNTY
start	40.0794151192358	-87.7990673709556	VERMILION
end	40.0588834821927	-87.8360461636444	VERMILION

443

End Points	Latitude	Longitude	COUNTY
start	40.3360527696651	-87.6231745570584	VERMILION
end	40.3553265493525	-87.5278198412106	VERMILION

Kickapoo Creek

471

End Points	Latitude	Longitude	COUNTY
start	39.4379695819539	-88.1681483569976	COLES
end	39.4597583113682	-88.2917593820249	COLES

Knights Branch

438

End Points	Latitude	Longitude	COUNTY
start	40.2763499940372	-87.7961879249888	VERMILION
end	40.2520446574291	-87.8336356533235	VERMILION

Little Embarras River

476

End Points	Latitude	Longitude	COUNTY
start	39.5736361588448	-88.0726889440362	COLES
end	39.6808912648 64	-87.9341744320393	EDGAR

BASIN NAME

Segment Name

Segment No.

End Points	Latitude	Longitude	COUNTY
Little Vermilion River			
426			
start	39.9463345271443	-87.5536756201362	VERMILION
end	39.9593741043792	-87.6447473681732	VERMILION
Middle Branch			
442			
start	40.3096675860339	-87.6376716065503	VERMILION
end	40.417753327133	-87.5275419211693	VERMILION
Middle Fork Vermilion River			
428			
start	40.1035656386662	-87.7169902321166	VERMILION
end	40.4043343147541	-88.0191381621282	FORD
Mill Creek			
487			
start	39.2394256838229	-87.6762126527038	CLARK
end	39.3566749194214	-87.7425049309309	CLARK
Muddy Creek			
242			
start	39.1821395682335	-88.2309155529877	CUMBERLAND
end	39.2033657707304	-88.2765033266093	CUMBERLAND
North Fork of Embarras River			
461			
start	38.9148628762488	-87.9834798036322	JASPER
end	39.0924749553725	-87.9784039128617	JASPER
North Fork Vermilion River			
441			
start	40.236054881277	-87.6293326109766	VERMILION
end	40.5010729612407	-87.5261721834388	IROQUOIS
Panther Creek			
462			
start	39.0924749553725	-87.9784039128617	JASPER
end	39.184289386946	-88.0087906828419	CUMBERLAND
Polecat Creek			
474			
start	39.5013303165832	-88.1055006912296	COLES
end	39.5162859310237	-88.0338496162262	COLES
Riley Creek			
472			
start	39.4712869216685	-88.2108945161318	COLES
end	39.5116227820733	-88.2569469311765	COLES
Salt Fork			
429			
start	40.1035656386662	-87.7169902321166	VERMILION
end	40.0368232483006	-88.0746580039075	CHAMPAIGN
455			
start	39.7425080214619	-87.572919448772	EDGAR
end	39.8018493662144	-87.5775868051385	EDGAR
Snake Creek			
454			
start	39.7128111863363	-87.6415954465778	EDGAR
end	39.7066978623237	-87.6543043306751	EDGAR
South Fork Brouilletts Creek			
453			

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
	start	39.7256495590209	-87.6437626049444	EDGAR
	end	39.7319449005729	-87.6951881181821	EDGAR

Stony Creek

431

	start	40.0943454186494	-87.8170769835194	VERMILION
	end	40.1548847864725	-87.8840063394108	VERMILION

Sugar Creek

456

	start	39.4838820536199	-87.5320762217325	EDGAR
	end	39.6298164781408	-87.6762882912482	EDGAR

Unnamed Tributary of Big Creek

459

	start	39.5047911835054	-87.7121475341945	EDGAR
	end	39.5692784693864	-87.7194139533441	EDGAR

Unnamed Tributary of Brouilletts Creek

451

	start	39.797449971524	-87.7178559181463	EDGAR
	end	39.831592697221	-87.7758036967074	EDGAR

Unnamed Tributary of Brushy Fork

482

	start	39.7340344129883	-88.0771406153965	DOUGLAS
	end	39.802586616189	-88.0753634663247	DOUGLAS

Unnamed Tributary of Deer Creek

486

	start	39.7102184848625	-88.1385435180688	DOUGLAS
	end	39.678866903649	-88.1425332064637	DOUGLAS

Unnamed Tributary of Embarras River

467

	start	38.9934159067144	-88.129258689394	JASPER
	end	39.0034725453128	-88.1210073578163	JASPER

Unnamed Tributary of Greasy Creek

481

	start	39.6182255297223	-88.1320998047424	COLES
	end	39.621059195964	-88.1538483534688	COLES

Unnamed Tributary of Hickory Creek

210

	start	38.99191464315	-87.989292523907	JASPER
	end	39.0117394234421	-87.9896104862878	JASPER

Unnamed Tributary of Middle Fork Vermilion River

434

	start	40.3478602982847	-87.9479087836067	CHAMPAIGN
	end	40.3408935605508	-87.9885982351498	CHAMPAIGN

Unnamed Tributary of Stony Creek

430

	start	40.1548847864725	-87.8840063394108	VERMILION
	end	40.1706704853124	-87.9033972187304	VERMILION

Unnamed Tributary or North Fork of the Vermilion River

444

	start	40.3553498759616	-87.6852979017427	VERMILION
	end	40.3665727663496	-87.733231992072	VERMILION

445

	start	40.483638183168	-87.5751075709757	VERMILION
	end	40.4930209841439	-87.5771391859822	IROQUOIS

BASIN NAME

Segment Name

Segment No.

End Points		Latitude	Longitude	COUNTY
446				
	start	40.423223711311	-87.6788932053507	VERMILION
	end	40.4280461995299	-87.6895565256772	VERMILION
Vermilion River				
427				
	start	40.0116868805566	-87.5337540394346	VERMILION
	end	40.1035656386662	-87.7169902321166	VERMILION
Wabash River				
488				
	end	39.3034266238732	-87.605592332246	CLARK
West Crooked Creek				
466				
	start	39.0356467346919	-88.0923368283887	JASPER
	end	39.0545759701349	-88.1009871944535	JASPER
West Fork Big Creek				
19				
	start	39.436126036547	-87.7023848396263	CLARK
	end	39.5012337820195	-87.8003199656505	EDGAR
Willow Creek				
463				
	start	39.0191952007294	-87.9402449982878	CRAWFORD
	end	39.0529145507759	-87.9280073176635	CRAWFORD

Recommended Revisions to the

Illinois General Use Water-Quality Standard for Dissolved Oxygen

March 31, 2006

by

Illinois Department of Natural Resources

and

Illinois Environmental Protection Agency

Overview of recommended revisions to the Illinois water-quality standard for dissolved oxygen

In April 2004, the Illinois Association of Wastewater Agencies proposed revisions to the General Use water-quality standard for dissolved oxygen (In the matter of: Proposed Amendments to Dissolved Oxygen Standard, 35 Ill. Adm. Code 302.206, R-04-25). In response to this proposal, the Illinois Department of Natural Resources (Illinois DNR) and the Illinois Environmental Protection Agency (Illinois EPA) recommend alternative revisions of the dissolved oxygen standard. Illinois DNR and Illinois EPA believe that the current standard for Illinois General Use waters is too simplistic; it inadequately accounts for the varied dissolved oxygen requirements of aquatic life in these waters. The current standard also inadequately accounts for how dissolved oxygen concentrations vary across a broad range of natural aquatic conditions throughout Illinois.

To replace the current General Use dissolved oxygen standard, Illinois DNR and Illinois EPA recommend two levels of standards, each level applying to one of two sets of waters in Illinois. One level applies to the large majority of General Use waters and is designed to ensure sufficient oxygen concentrations for the aquatic life therein. Another higher level of standards applies to a small, selected subset of General Use waters; these thresholds are designed to protect Illinois' most sensitive types and life stages of aquatic life that require relatively higher dissolved oxygen concentrations. Illinois DNR and Illinois EPA identify about 8% of the length of Illinois' 71,394 stream miles as requiring these higher dissolved oxygen levels (based on stream miles in the U.S. Geological Survey National Hydrography Dataset; see internet website: *//nhd.usgs.gov/*). The recommended numeric standards for each of these two sets of General Use waters are based primarily on the U.S. Environmental Protection Agency (USEPA) national-criteria document, "Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater)" (USEPA 1986). Illinois DNR and Illinois EPA use this document as a foundation from which to interpret and incorporate more-recent information specifically applicable to the dissolved oxygen needs of aquatic life in Illinois waters.

The revisions to the current dissolved oxygen standard proposed by the Illinois Association of Wastewater Agencies (IAWA) are also based on the USEPA (1986) national-criteria document; however, Illinois DNR's and Illinois EPA's recommended revisions differ from those of IAWA in the following primary ways (Figure 1):

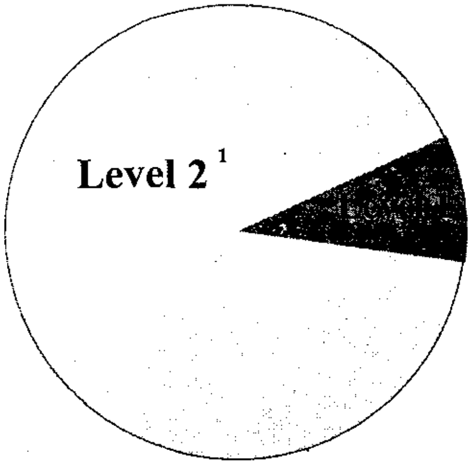
1) Illinois DNR and Illinois EPA define two levels of numeric standards, with a higher level that provides enhanced protection in waters that have organisms especially sensitive to low dissolved oxygen levels. IAWA's proposed revisions make no such distinction.

2) Illinois DNR and Illinois EPA provide a narrative standard for waters that naturally cannot achieve consistently higher levels of dissolved oxygen, e.g., wetlands, sloughs, river backwaters, and lakes and reservoirs below the thermocline. IAWA's proposed dissolved oxygen standards apply universally to all General Use waters (In the matter of: Proposed Amendments to Dissolved Oxygen Standard, 35 Ill. Adm. Code 302.206, R-04-25, Exhibit 1, April 19, 2004).

