BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	**R08-09 Subdocket D**
CHICAGO AREA WATERWAY SYSTEM	)	**(Rulemaking – Water)**
AND THE LOWER DES PLAINES RIVER:	)	
PROPOSED AMENDMENTS TO 35 Ill.	)	
Adm. Code Parts 301, 302, 303 and 304	)	

NOTICE OF FILING

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Attached Service List

PLEASE TAKE NOTICE that I have today filed with the Illinois Pollution Control Board, Midwest Generation L.L.C.'s Post-Hearing Comments including attachments, a copy of which is herewith served upon you.

Dated: April 30, 2014

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CERTIFICATE OF SERVICE

The undersigned, an attorney, certifies that a true copy of the foregoing Notice of Filing and Midwest Generation L.L.C.'s Post Hearing Comments with attachments were filed electronically on April 30, 2014 with the following:

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and that true copies were sent via email and mailed by First Class Mail, postage prepaid, on April 30, 2014 to the parties listed on the foregoing Service List.

/s/ Susan M. Franzetti

ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND EFFLUENT LIMITATIONS FOR THE CHICAGO AREA WATERWAY SYSTEM AND LOWER DES PLAINES RIVER PROPOSED AMENDMENTS TO 35 ILL. ADM. CODE 301, 302, 303, AND 304	)	**R08-9 Subdocket D (Rulemaking-Water)**

MIDWEST GENERATION'S POST-HEARINGS COMMENTS

I. Introduction

On April 1, 2014, NRG Energy, Inc. ("NRG") acquired certain of the subsidiaries of Edison Mission Energy, including Midwest Generation, LLC ("Midwest Generation"). Stepping into the "shoes" of Midwest Generation in this proceeding, NRG recognizes that the Illinois Pollution Control Board (the "Board"), the Illinois Environmental Protection Agency ("Illinois EPA" or the "Agency") and all other participating parties have devoted a significant amount of time and effort to this rulemaking, for which all are to be commended. NRG and Midwest Generation also appreciate the Board's allowance of an extension of the deadline for these comments. This extension has allowed Midwest Generation an opportunity to present its concerns regarding the proposed Subdocket D aquatic life use ("ALU") water quality standards ("WQS" or "standards") for the Board's consideration.

Midwest Generation's comments focus on the Subdocket D proposed thermal WQS because they threaten the viability of existing and future operations of its three electric generating stations, the Will County and Joliet 9 and 29 stations. Will County station discharges into the Chicago Sanitary and Ship Canal ("CSSC"), which is now subject to the newly adopted aquatic life use ("ALU") designation known as "Aquatic Life Use B" ("Use B"). The two Midwest Generation Lower Des Plaines River facilities, Joliet 9 and Joliet 29, discharge to the Upper Dresden Island Pool,[1] which is now subject to the new "Upper Dresden Island Pool Aquatic Life Use" ("UDIP Use").

[1] The Joliet Stations are sometimes referred to by their unit numbers. Joliet 9 is the same as "Joliet Unit 6" and Joliet 29 is the same as "Joliet Units 7 & 8." See Ex. 364 at 2-3.

As discussed below, the Agency's proposed thermal standards raise several significant legal and technical concerns. First, the Agency's proposed thermal standards are not scientifically justified and are severely flawed in several ways. One major flaw is that the proposed standards are not consistent with the extensive biological data available for these waters. The biological data were not taken into consideration by the Agency or its thermal standards consultant Mr. Christopher Yoder ("Mr. Yoder"). The biological data collected from over twenty years of studies support the adoption of less restrictive temperature standards that are still protective of the aquatic life use designations for these waters.

Another major flaw is that the Agency's proposed thermal standards are more restrictive than even the existing General Use thermal standards in 35 Ill. Adm. Code § 302.211, which apply to higher quality waters with more thermally sensitive aquatic life. Through multiple triennial reviews, the General Use thermal standards have been found by the Agency to be adequately protective of Illinois waters that are capable of fully attaining the Clean Water Act's aquatic life use goals. Thus, it is unjustified and defies any logic to apply stricter thermal standards to the Use B and UDIP Use waters which are intended to protect lower quality aquatic life populations. Given the clear deficiencies in the derivation and content of the Agency's proposed Subdocket D thermal standards, if the Board were to adopt them, it would set an unscientific and untenable precedent for any future Board review of General Use thermal standards. Midwest Generation strongly urges the Board not to adopt the Agency's proposed Subdocket D thermal standards.

Instead, Midwest Generation requests that the Board adopt the proposed thermal standards developed by EA Engineering & Science ("EA" or "EA Engineering") which Midwest Generation provided to the Agency in 2007, or alternatively, the 2003 proposed thermal standards which were also submitted by Midwest Generation for the Agency's consideration. Unlike the Agency's proposed standards, the 2003 and 2007 thermal standards proposals are appropriately protective of the aquatic life reasonably expected to be present in these waters. The 2007 proposed thermal standards are the result of an extensive analysis of both the biological data collected from the Upper Illinois Waterway ("UIW") waters (encompassing an area both upstream and downstream of the UDIP) and validated literature data concerning aquatic life thermal tolerances. The 2007 thermal standards proposal is also supported by extensive statistical analysis which was not performed on the Agency's proposed standards.

Both proposals are consistent with the Clean Water Act's requirements and U.S. Environmental Protection Agency ("U.S. EPA") guidance concerning the derivation of thermal water quality standards.

Alternatively, because the Agency's proposed thermal standards for the UDIP Use are so objectionable both legally and technically, and threaten to eliminate the viability of the continuing operations of the Midwest Generation stations, Midwest Generation also brings to the Board's attention other numerical thermal standards alternatives for its UDIP Use consideration, such as the AS96-10 and General Use thermal standards. Midwest Generation maintains that neither of these standards is appropriate for the UDIP because they contain more stringent requirements than are necessary to protect the UDIP designated use. However, should the Board not adopt the alternative 2003 and 2007 thermal standards proposed by Midwest Generation, then these alternatives are somewhat less objectionable than the Agency's proposed thermal standards.

Finally, regardless of which thermal standards the Board adopts, it is likely that Midwest Generation will need to seek regulatory relief from the Use B and UDIP Use thermal standards because the technical feasibility and economic reasonableness of compliance is at best uncertain and more likely unsustainable. Therefore, Midwest Generation's comments below also include requests to the Board for clarification of relevant regulatory relief issues regarding compliance schedules and variances. Midwest Generation also proposes that the Board either delay the effective date of these rules or incorporate variance relief as part of its Subdocket D decision consistent with U.S. EPA guidance.

II. Governing Law and Regulations

Under the federal Clean Water Act, 33 U.S.C. §§ 1251 *et seq.* (the "CWA" or "Clean Water Act"), Illinois, like other states, has the primary authority to establish surface water quality standards for bodies of water within its borders.[2] See 33 U.S.C. § 1313(a), (d). The water quality standards include both "designated uses" of waters and water quality criteria to protect those uses. 33 U.S.C. § 1313(c)(2)(A). The uses and criteria constitute "standards" that are to ensure that the goals articulated in the CWA are met. 33 U.S.C. § 1313(c). Section

[2] The standards are then used to set effluent limitations in water-quality permits issued pursuant to the National Pollutant Discharge Elimination System ("NPDES") Program. 33 U.S.C. § 1313(c)(1).

131.11(a)(1) of the Clean Water Act regulations requires states to adopt water quality criteria to protect the designated use(s). 40 C.F.R. §131.11(a)(1).

In February 2014, the Board adopted new aquatic life use designations for the Chicago Area Waterway System ("CAWS") and the UDIP in Subdocket C of this rulemaking.[3] The Board adopted the following three aquatic life use designations: ALU A for certain segments of the CAWS; ALU B for other CAWS segments, including the CSSC on which Midwest Generation's Will County Station is located;[4] and the UDIP Use for the northern part of Dresden Pool in the Lower Des Plaines River, approximately a mile downstream of Brandon Road Lock and Dam, where Midwest Generation's Joliet 9 and 29 Stations are located.[5] ALUs A and B "are not capable of attaining an aquatic life use consistent with the section 101(a)(2) of the Clean Water Act goal (33 USC 1251(a)(2)."[6] The UDIP waters "are capable of maintaining, and shall have quality sufficient to protect, aquatic-life populations consisting of individuals of tolerant, intermediately tolerant, and intolerant types that are adaptive to the unique flow conditions necessary to maintain navigational use and upstream flood control functions of the waterway system."[7] As the Board explained in its Subdocket C Final Order, the UDIP Use designation "is consistent with the Agency's finding that the UDIP minimally meets the CWA aquatic life goal."[8]

States are also responsible for establishing numeric or narrative "criteria" (or both) that set limits on the amount of pollutants that may be present in the water without "impairing" the designated uses. 33 U.S.C. § 1313(c)(2)(A). The purpose of Subdocket D is to establish the numeric or narrative water quality criteria (hereinafter "standards") for the CAWS and UDIP use designations.

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[3] *In the Matter of: Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and Lower Des Plaines River: Proposed Amendments to 35 Ill. Adm. Code 301, 302, 303, and 304, R08-9 (Subdocket C)* Adopted Rule. Final Order. (IPCB February 6, 2014) ("Subdocket C Final Order").
[4] See 35 Ill. Admin. Code § 303.235(a) and (b)).
[5] See 35 Ill. Admin. Code § 303.230(a)).
[6] See 35 Ill. Admin. Code § 303.235(b)).
[7] See 35 Ill. Admin. Code § 303.230(a)).
[8] Subdocket C Final Order at p. 10.

III. Overview of the Agency's Proposed Thermal Water Quality Standards

The Illinois EPA originally proposed its Subdocket D revised thermal standards to the Board in 2007.[9] The Agency proposed for Use B waters, a daily maximum temperature of 90.3° F and varying period average temperatures for 17 separate time periods during a year.[10] Similarly, for the UDIP Use, the Agency proposed a daily maximum temperature of 88.7° F and varying period average temperatures for these same time periods.[11]

In May 2013, the Agency amended its proposed standards (the "Agency's May 2013 Amendments").[12] For the thermal standards, the Agency's May 2013 Amendments revised the period average thermal standards numeric values for both ALU Uses A and B based on a new Agency approach to calculating "background temperature." The Agency also added a narrative standard to protect against cold shock, in response to U.S. EPA's comment that it should do so.[13]

For the UDIP, in its November 4, 2013 comments to the Board in Subdocket C,[14] the Agency stated that if the Board proceeded to adopt the UDIP Use designation, which it did, the Agency would withdraw its proposal to apply the General Use water quality standards to the UDIP. The Agency instead provided certain changes to its originally proposed UDIP standards. The Agency's UDIP Use changes included the same period average temperatures it had proposed in its May 2013 Amendments for Use A. The Use B period average values differ from Use A and the UDIP Use only in the period of June 16 through September 15, when the Use B period average values are 86.7° F and the Use A/UDIP Use values are 85.1° F.[15] Therefore, the Agency is now proposing that virtually identical period average numeric temperature values be applied to all three use designations – ALU A, ALU B and the UDIP – even though the nature of the aquatic life to be protected under each of these uses is significantly different.

The Agency's proposed daily maximum temperature values for these three uses are similar. The proposed daily maximum value for both the ALU A and UDIP Uses is 88.7°F and

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[9] *In the Matter of Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and the Lower Des Plaines River: Proposed Amendments to 35 Ill. Adm. Code Parts 301, 302, 303 and 304*, R08-9 (Ill.Pol.Control.Bd. Oct. 26, 2007 ("Agency's Proposed Amendments").
[10] *Agency's Proposed Amendments,* proposed § 302.408(c).
[11] *Id.* at proposed § 302.408(d).
[12] *See Illinois Environmental Protection Agency's Motion to Amend the Regulatory Proposal Filed in 2007*, R08-9(D) (Ill.Pol.Control.Bd. May 24, 2013) ("May 2013 Amendments").
[13] Exhibit 480, *Pre-Filed Testimony of Scott Twait,* at pp. 7&9.
[14] *Comments of the Illinois Environmental Protection Agency on the Illinois Pollution Control Board's Subdocket C Second Notice Opinion and Order*, R08-9(C) at p. 15 (Ill.Pol.Control.Bd. Nov. 4, 2014).
[15] *Id.* at pp. 16-17.

the Use B proposed daily maximum value is only slightly higher at 90.3°F. These proposed daily maximum temperature values apply throughout the year.

IV. The Agency's Proposed Thermal Standards are Arbitrary

The proposed thermal standards for all of the CAWS and UDIP waters are stricter than the existing General Use thermal standards. In fact, the proposed UDIP thermal standards would set the most stringent thermal standards in Illinois. This makes no scientific or logical sense considering that the ALU Use A, the ALU Use B and the UDIP Use are all lower aquatic life use designations than is the General Use designation. Repeatedly, through years of triennial water quality standards reviews, the Illinois EPA has affirmed the continued application of General Use thermal standards to be adequately protective of Illinois waters. Accordingly, it would be arbitrary and irrational to adopt stricter thermal water quality standards for the Use B and UDIP waters when aquatic life use designations for those waters are lower than for General Use waters.

A. The Objective of Thermal Standards

The objective of the thermal standards is to protect the aquatic life as it is described in the use designation for each water segment. The objective is not to protect each individual fish from any thermal effects. Even natural waterway thermal conditions do not accomplish that objective. Natural waterway temperatures can vary significantly from season to season, year to year, and even hour to hour, and may not provide ideal conditions for every species of aquatic life that may reside within them. The Clean Water Act does not require establishing a thermal water quality standard that is optimal for all aquatic life everywhere in a water body at all times.

One of the challenges of this water quality standards rulemaking has been to create a temperature standard that supports the biological requirements of an aquatic community in what is a highly altered landscape. The Agency's proposed thermal standards suffer from a lack of biological and geographic consistency. This deficiency stems chiefly from the exclusive and flawed literature-based approach on which the proposed thermal standards are based, including the selection of literature-derived, limited data that project the most conservative end of optimum thermal preferences for fish in the natural environment.

From the beginning of this effort, the Illinois EPA said it did not have the internal resources to evaluate and craft appropriate thermal standards. The Illinois EPA accepted assistance and a method provided by a U.S. EPA contractor Midwest Biodiversity Institute ("MBI"), whose work was performed primarily by MBI's Mr. Yoder. Mr. Yoder's approach to selecting thermal WQS is not scientifically sound or defensible and fails to properly adjust literature-based data to incorporate known, real world conditions in these waters as documented in available biological data. Because water temperatures vary widely in time and space, even a body of water's natural thermal condition is not always optimum for fish. Here, the thermal regime of the CSSC and UDIP is heavily influenced by its artificially-controlled flows and the impounded condition of its waters due to the presence of several locks and dams.

Fish inhabit waters to the limit of their ability, not restricting themselves to optimum temperatures. The proposed thermal standards here fail to recognize the simple fact established by years of fish survey data available for this waterway that fish do and can thrive in temperatures higher than those proposed by the Agency.

B. The Proposed Daily Maximum Thermal Standards Method is Severely Flawed

The proposed Use B (as well as Use A) and UDIP thermal daily maximum water quality standards are based on an approach developed by Mr. Yoder, an approach that has not been adopted by the U.S. EPA and has only been used in Mr. Yoder's home state of Ohio.[16] Mr. Yoder's approach is flawed on several grounds.

Mr. Yoder used what he called his "Fish Temperature Model" to derive numeric thermal standards based on the species of fish he *believed* should be present in the Use B and UDIP waters. [17] As a preliminary matter, it should be clarified that the use of the term "model" to describe Mr. Yoder's approach is a misnomer. Mr. Yoder simply does not use any modeling.[18] Instead, the "model" is a database into which has been entered a collection of literature temperature data or data extrapolated by MBI/Mr. Yoder on various fish species.[19] From this database, the thermal endpoint data (*e.g.,* acute upper lethal temperatures) for each species are

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[16] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 76; January 31, 2008 Hearing Tr. at p. 214. Yoder testified that he patterned his procedure on the information in Exhibit 16, which references a single paper by Bush *et al.*(1974) as the basis for his method. Mr. Yoder was unaware of any subsequent studies that demonstrate the accuracy of this method. *Id.* at pp. 211-212.
[17] See Exhibit 15; See also Illinois Statement of Reasons ("SOR") at pp. 80-87; SOR Attachment GG (*Temperature Criteria Options for the Lower Des Plaines River*, Chris O. Yoder and Edward T. Rankin, Center for Applied Bioassessment and Biocriteria (Oct. 11, 2005)) as revised by SOR, Attachment HH (Letter from Chris O. Yoder to Toby Frevert).
[18] A true scientific model takes data and establishes mathematical relationships among the data or between the data and some other variable.
[19] Yoder Testimony, January 30, 2008 Hearing Tr. at pp. 54-6.

ranked from least to most sensitive. Thus, Mr. Yoder's approach is simply a ranking procedure; one that takes actual or interpreted endpoint values for measures such as the upper lethal temperature and arranges the endpoint values from least to most sensitive. Under the Yoder approach, the proposed daily maximum thermal standards for the UDIP Use and Use A/Use B waters are based solely on the "most sensitive" representative aquatic species ("RAS") determined from this ranking of thermal endpoint literature and extrapolated data. Where an endpoint value assigned to the most sensitive species in Mr. Yoder's RAS list is erroneous, then the resultant thermal criterion he recommends is also erroneous.

Mr. Yoder's approach is not consistent with the Clean Water Act. As discussed further below, his approach is also contrary to U.S. EPA guidance for establishing water quality standards which recommends using a 95% statistical approach to the data, not 100% as Mr. Yoder used. None of the literature values collected for any RAS other than his selected literature value, often from a single laboratory test, on one species is taken into account for deriving the daily maximum thermal standard.[20] Using Mr. Yoder's approach, there could be 100 species identified as representative of a water body but the thermal tolerances of 99 of those species would not matter. For example, in preparing the thermal endpoints for a General Use water, Mr. Yoder used the stonecat madtom fish species in his "General Use RAS 1" list of representative fish species for higher quality waters but eliminated that species when he prepared his alternative General Use RAS 2 list that he used as the basis for the UDIP Use thermal standards. Eliminating the stonecat madtom from the General Use RAS 2 list had the impact of dropping the short-term survival temperature by 4.5° F.[21] Similarly, as pointed out in the expert testimony of Lial F. Tischler on behalf of ExxonMobil Oil Corporation, if instead Mr. Yoder had used the secondary contact/indigenous species RAS list, the daily maximum temperature value would be 1.6°F higher than the proposed daily maximum standard (*i.e.*, 90.3°F instead of 88.7°F).[22] Hence, the only temperature endpoint value that matters for purposes of deriving the recommended thermal standard is the lowest one contained in Mr. Yoder's database for the most

[20] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 173.
[21] Yoder Testimony, January 30, 2008 Hearing Tr. at pp. 120-121.
[22] Exhibit 488, Pre-Filed Testimony of Lial F. Tischler on behalf of ExxonMobil Oil Corporation, at p. 37.

sensitive species on the RAS list that he selected from a table of species that he was given by U.S. EPA Region 5.[23]

As explained further below, Mr. Yoder's approach has several shortcomings.

1. The Proposed Thermal Standards are based on Questionable Data

First, Mr. Yoder did not conduct the critically important thermal literature data quality assurance review. Thus, it is not known whether the literature thermal data Mr. Yoder relied upon for deriving or extrapolating the daily maximum values are valid. Consistent with U.S. EPA 1985 guidance on the derivation of numerical water quality criteria (the "1985 National Guidelines"),[24] it is of paramount importance that the data selected for use be subject to adequate review to confirm its validity. "All data that are used should [have] enough supporting information to indicate that acceptable test procedures were used and that the results are probably reliable."[25] "Questionable data, whether published or unpublished, should not be used."[26] The issue of data review and acceptability is especially important when the proposed thermal standard is based on a single test result for a single most sensitive species, because an invalid or outlier data point will result in an erroneous, arbitrary limit if the value in question is associated with the species ranked most sensitive.

Mr. Yoder could not confirm whether the thermal endpoints which he provided to the Illinois EPA satisfied these data review requirements. He conceded he was not familiar enough with the U.S. EPA's 1985 guidance for deriving water quality criteria to opine as to whether what he did here would satisfy its quality assurance or quality control requirements.[27] He agreed that because a single species thermal endpoint value determines the numeric thermal standard, it is very important to determine the validity of the data.[28] In the case of the above-described, stonecat madtom thermal endpoint data, Mr. Yoder admitted that the data he used came from a

[23] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 37-40, 193; See also Exhibit 19 Table of RAS.
[24] *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses,* U.S. EPA, PB85-227049 (Jan. 1985) at pp.21-22 (the "U.S.EPA 1985 National Guidelines"). (Available on the internet at: http://owpubauthor.epa.gov/scitech/swguidance/standards/criteria/current/upload/2009_01_13_criteria_85guidelines.pdf)
[25] [U.S. EPA, 1985] *Id*. at p. 21.
[26] [U.S. EPA, 1985] *Id*.
[27] Yoder Testimony, January 31, 2008 Hearing Tr. at p. 60-62, 96-97.
[28] Yoder Testimony, January 31, 2008 Hearing Tr. at p. 75.

single test using only two test organisms obtained from a 1976 journal article.[29] He later testified that a valid thermal endpoint cannot be derived from using one or two test organisms.[30] In a more recent evaluation of thermal literature performed by the Electric Power Research Institute ("EPRI"), it is explained that the Critical Thermal Maximum ("CTM") laboratory test method establishes an estimated thermal endpoint for each single organism tested. Thus, a CTM can be established based on testing only one organism. EPRI's evaluation recommends that test results based on a small number of test organisms should be rejected and that CTM values based on tests with less than six fish not be used for criteria development.[31] Mr. Yoder's database that was used here (Exhibit 16) contains many examples of CTM-derived thermal endpoints based on testing three or fewer individuals.[32]

A review of Mr. Yoder's hearing testimony and work product shows that his description of the procedures he followed to develop the thermal endpoints he provided to Illinois EPA was inadequate to allow proper independent validation of his selected values.[33] Where literature data provided only a single reported thermal endpoint, Mr. Yoder created the thermal value by extrapolation to fill the literature "gap."[34] There is no evidence in this record showing that Mr. Yoder's extrapolation procedure has been peer reviewed or otherwise determined to be reliable.[35] In other cases, data from multiple studies were simply "averaged" to derive a single endpoint.[36]

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[29] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 127-8; January 31, 2008 Hearing Tr. at p. 90.

[30] Yoder Testimony, January 31, 2008 Hearing Tr. at p. 87. Mr. Yoder did not know how many studies using two or fewer organisms were included in his database. *Id*. at p. 90, 197-198.

[31] EPRI, *Thermal Toxicity Literature Evaluation, Final Report*, December 2011 (2011 EPRI Thermal Literature Report") at pps. 2-3, 2-4 and 5-3. Available on the internet at: www.epri.com (last checked 4/28/14).

[32] Among the most frequently cited sources in Ex. 16 for Mr. Yoder's thermal endpoint values is "Reuter and Herdendorf (1975)" and "Reuter and Herdendorf (1976)." As the 2011 EPRI Thermal Literature Report explains, of the 33 species tested by Reuter and Herdendorf in their studies, 17 CTMs reported were based on testing a single fish, and most of the rest were based on testing two to three individuals per species. *Id*. at p. 2-4. Also, with one exception, the CTM endpoints generated by Reutter and Herdendorf (1976) were all for fish "acclimated" to less than 25-30° C, the acclimation range that Mr. Yoder testified was appropriate for these waters. *Id*. at p. 2-3 and § 3.3.7.

[33] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 164-165.

[34] Exhibit 13, Yoder Pre-Filed Testimony, at p. 8.

[35] For example, Mr. Yoder testified that as part of another project, he obtain data collected by the Ohio River Valley Water Sanitation Commission (ORSANCO) to "update" his database, but he did not testify that he then updated the mathematical relationships in his extrapolation procedure based on the updated database. Yoder Testimony, January 30, 2008 Hearing Tr. at p. 198.

[36] Yoder Testimony, January 30, 2008 Hearing Tr. at pp. 56-7, 168. Because the studies in Yoder's database used different laboratory test methods (*e.g.,* ChTM, UILT, and CTM), he had to "convert everything to something compatible or equivalent to the incipient lethal temperature end point." *Id.* at 200-202.

Mr. Yoder provided no clear record of the literature data source(s) he used for the thermal endpoint values he provided to the Illinois EPA. He admitted that "without any knowledge of the decisions I made, [another expert] could potentially come out with a different answer."[37] Because Mr. Yoder's results are not reproducible, they do not follow the uncontroverted scientific method by which sound science is accomplished. Mr. Yoder was unaware of any set protocol for the literature data selection approach he used.[38] Mr. Yoder also admitted that he may have selected a thermal endpoint value from a paper where that value was not even the actual one presented by the paper's author.[39] Because he did not keep track of or otherwise disclose the basis of "his decisions," the proposed daily maximum values are supported by nothing more than Mr. Yoder's unsubstantiated thermal values, whose validity have not been confirmed. Even Mr. Yoder agreed that his model's thermal endpoint values will cause uncertainties that should be considered in the derivation or application of the daily maximum temperature criteria, but he did not discuss this or otherwise guide Illinois EPA as to how it should address these uncertainties.[40]

The raw thermal values database compiled by Mr. Yoder is provided in Appendix Table Z1 to Exhibit 16. Mr. Yoder calculated endpoints for 104 species and presented those endpoints in Table Z3. Because Mr. Yoder did not indicate which endpoint values he used, how he averaged those values, nor did he provide a clear explanation of how he chose one literature value over another, it is not possible to determine the accuracy of all the endpoints derived by Mr. Yoder (Table Z3) and on which he based his proposed thermal standards values in Exhibit 15.

At Midwest Generation's request, EA examined a significant portion of the Exhibit 16 data, including the literature references cited in support of the thermal values presented. EA's findings from this review are summarized in and attached as Attachment A. EA found that out of sixty-five percent of the 79 species it checked in Exhibit 16, at least one or more erroneous or inappropriate endpoint values were assigned to them by Mr. Yoder. One, two, or all three of the endpoints reported in Table Z3 of Exhibit 16 are wrong for at least 51 species. EA's analysis of

[37] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 210-213.
[38] Yoder Testimony, January 31, 2008 Hearing Tr. at p. 214.
[39] Yoder Testimony, January 31, 2008 Hearing Tr. at pp. 196-197. Such thermal endpoint values are denoted by an asterisk in Exhibit 16. *Id.*
[40] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 190-191.

the Exhibit 16 data found sixty erroneous endpoint values. As explained in more detail in Attachment A, these errors fall into the following categories: Critical Thermal Maximum (CTM) values not adjusted downward by 2° C as per Mr. Yoder's hearing testimony regarding his procedure to make them equivalent to Upper Incipient Lethal Temperature (UILT) values;[41] endpoints based on very small sample organism sizes, endpoints based on fish tested at acclimation temperatures lower than the ≥25° C acclimation values Mr. Yoder testified he selected as appropriate for these waters;[42] endpoints not adjusted according to the conversion factor provided in Table Z2 of Exhibit 16; and endpoints that do not correspond to any values in Table Z1 of Exhibit 16 and/or are otherwise erroneous. When multiple thermal endpoint values were listed in Exhibit 16, it is not clear how or which of these values were averaged to derive the thermal value shown in Table Z2. These expert review findings show that Mr. Yoder's actual procedures for selecting thermal endpoints are wrong, subjective, unreliable and/or, at best, unclear. In legal terms, his recommended thermal values for the waters at issue here are arbitrary and capricious.

An illustrative example from EA's review findings (Attachment A) is presented in more detail here to show the Board why any reliance upon Mr. Yoder's work to adopt thermal standards would result in arbitrary and capricious thermal standards. In Exhibit 16, Mr. Yoder reports that the optimum temperature for eastern sand darter is 25° C. According to Table Z1 of Exhibit 16, the cited literature source for this purported "optimum temperature" for the eastern sand darter is Scott and Crossman (1973).[43] Upon a review of Scott and Crossman (1973), a several hundred page book on fresh water fishes of Canada, it is indisputable that the 25° C value

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[41] Because the CTM method yields higher estimates of the upper lethal temperature of fishes compared to the ULT method, Mr. Yoder testified that he preferred to use input data based on ULT-derived endpoints. Yoder Testimony, January 30, 2008 Hearing Tr. at pp. 216-225. If no ULT data were available, Mr. Yoder subtracted 2° C from the CTM value to make it "equivalent to" an actual ULT-derived endpoint. (*Id.* at pp. 220-221). If the laboratory testing was not conducted at the acclimation temperatures of 25-30° C which Mr. Yoder preferred (*Id.* at p. 223), he considered not applying the 2°C adjustment factor. Mr. Yoder indicated that applying the 2° C adjustment factor was "a judgment call" (*Id.* at p. 224) and "it really gets down to a choice" (*Id.* at p. 225). Consequently, Mr. Yoder does not provide any clear protocol for applying his 2° C adjustment factor.

[42] As explained in the 2011 EPRI Thermal Literature Report, EPRI found from its review of the available studies on acclimation temperature that "the upper lethal limit for fish changes by 4° C for each 10° C change in acclimation temperature. This means that regulatory limits developed from endpoints based on fish acclimated to temperatures well below their upper temperature limit, regardless of how that limit is measured, will be overly restrictive because the temperature tolerance of such fish will be underestimated."

[43] The relevant pages from Scott and Crossman (1973), entitled "Fresh Water Fishes of Canada," which discuss the eastern sand darter, including the information on which Mr. Yoder relied, is attached as Attachment B to these comments.

was not reported or represented by the authors as an "optimum temperature" for this species. Instead, this thermal value was simply and solely the approximate water temperature at the time some eastern sand darter specimens were collected from the Chateauguay River in Canada. Scott and Crossman (1973) expressly caution that "we have no direct knowledge of [the sand darter's] biology"[44] and were instead simply reporting that these specimens "were caught over limestone terraces covered with a thin layer of mud with water temperatures of about 77°F (25°C)."[45] An isolated literature reference to an approximate water temperature value at which a particular species was collected certainly is not a scientific determination of an "optimum" temperature for that species, except apparently in Mr. Yoder's subjective and arbitrary opinion.

For the determinative "most sensitive species" for the UDIP, the white sucker with an endpoint value of 31.5° C, Mr. Yoder was not sure what data he used from the studies he listed in Exhibit 16 or whether or not he "averaged the data in some way" to derive this endpoint value.[46] (Mr. Yoder never reviewed the underlying studies from which his recommended thermal endpoint values were derived nor did he confirm that he was using more recent study results for a given species (as opposed to studies that may have been conducted decades ago with less defensible laboratory methods).[47] Repeated, but unsuccessful, attempts were made to extract from Mr. Yoder a clear description of the basis for the critically important 31.5° C white sucker thermal endpoint value he presented. After his hearing testimony, the Illinois EPA provided one white sucker article obtained from Mr. Yoder (see Exhibit 24). Thereafter, the Agency filed an affidavit by Mr. Yoder (see Exhibit 37) which includes a computer disc (CD) that was represented to contain other white sucker thermal data Mr. Yoder relied upon. It did not. The Agency then provided another CD (the "replacement" Exhibit 37). It still did not contain any white sucker study, any citation to a study or any other white sucker data. All that has been provided on the white sucker is Exhibit 24, a paper by Brungs and Jones (1977). The Brungs and Jones (1977) paper does not present an endpoint value of 31.5° C for white sucker. Thus, the record does not provide any scientific support for the selection of this white sucker

[44] *Id*. at p. 775.
[45] *Id*. at p. 776.
[46] Yoder Testimony, January 31, 2008 Hearing Tr. at p. 75-80.
[47] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 72; Yoder Testimony January 31, 2008 Hearing Tr. at p. 70-71. Yoder admitted to at least one occasion where he changed his proposed thermal endpoint value (one which was well below the ambient temperatures for Ohio in summer months) based on criticism he received from an ORSANCO subcommittee. *Id.*, January 31, 2008 Hearing Tr. at p. 167-169.

value by Mr. Yoder and hence, the Use A and UDIP Use daily maximum values on which it is purportedly based are not supported by scientific data.

Mr. Yoder's database is the sole but wholly unreliable basis on which the Agency has proposed the daily maximum thermal standards for the Use A, Use B and UDIP Use waters. Mr. Yoder's database cannot withstand the type of data validation approach that the Illinois EPA has applied in other rulemakings to adopt water quality standards.[48] Neither the Board nor Illinois EPA knows which, if any, of the thermal values Mr. Yoder used meet the criteria for acceptability laid out in the U.S. EPA guidance. EA's review findings of the database show that an overwhelming number of the thermal values do not meet recognized data acceptability criteria. Because confirmation of the validity of the Yoder thermal values is absent or their validity has been expressly refuted, the literature-based proposed daily maximum values for Use A, Use B and the UDIP Use should not be adopted. To do so on this record would clearly be an arbitrary and capricious decision.

2. The Approach to Deriving the Daily Maximum Standards is Contrary to U.S. EPA WQS Guidance

The Yoder approach deviates from standard U.S. EPA guidance regarding the derivation of water quality standards. U.S. EPA guidance provides that water quality standards should be designed to protect communities, not individual species (unless there is a threatened or endangered species present, which is not the case here). For example, U.S. EPA's 1985 National Guidelines provide that water quality criteria should be based on the 95th percentile of genus mean acute values, so protection of every species under every circumstance is not required.[49] U.S. EPA put it this way: "Because aquatic ecosystems can tolerate some stress and occasional

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[48] Illinois EPA has typically followed a data-validation approach consistent with the U.S.EPA National Guidelines in developing water quality standards. For example, when Illinois EPA proposed revised sulfate water quality standards in R07-9, it searched the sulfate database for "toxicity data that was reputable and representative of Illinois fauna" and eliminated data "deemed unacceptable for use in standards derivation." (Hearing Testimony of Brian Koch (IEPA) at p. 24, March 7, 2007, *In the Matter of: Triennial Review of Sulfate and Total Dissolved Solids Water Quality Standards: Proposed Amendments to 35 Ill. Adm. Code 302.102(b)(6), 302.102(b)(8),302.102(b)(10), 302.208(g), 309.103(c)(3), 405.109(b)(2)(A), 409.109(b)(2)(B), 406.100(d); Repealer of 35 Ill. Adm. Code 406.203 and Part 407; and Proposed New 35 Ill. Adm. Code 302.208(h)*, R07-09). Illinois EPA stated that "a key component in standards derivation is the gathering and assessing of available toxicity data." (*Id.*, emphasis added) In its data validation review, Illinois EPA confirmed that "several of the studies were deemed unacceptable for use in standards derivation." *Id.*

[49] U.S.EPA 1985 National Guidelines at p. 2.

adverse effects, protection of all species at all times and places is not deemed necessary."[50] Mr. Yoder disagreed. To derive the proposed daily maximum standards, he used instead the thermal endpoint data for 100% short-term survival of all RAS.[51] Thus, the proposed daily maximum values based on this data for both the UDIP Use and Use B are far too conservative and go well beyond what the Clean Water Act requires. As ExxonMobil's expert witness Mr. Tischler explained, Mr. Yoder's decision to use the 100% survival data value (88.7° F) instead of the 90 percent value (90.1° F) resulted in a more stringent proposed daily maximum standard for the UDIP. [52]

In 1977, the US EPA issued the only federal level guidance for how to assess possible thermal impacts, entitled "Interagency 316(a) Technical Guidance Manual And Guide For Thermal Effects Sections Of Nuclear Facilities Environmental Impact Statements."[53] Although over thirty years old, the U.S. EPA reaffirmed in 2008 its continued usefulness, stating that it "provides valuable technical information on conducting 316(a) demonstrations, useful to both facilities and permitting authorities."[54] Although this rulemaking does not involve a Section 316(a) assessment, much of the guidance provided by U.S.EPA is relevant to the issues presented here. In particular, the U.S. EPA states that the species selected for thermal evaluation of a water body should be to choose species that are both "representative" and "important," what it calls the "Representative Important Species" or "RIS," similar to but not the same as Mr. Yoder's use of "RAS."[55] Here, the Illinois EPA respectively used Mr. Yoder's 8 species RAS list ("Secondary Contact/Indigenous Aquatic Life") for the Use B waters and the 27 species RAS list (Modified Use) for the UDIP Use to develop the daily maximum thermal standards.[56] (See

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[50] U.S.EPA 1985 National Guidelines at pp. 1-2.
[51] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 173-75.
[52] Ex. 488, Pre-Filed Testimony of Lial Tischler, at p. 37.
[53] U.S. EPA, *Draft Interagency 316(a) Technical Guidance Manual and Guide For Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements*, May 1, 1977 ("U.S. EPA § 316(a) Guidance"), available at: http://www.epa.gov/npdespub/pubs/owm0001.pdf (last checked 4/28/14).
[54] U.S. EPA Memorandum, *Implementation of Clean Water Act Section 316(a) Thermal Variances in NPDES Permits (Review of Existing Requirements),* from James A. Hanlon, Director, Office of Wastewater Management, to Water Division Directors, Regions I-10, October 28, 2008, at p. 2 (available at: http://www.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-338.pdf, last checked 4/28/14). Under Section 316(a) of the Clean Water Act, if a discharge can demonstrate that the applicable thermal WQS is more stringent than necessary to assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the receiving waters, the discharger's thermal limits may be adjusted to a less stringent level.
[55] *Id.* at p. 35.
[56] Ex. 2, Pre-Filed Testimony of Scott Twait, at p. 12.

Exhibit 15 at Table 1). While most of the species in the RAS List for the Use B waters were reasonable choices, except for the fathead minnow, all of the following species on the UDIP Use RAS List were not "representative" and "important" as recommended by U.S. EPA's Section 316(a) guidance: northern pike, white sucker, fathead minnow, rock bass, and walleye. For each such species, the reasons why they should not have been included on these RAS Lists are explained briefly below:

Fathead Minnow: This species is rare in the Lower Des Plaines River and in the CSSC. The Metropolitan Water Reclamation District of Greater Chicago's ("MWRD") fish survey collection data for the period from 2008 to 2010 in the Lockport Pool showed no fathead minnow were collected.[57] Its close relative, the bluntnose minnow, which is present in the system, adequately represents the forage fish group and is already included on both the Use B and UDIP Use RAS List.

White Sucker: This species is rare in the Lower Des Plaines River. As shown in Table 1E of the 2003 EA Report, [58] fish data collected over a nine year period from 1994 to 2002 from the area of the Dresden Pool below the I-55 Bridge (the "Lower Dresden Pool"), where ambient temperatures are cooler than in the UDIP, only 11 white suckers were collected.[59] Despite being a highly "tolerant" species, within the meaning of the UDIP Use Designation adopted by the Board, it requires gravel/cobble areas with little or no siltation in which to spawn. Such areas are essentially absent in the UDIP and the rest of the Lower Des Plaines River. Species that are not able to establish self-sustaining populations should not be designated as RAS. The white sucker is somewhat thermally sensitive and even ambient background temperatures of the effluent-dominated system without the thermal industrial discharges are too high for this species during the summertime.

Northern Pike: Northern pike is a cool water species. Not only is the UDIP near the edge of their natural ranges, but there is little or no habitat in the UDIP or the entire Dresden Pool to support them. Northern pike require clear, well-vegetated lakes, pools, or backwaters to thrive and particularly to reproduce. Northern pike require soft substrate with

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[57] See, Pre-Filed Testimony of Jennifer Wasik, Attachment 8, *Fish Species and Number Collected at Lockport in the Chicago Sanitary and Ship Canal During 2008-2010*, filed October 8, 2010 in Subdocket C.
[58] The 2003 EA proposed thermal standards report, entitled *Appropriate Thermal Water Quality Standards for the Lower Des Plaines River*, January 23, 2003, Revised October 13, 2003 (hereinafter "EA 2003 Report" or "EA 2003 Thermal Standards,") is included in the attachments to the Agency's October 26, 2007 Initial Filing, Attachment A, Part 3, Appendix A, and a copy is attached here as Attachment D.
[59] 2003 EA Report at pp. 41-42, and Table 1E (Attachment D).

aquatic vegetation to spawn. Such areas are essentially absent from the UDIP. It is often classified as a cool water species so, like white sucker, ambient summertime water temperatures are likely too warm to support viable populations of this species. As shown in Table 1E of the 2003 EA Report (Attachment D), over the 1994 to 2002 period in the Lower Dresden Pool, only one northern pike was collected. This species is rare even in the Upper Marseilles Pool, further downstream from the Dresden Pool where General Use thermal standards also apply. [60]

Rock Bass: As its name implies, rock bass need rocks, typically of boulder size. This habitat type is absent in the UDIP so rock bass is not an appropriate RAS. Like the white sucker, only 11 rock bass were collected in a nine-year period from the Lower Dresden Pool. (2003 EA Report, Table 1E (Attachment D)).

Walleye: Like northern pike, walleye is also a cool water species, but is more thermally tolerant. Although walleye can live and feed in a variety of habitats, they need cobble substrates to spawn successfully. No such areas are present in the UDIP, the Lower Dresden Pool (below I-55 Bridge) or the Marseilles Pool. Nine years of fish collection data yielded only one walleye each from the Lower Dresden Pool and the Upper Marseilles Pool.[61]

As already explained above, the inclusion of the white sucker species appears to have driven the UDIP Use proposed daily maximum thermal standard. For the reasons stated above, it should not have been included in the thermal endpoint data Mr. Yoder provided to the Illinois EPA to derive this thermal standard.

Mr. Yoder himself acknowledged that the actual proposed daily maximum standards should not be based solely on the results of his literature data review. He advocated a "second step" in determining the proposed daily maximum standards - - consideration of the observed historical ambient temperature record for the receiving water.[62] In this second step, the available fish surveys data should have been considered to adapt the results of Mr. Yoder's literature

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[60] 2003 EA Report at pp. 41-42 and Table 1F (Attachment D). Even assuming the General Use thermal standards were applied to the UDIP, good northern pike populations would not become established. As was shown in Subdocket C, habitats upstream and downstream of the I-55 Bridge are similar. Hence, it follows that this species should have been able to establish viable populations in the lower Dresden Pool (below the I-55 Bridge) which is already subject to the General Use thermal standards. *Id.* at p. 42.

[61] EA 2003 Report at p. 41-42 (Attachment D).

[62] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 173-75.

review to these waters.[63] This second step could have provided standards that are both consistent with the Clean Water Act and U.S. EPA guidance. Standards that also may have been defensible under Illinois law as economically reasonable regulations. Because this step was not performed,[64] the proposed thermal standards are arbitrary.

3. The Approach to Deriving the Proposed Thermal Standards does not Reflect Real World Conditions

The literature-based approach to deriving the proposed daily maximum thermal standards cannot, by definition, adequately reflect real world conditions.[65] Fish, both juveniles and adults, have a well-established ability to avoid excessively warm or cool temperatures. The ability to avoid excessive temperatures explains why fish kills are rare during the summer.[66] In the real world, fish acclimate to temperature and avoid temperatures outside of their preferred range, which has been shown to be the case during the extensive field studies performed by EA Engineering.[67] Certainly, long-term avoidance of a particular habitat can be detrimental to aquatic population success, but short-term avoidance (*i.e.,* hours or days) is a beneficial, adaptive response. In nature, all species found at a location sometime during a year will not always be there. Seasonal and spatial thermal partitioning is an accepted feature of fish communities and is part of their inherent survival strategy. The long-term studies of the UDIP area by EA Engineering demonstrate that there is short term avoidance of the power plant discharge canals during the hotter periods of the summer, but that fish move back into these areas once more preferable temperatures resume. There is no evidence that fish permanently move from the area and do not return.[68]

The Yoder approach that Illinois EPA relies on here arbitrarily assumes that fish will not avoid pockets of higher temperatures. The result is a proposed daily maximum standard that

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[63] It is also important to consider that the predominant fish species, such as common carp, gizzard shad and channel catfish in the UDIP and CSSC waters are not temperature sensitive. See Seegert Hearing Testimony, November 10, 2008 PM session at pp. 18-21; see also Pre-Filed Testimony of Greg Seegert, Ex. 366 at p. 6).

[64] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 173-75

[65] While newer and more environmentally realistic methods have been developed for laboratory thermal studies on fish, such as the chronic thermal maximum (ChTM) method which is a slow heating laboratory method, Yoder could not identify whether any of his thermal endpoints for the daily maximum standards were based on tests using the ChTM method. Yoder Testimony, January 30, 2008 Hearing Tr. at p. 199-200, 216-220, 230-231.

[66] 2003 EA Report at p. 39, citing (EPRI 1981) and the U.S.EPA 1986 Gold Book (Attachment D).

[67] EA Engineering has been conducting fish surveys in the Upper Illinois Waterway ("UIW") and CAWS since 1980. Exhibit 366, Pre-Filed Testimony of Greg Seegert, at p. 16.

[68] EA 2003 Report at p. 39 (Attachment D).

overly protects the aquatic community so that every fish of every species reasonably expected to be present, either now or in the future, no matter how infrequently, in all areas of these waters at all times, is provided with a water temperature that is optimal – no matter the economic and other environmental costs of doing so, and irrespective of the fact that real world conditions would rarely provide this optimum environment.

C. The Proposed Daily Maximum Values Should Have Considered the Available Field Data

Mr. Yoder's limited directive for deriving suggested thermal standards purposefully biased the outcome of his work against any consideration of available fish thermal data from the area in and surrounding the UDIP, or for that matter, any other suggested approach to deriving thermal standards. Mr. Yoder conceded that the Ohio system on which his method is based emphasizes the use of field biological data.[69] But before providing his exclusively literature-based thermal endpoints data to the Illinois EPA, Mr. Yoder failed to use any available field biological data and did not factor in any of the over twenty years of fish thermal data available for these waters.[70] Mr. Yoder was aware of these site-specific fish studies, agreed the data were useful, conceded that biological field data are "pretty important" in assessing thermal conditions, but stated that reviewing the Lower Des Plaines River fish thermal data was, inexplicably, "outside the scope of [his] task."[71]

Hence, the thermal criteria derivation process used here inexplicably and arbitrarily ignored more definitive evidence available from approximately twenty years of fish surveys that have been conducted in the area by EA. As U.S. EPA has advocated in its 1985 National Guidelines, when sufficient site-specific field data are available, as is the case here, a field-based approach to deriving criteria should be used and endpoint measures should "take into account the appropriate features of the body of water and its aquatic community."[72] Mr. Yoder was aware of

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[69] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 88.

[70] In the early 1990's, in what has been identified in this record as the "UIW Study," Commonwealth Edison studied aquatic life in the 53-mile CAWS/UDIP reach between the diversion from Lake Michigan at Chicago and the Dresden Island Lock and Dam. Subsequently, the annual fish study reach area is a subset of the entire UIW. It extends approximately ten miles from the Lockport Lock and Dam on the Chicago Sanitary and Ship Canal down to area around the I-55 Bridge on the Lower Des Plaines River. Attachment MM to the Agency's initial filing in this rulemaking is one of the annual fish study reports on this subset area, the *2004 Lower Des Plaines River Fisheries Investigation, River Mile 274.4 through 285.5*, prepared by EA Engineering.

[71] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 83-85, 92, 97.

[72] 1985 National Guidelines at p. 3.

the August 2007 EA Engineering Report for the Lower Des Plaines River,[73] prepared for Midwest Generation and submitted to the Illinois EPA, which set forth an alternative, biologically-based approach to deriving thermal standards for the UDIP, but it was not provided to him to review.[74]

Whereas laboratory-derived data on thermal requirements for aquatic life can be used as a reasonable gauge when field data are lacking, the preferred measure of environmental acceptability is actual field data on temperatures effects. U.S. EPA § 316(a) Guidance recognizes this dichotomy by identifying two types of demonstration, one predictive (using largely laboratory data) and the other retrospective (using field studies). The "no prior appreciable harm" criterion for Section 316(a) retrospective analysis recognizes the primacy of actual field data. In general, the U.S. EPA advocated a balance between reliance on laboratory data and field surveys, such as the type conducted in the UDIP area by EA.[75] Because the approach here eliminated any consideration of field biological data, it is not consistent with this U.S. EPA guidance regarding the protection of the aquatic population in these waters.
The result of the flawed method followed here is that the Agency's proposed daily maximum thermal standards for the UDIP and the Use B Waters are not based on sound science. This basis is contrary to U.S. EPA's own directive that "State criteria must be based on sound scientific rationale."[76] The thermal standards developed based on Mr. Yoder's method are erroneous, arbitrary, overly conservative numeric values. The proposed daily maximum values rely exclusively on literature data, although much of it either unvalidated or refuted in this record. For all of the above reasons, the Board should reject the Agency's proposed daily maximum thermal standards.

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[73] The 2007 EA proposed thermal standards, entitled "Development of Biologically Based Thermal Limits for the Lower Des Plaines River," August 2007 (hereinafter "EA 2007 Report" or "EA 2007 Thermal Standards") were submitted to the Illinois EPA by Midwest Generation for its consideration in August 2007. A copy is attached here as Attachment C.
[74] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 86-87.
[75] U.S. EPA § 316(a) Guidance at p. 7.
[76] U.S. EPA's Updated Information for Chapter 3, Water Quality Standards Handbook, Section 3.3.3 State Criteria Requirements, available at: http://water.epa.gov/scitech/swguidance/standards/handbook/chapter03.cfm#section12 (last checked 4/19/14).