3) Illinois DNR and Illinois EPA recommend a longer period for the protection of early life stages of fish: March through July. IAWA's early-life-stage period is March through June.

4) Consistent with USEPA (1986), Illinois DNR and Illinois EPA include a 30-day chronic dissolved oxygen standard, i.e., daily mean averaged over 30 days. IAWA does not include a 30-day chronic standard.

Dissolved Oxygen Standards Recommended by Illinois DNR/EPA



General Use Waters

	Level 1 (enhanced protection) Early Life Stages of Fish: Present (March – July)	Level 1 (enhanced protection) Early Life Stages of Fish: Absent (August – Feb.)	Level 2 Early Life Stages of Fish: Present (March – July)	Level 2 Early Life Stages of Fish: Absent (August – Feb.)
Daily Minimum	5.0	4.0	5.0	3.5
7-day Mean of Daily Minima		4.5		4.0
7-day Mean of Daily Means	6.25		6.0	
30-day Mean of Daily Means		6.0		5.5

[1] Wetlands, sloughs, river backwaters, lakes below thermocline, etc. are protected by a narrative standard.

Dissolved Oxygen Standards Proposed by IAWA

	Early Life Stages of Fish: Present (March – June)	Early Life Stages of Fish: Absent (July – Feb.)
Daily Minimum	5.0	3.5
7-day Mean of Daily Minima		4.0
7-day Mean of Daily Means	6.0	
30-day Mean of Daily Means		—

Figure 1. Comparison between dissolved oxygen standards recommended by Illinois DNR/Illinois EPA and those proposed by IAWA.

USEPA's water-quality criteria for dissolved oxygen provide a sound, scientific foundation

Illinois DNR and Illinois EPA primarily base the recommended revisions to dissolved oxygen standards on information in USEPA (1986), which provides a sound, scientifically based foundation. The USEPA (1986) criteria for dissolved oxygen address three critical elements not addressed by the current Illinois standard. First, the USEPA criteria account for differences in sensitivity to low dissolved oxygen among types of fishes or macroinvertebrates. Second, the USEPA criteria account for differences in sensitivity among life stages of fish. Third, the USEPA criteria provide practical considerations that account for occasional natural occurrences of low dissolved oxygen. Incorporation of these elements greatly improves the utility of the Illinois standards.

Illinois DNR and Illinois EPA recognize some limitations in using the information in USEPA (1986) to revise Illinois dissolved oxygen standards; therefore, these recommended standards revisions are supported further by more-recent information that pertains specifically to aquatic life in Illinois waters. In general, to determine how the USEPA (1986) criteria apply in Illinois, Illinois DNR and Illinois EPA address two primary questions:

1) Are the USEPA (1986) dissolved oxygen criteria sufficient for protecting the most sensitive (to low dissolved oxygen) of the numerous types and life stages of fish and macroinvertebrates that live in Illinois waters?

2) If not, then what alternative dissolved oxygen criteria would ensure sufficient protection and in which Illinois waters should these higher criteria apply?

How the basic structure of USEPA criteria for dissolved oxygen applies to Illinois dissolved oxygen standards

USEPA (1986) accounts for differences in dissolved oxygen sensitivity among types of fish or macroinvertebrates by providing two different levels of dissolved oxygen criteria, labeled as: "coldwater" vs. "warmwater". USEPA (1986) states, "*Criteria for coldwater fish are intended to apply to waters containing a population of one or more species in the family Salmonidae (Bailey et al. 1970) or to waters containing other coldwater or coolwater fish deemed by the user to be closer to salmonids in sensitivity than to most warmwater species... The warmwater criteria are necessary to protect early life stages of warmwater fish as sensitive as channel catfish and to protect other life stages of fish as sensitive as largemouth bass*" (p. 33; emphasis added). These limits on the applicability of USEPA's "warmwater" criteria provide the primary basis for much of the discussion that follows in this document. Additional to differences among species, USEPA (1986) accounts for differences in dissolved oxygen sensitivity based on a fish's life stage: early life stages vs. other. Overall, USEPA's (1986) approach results in four sets of dissolved oxygen criteria (Table 1, columns 4, 5, 8, and 9).

Based on the information available at the time, USEPA's four categories of dissolved oxygen criteria represented a practicable way of accounting for how different types and life stages of aquatic life were known to differ in their sensitivity to low dissolved oxygen. Illinois' current water-quality standard for dissolved oxygen was developed and adopted before 1986 (Illinois Pollution Control Board 1972); it does not account for these differences. Therefore, revising Illinois' current dissolved oxygen standard begins with evaluating how the USEPA (1986) criteria apply to Illinois waters. By carefully considering the strengths and limitations of USEPA's (1986) dissolved oxygen criteria, Illinois DNR and Illinois EPA believe that these nationally recommended criteria can be used as the basic framework for determining the most-appropriate standards for protecting aquatic life in Illinois. Illinois DNR and Illinois EPA build on this framework by incorporating information that has become available since 1986 and that pertains more directly to the many types of fish and macroinvertebrates that inhabit Illinois waters.

Recommended dissolved oxygen standards to protect aquatic life in Illinois

For the large majority of Illinois General Use waters (Level 2 in Figure 1), the dissolved oxygen standards recommended by Illinois DNR and Illinois EPA reflect the USEPA (1986) criteria (Table 1). For a small subset of General Use waters (Level 1 in Figure 1), Illinois DNR and Illinois EPA recommend the following. Based on the sensitivities of Illinois fishes and macroinvertebrates to low dissolved oxygen, Illinois DNR and Illinois EPA recommend a "daily minimum" (acute) dissolved oxygen standard of 4.0 mg/l to protect Illinois aquatic life that are most sensitive to low dissolved oxygen when early life stages of fish are absent (Table 1, column 7). This threshold concentration is based primarily on protecting the most-sensitive macroinvertebrates and is consistent with USEPA's (1986) recommendation. "*In summarizing* *the state of knowledge regarding the relative sensitivity of fish and invertebrates to low dissolved oxygen, it seems that some species of insects and other crustaceans are killed at concentrations survived by all species of fish tested. Thus, while most fish will survive exposure to 3 mg/l, many species of invertebrates are killed by concentrations as high as 4 mg/l*" (USEPA 1986, p. 23).

For the same small subset of General Use waters (Level 1 in Figure 1), Table 1 (columns 6 and 7) shows Illinois DNR's and Illinois EPA's recommendations for chronic dissolved oxygen standards. Using fish-species' relative chronic sensitivities (Rankin 2004) and some limited information for macroinvertebrates—but lacking specific information about chronic thresholds for the large majority of Illinois organisms—Illinois DNR and Illinois EPA recommend chronic standards that represent a practical balance. This balance primarily reflects that several Illinois fish species are intermediate in chronic sensitivity between sensitive salmonids (i.e., trout, salmon) and the two less sensitive species used as benchmarks for the USEPA (1986) "warmwater" criteria (i.e., largemouth bass, channel catfish). Consequently, Illinois DNR and Illinois EPA simply select dissolved oxygen concentrations halfway between the USEPA (1986) "coldwater" and "warmwater" chronic levels. For example, for the period when early life stages are absent, the USEPA "coldwater" threshold for the 7-day mean of daily minima is 5.0 mg/l, and the analogous "warmwater" threshold is 4.0 mg/l. Illinois DNR and Illinois EPA select the midpoint, 4.5 mg/l (Table 1, column 7), as the threshold for "intermediate" waters—which were selected based on the approach explained later in this document.

Table 1. Allowable minimum concentrations of dissolved oxygen for the protection of aquatic life. Thresholds shown are those recommended either by USEPA (1986) or jointly by Illinois DNR and Illinois EPA. Different minima apply for each of three types of aquatic habitat, based on the relative sensitivity to low dissolved oxygen of the animal life therein: "coldwater" vs. intermediate vs. "warmwater". For each type of habitat, minima are also stratified by time period, based on the presence of early life stages of fish. For particular situations not indicated in the table (e.g., manipulable discharges), alternative USEPA minima may apply (see USEPA [1986] pp. 34 and 37-38).

Dissolved Oxygen Measure	Type of Dissolved Oxygen Measure	Recom-mended By	Habitats of Organisms More Sensitive to Low Dissolved Oxygen ("Coldwater")		Illinois General Use Waters			
					Habitats of Organisms Intermediate in Sensitivity to Low Dissolved Oxygen		Habitats of Organisms Less Sensitive to Low Dissolved Oxygen ("Warmwater")	
			Early Life Stages of Fish:		Early Life Stages of Fish:		Early Life Stages of Fish:	
			Present	Absent	Present (March - July)	Absent (August - Feb.)	Present (March - July) [3]	Absent (August - Feb.)[3]
Daily Minimum [1]	acute	USEPA	5.0 mg/l	4.0 mg/l			5.0 mg/l	3.0 mg/l
		IDNR/ IEPA			5.0 mg/l	4.0 mg/l	5.0 mg/l	3.5 mg/l
Arithmetic Mean of Daily Minima, For a Contiguous 7-Day Period	chronic	USEPA		5.0 mg/l				4.0 mg/l
		IDNR/ IEPA				4.5 mg/l		4.0 mg/l
Arithmetic Mean of Daily Means [2], For a Contiguous 7-Day Period	chronic	USEPA	6.5 mg/l				6.0 mg/l	
		IDNR/ IEPA			6.25 mg/l		6.0 mg/l	
Arithmetic Mean of Daily Means [2], For a Contiguous 30-Day Period	chronic	USEPA		6.5 mg/l				5.5 mg/l
		IDNR/ IEPA				6.0 mg/l		5.5 mg/l
(column 1)	(column 2)	(column 3)	(column 4)	(column 5)	(column 6)	(column 7)	(column 8)	(column 9)

1 "Daily minimum" is the minimum dissolved oxygen concentration that occurs during a single calendar day.
2 "Daily mean" is the arithmetic mean of dissolved oxygen concentrations measured in a single calendar day.
3 These bounds are recommended by Illinois DNR and Illinois EPA only; USEPA (1986) does not provide specific bounds for the presence vs. absence of early life stages.