V. The Proposed Period Average Thermal Standards are Unnecessary, Inapplicable to these Highly Modified Waters and Overly Stringent

The proposed period average thermal WQS are virtually the same for all Use A, Use B and UDIP waters, with the sole exception being a slightly higher value for Use B waters in the summer months. In the Agency's May 2013 Amendments, it changed the period average thermal standards for the non-summer months for both Use A and Use B waters. In the Agency's subsequently filed Subdocket C First Notice Comments, it also proposed the same Use A changes for the UDIP period averages.[77] These three aquatic life use designations are different and are intended to protect aquatic life populations of differing quality and hence, differing thermal tolerances. The fact that the Agency's thermal standards approach does not significantly distinguish between or among these differing uses is the first indication that the standards are not scientifically justified and are overly conservative in one or more respects. Our environmental laws reflect a delicate balance among the cost of electricity to consumers, reliability, and air/water quality. If adopted as proposed, this rule would upset the delicate balance between the benefits and burdens that these regulations are intended to achieve.

The Agency intends that the period average values represent "background temperatures." In its May 2013 Amendments, the Agency used two sources for determining these values. The Agency used either the effluent temperatures from the MWRD or the Cal-Sag Channel-Route 83 temperature monitoring station (instead of the originally selected Route 83 CSSC temperature monitoring station). In addition, the Agency used the 90th percentile of the temperature data (instead of the previously selected 75th percentile) from the Cal-Sag Channel-Route 83 station, but still used the 75th percentile of the effluent temperature data.

In calculating the period average standards, the Agency selected the least restrictive of the 75th percentile of the MWRD effluent temperature data and the 90th percentile of the Cal-Sag Channel – Route 83 station. This resulted in using the MWRD's effluent temperatures for certain non-summer period averages (January, February, September 16-30, October, November and December), with the remaining non-summer period averages based on the Cal-Sag Channel-Route 83 station temperature data (March, April, May, and June 1-15). In addition, it appears that the Agency then further reduced the non-winter period averages by an additional 2° F to set the summer period averages, although it does not know if there is a scientific justification for

[77] Illinois EPA Subdocket C Second Notice Comments at pps. 15-17.

doing so.[78] The end result of the Agency's proposed revisions to the period averages for Use B and the UDIP Use was to make the period averages more stringent for most of the seventeen time periods during the year.

The proposed period average standards are not based on sound science. They are not based on either laboratory or field derived thermal effects end points for aquatic species.[79] The Agency admitted that no effort was made to compare the proposed period average standards to studies or other biological data to determine whether they are more stringent than necessary to protect the species expected to be present.[80]

The Agency defends its use of MWRD effluent data as "background temperatures" on the grounds these temperatures are protective of aquatic life.[81] Yet the Agency agrees that the fish have to "acclimate" thermally to these effluent-dominated warmer waters.[82] Apparently, the Agency interprets the Clean Water Act's provisions to allow for maintaining the existing thermal regime created by effluent-dominated waters, but only when doing so avoids the risk of requiring a major POTW like the Stickney Plant to "cool" its discharges. However, no other effluent discharges to these waters are afforded the same deference or tolerance. No explanation has been provided showing how this discrimination between effluent sources is consistent with the Clean Water Act.

The proposed period average thermal standards are not rationally based on the fundamental nature of the Use B and UDIP waters. At all times of the year, not just when the MWRD effluent temperatures are higher than those at the other Cal-Sag station, these are effluent-dominated waters. Hence, their "natural" thermal regime is dominated by the temperatures of effluent discharges. As the Board has previously found, "[t]he flow in the CSSC is predominantly treated and partially treated effluents from the District's wastewater reclamation plants and combined sewer overflows (CSOs)."[83] The Agency testified that the portion of the flow in the lower CSSC from the MWRD effluent discharges ranges from 50% to 75% and up to 100% (when no precipitation in present, which is usually the fall and winter

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[78] *Id*. at p. 222.
[79] 7/29/13 Hearing Tr. at p. 222.
[80] *Id*. at pp. 223-24.
[81] 7/29/13 Hearing Tr. at pp. 213-14.
[82] *Id*.
[83] Subdocket C First Notice Opinion, Feb. 21, 2013, p. 7.

periods).[84] It also carries pollutants from storm events, CSOs, storm water flows and flows from run-off snow melt conditions. In the UDIP, the effluent discharges from the upstream wastewater reclamation plants are almost 90% of the flow and during the winter almost the entire low flow consists of effluent discharges.[85] The high flows in these waters are dominated by urban runoff.[86] While there is not much room in these statistics for the effluent and urban run-off contributions to the flow to increase, it is likely to do so as future discretionary diversion from Lake Michigan into the CSSC incrementally decreases and the benefit of any cooler water from Lake Michigan declines.

As the Board acknowledged in its Subdocket C First Notice Opinion, "the temperature of the effluents determines the base temperature of the river, more so than it having a natural temperature."[87] As a consequence of their effluent-dominated nature, the "natural" thermal regime of these waters reflects seasonal changes primarily determined by the seasonal temperature of the effluent discharges. The effluent-dominated nature of these waters results in ambient temperatures that do not vary on a year-round basis to the same extent as non-effluent dominated waters. The MWRD's effluent discharges tend to have a relatively constant, moderate temperature which has the effect of dampening seasonal and diurnal changes.[88] Water temperatures increase from the CSSC to the UDIP area, due to a combination of ambient solar heating, WWTP discharges, power plant contributions and non-point source sheet runoff from urbanized areas.[89] Hence, while there are seasonal thermal changes, they are not like those in "natural" waters. Unless the temperature of the dominant effluent discharge from the MWRD's Stickney Plant on the CSSC is subject to thermal control, the background temperature of this waterway will remain elevated during the winter and spring months.[90]

The proposed period average values irrationally attempt to convert these effluent-dominated waters into natural water bodies, which they are not. The proposed period average values also ignore the impounded nature of these waters. As ExxonMobil's expert Mr. Tischler

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[84] Twait Testimony, July 29, 2013 Hearing Transcript at pp. 75-76.
[85] Opinion and Order, Second Notice in Subdocket A, *In the Matter of Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and Lower Des Plaines River: Proposed Amendments to 35 Ill. Adm. Code 301, 302, 303, and 304*, R08-09 at 48 and Attachment A, UAA Report, at 1-8.
[86] 9/23/13 Hearing Tr. at 98-99.
[87] Subdocket C First Notice Opinion and Order at p. 38.
[88] EA 2003 Report at p. 30 (Attachment D).
[89] EA 2003 Report at p. 30 (Attachment D), citing Final Report, UIW Study, 1995. Chapter 3.
[90] *Id*. at p. 32.

testified: "Temperature regimes in impounded surface waters are strongly influenced by the physical and hydrologic characteristics of the impoundment and natural heating and cooling are substantially different from freely flowing rivers."[91] Hence, Mr. Tischler challenged the representativeness of the Agency's use of water temperature data from a river site with higher stream velocities.[92]

Further, the Agency has not provided any scientific support for its premise that "cold periods" are necessary to protect for reproduction of the species expected to be present in these waters. The record lacks scientific literature supporting the conclusion that for the species expected to be present in these waters, in accordance with the Use B and UDIP use designations, they require the "cold periods" reflected in the proposed period average numeric thermal standards. As already explained above, colder water species like walleye are rarely found in these waters, largely due to habitat constraints. Mr. Yoder testified that there are no biological data assessments suggesting that maintaining the "normal seasonal cycle" requires achieving background temperatures uninfluenced by humans.[93] In sum, the Agency has no biological data to support its position that thermal values higher than its non-summer months period averages would inhibit aquatic life but rather is solely relying on Mr. Yoder's unproven "method" to conclude that background temperatures uninfluenced by man-made conditions should be maintained.[94] Such an approach illogically ignores the undisputed fact that the CSSC is a totally effluent-dominated, man-made, controlled water way which in turn heavily influences the thermal regime downstream in the UDIP.

Moreover, even assuming that the proposed period average values could be scientifically justified, the Agency's approach to calculating them is flawed and results in an overly conservative thermal WQS that is not required by the Clean Water Act. First, the use of either the 75th percentile or the 90th percentile data has no precedent in other states and is not consistent with a scientific approach or with U.S.EPA guidance.[95] U.S. EPA guidance provides for the use of either a 95th or 99th percentile approach.[96] Use of the 95th or 99th percentile, not the

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[91] Exhibit 488, Pre-Filed Testimony of Lial Tischler, at p. 38.
[92] *Id*. at p. 39.
[93] Yoder Testimony, January 31, 2008 Hearing Tr. at p. 126.
[94] Twait Testimony, July 29, 2013 Hearing Tr. at pp. 219-222.
[95] 7/29/13 Hearing Tr. at p. 218.
[96] Appendix E, Technical Support document for Water Quality-based Toxics Control, U.S.EPA, EPA/505/2-90-001 (Mar. 1991) available at: http://www.epa.gov/npdes/pubs/owm0264.pdf (last accessed April 23, 2014).

75th percentile, is a generally accepted scientific approach for developing WQS based on several years' worth of monitoring data, given expected year-to-year fluctuations. Particularly for waters such as these which are not capable of attaining the higher Illinois General Use designation, it is simply irrational to apply a more stringent and overly conservative approach to deriving thermal WQS than what the Clean Water Act requires for protection of the designated use.

Second, the Agency has not provided any rational or scientific basis for why, in this effluent dominated stream, the use of the 75th percentile for the effluent temperature data is justified.[97] As the Agency's Mr. Twait admitted in his testimony, the result of using the MWRD effluent 75th percentile data is that there will be times when these calculated background temperatures are exceeded by the actual ambient background temperatures in the stream.[98] At a minimum, the same statistical basis, such as the 95th or 99th percentile data should be used for both the effluent temperature data and the Cal-Sag Channel-Route 83 station data. As proposed, the non-summer period averages for both Use B and the UDIP are an arbitrary mix of "background values" from the Cal-Sag Channel-Route 83 station and MWRD effluent temperatures.

Third, the underlying thermal monitoring data which the Agency provided during the July 2013 hearing, in Exhibit 485, is both limited in scope and unclear as to what thermal monitoring data it contains. Exhibit 485 is a series of spreadsheets prepared by the Agency showing period average temperature values for eight thermal monitoring stations in the CAWS based on monitoring data that the Agency obtained from the MWRD. It is limited in scope because none of the data the Agency considered extends beyond the mid-2007 time period. Hence, it excludes more recent time periods, such as 2012 which was a particularly warm year in which multiple Illinois dischargers, including Midwest Generation, had to seek thermal provisional variances. The data it contains is unclear because when the Agency introduced Exhibit 485, the Agency's witness Mr. Twait could not identify either the location of each of the thermal monitoring stations nor their "order" going from upstream to downstream. Upon further review of Exhibit 485, the descriptions for certain of these monitoring stations were inadequate

[97] See, *e.g.*, July 29, 2013 Hearing Tr.at pp. 126-132, 157-167; Ex. 484 (chart of how non-summer period averages calculated from 1998-2007 thermal data).
[98] See July 29, 2013 Hearing Tr. at pp. 166-73; see also pp. 192-199 and Ex. 487 – MWRD data showing 2007-2012 temperature data and percent compliance at certain monitoring stations with period averages.

to allow for verification of their location, including by checking the identity of thermal monitoring stations on the MWRD website. Hence, it is not possible to verify the accuracy of the Agency's calculation of these period average values. Therefore, the only information provided in support of the period average values is not in accordance with established scientific method because it cannot be verified.

On their face, the significantly lower non-summer months period average temperatures are impossible to justify based on this record. It must be acknowledged that an impounded, effluent-dominated system such as the Use B and UDIP waters is going to be thermally peculiar and the imposition of any regulation specifying "natural" seasonal thermal regimes is both unrealistic and unsupported by sound science. The proposed thermal standards are based on the ill-founded concept of adopting numeric criteria based on an artificial "natural thermal regime" potential for these waters. Given the extent that these waters have been altered, the proposed thermal standards would be, in effect, forcing upon these waters a seasonal regime that they cannot reasonably attain, even if all of the municipal effluent that provides most of the flow and the industrial thermal discharges were eliminated.

VI. The Board should Reject the Agency's Proposed Cold Shock Amendment

The Agency's May 2013 Amendments, as subsequently modified by its Exhibit 482 revisions, introduced a new narrative "cold shock" provision in proposed Section 302.408(d), which provides as follows:

> Water temperatures of discharges to the CAWS Aquatic Life Use A Waters and CAWS and Brandon Pool Aquatic Life Use B Waters shall be controlled in a manner to protect fish and aquatic life from the deleterious effects of cold shock.

The Illinois EPA is not aware of any cold shock incidents occurring in these waters or in Illinois waters generally.[99] This proposed narrative standard amendment is not of the Agency's creation, but rather comes from U.S. EPA Region 5. The Illinois EPA's witness Scott Twait testified that the U.S. EPA Region 5 told Illinois EPA a cold shock rule was necessary and provided the proposed language (see Exhibit 486).[100]

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[99] Twait Testimony, July 29, 2013 Hearing Tr. at pp. 176, 186-187.
[100] *Id*. at pp. 176-179.

The proposed narrative cold shock rule is not only unnecessary, but impermissibly vague. In *American Paper Institute v. U.S. Environmental Protection Agency*, the U.S. Court of Appeals for the D.C. Circuit denied a petition to review pollution limits in a NPDES permit based on narrative criteria. *Am. Paper Inst. v. U.S. Envtl. Prot. Agency*, 996 F.2d 346, 351-2, 356 (D.C. Cir. 1993). The court suggested that the use of narrative criteria leaves permit writers in the unenviable position of drafting permit limits without clear guidance. *Id.* at 350. In the U.S.EPA's 1992 report concerning thermal discharges from power plants, entitled "*Review of Water Quality Standards Permit Limitations and Variances For Thermal Discharges At Power Plants*," it concluded that "guidance also needs to be developed on cold shock, especially for older peak power facilities which operate part-time."[101] The U.S. EPA has not developed any cold shock guidance. Particularly given the lack of any available regulatory guidance, the proposed narrative cold shock rule does not provide clear guidance either to Illinois EPA permit writers or to dischargers who may be subject to this rule.

Mr. Twait also testified that the U.S. EPA provided an alternative approach to addressing its cold shock concerns. The U.S. EPA advised that Illinois EPA could provide additional information to demonstrate that its proposed numeric thermal standards will prevent cold shock. If the Board concludes that the thermal standards should protect against cold shock, the Board should adopt the numeric approach presented in Section IX.A.1. below that eliminates the impermissible vagueness in the proposed section 302.408 narrative language.

VII. The Process Followed to Derive the Proposed Daily Maximum Thermal Standards is Contrary to the Clean Water Act's Mandate of State Primacy

Section 303 of the Clean Water Act, 33 U.S.C. § 1313(c), establishes the structure for the establishment of water quality standards. Section 303(c) clearly provides that states have the primary role and responsibility in developing water quality standards applicable to state waters. U.S. EPA's role is to review new and revised state water quality standards to determine whether they meet Clean Water Act requirements.[102] U.S. EPA's review is for the purpose of

[101] U.S. EPA, *Review of Water Quality Standards Permit Limitations and Variances For Thermal Discharges At Power Plants*, EPA 831-R92001, October 1992, at p. 18; See also Twait Testimony, July 29, 2013 Hearing Tr. at pp. 244-145.
[102] See 33 U.S.C. § 1313(c)(2); Specific elements of the U.S. EPA's review of WQS are set forth in 40 C.F.R. §§ 131.5 and 131.6.

determining if the standards are or are not consistent with the Clean Water Act.[103] It approves the WQS if they are consistent with the Clean Water Act or notifies the state that they are not consistent and specifies the revisions to be made.[104]

With respect to the development of the proposed Subdocket D thermal standards, the clear line the Clean Water Act envisions between the respective roles of the State of Illinois and the U.S. EPA was blurred. Instead of the Illinois EPA maintaining a primary role in the development of the proposed thermal standards, the U.S. EPA became directly and actively involved in the development of the standards. As a result, this rulemaking process ran afoul of the Clean Water Act's mandate of state primacy in this area. Instead of limiting its review to whether the Agency's proposed thermal standards were or were not consistent with the Clean Water Act's requirements, the U.S. EPA became so directly involved in the thermal standards derivation process at the state level that the resulting thermal standards proposed here are not "primarily" the work of the Illinois EPA, but rather of the U.S. EPA's views regarding what the appropriate thermal standards for these waters should be.

To be clear, Midwest Generation is not implying that the WQS derivation process followed here was done with any ill intent by either the state or the U.S. EPA. The U.S. EPA Region 5 provided its contractor, MBI, Mr. Yoder's employer, and the funding for use of its contractor, to the Illinois EPA for the development of the thermal standards in an effort to assist the Agency.[105] The Illinois EPA thereafter relied upon Mr. Yoder to ensure that the thermal standards report produced for the Agency (Exhibit 15) was consistent with U.S. EPA guidance.[106] However, in the course of Mr. Yoder's work to derive the thermal standards, there was clearly direct and significant involvement in the preparation of the Illinois proposed thermal standards by U.S. EPA Region 5 personnel. Illinois EPA staff testified that U.S. EPA Region 5 personnel were directly involved in reviewing Mr. Yoder's work. For example, it was U.S. EPA Region 5 personnel who advised Mr. Yoder to add the white sucker as a RAS for certain CAWS waters and also the stonecat madtom fish species for the UDIP (although this species was later eliminated from consideration by the Illinois EPA).[107] The Illinois EPA in turn wholly relied on

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[103] See 33 U.S.C. § 1313(c)(3); 40 C.F.R. § 131.21.
[104] *Id.*
[105] March 11, 2008 Hearing Tr. at pp. 187-188.
[106] March 20, 2008 Hearing Tr. at p. 194.
[107] March 11, 2008 Hearing Tr. at pp. 198-203, 210.

the white sucker literature data that Mr. Yoder selected for deriving the daily maximum thermal standards for Use A and UDIP Use waters.[108] In the materials the Agency produced regarding how Mr. Yoder performed his work to generate the thermal standards recommendations (Exhibit 37), there are several e-mails from Region 5 personnel that appear to be providing comment on earlier drafts of Mr. Yoder's report (Exhibit 15) containing the recommended thermal standards.[109] From these e-mails, it appears that Mr. Yoder submitted an initial draft of his report which contained more lenient thermal standards recommendations to U.S. EPA for review.

U.S. EPA's direct influence over the thermal standards derivation process, specifically its directive to Mr. Yoder to include the white sucker species, determined several aspects of the Agency's proposed thermal standards. It resulted in the Use B year-round daily maximum standard becoming more stringent, from 91.9° F to 90.3° F, as well as the summer months period averages, which decreased from 88.3° F to 86.7° F.[110] U.S. EPA Region 5 staff also directed Mr. Yoder as to what monitoring station to use for purposes of selecting background temperatures for the CAWS and UDIP.[111] Because the Illinois EPA relied on Mr. Yoder, it did not review any chronic thermal data to determine whether the period average standards concept which Mr. Yoder proposed was really necessary.[112] The period average concept originates solely from Mr. Yoder's approach – a concept that was never even briefly discussed during the many stakeholder discussions on the proposed thermal standards that the Illinois EPA held.[113] Finally, at the direction of U.S. EPA Region 5, the Agency has included a vague and indeterminate cold shock narrative provision in its proposed thermal standards.

The U.S. EPA's direct and active involvement in the derivation of the Illinois EPA's thermal standards directly conflicts with, and is contrary to, the Clean Water Act's mandate that the states, not the U.S. EPA, must have the primary role in determining water quality standards in each state for all state waters. In this instance, the U.S. EPA crossed the line drawn by the Clean Water Act that limits its role to reviewing and approving or disapproving state water

[108] March 12, 2008 Hearing Tr. at p. 78.
[109] See various e-mails between C. Yoder and P. Howe (U.S. EPA Region 5) contained in the first documents contained on the CD that is Exhibit 37 in this proceeding.
[110] Twait Testimony, March 11, 2008 Hearing Tr. at pp. 202-203; March 12, 2008 Hearing Tr. at p. 70.
[111] January 31, 2008 Hearing Tr. at pp. 150-151.
[112] Twait Testimony, March 12, 2008 Hearing Tr. at p. 10.
[113] *Id*. at p. 54.

quality standards based on whether they are consistent with the Clean Water Act. The U.S. EPA certainly may provide guidance to the states, but it is not supposed to actively engage in or direct the state's derivation of its water quality standards as was done here.

The overreaching participation by the U.S. EPA in the Illinois thermal standards development process had other negative effects regarding the process the Agency followed to derive its proposed thermal standards. The evidence strongly suggests that because the U.S. EPA supplied Illinois EPA with its contractor, and then directed that contractor's work, the Illinois EPA was reluctant to give any serious consideration to alternative approaches, or to other relevant data, that were not part of the MBI scope of work for which U.S. EPA funding was being provided, and as to which U.S. EPA was directly reviewing and commenting on the work product produced by its contractor MBI. For example, Mr. Yoder agreed that the years of biological data that had been collected for in the area of the UDIP were relevant to consider in deriving the thermal standards, but he did not do so because it was beyond the scope of work he was given to do.[114]

The U.S. EPA funding was for the purpose of, and limited to, supporting only Mr. Yoder's approach to deriving thermal standards. Consequently, as the Illinois EPA's Mr. Twait testified, while the Agency was not opposed to looking at other methodologies, it said it did not have the resources to do so.[115] There is no evidence in the record indicating that the Agency pursued any other funding sources or gave interested parties who would be subject to these rules, an opportunity to provide such additional funding. In another context where Mr. Yoder performed similar work in Ohio, and funding restrictions were not such a limiting factor, he was requested to look at alternative approaches to the thermal standards derivation approach he had developed.[116] One of those approaches was the Wisconsin approach which, as Mr. Twait described, includes both generic standards and a "discharger specific" approach that takes into account the ambient temperatures in the water body, the temperature of a discharge and also applicable mixing zones, unlike the literature-based approach Mr. Yoder employed.[117] The biased nature of the derivation of the Agency's proposed thermal standards extended to the extensive documentation and support for alternative approaches to deriving the thermal standards

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[114] Yoder Testimony, January 30, 2008 Hearing Tr. at p. 83-85, 92, 97.
[115] Twait Testimony, March 10, 2008 Hearing Tr. at p. 191.
[116] *Id.* at pp. 189-190.
[117] *Id.* at pp. 190-191.

which Midwest Generation's thermal expert EA Engineering provided to the Illinois EPA for its review in both 2003 and 2007. With respect to the August 2007 EA proposed thermal approach, the Agency did not review it because its "rulemaking was basically set" and it was not going to change its proposal "at that time."[118]

Based on this record, Midwest Generation submits that the Agency's proposed thermal standards derivation process was biased and contrary to the provisions of the Clean Water Act. The process involved overreaching by the U.S. EPA into the State of Illinois' primary authority to develop water quality standards free of such direct participation, as contemplated and mandated by the Clean Water Act. In the end, the proposed thermal standards are flawed because they are the result of a biased, exclusionary approach that was dictated by the scope of work given to the U.S. EPA's contractor MBI/Yoder, along with the funding limitations that accompanied that directive. The end result of diverging from the Clean Water Act's prescribed process for the promulgation of water quality standards is proposed thermal standards that are not primarily the state's work product, do not follow the 1985 National Guidelines for consistency with the Clean Water Act because they ignore field biological data, and rely instead upon data that is erroneous, unverifiable and contrary to sound science.

VIII. The Agency's Proposed UAA Thermal Standards Are Not Economically Reasonable

Under Section 27 of the Illinois Environmental Protection Act, when promulgating a rule, the Board must take into account several matters including the technical feasibility and economic reasonableness of reducing pollution.[119] As the Illinois EPA pointed out in its Statement of Reasons, the Board is required to examine the economic impacts of any new technology required by the rulemaking. The Lower Des Plaines River UAA Report also noted that economic and operational considerations may be significant and should be given due consideration.[120]

To achieve and maintain compliance with the proposed UAA thermal standards, retrofitting the Midwest Generation stations to closed-cycle cooling, through the use of cooling tower technology, is the only option that would effectively achieve and maintain compliance

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[118] Twait Testimony, March 10, 2008 Hearing Tr. at p. 192.
[119] 415 ILCS 5/27(a) (2010). The Board also makes a determination whether the proposed rule has any adverse economic impact on the people of Illinois. 415 ILCS 5/27(b) (2010)
[120] Attachment A, UAA Report at 2-104.

with the proposed UAA thermal standards. [121] The evidence shows that the costs of doing so are not economically reasonable, particularly given the absence of any significant environmental benefit.

The three Will County and Joliet Stations are coal-fired and utilize an open cycle, once-through condenser cooling system that requires the use of large volumes of surface water.[122] Water enters the plants, is circulated through the station's condensers to cool steam produced by the electric generating process, and then is discharged at a higher temperature back into the receiving water. [123] Only one of these stations, Joliet 29, has cooling towers. The Joliet 29 (Units 7&8) cooling towers, installed in 1999, are open-cycle, non-recirculating cooling towers.[124] The towers are "helper cooling towers," meaning they are not designed for long-term continuous runs, but rather can be used on an as-needed basis. The towers cool approximately one-third of Joliet 29's total design discharge.[125]

In the UAA Subdocket C proceedings, Midwest Generation presented the expert testimony of Ray E. Henry, Principal Consultant with Sargent & Lundy, LLC, and an extensive compliance costs study prepared by Sargent & Lundy, a recognized expert in the field.[126] Sargent & Lundy evaluated the feasibility of both open-cycle cooling and closed cycle cooling on all five of the then existing Midwest Generation facilities, as well as the addition of helper cooling towers. As Mr. Henry testified, Sargent & Lundy concluded that helper cooling towers and open cycle cooling would not be able to achieve and maintain the proposed UAA thermal standards.[127] The Sargent & Lundy study showed that if the Board were to adopt the Agency's proposed UDIP and Use B (for the CSSC) thermal standards, which it now has done, these stations would have to install closed-cycle cooling through the use of cooling towers and the combined compliance costs would be well over $600 million dollars, with annual estimated operation and maintenance ("O&M") costs of approximately $17 million based on 2011

[121] Ex. 440 at p. 8.
[122] Ex. 364 at p. 2.
[123] Ex. 364 at pp. 2-3.
[124] Ex. 364 at p. 4.
[125] Ex. 364 at p. 4.
[126] Ex. 440, Pre-Filed Testimony of Ray E. Henry.
[127] Ex. 440 at p. 6.

dollars.[128] Midwest Generation maintains that such exorbitant compliance costs are not justified or economically reasonable within the meaning of section 27 of the Illinois Environmental Protection Act, based on the evidence presented in this rule-making to date.

The estimated capital costs include $115 million for the Joliet 6 facility and $300 million for the Joliet 7&8 facility, for a combined total of over $415 million in capital costs just for the two Joliet Stations located in the UDIP. An additional estimated capital cost of $257 million for the Will County Station.[129] The largest capital expense was the cooling towers themselves.[130] The estimated O&M costs total over $17 million per year for these three facilities (approximately $2.7 million for Joliet 6, $9.1 million for Joliet 7&8 and $5.8 million for Will County).[131] The additional power necessary to pump water to the cooling towers would be redirected from each station's output, resulting in an additional revenue loss beyond the estimated capital and O&M cost totals.[132] These costs represent the low end of the range of closed-cycle cooling costs because they do not include additional potential costs that were not considered or included in Sargent & Lundy's cost estimates, such as noise and plume abatement, icing and fogging issues, air permitting issues, and other regulatory agency requirements, as well as multiple other unknown complications that could occur during the actual design and construction of the closed-cycle cooling systems.[133] Nothing in this record disputes or rebuts the compliance cost evidence Midwest Generation presented.

The costs of compliance that are associated with the Agency's proposed UDIP thermal standards are clearly not economically reasonable. There also is no evidence showing any improvement to the aquatic communities in the UDIP or the CSSC segments that could possibly justify the extreme costs to achieve the proposed thermal standards. Clearly, the record shows that any minimal environmental benefit that may potentially be realized is greatly outweighed by the economically unreasonable compliance costs that would be incurred to achieve it. Consistent with both the CWA and the Illinois Environmental Protection Act, the Board should not adopt

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[128] See Ex. 440 Pre-Filed Testimony of Ray E. Henry at pp. 14-15 and attached Ex. B thereto (the Sargent & Lundy Report); March 9, 2011 Hearing Transcript at p. 45 *et seq.* The estimated costs provided here exclude those costs associated with the now closed Fisk and Crawford Stations, which were operating at the time Sargent & Lundy prepared its Report and also when Mr. Henry testified in this proceeding.
[129] Ex. 440 at p. 14.
[130] Ex. 440 at p. 14.
[131] Ex. 440 at p. 15 and Table ES-2.
[132] Ex. 440 at p. 15, March 8, 2011 Hearing Tr. at p. 98.
[133] Ex. 440 at 17.

the proposed UDIP and Use B thermal standards. Or, if it does, it at least must adopt provisions regarding appropriate variance relief to address the significant adverse effects that will result to dischargers like Midwest Generation, as discussed further below in Section XI.

IX. Alternative Thermal Standards Options for the UDIP and Use B CSSC Waters are Available and Should be Considered by the Board

There is available information from the work performed by EA on which the Board can rely to identify and adopt thermal standards that are appropriately protective of the Use B and UDIP waters, unlike the Agency's proposed standards. Particularly for the UDIP, in both its Subdocket C First Notice and Final Order Opinions, the Board specifically acknowledged it was "mindful that, particularly in the area of temperature, water quality standards may need to be adapted for the UDIP."[134] As stated earlier in these comments, it is completely illogical to adopt the Illinois EPA's current proposal because it contains thermal standards for both the Use B and UDIP waters that are significantly more stringent than even the General Use standards which apply to higher quality, more natural Illinois waters. Such an outcome is not scientifically or rationally justified and sets an abnormal precedent.

The Board has all of the following alternative thermal standards options it should consider adopting in lieu of the Agency's proposed thermal standards:

1. There are proposed thermal standards prepared by a recognized expert in the field, EA Engineering, in both the revised October 2003 (the "2003 EA Thermal Standards")[135] and 2007 (the "2007 EA Thermal Standards") proposals Midwest Generation submitted to the Illinois EPA.[136] (A copy of the 2007 Midwest Generation submission to the Agency of the 2007 EA Thermal Standards, entitled "Development of Biologically Based Thermal Limits for the Lower Des Plaines River" is attached as Attachment C to these comments. A copy of the 2003 EA Thermal Standards report, entitled "Appropriate Thermal Water Quality Standards For The Lower Des Plaines River," is also attached as Attachment D.)

2. The 1996 Adjusted Thermal Standards adopted by the Board in AS96-10; and

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[134] Subdocket C First Notice Opinion and Order at p. 221; Subdocket C Final Order and Opinion at p. 10.

[135] The 2003 EA proposed thermal standards report is included in the attachments to the Agency's October 26, 2007 Initial Filing, Attachment A, Part 3, Appendix A. It is also described and referenced in the Lower Des Plaines UAA Report, Attachment A to SOR.

[136] The 2007 EA Thermal Standards were submitted to the Illinois EPA by Midwest Generation for its consideration in August 2007. However, in its 2008 hearing testimony, the Illinois EPA stated that it did not have time to consider them before it filed the proposed thermal standards in this rulemaking in October 2007. Twait Testimony, March 10, 2008 Hearing Tr. at p. 192. Apparently, the Agency has continued to ignore them.

3. The numerical General Use thermal standards in 35 Ill. Adm. Code §302.211 (the General Use narrative prohibition against a 5° increase in ambient temperatures above "natural" temperatures was not intended to and should not apply to these effluent-dominated, artificially controlled and man-made waters).

Both the 2003 and 2007 EA Thermal Standards, as well as the AS96-10 Adjusted Thermal Standards, are based on information collected from the UIW Studies that were developed and implemented under the direction of an ad hoc task force consisting of representatives from Illinois EPA, U.S. EPA Region 5, Illinois Department of Natural Resources and the MWRD, as well as other interested public, private and academic groups. Representatives of Illinois EPA, IDNR and U.S. EPA have recognized the UIW Study as the most comprehensive, multi-disciplinary effort ever performed on this waterway. A description of the UIW study is contained in Appendix 2 of the 2003 EA Report (Attachment D) and in the Board's AS96-10 Opinion. [137]

The UIW Study not only included a literature review on effects of temperature on fish as well as interactions of temperature and chemicals of freshwater biota, but also went the next step (the one not conducted for the Agency's proposed thermal standards) to collect and consider biological monitoring data of not only fish, but also phytoplankton/periphyton, macrophytes, benthic invertebrates and ichthyoplankton.[138]

Both the 1996 Adjusted Thermal Standards and the numerical General Use standards are still more protective than is necessary for the Use B and UDIP waters. They were adopted to protect higher quality General Use waters. But at least they are not overly protective to the same extent as the Agency's proposed thermal standards. On a relative scale, they are less objectionable than are the Agency's proposed thermal standards, which is why they are presented here.

Each of the above alternatives is discussed in more detail below.

A. Overview of the 2007 and 2003 EA Thermal Standards

The 2007 EA Thermal Standards are primarily based on the biological data collected from the UIW Studies beginning in 1994 and from the subsequent annual surveys in the

[137] See also, IPCB Order and Opinion, AS96-10 (Oct. 3, 1996).
[138] 2003 EA Report (Attachment D) at Appendix 2, p. 76.

Lockport, Brandon and Dresden Pools and in the area of the south branch of the Chicago River, immediately upstream of the CSSC that EA subsequently continued after the Board granted the AS96-10 relief.[139] EA's accompanying 2007 Report (Attachment C) explains "why use of the extensive, site-specific field database that has been collected in Dresden Pool is the most appropriate and robust method to derive thermal limits for the UIW" (*e.g.,* the UDIP).[140] These data collections in the UIW database number in the thousands over the approximately twenty year period of data used to derive these standards.[141] Since 1993, EA Engineering has made a total of 3,159 collections from the Dresden, Brandon, and Lockport Pools to assess the resident fish populations. (This compares to only 22 collections made by MBI from these pools, only six of which were collected from the UDP, and all of which were collected during a single year (2006)).[142] For example, during just the period through 2005, EA made 557 collections in the Lockport Pool alone.[143] There were 77 different fish species included in the database that EA used to derive the 2007 Thermal Standards. The UIW data collected by EA meets the standard of "high quality data" specified in U.S. EPA guidance regarding the derivation of WQS.[144] As the Board acknowledged in its Subdocket C First Notice Opinion, the EA studies were the only source of data used for the LDPR UAA analysis - - a testament to the quality and reliability of this data.[145]

As EA explains in its 2007 Thermal Standards Report (Attachment C), its approach is based on deriving thermal limits that ensure a balanced aquatic community is achieved and maintained for the water body. This approach is consistent with the requirement in Section 316(a) of the Clean Water Act that at all times, a balanced, indigenous population must be maintained.

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[139] 2007 EA Report (Attachment C) at p. 3; Hearing Testimony of Greg Seegert (EA), 11/10/08AM Hearing Tr. at p. 22. Because of changes to sampling methods and locations that have occurred since 1994, the earlier biological data collected in the UIW since 1978 was not used to derive the EA thermal standards. 2007 EA Report at p. 3.
[140] 2007 EA Report (Attachment C) at p. 2.
[141] Because of changes to sampling methods and locations that have occurred since 1994, the earlier biological data collected in the UIW since 1978 was not used to derive the EA thermal standards. 2007 EA Report (Attachment C) at p. 3.
[142] A more detailed discussion of the EA fish surveys is contained in the 2008 EA Engineering Report which is part of Exhibit 366, Ex. 2, Attachment 1.
[143] November 10, 2008AM Hearing Tr. at p. 22.
[144] 2007 EA Report (Attachment C) at pp. 3-4.
[145] Subdocket C First Notice at p. 40.

Also, the underlying field-collected biological data on which the 2007 EA Thermal Standards are based properly, but conservatively, takes into account avoidance behavior because if a species avoids a thermally-enhanced area during the May through September annual time period during which the field collection work was performed, its absence is noted and the biological measurements that were used (*e.g.,* species richness and the modified Index of Well Being) were "reduced accordingly to reflect their absence." [146]

EA's proposed standards are also consistent with U.S. EPA's 1977 Guidance and accepted methods regarding the selection of representative species. For the UDIP Proposed Thermal Standards, EA compiled and reviewed peer-reviewed, acceptable thermal tolerance data on the following RAS species: Smallmouth bass, Green sunfish, Gizzard shad, Smallmouth buffalo, Freshwater drum, Largemouth bass, Bluegill, Emerald shiner, Channel catfish, Common carp, Bluntnose minnow and Redhorse.[147] All these UDIP species, except for redhorse, have upper temperature tolerances in the mid to high 30s °C (95 – 100 °F), which indicates that occasional exposure to temperatures in the mid to high 90's °F should have little effect on these species. The fact that populations of several of these species are good in the Upper Dresden Pool supports this interpretation.[148] Further, EA's studies have shown that factors other than temperature (likely either poor habitat or sediment quality) limit redhorse abundance in the entire Dresden Pool, not just the UDIP.[149] As EA explained in proposing its thermal standards, "[t]he biological community data collected on the Lower Des Plaines River for the past 20+ years is more reliable and ecologically meaningful. It warrants a higher level of credence than laboratory-derived endpoints that attempt to predict how the biological community would respond."[150]

The numeric temperature provisions of the EA 2007 and 2003 Thermal Standards are described further below.

1. 2007 EA Thermal Standards

To derive the 2007 EA Thermal Standards, the biological data and measurements used by EA, as described above, were subjected to two different and independent statistical analyses to

[146] 2007 EA Report (Attachment C) at pp. 4-5.
[147] 2003 EA Report (Attachment D) at pp. 41-42.
[148] *Id*. at p. 42-43 and Table 2 (setting forth the thermal literature values and sources used by EA).
[149] *Id*. at p. 44, Tables 3 and 4.
[150] *Id*. at p. 46.

identify and confirm the appropriate thermal values.[151] Based on these analyses, EA determined that a balanced, indigenous aquatic population would be protected if the monthly average temperatures do not exceed 90° F (the thermal value generated by the more conservative of the two statistical analyses) and the daily average temperatures do not exceed 93° F.[152] These proposed values were also "ground truthed" by consideration of U.S. EPA laboratory-derived data.

Accordingly, consistent with EA's analysis and recommendations, in the 2007 EA Thermal Standards, Midwest Generation proposed to the Illinois EPA a summer maximum monthly average temperature of 90°F, with a maximum daily average temperature not to exceed 93° F. For the non-summer months, and in a manner that addresses U.S. EPA's concerns regarding cold shock, the 2007 EA Thermal Standards proposed a standard that prohibited a change in the ambient temperatures of more than 27° F. This non-summer month standard addresses any perceived risks of cold shock occurring in Illinois waters and is based on U.S. EPA guidance.[153] As explained in further detail in the EA 2007 Report (Attachment C), this recommended thermal standard is based on the studies performed and guidance provided by two recognized experts in the thermal field, Brungs and Jones (1977), showing that in the typical winter ambient conditions found in the Lower Des Plaines River, so long as Delta T temperatures are ≤27° F, no cold shock mortality would be expected to occur.[154] Beyond protecting against a sudden drop in the ambient temperature of the water body, there is no scientific justification for setting additional thermal standards for the UDIP because there are no species that are present or expected to be present that require "a long chill period" in order to protect their reproduction, maturation and spawning behaviors.[155]

Unlike the Agency's proposed thermal standards, the 2007 EA Report containing the 2007 EA Thermal Standards was reviewed by a second independent expert, Dr. Charles C. Coutant. Dr. Coutant is a nationally recognized thermal standards expert who has been integrally involved in the development of thermal standards guidance at both the federal and state level,

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[151] 2007 EA Report (Attachment D) at pp. 6-7.
[152] *Id*. at p. 8.
[153] See Red Book 1976. Quality Criteria for Water, U.S.EPA PB 263 943, at p. 432.
[154] 2007 EA Report (Attachment C) at p. 9.
[155] *Id*. at p. 9.

including the U.S. EPA's development of the 1977 Clean Water Act Section 316(a) guidance.[156] Dr. Coutant was provided the 2007 EA Report to review. He submitted the results of his review to Midwest Generation by letter dated August 9, 2007, a copy of which is attached to these comments as Attachment E. In Dr. Coutant's opinion, EA's thermal analyses and findings were "sound, consistent with recognized scientific literature and administrative guidance, and with appropriate discussion justifying the approach."[157] Dr. Coutant concluded that the numerical thermal values for the UDIP derived by EA were supported by their technical analyses, which was both "appropriate and well done." In Dr. Coutant's opinion, EA's approach was "technically sound and directed appropriately at the issue of setting biologically based water temperature standards in the Lower Des Plaines River" and "provides both scientific and administrative justification for emphasizing the field approach in this situation." Specifically with respect to the proposed winter months UDIP thermal standard to address cold shock concerns, Dr. Coutant found EA's analysis to be "consistent with EPA guidance, [his] own development of cold kill guidance for power plants…and the wintertime conditions of the Lower Des Plaines River."[158] Dr. Coutant also agreed with the EA 2007 Report's "discussion of the need for verification of data (for validity and suitability) used for establishing water quality criteria and standards." He found the examples EA provided of the problems and errors with the MBI/Yoder report (Exs. 15 and 16) to be "clearly unacceptable scientifically" and stated that he put more credence on the field data and analysis provided in the EA 2007 Report.[159]

2. 2003 EA Thermal Standards

The 2003 EA Thermal Standards were based upon the recommendations contained in the 2003 EA Thermal Standards Report. In the 2003 EA Thermal Standards, EA provided a similar but somewhat different approach to the UDIP thermal standards. The 2003 EA Thermal Standards, in Table 5, set forth recommended daily average temperatures throughout the year.

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[156] Since the 1970's, Dr. Coutant has served in several preeminent roles regarding heat and temperature issues, including the preparation of U.S. EPA guidance on thermal issues. Dr. Coutant was a co-author of the U.S. EPA's 1977 interagency guidance for implementing Section 316(a) of the Clean Water Act and was also the principal author of the Heat and Temperature chapter of the National Academy of Sciences/National Academy of Engineering report Water Quality Criteria-1972. Dr. Coutant also is familiar with the UDIP area from his work as the Co-Chair of the UIW Ecological Study Task Force in the early 1990's. Dr. Coutant retired from the Oak Ridge National Laboratory in 2005. See Coutant August 9, 2007 Letter ("Coutant Letter") (Attachment E) at p. 1.
[157] Coutant Letter at p. 2.
[158] *Id.*
[159] *Id.*

Like the 2007 EA Thermal Standards, the EA Thermal Standards for the summer period is also based on the biological data collected from the UIW studies. The main difference between the 2003 and 2007 EA Thermal Standards is that the 2007 EA Thermal Standards included more extensive statistical analysis of the biological field data upon which each proposal was based for the summer period temperatures. The 2003 proposed temperature limits for the non-summer months were patterned after the existing thermal regime in the waterway, which reflected more seasonal fluctuation than the existing Secondary Contact thermal limits, but also took into account the many unequivocally human-induced waterway conditions, which have a great influence on ambient waterway temperatures. The 2003 Proposal did not specifically address the potential cold shock issue which has since been raised during the UAA hearing process. However, both thermal standards proposals are biologically appropriate for the UDIP and are based on sound science and real-world data.

The numeric limits in the EA Thermal Standards are based on the general seasonal temperature cycle of the waterway and incorporate a margin of safety.[160] They are far more reflective of the "real world" ambient conditions actually encountered in the UDIP and complement the existing AS96-10 adjusted thermal standards which are applicable at the I-55 Bridge, in recognition of the UDIP's transition role between Use B and General Use waters.[161]

The 2003 UDIP Proposal provides for daily average maximum standards as follows:

January:	72° F
February:	77° F
March:	82° F
April:	90° F
May 1-15:	92° F
May 16-31:	93° F
June:	93° F
July:	93° F
August:	93° F
September:	93° F
October:	92° F
November:	90° F
December:	82° F

[160] 2003 EA Report (Attachment D) at p. 65.
[161] *Id*. at p. 65.

Under this proposal, maximum temperature in the main body of the river shall not exceed the maximum limits listed above by more than 5°F for more than 5% of the hours in the 12 month period ending December 31 of each calendar year. Consistent with the existing Illinois water quality standards, Midwest Generation proposed that compliance with these thermal standards would be measured at the edge of the allowed mixing zone.

3. Use B (CSSC) Proposed Thermal Standards

As the Board recognized in the recently enacted ALU Use B, the aquatic life use in the CSSC represents an aquatic community of significantly lesser quality than in the UDIP. Particularly with respect to the fish species present or which can reasonably be expected to be present, the potential CSSC and UDIP aquatic communities are very different. This is particularly true today in the CSSC, and for the foreseeable future, because of the continuing and significant stress to aquatic life caused by the combined sewer overflows (CSOs). Even once the Tunnel and Reservoir Plan (“TARP”) is completed, scheduled for the late 2020’s, the evidence shows there will still be CSO events. Unless the locks and dams are removed, and the urbanized nature of the area significantly changed, both highly unlikely, the accumulation of silt in the CSSC, much of it contaminated, also continues. Thus, the Board would be justified in adopting the existing secondary contact indigenous aquatic life thermal standards: a maximum temperature of 93° F, which can be exceeded 5 percent of the time, but can never exceed 100° F. 35 Ill. Admin. Code §302.408.

The very poor aquatic life conditions, both in terms of the absence of adequate habitat and the presence of significant stressors from CSOs and urban runoff, are reasonably expected to continue until well into the next decade. Consequently, maintaining the existing thermal standards will be adequately protective. Further, the presence of the electric barriers in the CSSC prevents aquatic life from using the CSSC as a migration pathway. As the Board has noted, fish can swim from one area to another, but the electric barriers prevent this from occurring in the CSSC. Further, as Mr. Seegert testified, there are differences in what waters fish prefer.[162] Hence, the fish that prefer the relatively better quality of the downstream UDIP are not going to prefer to inhabit the CSSC. This difference is reflected in the Board’s selection of

[162] Seegert Testimony, November 9, 2008 Hearing Tr. at p. 15-16.

different aquatic life use designations for the CSSC and UDIP. It follows that the thermal water quality standards for the CSSC should be different, and less stringent, than those for the UDIP.

If there are any improvements in the quality of CSSC waters in the future, the thermal standards may be revised at that time. The Clean Water Act provides for doing so pursuant to the requirement that Illinois EPA conduct a triennial review of the thermal water quality standards.

B. The AS96-10 Thermal Standards

Midwest Generation maintains that either the 2003 or 2007 EA Thermal Standards for the UDIP and the existing secondary contact thermal standards for the Use B waters should be adopted by the Board. However, should the Board disagree, then out of the other potential thermal standards alternatives available for consideration by the Board, the thermal standards adopted by the Board in the AS96-10 adjusted standards proceeding are less objectionable than the Agency's proposed thermal standards for the UDIP Use, although still overly protective of these waters. Accordingly, they are presented here for the Board's consideration.

In the 1996 decision in Docket No. AS96-10, the Board granted an adjusted thermal standard to Commonwealth Edison ("ComEd"), applicable at the I-55 Bridge, for the Midwest Generation power plant discharges (the "Adjusted I-55 Thermal Standard).[163] As the Board is aware, the I-55 Bridge is the geographical dividing line between the UDIP Use and the downstream General Use waters. In the AS96-10 proceeding, the Board also had the benefit of reviewing in detail the 1991-1995 comprehensive UIW Study performed by EA Engineering and overseen by the UIW Task Force.[164] The UIW Study provided a sound scientific, biological basis on which the Adjusted I-55 Thermal Standard was developed.[165]

The Adjusted I-55 Thermal Standard includes the following daily maximum thermal limits and conditions:

January:	60° F
February:	60° F
March:	65° F
April 1-15:	73° F

[163] In 2000, the Board again found that the conditions in the UIW, including the lack of impact that the adjusted thermal standards would have on the ecosystem of the receiving waterway, granted the transfer of the adjusted thermal limits from ComEd to Midwest Generation. (AS96-10 Opinion and Order, March 16, 2000)
[164] See IPCB Order and Opinion, AS96-10 (Oct. 3, 1996).
[165] *Id.* (Appendix 2 at p. 76).

April 16-30:	80° F
May 1-15:	85° F
May 16-31:	90° F
June 1-15:	90° F
June 16-30:	91° F
July:	91° F
August:	91° F
September:	90° F
October:	85° F
November:	75° F
December:	65° F

The Adjusted I-55 Thermal Standard may be exceeded by no more than 3° F during 2% of the hours in the 12-month period ending December 31, except that at no time shall the water temperature at the I-55 Bridge exceed 93° F.

Midwest Generation submits that if the Board were to adopt the Adjusted I-55 Thermal Standard for the entire UDIP, the numeric standards should be applied on an average basis, not an instantaneous daily maximum basis. Because these standards were developed to protect the higher quality General Use waters downstream of the I-55 Bridge, if applied as instantaneous maximums within the UDIP, they are stricter than what is necessary to adequately protect the aquatic life present or expected to be present in those waters.

As noted above, the Adjusted I-55 Thermal Standard is based on sound science and reliable biological data for the protection of the General Use waters downstream of the I-55 Bridge. It was subjected to extensive review by the Board, federal and state environmental regulators, public and private entities. The absence of any measurable adverse impacts to aquatic life from these adjusted standards has been consistently confirmed each year by the results of EA's annual surveys in the area downstream and upstream of the I-55 Bridge. They are proven thermal standards which are consistent with the requirements of the Clean Water Act for protecting the General Use waters below the I-55 Bridge. These proposed standards are stricter than what is necessary to protect the UDIP Use, but they are preferable to the unscientific, erroneous and overly stringent thermal values proposed by the Agency based on the Yoder method.