Different types of Illinois fish and macroinvertebrates require different dissolved oxygen standards

Differences in dissolved oxygen requirements among types of Illinois stream fish

Illinois DNR and Illinois EPA believe that although USEPA's "warmwater" dissolved oxygen criteria (Table 1, columns 8 and 9) are appropriate for the large majority of Illinois waters, they provide insufficient protection for several species of Illinois stream fish that inhabit a small but significant proportion of Illinois streams. Because USEPA (1986) "warmwater" criteria are based on information for only a few tested "warmwater" fish species, they are limited to being protective only of fishes as sensitive as channel catfish (early life stages) or largemouth bass (other life stages). For Illinois waters, this limitation must be addressed and accounted for.

Over 160 fish species are known to inhabit Illinois streams (Smith 1979; Illinois Natural History Survey internet website: *www.inhs.uiuc.edu/cbd/ilspecies/fishsplist.html*); for a large majority of these species, absolute sensitivity to low dissolved oxygen remains unknown. As explained below, some Illinois stream-fish species have sensitivity between "coldwater" species (e.g., trout, salmon) and the two species that represent the threshold of protection provided by USEPA's (1986) "warmwater" criteria. For example, smallmouth bass inhabit Illinois streams and have been noted by USEPA (1986) as one of the most sensitive of the non-salmonid species tested. Because some Illinois fishes have sensitivity between that of salmonids and that of largemouth bass or channel catfish, it is reasonable to expect that some Illinois waters inhabited by these "intermediate" species would require dissolved oxygen standards higher than the USEPA (1986) "warmwater" criteria but not as high as the "coldwater" criteria. USEPA (1986) clearly recognizes this potential need. "*Some coolwater species may require more protection than that afforded by the other life stage criteria for warmwater fish and it may be desirable to protect sensitive coolwater species with the coldwater criteria. Many states have more stringent dissolved oxygen standards for cooler waters, waters that contain either salmonids, nonsalmonid coolwater fish, or the sensitive centrarchid, the smallmouth bass*" (p. 33).

Illinois DNR and Illinois EPA identify 31 Illinois stream-fish species that require dissolved oxygen minima higher than the USEPA "warmwater" criteria (Table 2). This selection of sensitive fish species is based primarily on field-based rankings of species' sensitivities to low dissolved oxygen (Rankin 2004). Rankin (2004) used field data of about 90 fish species collected from hundreds of stream locations in Ohio to determine a relative ranking of sensitivity for each species. The rankings are based on relations between observed dissolved oxygen concentrations and the relative abundance of each fish species. These rankings provide useful "real-world" evidence of how the occurrence and abundance of fish at a site are related to dissolved oxygen concentrations. Because these relations are correlative, they do not provide absolute evidence that low dissolved oxygen caused low observed abundance. Nevertheless, considering the limited information available on specific sensitivities of each of Illinois' many stream-fish species, Illinois DNR and Illinois EPA believe that Rankin's (2004) results pertain especially well to Illinois because over 80 of the Ohio fish species also inhabit Illinois streams.

Rankin (2004) used weighted (by abundance) means of minimum dissolved oxygen concentrations to rank each fish species according to its relative sensitivity to low dissolved oxygen. For each species, the weighted mean represents the typical daylight minimum dissolved oxygen concentration where the species tends to be most abundant. Rankin cautions against using these numeric values directly; rather, he advises that the relative rankings of the fish species are much more useful (personal communication on January 31, 2006 between Edward T. Rankin, Senior Research Associate, Center for Applied Bioassessment and Biocriteria, Columbus, Ohio; and Roy Smogor, Illinois Environmental Protection Agency, Springfield, Illinois). Using the relative dissolved oxygen sensitivities in Rankin (2004), Illinois DNR and Illinois EPA selected rock bass as a benchmark species. Namely, all species ranked as equally or more sensitive than rock bass were considered as candidates for a list of Illinois fish species that are more sensitive to low dissolved oxygen than channel catfish and largemouth bass and thus require dissolved oxygen minima higher than the USEPA (1986) "warmwater" criteria. Rankin (2004) indicates that rock bass are more sensitive to low dissolved oxygen than both channel catfish and largemouth bass. Illinois DNR fisheries biologists selected rock bass as the benchmark species because of its affinity to transitional warm/cool waters.

Of 35 Illinois candidate species indicated in Rankin (2004) as equally or more sensitive than rock bass, eleven were not selected for the list of Illinois sensitive species. Based on their experience with these fishes in Illinois streams, Illinois DNR fisheries biologists believe that these excluded species are not especially sensitive to low dissolved oxygen, relative to the other species considered.

One species (i.e., brook stickleback) indicated in Rankin (2004) as less sensitive than rock bass, is included in the list of sensitive Illinois fishes. Additionally, five species not addressed in

Rankin (2004) (i.e., northern brook lamprey, banded sculpin, longnose dace, Ozark minnow, and Iowa darter) were added to the list of sensitive fish species in Illinois. These six species are included based on their affinities to cool, well-oxygenated waters. USEPA (1986) acknowledges that "*there is apparently enough anecdotal information to suggest that many coolwater species are more sensitive to dissolved oxygen depletion than are warmwater species*" (p. 2) and therefore need incrementally higher protection for dissolved oxygen.

Table 2. Illinois stream fishes most sensitive to low dissolved oxygen.

Common Name	Scientific Name	Family
American brook lamprey	*Lampetra appendix*	Petromyzontidae
Northern brook lamprey	*Ichthyomyzon fossor*	Petromyzontidae
Black redhorse	*Moxostoma duquesnei*	Catostomidae
Northern hog sucker	*Hypentelium nigricans*	Catostomidae
Silver redhorse	*Moxostoma anisurum*	Catostomidae
Rock bass	*Ambloplites rupestris*	Centrarchidae
Smallmouth bass	*Micropterus dolomieu*	Centrarchidae
Spotted bass	*Micropterus punctulatus*	Centrarchidae
Banded sculpin	*Cottus carolinae*	Cottidae
Mottled sculpin	*Cottus bairdi*	Cottidae
Bigeye chub	*Hybopsis amblops*	Cyprinidae
Bigmouth shiner	*Notropis dorsalis*	Cyprinidae
Blacknose dace	*Rhinichthys atratulus*	Cyprinidae
Common shiner	*Luxilius cornutus*	Cyprinidae
Gravel chub	*Erimystax x-punctatus*	Cyprinidae
Hornyhead chub	*Nocomis biguttatus*	Cyprinidae
Longnose dace	*Rhinichthys cataractae*	Cyprinidae
Ozark minnow	*Notropis nubilus*	Cyprinidae
River chub	*Nocomis micropogon*	Cyprinidae
Rosyface shiner	*Notropis rubellus*	Cyprinidae
Southern redbelly dace	*Phoxinus erythrogaster*	Cyprinidae
Steelcolor shiner	*Cyprinella whipplei*	Cyprinidae
Brook stickleback	*Culaea inconstans*	Gasterosteidae
Brindled madtom	*Noturus miurus*	Ictaluridae
Stonecat	*Noturus flavus*	Ictaluridae
Banded darter	*Etheostoma zonale*	Percidae
Fantail darter	*Etheostoma flabellare*	Percidae
Greenside darter	*Etheostoma blennioides*	Percidae
Iowa darter	*Etheostoma exile*	Percidae
Rainbow darter	*Etheostoma caeruleum*	Percidae
Slenderhead darter	*Percina phoxocephala*	Percidae

Differences in dissolved oxygen requirements among types of Illinois stream macroinvertebrates (e.g., insects, crayfish, worms, snails, mussels)

Similar to the situation for Illinois fishes, although USEPA's (1986) "warmwater" dissolved oxygen criteria are appropriate for the large majority of Illinois waters, they provide insufficient protection for several types of aquatic macroinvertebrates that inhabit a small but significant proportion of Illinois streams. In developing their criteria, USEPA (1986) relied primarily on only two studies of relatively few types of insects from streams in Montana, Utah, and Minnesota. A recent summary of the scientific literature on the sensitivity of stream macroinvertbrates to low dissolved oxygen indicates that specific information remains very limited (Connolly et al. 2004). This relative lack of information is surprising given the longstanding, widespread recognition of macroinvertebrates as useful indicators of deleterious human impacts on dissolved oxygen levels in surface waters (Connolly et al. 2004). Recognizing these limitations, USEPA (1986) qualified their recommendations accordingly. "*Few appropriate data are available on the effects of reduced dissolved oxygen on freshwater invertebrates. However, historical consensus states that, if all life stages of fish are protected, the invertebrate communities, although not necessarily unchanged, should be adequately protected. This is a generalization to which there may be exceptions of environmental significance. Acutely lethal concentrations of dissolved oxygen appear to be higher for many aquatic insects than for fish*" (USEPA 1986, p. 29).

Despite the predominance of fish-based thresholds in the USEPA (1986) dissolved oxygen criteria, one part of these criteria clearly recognizes greater sensitivity of some macroinvertebrates compared to fish. Namely, the "coldwater" daily minimum is designed specifically to protect sensitive macroinvertebrates (4.0 mg/l; Table 1, column 5). "*Although the acute lethal limit for salmonids is at or below 3 mg/l, the coldwater minimum has been established at 4 mg/l because a significant proportion of the insect species common to salmonid habitats are less tolerant of acute exposures to low dissolved oxygen than are salmonids*" (USEPA 1986, p. 33). As explained below, some Illinois macroinvertebrates are as sensitive to low dissolved oxygen as those on which this USEPA (1986) "coldwater" threshold was based; therefore, a daily minimum of 4.0 mg/l is appropriate for Illinois waters inhabited by these types.

Illinois DNR and Illinois EPA considered various information on the dissolved oxygen sensitivities of Illinois stream macroinvertebrates. A "macroinvertebrate" is defined as any invertebrate of a body size that would prevent it from passing through a sieve with mesh size of 595 μm (i.e., U.S. Standard No.30). Typical Illinois stream macroinvertebrates include insects, crayfish, scuds, sowbugs, worms, leeches, flatworms, snails, and mussels. Mussels are addressed separately later in this document.

Illinois DNR and Illinois EPA used the Illinois EPA Macroinvertebrate Tolerance List to determine relative sensitivity, to low dissolved oxygen, of Illinois stream macroinvertebrates (excluding mussels). This tolerance list reflects a long history of working with macroinvertebrates in Illinois to evaluate the effects and extent of organic pollution. The Illinois Department of Public Health began classifying macroinvertebrates found in Illinois streams relative to their tolerance to organic wastes in the 1950s. Macroinvertebrates were placed in one of three categories: tolerant, various, or intolerant, based on the stream conditions where they occurred. The composition of the macroinvertebrate community was then used to determine whether or not a water was polluted. Macroinvertebrates classified as intolerant were considered to require "*...ideal conditions in respect to dissolved oxygen, biochemical oxygen demand...*" (p. 1 in "A Method of Cataloging Stream Bottom Organisms in Respect to Their Pollutional Tolerance" by Robert H. Shiffman, Illinois Department of Public Health, 1954). Weber (1973) went on to define intolerant macroinvertebrates as, *"Organisms that are not found in association with even moderate levels of organic contaminants and are generally intolerant of even moderate reductions in dissolved oxygen"* (p. 18). In Wisconsin, Hilsenhoff (1977) began assigning numeric values of tolerance to organic pollution to macroinvertebrates. A "biotic index" was then calculated reflecting the weighted average of tolerance values at a stream site. Hilsenhoff (1977) found that of nine physicochemical variables tested, dissolved oxygen had the most significant correlation with the macroinvertebrate biotic index that was based on tolerance values.

The Illinois EPA Macroinvertebrate Tolerance List currently reflects the system utilized by Hilsenhoff. Pollution tolerance ratings of macroinvertebrates on the list range from 0 to 11; with a rating of zero assigned to taxa found only in unaltered streams of high water quality, and a rating of 11 assigned to taxa known to occur in severely polluted or disturbed streams. Intermediate ratings are assigned based on an organism's relative degree of tolerance or intolerance to pollution. Although information on the relative tolerance of an organism to other pollutants such as metals toxicity or pH are considered, organic pollution remains the foundation of the rating. The Illinois EPA Macroinvertebrate Tolerance List does not indicate acute or chronic toxicity, but does provide a relative ranking of macroinvertebrate sensitivity to primarily dissolved oxygen.

Some types of Illinois macroinvertebrates require dissolved oxygen minima higher than the "warmwater" criteria proposed by USEPA. USEPA (1986; Table 6, p. 22) includes three macroinvertebrate taxa found in Illinois that require 3.5 mg/l dissolved oxygen or higher to survive: *Baetisca laurentina, Hydropsyche* sp., and *Neophylax* sp. Additionally, Connolly et. al. (2004) found sub-lethal effects on mayflies (order Ephemeroptera) when dissolved oxygen was in the 25-35% saturation range, which translates to a dissolved oxygen concentration of about 3.0 mg/l at the temperatures studied. The sub-lethal effects were related to the failure of some mayflies to emerge into the adult stage; thus, dissolved oxygen concentrations that drop to 3.0 mg/l could potentially hamper the sustainability of mayfly populations. Based on this information, Illinois DNR and Illinois EPA believe that some Illinois macroinvertebrate taxa require higher dissolved oxygen minima than the USEPA "warmwater" criteria.

However, given the large number and variety of macroinvertebrates in Illinois and the limited references in the literature to specific dissolved oxygen requirements to specific taxa, identifying individual taxa that might require higher dissolved oxygen than the "warmwater" criteria is problematic. Consensus of Illinois EPA biologists was that macroinvertebrates with tolerance ratings less than or equal to 3.5 would require dissolved oxygen concentrations higher than the "warmwater" criteria (note the tolerance rating does not correspond to a dissolved oxygen concentration).

Illinois DNR and Illinois EPA identify 83 macroinvertebrate taxa that have tolerance ratings of 3.5 or less (Table 3). An initial list of dissolved oxygen sensitive taxa was generated by querying the Illinois EPA BIOS database for taxa with a tolerance equal to or less than 3.5. The initial screening list of sensitive macroinvertebrate taxa (n = 165) was distributed and reviewed by Illinois EPA biologists and Illinois DNR staff. Mussels (family Unionidae) were excluded from the initial list since they are collected sporadically and were being evaluated separately by Illinois DNR staff. Taxa identified at the family level were then eliminated as being too general, as were a few Dipteran taxa that had limited distributions and occurred primarily at degraded sites. The final list of taxa was based on those found in Illinois EPA macroinvertebrate samples collected from wadable streams between 2001 and 2004 (n = 399 samples). Table 3 shows the sensitive macroinvertebrate taxa that actually occurred in the samples used. This list does not represent all Illinois taxa with tolerance ratings of 3.5 or less; rather, it only includes the ones most likely to be collected during Illinois EPA's annual sampling period, June 1 through October 15. Some Illinois sensitive taxa are not well represented in the list, e.g., several stonefly taxa (order Plecoptera), because their life cycles do not correspond with the presence of life stages amenable to capture during late spring to early autumn.

Like other aquatic macroinvertebrates, mussel species vary in their sensitivity to dissolved oxygen. Based on the limited available scientific information, Illinois DNR identifies two species, the Rainbow (*Villosa iris*) and the Elephantear (*Elliptio crassidens*) as especially sensitive to low dissolved oxygen and thus requiring minima higher than the USEPA (1986) "warmwater" criteria. Two studies directly address dissolved oxygen sensitivity of these two species (Chen et al. 2001; Johnson et al. 2001). Chen et al. (2001) found that "*Villosa iris* [and one other species]..., *which generally live in well oxygenated stream and river riffles... exhibited the poorest ability to regulate OC* [oxygen consumption] *under conditions of low oxygen availability*" (p. 212). The authors also state, "*...for V. iris, DO* [dissolved oxygen] *should probably be higher than 6 mg* l^{-1} [mg/l] *to ensure that aerobic metabolism remains relatively unchanged*" (p. 214). Dissolved oxygen requirements of *Elliptio crassidens* were investigated by Johnson et al. (2001), who report that this mussel species had one of the highest mortality rates (82%) of the species studied when exposed to dissolved oxygen concentrations below 5 mg/l.

Table 3. Illinois macroinvertebrates most sensitive to low dissolved oxygen (i.e., tolerance rating ≤ 3.5) and occurring in Illinois EPA stream collections in 2001 through 2004. Mussels are excluded. The abbreviation "sp." means unspecified species.

Scientific Name	Tolerance Rating	Scientific Name (cont.)	Tolerance Rating (cont.)	Scientific Name (cont.)	Tolerance Rating (cont.)
Amphipoda		*Hetaerina* sp.	3	*Glossosoma* sp.	3.5
Gammarus sp.	3	*Hetaerina americana*	3	*Helicopsyche borealis*	2
Gammarus fasciatus	3	*Hetaerina titia*	3	*Hydroptila* sp.	2
Gammarus pseudolimnaeus	3	*Macromia* sp.	3	*Nectopsyche* sp.	3
		Macromia illinoiensis	3	*Nectopsyche candida*	3
Ephemeroptera (mayflies)		*Macromia taeniolata*	3	*Nectopsyche diarina*	3
Baetis tricaudatus	1	*Erpetogomphus* sp.	2	*Nectopsyche exquisita*	3
Baetisca bajkovi	3	*Nasiaeschna pentacantha*	2	*Neureclipsis* sp.	3
Baetisca sp.	3	*Neurocordulia* sp.	3	*Nyctiophylax* sp.	1
Brachycercus sp.	3	*Neurocordulia molesta*	3	*Polycentropus* sp.	3
Centroptilum sp.	2	*Ophiogomphus* sp.	2	*Ptilostomis* sp.	3
Choroterpes sp.	2	*Plauditus* sp.	3	*Pycnopsyche* sp.	3
Ephemera simulans	3	*Somatochlora* sp.	1	*Triaenodes* sp.	3
Ephoron sp.	2				
Ephoron album	2	Plecoptera (stoneflies)			
Ephoron leukon	2	*Acroneuria* sp.	1	Coleoptera (beetles)	
Heptagenia flavescens	2	*Neoperla* sp.	1	*Ancyronyx variegata*	2
Heptagenia hebe	3	*Pteronarcys* sp.	2	*Macronychus glabratus*	2
Heptagenia perfida	1				
Isonychia sp.	3	Megaloptera		Diptera (flies)	
Leucrocuta sp.	3	*Corydalus cornutus*	3	*Corynoneura* sp.	2
Leucrocuta hebe	3	*Nigronia* sp.	2	*Limonia* sp.	3
Leucrocuta maculipennis	3	*Nigronia serricornis*	2	*Meropelopia* sp.	3
Nixe sp.	3			*Nilothauma* sp.	3
Nixe perfida	1	Neuroptera		*Paratendipes* sp.	3
Paraleptophlebia sp.	2	*Sisyra* sp.	1	*Pentaneura* sp.	3
Stenonema ares	3			*Rheopelopia* sp.	3
Stenonema mediopunctatum	2	Trichoptera (caddisflies)		*Robackia* sp.	3
Stenonema pulchellum	3	*Agraylea* sp.	2	*Stempellina* sp.	2
		Brachycentrus numerosus	1	*Stempellinella* sp.	2
Odonata (dragon/damsel)		*Ceraclea* sp.	3	*Stenochironomus* sp.	3
Basiaeschna janata	2	*Ceraclea maculata*	3	*Thienemaniella* sp.	2
Boyeria sp.	3	*Chimarra* sp.	3	*Thienemaniella xena*	2
Boyeria vinosa	3	*Chimarra obscura*	3		