C. The General Use Thermal Standards

In its Subdocket C First Notice Opinion, the Board considered applying the General Use designation and the accompanying General Use water quality standards to the UDIP. The Board contemplated this approach because almost all of the General Use numeric water quality standards, except for temperature and dissolved oxygen, were the same as the proposed UDIP Use water quality standards. For temperature, as has been noted above, the proposed UDIP water quality standards were stricter than the General Use standards. Although the Board ultimately decided in Subdocket C to adopt the UDIP Use instead of the General Use designation for the UDIP waters, for the reasons already stated above, it would be arbitrary to adopt the Agency's proposed UDIP Use thermal standards. The General Use thermal standards apply to Illinois waters that are fully capable of meeting a full aquatic life use goal. The UDIP Use designation does not go this far. The UDIP Use recognizes that the UDIP has a lower aquatic life use potential than do General Use waters. Consequently, the adoption of the General Use thermal standards for the UDIP is not justified by the requirements of the Clean Water Act and these standards were not intended to apply to a lower aquatic life use water like the UDIP. However, as noted above with regard to the Adjusted I-55 Bridge Thermal Standards, the application of the numeric General Use thermal standards to the UDIP is less objectionable, although still an inappropriate approach.

X. A Regulatory Amendment Clarifying that Compliance Schedules are Authorized by the Illinois Water Quality Standards is Appropriate

The Board should include a provision in the adopted Subdocket D water quality standards which expressly and clearly authorizes the use of compliance schedules.[166] Clean Water Act Section 301(b)(1)(C) clearly provides that a "schedule of compliance, established pursuant to State law or regulations," is an appropriate mechanism for meeting water quality standards. Clean Water Act Section 303(e)(3)(A) makes it clear that schedules of compliance are part of a state's continuing planning process for achieving water quality standards. In recognition of the role compliance schedules plays in implementing permit limits 40 C.F.R. § 122.47 authorizes compliance schedules for federally administered NPDES programs and 40 C.F.R. § 123.25 provides that authorized state programs may include compliance schedules pursuant to legal authority under state law. Thus, compliance schedules may be appropriately addressed in the Subdocket D regulations as part of Illinois' implementation of the Clean Water Act.

[166] Section 502(17) of the Clean Water Act, 33 US.C. §1376(17), defines a schedule of compliance as "a schedule of remedial measures including an enforceable sequence of actions or operations leading to compliance with an effluent limitation, other limitation, prohibition, or standard."

While it is arguable whether an express authorization of compliance schedules in a state's water quality standards is required before a compliance schedule may be included in a discharger's NPDES permit, the U.S. EPA's position is that it is. In its September 4, 2013 Proposed Rule on "Water Quality Standards Regulatory Clarifications" (the "Clarifications Rule") the U.S. EPA proposed to add a new regulatory provision at 40 C.F.R. § 131.14 of the federal water quality standards to "clarify that a permitting authority may only issue compliance schedules for WQBELs in NPDES permits if the state or tribe has authorized issuance of such compliance schedules pursuant to state or tribal law in its water quality standards or implementing regulations."[167]

At present, because the authorization of compliance schedules is contained in Section 309.148 of Part 309 "Permits" of the Illinois Water Pollution Regulations, it may be unclear to U.S. EPA whether this existing Illinois rule is intended to implement the Clean Water Act's requirement that compliance schedules be authorized "in [a state's] water quality standards or implementing regulations." Certainly, Section 309.148 should be properly interpreted to constitute part of the Illinois "implementing regulations" referenced by the U.S. EPA in its September 2013 Clarifications Rule. However, because the Illinois water quality standards are contained in other part of the Illinois Water Pollution Regulations, Parts 302 and 303, it is possible that if the proposed CAWS and UDIP water quality standards regulations do not expressly include authorization for a compliance schedule, the U.S. EPA may later question whether Illinois intended that compliance schedules may be included in NPDES permits issued by the Illinois EPA which incorporate WQBELs based on these new water quality standards.

As proposed, the Subdocket D Part 302 amendments do not contain an express provision authorizing the use of compliance schedules as set forth in Section 309.148. To lend certainty to the availability of compliance schedules, they should. Otherwise, an issue may arise in the future as to whether the Illinois EPA may include a compliance schedule for any of the new Subdocket D water quality standards in NPDES permits issued after the rules become effective. For this reason, and to avoid any doubt, Midwest Generation suggests for the Board's consideration the following proposed amendment to Section 302.101(a):

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[167] See *Water Quality Standards Regulatory Clarifications Proposed Rule*, 78 Fed.Reg. 54518, 54536-7 (September 4, 2013).

Section 302.101 Scope and Applicability

a) This Part contains schedules of water quality standards which are applicable throughout the State as designated in 35 Ill. Adm. Code 303. Site specific water quality standards are found with the water use designations in 35 Ill. Adm. Code 303. The issuance of compliance schedules for the water quality standards contained in this Part is authorized in accordance with the requirements set forth in 35 Ill.Adm.Code §309.138.

Where a state's water quality standards or implementing regulations do not contain a provision authorizing compliance schedules, there is precedent holding that even U.S. EPA may not do so, based on the primacy of state authority in this area. *In the Matter of Star-Kist Caribe, Inc.* (NPDES Appeal No. 88-5), 1990 EPA App. LEXIS 45 (April 16, 1990) (Star-Kist), held that EPA may not unilaterally amend state water quality standards by applying compliance schedules that were not established by the state. With respect to the primacy of state authority, the opinion provides:

> In sum, the language, structure, and objectives of the [Clean Water] Act, as set forth in §§ 101(a) and (b), 402(a)(3), and 510, all support an interpretation of § 301(b)(1)(C) that Congress intended the States, not EPA, to become the proper authorities to define appropriate deadlines for complying with their own state law requirements. Just how stringent such limitations are, or whether limited forms of relief such as variances, mixing zones, and compliance schedules should be granted are purely matters of state law, which EPA has no authority to override. Consequently, if a State elects not to include a provision for a schedule of compliance in a water quality standard, EPA has no authority to override the State's authority by adding a schedule of compliance of its own invention.

Star-Kist, at *19-20 (footnote omitted). However, if Illinois has the legal authority, under its own laws and regulations, to allow compliance schedules in permits, then Illinois EPA may use such compliance schedules to implement the Subdocket D water quality standards.

Midwest Generation, among others, provided hearing testimony and its expert's (Sargent & Lundy) detailed technical report (Ex. 440) showing that if thermal standards like the proposed Use B and UDIP thermal standards are adopted, it would face a massive effort to attempt to achieve compliance, if compliance proved to be a feasible or economically achievable goal. At the least, a compliance schedule spanning several years would be necessary.[168]

Accordingly, it is important that the Board lend clarity to the compliance schedule authorization issue and assure that dischargers to the Subdocket D waters are able to obtain compliance schedules for water quality-based effluent limitations as authorized in and in accordance with the Part 309 Permits rules.

XI. Variances Issues and the "Permit Shield" Under Revised Subdocket D Thermal Water Quality Standards

In the course of the Agency's testimony during the September 23, 2013 Subdocket D hearing, Scott Twait of Illinois EPA correctly explained that if revised thermal standards are adopted by the Board, they would not be self-implementing. The Agency must conduct a review of each NPDES permit for thermal discharges to these waters and determine how to implement these water quality standards for a particular discharge. Due to the resources involved in performing this work, the Agency is uncertain regarding the timing and implementation of these NPDES permit reviews.[169] For a thermal discharger like Midwest Generation, there is a significant risk of receiving NPDES permit temperature limits that it cannot meet, with or without a compliance schedule. This is true regardless of whether the Board adopts the Agency's proposed thermal standards or any of the other revised thermal standard options discussed above. The Board needs to consider ways in which it may afford existing dischargers to these waters relief that is consistent with applicable law. Suggested below are several means available to the Board to do so.

[168] The Sargent & Lundy Report (Ex. 440) describes an extensive, multi-faceted compliance effort that clearly would require several years to accomplish, if it turns out to be feasible. Additional, extensive studies would be needed just to gather all of the information necessary to determine if the project could be accomplished and, if so, to prepare a final design. If an effective final design is feasible, just the permitting and construction stages of the project at each station would span at least two years. See Figure 6.1 of Ex. 440, at p. 6-1 *et seq.*

[169] Twait Testimony, September 23, 2013 Hearing Tr. at pp. 40-44.

A. The Existing Uncertainty Surrounding Variance Relief Warrants the Board's Attention

While there are site-specific alternatives available to Midwest Generation, such as a 316(a) thermal variance under the newly adopted Board procedural rules[170] or a water quality standards variance pursuant to Illinois law and Clean Water Act regulation 40 C.F.R 131.13, these alternatives will take considerable time to pursue to completion. Moreover, the Board's finding in Subdocket C that the UDIP does not satisfy one or more of the six UAA Factors in 40 C.F.R. 131.10(g) creates further uncertainty regarding the availability of variance relief. The current regulatory landscape of the demonstration necessary to obtain variance relief is at best very unclear. The Illinois EPA's understanding is that a variance or adjusted standard pursuant to Clean Water Act Section 303(c) can be granted that still protects the existing use.[171] The Illinois EPA's interpretation is also consistent with the fact that in the CSSC and UDIP, elevated temperature is not what prevents these waters from achieving the designated use. Hence, allowing a thermal variance does not equate to a "removal" of the designated use.

However, the U.S. EPA has expressed a different view on water quality standards variances for Subdocket D waters, even if they are limited to a single constituent. The existing authorization for water quality variances in 40 C.F.R. § 131.13 generally provides that states may provide for variances in their water quality standards. The U.S. EPA has indicated that the availability of such variances is subject to further constraints. In both its June 2012 U.S. EPA letter to the MWRD[172] regarding a requested dissolved oxygen ("DO") variance and in a March 15, 2013 letter[173] to the Agency disapproving a total dissolved solids ("TDS") water quality variance for CITGO Petroleum Corporation and PDV Midwest Refining, L.L.C., the U.S. EPA stated that a water quality standards variance is only allowed if one or more of the UAA factors is met because such a variance constitutes the temporary removal of the designated use.[174] (The U.S. EPA is seeking to codify its interpretation of the Clean Water Act's variance provisions in

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[170] See *In the Matter of: Procedural Rules for Alternative Thermal Effluent Limitations Under Section 316(a) of the Clean Water Act: Proposed New 35 Ill. Adm. Code Part 106, Subpart K and Amended Section 304.141(c),* R13-20, Adopted Rule. Final Opinion and Order (Ill.Pol.Control.Bd. February 20, 2014).
[171] Twait Testimony, September 23, 2013 Hearing Tr. at p. 56.
[172] Exhibit A to Report of Metropolitan Water Reclamation District of Greater Chicago and Environmental Groups Regarding Proposed Aquatic Life Designated Uses, R08-09(C and D)(Ill.Pol.Control.Bd. Jan. 9, 2013)
[173] March 15, 2013 Letter from Susan Hedman, Regional Administrator, Region 5, U.S. EPA, to John M. Kim, Illinois EPA, P.C. 1367, R08-0-9(D) (Ill.Pol.Control.Bd. Mar. 19, 2013)
[174] *Id*. at pp. 1-2.

its proposed Clarifications Rule in which it proposes new variance provisions in 40 C.F.R. § 131.14.) The U.S. EPA concluded that Illinois' allowance of a variance in Section 35 of the Illinois Environmental Protection Act based on "compliance with any rule or regulation, requirement or order of the Board would impose an arbitrary or unreasonable hardship" is not authorized under the Part 131 Clean Water Act implementing regulations.[175]

B. Delaying the Effective Date of any Revised Thermal Standards

Given the uncertainty created by these recent developments regarding the demonstration necessary to obtain a water quality standards variance, the Board should provide for a delayed effective date for any revised thermal standards for the CSSC and UDIP. Postponing the effective date of the thermal water quality standards will at least allow necessary time for clarification under Illinois and federal law regarding what the variance criteria are and what the demonstration must be to qualify for a WQS variance. Dischargers like Midwest Generation will then have an opportunity to gain an understanding of, prepare and pursue requests for, necessary variance relief without being in potential jeopardy in the interim.

Importantly, as explained in the 2003 EA Report (Attachment D at p. 38), the thermal contribution of the Midwest Generation plants is not sufficient to raise temperatures to a range that would exclude expected species. Therefore, providing time to identify an appropriate form of regulatory relief for these discharges will not threaten to impair the designated use of these waters.

The same is true of the alternative option of pursuing 316(a) thermal variance relief. Midwest Generation needs time to evaluate the option of pursuing 316(a) thermal variance relief that is protective of the existing "balanced, indigenous aquatic population" in both the CSSC and the UDIP. While much of the work to gather the biological data necessary to pursue such relief has been accomplished through EA's work in these waters, additional stream studies may be necessary to ensure that the requisite 316(a) demonstration can be made. Midwest Generation simply has not had sufficient time since assuming ownership of the plants on April 1, 2014 to conduct such an evaluation.

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[175] *Id.*

C. Request for Clarification of Applicability of UAA Factors to UDIP Variances

The Board may not be able to bring absolute certainty now to the issues surrounding the availability of WQS variance relief. However, it can provide much needed guidance on related issues. Although Midwest Generation disagreed with the Board's selection of the UDIP Use designation based on evidence showing that more than one of the UAA Factors was satisfied, it did not understand the Board to be addressing the separate issues of: (a) whether one or more of the UAA Factors could be satisfied by a discharger seeking variance relief for a specific discharge; or (b) that such a showing could not be made in any circumstance because it inherently constitutes the removal of the designated use. WQS variance issues were not before the Board in Subdocket C. It would be helpful if the Board would confirm in Subdocket D opinions that it did not intend its Subdocket C decision to prohibit a showing in the variance context that one or more of the UAA Factors could be satisfied.

D. Request for Multi-Discharger or Waterbody Variances

Alternatively, the Board may provide for a multi-discharger variance or a waterbody variance from the thermal water quality standards for the CSSC and UDIP waters. Both of these options have been recently endorsed by the U.S. EPA in its proposed rule on water quality standards clarifications.[176] The information in this record supports the use of either variance mechanism. The need for a thermal variance is not exclusive to Midwest Generation. Both Stepan and ExxonMobil also have provided testimony and other information in this proceeding describing compliance difficulties related to their ability to comply with more restrictive thermal standards. If the proposed Use B period averages are adopted for the CSSC, the MWRD has indicated that it may not be able to achieve consistent compliance at its Stickney Plant.[177]

In its proposed rule on water quality standards clarifications, the U.S. EPA has confirmed that a streamlined variance process that grants "one variance that applies to multiple dischargers (*i.e.,* a multiple discharger variance)" is allowed under the Clean Water Act "if a state…believes that the designated use and criterion is unattainable as it applies to multiple permittees because they are all experiencing challenges in meeting their WQBELs for the same pollutant for the same reason, regardless of whether or not they are located on the same water body."[178] All of

[176] U.S. EPA's Proposed Clarifications Rule, 78 Fed.Reg at 54518.
[177] Hearing Testimony of Scott Twait and Jennifer Wasik, July 29, 2013 Hearing Tr. at pp. 193-194.
[178] U.S. EPA's Proposed Clarifications Rule, 78 Fed.Reg at 54532.

the above dischargers to the CSSC and UDIP have expressed they will experience challenges in meeting the thermal WQS.

Similarly, the alternative "waterbody variance," which applies to the water body itself and not to specific discharges, is available here because the stream data shows that the thermal standards are not currently attainable and, for the UDIP, its designated use is not attainable immediately. Where these conditions exist, the U.S. EPA has stated that the state "may adopt a waterbody variance as an alternative to a designated use change for the water body so long as the variance is consistent with the CWA and implementing regulations."[179] As U.S. EPA explained, the waterbody variance approach "provides time for the state or tribe to work with both point and nonpoint sources to determine and implement adaptive management approaches on a waterbody/watershed scale to achieve pollutant reductions and strive toward attaining the water body's designated use and associated criteria."[180]

Through the Sargent & Lundy testimony and report presented on behalf of Midwest Generation in Subdocket C, it is clear that achieving compliance with revised thermal standards at all three Midwest Generation stations may be technically infeasible or economically unreasonable. The evidence in Subdocket C also showed that due to existing non-thermal stressors in these waters, such as habitat and flow conditions, CSOs, sedimentation and urban runoff, are having a greater effect on these waters than is temperature. While the Midwest Generation discharges are a contributing source of thermal conditions, they are not the only cause. Midwest Generation cannot adjust, let alone control, the management of the flow in the CSSC and UDIP that contributes to creating low or no flow conditions that exacerbate the thermal conditions in these waters, particularly in the challenging summer months when energy demand is high. The Illinois EPA's Scott Twait acknowledged in his testimony that nonpoint discharges also should be addressed as part of the effort to achieve the proposed thermal standards in an equitable manner.[181]

Under a multi-discharger or waterbody variance, existing data on the Midwest Generation thermal discharges shows that there will not be significant harm to the existing aquatic life. As the EA studies have shown, there is a limited extent of influence of the thermal plumes from the

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[179] U.S. EPA Proposed Clarifications Rule, 78 Fed.Reg.at 54532.
[180] *Id.*
[181] Twait Testimony, September 23, 2013 Hearing Tr. at p. 41.

Midwest Generation plants. Although there may be times during the mid-summer time period that thermal discharge levels may exclude more temperature-sensitive fish species from the hottest portions of the discharge plumes, the areas affected are quite small.[182] Thermal plume observations conducted in 1993-1994 and 2002 from the Joliet stations showed that at least 75% of the cross-section of the stream was in compliance with applicable thermal standards, provided a zone of passage for aquatic life and met mixing zone requirements of 35 Ill. Adm. Code § 302.102.[183] Being surficial in nature, the thermal plumes also have no negative impacts on the existing physical habitats for aquatic life in the Lower Des Plaines River.[184] The UIW Study data and the annual on-going EA monitoring, show that the magnitude, duration and extent of temperature in the Lower Des Plaines River is within the tolerance range for most species expected to reside in this waterway.[185] The dissolved oxygen data taken from both the continuous I-55 Bridge monitoring and measurements taken during EA's annual fish monitoring program also show that overall, average dissolved oxygen levels are well above that needed to sustain the indigenous biological community.[186]

The Board's adoption as part of the Subdocket D water quality standards of a water body variance mechanism would allow for the creation and implementation of a much needed, multi-faceted water body approach to achieving thermal standards, and the necessary time to do so, without unreasonably burdening dischargers like Midwest Generation who are not the sole contributing cause of the ambient temperatures in these waters. It would allow time for Midwest Generation to determine how it may operate its plants so as to achieve reasonable progress on thermal compliance under existing conditions and constraints. It would also allow Midwest Generation the necessary time to develop the basis for pursuing a 316(a) thermal variance that is protective of the existing "balanced, indigenous aquatic population" in both the CSSC and the UDIP. While much of the work to gather the biological data necessary to pursue such relief has been accomplished, additional stream studies may be necessary to ensure that the requisite 316(a) demonstration can be made.

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182 2003 EA Thermal Report (Attachment D) at p. 30. These same areas attract fish during the colder months of the year. *Id.*
183 2003 EA Thermal Report (Attachment D) at pp. 30 & 35.
184 *Id*. at p. 30.
185 *Id*. at pp. 34 & 38.
186 *Id*. at p. 37.

E. Request for Recognition of the "Permit Shield" for Existing NPDES Permits

Similarly, it would be helpful if the Board expressly recognized that consistent with the Clean Water Act, any new water quality standards it may adopt in Subdocket D are not automatically a part of a discharger's obligations under its existing NPDES permit. Clean Water Act Section 301(b)(1)(C) requires that permits include any effluent limitations necessary to meet water quality standards. However, section 301(b)(1)(C) speaks to water quality standards that were in effect at the time of permitting. This is made clear by Section 402(k) of the Clean Water Act, 33 U.S.C. § 1342(k), which provides what is known as a "permit shield." Section 402(k) expressly provides that compliance with a NPDES permit will be deemed compliance with the other provisions of the Act, including the prohibition against unpermitted discharges. Long ago, the United States Supreme Court, in *E.I. du Pont de Nemours & Co. v. Train*, 430 U.S. 112, 138 n.28 (1977), explained that the permit shield's purpose is "to relieve [permit holders] of having to litigate in an enforcement action the question whether their permits are sufficiently strict. In short, [the permit shield] serves the purpose of giving permits finality."

The U.S.EPA reaffirmed the purpose of the permit shield in its "Policy Statement on Scope of Discharge Authorization and Shield Associated with NPDES Permits," U.S. Environmental Protection Agency Memorandum, July 1, 1994 ("1994 Policy Statement").[187] In the 1994 Policy Statement, the U.S.EPA states that the permit "provides authorization and therefore a shield for…pollutants specifically limited in the permit or pollutants which the permit,…explicitly identif[ies] as controlled through indicator parameters." *Id* at 2. As the Fourth Circuit Appellate Court stated in *Piney Run Preservation Ass'n v. County Com'rs of Carroll County, MD*, 268 F.3d 255, 269 (4th Cir. 2001), "[t]he scope of the permit shield defense is relatively straightforward. An NPDES permit holder is shielded from CWA liability for discharges in compliance with its permit."[188] Thus, for dischargers to the Subdocket D waters that have existing NPDES permits with thermal limitations for which the permit shield

[187] The U.S. EPA subsequently revised the 1994 Policy Statement (undated) to clarify that the underlying information submitted by the permittee must be in writing. A copy of the revised 1994 Policy Statement is available at: http://archive.nacwa.org/getfile1993.pdf?fn=2006law-a.woodis2.pdf (last checked 4/28/14).

[188] In *Piney Run Preservation Ass'n v. County Com'rs of Carroll County, MD*, 268 F.3d 255, 269 (4th Cir. 2001), a citizen suit was brought against the an NPDES permittee alleging discharges of thermal pollution in violation of the defendant's NPDES permit. The defendant NPDES permittee had disclosed the thermal discharges to the Maryland Dept. of Environment ("MDE"), but the MDE did not place thermal limits in the permit. Based upon the 1994 Policy Statement, the Court found that the defendant was entitled to the permit shield and hence, was not liable under the CWA.

applies, the revised thermal WQS adopted by the Board will not automatically apply to their discharges. Midwest Generation and other dischargers to the Subdocket D waters would benefit from having the Board recognize that its adoption of new or revised water quality standards is not intended to and does not supersede or diminish the protections afforded by the Clean Water Act's permit shield provisions for existing NPDES permittees.

XII. Conclusion

Midwest Generation urges the Board not to adopt the thermal standards proposed by the Illinois EPA for Use B and the UDIP Use waters. The proposed thermal standards are not scientifically justified, are severely flawed, and are inconsistent with the extensive biological data available for these waters. The 2007 EA Thermal Standards, which are based on biological data collected from over twenty years of studies in the UDIP area, present the Board with a scientifically sound alternative thermal standard for the UDIP waters which is consistent with U.S. EPA guidance and supported by two independent statistical analyses of the biological data. Further, the 2007 EA Thermal Standards are endorsed by a nationally recognized thermal expert, Dr. Charles Coutant. In the alternative, the 2003 EA Thermal Standards are also an acceptable alternative here if the Board determines that year-round daily average maximum thermal standards are needed in addition to the cold shock prevention provision in the 2007 EA Thermal Standards for the non-summer month periods.

If the Board does not adopt either of the EA prepared thermal standards, then there are still preferable alternatives to the Agency's proposed thermal standards available for the Board's consideration, such as the Adjusted I-55 Bridge Thermal Standards or the numerical General Use standards, both of which have been found to be protective of higher quality waters with more thermally sensitive aquatic life. While Midwest Generation maintains that neither of these standards is appropriate for these waters because they contain more stringent requirements than is necessary to protect the designated use, they are less objectionable than are the Agency's proposed thermal standards.

Finally, regardless of which thermal standards the Board adopts, the Board should provide more clarity on relevant regulatory relief issues regarding compliance schedules and variances. Midwest Generation also proposes that the Board either defer the effective date of these rules or incorporate variance relief as part of its Subdocket D decision consistent with U.S. EPA guidance.

Respectfully submitted,

Midwest Generation, LLC

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Dated: April 30, 2014

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MIDWEST GENERATION'S ATTACHMENTS TO SUBDOCKET D

POST-HEARING COMMENTS

(For Comments mailed to Service List, the Attachments are on a CD)

A EA Engineering Comments Regarding the Thermal Endpoint Values Selected for Use in Fish Temperature Model (Appendix Table Z-3)

B Scott, W.B. and Crossman, E.J., Fresh Water Fishes of Canada, *Fisheries Research Board of Canada, Ottawa*, 1973.

C *Development of Biologically Based Thermal Limits for the Lower Des Plaines River*, Prepared by EA Engineering, Science and Technology Inc. August 2007.

D *Appropriate Thermal Water Quality Standards For The Lower Des Plaines River. Summary Report* Prepared by Midwest Generation and EA Engineering, Science and Technology, Inc. January 23, 2003, Revised October 13, 2003.

E Dr. Charles C. Coutant Letter, August 9, 2007

UAA SUBDOCKET D
PCB R08-09(D)

MIDWEST GENERATION'S POST–HEARING COMMENTS

ATTACHMENT A

EA ENGINEERING COMMENTS REGARDING THE MBI/YODER THERMAL ENDPOINT VALUES SELECTED FOR USE IN FISH TEMPERATURE MODEL (IPCB R08-09, EXHIBIT 16, APPENDIX TABLE Z-3).

Bold endpoints indicate those adjusted using the conversion factors in Table Z-2

Color Code: Red= Erroneous Value; Green=Correct Value; Yellow=Value could not be checked because too many endpoints; Blue=Estimated value that is correct assuming the value to which the conversion factor was applied is correct; White=Attempted to calculate the endpoint but could not duplicate the value shown in Z-3.

Species	Optimum (OPT)	Avoidance (UAT)	Upper Lethal (ULT)	Comments
Silver lamprey	**23.7**	**26.3**	31.5	OPT and UAT based on average conversion factors from Table Z-2, but ULT represents CTM that was not adjusted by 2C and represents one fish tested at 4.5C, well below the stated target of 25C.
No. Brook lamprey	**22.7**	**27.2**	30.5	OPT and UAT based on average conversion factors in Table Z-2; ULT based on low (15C) acclimation temperature.
Am. Brook lamprey	**21.7**	**26.2**	29.5	OPT and UAT based on average conversion factors in Table Z-2; ULT based on low (15C) acclimation temperature.
Paddlefish	**25.4**	**29.9**	33.2	The CTM for 80 day old paddlefish was adjusted by 2C; ambient (21C) close to the target of 25C.
Longnose gar	32.5	34.5	**37.8**	UAT represents mean of endpoints in Table Z-1 and ULT converted per average factor from Table Z-2. Unable to confirm OPT.
Shortnose gar	**32.0**	35.5	**38.8**	UAT based on mean of two observations and ULT estimated based on average conversion factor from Table Z-2. OPT was estimated but not in a manner consistent with Table Z-2; should be 35.5 - 1.5 = 34C, not 35.5-3.5 = 32C.
Bowfin	27.4	**31.9**	35.2	CTM not adjusted by 2C; All behavorial optimums were >27.4C. UAT based on conversion factors in Table Z-2.
Mooneye	21.7	28.5	**32.1**	UAT from field data and ULT adjusted per Table Z-2. OPT is much lower than data in Table Z-3 (27.5-29C).
Goldeye	22.2	29.0	**32.6**	UAT based on field data. UAT given as 28.0C in Table Z-1 but erroneously shown as 29.0C in Z-3; ULT adjusted by 3.3 as per Table Z-2 but should be 31.6C because UAT is 28, not 29C. OPT in Z-3 (22.2C) is much lower than values shown in Table Z-1 (27-29C).
Alewife	21.7	30.0	32.1	Too many endpoints to confirm values.
Gizzard shad	30.0	34.0	35.8	ULT from test at acclimation of 30C? Number of observations precludes reconciliation of OPT and UAT.
Skipjack herring	27.3	30.7	**34.3**	Confirmed; OPT and ULT represent means of two or three endpoints; ULT estimated per Table Z-2.
Central mudminnow	**25.4**	28.9	36.0	ULT derived from field observations and reported by author as 38C; no basis for subtracting 2C from this value. UAT based on erroneous interpretation of data in Scott and Crossman 1973. OPT based on UAT minus 3.5C.
Grass pickerel	26.6	30.1	34.3	OPT shown as 26C in Table Z-1, but erroneously as 26.6C in Z-3. ULT based on the correct OPT of 26C + conversion of 8.3C from Table Z-2, but UAT based on the incorrect OPT of 26.6 +3.5 = 30.1C.
Chain pickerel	24.0	**29.0**	**32.3**	OPT from Table Z-1, adjustment for OPT and UAT consistent with Table Z-2.
Northern pike	21.8	**28.9**	32.2	OPT and ULT not confirmed because of the number of endpoints: UAT adjusted consistent with average conversion factor from Table Z-2.
Muskellunge	**24.2**	**29.2**	32.5	Could not duplicate the ULT; OPT and UAT based on conversion factors from Table Z-2.
Muskellunge x N. Pike	**24.3**	**29.3**	32.6	Confirmed.
Smallmouth buffalo	28.5	34.1	**37.4**	The only upper lethal in Table Z-1 is a CTM of 31.3C derived at a low (10C) acclimation temperature. However, Mr. Yoder did not use this value because the ULT in Z-3 is based on the UAT of 34.1 + 3.3 = 37.4C. OPT range in Z-1 is 31-34C, much higher than the 28.5C used in Z-3.
Bigmouth buffalo	**29.9**	33.3	**36.6**	UAT = mean of two endpoints; adjustments for OPT and ULT consistent with conversion factors in Table Z-2.
River carpsucker	29.5	33.5	35.2	UAT based on one study (Yoder and Gammon 1976) but two studies with higher values not used. OPT shown as 31.5 to 34.5 in Z-1 so OPT value of 29.5C in Z-3 is incorrect.
Quillback carpsucker	30.0	34.2	35.2	ULT based on CTM of 37.2 that was adjusted by 2C. That CTM was based on only 3 fish acclimated at 23.3C. Did not use CTM of 38.8 cited in Z-1.
Highfin carpsucker	**30.5**	33.9	**37.2**	Confirmed.
Golden redhorse	**25.6**	28.5	33.4	OPT estimated based on ULT minus 7.8C as per Z-2 but higher (26-27.5C) actual OPT values in Z-1 ignored.
Smallmouth redhorse	**25.5**	28.5	33.3	Could not duplicate the ULT. It should be 32.9C based on two endpoints derived using the slow heating method. OPT based on ULT (33.3C) - 7.8C.
River redhorse	--	--	--	Table Z-1 does not contain any data for this species.
Greater redhorse	--	--	--	Table Z-1 does not contain any data for this species
Robust redhorse	**26.3**	**30.8**	34.1	Confirmed but not geographically appropriate
Common white sucker	26.0	28.7	31.5	According to Yoder, the ULT value of 31.5C came from Brungs + Jones 1977 but the B+J values he cites in Z-1 do not appear in Brungs + Jones. UAT is mean of two endpoints in Z-1. Too many endpoints to confirm OPT.
Longnose sucker	**18.7**	**23.2**	26.5	ULT based on fish acclimated to 14C: OPT and UAT are adjusted consistent with conversion factors in Table Z-2
Hog sucker	27.3	31.6	33.0	Could not confirm OPT and UAT because of the number of endpoints

EA ENGINEERING COMMENTS REGARDING THE MBI/YODER THERMAL ENDPOINT VALUES SELECTED FOR USE IN FISH TEMPERATURE MODEL (IPCB R08-09, EXHIBIT 16, APPENDIX TABLE Z-3).

Species	Optimum (OPT)	Avoidance (UAT)	Upper Lethal (ULT)	Comments
Spotted sucker	24.8	27.0	31.0	The only upper lethal reported in Z-1 was a CTM of >31C and it was based on a single fish
Grass carp	25.3	**34.0**	37.3	Confirmed
Bighead carp	25.4	**33.5**	36.8	Confirmed
Grass x Bighead carp	28.2	**35.0**	38.3	Confirmed
Common carp	31.5	34.9	37.3	Could not confirm endpoints because of the number of endpoints
Goldfish	30.0	**34.6**	37.9	Could not confirm endpoints because of the number of endpoints
Carp x Goldfish	--	--	--	No data in Table Z-1 for this hybrid.
Golden shiner	27.8	**30.7**	34.0	Could not duplicate the OPT value. UAT based on ULT of 34C minus the 3.3 average conversion factor but should have used 2.3 for small cyprinids. Too many ULT values to confirm.
Bigeye chub	**26.1**	**29.4**	31.7	Upper lethal based on a CTM for fish acclimated to 10C; did not adjust CTM by 2C
Sand shiner	**29.4**	**32.7**	35.0	Confirmed; ULT based on CTM of 37.0C from Smale and Rabeni (1995) and adjusted by 2C; OPT and UAT estimated per conversion factors in Table Z-2
Emerald shiner	22.5	**29.8**	32.1	Not Confirmed because of the number of endpoints
Bigeye shiner	27.7	**30.7**	33.0	ULT based on CTM of 35 from Mathews (1981) and adjusted by 2C even though acclimation temperature was 15C. Yoder did NOT apply the 2C adjustment factor to most species acclimated to 15C. UAT estimated per conversion factors in Table Z-2
Common shiner	**26.8**	**30.1**	32.4	ULT not confirmed because of the number of endpoints; OPT and UAT estimated consistent with the conversion factors in Table Z-2.
Striped shiner	**28.0**	**31.3**	33.6	ULT not could not be duplicated; OPT and UAT estimated consistent with the conversion factors in Table Z-2.
Spotfin shiner	29.8	33.7	36.0	OPT and UAT not confirmed because of the number of endpoints. ULT apparently based on Cherry et al. (1977).
Rosyface shiner	27.6	32.0	33.0	Not confirmed because of the number of endpoints.
Silver shiner	26.9	31.1	**33.4**	ULT estimated using conversion factor of 2.2 in Table Z-2. OPT + UAT confirmed.
Scarlet shiner	**28.1**	32.2	**34.5**	Species is rosefin shiner. UAT confirmed. OPT and ULT based on "small" cyprinid conversion factors.
Redfin shiner	**28.6**	31.9	34.2	Confirmed; OPT and UAT estimated based on conversion factors in Table Z-2.
Red shiner	**30.5**	**33.8**	36.1	ULT based on CTM endpoints of 36.2 and 35.9-36.3C at acclimation temperatures of 21-22C, but the average CTM value NOT lowered by 2C. OPT + UAT based on small cyprinid conversion factors.
Mimic shiner	**28.4**	32.5	**34.8**	UAT endpoint not given by author, rather it was estimated by Yoder from the reported results. OPT + ULT based on small cyprinid conversion factors applied to the UAT.
Bigmouth shiner	**29.0**	**32.3**	34.6	Confirmed
Blackchin shiner	**30.4**	**33.7**	36.0	Confirmed
Spottail shiner	27.3	34.5	35.6	Not Confirmed because of the number of endpoints
Creek chub	**28.1**	31.4	33.7	According to Z-3, only OPT was estimated. It was estimated from conversion factors in Table Z-2. The only UAT given in Z-1 is 33.9C so the UAT value of 31.4C in Z-3 is wrong. There were too many endpoints to confirm ULT.
River chub	**25.3**	**28.6**	30.9	CMT of 30.9C not adjusted by 2C. OPT and UAT were adjusted correctly but they are 2C higher than if the CTM had been adjusted by 2C.
Hornyhead chub	**28.0**	**31.3**	33.6	Confirmed
Suckermouth minnow	**27.8**	**31.1**	33.4	ULT should be 31.4 as it is based on a CTM of 33.4 that was not adjusted by 2C. This CTM was derived on fish acclimated to 10C. The OPT and UAT were correctly estimated from conversion factors in Table Z-2, however, they are 2C higher than if the CTM had been adjusted by 2C.
Stoneroller	28.2	33.0	35.5	Not Confirmed because of the number of endpoints
Fathead minnow	27.7	31.5	34.5	Not Confirmed because of the number of endpoints
Bluntnose minnow	27.5	31.4	32.4	Not Confirmed because of the number of endpoints
Bullhead minnow	**31.7**	**35.0**	37.3	Confirmed
Silverjaw minnow	**27.0**	31.1	35.0	Confirmed ULT and UAT. OPT based on UAT - 4.1C as per Z-2.
W. Blacknose dace	25.5	30.6	31.6	OPT apparently based on the mean of a range of 23.3-27.2C, but that mean should be 25.2, not 25.5; UAT and ULT not confirmed because of the number of endpoints.

EA ENGINEERING COMMENTS REGARDING THE MBI/YODER THERMAL ENDPOINT VALUES SELECTED FOR USE IN FISH TEMPERATURE MODEL (IPCB R08-09, EXHIBIT 16, APPENDIX TABLE Z-3).

Species	Optimum (OPT)	Avoidance (UAT)	Upper Lethal (ULT)	Comments
Longnose dace	**25.8**	30.0	31.4	ULT is based on a CTM of 31.4C that was not adjusted by 2C. UAT confirmed. OPT was adjusted correctly but is 2C too high because the ULT was not adjusted.
Mosquitofish	32.9	36.8	38.5	Not Confirmed because of the number of endpoints
Blackstripe topminnow	**30.2**	**34.7**	38.0	ULT based on mean CTM of 40C minus 2C. OPT + UAT based on ULT minus the average conversion factor
E. banded killifish	27.7	**34.9**	38.2	OPT value could not be confirmed because of the number of values. UAT based on ULT-3.3C. The ULT of 38.2 was not consistent with either of the two CTMs (36.8 and 41.6C) in Z-1.
Brook silverside	25.0	**31.7**	35.0	ULT based on CTM of 36C, so ULT should be 34C, not 35C. UAT based on conversion factor of 3.3 in Table Z-2. Could not duplicate the OPT.
Striped bass	28.5	**31.1**	**36.3**	Not clear why the OPT of 28.5C was chosen and multiple other OPT values were ignored.
White bass	29.5	33.3	35.6	Not confirmed because of the number of endpoints
Striped x white bass	**28.7**	**32.4**	36.5	Could not duplicate ULT. The CTMs in Z-1 derived for fish tested at acclimation temps of ≥29.2C would yield ULTs higher than 36.5C. OPT and UAT based on conversion factors in Table Z-2.
Channel catfish	31.1	34.8	38.3	Not confirmed because of the number of endpoints.
Blue catfish	**30.9**	33.9	**37.2**	Confirmed.
Brown bullhead	28.1	**31.1**	35.2	Not confirmed because of the number of endpoints.
Yellow bullhead	28.3	**31.3**	36.4	Footnote in Z-1 is wrong. The value of 36.4C is a CTM not a ULT and therefore should have been adjusted by 2C. CTM based on 1 fish. OPT represents single endpoint (Su) 28.3: Unclear why other OPT values not used. UAT is OPT +3.0C.
Black bullhead	**27.6**	**32.1**	35.4	Confirmed...ULT is average of 2 endpoints: correct average conversion factors used to derive OPT + UAT.
Flathead catfish	31.1	34.7	**38.0**	UAT confirmed. ULT based on UAT + 3.3C (average) conversion factor. Could not duplicate OPT.
Stonecat madtom	**21.2**	**25.7**	29.0	ULT based on CTM of 29C that should have been adjusted by 2C; additionally the CTM test used an acclimation temperature of 1.6C (not 16C as shown in Table Z-1) and only one fish was tested
Tadpole madtom	**28.2**	**32.7**	36.0	Confirmed
American eel	20.5	33.0	**36.3**	Confirmed
White crappie	28.6	30.8	32.5	UAT + ULT consistant with data in Z-1. Could not duplicate OPT.
Black crappie	27.6	29.7	34.7	Not confirmed because of the number of endpoints
Rock bass	28.1	33.0	35.0	Unable to confirm OPT and UAT because of the number of endpoints. ULT should be either 34C based on the CTM endpoint of 36C for R+H (only 3 fish tested by R&H 1976) or 36C based on Cherry et al.'s 7-day ULT of 36C. Cherry et al. used the preferred methodology.
Largemouth bass	29.1	31.6	34.5	Not confirmed because of the number of endpoints.
Spotted bass	30.6	33.3	36.0	OPT and UAT not confirmed because of the number of endpoints. ULT confirmed.
Smallmouth bass	30.0	32.0	34.7	OPT and UAT not confirmed because of the number of endpoints...none of the three upper lethal endpoints in Z-1 or the average of these 3 match the value of 34.7C in Z-3.
Bluegill	30.4	33.8	36.4	Not confirmed because of the number of endpoints.
Green sunfish	27.8	30.9	35.3	Not confirmed because of the number of endpoints.
Pumpkinseed sunfish	28.4	**30.5**	34.6	Not confirmed because of the number of endpoints.
Longear sunfish	24.1	**31.0**	35.9	OPT apparently based on only one of several endpoints. UAT should not have been estimated because a measured UAT of 37.8C is given in Table Z-1. The estimated UAT of 31C not based on conversion factors in Z-2. Too many endpoints to confirm ULT.
Redear sunfish	21.9	**30.3**	34.4	ULT should be 35.4C based on CTM of 37.4 C in Table Z-1, but that CTM was based on testing one fish. All the OPT values in Z1 are >21.9,the value shown in Z-3.
Orangespotted sunfish	28.7	**31.3**	35.4	ULT should 34.4C based on CTM of 36.4C from Smale and Rabeni 1995. UAT = ULT - 4.1C. OPT value of 28.7C in Z-3 is > all OPT values in Z-1.
Warmouth	**25.1**	**28.8**	32.9	CTM of 32.9C not adjusted by 2C; low (10C) CTM acclimation temperature. OPT and UAT estimates based on 32.9C being a ULT, which it is not.
Yellow perch	22.6	29.8	32.9	Not confirmed because of the number of endpoints.
Walleye	22.8	30.0	32.9	Not confirmed because of the number of endpoints.
Sauger	23.9	30.3	32.9	Not confirmed because of the number of endpoints.

EA ENGINEERING COMMENTS REGARDING THE MBI/YODER THERMAL ENDPOINT VALUES SELECTED FOR USE IN FISH TEMPERATURE MODEL (IPCB R08-09, EXHIBIT 16, APPENDIX TABLE Z-3).

Species	Optimum (OPT)	Avoidance (UAT)	Upper Lethal (ULT)	Comments
Orangethroat darter	24.6	29.0	32.9	OPT + UAT confirmed. Could not duplicate ULT.
Rainbow darter	20.1	**29.6**	32.9	ULT should be based on CTM of 35.6C adjusted by 2C so ULT should be 33.6C. UAT based on subtracting 3.3 from the erroneous ULT of 32.9C. OPT based on averaging summer + spring endpoints.
Dusky darter	22.5	**29.6**	32.9	According to Z-3, the ULT was not estimated but the only ULT value in Z-1 is 27C, not 32.9C as listed in Z-3. UAT based on ULT - 3.3C (average) conversion factor.
E. Sand darter	25.0	**30.8**	**33.3**	OPT is not a final preferendum: UAT and ULT based on applying average adjustment factors of 5.8 and 8.3C to the erroneous OPT.
Logperch	22.0	**22.7**	**31.5**	OPT is based on egg hatching success, which is not a standard way to measure OPT. Based on the conversion factors in Table Z-2, UAT should be 27.8C and ULT should be 30.3C.
Greenside darter	22.5	**28.9**	32.2	ULT based on CTM of 32.2C that was not adjusted by 2C. According to Z-3, UAT was estimated but actual value of 35C is provided in Z1. Could not duplicate OPT.
Fantail darter	19.7	30.6	32.8	Could not duplicate OPT. Upper lethal values in Z-1 at recommended acclimation temperatures are well above the ULT value of 32.8C in Z-3.
Johnny darter	22.7	**30.3**	33.6	OPT should be 22.9C based on Table Z-1. The only ULT values in Z-1 derived at the recommended acclimation temperatures are well above the value 33.6C used in Z-3.
Freshwater drum	29.1	31.2	33.4	ULT represents mean of two endpoints; UAT represents the mean of four endpoints. Could not duplicate OPT.
Total # endpoints	104	104	104	
# of estimated endpoints	38	51	18	
% of estimated endpoints	37%	49%	17%	
Total estimated		107		
Percent estimated		34%		
# erroneous endpoints	16	12	32	
% erroneous endpoints	15%	12%	31%	
Total erroneous		60		
% erroneous		19%		
# of endpoints that could not be checked	30	28	28	
% not checked	29%	27%	27%	
Total not checked		86		
% not checked		28%		
% erroneous/# checked		27%		

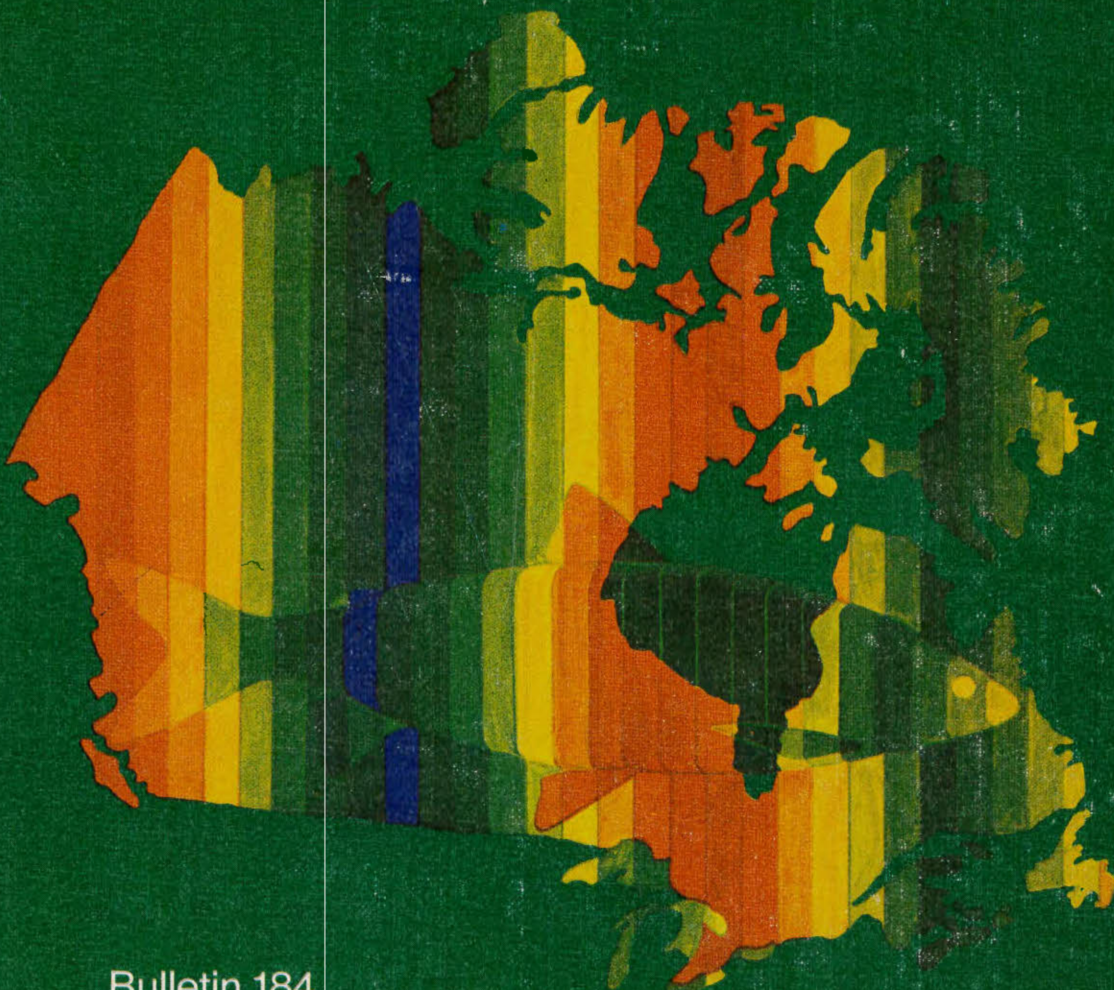
UAA SUBDOCKET D
PCB R08-09(D)

MIDWEST GENERATION'S POST–HEARING COMMENTS

ATTACHMENT B

W. B. Scott * E. J. Crossman

FRESHWATER FISHES OF CANADA



Bulletin 184

Fisheries Research Board of Canada, Ottawa 1973

Environment Canada Environnement Canada

FRESHWATER FISHES OF CANADA

W. B. SCOTT • E. J. CROSSMAN

Department of Ichthyology and Herpetology

Royal Ontario Museum, Toronto

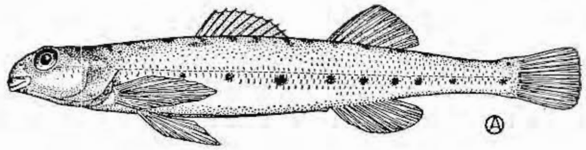
BULLETIN 184

Fisheries Research Board of Canada, Ottawa 1973

Frontispiece: Lake Whitefishes

EASTERN SAND DARTER

Ammocrypta pellucida (Putnam)



Description Body elongate, average total length about 2.5 inches (64 mm), not noticeably compressed laterally except posteriorly, body not deep, greatest depth less than head length, 8.6–11.9% of total length; flesh of body somewhat pellucid. Head moderate, its length 17.2–20.8% of total length, gill membranes joined at an acute angle and free from isthmus, opercle with a flattened, triangular spine; eye diameter 19.4–29.6% of head length; snout length usually greater than eye diameter, and often down curved, its length 26.5–32.7% of head length; premaxillaries non-protractile but separated from snout by shallow groove; mouth moderately large, maxillary not extending to anterior margin of eye; teeth small, fine, not enlarged. Branchiostegal rays 6,6. Fins: dorsals 2, first dorsal spiny, of 8–11 weak spines, second dorsal soft rayed, of 9–12 rays, usually 10 or 11, dorsals distinctly separated; caudal only slightly forked, nearly truncate, of 19 rays; anal with 1 thin weak spine and 8–10 (usually 9) soft rays; pelvics relatively well developed; pectorals relatively well developed. Scales ctenoid, 62–77 in a lateral series, weakly developed but better developed along midline of sides, scales above midline of sides with black margin posteriorly; lateral line usually complete or nearly so. Vertebrae 40–43.

Colour Overall colouration is light, the back is slightly yellowish, becoming silvery white on the lower part of sides and on ventral surface. There is a row of 10–14 small, rounded, green spots along the midline of each side, and 12–16 spots along midline of back, which become paired at bases of dorsal fins. Only adults exhibit the yellowish colouration while young fish tend to be white or silvery.

Distribution The eastern sand darter ranges from Lac St. Pierre in the upper St. Lawrence River, and the Lake Champlain drainage in Vermont, south to West Virginia and Kentucky; west through southwestern Ontario to southeastern Michigan.

In Canada it has been reported from Quebec in the lakelike expansions of the upper St. Lawrence River and their tributaries, such as Lac St. Pierre (Cuerrier et al. 1946, who reported it common iu 1941), and Lake of Two Mountains and the Chateauguay River which flows into Lac St. Louis (Vladykov 1942). In Ontario, it was found occasionally in Lake Erie tributaries, in the Thames River of the Lake St. Clair drainage, and tributary streams of southern Lake Hurou. It has not been reported from the north shore of Lake Ontario.

Except as noted above for Lac St. Pierre, it is not a common species and we know of no captures in Ontario streams for over 25 years, except for records from two Lake Erie tributaries in 1955.

Biology The eastern sand darter has received no attention in Canadian waters, beyond statements of its occurrence, and, hence, we have uo direct knowledge of its biology.

The preferred habitat is said to be sand-bottomed areas in streams and rivers and sandy shoals in lakes. In such locations, the sand darter can bury itself with only its eyes exposed above the sand (Trautman 1957). The Chateauguay River specimens reported by Vladykov were caught over limestone terraces covered with a thin layer of mud with water temperature about 77° F (25° C) and *p*H of 8.6. The specimens taken in Lake of Two Mountains, Que., were caught over a sand–clay bottom, while the water temperature was 75.2° F (24° C) and *p*H 8.2.

During exploratory otter trawling in Lake Erie in 1957, by the United States Bureau of Commercial Fisheries, sand darters were caught in otter trawls at depths to 48 feet (14.6 m) in the eastern basin and from 18 to 42 feet (5.5–12.8 m) in the western basin.

From its place of concealment in the sand, the sand darter is said to dash out and capture passing prey. Midge larvae were found in the stomachs of darters captured in Ohio waters of Lake Erie (Turner 1921) and we presume that various entomostracans are among the major food items in Canadian waters.

Bangham and Hunter (1939) examined 15 sand darters from western Lake Erie and found 9 infected. The parasites identified were trematodes, *Neascus* sp., *Tetracotyle* sp., *Lebouria cooperi*, and nematodes *Camallanus oxycephalus* and *Agamonema* sp.

Relation to man This is an uncommon species in Canadian waters and is probably even less common now than formerly. It seems unlikely that it could long survive the environmental onslaught from highly industrialized areas, such as those around Montreal. Sand-bottom regions in streams and rivers, which is the preferred habitat, are much less available since such areas tend to become silted over, especially in the populated regions where this species occurred. Trautman (1957) noted that the preferred habitat was much reduced in Ohio and that sand darters were much less common than before 1945.

Nomenclature

Pleurolepis pellucidus	— Baird (*in* Putnam 1863: 5) (type locality — none)
Etheostoma pellucidum Baird	— Putnam 1863: 5
Vigil pellucidus (Baird)	— Jordan, Evermann, and Clark 1930: 288
Ammocrypta pellucida (Baird)	— Dymond 1947: 25
Ammocrypta (Ammocrypta) pellucida (Agassiz)	— Collette and Knapp 1966: 60
Ammocrypta pellucida (Putnam)	— Bailey et al. 1970: 75

Etymology *Ammocrypta* — sand, concealed; *pellucida* — from *pellucidus*, meaning transparent.

Common names Eastern sand darter, sand darter. French common name: *dard de sable*.

UAA SUBDOCKET D
PCB R08-09(D)

MIDWEST GENERATION'S POST–HEARING COMMENTS

ATTACHMENT C

MIDWEST
GENERATION EME, LLC
An EDISON INTERNATIONAL℠ Company

Basil G. Constantelos
Director, Environmental Services

August 16, 2007

Mr. Toby Frevert
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62794-9276

Subject: Midwest Generation Thermal Water Quality Standard Proposal for the Upper Dresden Pool

Dear Toby:

Enclosed is Midwest Generation's (MWGen) revised proposal for the thermal water quality standards for the Dresden Pool of the Lower Des Plaines River. A great deal of effort has gone into the development of these proposed thermal standards, and I hope the Agency will give them careful consideration.

The US EPA has stated that, where feasible, numerical aquatic life national criteria should be developed by conducting field tests, and should not cause "any unacceptable long-term or short-term effects on the aquatic organisms or their uses." Fortunately, extensive biological data exists for the Des Plaines River which has been used to develop these recommended standards. The proposed thermal standards are based on an analysis of the fish community which exists in the River and covers many years of standardized fish collection and field measurement. The underlying analysis and methodology on which we based our revised proposal is set forth in the enclosed August 2007 report prepared by EA Engineering, Science & Technology (EA). It should be further noted that our field data includes a total of 77 different fish species, including the 27 Representative Aquatic Species (RAS) species listed in the Midwest Biodiversity Institute (MBI) report for modified use.

EA used statistical analyses of the Lower Des Plaines River biological field data to reach its findings and recommendations. Because the EA methodology is based on extensive and reliable field data, we are confident its findings and recommendations provide a better and scientifically stronger basis for setting thermal water quality standards than those recommended in the report authored by the MBI. This is not solely our view. We provided the EA report to Dr. Charles C. Coutant, a highly respected, nationally recognized expert on thermal impacts on fish, for peer review and comment. As expressed in the enclosed August 9, 2007, letter from Dr. Coutant, in his expert opinion, the EA methodology is "scientifically superior" to the laboratory-derived values ranking approach employed in the MBI report.

Midwest Generation EME, LLC
One Financial Place
440 South LaSalle Street
Suite 3500
Chicago, IL 60605
Tel: 312 583 6029
Fax: 312 788 5529

Based on the findings and recommendations in the EA Report, the revised thermal water quality standards we are recommending for the Dresden Pool include summer monthly averages of 90° F with a maximum daily average of 93° F. This is a significant reduction from the current Secondary Contact thermal standard of 93° F not to exceed 100° F. The proposed thermal water quality standards are consistent with the use attainment potential of the Dresden Pool in the Lower Des Plaines River and will provide the necessary protection for the aquatic community that can live there.

We have not revised our prior proposal that the thermal water quality standards for the Lockport and Brandon Pools be maintained at the current levels. We believe that maintaining the existing thermal standards in the Lockport and Brandon Pools remains appropriate given their more limited-use classification status.

I look forward to discussing this proposal at your earliest convenience.

Sincerely,

Basil G. Constantelos
Director, Environmental Services

Enclosures

cc: Doug Scott—Illinois EPA
Marcia Willhite—Illinois EPA
Scott Twait—Illinois EPA

EA Project 61393.26

Development of Biologically Based Thermal Limits for the Lower Des Plaines River

Prepared for

Midwest Generation
Chicago, IL

Prepared by

EA Engineering, Science, and Technology, Inc.
444 Lake Cook Road, Suite 18
Deerfield, IL 60015

August 2007

1. INTRODUCTION

As part of efforts to establish new aquatic life uses for the Dresden, Brandon, and Lockport Pools of the Upper Illinois Waterway (UIW), Illinois EPA (IEPA) is considering revised thermal water quality standards for all or portions of the UIW. In Illinois, as is true in many other states, the thermal standards now in effect were developed 20-30 years ago. When deriving updated standards for various water quality constituents, IEPA typically follows guidance provided by US EPA on deriving water quality criteria for aquatic organisms (US EPA 1985). Although that guidance will require some modification because of the unique properties of temperature, the conceptual framework is valid and provides guidance that is applicable to temperature as well as other water quality constituents

This report describes why use of the extensive, site-specific field database that has been collected in Dresden Pool is the most appropriate and robust method to derive thermal limits for that portion of the UIW. When site-specific field data of sufficient quantity and quality are available, as is the case in the UIW, a "field approach" that uses this data in deriving criteria is better than an approach based solely on laboratory-derived values (the "lab-based approach") (US EPA 1985). In addition to the fundamental advantages that a field approach offers over a lab approach, there are several concerns about the specific lab-based approach that IEPA is considering here to derive thermal water quality standards for the Dresden Pool. The shortcomings of the lab approach are also presented in this report.

2. WHY A COMMUNITY-BASED APPROACH USING FIELD DATA IS BETTER

US EPA (1985) notes that, where feasible, numerical aquatic life national criteria should be developed by conducting field tests. According to this document, the highest (or in some cases [e.g., pH] the lowest) concentration that did not cause "any unacceptable long-term or short-term effect on the aquatic organisms or their uses" would become the criterion. They note, however, that this community-based approach is not feasible on the national level "because it is not feasible to determine national criteria by conducting such field studies"; thus, US EPA developed guidelines for using lab-derived data. However, it is clear that US EPA endorses the use of acceptable field data over lab data. They go on to note that "high quality" field studies are necessary and that endpoint measures, such as the number of species or taxa, should "take into account the appropriate features of the body of water and its aquatic community." "High quality" studies are those conducted by experienced personnel following standardized and accepted protocols, and which include a defined QA/QC program. As described below, as well as in previous submittals, a high-quality biological monitoring program has been in effect in the UIW for nearly 30 years (EA 2007). This monitoring program together with subsequent analysis of the data collected, take into account site-specific features such as habitat quality, sediment contamination, and barge traffic, just as US EPA had envisioned.

Not only is a community-based approach consistent with US EPA guidance regarding development of water quality criteria, it also is consistent with US EPA guidance specific to thermal assessments. Clean Water Act Section 316(a) guidance indicates that thermal conditions are acceptable as long as the maintenance and protection of a "balanced, indigenous community" is assured (US EPA 1977). In many situations, little or no field biological data are available from which to derive criteria. In such situations, it is agreed that the use of laboratory-derived limits is, by necessity, appropriate. However, in this case, there are many years of high quality field data collected in a reliable and consistent manner available for analysis. As IEPA is aware, biological monitoring of the UIW has been conducted since 1978. However, changes in electrofishing effort and technique as well as sampling locations over time make comparisons to these earlier data difficult. Therefore, to ensure that any changes, or lack thereof, in the fish community are not the result of sampling methodology, level of effort or location differences, this analysis is restricted to data collected since 1994, because sampling methodology, level of effort and sampling locations have remained consistent since that time .

Consistent with US EPA guidance (US EPA 1977, 1985), it is appropriate to let the aquatic community "speak for itself". US EPA (US EPA 1977, 1985) and other guidance (Ohio EPA 1978) emphasize the need for high quality data, which cover a variety of seasonal conditions. The site-specific UIW data have been collected through multiple sampling trips, typically from the late spring (May) through the early fall (September) on a nearly annual basis. Even though both seining and electrofishing data are available, this analysis relies only on the electrofishing data because they are easier to quantify and represent the broadest cross-section of the fish community. Even restricting the data set in this manner still results in 814 electrofishing sampling passes being available for analysis for the entire (upper and lower) Dresden Pool.

Utilization of the field-collected biological data allows avoidance (thermal habitat partitioning) to be taken into account in a conservative fashion because if a species avoids a thermally-enhanced area, even on a short-term basis, that species will not be collected and thus the biological measurements described below will be reduced accordingly to reflect their absence. Short-term avoidance is a positive, protective attribute that allows fish to temporarily avoid areas that might be lethal or unduly stressful. However, avoidance, if it persists for long periods can be detrimental by excluding fish from preferred feeding, nursery, or spawning areas.

Thermal habitat partitioning is a common feature in natural environments (Nielsen et al 1994, Schrank et al 2003). Spatial heterogeneity in rivers allows fish the opportunity to select among differing thermal environments. Temporal heterogeneity can also allow fish to persist in warm-water habitats that otherwise would be inhospitable. Night-time cooling (i.e., diel variations in temperature) is one example of temporal heterogeneity.

Studies have been done to compare the actual distribution of fish in a stream versus the expected distribution based on lab-derived upper lethal temperatures. Shrank et al. (2003) hypothesized that fish would emigrate or die as summer water temperatures increased beyond the 7-d upper incipient lethal temperature (LT50) of 24.2 C they determined from laboratory experiments. However, they found that "fish neither emigrated from warm stream reaches nor experienced mortality, despite the presence of maximum daily water temperatures as high as 27 C." The researchers hypothesized that large diel fluctuations allowed these fish to survive despite 2-5 weeks of daily exposure to temperatures exceeding the 7-d LT50. Observations like this are especially relevant because they illustrate the dichotomy between lab-derived values and what actually happens in the real world.

Also, if upward thermal acclimation has taken place, which allows fish to occupy warm water without harm, that will also be taken into account by field sampling. Furthermore, the long-term period over which data have been collected will include the full range of environmental conditions that fishes might encounter. Lastly, because hundreds of data points are incorporated into the current analysis, any potential outliers will not unduly affect the results by producing either overly conservative or overly lenient limits.

3. THE COMMUNITY-BASED FIELD DATA APPROACH

The approach used for this analysis is based on setting a thermal limit that does not significantly reduce appropriate measures of community balance, i.e., a balanced community should be achieved. [NOTE- UAA says you don't just maintain what exists but you have to set the standards per the attainable use]Although US EPA guidance on this matter is not as clear for setting thermal standards as it is for Section 316(a) demonstrations, the overall premise is that thermal conditions are acceptable as long as they do not significantly reduce the "ecological balance" from what it would otherwise be in the absence of thermal enhancement. In this regard, it is important to note that based on several community-level measures like species richness, Index of Well-Being scores, and Index of Biotic Integrity scores, the current biological community of the Lower Des Plaines River (LDPR) is only fair to poor depending on the segment being considered. For example, IWBmod scores in Dresden Pool upstream and downstream of I-55 are typically in the 6 to 7 range (Figure 1) and IBI scores are in the low to mid-20s (Midwest Generation 2003). For reasons articulated in previous submittals (e.g., EA 2007), these somewhat impaired conditions are most likely the result of factors other than temperature and the community is as "balanced" as it can be given the habitat and sediment conditions that currently prevail. These conditions will likely continue unless significant physical improvements are made to the waterway, including, but not limited to: enhancement/creation of appropriate physical habitat to support higher quality aquatic life, improvements in the flow regime to more closely approximate natural conditions, lessening of the impacts of commercial navigational traffic, and remediation of contaminated sediments. In other words, "balanced" must be considered in the context of appropriate aquatic life use designations.

To measure balance, two widely recognized benchmarks were used, species richness and IWBmod (modified Index of Well Being) scores. Species richness is usually considered to be one of the most powerful of the IBI (Index of Biological Integrity) metrics (Ohio EPA 1987, Simon 1992). The IBI measures and scores various attributes (usually referred to as metrics) of the fish community, then sums the individual metric scores to yield the overall IBI score. The IBI is widely used in Illinois (Smogor 2003) and other Midwestern states (Indiana-Simon 1992; Ohio-Ohio EPA 1987; Wisconsin-Lyons 1992). Overall IBI scores were not calculated for the UIW because a calibrated IBI is not available for Illinois streams the size of the LDPR, so the most robust IBI metric, species richness, was used. In this case, to be conservative, only native species were counted, which is consistent with how most IBIs are performed. This was done because several non-native species, particularly common carp and goldfish, are very temperature tolerant so their inclusion might skew the results toward higher, more lenient temperature standards.

The other measure employed in this analysis, the IWBmod, is a frequently used index. It is one of the two fish indices used to determine attainment in Ohio (Ohio EPA 1987). The IWBmod was previously judged by the Upper Illinois Waterway Ecological Study Taskforce (stakeholder groups included US EPA, IEPA, IDNR, MWRDGC, USFWS, Sierra Club and Commonwealth Edison) to be an appropriate index for the UIW Study (Commonwealth Edison 1996). It is appropriate here because as fish abundance (either by number or weight) goes down, so do IWBmod scores.

Thus, fish avoiding an area because temperature in the area was above their preferred range would cause IWBmod scores to be lower. Also, if large numbers of thermally tolerant species (e.g., channel catfish, bluegill, etc.) prosper at the expense of less thermally tolerant species, then lower IWBmod scores will result because of the lack of diversity. The IWBmod already excludes many thermally tolerant species (e.g., common carp, goldfish, golden shiner, green sunfish, etc.). Because the IWBmod responds in a predictable manner, it provides a reliable yardstick for determining whether a balanced aquatic community exists.

To determine at what temperature these two measures declined significantly, two statistical approaches were used, pair-wise ANOVA comparisons and Loess regression.

Pair-wise ANOVA Comparisons

To determine how these two measures responded to temperature, native species richness values and IWBmod scores were plotted versus the temperature during each collection event (N=814) in Dresden Pool. In both cases, the widely-scattered data followed a parabola-shaped curve (Figures 2 and 3). In such situations, the goal is to find the curve that best fits the data. In this case, the best fit (i.e., the highest R^2 value) for a summary regression curve was obtained when the data were grouped into 5-degree increments. Grouping the data in this way resulted in high R^2 values for both richness (0.95) and IWBmod (0.89), meaning that the curves fit the data very well (Figures 4 and 5). Visual examination of the curves indicates that both richness values and IWBmod scores decline at very high (as well as at lower) temperatures. To determine at what 5-degree temperature interval native species richness and IWBmod values declined significantly, a series of pair-wise ANOVA (Analysis of Variance) comparisons was done. ANOVA comparisons are a standard way to compare values statistically to see if they are similar (i.e., statistically indistinguishable) or different (i.e., statistically different). In Dresden Pool where the data set was largest, it was found that richness and IWBmod values were highest and statistically similar across a broad plateau from 65.0 to 89.9 F meaning that temperature had no significant effect on these scores throughout this range (Table 1). However, both measures were significantly lower at the 5-degree increment from 90.0 to 94.9 F. To determine precisely where the decline began, the 5-degree increment from 90.0 to 94.9 F was split into five one degree intervals. For IWBmod, the decline was clear at ≥93 F, while for species richness, the clear-cut decline came at ≥94 F (Table 1). Conversely, neither measure showed any decline in the increment from 90-90.9 F. Between 91 and 93 F, however, the picture is not so clear. In the 91.0 to 91.9 F interval, both measures declined, but species richness rebounded in the 92.0 to 92.9 F interval (Table 1). Despite the evidence that species richness may not be consistently affected until 93 F, a conservative approach is warranted. Therefore, based on the pair-wise ANOVA comparisons, 91 F is indicated as a valid standard because of the decline in IWBmod values in the next higher interval.

Regardless of the final value chosen, it is important to recognize that brief excursions above this value are acceptable. For example, US EPA (1985) stated "the concentration of a pollutant in a body of water can be above the CCC (Criterion Continuous Concentration) without causing an unacceptable effect if (a) the magnitudes and durations of the excursions above the CCC are appropriately limited and (b) there are compensating periods of time during which the concentration is below the CCC". The endpoints (i.e., species richness and IWBmod) used in this analysis are indicators of the long-term responses by the fish community to a range of temperatures. Therefore, 91 F should not be thought of as an acute limit but instead should be applied as a monthly average temperature for the LDPR for the summer months. Based on the relationship between acute and chronic temperatures, a maximum daily average of 94 F should provide protection against unacceptable temperature extremes. Instantaneous values above 94 F would be acceptable so long as the daily average was met. For example, diel temperature fluctuations above 94 F would be acceptable so long as 94 F was met as a maximum daily average.

Loess Regression

To provide a second, independent assessment of the data set, the Dresden Pool data set was analyzed using Loess regression. Loess regression does a sequence of regressions in a window that slides across the data. It is like a moving average except that the estimate is based on regression rather than a mean. It functions as a data smoother and there is no underlying model other than the regression equation used. Parameters that can be adjusted are the width of the regression window and whether the regression is linear or quadratic. For this analysis, a window of 40% of the data and a quadratic regression was used. The procedure works as follows: if the data window chosen is 21 data points wide, then a regression would be done on the first 21 points, and you would use the predicted point for the middle point in the window (data record 11) as the prediction at point 11. Then the window would be moved one point right to include points 2-22. The regression would be repeated for this group and one would use the prediction at the midpoint (now point 12) of this window and so on, until the entire data set is covered.

As can be seen in Figures 6 and 7, the Loess procedure also yields a basically inverted U curve. For species richness, the Loess procedure indicates that richness is similar across a fairly broad temperature plateau from about 65 F to 87 F (Figure 6). Below 65 F and above 87 F, richness appears to decrease. To determine at what temperature species richness was reduced significantly, richness at various high temperatures was compared to richness at a point (72F) representative of the plateau. Because multiple sequential comparisons were made, a P value of 0.01 was used to determine significance. It was found that richness was significantly lower at 90 F:

Mean temp	P
86	0.337
87	0.323
88	0.217
89	0.036
90	0.004

With regard to IWBmod values, there again is a broad plateau (Figure 7). The decline at the high end of the plateau begins at or near 87 F, the same point as for species richness. However, at the low end, IWBmod scores appear to decline at temperatures below about 68 F, rather than at 65 F as was the case for native species richness. It was found that IWBmod scores also declined significantly at 90 F:

Mean temp	P
86	0.443
87	0.319
88	0.134
89	0.016
90	0.001

In summary, the pair-wise ANOVA comparisons and the Loess procedure, two independent statistical techniques, both indicate that temperatures need to exceed 90 or 91 F to result in a significant decline in native species richness or IWBmod values. Thus, a balanced indigenous community should persist so long as monthly average temperatures do not exceed 90 F (the more conservative of the two estimates) and daily average temperatures do not exceed 93 F.

4. WINTER THERMAL LIMITS

Winter thermal limits are usually designed to prevent fish deaths in the event that water temperature drops rapidly to ambient levels (Brungs and Jones 1977). One exception to this is a reported need for yellow perch to have "a long chill period during the winter for optimum egg maturation and spawning" (Brungs and Jones 1977). This statement appears to be based on a paper by Hokanson (1976). We are not aware of any follow-up research that either supports or refutes the conclusions of Hokanson. However, even if Hokanson's conclusion is correct, no special protection of yellow perch is appropriate in the LDPR. Yellow perch is a lentic (lake) species that exists only in small numbers in lotic (river) systems unless those systems contain extensive backwater areas. Because the LDPR has little backwater habitat, yellow perch are and will remain a minor player in the Des Plaines River ecosystem.

Brungs and Jones (1977) go on to state that except in special circumstances "[i]t is unlikely that any significant effects on fish populations could occur as long as death (due to cold shock) was prevented." Based on the need to prevent cold shock deaths, Brungs and Jones (1977) prepared a nomograph that plotted permissible plume temperature against ambient temperatures. Because of the dominant influence of treated waste water from the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) Stickney WWTP, water temperatures in the LDPR during the winter typically do not drop below 50 F. According to the guidance provided by Brungs and Jones (1977), a plume temperature of 77 F would be acceptable under an ambient temperature of 50 F. If the ambient temperature was 54.5 F, a plume temperature of 86 F would be acceptable. Thus, so long as Delta T temperatures are ≤27 F and the ambient temperature is ≥50 F, no cold shock mortality would be expected for the UIW. A further margin of safety is provided by the fact that the Midwest Generation Joliet Generating Station has more than one unit. Thus, even if one unit goes down, there still will be one or more units continuing to operate, preventing rapid cooling to ambient temperatures.

In summary, the only discernible reason for winter temperature regulation is to prevent cold shock deaths and this can be accomplished, based on the available biological references, so long as plume temperatures do not exceed ambient temperatures by >27 F.

5. WHY A LABORATORY-BASED APPROACH IS NOT APPROPRIATE

Illinois EPA is considering applying water temperature limits using a "model" originally developed by the Ohio EPA and updated by the Midwest Biodiversity Institute (MBI 2005a). However, the "model" is not a model; rather it simply ranks thermal endpoint data (e.g., acute upper lethal temperatures) for each species from least to most sensitive. The proposed limit is then based on the most sensitive species among the ranked data. This MBI-approach has several scientific shortcomings, as discussed below.

(1) **The database on acute upper lethal temperatures has not been verified.**

In the MBI-approach, the only value that is used to derive the criterion is the one for the species ranked most sensitive. Therefore, it is of paramount importance that this value be valid. However, contrary to US EPA guidance (1985), the database has not been checked. US EPA (1985) indicates that after the data are collected, the next step is to review them for acceptability (Executive Summary, p. iv). Later (p. 21-22), they indicate that "questionable data, whether published or unpublished, should not be used" and give examples of types of data that should not be used. Beginning in the 1980's and continuing until the present, US EPA periodically updates its national water quality criteria for priority pollutants. Unfortunately, US EPA has never updated its temperature criteria. For each toxicant, US EPA compiles a toxicity database, reviews the data in the database to determine if they are acceptable, then publishes draft criteria. The public and interested parties then have the opportunity to comment on the draft criteria and the quality of the data used to derive the criteria.

In this case, the important step of data review has not been conducted. Thus, we do not know whether the data included in the MBI analysis are "acceptable." The issue of data review and acceptability is especially important when the criterion is based on the single most sensitive species because an invalid or outlier data point will result in an erroneous standard if the value in question was associated with the species ranked most sensitive. To avoid such errors, other states (e.g., Colorado and Wisconsin) have developed validation criteria for experimental data used to develop temperature criteria and standards.

The issue of data quality was discussed at length in a paper by Dr. W. Stubblefield (Stubblefield 2001). In this paper, he notes that US EPA is attempting to develop standardized data acceptance criteria for its AQUIRE database. Data currently included in AQUIRE are not evaluated for quality of utility – only the quality of the study report is provided in the "document code." EVISTRA (**E**valuation and **I**nterpretation of Suitable **T**est **R**esults) is intended to remedy this deficiency and provide information about the overall *quality* of a study and the *suitability* of the data for the purpose of deriving numeric criteria and/or standards. A draft version of the EVISTRA guidance document can be obtained at www.epa.gov/med/databases/evistra.html. According to Dr. Stubblefield, "the importance of individual data quality cannot be overemphasized. This is especially true in those cases where the results of a single toxicity test are driving the derivation of a criterion."

Our review of a few of the more sensitive species listed in a MBI report concerning thermal limits for the Ohio River (MBI 2005b) found several erroneous or misapplied values in the database used by MBI. For example, the limit originally proposed for the Ohio River was based on the upper lethal temperature of logperch. A review of the paper in which the logperch data were reported (Hubbs 1961) revealed several problems:

- The 26 C value used by MBI as an acute endpoint is in fact a chronic endpoint based on reproductive measures.

- Hubbs, the author of the original paper, acknowledged that temperature control "was not as accurate as desired, with fluctuations of ±2 C".

To confirm the erroneous nature of the 26 C value, EA examined the temperatures at which thousands of logperch were collected from the Ohio River. We found that in much of the river, the median temperature at which they were collected exceeded their purported upper lethal temperature. As a result of these errors, logperch was deleted from consideration when ORSANCO developed its final thermal criteria for the Ohio River.

Further review of the Ohio River database compiled by MBI indicated that additional unacceptable values had been included. For example, upper lethal temperatures for several species had been based on the testing of only two specimens (stonecat) and, in three cases, only a **single** fish (silver lamprey, spotted sucker, and redear sunfish) was used to derive the LC50 (Reuter and Herdendorf 1975). The data were further compromised by the fact that in several cases only winter-acclimated fish were tested. This renders these data invalid for use as upper lethals because the upper lethals reported for these winter-acclimated fish would be higher if they were based on summer-acclimated fish.

The erroneous and scientifically unacceptable values described above were based on reviewing only a small portion of the MBI data set. In that case, as well as in the current situation, these inappropriate values would not have been found without examining the database carefully. Without a review, as recommended by USEPA, it is impossible to determine the validity of the database that MBI compiled for the LDPR.

In fact, Illinois EPA followed this data-validation approach recently when it proposed new sulfate limits. IEPA searched the sulfate database for "toxicity data that was reputable and representative of Illinois fauna" (testimony of Mr. Brian Koch, February 2007). He also stated that "a key component in standards derivation is the gathering and **assessing** (emphasis added) available toxicity data." He goes on to note that following consultation with US EPA and the industry consultant, "several of the studies were deemed unacceptable for use in standards derivation." The agency even went so far as to explain the acceptance or rejection of each study.

Presently, EA does not know which, if any, of the thermal values in the MBI database are unacceptable, and neither does MBI, US EPA, or IEPA. Without this knowledge, valid lab-based criteria can not be developed.

(2) The approach relies on the protection of one species rather than protection of the community.

Standard US EPA and 316(a) guidance indicates that water quality limits should be designed to protect communities, not individual species (unless there is a threatened or endangered species to be protected). US EPA guidance (US EPA 1985) states that water quality criteria should be based on the 95th percentile of genus mean acute values. The MBI approach of determining temperature limits based on the most sensitive species is directly contrary to this USEPA guidance. US EPA (1985) put it this way, "[b]ecause aquatic ecosystems can tolerate some stress and occasional adverse effects, protection of all species at all times and places is not deemed necessary."

Therefore, the fact that the ranking approach uses only the single most sensitive species to determine the thermal limit is not only contrary to USEPA guidance, but is also inconsistent with well established methods for the protection of aquatic communities.

(3) This approach does not take avoidance and natural thermal habitat partitioning into account.

We recognize that long-term avoidance of a habitat can be detrimental to population success, but short-term avoidance should be viewed as a beneficial, adaptive response. In the natural environment, all species found at a location sometime during a year will not always be there. Seasonal and spatial thermal partitioning is an accepted feature of fish communities. The approach recommended by MBI assumes that fish will not avoid potentially lethal temperatures when in fact, they will. The approach recommended in this proposal allows short-term avoidance to be conservatively considered.

(4) The approach does not emphasize real-world, field data.

Whereas laboratory-derived data on thermal requirements can be used as a reasonable gauge when field data on occurrence are lacking, a better and more reliable measure of environmental acceptability is actual field data on occurrence and temperatures. Section 316(a) guidance (EPA 1977) recognizes this dichotomy by identifying two types of demonstration, one predictive (using largely laboratory data) and the other retrospective (using field studies). The "no prior appreciable harm" criterion for Section 316(a) retrospective analyses recognizes the primacy of actual field data.

To determine how well the LDPR field-collected data correlated with the laboratory-derived data compiled by MBI, we examined the 13-year data set (i.e., 1994-2006) from the LDPR. Based on temperatures recorded at each collecting location, a series of values and percentiles were calculated, ranging from the maximum temperature at which each fish species was collected to the median temperature (i.e., 50th percentile), the temperature at which half the values were above and half the values were below. If the lab data compiled by MBI are an accurate predictor of the real-world response of fishes, then species should not be collected at temperatures above their upper avoidance temperature (UA) nor at temperatures greater than their upper incipient lethal temperature (UILT). Provided below is a listing of just some of the discrepancies found when the field and lab data were compared for several fishes:

Golden redhorse – the max field temp of 33.5 C was above both the UA (28.5 C) and UILT (33.4 C); the 95% (31.3 C), 90% (30.8 C), and 75% (29.4 C) temps were above the UA (28.5 C).

White sucker – the max field temp of 32.0 C was above both the UA (28.7 C) and UILT (31.5 C); the 95% (31.0 C) and 90% (30.1 C) temps were above the UA (28.5).

Bluntnose minnow – the max field temp (37.6 C) and 95% (32.9 C) temps were above both the UA (31.4 C) and UILT (32.4 C); the 90% (31.7 C) temp was above the UA, but below the UILT.

Yellow bullhead – the max field temp (36.0 C), 95% (32.2 C), and 90% (31.6 C) temps were all above the UA (31.3 C), but below the UILT (36.4 C).

Largemouth bass – the max field temp of 37.6 C was above both the UA (31.6 C) and UILT (34.5 C); the 95% (33.0 C) and 90% (31.9 C) temps were above the UA, but below the UILT.

Green sunfish – the max field temp of 38.2 C was above both the UA (30.9 C) and UILT (35.3 C); the 95% (33.7 C) and 90% (32.3 C) temps were above the UA.

Thus, many fishes in the LDPR were collected at temperatures above their lab-derived avoidance temperatures, and for several species, 5-10%, or even 25%, of the specimens were collected above their purported upper lethal temperature.

Based on the above-described concerns regarding the laboratory-derived thermal criteria for the LDPR, and the availability of high quality LDPR field-collected data, EA believes that the IEPA should adopt the field approach to deriving thermal water quality standards for the Dresden Pool of the LDPR. The field approach provides a more reliable methodology to identifying thermal standards that are adequately protective of the aquatic community that can be achieved in the LDPR without the risk that overly stringent standards will be adopted.

6. SUMMARY / CONCLUSIONS

Applying the field approach to the LDPR data, EA performed two independent statistical assessments of the LDPR data set, using pair-wise ANOVA comparisons and the Loess procedure. In summary, the pair-wise ANOVA comparisons and the Loess procedure both indicate that temperatures would need to exceed 90 or 91 F to result in a significant decline in native species richness or IWBmod values. Thus, a balanced indigenous community can be attained and should persist in the LDPR so long as monthly average temperatures do not exceed 90 F (the more conservative of the two estimates) and maximum daily average temperatures do not exceed 93 F.

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Figure 1. Longitudinal Comparisons of IWB and IWBmod Scores, 2005.

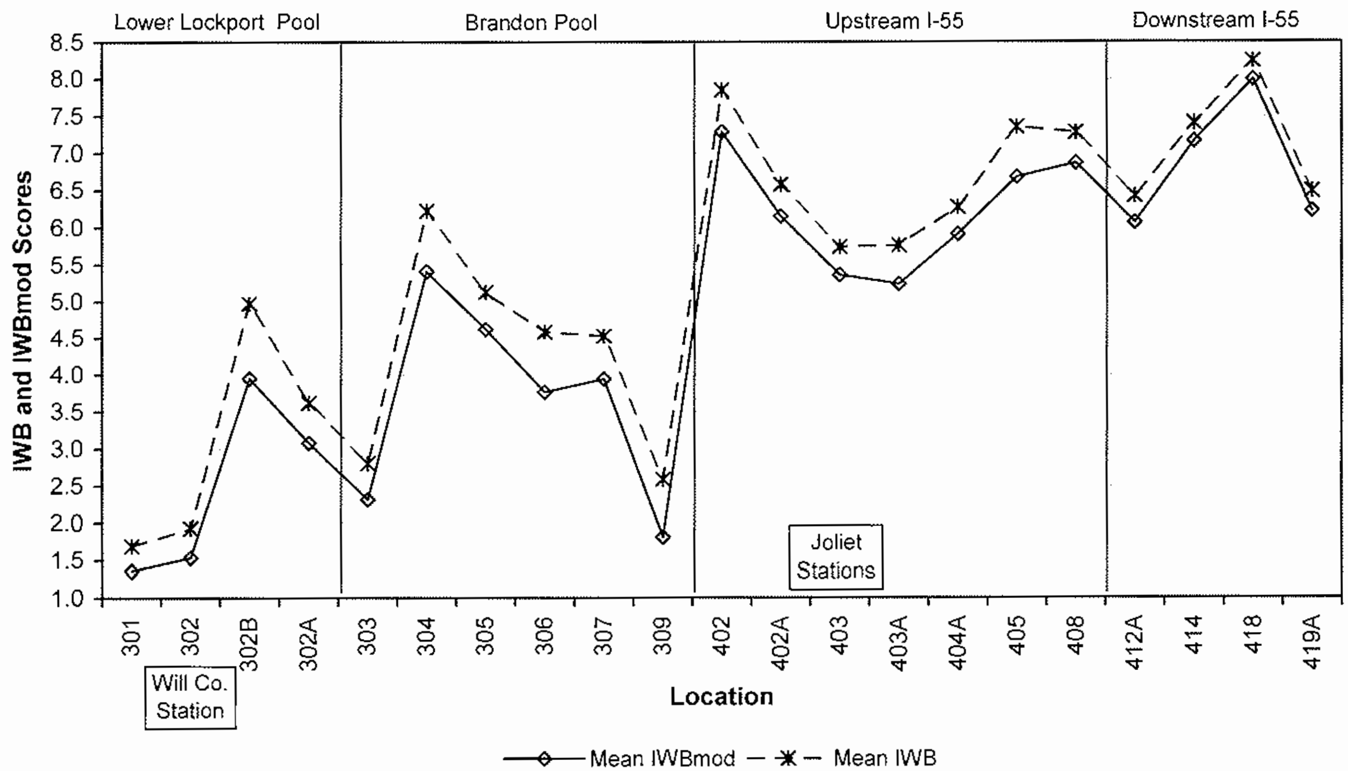
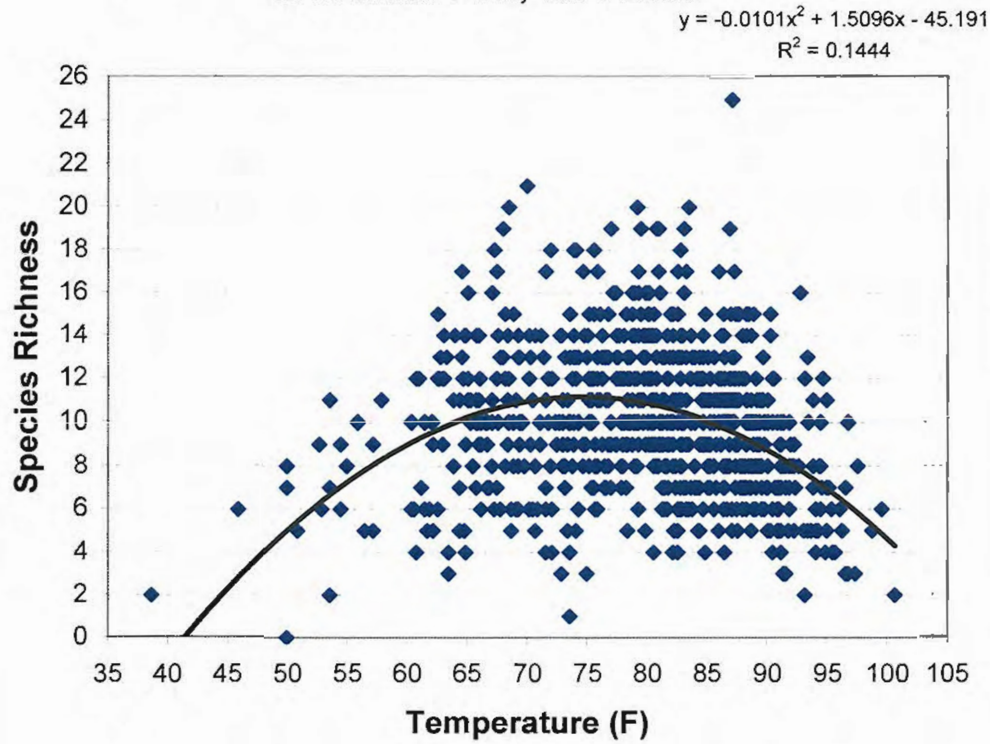


Figure 2. Native Species Richness vs. Temperature in Dresden Pool, 1994-2005.



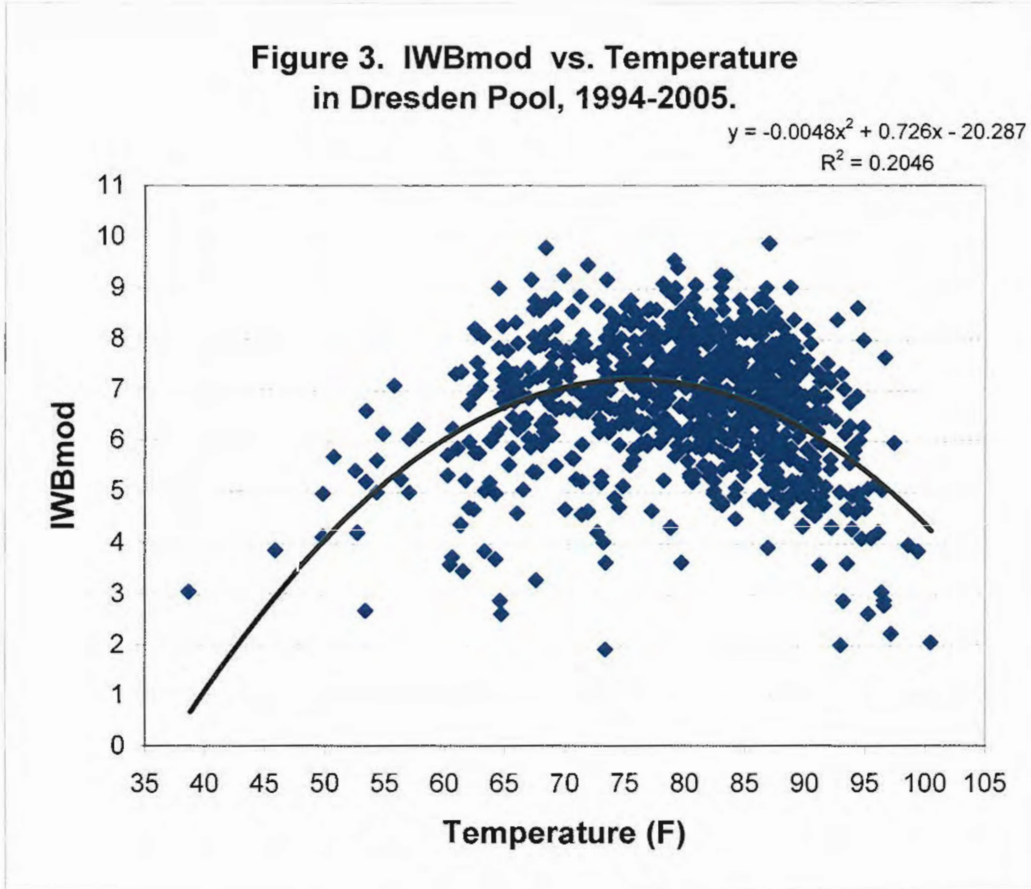
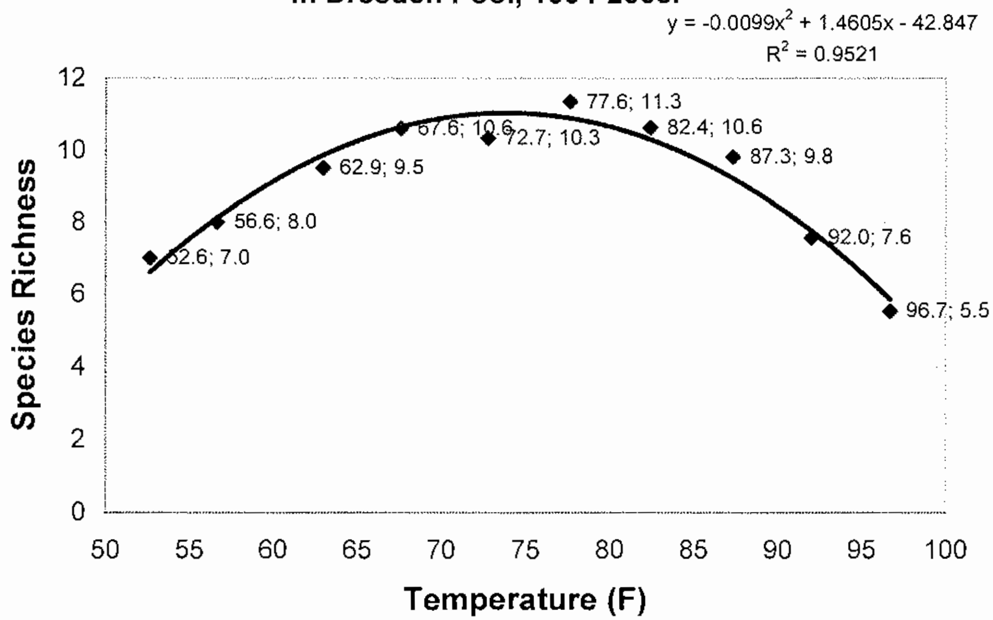


Figure 3. IWBmod vs. Temperature
in Dresden Pool, 1994-2005.
y = -0.0048x2 + 0.726x - 20.287
R2 = 0.2046
IWBmod
Temperature (F)
0
1
2
3
4
5
6
7
8
9
10
11
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105

Figure 4. Native Species Richness vs. Temperature (averaged in 5-degree increments) in Dresden Pool, 1994-2005.



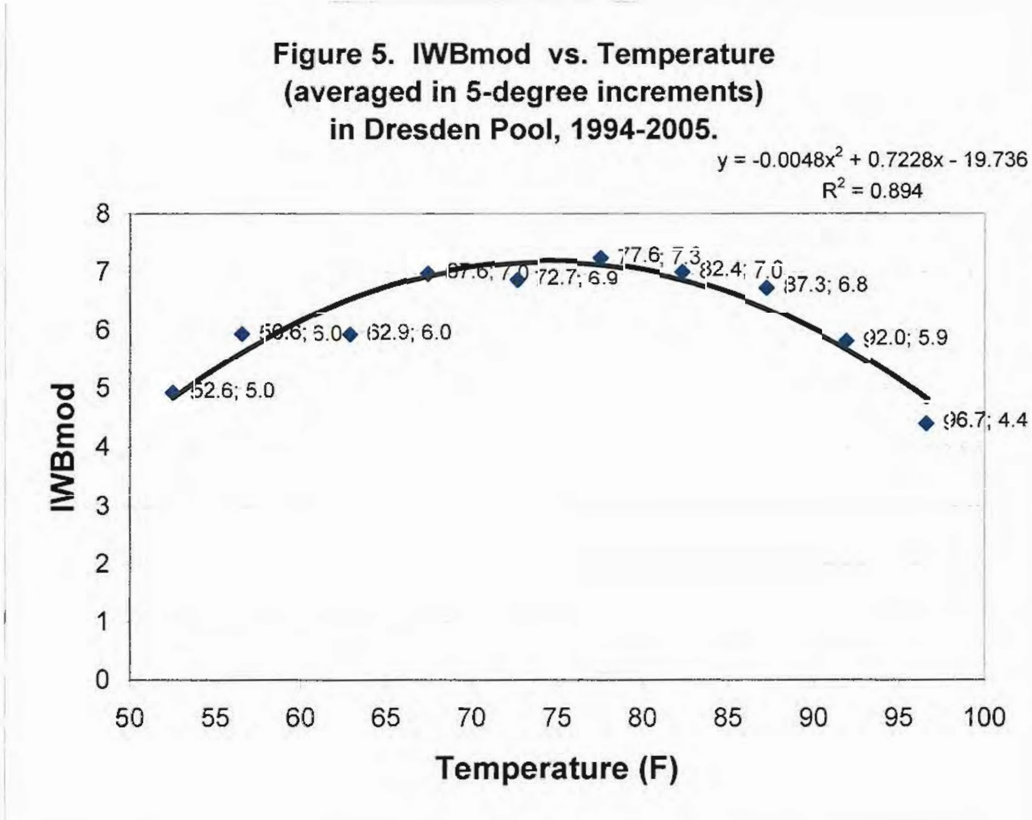


Figure 5. IWBmod vs. Temperature
(averaged in 5-degree increments)
in Dresden Pool, 1994-2005.
y = -0.0048x2 + 0.7228x - 19.736
R2 = 0.894
IWBmod
Temperature (F)
52.6; 5.0
56.6; 6.0
62.9; 6.0
67.6; 7.0
72.7; 6.9
77.6; 7.3
82.4; 7.0
87.3; 6.8
92.0; 5.9
96.7; 4.4
0
1
2
3
4
5
6
7
8
50
55
60
65
70
75
80
85
90
95
100

Table 1. Statistical Comparisons of Mean Native Species Richness and IWBmod Values Among 5-Degree and 1-Degree (F) Temperature Ranges for Electrofishing Data from the Lower Des Plaines River in Dresden Pool, 1994-2005.

Parameter	50.0-54.9	55.0-59.9	60.0-64.9	65.0-69.9	70.0-74.9	75.0-79.9	80.0-84.9	85.0-89.9	90.0-90.9	91.0-91.9	92.0-92.9	93.0-93.9	94.0-94.9	95.0-100.7	Significant Difference[a]	F Value	P Value
Native Species Richness[b]	7.0	8.0	9.5	10.6	10.3	11.3	10.6	9.8	8.2	7.0	8.8	7.5	6.6	5.5	Yes	10.36	<0.01
	CDE	ABCDE	ABCD	AB	ABC	A	AB	ABCD	ABCDE	CDE	ABCDE	BCDE	DE	E[c]			
IWBmod[b]	5.0	6.0	6.0	7.0	6.9	7.3	7.0	6.8	6.1	5.8	6.5	5.2	5.6	4.4	Yes	12.25	<0.01
	D	BCD	ABCD	AB	AB	A	AB	ABC	ABCD	BCD	ABC	CD	CD	D			
N	10	6	41	70	78	136	195	182	24	22	8	11	12	19			

(a) Results of one-factor parametric Analysis of Variance tests (alpha=0.05).
(b) Data ranks used for statistical analyses because raw data and log transformed data are not normally distributed.
(c) Results of Tukey's Studentized Range Test; values with the same letters are not significantly different (alpha=0.05).