Difficulties in interpreting critical thresholds of dissolved oxygen for aquatic life

Difficulties exist in determining meaningful thresholds to serve as ambient water-quality standards for dissolved oxygen. To account for these difficulties, Illinois DNR and Illinois EPA focus on relative rankings—rather than reported numeric thresholds—of dissolved oxygen sensitivity as the most valid and useful approach to determine which types of Illinois fish or macroinvertebrates require dissolved oxygen minima higher than the USEPA (1986) "warmwater" criteria. For fish, Illinois DNR and Illinois EPA rely primarily on field-based relations between dissolved oxygen and fish abundance (Rankin 2004) because traditional experimental information on dissolved oxygen sensitivity is lacking for many Illinois fish species. Moreover, particularly for non-toxic substances like dissolved oxygen, sole reliance on laboratory-based acute thresholds is not recommended. For example, in a laboratory-based study of stream-fish species' acute sensitivities to low dissolved oxygen, Smale and Rabeni (1995) caution, "*Considerable differences have been found between laboratory tolerance values and lethal conditions in natural situations (Moore 1942; Davis 1975). It may not be appropriate to use laboratory measurements to predict specific, numerical values of either hypoxia or hyperthermia that would be lethal to fish in the wild*" (p. 699). Other scientists have long recognized this difficulty in applying laboratory-based thresholds of low dissolved oxygen as water-quality standards intended to protect fish in their natural habitats (Aquatic Life Advisory Committee of the Ohio River Valley Water Sanitation Commission 1956; Davis et al. 1979; USEPA 1986). Smale and Rabeni (1995) further state, "*The complexity of environmental challenges faced by fish in natural situations does not inspire confidence in the applicability of* *apparently simplistic and reductionist laboratory tolerance data... However, even laboratory measurements that are too simplistic to precisely predict absolute values of temperature or dissolved oxygen levels that are limiting to fish in natural environments may still be used in a relative manner to distinguish tolerant from sensitive species*" (p. 711). These caveats also pertain to analogous macroinvertebrate studies (e.g., Davis 1975; USEPA 1986; Connolly et al. 2004). USEPA's (1986) national-criteria document for dissolved oxygen carefully considers some of these potential shortcomings. Illinois DNR's and Illinois EPA's approach accounts for these concerns in light of similar cautions and suggestions in later studies.

Different life stages of Illinois fishes require different dissolved oxygen standards

The USEPA (1986) national criteria for dissolved oxygen recommendations are clear in the need to protect for early life stages of fish. The existing Illinois water quality standards for dissolved oxygen were adopted years prior to the USEPA 1986 national criteria, and therefore, do not specifically address these early life stages through a defined sensitive season. USEPA (1986) defines early life stages as, "*Includes all embryonic and larval stages and juvenile forms to 30-days following hatching*" (p. 34).

Available science behind fish spawning and fry development is essential data that must be studied to properly decide the most appropriate date in Illinois. It must be further recognized that other varying factors in any given year (weather conditions, stream flow and temperature, etc.), will have significant local influence on spawning periods of Illinois stream fishes.

Illinois DNR and Illinois EPA recommend July 31 as the date separating the "early life stage present" from the "early life stage absent" periods. This is in contrast to the IAWA's recommended date of June 30.

In supporting IAWA's petition, Dr. Garvey provided summaries of some of the scientific data behind fish spawning and fry development in Illinois. Dr. Garvey further discusses spawning strategies in Illinois fish (see Exhibit #8, Protracted Spawning in Stream Fishes - Implications for Proposed Dissolved Oxygen Standards). Dr. Garvey concludes that whatever spawning occurs toward the end of the spawning period (in many cases these are the months of July and August) is largely unimportant to the well being of the species. He lists a number of factors that contribute to the low survival of late-spawned individuals including predation and lack of fitness for winter survival.

Fisheries scientists and natural-resource managers in Illinois DNR and Illinois EPA partially agree with Dr. Garvey's explanation of the relative insignificance of late spawning to the overall well being of fish species, as long as that date ensures the critical spawning periods have passed and the frequency of spawning failures early in the spawning period do not change from typical natural conditions. In years when early season spawning is not successful for any number of environmental reasons, the "late" season spawning activity may provide the only individuals recruited to the population in that year. Thus, the relative importance of the late season spawned fish in some years is much greater than in typical years when the majority of recruitment comes from the early season spawned individuals.

Many of the fish species evaluated by Dr. Garvey are spring spawners. Illinois DNR and Illinois EPA fisheries scientists and resource managers believe that additional science and data for late spring and summer spawners are of critical interest when setting the cut-off date. Therefore, available literature for Illinois fishes that spawn in either late spring or primarily in summer has been further investigated.

Species considered to be late spring spawners (i.e., those that may spawn into late June) include channel catfish and smallmouth bass; these two species are important for recreational fishing in Illinois. Simon and Wallus (2003) stated that for channel catfish "*yolk-sac larvae and early juveniles were collected mid-May through August with peaks in June and July in the Tennessee and lower Ohio Rivers*" (p. 100). First-hand knowledge and field observations by Illinois DNR resource managers support Simon and Wallus (2003) conclusions. Additionally for smallmouth bass, spawning periods have been documented by Michigan DNR (2004) between late April and early July in Michigan. Simonson (2001) reports similar spawning periods from mid-May through June for smallmouth bass in Wisconsin. In Illinois, smallmouth bass spawn from mid-April through late June with the main spawning period in June (Smith 1979; Sallee et al. 1991). First-hand knowledge and field observations by Illinois DNR resource managers in northern Illinois streams support the spawning period findings of both Michigan DNR (2004) and Simonson (2001).

Illinois DNR and Illinois EPA relied on published text of the natural history of fishes from

Illinois (Smith 1979), Missouri (Pflieger 1997), Virginia (Jenkins and Burkhead 1994), Tennessee (Etnier and Starnes 1993), Wisconsin (Becker 1983) and Arkansas (Robison and Buchanan 1988) to identify fish with summer spawning periods. These data sources were used for species that are common to Illinois. A summary of the range of spawning periods compiled from these works is provided in Table 4. It is significant to note that two of the fish species with summer spawning periods, bigmouth shiner (*Notropis dorsalis*) and stonecat (*Noturus flavus*), have been identified by Illinois DNR and Illinois EPA fisheries scientists and resource managers as more-sensitive to low dissolved oxygen than most other Illinois stream-fish species. Spawning periods identified in Table 4 represent only the time of deposition and fertilization of eggs, and do not include the period of other early life stages of embryonic and fry development. The July 31 date recommended by Illinois DNR and Illinois EPA is highlighted in Table 4. In general, by July 31, all late spawning fish species will have a substantial majority of their spawning and fry development into dates when higher dissolved oxygen standards will be in effect. Even though some larvae will be present into August, Illinois fisheries managers believe the July 31 date should not be detrimental to the overall recruitment of a year class for fish species.

Based on the literature presented for late spring spawnings, summer spawners, and those fish species such as madtoms that can spawn over a wide period, Illinois DNR and Illinois EPA fisheries scientists and resource managers have concluded that an additional 30-day period is necessary to include the "summer spawners" and to protect early life stages of Illinois fish. While the IAWA proposed date of June 30 protects the majority of "spring" spawns, it neglects to include the spawning period of the "summer" spawners, and neglects to include a 30-day period for protection of post-hatch embryonic and yolk-sac fry development. Illinois DNR and Illinois EPA fisheries scientists and resource managers judge that the proposed date of July 31 adequately protects fish eggs and fry and therefore demarcates the two most appropriate periods for dissolved oxygen water quality standards.

Table 4. Spawning periods of some Illinois stream fishes. Shaded lines represent spawning period of each species. "Spawning period" is the time of deposition and fertilization of eggs. "Spawning time" does not include the period of embryonic development and later. Vertical dark line at July 31 indicates the end of the early life stage period, as recommended by Illinois DNR and Illinois EPA. Spawning period is based on information in the following texts: Smith (1979), Becker (1983), Robison and Buchanan (1988), Etnier and Starnes (1993), Jenkins and Burkhead (1994), and Pflieger (1997).

Fish Name	Mar01-15	Mar16-31	Apr01-15	Apr16-30	May01-15	May16-31	Jun01-15	Jun16-30	Jul01-15	Jul16-31	Aug01-15	Aug16-31	Sep01-15	Sep16-30
Minnow Family														
golden shiner				■	■	■	■	■	■	■	■	■		
southern redbelly dace				■	■	■	■	■						
creek chub		■	■	■	■	■								
hornyhead chub			■	■	■	■	■	■	■					
river chub			■	■	■	■	■	■						
central stoneroller		■	■	■	■	■	■	■						
largescale stoneroller					■	■	■	■						
suckermouth minnow			■	■	■	■	■	■	■	■	■	■		
blacknose dace			■	■	■	■	■	■	■	■				
longnose dace			■	■	■	■	■							
silver chub							■	■	■	■				
speckled chub					■	■	■	■	■	■	■	■		
central silvery minnow							■	■	■	■				
plains minnow				■	■	■	■	■	■	■	■			
brassy minnow						■	■							
cypress minnow			■	■										