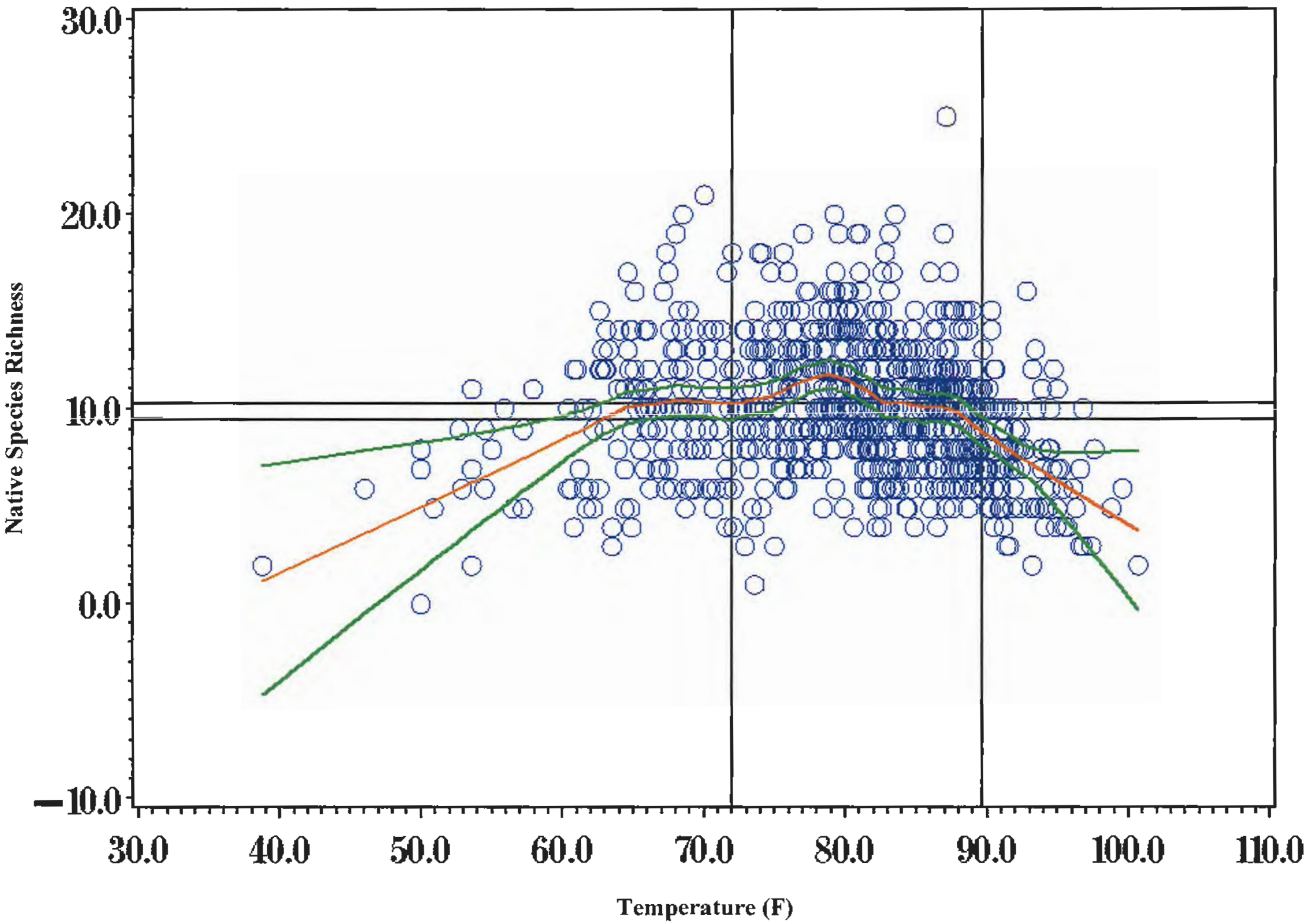


Figure 6. Loess regression of Number of species versus mean temperature. The upper horizontal line shows the predicted value of the plateau (72 degrees) the lower horizontal line shows the lower limb of the confidence interval at 72 degrees. The Left vertical line shows 72 degrees. The Right vertical line shows the temperature where number of species drops significantly below the plateau.

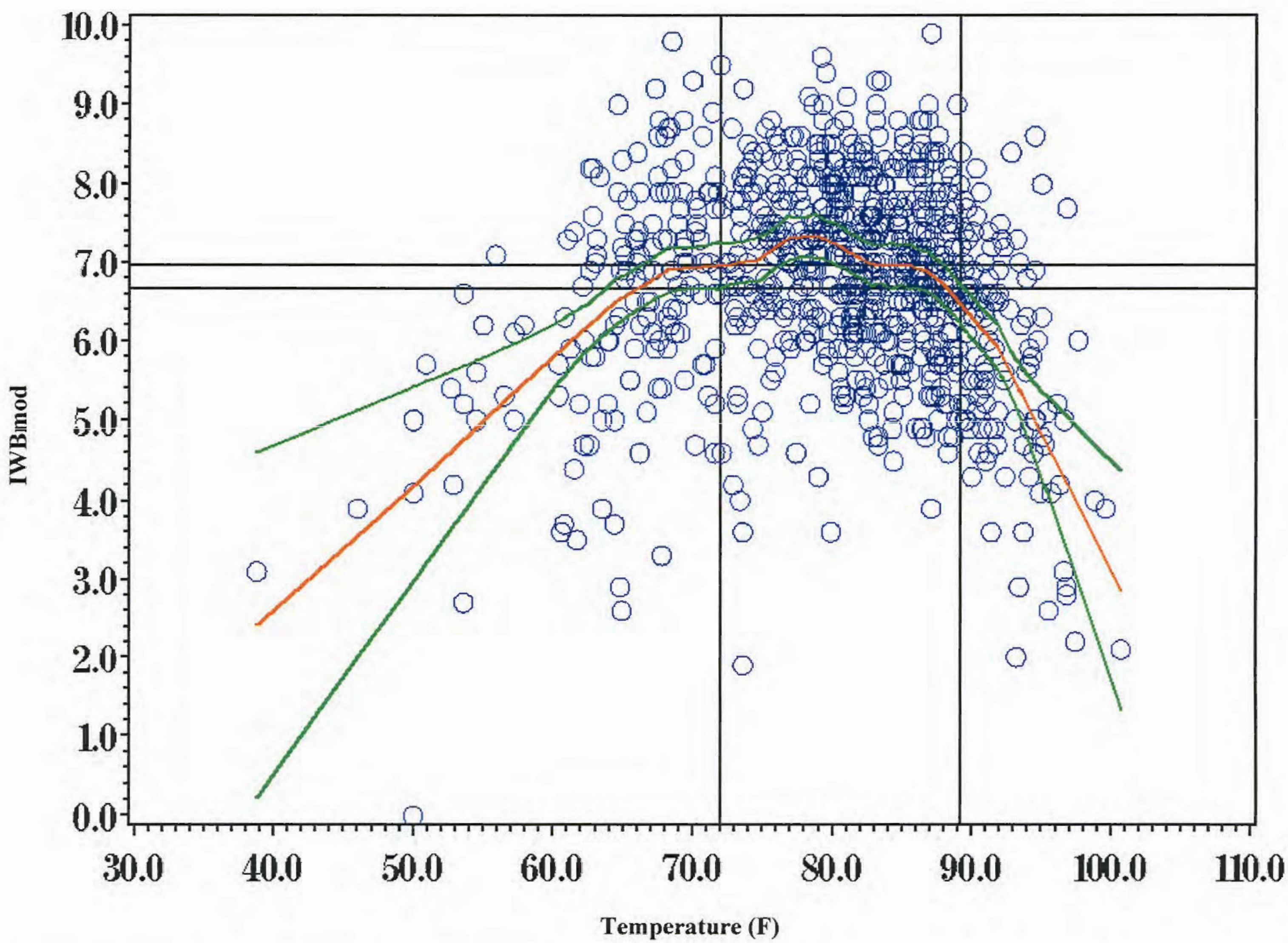


Figure 7. Loess regression of IWBmod versus mean temperature. The upper horizontal line shows the predicted value of the plateau (72 degrees) the lower horizontal line shows the lower limb of the confidence interval at 72 degrees. The Left vertical line shows 72 degrees. The Right vertical line shows temperature where the Index drops significantly below the plateau.

UAA SUBDOCKET D
PCB R08-09(D)

MIDWEST GENERATION'S POST–HEARING COMMENTS

ATTACHMENT D

APPROPRIATE THERMAL WATER QUALITY STANDARDS
FOR THE LOWER DES PLAINES RIVER

Summary Report
Prepared by Midwest Generation and EA Engineering, Science and Technology, Inc.

Original Issued: January 24, 2003
Revised: October 13, 2003

I. INTRODUCTION

Midwest Generation, with the assistance of EA Engineering, Science and Technology, Inc., has prepared this report for inclusion in the record of the current Use Attainability Analysis (UAA) for the Lower Des Plaines River. Under the federal Clean Water Act regulations, a UAA is required in order to determine if fishable and swimmable uses, reflecting the goals of the Clean Water Act, are not attainable for a particular water body or segment thereof. [See 40 C.F.R. **§** 131.10(j)].

This report evaluates and compares the present physical, chemical and biological characteristics of the Lower Des Plaines River to the current and proposed future thermal regime of the waterway. The results of this evaluation and comparison support the application of thermal water quality standards that are biologically appropriate and adequately protective of the existing and potential uses of this waterway, given the constraints on the system that are permanent or cannot be mitigated.

A. UAA Regulatory Overview

A use attainability analysis is defined as:

> ...a structured scientific assessment of the factors affecting the attainment of a use which may include physical, chemical, biological, and economic factors as described in Section 131.10(g). [40 CFR Section 131.3].

A "use attainability analysis" includes six factors that are to be considered in determining whether the fishable/swimmable goals of the Clean Water Act are attainable for a particular water body. [40 CFR **§** 131.10(g)]. These six UAA factors are discussed in this report and are summarized in Appendix 1. Under the UAA regulation, only one or more of these factors must be satisfied in order to determine that a water body is not capable of attaining the Clean Water Act's fishable/swimmable goals. Of particular relevance in this report are the following four UAA factors (the paragraph numbering is as found in 40 CFR 131.10(g)):

> 2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the

discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met;

3. Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place;

4. Dams, diversions, or other types of hydrologic modifications preclude the attainment of use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in attainment of the use;

5. Physical conditions related to the natural features of the water body, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses.

B. Application of the UAA Factors to Assess Chemical, Biological and Physical Characteristics of the Lower Des Plaines River

U.S. EPA has long advocated the concept of independent application when using the assessment tools available to make use designation decisions:

> *"Independent application means that any one of the three types of assessment information (i.e. chemistry, toxicity testing results, and ecological assessment) provides conclusive evidence of nonattainment of water quality standards regardless of the results from other types of assessment information. Each type of assessment is sensitive to different types of water quality impact. Although rare, apparent conflicts in the results from different approaches can occur. These apparent conflicts occur when one assessment approach detects a problem to which the other approaches are not sensitive. This policy establishes that a demonstration of water quality standards nonattainment using one assessment method does not require confirmation with a second method and that the failure of a second method to confirm impact does not negate the results of the initial assessment."* (See U.S.EPA, June 19, 1991 Transmittal of Final Policy on Biological Assessments and Criteria).

Therefore, to reliably determine whether or not fishable and swimmable uses are attainable for the Lower Des Plaines River, the UAA must include consideration of **physical** and **biological integrity**, not simply chemical water quality. In EPA's Water Quality Standards Handbook, Second Edition (1994), the use of biological criteria to support designated aquatic life use classifications is strongly encouraged.

Approximately 20 years later, the U.S.EPA continues to endorse the use of biological assessments and criteria as a very reliable tool in the development of appropriate water quality standards:

> "*Ecological integrity is a combination of these three components: chemical integrity, physical integrity and biological integrity. When one or more of these components is*

> *degraded, the health of the waterbody will be affected, and in most cases, the aquatic life there will reflect that degradation. Aquatic life integrates the cumulative effects of different stressors such as excess nutrients, toxic chemicals, increased temperature, and excessive sediment loading. Therefore, bioassessments allow one to measure the aggregate impact of the stressors. Because biological communities respond to stresses over time, they provide information that more rapidly-changing water chemistry measurements or toxicity tests do not always produce. As such, bioassessment provides a more reliable assessment of long-term biological changes in the condition of a waterbody. The central purpose of assessing biological condition of aquatic communities is to determine how well a water body supports aquatic life".* (EPA 822-F-02-006, Summer, 2002)

The importance of basing use designations on biological integrity (as the overall integrator of waterbody conditions) was emphasized at the U.S.EPA sponsored "National Conference on Tools for Urban Water Resource Management and Protection" in 2000. In particular, the relationship between the Index of Biotic Integrity (IBI), an indicator of biological health, and a qualitative analysis of overlying stressors in six major metropolitan areas in Ohio were used by Yoder, Miltner and White, (2000) to suggest that there is a threshold of watershed urbanization (e.g.>60%) beyond which attainment of warmwater habitat (equivalent to Illinois' General Use) is unlikely. Similar reliance on biological assessment data and information were also recognized by an number of experts in the proceedings of the National Symposium on "Designating Attainable Uses for the Nation's Waters" held on June 3-4, 2002 in Washington, D.C. (GLEC, July 2002).

While Illinois does not have an established bioassessment program in place for large rivers, the draft bioassessment methodology that the Illinois EPA has developed, based on smaller order streams, can be successfully applied to the Lower Des Plaines River. Further, because of more than 20 years of biological and habitat monitoring data available on the UAA Reach, there is an extensive data base to which this draft bioassessment methodology can be applied to make decisions regarding the appropriate use designations for the Lower Des Plaines River.

Certainly, the chemical water quality of the Lower Des Plaines River has improved over the past 20 years. However, as the U.S. EPA and others have stated, chemical water quality alone does not dictate the potential of the waterway from an ecological perspective. Because the UAA analysis by Novotny/Hey & Associates focuses primarily on the chemical water quality of the Lower Des Plaines River, the information and supporting data presented in this report will address the other two key elements of a UAA--the physical and biological aspects of the Lower Des Plaines River and their overall potential for improvement, in the context of the 6 UAA factors. This extensive review of the physical and biological characteristics of the water body shows that focusing primarily on the chemical quality of the Lower Des Plaines River does not provide a reliable basis on which to determine its use potential. The UAA analysis presented in this report shows that the physical and biological constraints present in the Lower Des Plaines River make the full fishable/swimmable uses inherent to a General Use classification unattainable in this water body. Barring further refinements, such as the addition of subclassifications, to the existing Illinois Use Classification system, the Lower Des Plaines River is properly classified as a Secondary Contact Use water body.

II. BACKGROUND

Much of the background information and data contained in this report was drawn from the comprehensive ecosystem study of the entire Upper Illinois Waterway (UIW) performed by Commonwealth Edison ("ComEd") in the early to mid-1990's. Development and implementation of this study was done under the direction of an ad hoc task force consisting of representatives from Illinois EPA, U.S. EPA Region 5, Illinois Department of Natural Resources and the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), as well as other interested public, private and academic groups. (See UIW Summary at Appendix 2) Representatives of Illinois EPA, IDNR and U.S. EPA have recognized the UIW Study as the most comprehensive, multi-disciplinary effort ever performed on this waterway.

The overriding purpose of the comprehensive, multi-year UIW investigation was to better understand the effects that temperature increases caused by power plants have on aquatic biota and especially their potential to stimulate or hinder improvement of the waterway.

A majority of the information collected as part of the UIW Study is still valid today. The UIW Study data and findings need to be carefully considered in the UAA for the Lower Des Plaines River, including any assessment of appropriate thermal water quality criteria for the Lower Des Plaines River, to ensure that the most complete and reliable data available are used to determine what use(s) are attainable for this water body. Due to their comprehensive length, this report cannot extensively reference the studies performed as part of the UIW effort, but does provide a full executive summary in Appendix 2. All UIW documents are publicly available for review and can be provided upon request. (See listing of UIW Study individual reports and content summaries in Appendix 3).

III. HISTORY OF THE WATERWAY

The 53-mile section of the UIW originally studied by ComEd is a mix of artificial and greatly-modified natural waterways extending Southwest from Chicago to the Kankakee River. (Figure 1). Early in the history of Chicago, a plan was conceived to protect the area's primary water supply, Lake Michigan, by constructing three man-made waterways to permanently reverse the flows of the Chicago and Calumet River systems away from the lake, and divert the contaminated water downstream where it could be diluted in the Des Plaines and eventually the Illinois River. The man-made Chicago Sanitary and Ship Canal, completed in 1907, merges with the Des Plaines River about 40 miles downstream of Lake Michigan near Lockport, Illinois. Diversion water from Lake Michigan increased the navigation capabilities of the system and provided additional waste dilution. Construction of the Cal-Sag Channel was completed in 1922, connecting the Calumet and Little Calumet Rivers with the Chicago Sanitary and Ship Canal. Construction of these man-made waterways was a significant ecological event. It provided a direct link between the Great Lakes Drainage and the Mississippi Drainage.

Reconstruction of the UIW in its present form began in 1919. A new and larger channel was constructed in the Lower Des Plaines River and the upper Illinois River to form a continuous navigational channel from Lake Michigan to the Mississippi River. This new channel was at least nine feet deep and 300 feet wide throughout and greatly increased the barge transport capabilities of the system. The project included construction of seven major locks and three dams, including a 40-foot dam just south of Lockport and a 34-foot dam just south of Joliet at Brandon Road. A third, 22-foot dam was constructed at Dresden Island, less than two miles downstream from the confluence of the Kankakee and Des Plaines Rivers.

In its UIW Study, ComEd covered the 53-mile reach between the diversion from Lake Michigan at Chicago and the Dresden Island Lock and Dam. The current UAA study reach area is a subset of the entire UIW. It extends from the Lockport Lock and Dam on the Chicago Sanitary and Ship Canal (RM 290) down to the I-55 Bridge on the Lower Des Plaines River (RM 278). This subset of the UIW is referred to herein as the "UAA Reach".

A. Power Plants in the UAA Reach

There are two open-cycle, coal-fired power plants that discharge either into or immediately above the UAA Reach. These plants, formerly owned and operated by ComEd, were sold to Midwest Generation in December, 1999. They include:

> **Will County Station** is located in Romeoville, Illinois, near the intersection of the Chicago Sanitary and Ship Canal and 135th Street. (RM 295.5) The station has a total of 4 units, with a combined capability of 1154 gross megawatts of electricity. (For reference: 1 megawatt is enough power to service approximately 1000 homes). The first Will County unit began operations in 1955; the most recent unit came on-line in 1963.

> **Joliet Stations #9 (Unit 6) and #29 (Units 7&8)** are capable of producing a total of approximately 1414 megawatts of electricity. The stations are located in Will County, approximately one mile southwest of the City of Joliet, Illinois. (RM 285) They are located on the Lower Des Plaines River just downstream of the Brandon Road Lock and Dam. The older Joliet unit began operating in 1959; the two newer units came on-line in 1966. Joliet Station #29 has 24 supplemental cooling towers to assist with heat dissipation. These towers were installed in 1999 and are used, as needed, to maintain near and far-field compliance with the existing thermal water quality standards.

Figure 1: Map of Upper Illinois Waterway, Including UAA Reach

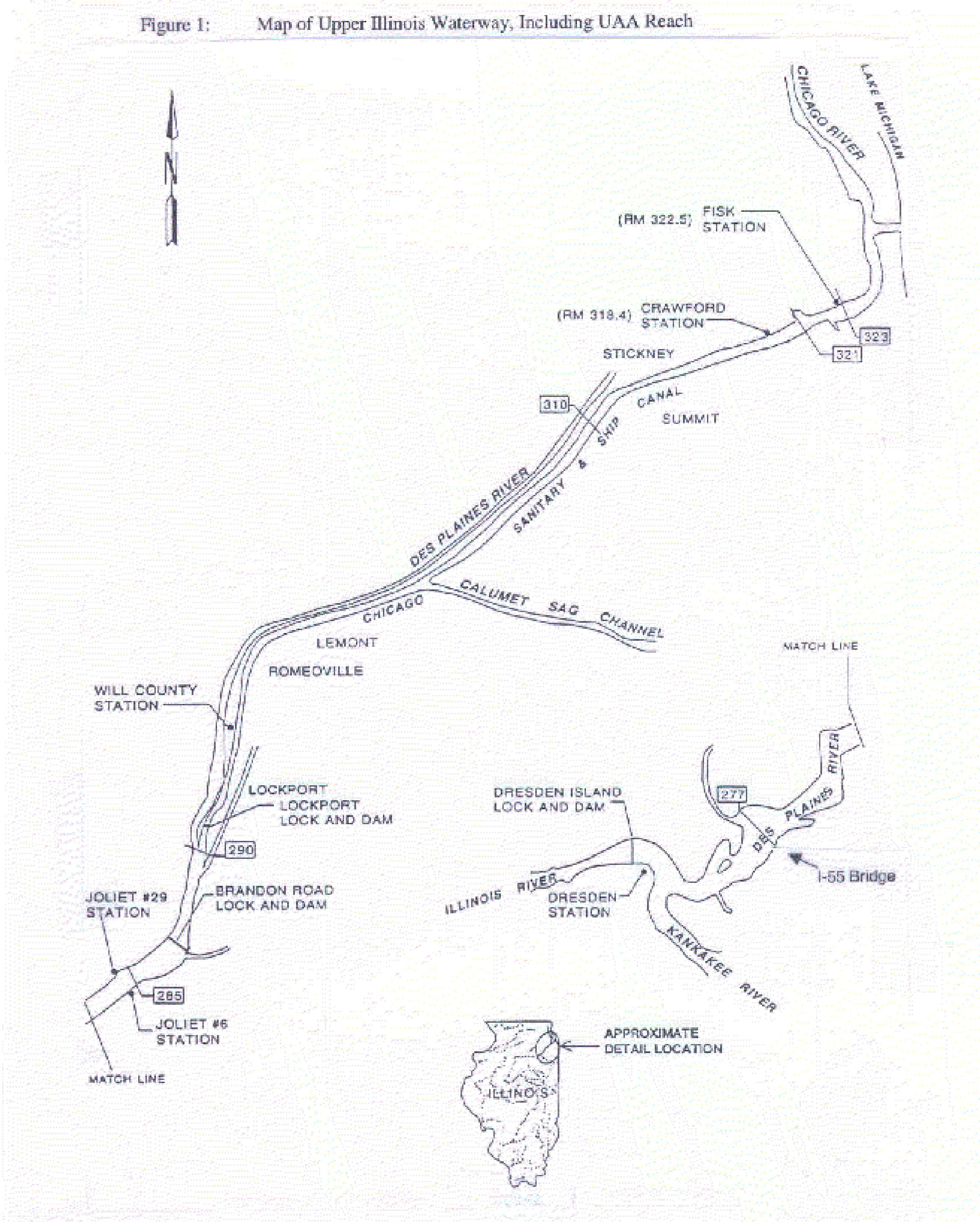


Table 1: Listing of Current Water Quality Limitations In Effect for the Lower Des Plaines River

PARAMETER	UNITS	GENERAL USE	SECONDARY CONTACT AND INDIGENOUS AQUATIC LIFE
pH	SU	6.5 minimum 9.0 maximum	6.0 minimum 9.0 maximum
Dissolved Oxygen	mg/L	5.0 minimum	4.0 minimum (2)
Arsenic	µg/L	(3)	1000
Barium	µg/L	5000	5000
Boron	µg/L	1000	(4)
Cadmium	µg/L	(3)	150
Chloride	mg/L	500	---
Chromium (Total)	µg/L	---	---
Chromium (Trivalent)	µg/L	(3)	1000
Chromium (Hexavalent)	µg/L	(3)	300
Copper	µg/L	(3)	1000
Cyanide	mg/L	(3)	0.1
Fluoride	mg/L	1.4	15.0
Iron (Total)	µg/L	---	2000
Iron (Dissolved)	µg/L	1000	500
Lead	µg/L	(3)	100
Manganese	µg/L	1000	1000
Mercury	µg/L	(3)	0.5
Nickel	µg/L	1000	1000
Phenols	µg/L	100	300
Selenium	µg/L	1000	1000
Silver	µg/L	5.0	100
Sulfate	mg/L	500	---
Total Dissolved Solids	mg/L	1000	1500
Total Residual Chlorine	µg/L	(3)	---
Zinc	µg/L	1000	1000
Fecal Coliform Bacteria			
May-Oct.	#/100 ml	200(5)	---
Nov.-April	#/100 ml	---	---

Table 1: Listing of Current Water Quality Limitations In Effect for the Lower Des Plaines River

PARAMETER	UNITS	GENERAL USE	SECONDARY CONTACT AND INDIGENOUS AQUATIC LIFE
Ammonia Nitrogen (total)	mg/L	15 (6)	---
Un-ionized Ammonia	mg/L	(3)	0.1
Nitrate Nitrogen	mg/L	---	---
Oil and Grease	mg/L	---	15.0
Total Phosphorus	mg/L	0.05 (7)	---
Aldrin	µg/L	---	---
Dieldrin	µg/L	---	---
Endrin	µg/L	---	---
Total DDT	µg/L	---	---
Total Chlordane	µg/L	---	---
Methoxychlor	µg/L	---	---
Toxaphene	µg/L	---	---
Heptachlor	µg/L	---	---
Heptachlor epoxide	µg/L	---	---
Lindane	µg/L	---	---
Parathion	µg/L	---	---
2,4-D	µg/L	---	---
Silvex	µg/L	---	---

mg/L = milligrams per liter µg/L = micrograms per liter

1. 35 IL. Adm. Code Part 302 (1999).
2. Excluding the Calumet-Sag Channel, which shall not be less than 3.0 mg/L at any time.
3. Acute and Chronic Standards (see Table 3-2).
4. (-) means no numeric standard specified; narrative standard applies.
5. Waterbody reaches physically unsuited for primary contact uses and not found in urban areas or parks may be designated as unprotected.
6. The allowable concentration varies in accordance with water temperature and pH values. 15 mg/L is the maximum total ammonia nitrogen value allowed. In general, as both temperature and pH decrease, the allowable value of total ammonia nitrogen increases as calculated from the un-ionized ammonia nitrogen standards.
7. Standard applies to certain lakes and reservoirs and at the point of entry of any stream to these lakes and reservoirs.

Table 1: Listing of Current Water Quality Limitations In Effect for the Lower Des Plaines River

Acute and Chronic Illinois General Use Water Quality Standards. [1]

Parameter	Units	Acute standard [2]	Chronic Standard [3]
Un-ionized ammonia			
April-October	mg/L	0.33	0.057 [6]
November-March	mg/L	0.14	0.025 [6]
Arsenic (total)	µg/L	360	190
Cadmium (total)	µg/L	exp[A+B ln(H)] A = -2.918 B = 1.128 but not to exceed 50 Φg/L	exp[A+B ln(H)] A = -3.490 B = 0.7852
Chlorine (total residual)	µg/L	19	11
Chromium (total Hexavalent)	µg/L	16	11
Chromium (total trivalent)	µg/L	exp[A+B ln(H)] A = 3.688 B = 0.819	exp[A+B ln(H)] A = 1.561 B = 0.819
Copper (total)	µg/L	exp[A+B ln(H)] A = -1.464 B = 0.9422	exp[A+B ln(H)] A = -1.465 B = 0.8545
Cyanide (weak acid dissociable) [4]	µg/L	22	5.2
Lead (total)	µg/L	exp[A+B ln(H)] A = -1.301 B = 1.273	exp[A+B ln(H)] A = -2.863 B = 1.273
Mercury (total) [5]	µg/L	2.6	1.3

Where: Exp(x) = base of natural logarithms raised to x power

ln(H) = natural logarithm of hardness of the receiving water in mg/L

1. 35 IL. Adm. Code Part 302 (1999).
2. Not to be exceeded except where a zone of initial dilution is granted.
3. Not to be exceeded by the average of at least four consecutive samples collected over any period of at least four days.
4. American Public Health Association. 1998. Standard Methods for the Examination of Water and Wastewater. 20th edition. American Public Health Association, American Water Works Association, Water Environment Federation. 4500-CN 1. STORET No. 718.
5. Human health standard is 0.012 mg/L.
6. Unless an effluent modified water is recognized in an NPDES permit.

IV. CURRENT UAA REACH USE DESIGNATION AND THERMAL WATER QUALITY STANDARDS

A "designated use" is the use specified in state water quality standards for each water body or segment. In setting use designations, a state is required to protect "existing uses." (40 CFR §131.10 and §131.12). "Existing uses" are defined as "those uses actually attained in the water body on or after November 18, 1975, whether or not they are included in the water quality standards." For the UIW, Illinois EPA is obligated to protect the uses actually attained as of November 18, 1975 or thereafter. In January, 1974, the Illinois Pollution Control Board (the "Board") designated the UIW as a "Secondary Contact and Indigenous Aquatic Life" use water body under the Illinois use classification system (hereinafter referred to as "Secondary Contact"). With little change since its adoption in 1974, the purpose of the Illinois Secondary Contact use classification is described in 35 Ill. Adm. Code §302.402 as follows:

> Secondary contact and indigenous aquatic life standards are intended for those waters not suited for general use activities but which will be appropriate for all secondary contact uses and which will be capable of supporting an indigenous aquatic life limited only by the physical configuration of the body of water, characteristics and origin of the water and the presence of contaminants in amounts that do not exceed the water quality standards listed in Subpart D.

The entire UIW from the South Branch of the Chicago River down to the I-55 Bridge has a designated use of Secondary Contact and Indigenous Aquatic Life. The narrative and chemical criteria associated with the Secondary Contact use designation are listed in Table 1. Other waters in the state (aside from Lake Michigan and Public and Food Processing Water Supply, which have their own specific limitations) are designated as General Use waters under the Illinois use classification system.

A. Thermal Water Quality Standards

With regard to thermal water quality limitations, there are significant differences between Secondary Use and General Use, as summarized below:

<u>1. Secondary Contact</u>

- Temperature shall not exceed 93 ^{o}F for more than 5% of the time, or 100 ^{o}F at any time (at the edge of the allowable mixing zone defined by Rule 302.102 of IAC, Title 35, Chapter 1, Subtitle C).
- Total of approx. 438 allowable excursion hours in any 12-month rolling period
- 100 ^{o}F maximum limitation, year-round

2. General Use (applicable downstream of the I-55 Bridge)

Narrative Criteria:

- There shall be no abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions.
- The normal daily and seasonal fluctuations which existed before the addition of heat due to other than natural causes shall be maintained.

Numeric Criteria:

- The water temperature at representative locations in the main river shall not exceed the maximum limits below during more than 1% of the hours in any 12-month period ending with any month. Moreover, at no time shall water temperature at such locations exceed the maximum limits by more than 3 ^{o}F:

  DECEMBER-MARCH: 60 ^{o}F

  APRIL-NOVEMBER: 90 ^{o}F

- Total of approx. 87 allowable excursion hours in any 12-month rolling period

- The maximum temperature rise above natural temperatures shall not exceed 5 ^{o}F.

The General Use thermal limitations are considerably more stringent than the Secondary Contact limits, both in numeric criteria and number of allowable excursion hours. Of equal concern here is that the General Use thermal standards by their express terms were intended to apply to "natural" waterways. The narrative General Use thermal standards assume that "natural" conditions existed in the waterway before the addition of point source discharges. Hence, the General Use thermal standards prohibit temperatures from rising more than 5 ^{o}F above "natural temperatures" and also require the maintenance of natural fluctuations in thermal levels in the waterway that existed before the addition of "other than natural" causes. The General Use thermal water quality standards were never intended to apply, and by their terms, cannot be applied to a waterway like the UAA Reach. The Lower Des Plaines River is not a "natural" waterway. It is a primarily man-made, artificial waterway with physical characteristics ill-suited to the application of General Use standards. It was constructed and/or altered for the purpose of protecting the water quality of Lake Michigan and maximizing commercial navigation, with the help of a lock and dam system that artificially creates and regulates water levels and flows. It does not have a "natural" temperature. It has temperatures that are dictated by the man-made uses for which it was constructed and/or altered.

3. Adjusted Thermal Standard for I-55

In addition to the two thermal limitations outlined above, there is an adjusted thermal limitation at the I-55 Bridge currently applicable only to Midwest Generation Power Plants. This adjusted limit was granted by the Illinois Pollution Control Board (IPCB) in Docket

Number AS96-10 , based on the results of the comprehensive UIW study performed by ComEd and overseen by the UIW Task Force. (See IPCB Order and Opinion, AS96-10, dated Oct. 3, 1996). The Adjusted I-55 Thermal Standard includes the following thermal limits and conditions:

<u>Adjusted I-55 Thermal Standard</u>

January:	60 ^{o}F
February:	60 ^{o}F
March:	65 ^{o}F
April 1-15:	73 ^{o}F
April 16-30:	80 ^{o}F
May 1-15:	85 ^{o}F
May 16-31:	90 ^{o}F
June 1-15:	90 ^{o}F
June 16-30:	91 ^{o}F
July:	91 ^{o}F
August:	91 ^{o}F
September:	90 ^{o} F
October:	85 ^{o} F
November:	75 ^{o} F
December:	65 ^{o} F

The Adjusted I-55 Thermal Standard may be exceeded by no more than 3 ^{o} F during 2% of the hours in the 12-month period ending December 31, except that at no time shall Midwest Generation's plants cause the water temperature at the I-55 Bridge to exceed 93 ^{o} F.

- A total of 175 excursion hours per calendar year are allowed.

The Adjusted I-55 Thermal Standard replaces the General Use Thermal Water Quality Standard for the Midwest Generation Plants. The Adjusted I-55 Thermal Standard recognizes the limitations and artificial influences on the thermal conditions of the UAA Reach while continuing to protect the existing uses of that waterbody.

V. THE RELATIONSHIP BETWEEN THE ADJUSTED THERMAL STANDARD AT I-55 AND THE UAA FOR THE LOWER DES PLAINES RIVER

In seeking the thermal adjusted standard from the IPCB in 1996, ComEd was required, in part, to show that the proposed adjusted standard would not adversely impact or prevent improvements to the aquatic community within the UAA Reach. In that proceeding before the IPCB, ComEd presented data for the entire UIW waterway, from Lake Michigan downstream to the Dresden Island Lock and Dam. The data presented demonstrated that thermal discharges from the power plants are not the main factor limiting further improvements in the aquatic community in the entire waterway, including the UAA Reach. There are other physical and biological constraints that prevent those improvements. These findings from the UIW Study, relied upon previously by the IPCB in AS96-10 adjusted standard proceeding, are equally applicable here in the UAA of the Lower Des Plaines River.

According to Section 27(a) of the Illinois Environmental Protection Act (the "Act"), the IPCB was required to take into account the following factors in determining whether to grant the adjusted thermal standard requested by ComEd:

(a) the existing physical conditions;
(b) the character of the area involved, including surrounding land uses;
(c) zoning classifications;
(d) nature of the receiving water body, and
(e) the technical feasibility and economic reasonableness of measuring or reducing the particular type of pollution.

The Illinois EPA also addressed each of these factors in its recommendation filed with the Board to grant the adjusted standard in AS96-10. (AS96-10 Agency Recommendation, filed August 9, 1996) The IPCB summarized the Agency's recommendation as follows:

> While stating that it was "technically feasible" to reduce the effluent temperature from the plants to meet the General Use Thermal WQS (at I-55) by the use of cooling towers... the Agency provided the opinion that <u>the costs of installing additional cooling "may not be economically reasonable when compared to the</u> **<u>likelihood of no improvement in the aquatic community of the UIW</u>**". (AS96-10, Opinion and Order at p.7)--(emphasis added).

After a thorough review of the information presented in the AS96-10 proceeding, in October, 1996, the Board granted ComEd the requested I-55 adjusted thermal limitations applicable at the I-55 Bridge in the Des Plaines River. (General Use thermal water quality standards continue to apply to the waterway below the I-55 Bridge). In granting ComEd the thermal adjusted standard, the Board accepted, with the Illinois EPA's support, the findings of the UIW Study. The UIW Study found that the operation of these power plants does not interfere with maintaining a reasonably balanced indigenous community of aquatic organisms in the UIW consistent with the limited physical habitat and history of chemical contamination that remains in the sediment and the predominant uses of the waterway, namely barge transport and conveyance of non-point and treated point source discharges.

In 2000, with Illinois EPA support, the Board again found that the conditions in the UIW, including the lack of impact that the adjusted thermal standards would have on the ecosystem of the receiving waterway, supported the transfer of the adjusted thermal limits from ComEd to Midwest Generation. (AS96-10 Opinion and Order, March 16, 2000)

The Board concluded that conditions in the Lower Des Plaines River in 2000 had not changed appreciably from when the original thermal adjusted standard was granted, based on the 1991-1995 data presented in the UIW Study. Today, just a few years later, these significant limiting factors in the UAA Reach are still present and prevent it from attaining full General Use status.

There have been no significant changes in Midwest Generation's operation of its power plants since the AS96-10 adjusted thermal standard was granted. No adverse impacts have been observed on the indigenous fish community during the course of the plants' operation since Midwest Generation assumed ownership in late 1999. Annual fisheries monitoring has demonstrated that the fish community present is consistent with what one would expect for an impaired waterway. Midwest Generation continues to monitor the fish community in the system, as well as temperature and dissolved oxygen at the I-55 Bridge, on a regular basis. Results of these studies are submitted to Illinois EPA and other regulatory/environmental groups on an annual basis. The more recent monitoring results continue to show no appreciable changes from the 1991-1995 data on which the IPCB granted the thermal adjusted standard.

VI. CURRENT THERMAL COMPLIANCE STATUS

All thermal discharges from Midwest Generation's power plants continue to meet the near-field Secondary Contact standards at the edge of the allowed mixing zone, as well as the far-field adjusted thermal standard at the I-55 bridge. Compliance is maintained through continuous real-time monitoring, as well as the use of customized thermo-hydrodynamic modeling to adjust station operations, when warranted, to meet both near and far-field thermal limitations.

VII. PHYSICAL/HYDRAULIC/CHEMICAL NATURE OF THE SYSTEM

The upper two-thirds of the UIW can best be characterized as a slow-moving, relatively uniform canal with little or no natural shoreline. The bottom one third is, in essence, a series of impoundments separated by locks and dams. The hydrology of the entire system is complex, owing to the diverse mixture of water sources and their inherent flow variabilities. The flow rate in the system is unstable, especially in close proximity to the Locks and Dams, and is largely controlled by flows regulated by the locks and dams, in response to navigational needs, as well as upstream run-off events. (MWRD, 1992)

The inputs from all water sources vary seasonally, although the system is dominated by wastewater treatment plant discharges year-round (Dick Lanyon, MWRD, personal communication). Currently, summer discretionary diversions from Lake Michigan account for less than 50% of the overall flow. Moreover, as the discretionary diversion from Lake Michigan into the Ship Canal incrementally decreases as more lake water is used for domestic purposes, the system will eventually be dominated solely by wastewater treatment plant (WWTP) flows and non-point source run-off year-round, without the benefit of any dilution water from Lake Michigan.

A. Brief Description of the Pools Comprising the Upper Illinois Waterway

Lockport Pool (Not part of the UAA Reach): 34 mile reach. Narrow, dredged waterway with borders comprised of vertical rock, pilings or rip-rap. Depths vary from 16 to 26 feet.

Brandon Pool: 5 mile reach. Extends for five miles from the Lockport Lock and Dam to the Brandon Road Lock and Dam. The Des Plaines River enters the Brandon Pool just downstream of the Lockport Lock and Dam (RM 290) at which point the waterway changes from a narrow man-made channel to a wider canal with an average depth of 20 feet and variable width.

Dresden Pool: 15 mile reach. Extends from the Brandon Road Lock and Dam down to the Dresden Island Lock and Dam. Main channel depths vary from 15 to 20 feet. The Dresden Pool has less artificial shoreline than the other two navigational pools. In addition, it has limited off-channel backwater and slough areas which are largely absent in the upstream reaches. Dresden Pool also has several minor tributaries, including the DuPage River, Hickory Creek, Jackson Creek and Grant Creek.

Both the Brandon Pool and upper portion of the Dresden Pool are being evaluated to determine if it is appropriate to change their current use designation. Lockport, Brandon and Upper Dresden Pool waters are currently designated as Secondary Contact waterways. (See Table 1)

B. Effects of Artificial Flow Control and Barge Traffic

From the information presented to the UAA Task Force, Hey and Associates' cursory review of selected data and conclusions regarding the lack of impact by barge traffic on the system is notably incomplete. The review was largely confined to the potential effects on main channel chemical water column quality. It did not take into consideration the significant impacts that frequent barge traffic in the UAA Reach has on the aquatic biota or their preferred habitats within the waterway as a whole.

The transportation of commodities along the UAA Reach continually affects the physical and biological quality of the system. The waterways are typically ice-free in the winter, allowing barges to navigate the UAA Reach year-round. Pool water levels are variably controlled to aid barge navigation, as well as to reduce flooding, thereby eliminating environmentally beneficial seasonal flushing events found in natural systems. The frequent manipulation of pool levels and flows to balance navigational requirements, along with the need to release the magnitude of excess water resulting from rainfall and snowmelt runoff, results in continuous disruptions to the biota that are not found in natural systems. Due to the relatively narrow breadth of the waterway, surge effects from the barges continually disrupt the channel border areas and carry fine-grained sediments into protected backwater and off-channel habitats. (Burton, 1995b)

The constant barge traffic through the UAA Reach may adversely affect aquatic organisms, particularly fishes, by:

(1) physically injuring or stranding fishes,
(2) disrupting or disturbing spawning habitat,
(3) uprooting aquatic vegetation,
(4) increasing turbidity via resuspension of bottom materials, and
(5) enhancing toxicity by resuspending and dispersing the fine-grained sediments shown to be associated with toxic compounds.

The net effect of barge traffic on the UAA reach is to make the main channel and border areas a less hospitable environment for most aquatic life and for recreational users alike.

As acknowledged by U.S. EPA and well-established in the literature, the presence of dams reduces the abundance and diversity of riverine species. This is a result of interrupting or eliminating migration, the pooling effect upstream of each dam, the sediment that builds up behind dams, etc. Species most effected are so-called fluvial specialists (e.g., most darters, many suckers, etc.), whereas habitat generalists (e.g., common carp, gizzard shad, channel catfish), and pelagic species (e.g. emerald shiner, freshwater drum) do quite well under impounded conditions. Similarly, simple lithophiles (e.g., redhorse and most darters), which require clean, hard substrates, do poorly in impounded situations because of increased siltation while those that are nest builders (e.g., centrarchids), or have modified spawning strategies (e.g., bluntnose minnow) do quite well under the same set of circumstances.

The studies that U.S. EPA conducted and/or sponsored on the Fox River clearly demonstrate these impacts as shown by declines in IBI scores upstream of each dam. The adverse impacts on aquatic communities caused by dams are recognized by other Region 5 States. For example, Wisconsin and Michigan are actively promoting dam removal. Ohio has a separate use classification that recognizes effects from dams, as reflected by the subcategory of their Modified Warmwater Habitat (MWH) designation noted as “impounded”. In addition, Ohio also retains a MWH subcategory for “Channel-Modified” conditions. (See Table 7-15 of Ohio Administrative Code, Chapter 3745-1, effective July 7, 2003).

A recent study by United States Geological Survey (USGS) and the Illinois Natural History Survey (INHS) has documented direct mortality to aquatic life caused by towboats. Gutreuter et al (2003) found that various medium to large fish were killed as a result of propeller strikes in Pool 26 of the Mississippi River, as well as the lower portion of the Illinois River. They estimated that 790,000 gizzard shad were killed in just this area as a result of propeller strikes. The number of fish killed was a function of the number of fish killed per kilometer times the amount of barge traffic (kilometers traveled). On a large river such as the Mississippi, at least some fish will move away in response to oncoming barge traffic. (Lowery 1987, Todd et al 1989). In a smaller, narrower river like the Des Plaines, propeller avoidance would likely be more difficult, so it is reasonable to assume that the mortality rate estimated for the Mississippi River will at least be as high and may be higher in the Des Plaines River. So, in addition to detrimental effects due to re-suspension of sediment (contaminated and otherwise) and localized changes in water levels due to barge traffic and storm water control, direct mortality to the aquatic community due to barge traffic also has now been documented.

The system’s hydraulic modifications are solely under the control of MWRDGC and the U.S. Army Corps of Engineers, and are in place exclusively to accommodate flood control and commercial navigation. There is no indication that navigational/flow control and ensuing barge traffic will ever be removed as a existing use for this waterway, as “navigation” is a protected use under the Clean Water Act. (See Clean Water Act, § 303(c)(2)(A)). As such, it constitutes a “permanent” modification which significantly precludes the attainment of full General Use in the UAA waterway under Factor #4 of the UAA criteria. (Appendix 1).

A considerable body of research has been collected during the past 20 years showing that significant adverse impacts are associated with the type of hydraulic modifications found in the

UAA Reach. For similar conditions, other states, such as Ohio, have refined their use classification systems to address the specific limitations posed by such modifications Here, even the IEPA Consultant's Draft UAA report acknowledged (See Draft UAA Report, p. 8-16) that expectations for the Upper Dresden Pool were lower because of hydraulic impacts and thus suggested the creation of a proposed use category called "General Use Impounded". Clearly, the reasonable biological expectations for areas like the UAA Reach are lower than those required for a General Use Classification System. The hydraulic modifications in the UAA Reach support either retention of the existing Secondary Contact use or creating a new use that could include modified water quality standards and associated criteria to reflect the aquatic community and recreational use limitations imposed by such adverse, persistent constraints.

C. Pollutant Loadings to the UAA Reach

A major component of the flow to the UAA Reach, 70% or more of the flow upstream of Brandon Road Lock and Dam is derived from treated wastewater discharges (Final Report, UIW Study, 1995. p. 10.4-2). These discharges,, by their nature and volume alone, remain a significant influence on conditions for aquatic life in the UAA Reach, and the UIW as a whole. A wide variety of industrial facilities line the shores of the UIW, particularly in the Lockport and Brandon Pools. (There are no power plants that discharge directly into the Brandon Pool). Discharges from these facilities are currently controlled by the NPDES permitting program, in accordance with the existing Secondary Contact Water Quality Standards.

Current monitoring data presented in the preliminary UAA reports indicate that water column quality may have improved over the years to the extent that most General Use chemical criteria are now being met within the waterway below Brandon Lock and Dam, and possibly upstream as well. (This subject is addressed in detail in the Hey and Associates' Draft Final UAA Report and will not be described here). However, there are still many non-point sources, as well as combined sewer overflows (CSO), that contribute to the overall pollutant loading to the system, including its sediment contamination, and are not readily controllable through current regulatory mechanisms. According to the U.S. EPA's review of the states' 2002 section 303(d) Lists, pathogens are the second most frequent cause of water quality impairments under the Clean Water Act. Excessive nutrients are also among the top four leading causes of water quality impairments. (U.S. EPA, August 2003). Hey and Associates found that the General Use fecal coliform standard cannot be met in the UAA Reach and that nutrient standards not yet developed but under consideration for Illinois General Use streams also may not be attainable in this waterway (Draft UAA Report, Chapter 7)

D. Extent and Physical Characteristics of Sediments in the UIW

From an aquatic ecological perspective, a significant stressor in the UAA Reach is the accumulation of fine-grained sediments and the presence of legacy contaminants from historic discharges. Next to structural habitat availability (discussed in the following section), the physical nature of the sediment in the UIW continues to be one of the most significant factors adversely influencing the present and future expected assemblage of aquatic biota present in the Lower Des Plaines River.

In the July 2002 U.S. EPA draft guidance on non-point source pollution, U. S. EPA identified many detrimental effects on aquatic life caused by excessive sedimentation from urban run-off. (U.S. EPA, July, 2002. p. 26-31) Sediment, whether contaminated or not, was found to be the leading cause of impairment accounting for 38% of the impaired waters in the nation. More recently, the U.S. EPA reported that "[s]edimentation and siltation problems account for more identified water quality impairments of U.S. waters than any other pollutant." (U.S. EPA, August, 2003). Excessive erosion, transport and deposition of sediment in surface waters is a significant form of pollution. Sediment imbalances impair many waters' designated uses. Excessive sediment can impair aquatic life by filling interstitial spaces of spawning gravels, impairing fish food sources, filling rearing pools, and reducing beneficial habitat structure in stream channels.

While the UIW Study did not quantify the amount of sediment present within the waterway, it did examine the types of sediment present, as well as its depositional pattern, particularly as it relates to the presence of contaminated sediment in the waterway.

The extensive studies performed by ComEd in the mid 90's (Burton, 1995a and 1995b, and 1998, 1999) found that contaminated sediments occur in all three navigational pools and are present primarily in side-channels and backwater areas. Sediment inputs from local drainages appear to have covered the historically contaminated sediments in some areas, especially along the lower reaches of the Dresden Pool. However, substantial deposits of fine-grained and potentially contaminated materials remain throughout the UIW, including in the limited habitat areas in the UAA Reach, posing a permanent impediment to significant improvement of overall ecological integrity of the system. In a recently completed (EA. May, 2003) habitat evaluation on the Dresden Pool, it was found that sedimentation was moderate to severe in many (23 out of 34, or 70%) of the areas where QHEI scores were calculated. Sedimentation appears to have gotten worse over the past 5-10 years (e.g., DuPage Delta). (Maps of QHEI locations are available upon request--large bmp files: 9.8MB).

A key limiting factor to improved biological conditions in the UAA Reach is the <u>physical characteristics</u> of the sediment itself (i.e., fine, silty, organic). The fine, silty and organic nature of the sediments are not suitable for many higher quality fish species which need a hard, clean substrate for spawning. Even if the stream could be remediated and the existing sediment (contaminated or not) removed, the nature of the waterway itself (e.g. impounded) would ensure that additional fine, silty sediment (whether clean or contaminated) would continue to be deposited, thereby preventing an improved habitat for better quality aquatic life. The unpreventable and irreversible accumulation and physical quality of the sediments that will always be present in the system is limiting further biological improvements in the UAA Reach, with existing, depositional area sediment contamination exacerbating the fundamental siltation problem.

As part of ComEd's UIW Study, conducted from 1991-1995, a thorough literature review (EA, 1992), followed by a detailed risk screening (LMS, 1995), defined historic patterns of sediment contamination in the Lower Des Plaines River and identified the following list of contaminants of special concern: **ammonia, arsenic, cadmium, chlordane, chromium, copper, DDT, dieldrin, lead, mercury, nickel, PCBs, PAHs and zinc.**

Intensive sediment and immediately overlying water column samples were subsequently taken and analyzed as part of the UIW study. (Burton, 1995a) Toxicity varied among pools and habitat types. Differences were correlated with sedimentation patterns. Fine-grained sediments from depositional areas were found to be the most toxic. Overlying waters also were found to be toxic. These fine-grained, contaminated sediments tend to occur at the tributary mouths and in backwater and protected areas of main channel border habitat---especially in the Lockport and Brandon Pools. These contaminated sediment depositional areas provide the primary source of potential habitat for the fish community. As such, the fish are likely exposed to whatever contamination currently exists within these specific areas. In contrast, sediments collected from main channel habitat and power plant intakes and discharges throughout the UIW generally had no or very little sediment toxicity. However, these areas do not provide suitable aquatic habitat for most aquatic organisms.

Monitoring by the Illinois Department of Natural Resources (IDNR) has shown significant body burdens of contaminants in adult, bottom-feeding fishes within the UAA Reach, as well as elsewhere in the UIW. These results are used by the Illinois Department of Public Health (IDPH) to establish annual human health risk advisories. (IDNR, 2002-2003 and IDPH, 2002-2003) There is an on-going consumption advisory for bottom-feeding fish species in effect for the Dresden Pool, as well as the upstream reaches and further downstream. This fish consumption advisory is clear and continuing evidence of the prevalence and persistence of sediment contamination in the UAA Reach.

The highest levels of toxicity were found in sediments collected between the junction of the Cal-Sag Channel and the Chicago Sanitary and Ship Canal and the Brandon Road Lock and Dam tailwaters. The Brandon tailwater area has been previously identified as the best quality aquatic habitat in the UAA Reach, based on its physical characteristics. (These are the same depositional areas AquaNova and Hey and Assoc. identify as potential “recreational use” waters (littoral zones)). Sediment toxicity in the Dresden Pool was more variable than in the two upper pools, with effects observed predominantly on growth. Toxicity was not restricted to the surface sediments, as much of the historic deposition has since been covered over by cleaner material.

More recent sediment sampling in the UAA Reach was performed by U.S. EPA Region 5 during the summer of 2001. Results of this investigation only have been released as part of the draft UAA Report, and have not undergone prior review by the UAA Biological Subcommittee or the UAA Workgroup. A thorough review of this data should be conducted as part of the overall evaluation of the future use potential of the waterway; however, these results must also be viewed with caution. Sediment is so heterogeneous and selectively dispersed in the system that unless a large quantity of samples are taken and analyzed, as was done in the previous UIW Study, the sampling may not be fully representative of the UAA Reach. Areas of significant contamination may be missed by a random sampling program. The draft UAA Report presents only average sediment sampling values from the U.S. EPA sediment sampling database. This partial disclosure of the U.S. EPA 2001 sediment sampling results does not allow for a meaningful, scientific assessment of the data. The average values do not reveal whether they reflect either a broad or narrow range of individual sediment sampling location results.

Grouping sediment data together to present only an "average" concentration of chemicals/metals/ toxics does not provide a true picture of where the specific areas of contamination are or the associated contamination levels. Averaging dampens out the heterogeneity of sediment quality and distribution, which is an extremely important factor in determining the adverse exposure levels sediment present to biological organisms. The data presented in the draft UAA Report does not disclose or differentiate between sediment sample type(s) or specific sampling site(s) at any given River Mile location. Thus, there is no way to determine if it reflects the results of main channel or side-channel/backwater areas. As explained above, sediment distribution (and any associated contamination) is extremely heterogeneous in nature within the UAA Reach. Depositional areas that would otherwise provide available fish habitat, such as those found just above or below lock and dams or backwaters/side channels, have large accumulations of sediment, while locations near the main channel may have sparse or no sediment accumulation, due to the scouring effects of barges and sporadic high river flows. Accordingly, sediment sampling results that average the values across various types of sediment areas will likely understate the levels of sediment toxicity present in the aquatic habitat areas in the UAA Reach.

In contrast, the sediment data obtained during the course of the UIW studies has been fully disclosed and peer reviewed. It represents the most comprehensive record available of current sediment quality and composition in the system, as well as how its presence in various locations relates to habitat quality and toxicity, within the UAA Reach and beyond. Since sediment characteristics do not change appreciably over a few year's time, the results of the UIW sediment characterization/toxicity work remain valid and applicable to this UAA process. A thorough and reliable assessment of sediment quality is critical to the overall use designation assessment of the Lower Des Plaines River. It affects the assessment of both biological habitat quality and the long-term potential for future recreational activity in the waterway. As noted earlier, the areas that are the most important biologically are also the areas that have been found to be the most contaminated.

The IEPA consultants assume that any contaminated sediments can be removed permanently and are not a limiting factor to the overall improvement of the waterway. However, this contamination is the result of historic deposition. It is not solely due to current point source discharges which could, theoretically, be controlled through tighter NPDES permit limits. No proposal, plan or funding has yet been identified by anyone that would remove the biological limitations these sediments (contaminated and otherwise) place on the UAA Reach and prevent them from reoccurring.

Even if remediation of any historically contaminated sediments was feasible, the impounded nature of the waterway will result in the continual deposition of fine, silty sediments, especially in the main-channel border, side-channels and backwaters where the majority of aquatic organisms reside. This type of sediment, as well as the continual barge traffic that affects its ultimate location in the waterway, is not conducive to the development of an improved biological community. The physical quality of the sediments in the system will continue to limit further biological improvements, with existing, depositional area sediment contamination exacerbating the siltation problem. The presence and persistence of fine-grained sediments in the UAA Reach constitutes a "lack of proper substrate..., unrelated to water quality," within the meaning of the UAA regulations (UAA Factor #5), that preclude the attainment of aquatic life protection uses.

E. Effect of Temperature on Contaminated Sediments

Generalizing on the effects that elevated water temperatures may have on contaminants in the UIW is a difficult task. Elevated water temperatures may increase the rate of chemical or biological degradation of complex organics, strengthen or weaken the physical or electrostatic bonding of toxicants to inert substrates or to other chemical molecules, increase or decrease the rates at which organisms take up materials, increase physiological capabilities of the organism to eliminate or metabolize toxicants, thereby altering the level of concentration of the chemical at which toxic effects are expressed, and so on. Since it has been shown that the thermal discharges to the system are buoyant and do not generally affect the lower portion of the river, the sediments are not likely exposed to high water temperatures and should not be impacted by them, either positively or negatively. (Burton, 1995a) In any event, the overriding negative effects caused by the levels of contamination that remain present in the system, as well as the presence of fine-grained sediments themselves, regardless of whether they are contaminated or not, pose a continuing concern for the future potential of the waterway to meet a higher use.

F. Physical Habitats

1. Types and Availability of Physical Habitats

An obvious requirement for a diverse aquatic biota is a suitable variety of living spaces. As part of the original UIW study performed by ComEd, the entire UIW was surveyed to determine the types, distribution and relative amounts of physical habitats available in the three navigational pools. (Habitat definitions conventional for large rivers and reservoir systems were used in the survey). These habitat classifications are still valid today, as they are based on physical characteristics of the waterway, that have not changed appreciably since the UIW study. (EA, 1993)

Main Channel:	51.6%
Main Channel Border:	22.4%
Backwaters, Sloughs and Artificial Embayments:	10.4%
Tributary Deltas:	7.0%
Tailwaters:	4.6%
Tributary Mouths:	3.0%
Intake/Discharge Embayments:	1.0%

The preponderance of habitat available in the system is main channel (MC) and main channel border (MCB), areas where the effects of barge transport and industrial and municipal discharges are especially dominant. Main channel habitat, which accounts for more than 50% of the available area, is poor habitat for most fishes owing to excessive depths, scour and lack of food resources. Protected backwater areas and tributary mouths are almost non-existent in the Lockport Pool and uncommon in the Brandon Pool. These two upper pools are primarily artificial or dredged waterways with a uniform bottom and shear rock, piling or rip-rap borders.

A greater diversity of habitats is available downstream in the Dresden Pool, although these are still adversely affected by barge traffic and historical sediment deposition.

2. Physical Habitat Quality

Quantitative techniques for evaluating physical habitat in large river systems are generally lacking. Although it has shortcomings and limitations, the best quantitative system available for the UIW is the Qualitative Habitat Evaluation Index (QHEI) (Rankin, 1989). This numeric index ranks aquatic habitats as to selected attributes, availability and desirable quality characteristics. The outcome is a numeric score (ranging from 0-100) that allows comparison of habitats from other aquatic systems. The higher the numeric score, the better the quality of aquatic habitat in the waterway. The points allotted for the QHEI scores are divided as follows: Substrate (20 pts), Cover (20 pts), Channel Morphology (20 pts), Riparian Zone (10 pts), Pool/Riffle Quality (20 pts) and Gradient (20 pts).

The UIW studies found that average QHEI scores for the different habitat types ranged from 42 to 69, with the higher values attributed only to tributary mouths, a small riffle-run area in the Upper Des Plaines River, and the Brandon Road tailwater. The predominantly low scores reflect the artificial nature of the system and the limited variety of habitat. Channelization, inadequate in stream cover, lack of riffle-run habitat, excessive siltation, lack of clean, hard substrates, and poor quality riparian and floodplain areas all contribute to the low QHEI scores.

The UIW study also found that habitat conditions were poorest in the Lockport Pool (mean QHEI = 45.3), marginally better in the Brandon Pool (mean QHEI = 48.6) and better still in the Dresden Pool (mean QHEI = 54.8). However, even the best of these three QHEI scores is well below values typical of unaltered systems of comparable size. For example, Ohio EPA identifies a target minimum value of 60 as necessary to assume a potential for warmwater habitat use. All of the QHEI scores for the UAA Reach, except for the Brandon Road tailwater, were well below the target score of 60 that would be the Ohio equivalent to consider a General Use designation.

A more recent and more extensive habitat evaluation study was performed by EA Engineering, Science and Technology (“EA”) in May 2003 on the entire Dresden Pool. QHEI scores were calculated along both banks of the river at 0.5 mile intervals throughout the pool. Field biologists from Illinois EPA accompanied EA during this investigation. Results are presented in Tables 1A and 1B. The results of this 2003 study show that habitat conditions today in the UAA Reach remain relatively unchanged from when first reviewed as part of the comprehensive UIW studies conducted in the early to mid-1990s. In fact, average scores now are even lower than they were in the mid-90’s. The recent QHEI scores for the UAA waterway are all clearly well below what would be expected for a General Use stream under the Illinois use classification system. EA personnel reviewed the QHEI scores collected at all 34 locations and determined that poor habitat is pervasive throughout the Pool. IEPA biologists, present throughout the evaluation process, concurred that the entire area “looked the same” (Joe Vondruska, EA, personal communication).

Modifications to the QHEI factors which could improve overall habitat should be considered by Illinois EPA and its consultants as part of the UAA analysis. On the whole, however, the individual QHEI metrics which are the major contributors to degraded habitat quality are those that cannot be feasibly or economically reasonably mitigated, including insufficient current speed, sediment quality (physical characteristics of the sediments), excessive siltation, lack of riffle areas, little or no sinuosity and poor riparian development (Table 1C).

Table 1A. Des Plaines River QHEI Scores, 21 May 2003.

Upstream I55			Downstream I55		
	QHEI Score			QHEI Score	
RM	Right Bank	Left Bank	**RM**	Right Bank	Left Bank
285.5	65.5 (TW)*	48 (MCB)	277.5 (408)	28 (MCB)	45.5 (MCB)
284.5	47.5 (MCB)	36.5 (MCB)	276.5	39 (MCB)	42 (MCB)
283.8 (403A)	43.5 (MCB)	39 (MCB)	275.5	49.5 (MCB)	57 (MCB)
282.5	35.5 (MCB)	36.5 (MCB)	274.4 (419A)	60 (MCB)	40 (MCB)
281.5	36 (MCB)	36 (MCB)	273.5 (501)	54.5 (MCB)	28 (MCB)
280.5	38 (MCB)	41 (MCB)	272.5	56 (MCB)	37 (MCB)
279.5	59 (MCB)	49 (MCB)	272.0 (510/507)	51 (MCB)	32.5 (MCB)
278.5	56 (MCB)	48 (MCB)			
	Overall Mean = 44.7 (Range = 35.5-65.5)			Overall Mean = 44.3 (Range = 28-60)	

* Habitat Type: TW = Tailwater MCB = Main Channel Border

Table 1B. QHEI Scores at Off-Channel Locations.

Location	**Score**
405--Treats Island (RM 279.7)	53
408--Mouth of Jackson Creek (RM 278.3)	54.7
414--Bear Island Slough (RM 275.9)	40.5
418--Mouth of Grant Creek (RM 274.8)	57.5

Provided below are the 10 major components of the QHEI that contributed to the low scores:

Table 1C--Dresden Pool Individual QHEI Factors--May 2003

Factor	**No. of Locations Affected (out of 34)**
Poor Development (of riffles)	ALL
No Riffles	32
Current Speed None or Slow	32
Recent Channelization or Lack or Recovery	30
No Sinuosity	23
Moderate to Heavy Silt	23
Extensive or Moderate/Extensive Embeddness	19
Only Substrate Silt or Detritus	10
Poor (≤ 6) Instream cover	8
Urban or Industrial Riparian Zone	6

Practically speaking, these factors either cannot be remediated (e.g. lack of sinuosity, substrate only silt) or the effort to remediate them, (e.g., the amount of instream cover) would be unprecedented for a stream of this size.

In addition, EA reviewed the habitat characteristics of the Brandon and Upper Dresden Pools and compared them to Ohio's use designations for Warm Water Habitat (WWH) and Modified Warm Water Habitat (MWH) to provide additional analysis, as requested by U.S. EPA. The results of this effort are presented in the following table (Table 1D), which was compiled based on the same criteria used by Ohio EPA to determine whether an area should be classified as WWH or MWH. As these data show, both the Brandon and Upstream Dresden Pool areas share many of the characteristics of modified warm water habitat streams, and except for depth, possess **none** of the characteristics associated with warm water habitat streams.

Table 1D. Comparison of warm water habitat (WWH) and modified warm water habitat (MWH) characteristics of the Des Plaines River.

	Brandon Pool	Upper Dresden Pool
WWH Characteristics		
No Channelization or Recovered		
Boulder, Cobble, Gravel Substrates		
Silt Free		
Good-Excellent Development		
Moderate-High Sinuosity		
Cover Moderate to Extensive		
Fast currents & Eddies		
Low/Normal Substrate Embeddness		
Max Depth > 40cm	X	X
Low/No Riffle embeddness		
Total WWH Characteristics	1	1
MWH Characteristics with High Influence		
Recent Channelization		
Silt/Muck Substrates	X	X
No Sinuosity	X	X
Sparse/No Cover	X	X
Total MWH (High)	3	3
MMH Characteristics With Moderate Influence		
Recovering Channelization	X	X
High or Moderate Silt Over Other Substrates		
Sand Substance (Boat)		
Fair/Poor Development	X	X
Low Sinuosity		
Only 1-2 Cover Types		
Intermittent or Interstitial		
Max Depth < 40cm		
High Embeddness of Riffle Substrates	X	X
Lack of Fast Current	X	X
Total MWH (Moderate	4	4
Total MWH (All)	7	7

With regard to the approach summarized in Table 1D, Yoder and Rankin (1996) stated that "as the predominance of modified habitat attributes increase to a modified warmwater ratio of greater than 1.0-1.5, the likelihood of having IBI scores consistent with the WWH use declines." In both Brandon Pool and Dresden Pool, the ratio is 7:1, far greater than 1.5:1 trigger point suggested by Yoder and Rankin. Thus, it is clear, based on this well established methodology, that neither of these areas is capable of attaining a Warmwater (i.e.General) Use, so some lower classification is clearly warranted.

These unalterable limitations in the physical conditions/habitat features of the waterbody, even without the presence of contamination, preclude the attainment of aquatic life protection uses consistent with General Use requirements. Therefore, these limitations meet the requirements of factor #5 of the UAA criteria for determining that General Use is not an attainable use designation for the UAA Reach. (Appendix 1).

Also, in the May 2003 EA study, no significant differences were found between habitat type or availability upstream or downstream of I-55. Similarly, the fish community downstream of I-55, where General use thermal water quality standards are in force, is not appreciably better than the fish community upstream of I-55, where Secondary Contact thermal limits are effective. This demonstrates that the maintenance of General Use thermal standards in the area downstream of I-55 does not allow attainment of a fish community commensurate with a General Use designation. The fish community is comparable upstream of I-55 where the less restrictive thermal Secondary Contact standards apply. If thermal levels made any appreciable difference, this would not be the case. Clearly, there are factors like the absence of adequate habitat in the Lower Des Plaines River, not thermal levels, that are limiting the assemblage of aquatic organisms present in the waterway.

The absence of adequate habitat limits the fish species that can inhabit the UAA Reach. Fish species whose natural history minimizes contact with the sediments or that are highly tolerant of degraded conditions, that preferentially attach to "clean or non-silty" substrates such as rocks or rip-rap around power plant intakes, are pelagic in nature or that prefer to live along rocky submerged cliffs, can be expected to inhabit the system. However, most aquatic species, especially fishes, require a sequence of varying habitat types as they proceed through the different life stages. The overall lack of habitat diversity in the UIW represents a serious impediment to the development of a more diverse resident aquatic biota consistent with a General Use designation. (Final Report, UIW Study, 1995. p. 2.6-1)

G. Limitations of the Illinois Use Classification System

Section 303(c) of the Clean Water Act provides that in setting water quality standards, States should consider the following factors: the use and value of State waters for public water supplies, propagation of fish and wildlife, recreation, agriculture and industrial purposes, and navigation. (See also 40 CFR §131.10(a)). Thus, the Act allows the States to consider the use and value of the particular water body in determining its appropriate use designation. Within these directives, a state has the flexibility to develop and adopt whatever use classification system, including subcategories of uses, it deems appropriate. For example, Section 303(c)(2)(A) of the Clean

Water Act includes "industry", "navigation", "marinas" and "agriculture", among the many suggested use designations for a water body.

However, Illinois has only two generic use designations for inland waterways: Secondary Contact and Indigenous Aquatic Life and General Use**.** The General Use classification is a broad aquatic life use that assumes a water body will support all aquatic life and all types of recreational uses. It does not differentiate among aquatic communities or the physical characteristics of a water body. Illinois also has not developed any use subcategories under its existing use classification system. As the U.S. EPA has noted, making a determination of non-attainment in waters with broad use categories may be difficult and open to alternative interpretations. (See *Water Quality Standards Handbook: Second Edition*, U.S. EPA, August 1994, Section 2.4, p. 2-5). Due to the lack of any refined delineation of use classifications in Illinois, there is a regulatory bias in favor of designating or "defaulting" waterways to the General Use classification.

In U.S.EPA's Water Quality Standards Handbook (Second edition. 1994--p.2.5), the Agency discusses the need for sub-categories of use in certain cases:

> *"Designated uses are described as being intentionally general. However, States may develop subcategories within use designations to refine and clarify the use class. Clarification of the use class is particularly helpful when a variety of surface waters within distinct characteristics fit within the same use class, or* ***do not fit well into any category****."* (emphasis added).

In the newly published "Strategy for Water Quality Standards and Criteria" document (U.S. EPA, August, 2003), it was stated that "assigning tiered designated uses is an essential step in setting water quality standards." EPA's Office of Science and Technology (OST) agrees that refined uses including biologically "tiered" uses can improve the effectiveness and credibility of state and tribal standards in many situations. "Many states are learning that refined uses offer advantages for waterways where information is available to develop them. For example, they can provide better operational definitions of desired outcomes, and can provide flexibility to describe locally-important variations that broad uses cannot." (EPA Strategy for Water Quality Standards and Criteria--August, 2003. EPA-823-R-03-010, p. 24).

Other Region 5 states either already have or are in the process of refining and expanding their use classifications. Ohio has four warmwater aquatic life use classifications. Their very best streams are classified as Exceptional Use. The majority of Ohio streams are classified as Warmwater Use; this use would be equivalent to Illinois' General Use. The next lower Ohio classification is Modified Use, which they further subdivide depending on the type of modification, e.g., Impounded (dams), Channelized, or Acid Mine Drainage. Thus, Ohio clearly recognizes that dams, due to their impounding effect, can necessitate a lower use classification. Lastly, Ohio has a category called Limited Resource Water, which is their lowest classification. In some cases, water quality criteria are adjusted to provide the level of protection necessary to protect each of Ohio's uses.

In comparison to Illinois' existing use designations, the state of Ohio's use classification system has a range of acceptable use designations based on measured physical, chemical and biological criteria. In Ohio's use designation guidance documents, the Ohio EPA has noted that sites with QHEI scores of less than 60 often do not support balanced, indigenous aquatic communities. (Ohio EPA, 1989a) Ohio EPA also notes that streams with gradients <5 ft/mile (as is the case in the UAA Reach) are very slow to recover or may not recover at all, resulting in an "irretrievable anthropogenic modification".

Wisconsin is in the process of developing new and more refined uses and has prepared (November 2002) a Draft document entitled "Guidelines for Designating Fish and Aquatic Life Uses for Wisconsin Surface Waters". For warmwater, Wisconsin is proposing the following categories: Diverse Fish and Aquatic Life (which they propose to further subdivide), Tolerant Fish and Aquatic Life, and Very Tolerant Aquatic Life. These categories would be quite similar to Ohio's Warmwater, Modified Warmwater, and Limited Resource Water uses, respectively. The draft Wisconsin guidance lists the factors which would allow one of their streams to be put into one of the two lower use categories. Three of the reasons they cite are particularly relevant to the UAA Reach:

1) "Dams, diversions or other types of hydrologic modifications preclude the attainment of a Diverse Fish and Aquatic Life community, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of a Diverse Fish and Aquatic Life community."

   Thus, Wisconsin, like Ohio, recognizes the negative effect that dams can have on aquatic life.

2) "Human caused conditions or sources of pollution prevent the attainment of a Diverse Fish and Aquatic Life community and cannot be remedied or would cause more environmental damage to correct than to leave in place."

   They go on to note that "This condition can occur where years of poor land management have resulted in sediment and nutrient deposits in streams and other water bodies. These deposits can result in habitat destruction and degraded water quality. These conditions may not be attributable to one source and cannot be remediated through enforcement or reasonable management actions. Degraded habitat or water quality will likely continue to persist even with better land management in the watershed."

   The problem of legacy sediment contamination in the UAA Reach clearly would fall under this definition.

3) "Physical conditions related to the natural features of the water body, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of a Diverse Fish and Aquatic Life community."
   Wisconsin proposes to apply this to situations where the lack of these features is a result of the natural condition of the waterway. Nonetheless, it is a clear acknowledgement that

> these factors, whether a result of natural conditions, or from the damming of a river, as in the UAA Reach, has severe consequences to the biota.

Given the precedents established by these other Region 5 states, Illinois should give strong consideration to developing one or more new and more appropriate use categories.

In its *Water Quality Standards Handbook*, the U.S. EPA offers some guidance in establishing subcategories of use designations. The U.S. EPA notes that subcategories of aquatic life uses may be based on: attainable habitat (*e.g.,* coldwater versus warmwater habitat); innate differences in community structure and function (*e.g.,* high versus low species richness or productivity); or fundamental differences in important community components (*e.g.,* warmwater fish communities dominated by bass versus catfish). (*Water Quality Standards Handbook: Second Edition*, U.S. EPA, August 1994, Section 2.4). The U.S. EPA also suggests using biological data as a basis for creating subcategories, such as using measurable biological attributes to create a use subcategory. *Id.*

In general, the U.S. EPA supports the use of greater specificity by states in defining use classification systems. It is considering revisions to the water quality regulations that would require more precise use designation systems by the states. In its 1998 Advanced Notice of Proposed Rulemaking on the Part 131 water quality regulations, the U.S. EPA said:

> [T]he Agency's current thinking is that there is a growing need to more precisely tailor use descriptions and criteria to match site-specific conditions, ensuring that uses and criteria provide an appropriate level of protection which, to the extent possible, is neither over nor under protective. 63 Fed.Reg. 36750 (July 7, 1998).

The discussions held during the recent U.S. EPA-sponsored national symposium entitled "Designating Attainable Uses for the Nation's Waters" (GLEC, July, 2002) also highlighted the current need for more refined designated uses with more differentiated criteria applicable to site-specific waterbodies.

For Illinois, the development of additional use classification designations to address those waters which fall between Secondary Contact and General Use may be an appropriate course of action to further evaluate the proper use classification of the UAA Reach[1].

The Lower Des Plaines River data reveals that in some ways it can attain uses that are higher than those included in the Secondary Contact Use designation. However, the application of the UAA regulatory factors shows that it cannot attain a General Use designation. The alternative of creating a new use designation or a subcategory that incorporates an appropriate hybrid of General and Secondary Use water quality standards is an option that would be consistent with U.S. EPA guidance and current thinking on use classification systems.

[1] The Clean Water Act regulations require an opportunity for public hearing before a State may establish a use subcategory. See 40 C.F.R. § 131.10(e).

An additional use category would allow the State to recognize and maintain the improvements that have been made in the Lower Des Plaines River chemical water quality over time, while also accurately concluding that certain fishable/swimmable uses are not attainable. Under such an additional use category, less stringent limitations are justified and warranted for those parameters which are not responsible for limiting the existing and potential indigenous aquatic community or preventing full recreational uses in a physically compromised system.

VIII. POWER PLANT EFFECTS ON THE WATERWAY

A. Effects of Power Plants on Physical Habitat

Power plants add to the availability of physical habitats in a localized but generally positive way. Intake and discharge embayments provide protected off-channel refuges. High velocities in the discharge areas tend to scour fine, contaminated sediments. Discharge water temperatures during mid-summer reach levels sufficient to exclude many of the more heat-sensitive fish species from the hottest portions of the plumes, but the areas affected are quite small. These same areas attract fish during the colder months of the year. Thermal plume observations conducted in connection with the UIW study in 1993-1994 revealed that in each instance at least 75% of the cross-section of the stream was in compliance with applicable thermal standards, providing a zone of passage for potentially affected organisms. (Final Report, UIW Study, 1995. Chapter 3). The data collected during the 2002 Joliet thermal plume studies conducted by EA for Midwest Generation, during typical summer operating conditions, showed that the two thermal plumes from the Joliet Stations are continuing to meet both the mixing zone and zone of passage requirements of 302.102 in the context of the existing Secondary Contact thermal water quality standards (EA, 2003, p 13-15). Being surficial in nature, the thermal plumes from Midwest Generation's plants have no negative impacts on the existing physical habitats for aquatic life in the Lower Des Plaines River.

B. Water Temperature Regime

Generally, main channel water temperatures in the entire UIW tend to be warmer year round than would be expected for a river of comparable size in this geographic region. As an effluent-dominated waterway, the primary causes of the elevated thermal regime in the UIW are discharges from power plants and wastewater treatment plants (WWTP). WWTPs contribute a large component of the flow (100 % during low flow periods) and their discharges tend to have a relatively constant, moderate temperature which has the effect of dampening seasonal and diurnal changes. While power plants do not change the volume of flow, they add heat and raise the water temperatures not only near the plant, but progressively downstream. The increases in incremental temperature gradually diminish as heat is lost to the atmosphere, but overall water temperatures do increase from the Chicago Metropolitan area to the Joliet area, due to a combination of ambient solar heating, WWTP discharges, power plant contributions and non-point source sheet runoff from urbanized areas. (Final Report, UIW Study, 1995. Chapter 3).

The UIW study confirmed the cyclic nature of both temperatures and organism life stages in the waterway. Because nearly all temperate zone organisms normally live in temperatures that cycle annually, it is assumed that maintenance of a seasonal cycle is important. Thermal modeling shows that water temperatures in the system are higher than they would be without the power plants in operation, but that the seasonal cycle is nonetheless preserved. The UIW studies observed actual conditions associated with power plant operations. It also confirmed that biological cycles are maintained in the waterway. The timing of biological cycles did not appear to be altered significantly, although some shifts probably do occur because the temperature cycle in the waterway cannot be considered "natural".

C. Longitudinal Temperature Distributions

The variability in temperatures inherent in the water source inputs to the UIW, atmospheric conditions (largely unpredictable), and operations of the power stations make concise, quantitative portrayal of longitudinal temperatures throughout the system extremely difficult. Midwest Generation uses predictive mathematical models to extrapolate hypothetical temperature distributions assuming fixed representative inputs and atmospheric conditions. The reliability of these models to depict realistic conditions has been confirmed for a wide range of seasonal and operational circumstances. (Holly, et. al, 1994-1995)

All of Midwest Generation's power plants in the UIW utilize once-through, open cycle cooling systems. Each plant takes relatively large volumes of water through its condensers and discharges it directly back into the waterway at an elevated temperature. Stations must meet the current Secondary Contact thermal limitations at the edge of the allowable mixing zone. Compliance is monitored by reporting end-of-pipe temperatures, per NPDES permit requirements. Compliance is verified internally by performing mass-balance calculations to determine the fully mixed waterway temperature. Field verification studies have been performed, including the field studies performed by ENSR as part of the UIW Study (ENSR, 1995) , as well as more recent studies (EA, 2003) that demonstrate compliance with the Secondary Contact thermal limits at the edge of the allowed mixing zone.

The UIW thermal modeling analysis shows that the overall thermal regime of the waterway downstream of the MWRDGC's Stickney Water Reclamation Plant (WRP) is influenced more by the temperature of the Stickney WRP treated effluent discharge than by any upstream temperatures: warmer in the winter, cooler in the summer. Therefore, any impacts on temperature from the operation of Midwest Generation's Fisk and Crawford Plants (located upstream of the Stickney WRP and approx. 33 River Miles upstream of the UAA Reach) on the Lower Des Plaines are negligible.

D. Non-Summer Water Temperatures in the Lower Des Plaines River:

While summer temperatures have been the primary focus in the draft UAA report, non-summer temperature limits also need to be adequately addressed in the course of the this UAA evaluation. There are periods during the Winter and Spring when ambient river temperatures currently exceed the corresponding General Use thermal water quality limit, largely due to the influences of the MWRDGC's Stickney Water Reclamation Plant (the "Stickney WRP"). The Stickney WRP provides up to 100 % of the flow to the waterway during the winter months. Its discharge elevates UIW temperatures above what would be found in a natural waterway during this time of year. The result is an altered thermal regime, regardless of the input of heat from MWGen's plants.

This phenomenon is substantiated by MWGen's temperature monitoring data upstream of the UAA study reach that indicates ambient water temperatures often exceed the General Use thermal water quality criteria limit of 60 ^{o}F / 63 ^{o}F during the winter months. This is largely due, as indicated above, to the significant influence of MWRD's treated wastewater discharge on the waterway. Unless the temperature of this dominant discharge is controlled to ensure that downstream ambient temperatures meet the General Use criteria, the "natural" (in so far as anything can be considered natural in this waterway) background temperature of this waterway will remain elevated during the Winter and Spring months.

The Cal-Sag Channel enters the Chicago Sanitary and Ship Canal between the Stickney WRP discharge and Will County Station. Inflow temperatures from the Cal-Sag tend to be very similar to those at the Roosevelt Road Bridge (the most upstream influent point in the UIW system). Proceeding downstream, the next significant thermal input in the Lockport Pool (aside from the MWRD discharge during the winter months) is the discharge from Midwest Generation's Will County Station. Some of the heat from the Will County Station's discharge is gradually dissipated to the atmosphere along the approximately five mile reach from the Station to the Lockport Dam. This cooling continues for another mile and a half below the Lockport Dam, at which point it is further diluted by the discharge from the upper Des Plaines River. Inflows from the upper Des Plaines tend to have a cooling effect on the Lower Des Plaines River year-round, although the volume of total flow contributed is minimal.

Joliet Stations #9 and #29 are located in the Dresden Pool approximately a mile downstream of Brandon Road Lock and Dam. The waterway in this lower pool has a moderately large cross-sectional area (and surface area) and water movement downstream is relatively slow. A substantial portion of the heat input from the Joliet Stations is lost to the atmosphere before the flow reaches the I-55 Bridge located approximately seven miles downstream--the point at which General Use water quality standards begin.

Five miles downstream of I-55, the mixing of the Lower Des Plaines River with the cooler waters of the Kankakee River further reduces the water temperature. However, the inflow of the Kankakee tends to be compressed along the south bank of the channel such that full mixing (and reduction of the temperature by dilution) does not occur until downstream of the Dresden Island Lock and Dam. (Holly, et. al. 1995)

E. Lack of Thermal Effects on Phytoplankton and Zooplankton

The warmest areas in the UAA Reach occur in the near-field plumes immediately downstream of the points of discharge from Midwest Generation's power plants. Important questions associated with possible near-field impacts include whether these temperatures are sufficiently high to kill or injure planktonic organisms passing through the plants' cooling systems, whether mobile organisms will be excluded from areas in the immediate discharge vicinity, and whether the movements of mobile organisms up and down the waterway will be blocked by elevated temperatures that might completely occupy the cross-section near any particular station. The

UIW Study components were designed to respond to these questions. More recent information (EA, 2003) also confirms the limited extent of influence of the thermal plumes from MWGen's Joliet plants on the lower Des Plaines River under typical summertime operations.

The UIW Study showed that truly planktonic forms of algae (and presumably zooplankton) make up a very minor component of the flora and fauna in the UAA Reach. (Final Report, UIW Study, 1995. Chapter 5). For the most part, planktonic organisms are represented by species that attach to or are closely associated with the substrate--periphytic algae and grazing zooplankters. The UIW Study results indicate that phytoplankton densities generally increase with distance downstream. These increases are related to an expansion of available habitats in the lower pools, the input of plankton from tributaries in these pools, and to some extent, from increased growth rates due to elevated water temperatures.

Previously done studies documented in the UIW report, as well as the monitoring work done for the UIW study, confirm that algae in the UIW system have little susceptibility to entrainment and that similar community structure and abundances are found throughout the UIW. The community below Dresden Lock and Dam (RM 271.4) on the Illinois River was similar to that in the upper Des Plaines River and the Kankakee River. These results indicate that members of the phytoplankton communities in the system receiving warm-water effluents were similar to those removed from this influence. Although identified as a potential concern in the draft UAA report, the UIW studies of phytoplankton and periphyton clearly show that the system is <u>not</u> dominated by blue-green algae. It is, in fact, populated by the same species assemblage as other similar river-reservoir navigation channels. Phytoplankton density at Joliet was comparable to the density observed in Pool 19 of the Mississippi River, which is not thermally impacted. This shows that members of the phytoplankton and zooplankton communities are not impacted on a long-term basis by power generation.

F. No Adverse Thermal Effects on Macrophytes

Surveys showed that aquatic macrophytes occur throughout the UIW wherever suitable substrate occurs (Final Report, UIW Study, 1995. Chapter 6). Elevated water temperatures seem to be having no adverse effect on macrophyte stands, either in the general, system-wide context or in the immediate vicinity of power plant discharges. As the result of respiration, oxygen levels within the confines of the macrophyte beds may fall to low levels during the night, especially in the two upper pools. This may limit the value of such areas as habitat for sensitive fish species and life stages.

G. No Adverse Thermal Effects on Benthic Macroinvertebrates

The elevated water temperatures below power plant discharges or the generally warmer conditions that prevail in the UIW relative to nearby waterways are not adversely affecting macroinvertebrate composition or distributions. Habitat condition, as well as sediment quality, rather than temperature, appear to be the primary controllers of benthic invertebrate community composition within the UIW system. (Final Report, UIW Study, 1995. Chapter 7). The assemblages of near-field areas at each of the generating stations studied generally demonstrated an overall improvement in community quality relative to areas either upstream or further downstream of the discharge, a result likely arising from improvements in flow regime within the discharge canals themselves. The UIW Study findings directly contradict the draft UAA report contention that the number and distribution of bottom organisms decreases as temperature increases. This might hold true where identical, suitable habitat conditions are present and not variable, as in the case of the Lower Des Plaines River, where macroinvertebrate habitat conditions are generally better within the discharge canals of the power plants than elsewhere in the waterway, despite the sometimes elevated temperature conditions. It is also important to understand that the warmest temperatures occur in the upper to middle portions of the water column, thus not affecting bottom-dwelling benthic macroinvertebrates. In the UIW study, any taxa that were found to be reduced or eliminated within the near-field areas typically demonstrated a rapid recovery to the composition and condition of those upstream of the discharges. This suggests that there was no observable cumulative impact of thermal effluents on the macroinvertebrate community.

H. Effect on Fisheries

The "Selection of the Temperature Standard" and "Critique of the Current Secondary Contact and Indigenous Aquatic Life Standard" sections of the draft UAA report have many inaccurate statements regarding temperature effects on riverine species and ecosystem processes. High and low temperatures may or may not be detrimental to aquatic life that resides in the UIW. There is not a simple relationship, as noted from many past studies (e.g., Cairns et al. 1973; Cairns et al. 1978; review by the Institute for Environmental Quality 1995). Both low and high temperatures can increase AND decrease toxicity due to exposures from other chemical stressors, such as found in the UIW, and is both species, toxicant type, toxicant concentration and species dependent. The overly simplistic statement that high temperatures increase toxicity is simply incorrect. Nitrification is also inhibited by cold temperatures and ammonia is not always consumed in the upper sediment layers. Nitrification is very sensitive to toxicants, which abound in the depositional sediments. The UAA consultants AquaNova and Hey and Associates incorrectly imply that high temperatures are always detrimental by focusing only on negative thermal impacts and over-generalizing. Both ammonia and ammonium can be toxic but this is both species and concentration dependent. For example, the amphipod *Hyalella azteca* is more sensitive to total ammonia than the un-ionized form. Blue green algae are not a concern in the UIW due to its high flow. Toxic cyanobacterial blooms have only been noted in pond, lake and reservoir ecosystems. So, many of the "negative" examples used in the draft UAA Report do not apply to the UIW, yet their presentation implies that they do.

The UIW study data, as well as the results of MWGen's on-going monitoring, show that the magnitude, duration and extent of excess temperature in the Lower Des Plaines River is within the tolerance range for most of the species expected to reside in this waterway, given the existing physical constraints. Contrary to the implication in the draft UAA Report (October, 2003 revised temperature section, p. 2-93) , "[d]irect deaths from excessive temperature beyond the thermal lethal point" have never been documented in the Lower Des Plaines River. MWGen's monitoring work (EA, 1997-2002) continues to show that dissolved oxygen levels in the Lower Des Plaines remain at or above that needed to support the indigenous aquatic community. MWGen's long-term fisheries monitoring program (EA, 2002) assessments of fish condition show that there are no obvious food availability problems in the system. Synergisms between heat and toxic substances have been shown by Burton's studies (1995, 1998, 1999), however, these studies were conducted under controlled laboratory or in-situ conditions which represented worst-case exposure conditions. In reality, the heat from MWGen's power plants does not reach the areas where most of the sediment-bound contaminants are found.

Exclusion areas--small areas of elevated temperature avoided by sensitive mobile organisms--will occur in the immediate discharge vicinities for all of the Midwest Generation stations during the warmer months. The three-dimensional mapping of the thermal plumes (ENSR, 1994, EA, 2003), shows that buoyancy of warm water limits these exclusion areas to upper water column layers and that a zone of passage at cooler temperatures (of at least 75% of the cross-section of the waterway) remains beneath the surface thermal plume at any time. As part of the UIW Study, fly-over, infra-red imagery was taken of the waterway. (Brady, 1993-1994) These data also confirm the surficial nature of the thermal plumes in both the summer and winter periods.

These findings, together with the fact that no fish kills have been reported in or around any of Midwest Generation's stations, support the premise that resident fish species can and do move temporarily out of thermally enhanced areas and into portions of the river that are more suited to their preferred temperature range. Thermal refuges (e.g. tributary mouths) exist throughout the expanse of the Lower Des Plaines River downstream of Brandon Road Lock and Dam, and are also found upstream, although are more limited there due to the physical structure of the canal in this area.

The fishery of the UIW is basically a "warm-water" assemblage consistent with the physical circumstances of the system. Common carp dominate the biomass throughout the system. Improvements in the diversity of species occur as one moves downstream through the three navigational pools. The assemblage inhabiting the Dresden Pool, though improved over those of the Lockport and Brandon Pools, is still well below expectations. Brandon Road Lock and Dam is clearly a transition point for the fishery, based primarily on improvements in habitat availability relative to the upstream reaches. While it may not be possible to separate the various stressors to the system to determine which ones are most responsible for the limitations on the biological potential of the waterway, thermal discharges are not sufficient to account for the lack of a balanced indigenous fish community in the Lower Des Plaines River. Given the lack of balance in the Lower Dresden Pool, even if thermal discharges were to required to comply with General Use Thermal Standards, there still would not be a balanced indigenous fish community in the UAA Reach.

The warmer overall conditions of the waterway may also play a beneficial role in protecting the aquatic ecosystem as a whole, especially in light of the recent efforts of state and federal natural resources agencies to deter the threat of invasive species to our waterways. The water temperatures currently encountered in the UAA reach may actually serve to preclude the migration of non-native invasive alien species of fish, such as the Asian carp, to more sensitive waterbodies, such as the Great Lakes, which, if unchecked, could have a devastating effect on Lake Michigan's indigenous aquatic community/sport fishing industry. Midwest Generation has been working cooperatively with state and federal natural resources agencies to assist in the development of plans to control the migration of invasive species in the UAA waterway, using whatever means are technically and legally available.

I. Temperature Effects on Dissolved Oxygen Levels

For purposes of analyzing dissolved oxygen (D.O.) levels, the waterway can be divided into two segments: the area above and the area below the Brandon Lock and Dam. Dissolved oxygen levels vary seasonally in both areas in accordance with the prevailing water temperature regime, the changing solubilities of oxygen and with oxygen levels in tributaries and other source waters. Oxygen concentrations in the Lockport and Brandon Pools are typically below saturation, periodically dropping below the Illinois Secondary Contact standard of 4.0 ppm. Generally, higher oxygen levels are observed downstream of the Brandon tailwaters and in the Dresden Pool. In part, this is the result of the reaeration that occurs at the Brandon Road Dam and transport through the tailwater area. Dissolved oxygen levels in the Dresden Pool main channel are generally improved over those in the two upper pools, and are generally in compliance with applicable limits. (EA, 1997-2002 Temp/D.O. Study Reports).

It has also been speculated that power plant discharges, by adding an increment of heat to the overall waterway, are accelerating the bacterial and chemical decomposition of organic matter and the respiration of aquatic plants, thereby reducing dissolved oxygen levels. While this may be conceptually correct, the actual reduction is very small, and more importantly, accelerating decomposition has the overall positive effect of reducing levels of organic materials in the system. It is likely that occasional decreases in dissolved oxygen levels in the system are primarily caused by heavy rainfall events, nutrient introduction and primary productivity cycling and/or increased boat traffic, rather than the input of heat from power plants. (EA 2001 Temp./D.O. Study Report, p. 8-11). Illinois EPA's UAA consultant also has suggested that the cause of sporadically low D.O. cycles in the system may be more the result of nutrient enrichment and photosynthesis, rather than strictly thermal inputs. (Vladimir Novotny --personal communication. December 13, 2001).

At times power plants can also contribute to increasing the level of dissolved oxygen in a waterway. In the UAA Reach, the intermittent use of Joliet Station #29's supplemental cooling towers during warm weather periods contributes additional dissolved oxygen to the waterway. The total contribution has not been quantified but may more than offset any incremental decreases in dissolved oxygen perceived to be the result of power plant operations under high temperature conditions.

Significantly, the water temperature/dissolved oxygen studies at the I-55 Bridge performed annually by ComEd/Midwest Generation since 1997 have not shown consistent correlations between high water temperatures and prolonged adverse levels of dissolved oxygen. Supplemental physicochemical monitoring done as part of Midwest Generation's long-term fisheries monitoring system also show that dissolved oxygen levels are variable throughout the waterway during the course of the monitoring period. Typically, D.O. levels are at or above minimum limits in the various habitats sampled over the course of the summer period. (EA Upper Illinois Waterway Fisheries Investigation Reports, 2000, 2001, 2002) The observation that lower D.O. levels in the system are generally limited to a few locations for short periods of time indicates that low D.O. is not a widespread problem in the waterway.

Short-term, localized "low" D.O. levels, whatever the cause, should not have any measurable adverse impacts on the aquatic community. The U.S. EPA Green Book (FWPCA, 1968) recommends a warm water fisheries one-day acceptable minimum dissolved oxygen concentration of 3.0 mg/l, with a 7-day minimum of 4.0 mg/l. Dissolved oxygen levels in the Lower Des Plaines River are generally well above these minimums. The data analysis presented as part of the current UAA Study, as well as the UIW Study results and current monitoring data, all indicate that dissolved oxygen levels in the Lower Des Plaines River are more than sufficient to support the indigenous aquatic community.

Overall, the average D.O. in the waterway is well above that needed to sustain the indigenous biological community, as evidenced by both continuous I-55 monitoring, as well as measurements taken as part of MWGen's long-term fisheries monitoring program. These data continue to show more than adequate levels of D.O. at all of the sampling locations in the Lower Des Plaines River, including the immediate generating station discharge canals, where water temperatures are the highest.

IX. UNIQUENESS OF THE WATERWAY

The Lower Des Plaines River, along with the Chicago Sanitary and Ship Canal, Cal-Sag Canal and portions of the Chicago River are the only major waterbodies in the State currently designated as Secondary Contact and Indigenous Aquatic Life waters. They have held this designation since its inception in 1974. This is due to the unusual and unique character of this waterway. Its uniqueness creates additional challenges in trying to determine what its overall potential as a valued State aquatic resource could be in the future.

The unique character of the UAA Reach makes it difficult to identify a biological reference site for this portion of the UIW. The UAA Biological Subcommittee had several discussions regarding the availability, or lack of availability, of a biological reference site for the Lower Des Plaines River UAA Reach. A reference site is needed in order to be able to compare biological measurements from the Lower Des Plaines River with other physically similar streams in the State to determine the overall potential of the system. Several rivers in the same ecoregion have been proposed for consideration as a reference site by various Subcommittee members and the IEPA consultants, but none has received the consensus support of the UAA Biological Subcommittee upon further review. This is because there are no other waterways in the State that have the same artificially-controlled flow/level regime, the man-made "shorelines" or the significant commercial navigational/storm water control uses of the UAA Reach. All of these characteristics must be considered for a proper assessment and comparison of biological potential, because they are <u>permanent</u> features of the UAA Reach.

Without an appropriate representative reference stream, a prediction that the UAA Reach can attain the General Use classification is highly speculative. In other words, there is no actual real-life stream that mirrors the UAA Reach to show with a reasonable degree of certainty that General Use can be attained. We lack this reasonable basis on which to determine what the UAA Reach is capable of regarding the type of aquatic life it can support with more stringent water quality limitations in place. For this reason, the suggestion that a separate use designation for this particular portion of the waterway should be developed based on what it actually has attained, or what it might reasonably attain in the future, warrants further review.

X. CURRENT MONITORING STUDIES OF THE UAA REACH

Midwest Generation continues to perform physical monitoring in the UAA Reach, including temperature monitoring (done year round at each generating station and at the I-55 Bridge), as well as seasonal temperature/dissolved oxygen monitoring at I-55. Midwest Generation, working with the Iowa Institute of Hydraulic Research, also continues to perform thermo-hydrodynamic modeling of the waterway as part of its on-going compliance commitment. These models are, by necessity, very customized in nature, due to the unique circumstances present in the river system.

The studies conducted on the UIW show the waterway to be populated with aquatic biota capable of carrying out their life functions under the constraints of available physical habitat. The studies also show that some species (e.g. walleye) and organism groups (e.g. redhorses) that might be expected in a slow-moving river-reservoir system in the Midwest at this latitude, though present, are found in reduced numbers.

The important questions here are:

(1) Is the heat contribution of Midwest Generation’s plants sufficient to raise temperatures to a range that would exclude expected species, or are the reduced numbers of such species a result of other factors, such as poor habitat?; and

(2) What temperature limits are reasonable for the protection of organisms one would reasonably expect to inhabit the waterway?

Although temperature is but one factor among many that the study has shown affects aquatic life, it is useful to examine the temperature requirements of the biota in relation to existing and expected future waterway temperatures. The best information on temperatures requirements for biota is available for fish. The fish community of the Lower Des Plaines River has been monitored on an ongoing basis for the past twenty-plus years, sponsored by ComEd/Midwest Generation. The monitoring results continue to show general improvements and/or status quo in the biological community over time under the existing Secondary Contact thermal water quality limits. These results indicate that the existing thermal levels in the UAA Reach are not a significantly limiting factor to the present or future expected biological community.

XI. ESTABLISHING PROTECTIVE THERMAL LIMITS FOR THE BRANDON POOL AND THE UPPER DRESDEN POOL

A. Temperature is a Unique Constituent

Temperature has several unique characteristics that need to be considered when determining appropriate and protective thermal limits. Temperature is non-conservative; excess temperature dissipates very rapidly to the atmosphere. It does not bioaccumulate and under most conditions it stratifies vertically in the water column, thus allowing for a zone of passage even when surface temperatures might be excessive. Because temperature "behaves" in a very predictable manner, thermal models can accurately predict the general spatial distribution of thermal plumes based on a few fairly simple input parameters. However, the sudden and unpredictable flow fluctuations that occur in the Des Plaines River as a result of artificially controlled flow management make predictions much more difficult than in natural systems.