Fish Name	Mar01-15	Mar16-31	Apr01-15	Apr16-30	May01-15	May16-31	Jun01-15	Jun16-30	Jul01-15	Jul16-31	Aug01-15	Aug16-31	Sep01-15	Sep16-30
striped shiner					■	■	■	■						
common shiner					■	■	■	■	■					
redfin shiner						■	■	■	■	■	■			
rosefin shiner					■	■	■	■						
ribbon shiner					■	■	■	■	■	■	■			
spotfin shiner							■	■	■	■	■	■		
steelcolor shiner							■	■	■	■	■			
blacktail shiner							■	■	■	■	■			
red shiner							■	■	■	■	■	■		
pugnose minnow								■	■					
fathead minnow						■	■	■	■	■	■	■		
bluntnose minnow					■	■	■	■	■	■	■	■		
bullhead minnow						■	■	■	■	■	■	■		
pugnose shiner					■	■	■	■						
emerald shiner							■	■	■	■	■			
river shiner							■	■	■	■	■	■		
bigeye shiner							■	■	■	■	■	■		
ghost shiner					■	■	■	■	■	■				
silverjaw minnow	■	■	■	■	■	■	■	■	■	■				
ironcolor shiner							■	■	■	■				
bigmouth shiner					■	■	■	■	■	■	■	■		
blackchin shiner							■	■	■	■				
blacknose shiner							■	■	■	■	■			
spottail shiner				■	■	■	■	■	■	■				
sand shiner					■	■	■	■	■	■	■	■	■	■
Ozark minnow					■	■	■	■	■	■				
rosyface shiner				■	■	■	■	■	■					
silverband shiner						■	■	■	■	■	■	■		

Fish Name	Mar01-15	Mar16-31	Apr01-15	Apr16-30	May01-15	May16-31	Jun01-15	Jun16-30	Jul01-15	Jul16-31	Aug01-15	Aug16-31	Sep01-15	Sep16-30
taillight shiner	■	■	■	■	■	■	■	■						
weed shiner	■	■	■	■	■	■	■	■	■	■	■	■	■	■
mimic shiner							■	■	■	■	■	■		
bigeye chub					■	■	■	■						
Sucker Family														
river carpsucker					■	■	■	■	■	■				
highfin carpsucker					■	■	■	■	■	■	■			
quillback			■	■	■	■	■	■	■	■	■	■	■	■
Catfish Family														
channel catfish					■	■	■	■	■	■				
flathead catfish							■	■	■	■				
stonecat							■	■	■	■				
tadpole madtom							■	■	■	■				
freckled madtom							■	■	■	■				
slender madtom						■	■	■	■	■				
northern madtom							■	■	■	■				
Sunfish & Bass Family														
warmouth						■	■	■	■	■	■			
green sunfish							■	■	■	■	■			
bluegill							■	■	■	■	■			
longear sunfish						■	■	■	■	■	■			
orangespotted sunfish							■	■	■	■	■			
pumpkinseed					■	■	■	■	■	■	■			
Killifishes,Topminnows, Mosquitofish, & Silversides														
banded killifish					■	■	■	■	■	■	■	■		

Fish Name	Mar01-15	Mar16-31	Apr01-15	Apr16-30	May01-15	May16-31	Jun01-15	Jun16-30	Jul01-15	Jul16-31	Aug01-15	Aug16-31	Sep01-15	Sep16-30
northern studfish														
starhead topminnow														
blackstripe topminnow														
blackspotted topminnow														
mosquitofish														
brook silverside														
inland silverside														
Perch & Darter Family														
western sand darter														

Natural variability of dissolved oxygen through time and across locations in Illinois requires practical application of standards

Like USEPA (1986) criteria, the dissolved oxygen standards recommended by Illinois DNR and Illinois EPA (Table 1, columns 6 – 9) include absolute, instantaneous thresholds called "daily minima". This type of acute water-quality standard reflects an unrealistic, idealized expectation. In reality, under some natural conditions, dissolved oxygen concentrations are likely to drop to levels normally expected to be acutely harmful to aquatic life. In surface waters, dissolved oxygen concentrations are influenced directly or indirectly by numerous interacting environmental factors, including temperature, atmospheric pressure, light intensity, ice cover, water clarity, and photosynthesis and respiration of plants and animals. Particular combinations of these factors can result in low dissolved oxygen levels unrelated to human impacts. For example, during summer and autumn, stratification in lakes or low flow in streams can result in dissolved oxygen depression (Hynes 1970). As reflected in the thresholds in Table 1, acute or chronic differences as small as 0.5 to 1.0 mg/l in dissolved oxygen concentration represent meaningful differences in potential effects on aquatic life. Such small critical differences coupled with relatively high natural variability confound the ability to select dissolved oxygen thresholds (i.e., water quality standards) that can consistently distinguish deleterious human impacts from natural influences on aquatic life. Developers of water-quality standards for dissolved oxygen widely recognize this difficulty (Aquatic Life Advisory Committee of the Ohio River Valley Water Sanitation Commission 1955; Davis 1975; Davis et al. 1979; USEPA 1986; Truelson 1997). USEPA (1986) states, "*Naturally-occurring dissolved oxygen concentrations may occasionally fall below target criteria levels due to a combination of low flow, high* *temperature, and natural oxygen demand... Under these circumstances the numerical criteria should be considered unattainable, but naturally-occurring conditions which fail to meet criteria should not be interpreted as violations of criteria. Although further reductions in dissolved oxygen may be inadvisable, effects of any reductions should be compared to natural ambient conditions and <u>not to ideal conditions</u>*" (p. 28; emphasis added).

To be useful, Illinois dissolved oxygen standards must accommodate the reality of how dissolved oxygen naturally varies through time and across locations in Illinois. Illinois DNR and Illinois EPA recommend an additional narrative part of the dissolved oxygen standards that addresses these issues. Specifically, Illinois DNR and Illinois EPA recommend that:

General Use waters at all locations shall maintain sufficient dissolved oxygen concentrations to prevent offensive conditions.... Quiescent and isolated sectors of General Use waters including but not limited to wetlands, sloughs, backwaters and lakes and reservoirs below the thermocline shall be maintained at sufficient dissolved oxygen concentrations to support their natural ecological functions and resident aquatic communities (<u>See</u> Toby Frevert Pre-filed Testimony, Attachment 1).

Which Illinois streams have a meaningful amount of sensitive organisms and thus require enhanced protection for dissolved oxygen?

Identify specific stream sites in Illinois that have a meaningful amount of sensitive organisms

Fish Dataset: Fish-community samples collected with various sampling gears in 1994 through 2005 by Illinois DNR were used. Fish data from the large rivers (i.e., Mississippi, Illinois, Wabash, and Ohio) were analyzed separately. Data from 1028 stations, including 98 large-river locations, were included in the analysis. Because a site may have been sampled multiple times for fish during the evaluation time frame, proportion of individuals and number of species from each sample were averaged to provide a single value for each biological measure for each site.

Macroinvertebrate Dataset (except mussels): Macroinvertebrate-community samples collected in 2001 through 2004 and available in the Illinois EPA BIOS database were used. Data from 380 stations were included in the analysis. Samples used were limited to those collected from wadable streams via Illinois EPA's recently incorporated "20-jab method". Before 2001, Illinois EPA collected stream-macroinvertebrate samples via a different method that precludes valid among-sample comparisons of proportional abundances, for example, the proportion of individuals identified as most sensitive to low dissolved oxygen. Differences between past and present collection methods also preclude combining data when determining the number of sensitive taxa per site because each method selectively collects different macroinvertebrate taxa.

Mussel Dataset: Mussel data compiled by the Illinois Natural History Survey from 1980 through 2005 were used. Species examined included *Elliptio crassidens* and those identified by Illinois DNR mussel experts as intolerant and riffle-dwelling. Data were collected through field collections including hand picking, brailing, and diving, as well as museum records. Locations were limited to include only presence of live mussels.

Of the 1110 sites evaluated, 329 had both fish and macroinvertebrate data; 699 sites had fish data only and 82 sites had macroinvertebrate data only.

Illinois DNR and Illinois EPA selected four biological measures by which to characterize each stream site: the number of sensitive fish species (see Table 2), the proportion of individual fish that are sensitive, the number of sensitive macroinvertebrate taxa (see Table 3), and the proportion of individual macroinvertebrates that are sensitive. Because available mussel data did not comprise community assessments, number of sensitive species and proportion of sensitive individuals could not be calculated.

Illinois DNR and Illinois EPA selected threshold values that represent the number of sensitive species/taxa and the proportional abundance of sensitive individuals typical of healthy streams. Threshold values for each of the four biological measures (Table 5) were determined by calculating the median value from sampling sites that were identified as attaining the Clean Water Act goal for aquatic life, referred to as full support. The calculation of the median was limited to full support waters in an attempt to limit the influence of environmental stresses, including habitat and chemicals. In large rivers, full support sites were chosen only from sites that fell on the main channel (i.e., not backwaters or side channels). The number of full support sites used to calculate threshold values varied from 45 sites in large rivers (i.e., Mississippi, Illinois, Wabash, and Ohio) to 368 sites for fish in streams and non-large rivers, with 246 full-support sites for macroinvertebrates.

For each site, values for each of the four biological measures were compared to established threshold values. Sites were selected as having a meaningful amount of sensitive organisms if at least two of the four biological measures considered equaled or exceeded the established threshold value for that measure. Sites that had fish-only or macroinvertebrate-only data were eligible for selection if they met or exceeded both thresholds for the available taxonomic group.

Table 5. Threshold values for each biological measure used to determine a meaningful amount of sensitive organisms.

	Percent as Sensitive Individuals	Number of Sensitive Taxa
Fish – Large Rivers	2.63	2
Fish – Streams/non-large rivers	9.3	4
Macroinvertebrates	6.25	5

Because of differences in the methods used to collect mussels vs. other macroinvertebrates in Illinois streams, the site-specific information available for mussels is not directly comparable. Consequently, the thresholds in Table 5 do not apply to the mussel information. Rather, any site known to be inhabited by at least one of the two dissolved oxygen-sensitive mussel species (i.e., *Villosa iris* and *Elliptio crassidens*) was considered to have a meaningful amount of sensitive organisms.

In summary, the analysis identified 374 stream sites that have a meaningful amount of sensitive organisms (Figure 2).

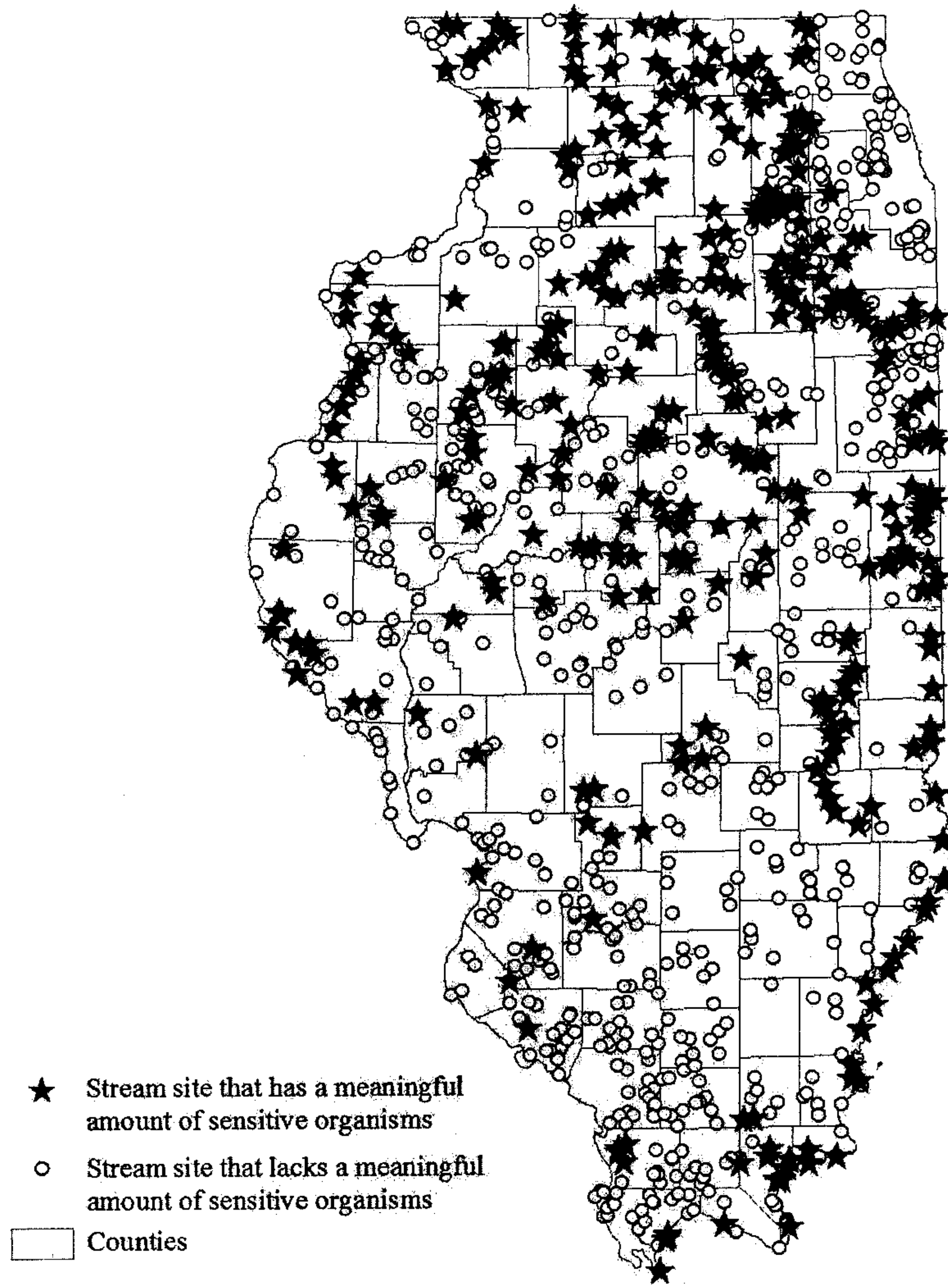


Figure 2. Stream sites from which fish, macroinvertebrate, or both types of information were used to determine locations that have meaningful amounts of dissolved oxygen-sensitive organisms.

Extrapolate site-based results to identify Illinois stream segments that require enhanced dissolved oxygen protection

Based on the widely documented knowledge that the physical and chemical properties of the water at a stream site reflect upstream influences (e.g., Omernik et al. 1981; Smart et al. 1981; Hunsaker and Levine 1995; but see Allan and Johnson 1997), Illinois DNR and Illinois EPA believe that the presence of a meaningful amount of sensitive organisms at a site reflects the need for enhanced dissolved oxygen protection at the site as well as upstream of the site. Unfortunately, Illinois DNR and Illinois EPA know of no criteria that can identify definitively the upstream extent of influence on dissolved oxygen for each site of concern; therefore, some simple, practical constraints for extrapolating from site-specific information to upstream stream segments were used. Specifically, the map-based information listed below was used to identify stream segments expected to have meaningful amounts of sensitive organisms and therefore requiring enhanced dissolved oxygen standards, i.e., minima higher than the USEPA (1986) "warmwater" criteria.

Illinois DNR and Illinois EPA primarily used four pieces of information referenced to or depicted as computer-mapped information throughout Illinois:

1) set of stream sites at which fish or macroinvertebrate samples indicate occurrence of a meaningful amount of sensitive organisms (Figure 2);
2) set of stream sites at which fish or macroinvertebrate samples indicate lack of a meaningful amount of sensitive organisms (Figure 2);
3) Illinois streams that are part of the National Hydrography Dataset (1:100,000 map

scale). This dataset is a "*comprehensive set of digital spatial data that contains information about surface water features such as lakes, ponds, streams, rivers, springs and wells*" (internet website: *//nhd.usgs.gov/*). This dataset is sponsored by the U. S. Geological Survey and the U. S. Environmental Protection Agency;

4) U.S. Geological Survey 7.5-minute topographic maps (map scale 1:24,000) for Illinois.

Figure 3 highlights the process for selecting stream segments for enhanced dissolved oxygen protection. These highlights do not apply to segments in the largest Illinois streams: Illinois River, Mississippi River, Ohio River, and Wabash River, which are addressed later in this section. First, proceeding upstream, any stream segment collocated with a site that has a meaningful amount of sensitive organisms was selected for enhanced protection. Second, for stream segments not collocated with, but upstream of, a site that has a meaningful amount of sensitive organisms, the segment was selected for enhanced protection only if all of these criteria applied:

1) The nearest downstream site that has sufficient biological information has a meaningful amount of sensitive organisms.

2) The nearest downstream site that has sufficient biological information is not a large-river site (see above). Illinois DNR and Illinois EPA judge that selecting all stream segments that occur upstream of a large-river site that has a meaningful amount of sensitive organisms is

an unreasonable approach. Such widespread extrapolation takes the concept of upstream influence to an impractical extreme.

3) The stream segment is not smaller than third order in size. Stream order is a relative measure of stream size; larger orders represent larger streams. Using third order as a size limit is consistent with the extent of the site-based fish and macroinvertebrate information used, which predominantly is from third-order streams and larger. Importantly, not all stream segments smaller than third order were denied enhanced protection outright. As per the first criterion, regardless of stream size, if sufficient biological information is available from the segment and the information indicates presence of a meaningful amount of sensitive organisms, the segment was selected for enhanced protection. Consequently, statewide, about 6% of the stream length selected for enhanced dissolved oxygen protection comprises streams smaller than third order.

4) The "stream segment" is free-flowing, i.e., not obviously part of a lake, reservoir, or large-river backwater. As previously mentioned, lakes, reservoirs, backwaters, and other lentic habitats require separate consideration from free-flowing streams when developing water quality standards for dissolved oxygen.

With the above exceptions, the selection of stream segments for enhanced protection proceeded upstream from any site that has a meaningful amount of sensitive organisms (Figure 4, "A" arrows). If a site was encountered that has sufficient biological information that indicates lack of a meaningful amount of sensitive organisms, then selection ceased about halfway to that point or at a practical endpoint such as an obvious confluence ("B" arrows). In a few cases, stream segments in the vicinity of a site that lacks a meaningful amount of sensitive organisms nonetheless were selected for enhanced dissolved oxygen protection because other nearby sites both upstream and downstream have meaningful amounts of sensitive organisms ("C" arrow). In general, in selecting stream segments for enhanced protection or not, evidence of a meaningful amount of sensitive organisms in the vicinity preceded lack of such evidence in the vicinity.

For large rivers, segments that include a site that has a meaningful amount of sensitive organisms were selected for enhanced dissolved oxygen protection. For the part of Mississippi River comprising navigational pools, all segments in the same river pool as a site that has a meaningful amount of sensitive organisms were selected. For the other large rivers, segments in the vicinity of a site that lacks a meaningful amount of sensitive organisms nonetheless were selected for enhanced dissolved oxygen protection for situations in which other nearby sites both upstream and downstream have meaningful amounts of sensitive organisms.

Figure 5 shows the stream segments that were selected by Illinois DNR and Illinois EPA for enhanced dissolved oxygen protection. A table containing stream names and location information of each stream segment can be found in the Attachment 1 of Toby Frevert's Pre-filed testimony. To generate this list, each selected stream segment was spatially located using a geographic information system (GIS). Latitude and longitude values were identified for each starting and ending point and a unique segment number was assigned to each pair of starting and ending points. The stream name of each segment was based on United States Geological Survey 7.5-minute digital topographic maps.