In addition to unique physical properties, fish have a well established ability to avoid excessively warm or cool temperatures (EPRI 1981). Assuming thermal refugia are available, fish will simply avoid areas that are too hot and return quickly when temperatures are more favorable. Thus, many species avoid thermal discharges during the middle of the summer, but seek out these areas during cooler periods. This is why many discharge areas are favored "fishing holes" over much of the year. Avoidance of excessive temperatures is why fish kills are rare during the summer...the more sensitive species simply leave the area. Thus, from a behavioral perspective, thermal avoidance is protective. It allows fishes to move away from conditions that otherwise may become lethal.

A distinction needs to be made between short term and long term avoidance (Ohio EPA 1978). Short-term avoidance is "the temporary avoidance by a species population caused by the onset of limiting or unfavorable environmental conditions" (Ohio EPA 1978). Short-term avoidance, though not rigorously defined, is typically considered to be on the order of hours or days, whereas long-term avoidance has been defined as the permanent or prolonged avoidance of an area (Ohio EPA 1978). Thus, long-term avoidance would be on the order of weeks or months. Long-term avoidance is an indicator of appreciable harm (assuming the area avoided is not trivial in size), whereas, short-term avoidance is not (Ohio EPA 1978). Fisheries studies performed by EA for over the past 20 years demonstrate that there is short term avoidance of the power plant discharge canals during the hotter periods of the summer, but that fish move back into the discharge areas once more preferable temperatures resume. There is no evidence that fish permanently move from the area and do not return.(EA Fisheries Monitoring Studies, various years).

The AquaNova/Hey Report states (p. 2-99) that "only adult fish are known to escape the impacts of high temperatures" and that the effect on juvenile fish is "uncertain". This is simply untrue. U.S. EPA has long acknowledged that juvenile fish can avoid high temperatures. For example, in their "Gold Book" (U.S. EPA 1986), the Agency states that "(J)uvenile and adult fish usually thremoregulate behaviorally by moving to water having the temperature closest to their thermal preference" (emphasis added). The EPA report goes on to note that "this response (avoidance) precludes problems of heat stress by juvenile and adult fish during the summer." (U.S. EPA

1986). Another interesting aspect of temperature is that the temperatures fish prefer during the summer are quite close (often within 2-4 °C) to those that are lethal (EPRI 1981).

B. Brandon Pool Current Conditions

As evidenced by the final meeting minutes of the UAA Biological Subcommittee (April 3, 2002), there was a general consensus reached by the biological experts assembled that a General Use classification is not appropriate for Brandon Pool. This determination was based on existing limitations (principally poor habitat quality, urbanization, sediment quality and barge traffic) which either cannot be changed (i.e., the habitat limitations and urbanization) or will not be changed in the foreseeable future, if at all (i.e., sediment quality and barge traffic). Because of these present and continuing limitations, the aquatic biota in the Brandon Pool will continue to be dominated by tolerant fishes and macroinvertebrates.

Given the existing and potential biotic community in the Brandon Pool, the present Secondary Contact thermal water quality standards (WQS) will be protective, whether the area remains Secondary Contact or is upgraded to a new “modified” use that also accounts for the limitations inherent in this segment of the UAA Reach.

C. Dresden Pool

If the use classification for the Upper Dresden Pool (i.e., the area upstream of I-55) remains as Secondary Contact, then the Secondary Contact thermal standards are and would remain appropriate to protect that use designation. However, as part of the UAA, a potential upgrade of the use designation to General Use or some other intermediate “modified” use is under review. Although Midwest Generation submits that a complete analysis of the UAA factors shows that General Use is not attainable for the UAA Reach, we have included in our review of the thermal standards whether more restrictive thermal standards would be needed to support any proposed upgrade in the use designation of the Upper Dresden Pool. As explained further below, this review concludes that more restrictive thermal standards would not result in any significant improvement to the aquatic communities in the Upper Dresden Pool.

To evaluate Upper Dresden Pool thermal alternatives, we applied some of the protocols typically used as part of a 316(a) demonstration under the Clean Water Act[1]. As with a UAA, a 316(a) analysis evaluates the physical, chemical and biological conditions of the waterway and characterizes potential stressors and their impacts. In a 316(a) demonstration, the main focus is on thermal discharges. The 316(a) process considers what thermal limits are necessary to support balanced, indigenous aquatic communities.

U.S. EPA has long recognized that it is not practical or necessary to evaluate the thermal tolerance of every aquatic species. It recommends that a group of Representative Important Species (RIS) be assessed.

[1]. A 316(a) demonstration is prepared to support the position that applicable thermal limits are more stringent than necessary to assure the protection and propagation of a balanced indigenous community of shellfish, fish, and wildlife in or on the water to which the discharge is made. The applicant attempts to demonstrate that alternative, less stringent thermal limits, will allow the protection of existing balanced indigenous communities, or alternatively, will allow the development of such a community if one is not present currently. This is the showing that ComEd successfully made before the Board in the AS96-10 proceeding.

According to U.S. EPA's Technical Guidance Document (U.S. EPA 1977), RIS are those that are:

1. Commercially or recreationally valuable;
2. Threatened or endangered;
3. Critical to the structure and function of the ecological system[1];
4. Potentially capable of becoming localized nuisance species;
5. Necessary in the food chain for the well-being of species determined in 1-4; or
6. Representative of the thermal requirements of important species but which themselves may not be important.

Recognizing that it is not possible or even necessary to study every species at a site in great detail due to time and resource limitations, U.S. EPA (1977) suggests that 5 to 15 species be designated as RIS because this range of RIS species allows for a representative assessment of the biotic community. Except for threatened and endangered (T&E) species, investigators generally pick species that are (or are expected to be) fairly common because it is difficult to assess the status of, or impacts to, species that occur in low abundance. Also, all other things being equal, species chosen as RIS should be ones for which thermal tolerance data are available.
Based on existing site-specific information, we compiled thermal tolerance data on the following Representative Important Species (RIS) consistent with the U.S. EPA suggestion:

Gamefish	Panfish	Forage Species	Benthic Species	Miscellaneous Species
Smallmouth bass	Green sunfish	Gizzard shad	Smallmouth buffalo	Freshwater drum
Largemouth bass	Bluegill	Emerald shiner	Channel catfish	Common carp
		Bluntnose minnow	Redhorse	

D. Justification for the Selection of RIS:

The selection of Representative Important Species (RIS) for the Lower Des Plaines River is consistent with accepted methods and guidance. MWGen also considered the inclusion of a number of cool water species, such as walleye, other percids and esocids, as suggested by U.S. EPA.

However, such cool water species are not appropriate representatives of the potential fish community in the Lower Des Plaines River. Not only is the Upper Dresden Pool near the edge of their natural ranges, but there is little or no habitat in the Brandon and Upper Dresden Pools to support them. For cool water species such as northern pike and yellow perch, which are examples of the percid species found in some Illinois waters, clear, well-vegetated lakes, pools, or backwaters are required for them to thrive and particularly to reproduce. Such areas are rare to nonexistent in these UIW pools. Therefore, these species will be limited naturally by the lack of suitable habitat.

1. To evaluate this factor, most investigators include at least one species at each trophic level (e.g. a herbivore, an insectivore, an omnivore and a top predator).

Even assuming the General Use Thermal Standards applied to the Upper Dresden Pool, neither good northern pike nor yellow perch populations would become established. Since, as shown during EA's recent habitat survey of the entire Dresden Pool (EA. May, 2003), habitats upstream and downstream of I-55 are similar, it follows that these species should have been able to establish viable populations in the lower Dresden Pool, which is already subject to the General Use thermal standard. However, data collected over the past nine years (See Table 1E), show that only one yellow perch and one northern pike have been collected from the General Use portion of the pool. Since populations of these two species in lower Dresden Pool are already protected by the General Use thermal standard, the only logical reason for their extreme rarity in lower Dresden Pool is lack of proper habitat or other non-thermal causes. Both species are also rare in the Upper Marseilles Pool , which is subject to the General Use thermal water quality standard, for the same reason (i.e. lack of habitat). (See Table 1F).

These cool water species are habitat limited in the UAA Reach and should not be designated as RIS. U.S. EPA (1977) guidance supports this approach for species at the edge of their range. The U.S. EPA report stated (p. 36) that "[w]ide-ranging species at the extremes of their ranges would generally not be considered acceptable as 'particularly vulnerable' or 'sensitive' representative species" though they still could be considered important." Here, based not only on their peripheral nature but also the obvious habitat limitations, the U.S. EPA guidance does not support their inclusion in the RIS designation.

Walleye are more thermally tolerant than yellow perch or northern pike and, as a result, are more widely distributed in Illinois (Smith 1979). Thus, they were not excluded from the MWGen RIS list based on being peripheral. However, like the two species just discussed, they clearly are habitat limited. Most walleye populations spawn over clear cobble or rubble areas, but some populations can spawn in flooded, well-vegetated backwaters. However, except for a small portion of the Brandon tailwaters, both habitat types are rare in Dresden Pool. Examination of data from Lower Dresden Pool and Upper Marseilles Pool supports our contention that walleye are habitat limited. Nine years of collecting fish has yielded only one walleye from the Lower Dresden Pool and only one from the Upper Marseilles Pool (See Tables 1E and 1F) despite the fact that General Use thermal standards prevail in both areas. Thus, there is no reason to believe that walleye would be any more successful in the Upper Dresden Pool than the Lower Dresden Pool.

If we compare catches of walleye with those of smallmouth bass, a species considered to have similar thermal tolerance, or to redhorse, which are likely more thermally sensitive (Reash et al 2000), it is equally clear that walleye numbers in these areas are constrained by something other than temperature. For example, Lower Dresden Pool, which yielded only one walleye, produced 477 smallmouth bass and 571 redhorse (all redhorse species combined) during the same period (See Tables 1E and 1F), and upper Marseilles Pool, which also yielded only one walleye, yielded 172 smallmouth bass and 348 redhorse. The only possible interpretation of this data is that walleye are habitat limited while the other two species, which have roughly similar thermal requirements, are not. Given that it is habitat limited, walleye is clearly not an appropriate RIS for the UAA Reach.

E. Temperature Tolerance of RIS

In considering the temperature tolerance of fish, it is important to recognize that their upper lethal temperature varies directly with acclimation temperature until that species can no longer be acclimated to any higher temperature (usually referred to as the ultimate upper incipient lethal temperature). Thus, fish exposed to summertime ambient conditions should be able to withstand water temperature at or near the upper end of the tolerance range reported for that species. All the Des Plaines River RIS except for redhorse, have upper temperature tolerances in the mid to high 30s °C (95 – 100 °F) (Table 2). This indicates that occasional exposure to temperatures in the mid to high 90s °F should have little effect on these species. The fact that populations of several RIS are good in the Upper Dresden Pool (EA 2001, 2002) supports this interpretation.

If Secondary Contact thermal standards are adversely affecting RIS, then one would expect that RIS catch rates would be lower in the Dresden Pool upstream of I-55, where the Secondary Contact thermal limits apply. Conversely, similar catch rates upstream and downstream of I-55 would suggest that the Secondary Contact thermal standards in the Upper Dresden Pool have little or no influence on the abundance of RIS. In Table 3, catch rates for all native RIS in the Dresden Pool (divided into the upstream and downstream of I-55 segments) are compared for the period 1999-2001. Thirty-three upstream vs. downstream comparisons can be made (11 taxa x 3 years). In 14 of the 33 comparisons, there is no appreciable difference between upstream and downstream of I-55 CPE's. In ten of 33 comparisons, CPE's are noticeably higher downstream of I-55. In nine of 33 comparisons, CPE's are noticeably higher upstream of I-55, where the Secondary Contact thermal limits apply. Thus, overall there is no clear pattern favoring the Dresden Pool segment upstream or downstream of I-55. On a species-specific basis, there are some differences. Emerald shiner, green sunfish, channel catfish, and freshwater drum are generally higher upstream of the I-55 Bridge. Catches of smallmouth bass, gizzard shad, bluntnose minnow, and smallmouth buffalo show no clear-cut upstream/downstream pattern. Redhorse, largemouth bass and especially bluegill CPE's are higher downstream of I-55. In sum, eight of the 11 RIS taxa show either no upstream/downstream preference or have slightly higher catch rates in the warmer upstream portion of the study area.

Largemouth bass, redhorse, and especially bluegill CPE's were generally higher in the cooler waters downstream of I-55. However, of these three species, only bluegill showed a large difference in catch rates. Both bluegill and largemouth bass are very thermally tolerant so their higher catches downstream of I-55 are likely not a result of avoiding the area upstream of I-55. Given that the abundance of most RIS is not lower upstream of I-55 and, even when catch rates are higher downstream of I-55, the difference is slight (bluegill being the only exception), it appears that changing the thermal standard upstream of I-55 from Secondary Contact to General Use may result in only a marginal improvement to the fish community.

The only species (group) that would likely be limited by the Secondary Contact thermal water quality standards are the redhorses. Little quantitative thermal data are available for redhorse but the limited data available indicate that its upper lethal limit is about 92 °F and they likely avoid temperatures in the mid to high 80s °F (Reash et al 2000). Although the thermal limits associated with the Secondary Contact use designation would likely be limiting to redhorse, it appears that other, more important factors, already limit redhorse abundance in the Lower Des Plaines River.

The Des Plaines River downstream of I-55 is already designated as General Use. If water temperature was the principal factor affecting redhorse abundance in the Des Plaines River, then one would expect that redhorse abundance would be much higher downstream of I-55, which is already subject to the General Use thermal standards, than upstream of I-55, where the Secondary Contact thermal limits apply. Furthermore, in the absence of other limiting factors, redhorse abundance in the Des Plaines River downstream of I-55 would be comparable to that seen in other similar sized rivers. Redhorse catch rates are higher in the Des Plaines River downstream of I-55 as compared to upstream of I-55 (Table 4). However, the difference is slight (about 2 fish/km downstream of I-55 compared to about 0.5 fish/ km upstream of I-55) and probably not biologically significant. Further, redhorse catches per unit of effort (CPEs) downstream of I-55 are much lower than they are in the Kankakee River (Table 4). This indicates that other factors (likely either poor habitat or sediment quality) limit redhorse abundance in the Dresden Pool. This being the case, imposing more restrictive thermal limitations on the river upstream of I-55 would likely result in only marginal improvement in redhorse abundance and little or no improvement in the other RIS.

F. Is a Balanced, Indigenous Aquatic Community Present?

Another way to determine whether existing or proposed thermal limits are protective is to determine whether a balanced, indigenous community (BIC) is present; or, if such a community is not present, are current thermal WQS precluding development of a BIC. Based on low Index of Biotic Integrity (IBI) scores (calculated using scoring procedures developed in Ohio, (Ohio EPA 1987), we conclude that a BIC is not present in the Des Plaines River below the Brandon Road Lock and Dam (i.e., Upper Dresden Pool). In both 2000 and 2001, mean IBI scores gradually improved from the mid-teens in Lockport and Brandon Pools to the low 20s in the Dresden Pool (Figures 2 & 3). A BIC should have IBI scores in the low 40s (Ohio EPA 1987). Thus, even in the “best” areas (i.e., those downstream of I-55), the Des Plaines River fish community is poor, with IBI scores not even approaching those that would be expected from a BIC.

G. Are the Secondary Thermal Limits the Cause of the Lack of Balance?

Given that a BIC is not present, it is appropriate to consider whether the lack of a BIC is due to thermal effects or other causes. Several lines of evidence suggest that the lack of a BIC is due primarily to factors other than thermal impacts.

First, IBI scores upstream of I-55, where the Secondary Contact thermal WQS apply, are only marginally lower than in the area downstream of I-55 where the more restrictive General Use thermal WQS apply (Figures 4-6). This indicates that even if the observed IBI differences are due to differences in thermal standards, the net environmental benefit associated with the more restrictive General Use standards is minor.

Second, the mean IBI score in the Joliet Station discharge was comparable to or higher than the mean score at the location just upstream of the station in two of the past three years (Figures 4-6). If the thermal discharge was causing a significant impact, then one would expect that the impact would be most severe in the discharge canal (where water temperatures are highest), but such is not the case.

Third, when slightly better IBI scores do occur in the Dresden Pool, they occur in off-channel areas (e.g., tributary mouth and slough locations) suggesting that, in general, habitat is more important than temperature in determining the quality of the aquatic biota. This assertion is supported by the fact that IBI scores in the Joliet discharge canal (DIS) are comparable to those at main channel border (MCB) locations both upstream and downstream of I-55. Also, temperature measurements in these off-channel areas can be as high or higher than those in the main channel, further indicating that temperature is not the driver in this system (EA 2002).

Fourth, within the upstream I-55 Segment, IBI scores in the Joliet Station discharge are comparable to (i.e., within 4 IBI units, Ohio EPA 1987) to those in other habitats, including Main Channel Border (MCB), Tributary Mouth (TM), and even Dam Tailwater, a habitat with a considerably higher QHEI score.

Fifth, if temperature was the driving factor with regard to the quality of the aquatic biota, then one would expect that IBI scores downstream of the discharge to be noticeably lower than those upstream of it. IBI scores at the first MCB location downstream of the discharge were slightly lower than at the MCB location upstream of the discharge in two of three years, however, the decline is minor (on average about 3 to 4 IBI units, Figures 4 & 6). Even if this small decline is real, the spatial extent of the decline is small. In 2001, IBI scores immediately upstream and downstream of the discharge were comparable (Figure 5). Further, the fact that IBI scores in the discharge itself, where water temperatures are highest, were higher than in areas downstream of it suggests that the slightly lower scores at the next location downstream (where temperatures would be lower) may not even be related to the thermal discharge.

In any case, it is reasonable to conclude that whatever thermal impacts there might be are minor, limited to a small area, and of minor consequence compared to other, more limiting factors.

If thermal is not the principal factor accounting for the lack of a BIC and causing a poor biota throughout the Dresden Pool, then it is reasonable to ask what factor(s) are limiting the biota. As discussed in greater detail elsewhere in this report, there are several factors that clearly limit the quality of the biota. The two most severe limiting factors are poor habitat quality and sediment quality/contamination. Constant barge traffic and urbanization are two likely additional factors, and, based on QHEI metric scores, siltation is also a likely contributing factor (Note: this refers to the general negative effects of siltation in general [e.g., burying of habitats], not the toxic component of sediment). It is also important to note that of possible contributing factors, only water temperature can be addressed in part by point source controls. Thus, even if General Use thermal standards were adopted for the Des Plaines River upstream of I-55, the relevant data shows that the aquatic biota would not significantly improve because the factors that do significantly limit the quality of the biota cannot and will not be controlled.

H. Would the Upper Dresden Pool Aquatic Biota Improve Significantly if General Use WQS Were Applied and Would a BIC be Achieved?

Theoretically, the numbers of only a few species would increase in the Upper Dresden Pool, with redhorse being the group most likely to improve. In reality, however, any improvement is likely to be negligible because other, more influential, factors limit the quality of the biota. With regard specifically to redhorse, this is clearly the case as the abundance of redhorse in Dresden Pool downstream of I-55, where General Use thermal WQS already exist, is only marginally higher than that in the Dresden Pool upstream of I-55. (Table 3). Some of the other reasons why meaningful improvement in the Upper Dresden Pool aquatic community is unlikely include the following:

(1) No thermally sensitive cold- or cool-water species are present
(2) Other factors, some of which are irreversible, limit the community
(3) The community in the Des Plaines River downstream of the I-55 Bridge is not balanced despite General Use WQS (and thermal limits) being in place
(4) The amount of clean spawning substrate is limited for certain fish species due to excessive siltation.

Therefore, except for a possible small increase in redhorse abundance, the fish and benthic communities of Dresden Pool upstream of I-55 are not likely to improve significantly even if General Use thermal standards are imposed. For these same reasons, it is highly unlikely that a BIC would develop in this area.

The biological community data collected on the Lower Des Plaines River for the past 20+ years is more reliable and ecologically meaningful. It warrants a higher level of credence than laboratory-derived endpoints that attempt to predict how the biological community would respond. Good populations will be maintained only if there is adequate early life history survival, successful spawning, etc. An examination of the long term data sets shows that those species tolerant of the extensive limiting conditions that exist in the study area (*e.g.*, gizzard shad, most centrarchids, various minnows, etc.) are doing quite well, whereas those that are more sensitive to these limitations (e.g., redhorse and darters) are not. Thus, it is factors other than temperature (*e.g.,* sedimentation, poor habitat, silty and/or contaminated sediments, etc.) that determine and limit the Upper Dresden and Brandon fish communities. Temperature plays an insignificant role. In other words, there would be no significant change in these fish populations even if General Use thermal standards were applied to the Upper Dresden and Brandon Pools.

Indeed, the results of the recent pool-wide habitat assessment (EA. May, 2003), coupled with the poor IBI scores throughout Dresden Pool suggest that, if anything, it is Lower Dresden pool that is misclassified. Because of poor habit conditions due to impounding and the other factors discussed previously, the biological data supports a lowering of the use classification of Lower Dresden Pool and does not support upgrading the use designation of the upper Dresden Pool.

TABLE 1E. NUMBER, CPE (No./km), AND RELATIVE ABUNDANCE OF ALL FISH TAXA COLLECTED ELECTROFISHING FROM LOWER DRESDEN POOL (between the I-55 bridge and Dresden Lock and Dam) FOR THE PERIOD OF 1994-2002.

SPECIES	LOWER DRESDEN POOL		
	#	CPE	%
LONGNOSE GAR	32	0.16	0.079
SHORTNOSE GAR	1	0.01	0.002
UNID GAR	3	0.02	0.007
SKIPJACK HERRING	35	0.18	0.087
GIZZARD SHAD	12,070	62.00	29.881
THREADFIN SHAD	391	2.01	0.968
GRASS PICKEREL	4	0.02	0.010
NORTHERN PIKE	1	0.01	0.002
CENTRAL STONEROLLER	5	0.03	0.012
GOLDFISH	9	0.05	0.022
GRASS CARP	1	0.01	0.002
COMMON CARP	1,022	5.25	2.530
CARP X GOLDFISH HYBRID	134	0.69	0.332
BIGHEAD CARP	2	0.01	0.005
GOLDEN SHINER	21	0.11	0.052
PALLID SHINER	3	0.02	0.007
EMERALD SHINER	3,781	19.42	9.360
GHOST SHINER	12	0.06	0.030
STRIPED SHINER	20	0.10	0.050
SPOTTAIL SHINER	347	1.78	0.859
RED SHINER	2	0.01	0.005
SPOTFIN SHINER	400	2.05	0.990
SAND SHINER	3	0.02	0.007
REDFIN SHINER	1	0.01	0.002
MIMIC SHINER	3	0.02	0.007
CHANNEL SHINER	1	0.01	0.002
BLUNTNOSE MINNOW	2,602	13.37	6.442
FATHEAD MINNOW	1	0.01	0.002
BULLHEAD MINNOW	1,141	5.86	2.825
RIVER CARPSUCKER	141	0.72	0.349
QUILLBACK	90	0.46	0.223
UNID CARPIODES	1	0.01	0.002
WHITE SUCKER	11	0.06	0.027
SMALLMOUTH BUFFALO	363	1.86	0.899
BIGMOUTH BUFFALO	21	0.11	0.052
BLACK BUFFALO	9	0.05	0.022
SPOTTED SUCKER	4	0.02	0.010
SILVER REDHORSE	28	0.14	0.069
RIVER REDHORSE	6	0.03	0.015
BLACK REDHORSE	1	0.01	0.002
GOLDEN REDHORSE	358	1.84	0.886
SHORTHEAD REDHORSE	177	0.91	0.438
UNID MOXOSTOMA	1	0.01	0.002
BLACK BULLHEAD	3	0.02	0.007
YELLOW BULLHEAD	47	0.24	0.116
CHANNEL CATFISH	376	1.93	0.931
UNID AMEIURUS	1	0.01	0.002
TADPOLE MADTOM	4	0.02	0.010
FLATHEAD CATFISH	17	0.09	0.042
TROUT-PERCH	1	0.01	0.002
BLACKSTRIPE TOPMINNOW	16	0.08	0.040
BROOK SILVERSIDE	98	0.50	0.243
WHITE PERCH	4	0.02	0.010
WHITE BASS	9	0.05	0.022
YELLOW BASS	8	0.04	0.020
HYBRID MORONE	2	0.01	0.005
UNID MORONE	5	0.03	0.012
ROCK BASS	11	0.06	0.027

TABLE 1E (cont.)

SPECIES (cont.)	LOWER DRESDEN POOL #	CPE	%
GREEN SUNFISH	3,146	16.16	7.788
PUMPKINSEED	26	0.13	0.064
WARMOUTH	5	0.03	0.012
ORANGESPOTTED SUNFISH	3,040	15.62	7.526
BLUEGILL	7,271	37.35	18.000
LONGEAR SUNFISH	67	0.34	0.166
REDEAR SUNFISH	1	0.01	0.002
HYBRID SUNFISH	108	0.55	0.267
UNID LEPOMIS	110	0.57	0.272
SMALLMOUTH BASS	477	2.45	1.181
LARGEMOUTH BASS	1,659	8.52	4.107
UNID MICROPTERUS	1	0.01	0.002
WHITE CRAPPIE	15	0.08	0.037
BLACK CRAPPIE	35	0.18	0.087
BANDED DARTER	1	0.01	0.002
YELLOW PERCH	1	0.01	0.002
LOGPERCH	126	0.65	0.312
BLACKSIDE DARTER	1	0.01	0.002
SLENDERHEAD DARTER	3	0.02	0.007
WALLEYE	1	0.01	0.002
FRESHWATER DRUM	439	2.26	1.087
TOTAL FISH	40,394	207.50	100.000

TABLE 1F. NUMBER, CPE (No./km), AND RELATIVE ABUNDANCE OF ALL FISH TAXA COLLECTED ELECTROFISHING DOWNSTREAM OF DRESDEN LOCK AND DAM FOR THE PERIOD OF 1994, 1995, AND 1999-2002.

SPECIES	D/S DRESDEN L&D		
	#	CPE	%
LONGNOSE GAR	18	0.41	0.239
SHORTNOSE GAR	1	0.02	0.013
UNID GAR	2	0.05	0.027
SKIPJACK HERRING	23	0.52	0.305
GIZZARD SHAD	1,003	22.80	13.301
THREADFIN SHAD	55	1.25	0.729
GOLDEYE	1	0.02	0.013
GRASS PICKEREL	1	0.02	0.013
NORTHERN PIKE	3	0.07	0.040
GRASS CARP	1	0.02	0.013
COMMON CARP	178	4.05	2.360
CARP X GOLDFISH HYBRID	2	0.05	0.027
GOLDEN SHINER	2	0.05	0.027
EMERALD SHINER	2,565	58.30	34.014
GHOST SHINER	7	0.16	0.093
STRIPED SHINER	7	0.16	0.093
SPOTTAIL SHINER	50	1.14	0.663
RED SHINER	5	0.11	0.066
SPOTFIN SHINER	422	9.59	5.596
SAND SHINER	36	0.82	0.477
MIMIC SHINER	9	0.20	0.119
SUCKERMOUTH MINNOW	8	0.18	0.106
BLUNTNOSE MINNOW	265	6.02	3.514
BULLHEAD MINNOW	257	5.84	3.408
RIVER CARPSUCKER	91	2.07	1.207
QUILLBACK	69	1.57	0.915
HIGHFIN CARPSUCKER	1	0.02	0.013
UNID CARPIODES	2	0.05	0.027
NORTHERN HOG SUCKER	7	0.16	0.093
SMALLMOUTH BUFFALO	180	4.09	2.387
BIGMOUTH BUFFALO	1	0.02	0.013
BLACK BUFFALO	1	0.02	0.013
SILVER REDHORSE	50	1.14	0.663
RIVER REDHORSE	3	0.07	0.040
BLACK REDHORSE	2	0.05	0.027
GOLDEN REDHORSE	236	5.36	3.130
SHORTHEAD REDHORSE	56	1.27	0.743
GREATER REDHORSE	1	0.02	0.013
BLACK BULLHEAD	1	0.02	0.013
CHANNEL CATFISH	126	2.86	1.671
FLATHEAD CATFISH	4	0.09	0.053
TROUT-PERCH	1	0.02	0.013
MOSQUITOFISH	2	0.05	0.027
BROOK SILVERSIDE	24	0.55	0.318
WHITE PERCH	3	0.07	0.040
WHITE BASS	50	1.14	0.663
YELLOW BASS	7	0.16	0.093
HYBRID MORONE	3	0.07	0.040
UNID MORONE	50	1.14	0.663
ROCK BASS	2	0.05	0.027
GREEN SUNFISH	466	10.59	6.180
PUMPKINSEED	1	0.02	0.013
ORANGESPOTTED SUNFISH	11	0.25	0.146
BLUEGILL	559	12.70	7.413
LONGEAR SUNFISH	7	0.16	0.093
HYBRID SUNFISH	2	0.05	0.027
SMALLMOUTH BASS	172	3.91	2.281
LARGEMOUTH BASS	174	3.95	2.307

TABLE 1F (cont.)

SPECIES	D/S DRESDEN L&D #	CPE	%
WHITE CRAPPIE	2	0.05	0.027
BLACK CRAPPIE	8	0.18	0.106
LOGPERCH	36	0.82	0.477
SLENDERHEAD DARTER	1	0.02	0.013
WALLEYE	1	0.02	0.013
FRESHWATER DRUM	207	4.70	2.745
TOTAL FISH	7,541	171.39	100.000

Table 2. Upper Thermal Temperatures of Various Des Plaines River RIS

Species	Location	Lifestage (size)	Upper Lethal Temp. (°C)	Reference
C. carp*	Poland	Juvi	40.6	Horoszewicz 1973
	Lake Erie	YOY	39.0	Reutter and Herdendorf 1975, Reutter and Herdendorf 1976
	Canada	YOY& Juvi	35.7	Black, E.C. 1953
Channel CF	Lake Erie	165	38.0	Reutter and Herdendorf 1975 Reutter and Herdendorf 1976
	AK hatchery	44-57	37.8	Allen and Strawn 1967
	Lower Susquehanna R, PA	158	36.5	Peterson, Sutterlin, and Metcalf 1979
	SC hatchery	50	36	Cheetham, et al. 1976
Bluegill	SC cooling ponds	Juvi (27-58 mm)	41.9-42.8	Holland, W.E., et al. 1974
	SC cooling ponds	40-82 mm	38.5-41.4	Holland, W.E., et al. 1974
	Wabash R, IN	49 mm	39.0	WAPORA, Inc. 1976
	TN	73, 140	37.4-39.2	Cox, D.K. 1974
	Lake Erie	168	38.3	Reutter and Herdendorf 1975, Reutter and Herdendorf 1976
	Mississippi River	Juvi	37.3	Banner and Van Arman 1973
	VA hatchery	50-100	36.0	Cherry, D.S., et al. 1977
	Lower Susquehanna R, PA	52-159	36.0	Peterson, Sutterlin, and Metcalf 1979; Peterson and Schutsky 1979
	Lower Susquehanna R, PA	52-159	35.8	Peterson, Sutterlin, and Metcalf 1979; Peterson and Schutsky 1979
	Lake Erie		35.5	Hickman and Dewey 1973
	Mississippi River	YOY	35.0	Cvancara, V.A. 1975
	Galveston Bay, TX		35.0	Chung, K. 1977
	Mississippi River	Juvi, adults	34, 33	Hart 1947
	Mississippi River	Eggs	33.8	Banner and Van Arman 1973
	Mississippi River	YOY	28.5	Cvancara, V.A. 1975, Cvancara, et al. 1977

* All data (except redhorse data) from Talmage, S. and D. Opresko. 1981. Literature Review: Response of Fish to Thermal Discharges. EPRI Publication EA-1840. Redhorse data from Reash, R., G. Seegert, and W. Goodfellow. 2000. Experimentally-derived upper thermal tolerances for redhorse suckers: revised 316(a) variance conditions at two generating facilities in Ohio. Env. Sci. & Policy Vol 3:S191-S196.

Table 2. Upper Thermal Temperatures of Various Des Plaines River RIS

Species	**Location**	**Lifestage (size)**	**Upper Lethal Temp. (^oC)**	**Reference**
LM bass	Parpond, SC	Immature	40.0	Smith, M.H. and Scott 1975
	Galveston Bay, TX		37.2	Courtenay, et al. 1973
	Mississippi River	YOY	36.2	Cvancara, V.A. 1975
	Galveston Bay, TX		36	Chung, K. 1977
	Mississippi River	YOY	35.6	Cvancara, V.A. 1975 Cvancara, V.A. et al. 1977
	Canada Lake	52 g	28.9	Black, E.C. 1953
SM bass	Alabama	YOY	37.0	Wrenn 1980
	Lake Erie	151	36.3	Reutter and Herdendorf 1975, Reutter and Herdendorf 1976
	New & East R., VA	50-100	35.0	Cherry, D.S. et al. 1977
	Alabama	Adults	35.0	Wrenn 1980
Green SF			35	Whitford 1970
FW Drum	Mississippi River	YOY	36.0	Cvancara 1975
	Lake Erie	180-212	34.0	Reutter and Herdendorf 1975, Reutter and Herdendorf 1976
	Mississippi River	YOY	32.8	Cvancara, V.A. 1975 Cvancara, V.A. et al. 1977
E. shiner	S. Canadian R, OK	Adults	37.7	Matthews and Maness 1979
	Lake Superior	Juvi	35.2	McCormick and Kleiner 1976
	Canada	Juvi	30.7	Hart 1947
Gizzard shad	Lake Erie	?	36.5	Hart 1952
	Lake Erie	152-167	31.7	Reutter and Herdendorf 1975, Reutter and Herdendorf 1976
	Mississippi	YOY	31.0	Cvancara, V.A. 1975
	Mississippi	YOY	28.5	Cvancara, V.A. 1975, Cvancara, et al. 1977
BN minnow	Wabash R, IN		38	WAPORA, Inc. 1971
	New & East Rivers, VA	50-100	32	Cherry, et al. 1977
	New York streams		31.9	Kowalski, et al. 1978
Shorthead RH	Muskingum R, OH	Juvi	33.3	Reash et al 2000
SM buffalo	Wabash R, IN		31-34 (preferred)	Gammon 1973
	Ohio River		22-23 (preferred)	Yoder & Gammon 1976

Table 3. Comparison of RIS Catch Rates (No/km) Upstream and Downstream of I55.

Species	1999		2000		2001	
	US I55	DS I55	US I55	DS I55	US I55	DS I55
Smallmouth bass	1.2	0.6	0.4	1.1	1.0	0.9
Largemouth bass	7.9	14.0	7.2	13.7	5.4	6.4
Green sunfish	29.7	12.6	24.5	28.9	16.9	7.0
Bluegill	10.6	50.9	19.0	86.4	18.2	33.9
Gizzard shad	32.1	51.0	27.0	62.3	65.1	84.9
Emerald shiner	10.1	3.2	7.7	1.8	11.4	9.2
Bluntnose minnow	8.3	12.1	6.2	26.7	20.9	19.1
Smallmouth buffalo	3.4	3.7	2.4	2.4	2.5	3.2
Channel catfish	3.2	1.9	3.6	2.0	3.5	1.9
Freshwater drum	3.0	2.6	4.6	1.6	3.0	2.4
Redhorse spp.	0.6	1.1	0.9	0.8	0.2	0.7

Table 4. Kankakee, Illinois and Des Plaines River Redhorse (all species combined)
Catch Rates

Kankakee River near Braidwood (11 locations)

YEAR	CPE (No./km)
1999	27.3
1998	17.5
1996	18.1
1993	25.2
1992	11.4
1991	15.6
1990	20.8
1989	21.5

Kankakee River (IDNR data, timed effort converted to effort per 1 km)

Wilmington Dam		I-55		Confluence	
YEAR	CPE	YEAR	CPE	YEAR	CPE
2000	88.0	2000	104.0	2000	4.0

Illinois River Downstream of Dresden Lock and Dam (upper Marseilles pool)

YEAR	CPE
1999	8.7
1995	15.3
1994	4.3

Illinois River Lower Dresden Pool (several locations)

YEAR	CPE
1999	0.9
1998	8.6
1997	5.6
1995	13.1
1994	3.3

Des Plaines River: Lower Dresden Pool Downstream I-55

YEAR	CPE
1999	1.1
1998	2.4
1997	2.5
1995	2.3
1994	2.5

Des Plaines River: Upper Dresden Pool Upstream I-55

YEAR	CPE
1999	0.6
1998	0.7
1997	0.8
1995	0.0
1994	0.3

Figure 2. Upper Illinois Waterway Mean IBI Scores, 2001.

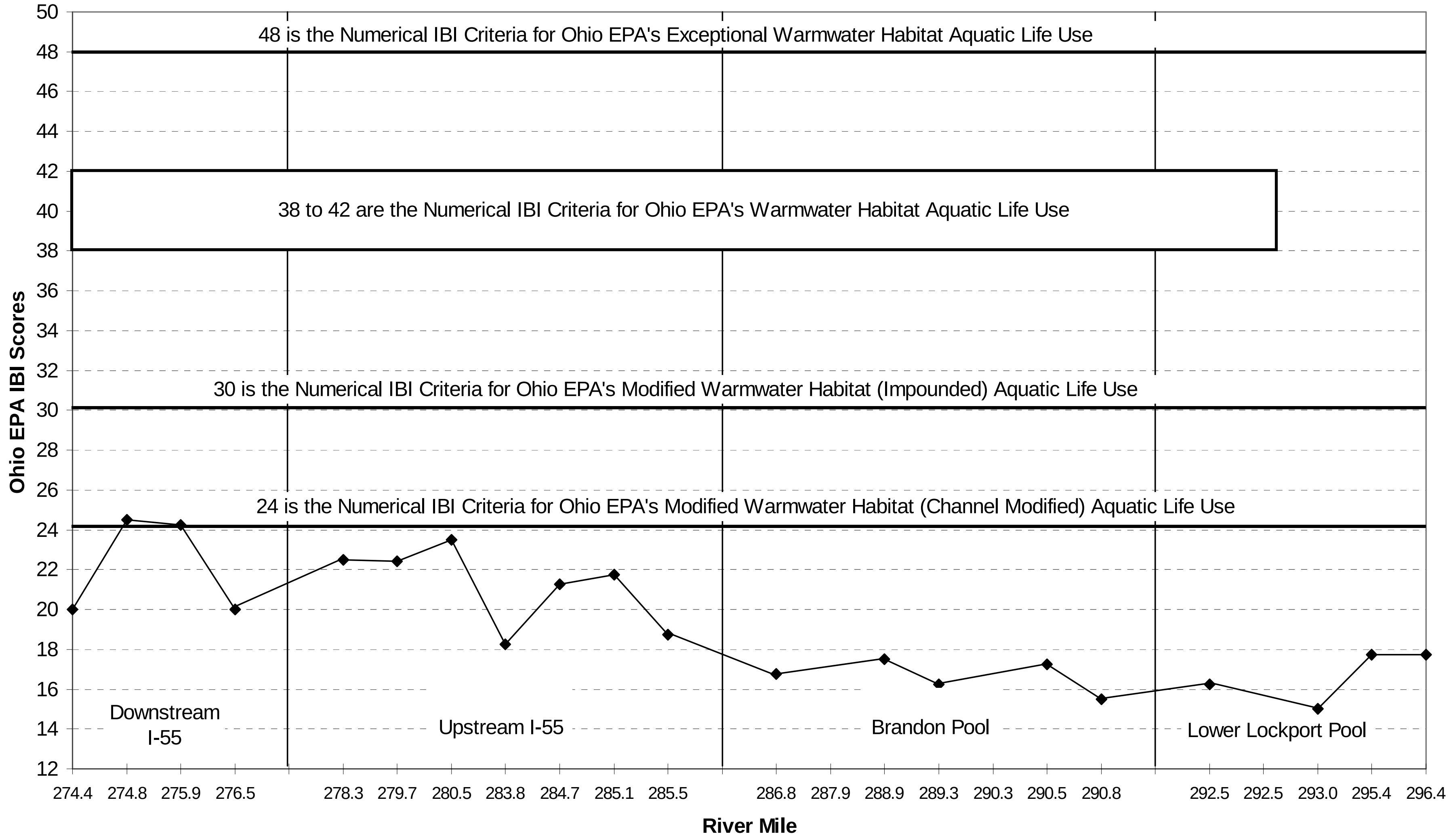


Figure 3. Upper Illinois Waterway Mean IBI Scores, 2000.

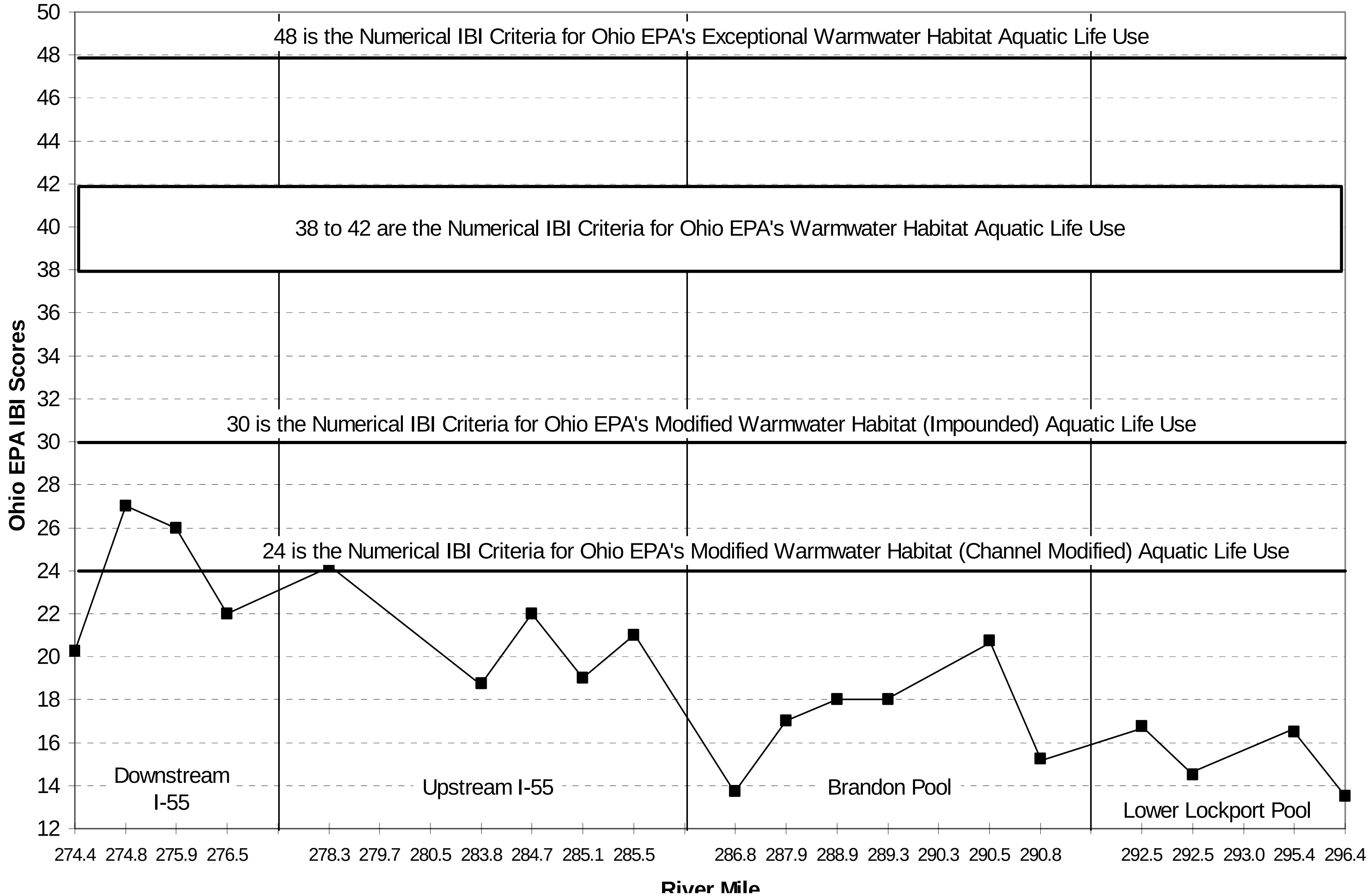


Figure 4. Mean IBI Scores Within the Upstream and Downstream I-55 Segments, 1999.

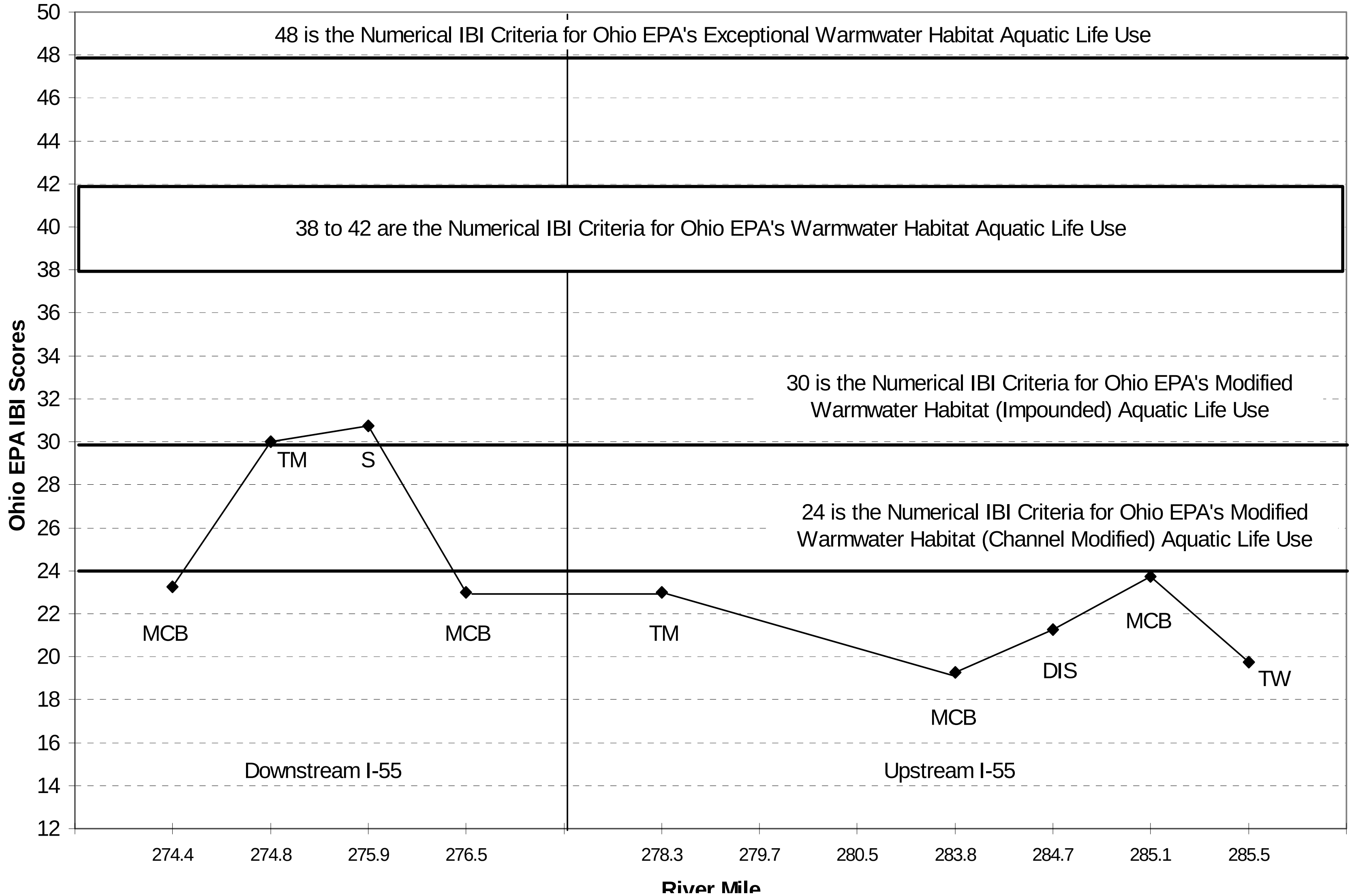


Figure 5. Mean IBI Scores Within the Upstream and Downstream I-55 Segments, 2000.