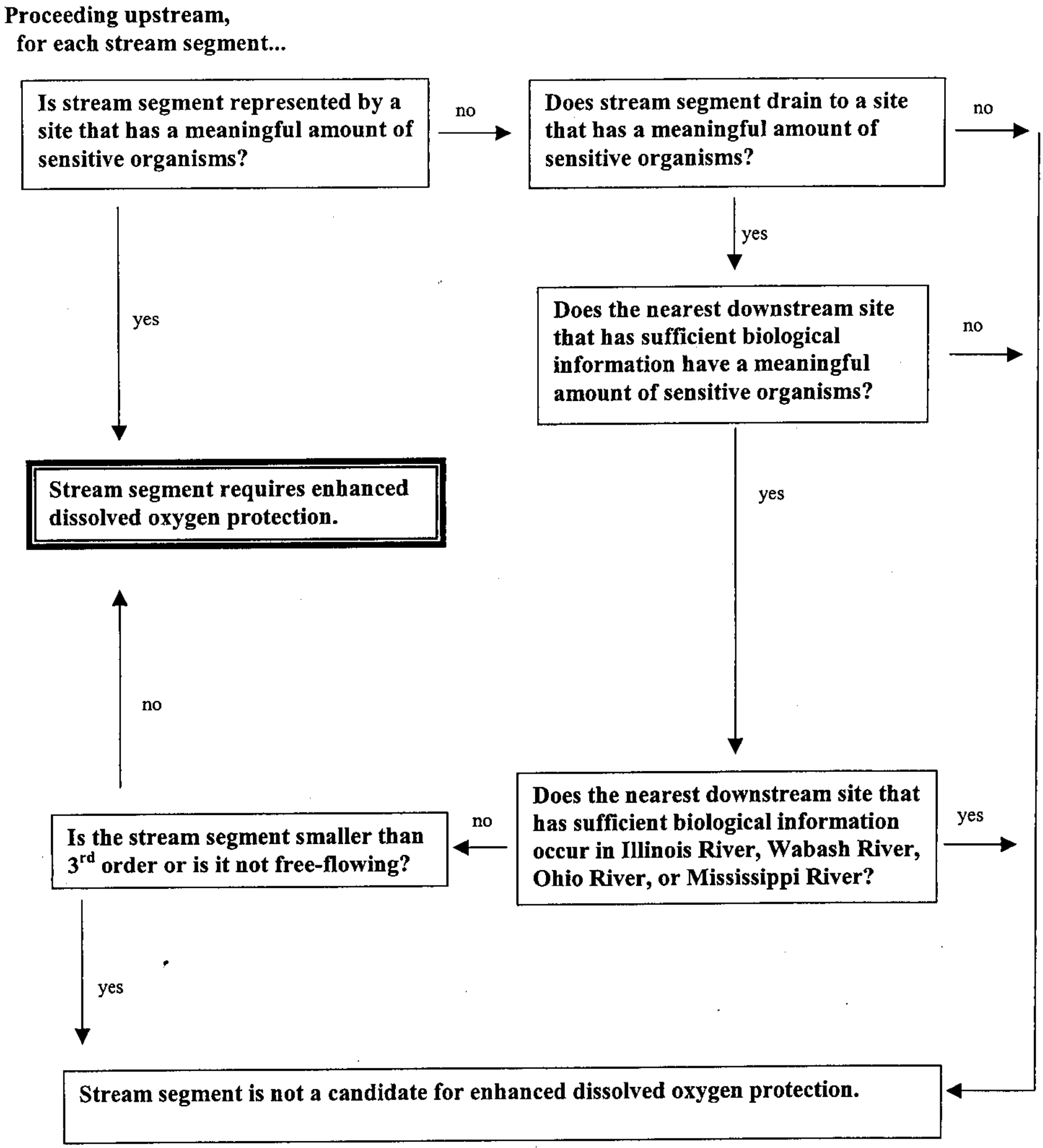


Figure 3. Guidelines for using site-specific fish or macroinvertebrate information to identify stream segments that require enhanced dissolved oxygen protection. These guidelines apply for segments not part of Illinois River, Mississippi River, Ohio River, or Wabash River.

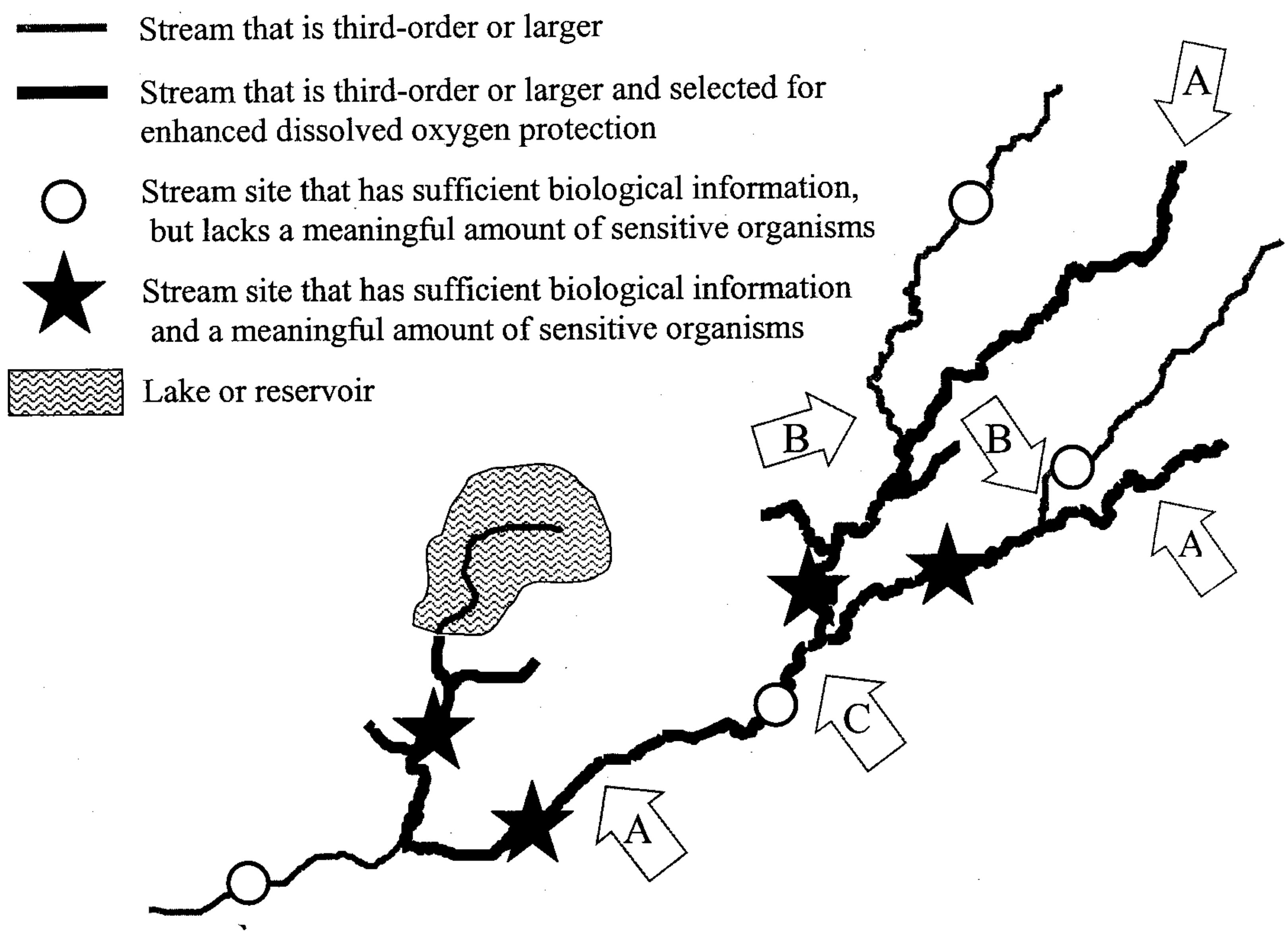


Figure 4. Example of using site-specific fish or macroinvertebrate information to identify stream segments that require enhanced dissolved oxygen protection Labeled arrows indicate examples addressed in the text.

Figure 5. Illinois streams selected for enhanced dissolved oxygen protection.

Review of stream segments selected for enhanced dissolved oxygen protection

Field biologists affiliated with Illinois DNR and Illinois EPA reviewed the stream segments selected for enhanced dissolved oxygen protection. Also, additional information on the presence of some mussel species was used to evaluate the selections. Although data on mussel sensitivity to low dissolved oxygen are limited, evidence suggests that riffle-dwelling mussel species are more sensitive than other types (Johnson et al. 2001). USEPA (1986) recognizes this connection to habitat. "*In general, stream invertebrates that are requisite riffle-dwellers probably have a higher dissolved oxygen requirement than other aquatic invertebrates*" (p. 3). Mussel experts in Illinois identified seven intolerant mussel species (including *V. iris*) as primarily riffle dwelling (Table 6). Ninety-seven percent of locations of riffle-dwelling mussels occur on segments selected for enhanced dissolved oxygen protection, thereby corroborating Illinois DNR's and Illinois EPA's use of the fish and non-mussel macroinvertebrate information in locating waters for enhanced protection.

Table 6. Intolerant, riffle-dwelling mussel species in Illinois.

Common Name	Scientific Name
Purple Wartyback	*Cyclonaias tuberculata*
Rabbitsfoot	*Quadrula cylindrica*
Snuffbox	*Epioblasma triquetra*
Wavyrayed Lampmussel	*Lampsilis fasciola*
Kidneyshell	*Ptychobranchus fasciolaris*
Ellipse	*Venustaconcha ellipsiformis*
Rainbow	*Villosa iris*

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STATE OF ILLINOIS)
) SS.
COUNTY OF SANGAMON)

PROOF OF SERVICE

I, the undersigned, on oath state that I have served the attached Pre-filed Testimony of Toby Frevert, Roy Smogor and Joel Cross upon the person to whom it is directed, by placing it in an envelope addressed to:

NOTICE

TO: Dorothy Gunn, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph Street 11-500
Chicago, Illinois 60601
(OVERNIGHT VIA MAIL)

Richard McGill, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 W. Randolph Street, Suite 11-500
Chicago, Illinois 60601
(OVERNIGHT VIA MAIL)

SEE ATTACHED SERVICE LIST
Regular Mail

and mailing it First Class Mail from Springfield, Illinois on April 3, 2006, with sufficient postage affixed.

Nancy J.D. Lamport

SUBSCRIBED AND SWORN TO BEFORE ME

This 3rd day of April, 2006

Cynthia L. Wolfe
Notary Public

OFFICIAL SEAL
CYNTHIA L. WOLFE
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 9-20-2007

THIS FILING IS SUBMITTED ON RECYCELD PAPER