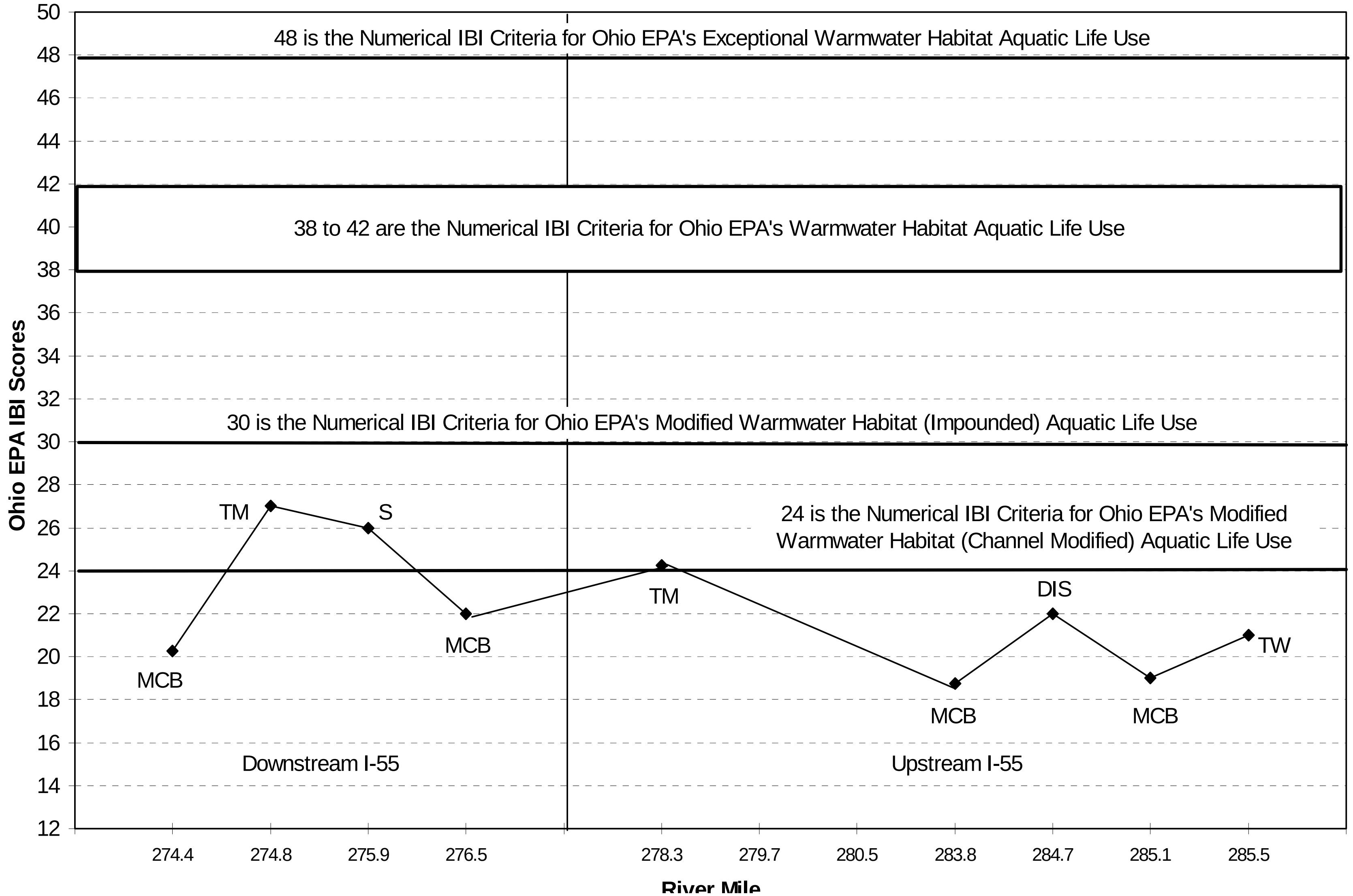
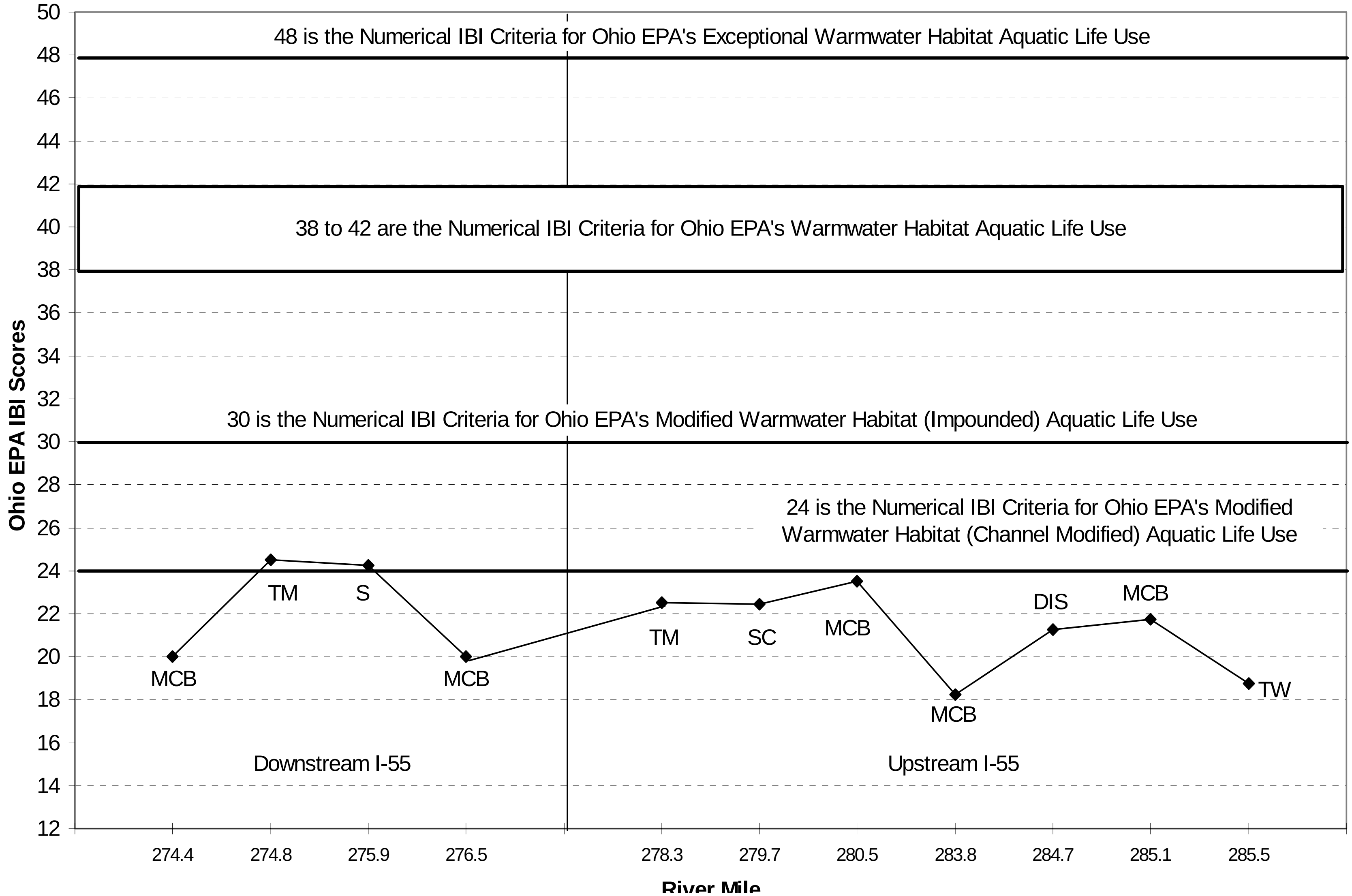


Figure 6. Mean IBI Scores Within the Upstream and Downstream I-55 Segments, 2001.



XII. COST/BENEFIT ISSUES

A significant question to be answered in the context of the current UAA process is: What is the cost/benefit of applying tighter limits and/or technological controls to further limit the amount of heat introduced to the system? The previous section has documented that the environmental benefit of lower temperatures in the Lower Des Plaines River would be negligible in the context of the existing and/or permanent physical limitations of this waterway. This section serves to provide general information for the Agency's consideration in determining appropriate thermal water quality limits for the UAA Reach which adequately serve both biological and industrial uses while not causing unjustified, adverse economic impacts. We have not attempted here to assess all of the other economic impacts that would be caused generally if the UAA Reach were upgraded to General Use. That inquiry is beyond the scope of this report.

A. Compliance with General Use Thermal Water Quality Limits

Based on modeling studies done as part of the UIW Study, it is unlikely the Lower Des Plaines River could meet the General Use thermal criteria even in the absence of power plant thermal discharges. (Final Report, UIW Study, 1995. Chapter 3). Applicability of these limitations to a system which is so heavily influenced by artificially controlled conditions and the effects of heavily urbanized surrounding areas is not likely to improve the biological community and is also not economically reasonable to achieve.

B. Costs Associated with Technological Controls and/or Operating Restrictions to Meet More Stringent Thermal Water Quality Standards

Review of the other UAA factors included in this report demonstrates that General Use is not attainable in the UAA waterway based on one or more of them Having shown that tone of more of the UAA factors is satisfied here, the proper legal conclusion is that the UAA Reach should not be designated as a General Use waterway. Therefore, MWGen believes that a full socio-economic impact study under the remaining sixth UAA regulatory factor is not warranted. However, at the Agency's request, a preliminary engineering cost estimate on the operational/technological considerations of meeting a stricter near-field water quality temperature limit will be provided by MWGen as part of this UAA effort. If the opportunity is provided, details regarding this cost estimate can be presented at a future UAA Workgroup meeting.

XIII. CURRENT AND FUTURE OPERATIONAL CONSIDERATIONS

A. SEASONALITY OF PEAK POWER PRODUCTION

The highest demand for Midwest Generation's product ("electricity") comes concurrently with the highest ambient air and water temperatures and lowest river flows. The critical summer period is when the need for electricity is the greatest. Air conditioning all of the commercial businesses and residential buildings in northern Illinois requires a tremendous amount of power. This is in addition to the normal demands on the system: lighting, computer systems, health care equipment, routine conveniences, etc. During the hottest times of the year, the ambient river temperatures are also increased, due to higher air temperatures and solar inputs. The discharges from our power plants also contribute to this temperature rise. This creates a situation in which thermal stress is exerted on the waterway from both natural and man-made sources, in response to ambient weather conditions.

Despite this reality, and yet in fact, because of it, Midwest Generation plants must remain available to provide needed power to the citizens and businesses of Northern Illinois (and beyond) during these periods. Production levels cannot be adjusted/moved to a less sensitive time of year, as an industrial manufacturing facility may be able to do. (i.e. Midwest Generation cannot "store" electricity made during off-peak seasons to provide for customer demand during critical summer periods).

Midwest Generation is very sensitive to potential impacts on the environment. We have a continuing commitment to remain in compliance with our permit limitations. We have continued to take significant steps to reduce effluent temperature levels during critical periods, including the use of cooling towers and unit deratings, in order to maintain compliance with all applicable thermal water quality standards while optimizing the ability of our stations to continue to produce needed power. Midwest Generation's goal is to strike an equitable and protective balance between the energy needs of the citizens of Illinois and the environmental concerns associated with our operations.

B. USE OF EXISTING COOLING TOWERS

The 24 mechanical draft, once-through cooling towers at Joliet Station #29 were installed on a completely voluntary basis by ComEd in 1999. (This installation took place after the current alternate thermal limits for I-55 were granted, not as a means to obtain them). Use of the towers serves to mitigate any potential adverse thermal impacts that station operations could have on either a near-or far-field basis. The towers are designed to operate on an intermittent basis only, and do not receive any type of treatment for biofouling control, other than drying. Operation of the towers results in an effective discharge temperature considerably less than the end-of-pipe value. Based on design criteria, the use of the towers is projected to result in a temperature decrease of at least 14 ^{o}F in the volume of discharge passed through them (approx. 33% of the total design flow of the station, or over 50% of the typical condenser flow rate). Based on actual temperature monitoring data, a comparison of the pre-cooling tower effluent and the post-cooling tower effluent shows a more typical temperature decrease is approximately 20 ^{o}F, and can be higher under elevated tower influent temperature conditions. This results in an overall effective discharge temperature at least 5 ^{o}F cooler, and more typically 10 ^{o}F cooler, than the corresponding condenser discharge temperature.

Station management remains committed to using the cooling towers on an as-needed basis, to ensure that all applicable thermal limitations continue to be met. In 2001, the towers were used for approximately 40 days during the year to maintain thermal compliance. In 2002, the towers were used for approximately 55 days. In 2003 (to-date), the towers were used for a total of approximately 37 days, primarily to control near-field compliance with the Secondary Contact thermal limits. While increased use of the cooling towers could possibly reduce the magnitude of potential temperature limit exceedances that occur within the allowable excursion hours provided in the Secondary Contact thermal standard, the cooling towers are not capable of providing the cooling needed to prevent the frequency of such elevated temperatures and hence, the requirement for significant unit deratings remains the same, raising the possibility of complete unit shutdowns, to meet more stringent thermal limits under General Use water quality standards.

C. CURRENT PLANT DERATINGS

Use of the existing Joliet Station cooling towers alone is often not sufficient to control the thermal discharge from the plant to meet the current Secondary Contact thermal limits under adverse weather/river flow conditions. Under these situations, units have been and will continue to be derated (i.e. megawatt load restricted) when compliance conditions warrant. Unfortunately, this forced loss of power occurs when it is most needed by the citizens and businesses of Northern Illinois. The cost of unplanned, emergency unit deratings to Midwest Generation is extremely high, in terms of lost revenue, and can adversely impact system reliability.

Derating is also not necessarily confined to the summer period. There have been several occasions in the recent past when the Joliet units have needed to reduce load to meet the applicable thermal limits during December and March/April, when upstream river temperatures were elevated and/or when abnormally warm weather conditions persisted over several days.

D. FUTURE COMPLIANCE ALTERNATIVES

Compliance costs are one of the factors to be considered under the UAA to evaluate the economic impact of any proposed use upgrade. Among the potential economic impacts caused by upgrading the UAA Reach to General Use are the costs for additional controls/deratings that would be required to meet these more stringent General Use thermal standards on a near-field basis for the Joliet and Will County Stations.

In the AS96-10 adjusted standard proceeding, ComEd presented evidence showing that the cost estimate to derate generating units to comply with the General Use thermal limits at I-55 (seven miles downstream of the Joliet Station discharge) was in the range of $3.5M to $16M annually (in 1995 dollars). As further shown below, complying with General Use thermal limits near-field, even with an allowed mixing zone, would be significantly more costly, and likely is not possible given the physical and technological constraints to doing so.

Based on a review of historical river temperature and station operating schedules, and confirmed by thermal modeling results, neither Will County nor Joliet Station can consistently meet the General Use thermal water quality standards under their current operational mode. This would be true for Joliet Station #29 even with all available supplemental cooling towers in operation.

Further, significant unit deratings would be required during non-summer periods should warmer weather conditions prevail during the period from December through March, when the General Use limit is 60/63 ^{o}F. Ambient, upstream temperatures of this magnitude have been observed during a number of years at both our Will County and Joliet Stations.

Installation of additional cooling towers would appear to be the solution of first choice. However, there are several, serious obstacles that surface upon further analysis.

The installation of additional supplemental cooling towers for either Joliet or Will County presents significant technological obstacles. Aside from the significant costs associated with the equipment, installation and operation/maintenance of additional cooling towers, there is not enough physical space at either station to accommodate the number of towers that would be needed to ensure uninterrupted unit operations during critical demand periods. It simply is not feasible to do. The number of towers that were installed at Joliet #29 in 1999 was chosen based not simply on historical derating information, but on the physical space available to accommodate them on-site. The 24 towers installed filled all of the available physical space along the Joliet Station discharge canal. These towers enable the Joliet Station to maintain compliance with the applicable thermal limits. They are not sufficient to achieve compliance with General Use thermal standards without drastically limiting the operating capability of the Joliet generating units.

To achieve compliance with more stringent thermal standards, significant unit deratings, and most probably total unit shut-downs, would be required under the critical load demand conditions typically encountered during hot, dry summers. The potential loss of electrical power totals approximately 2500 megawatts of normally available generation to the citizens of Northern Illinois, or the amount required to service approximately 2.5 million homes. These users would need to find an alternate source of power. Since Midwest Generation's sole business is to generate power for sale to the open market, the loss of this capability, due to a station's inability to consistently meet tighter thermal limits at normal operating loads, would likely result in the decision to shut down units unable to supply required power during peak demand times. While there are other sources of power in the area, these may not be available during critical demand conditions, due to prior sale commitments or operational problems. The potential result of the loss of this amount of power from the grid could, under extreme circumstances, lead to instability and ultimately rolling brown or black-outs under adverse weather conditions.

XIV. TEMPERATURE LIMIT PROPOSAL FOR THE BRANDON POOL

Based on the biological information and supporting data presented and/or referenced in this report, as well as the determination of the UAA Biological Subcommittee (See meeting notes dated April 3, 2002), the Brandon Pool cannot support a General Use designation. Dissolved oxygen, bacteria, copper and temperature limits are not currently meeting General Use standards in this segment of the waterway, largely due to unregulated and/or non-point source contributions. Moreover, the physical characteristics of the Brandon Pool will continue to limit its future potential to support a higher quality aquatic community, as well as any form of full body contact recreation. **For the above reasons, Midwest Generation submits that the existing Secondary Contact thermal water quality standards upstream of the Brandon Road Lock and Dam should be retained.** These standards remain adequately protective of the current and expected assemblage of aquatic organisms that inhabit the Brandon Pool, given the existing physical and chemical constraints of the system and the existing navigational uses.

XV. TEMPERATURE LIMIT PROPOSAL FOR THE UPPER DRESDEN POOL (From Brandon Road Lock and Dam to the I-55 Bridge)

Midwest Generation's operations are governed by the variable weather conditions and the artificially controlled UIW river flow, neither of which is reliably predictable in either the short or long-term. Midwest Generation has taken actions to ensure that its stations can continue to operate during high electrical demand periods, while still meeting all currently applicable thermal limitations. This compliance strategy involves using actual monitoring data to track actual UIW flow and thermal conditions and also employs thermal modeling to try to anticipate when river conditions will change and require more stringent control of thermal discharges. Midwest Generation remains on diligent and constant watch of the UIW in-stream conditions to adjust as necessary its unit loads so that compliance with existing thermal standards is maintained.

The biological and physical monitoring data from the ongoing collection efforts of Midwest Generation persuasively demonstrate that generally, existing thermal conditions in the UAA Reach have no significant adverse effects to the types of indigenous aquatic organisms existing in or expected to inhabit this waterway, given the existence of other permanent limitations and human-induced disturbances. In fact, under the prevailing ambient temperatures, there have been gradual improvements in the fish community over time, as predicted by this same type of evidence that was presented to support the IPCB's decision to grant the alternate thermal standards in the AS96-10 proceeding. All of this has been achieved because the continual input of heat to the system at Secondary Contact and AS96-10 levels does not cause significant adverse effects to the UAA Reach.

As such, **Midwest Generation submits that continuing compliance with the existing Secondary Contact limits near-field, and the alternate I-55 thermal limits far-field, as set forth in the AS 96-10 Board Opinion and Order, has and will continue to adequately protect the indigenous aquatic community in the entire UAA Reach. Actual river monitoring data for a period of over twenty years and reliable scientific evaluations of that**

data, supports the conclusion that additional or more stringent thermal restrictions are not likely to result in any substantial improvement in the biological community of the system.

Modified Thermal Limits for Upper Dresden Pool:

Under either the existing Secondary Contact or a new use designation, thermal water quality standards may be modified in order to provide further protection the current and expected assemblage of aquatic life that would reside in the Upper Dresden Pool, given appropriate consideration of the permanent constraints on the system under the UAA Factors 3, 4 and/or 5.

In an effort to make the thermal water quality standards more reflective of the existing seasonal variability in the Upper Dresden Pool, Midwest Generation proposes that a maximum thermal standard of 93 ^{o}F should apply during the summer months of June through September, with step-wise monthly or semi-monthly limits applied during the remainder of the year. Temperature in the main body of the river, as determined by the Midwest Generation's Near-Field Thermal Compliance Model, shall not exceed the maximum limits by more than 5 ^{o}F for more than 5% of the hours in the 12-month period ending December 31st. This proposal is also conditioned upon the allowance of a mixing zone consistent with Illinois regulations. This seasonal approach is consistent with the standards set in several other Region 5 states, including Ohio, and is also reflective of how the adjusted I-55 thermal standards were developed.

Table 5 shows the proposed maximum thermal limits for the Upper Dresden Pool. The numeric limits are based on the general seasonal temperature cycle of the waterway and incorporate an increased margin of safety, beyond that already currently afforded by the Secondary Contact thermal limits. Compliance with these proposed main river temperature standards can be documented through the use of the proposed Midwest Generation Near-Field Compliance Model, previously submitted to Illinois EPA and U.S. EPA Region 5 for review in 2001. (A copy this submittal is attached as Appendix 4.)

Midwest Generation has proposed this alternate temperature limitation for the Upper Dresden Pool in an effort to assist the Agency in the development of appropriate water quality limitations for this transitional waterway that are reflective of both the improvements and limitations inherent to the Lower Des Plaines River.

Under this proposal, water temperature limits would be gradually lowered over the Fall and Winter periods, and increased in the Spring period, in correspondence with the current modified thermal regime of the waterway. The seasonal cycle to be approximated by the step-wise progression of monthly or semi-monthly temperature limitations would be more reflective of the ambient conditions encountered and would also be complementary to the existing adjusted thermal standards at the I-55 Bridge. This approach is appropriate because the Upper Dresden Pool is basically a "transition zone" from Secondary Contact to General Use designated waters.

These proposed modifications to the Upper Dresden Pool thermal limits could be implemented as part of an overall sub-classification of the use designation for the Upper Dresden Pool. Alternatively, it may be accomplished by a site-specific classification for the Upper Dresden Pool with water quality standards that reflect the existing conditions in that segment of the UAA

Reach. More stringent thermal water quality limitations than those proposed above will only create significantly more burdensome and costly compliance requirements for Midwest Generation stations that are not economically sound or environmentally beneficial for this particular waterway. Such unnecessary restrictions also threaten to impose additional hardships on the general public due to the potential loss of existing levels of electrical power at competitive prices when it is most needed.

Table 5: Proposed Modified Thermal Limits for the Upper Dresden Pool
(Brandon Road Lock and Dam down to the I-55 Bridge):

Jan 1-31	Feb 1-29	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30	May 1-15	May 16-31	Jun 1-30	Jul 1-31	Aug 1-31	Sept 1-30	Oct 1-31	Nov 1-30	Dec 1-31
72	77	82	82	90	90	92	93	93	93	93	93	92	90	82

Maximum temperature in the main body of the river, as determined by the Midwest Generation's Near-Field Thermal Compliance Model, shall not exceed the maximum limits listed above by more than 5 ^{o}F for more than 5% of the hours in the 12 month period ending December 31st. This temperature limits proposal is also conditioned upon the allowance of a mixing zone consistent with Illinois regulations.

XVI. SUMMARY AND CONCLUSIONS

There is an abundance of data demonstrating that conditions in the UAA Reach are, and will remain, strongly limiting for aquatic life. The UIW Study results show that the lack of diversity and quality of physical habitats in the UAA Reach are the primary reasons why a full aquatic life use is not attainable. The existence of fine, silty sediments in the limited habitat areas that do exist in the UAA Reach, along with chemical contamination present in certain sediments, are also important, contributing factors that prevent the attainment of the “fishable/swimmable” uses represented by the General Use classification. Even if the physical habitat conditions could be improved significantly, the predominant uses of the waterway, namely barge transport and conveyance of treated effluents and storm water away from the Metropolitan Chicago area, would still have significant adverse effects on the biological community. Artificially controlled, variable flows and pool levels to accommodate navigational needs present a condition which is considerably altered from what would be found in a natural waterway. As such, these constraints are irreversible and cannot practically be mitigated. Similarly, there is no cost-effective or practical solution to the residual chemical sediment contamination that exists throughout the system, or the fact that the system will continue to be dominated by fine-grained sediment in the future, limiting its ability to support a more diverse biological community. In addition to continuing siltation, the impounding effect caused by the Brandon and Dresden Lock and Dams has permanently degraded the riverine habitat by the elimination of riffles and fast water areas. And finally, there is no legal authority to require the reduction of the non-point source run-off that enters the UAA Reach in significant amounts and aggravates further the chemical sediment contamination.

Ambient water temperatures (main channel temperatures without power plant contributions) approximate the regional norm for warm-water streams in spring, summer, and fall. Winter ambient water temperatures tend to be elevated slightly above regional expectations due to the large inputs of water from POTWs. The maximum summer temperature rise above background when the five Midwest Generation stations (Fisk, Crawford, Will County, Joliet #9, and Joliet #29) are operating at normal load schedules (all sources considered) is about 8 ^{o}F at I-55, while compared to the General Use standard’s prohibition of no more than a 5 ^{o}F rise above “natural” conditions. However, under winter conditions, the maximum temperature rise through the system is about 12 ^{o}F above background (assuming all plants are operating at normal load schedules, which is often not the case during the winter period when unit maintenance outages occur). Small areas around the discharges from the individual power stations may be warmer.

There is substantial temperature variability outside the main channel in the UAA Reach that is unrelated to power plant operations. Side channel, slough, and backwater habitats are often warmer than mid-channel areas in mid-summer (due to solar heating) and colder in winter. Complex physical and chemical interactions occur between the elevated temperatures and the dissolved oxygen cycle and the system dynamics of organic and inorganic toxicants. However, in no case is temperature the primary factory that constrains the establishment of more favorable physical and/or chemical conditions for aquatic life. In other words, even if the thermal standards were upgraded to General Use, the “fishable, swimmable” standards of the Clean Water Act would not be attained.

The extensive biological studies done to date continue to support the conclusion that, due to both physical and chemical limitations, the UIW as a whole, and the UAA Reach specifically, remains incapable of sustaining a high quality aquatic biota representative of the region and of true General Use waterbodies. At the same time, the studies provide no indication that water temperature is, in any way, significantly constraining the establishment of a unique biota suited to the physical and chemical limitations of the system. Species that find physical circumstances that suit their natural history appear to flourish within the limits set by sediment chemical contamination and physical constraints and navigational use of the UAA Reach. Species tolerant of the physical and chemical limitations that define the system are typically tolerant of the elevated temperature regime as well. The discharge temperatures allowed by the applicable Secondary Contact standards, including the AS96-10 limits, clearly do not further limit the representative fish species and other aquatic life present in the UAA Reach.

Moreover, conditions for aquatic life in the UAA reach are not expected to substantially improve in the foreseeable future, even if point source dischargers are required to reduce current loadings to the water body. The "recovery" of a degraded system generally depends on a sequence of improvements. Of primary importance is a substantive improvement in the physical, as well as the chemical condition of the waters. Suitable water clarity, dissolved oxygen content, and nutrient loadings associated with an absence or low levels of chemical contaminants such as trace metals, ammonia, herbicides, pesticides, petroleum products and other materials associated with agriculture, industrial processes, or urbanization are paramount. A diversity of uncontaminated physical habitats suitable to the native regional assemblage of aquatic life is also a necessary component of overall ecological integrity. Given a physical and chemical environment that meets minimal requirements for life, there must be a diversity of seed organisms available to recolonize a formerly degraded area. Finally, the physical/chemical environment must be sufficiently favorable to permit the recolonization process to proceed.

In the UAA Reach, the water quality has greatly improved since the adoption and application of the Secondary Contact water quality standards. These improvements stem from additional treatment and control implemented by public and private waste treatment facilities that discharge to the UAA Reach. Moreover, similar improvements have realized in the tributary drainages. There also is a suitably diverse assemblage of seed organisms available to colonize the UAA Reach. Nonetheless, irreversible obstacles still remain to the establishment of a higher quality biota. These obstacles include: (i) the general lack of habitat diversity and lack of balance among habitat types in the UAA Reach (*e.g.* except for the Brandon tailwaters, riffles are absent in the UAA study area); (ii), physical characteristics of the sediments; and (iii) contaminated sediments and physical habitat disturbances associated with barge traffic and water level fluctuations.

The resurgence of macrophyte beds, proliferation of more tolerant forms and continuous input of immigrants of more sensitive species from the tributaries to the UAA Reach serve to mask the prevailing level of physical and sediment-based chemical degradation that still exits. Colonization by more highly tolerant species and the ability of more sensitive immigrant organisms to survive in the system may provide some optimism which would lead to the misassumption that these species would be capable of carrying out their full life histories in the

UAA reach. However, there is little prospect of establishing a true resident biota of more sensitive native species similar to those inhabiting the higher quality tributaries that feed the system, such as the Kankakee River. Sufficient physical habitat to make this possible is simply not present in the UAA Reach. Moreover, the limited habitat that does exist is further constrained by the navigational traffic and the constant flow manipulations and alterations required to maintain this protected use in the UAA Reach.

The limiting factors in the UAA Reach are clearly and consistently the physical habitat and sediment quality limitations that characterize this system. These factors will remain unchanged for the foreseeable future. Each of these factors alone satisfy the requirements of the UAA analysis under the Clean Water Act regulations for maintaining the current use designation of the UAA Reach, or developing an alternate use designation that reflects the constraints present in the waterway. Clearly, the weight of the biological and physical evidence here supports the conclusion that General Use is not attainable for the UAA Reach, within the meaning of 40 CFR 131.10(g).

This report also has provided actual monitoring data and pertinent reference information to demonstrate that the thermal levels in the UAA Reach have not and cannot improve to those required under the General Use standards without a significant technical and financial burden to MWGen. To propose such a use upgrade, and the corresponding thermal water quality standards required by General Use, would likely result in a serious loss of electrical capacity to service the needs of Illinois industrial and residential users while not reaping any significant environmental benefits to the UAA Reach. Twenty-plus years of actual river monitoring data show that the present thermal regime of the Lower Des Plaines River has not negatively impacted the biological community that resides in the system. Other more important factors, such as habitat limitations, sediment quality and flow alterations/commercial navigation have far more influence on the overall assemblage of species capable of residing in the waterway both now and in the future. In addition, there is still a consumption advisory in effect for certain species of fish present in the UAA Reach--this alone should preclude the area from being designated as full General Use.

All of the above unalterable conditions and conditions that cannot be modified sufficiently satisfy one or more of the UAA six regulatory factors to allow for an alternate use designation for this industrialized urban waterway which would be commensurate with its permanently altered character. Accordingly, the Illinois EPA may elect to preserve the improvements in chemical water quality that have been realized in the UAA Reach by creating a new use classification or sub-classification that incorporates the chemical levels that are being attained by the UAA Reach. Ohio's more specific and refined use classification system is one approach that can serve as guidance to the Illinois EPA in crafting an alternative use designation. Better and more refined use designations, with correspondingly differentiated water quality standards, may help recognize the water quality improvements in the UAA Reach. As it currently stands, the Illinois use classification system is not differentiated sufficiently to acknowledge any use levels that fall between Secondary Contact and General Use. . The UAA study reach, as a whole, will not meet the criteria for a full General Use waterway. Further, as U.S. EPA's UAA guidance states, primary contact recreation, one of the requirements of a General Use classification, is also a significant concern for the UAA Reach. Navigational traffic, as well as widespread bacteriological concerns, threaten the safety of public recreation in the waters of the Lower Des Plaines River. Several deaths and near-misses have occurred in recent years, even with the current Secondary Contact designation in place. Further mishaps and/or potential tragedies are more likely to occur if the State deems the UAA Reach suitable for full body contact recreation. Absent some further refinement of the Illinois use classification system, the current Secondary Contact designated use is the only use designation attainable, as shown by the physical, sediment chemistry/character and biological data relating to the UAA Reach.

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APPENDIX 1

Use Attainability Analysis (UAA) Factors

A Use Attainability Analysis (UAA) consists of six factors that are to be considered in determining whether the fishable/swimmable goals of the Clean Water Act (CWA) may be attainable for a particular water body. (Ref: 40 CFR Section 131.10(g). These factors must be looked at holistically for the waterway, and not segmented for each particular aspect of the system, as the draft UAA report has done. Ecological integrity is the summation of all factors which influence the ability of organisms to carry out their full life cycles in a given waterway.

Based on the chemical, physical and biological data available for the waterway, the six factors are outlined below, along with a determination of their applicability to the Lower Des Plaines River UAA:

1. Naturally occurring pollutant concentration prevent the attainment of the use;

>>>Potentially applicable if ammonia is considered a naturally occurring pollutant.

2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met;

>>>Applicable to UAA Reach. See discussion in Paragraph 4 below regarding effect of low flow conditions and water levels.

3. Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place;

>>>Applicable to UAA Reach.

Widespread, historic sediment contamination (the result of human activities), as well as artificially-controlled flow manipulations and barge traffic disturbances affect the entire length of the UAA reach, and beyond. Barge traffic has been shown to be lethal to fish. Also, there has been no proposal made to remediate the existing sediment contamination problem and a means to prevent future sediment contamination from non-point sources is unknown. The impounded nature of the waterway will continue to result in the deposition of fine-grained, silty sediments (contaminated or not), which are not conducive to the development of higher quality fish and macroinvertebrate habitat. As water-borne commerce, transportation and industrial uses are protected uses under the CWA, it is unlikely that these activities will cease in the foreseeable future. As such, the waterway will continue to be dominated by upstream POTW and industrial effluents, artificial flow control, channelization and barge traffic effects.

APPENDIX 1

Use Attainability Analysis (UAA) Factors

4. Dams, diversions, or other types of hydrologic modifications preclude the attainment of use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in attainment of the use;

>>>Applicable to the UAA Reach.

The entire Upper Illinois Waterway (UIW), including the UAA reach, is basically a series of pools separated by locks and dams. Flow in the system is controlled entirely by diversions from Lake Michigan, effluents from large POTWs, and level manipulation to accommodate barge traffic. Besides their hydraulic influence, these dams greatly affect habitat quality by eliminating riffles, causing silty sediment deposition and reducing current speed, etc.

Flow rates are sporadic in nature and vary widely in magnitude on any given day. Flow patterns do not follow any natural, seasonal cycle and cannot be forecast with any measure of accuracy due to their completely artificial nature.

5. Physical conditions related to the natural features of the water body, such as the lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

>>>Applicable to the UAA Reach.

Limitations on available, suitable habitat in the system is the primary constraint which prevents further substantive improvements in the indigenous aquatic community. What habitats do exist are also continually disturbed by barge traffic and artificially controlled river flows and levels. There is little or no shoreline cover, fast water areas, riffles or other physical features needed for more desirable fish species to establish viable populations in this portion of the Lower Des Plaines River. The species that do exist and actually thrive in this system are those whose life history characteristics are better suited to the physical characteristics and conditions of the waterway.

6. Controls more stringent than those required by Section 301(b)(1)(A) and (B) and 306 of the CWA would result in substantial and widespread economic and social impact.

>>Applicable to the UAA Reach.

The cost to install and operate supplemental cooling for the three Midwest Generation Stations situated along this waterway to meet General Use thermal limitations would constitute a significant economic hardship on the company (assuming that installation is even feasible, due to physical space constraints at the sites). These costs would not be offset by any comparable significant environmental benefit, and would, conversely, create a serious and potentially dangerous situation in which the power supply of northern Illinois citizens could be severely jeopardized in times of greatest demand, because the Joliet #9, Joliet #29 and Will County Stations would be forced to shut down to meet the tighter General Use thermal water quality limits. The citizens of Illinois would suffer, and the aquatic community of the Lower Des Plaines would likely see no measurable or meaningful improvement.

APPENDIX 2

Executive Summary of UIW Study, Results and Conclusions

The UIW Investigation was initiated in late 1991 with an invitation to Illinois and Federal regulatory and water management agencies, certain public interest groups, and other water-users to participate. In response to this solicitation, a multi-institutional group - the Upper Illinois Waterway Task Force - was formed and charged with the design and oversight of studies that would clarify the current status of the waterway and aid in predicting future conditions. ComEd, in turn, committed to conduct the requisite studies deemed necessary by the Task Force and utilize this technical information base to develop recommendations for alternative thermal standards applicable to its power plants.

The investigation included a broad base of ecological studies of the waterway relevant to evaluating the aquatic ecosystem. It included studies of available habitats, biota that would be expected to be present in these habitats, levels of water and sediment contamination, chemical risk screening, surface thermal imagery of the entire waterway as well as in the immediate vicinities of the power stations, 3-dimensional reconstructions of the thermal plumes for each power station to evaluate zones of passage around the warmest parts, mathematical thermal modeling of the entire geographic reach considering all other relevant features affecting water temperature (including calibration using actual field measurements), and a 40+ year climatological reconstruction to estimate water temperatures under all historically known combinations of ambient weather and plant operating conditions. It included a thorough literature review of previous UIW studies, including contaminants in fish tissues. It also included literature reviews on effects of temperature on fish, interactions of temperature and chemicals of freshwater biota, and effects of turbidity and barge traffic on aquatic ecosystems. **These studies, in combination with the biological monitoring of phytoplankton/periphyton, macrophytes, benthic invertebrates, ichthyoplankton, fish, and fish diseases comprise the most thorough study of this portion of the UIW ever conducted.**

The studies and surveys performed clearly demonstrate that conditions in the waterway remain limiting for aquatic life. Lack of diversity and stability of physical habitats clearly are limiting factors, as are the pervasive chemical contamination in sediments and occasional depressed dissolved oxygen levels. The limitations are mostly severe in the upper pools. Prospects for improving physical habitat conditions are limited and tend to conflict with the predominant uses of the waterway, namely barge transport and conveyance of treated point and non-point source discharges. Similarly, there are no obvious practical and economical short-term solutions to the residual chemical contamination in sediments that persist throughout the system.

The biological studies conducted under the UIW Task Force's direction support the conclusion that, due to physical and chemical limitations, the UIW remains incapable of sustaining a high quality aquatic biota representative of the region. At the same time, **the studies provide no indication that the contribution to higher water temperature caused by power plant operation is constraining the establishment of aquatic biota suited to the physical and chemical limitations of the system**. Species that find physical circumstances that suit their natural history appear to flourish within the limits set by both chemical contamination and limited habitat. Species tolerant of the physical and chemical limitations that define the system are typically tolerant of the elevated temperature regime as well.

In short, operation of ComEd's (now Midwest Generation's) power plants does not interfere with maintaining a reasonably balanced indigenous community of aquatic organisms in the UIW consistent with its limited physical habitat, abnormal thermal pattern even in the absence of power stations, and history of chemical contamination that remains in sediments.

Based on the results of these studies, alternative thermal limitations for the I-55 Bridge were developed and submitted to the Illinois Pollution Control Board in the spring of 1996. The Board approved the proposed standards on October 3, 1996. The NPDES permits were modified to include the standards by February, 1997. **It is important to note that while alternate thermal limitations were approved for I-55 based on the study results, the supporting information contained in the UIW study reports also confirms that the Secondary Contact thermal limits remain generally supportive of the existing indigenous aquatic community in the upstream reaches, especially given the other permanent limitations in the system.** Midwest Generation continues to obtain information about the waterway by conducting focused studies on particular areas of concern, including potential effects on the fisheries community and temperature/dissolved oxygen interactions. All recent data suggest that temperature is not a significant contributor to the current biological integrity of the system. A reassessment of the conditions in the waterway will be made as conditions warrant.

APPENDIX 2

Executive Summaries from All Individual
Upper Illinois Waterway Studies

(included with original January 24, 2003 report--electronic copies not available)

APPENDIX 3

List of Individual Biological, Chemical and Physical Study Reports Associated with the Upper Illinois Waterway, 1990 to present

LITERATURE REVIEW

- EA Compilation/Annotation of Physical, Chemical & Biological Data Pertaining to CSSC, Lower Des Plaines & UIW 1980 - 1991
  - Main Report & Appendices - (July 1992)
- Reviews of Literature Concerning:
  - Effects of Temp. on fish
  - Effects of Freshwater Biota from Interactions of Temperature and Chemicals
  - Effects of Turbidity and Barge Traffic on Aquatic Ecosystems (Dec. 18, 1995)

PHYSICAL/CHEMICAL

- ENSR Physical-Chemical Study of UIW - Summer '93 - Spring '94
- ENSR D.O./Temp. Monitoring @ I-55 (1995)
- EA D.O./Temp. Monitoring @ I-55 (1997)
- EA D.O./Temp. Monitoring @ I-55 (1998)
- EA D.O./Temp. Monitoring @ I-55 (1999)
- EA D.O./Temp. Monitoring @ I-55 (2000)
- EA D.O./Temp. Monitoring @ I-55 (2001)
- EA D.O./Temp. Monitoring @ I-55 (2002)
- EA D.O./Temp. Monitoring @ I-55 (2003)--In progress

- Appendix A - Summary of Physico-chemical Measurements Collected by Municipal & Industrial Dischargers within ComEd's Area of Concern (1993)
  (reference copy only)
- Aerial Imagery of Surface Temps using Infrared (IR) Imagery
  - Summer 1993
  - Winter 1994
- Thermo-Hydrodynamic Model of the Chicago Sanitary & Ship Canal and the Lower Des Plaines River (Dec. 1994)
  (volumes 1 & 2)
- Fly-Over Photos (Natural & IR) (multiple years throughout study period)
- UIW Report on Estimation of Water Temperature Exceedance Probabilities in the UIW using Thermo-Hydrodynamic Modeling (Jan. 1996)
- LMS UIW Chemical Risk Screening (Jan. 1996)
  (Main Report & Appendices A - P)
- UIW 1994 - 1995 Sediment Contamination Assessment, G. Allen Burton Dec. 18, 1995

APPENDIX 3

List of Individual Biological, Chemical and Physical Study Reports Associated with the Upper Illinois Waterway, 1990 to present

PHYSICAL/CHEMICAL (cont).

- Continuous In-Situ Monitoring and Thermal Effect Characterization Tasks - Final Report June 18, 1998 (July 1997 - March 1998)
- Continuous In-Situ Monitoring and Thermal Effect Characterization Tasks - Final Report March 11, 1999 (July 1998 - October 1998)
- Habitat Evaluation of the Dresden Pool (May, 2003--unpublished), performed by EA Engineering, Science and Technology for Midwest Generation.

BIOLOGICAL

- Des Plaines River Long-Term Monitoring Program: Aquatic Biology Section Technical Report Phase I 1986 (6)
- Des Plaines River Long-Term Monitoring Program: Aquatic Biology Section Technical Report Phase II (87/04)

- Des Plaines River Long-Term Monitoring Program: Vegetation Analyses and Habitat Characterization (88/5)
- Des Plaines River Long-Term Monitoring Program -- Vegetation Analyses and Habitat Characterization (July 1992)

- 1993 Phytoplankton Survey (March 1994)

- Aquatic Macroinvertebrates within the Upper Illinois Waterway 1992-1993 Report (Feb. 2, 1994)

- 1993 Benthic Macroinvertebrate Investigation and Habitat Assessment (RM. 272-323) (Feb. 2, 1994)
- UIW 1994 Benthic Macroinvertebrate Investigation and Habitat Assessment (March 2, 1995)

- 1994 Aquatic Macrophyte Investigation and Habitat Assessment (Feb. 21, 1995)
- 1995 Aquatic Macrophyte Investigation and Habitat Assessment (Jan. 5, 1996)

- Winter Fisheries Survey on the Des Plaines River 1992 (May 1992)
- Lower Des Plaines River Aquatic Monitoring - Final Report 1992 (Jun 1993)
- Winter Fisheries Studies in the UIW 1993 (Oct. 1993)
- Spring Spawning Survey in the UIW 1993 (Oct. 1993)

APPENDIX 3

List of Individual Biological, Chemical and Physical Study Reports Associated with the Upper Illinois Waterway, 1990 to present

BIOLOGICAL (cont).

- 1994 Winter Fisheries Survey (July 1994)
- 1994 Ichthyoplankton Investigation (UIW) (April 1995)

- UIW 1993 Fisheries Investigation (March, 1994) (Report & Appendix)
- UIW 1994 Fisheries Investigation (March, 1995) (Report & Appendix)
- UIW 1995 Fisheries Investigation (Dec., 1996) (Report & Appendix)
- UIW 1997 Fisheries Investigation (Feb. 1998)
- UIW 1998 Fisheries Investigation (April 1999)
- UIW 1999 Fisheries Investigation (May, 2000)
- UIW 2000 Fisheries Investigation (March, 2001)
- UIW 2001 Fisheries Investigation (April, 2002)
- UIW 2002 Fisheries Investigation (May, 2003)
- UIW 2003 Fisheries Investigation (In Progress)

uiwstudies.doc

APPENDIX 4

Joliet 29 Near-Field Thermal Compliance Model

1.0 Introduction

This model calculates a "fully-mixed" receiving water temperature immediately downstream of the Joliet 29 condenser cooling water discharge. Compliance with the Secondary Contact temperature standards specified in the Joliet Station 29 NPDES permit is determined based on the output of this model. (Note: A similar model has also been developed for Joliet 9, but does not include operation of the supplemental cooling towers in its calculations).

The model determines the fully-mixed receiving water temperature by calculating a weighted average temperature of the receiving stream, after mixing with the station's condenser cooling water discharge, based on the effective temperature and flow of the condenser cooling water discharge and the temperature and flow of the receiving stream. This approach is patterned after the general mass balance procedure for conservative substances outlined in IEPA's *Illinois Strategy for Point Source Wasteload Allocation*, January 17, 1991.

2.0 Thermal Balance Procedure for Determination of Effective Discharge Temperature

The effective discharge temperature input for the model is determined by consideration of condenser cooling water flow, condenser cooling water discharge temperature, cooling tower flow, and cooling tower discharge temperature. When the cooling towers are not in operation, the effective discharge temperature is equal to the condenser cooling water discharge temperature. The basic thermal balance equation for determination of the effective discharge temperature is:

$$T_{EF} = \frac{T_{CW}(Q_{CW} - Q_T) + T_T Q_T}{Q_{CW}}$$

Term	Description
T_{EF}	Calculated effective condenser cooling water discharge temperature after mixing with cooling tower discharge, in degrees F.
T_{CW}	Actual condenser cooling water discharge temperature in degrees F. Temperature is continuously monitored by Bailey and Endeco systems at head of discharge canal.
Q_{CW}	Condenser cooling water flow in cubic feet per second (cfs). Flow is based on the number of circulating water pumps on at the time in question. Each of the four circulating water pumps is rated at 230,000 gpm (512.5 cfs).
Q_T	Flow of condenser cooling water routed through the cooling towers in cfs. Flow is based on the number of cooling tower pumps on at the time in question. Each of the 48 cooling tower pumps is rated at 7500 gpm (16.7 cfs).

T_T	Cooling tower discharge temperature in degrees F. Temperature is continuously monitored by three thermocouples in the cooling tower discharge flume. Input for the model is the average of the three readings.

3.0 Thermal Balance Procedure for Determination of Fully-Mixed Receiving Water Temperature

Fully mixed receiving water temperatures are determined using a thermal balance model that considers condenser cooling water flow, effective condenser cooling water discharge temperature, upstream river flow, and upstream river temperature. The basic thermal balance equation for determination of the fully-mixed receiving water temperature is:

$$T_{FM} = \frac{T_{EF}Q_{CW} + T_{US}(0.5*Q_{AV})}{Q_{CW} + (0.5*Q_{AV})}$$

Term	Description
T_{FM}	Calculated fully-mixed receiving water temperature in degrees F.
T_{EF}	Calculated effective condenser cooling water discharge temperature after mixing with cooling tower discharge, in degrees F. Determined using thermal balance procedure outlined in step 2.0.
Q_{CW}	Condenser cooling water flow in cubic feet per second. Flow is based on the number of circulating water pumps on at the time in question. Each of the four circulating water pumps is rated at 230,000 gpm (512.5 cfs).
Q_{AV}	Available receiving stream dilution flow in cfs. Available dilution flow is determined by subtracting condenser cooling water flow from the upstream river flow. If the upstream river flow is equal to or less than the condenser cooling water flow, the available receiving stream dilution flow is zero. Upstream river flow is the average value of flow recorded during the 24-hour period preceding the time in question. The primary source of flow data is the gauging station operated by the Army Corps of Engineers at the Brandon Road Lock and Dam. Secondary sources for flow data are the gaging station on the Chicago Sanitary and Ship Canal at Romeoville operated by the United States Geological Survey, and the Des Plaines River gaging station at Riverside, operated by the Army Corps of Engineers.
T_{US}	Upstream river temperature in degrees F. Temperature is continuously monitored by Bailey and Endeco systems in the station intake canal.

4.0 Near-Field Thermal Compliance Matrix

The excel-based Near-Field Thermal Compliance Matrix can be used by station personnel on an as-needed basis to insure that compliance with the Secondary Contact thermal standards is maintained under current receiving stream conditions. Input the condenser cooling water discharge temperature and flow and the cooling tower discharge temperature and flow; the matrix displays fully-mixed receiving water temperatures at various upstream river flows and temperatures. A sample output of the matrix is attached.

Example of Joliet 29 Near-Field Compliance Matrix: APPENDIX 4

Enter Cooling Tower Pump Rating in gpm and number of pumps on:

Cooling Tower Pump Rate: 7,500 gpm **Number of Pumps On:** 36

Calculated Tower Flow: 602 cfs

Enter Cooling Tower Discharge Temp: 84 degrees F

Enter Circ Water Pump Rating in gpm and number of pumps on:

Circ Water Pump Rate: 230,000 gpm **Number of Pumps On:** 3

Calculated Circ Water flow: 1537 cfs

Enter Circ Water Temp: 100 degrees F

Calculated effective discharge temp: 93.74 degrees F

		River Temperature													
Upstream River Flow, cfs	**Available Dilution Flow*, cfs**	75	76	77	78	79	80	81	82	83	84	85	86	87	88
2050	513	92.30	92.37	92.45	92.53	92.60	92.68	92.76	92.84	92.91	92.99	93.07	93.14	93.22	93.30
2250	713	91.79	91.90	92.00	92.10	92.21	92.31	92.42	92.52	92.62	92.73	92.83	92.94	93.04	93.14
2450	913	91.32	91.45	91.58	91.71	91.83	91.96	92.09	92.22	92.35	92.48	92.61	92.74	92.87	93.00
2650	1113	90.87	91.02	91.17	91.33	91.48	91.63	91.79	91.94	92.09	92.25	92.40	92.55	92.71	92.86
2850	1313	90.44	90.62	90.79	90.97	91.15	91.32	91.50	91.67	91.85	92.03	92.20	92.38	92.55	92.73
3050	1513	90.04	90.24	90.43	90.63	90.83	91.03	91.22	91.42	91.62	91.82	92.01	92.21	92.41	92.61
3250	1713	89.66	89.87	90.09	90.31	90.53	90.75	90.96	91.18	91.40	91.62	91.84	92.05	92.27	92.49
3450	1913	89.29	89.53	89.77	90.01	90.24	90.48	90.72	90.95	91.19	91.43	91.67	91.90	92.14	92.38
3650	2113	88.95	89.20	89.46	89.71	89.97	90.23	90.48	90.74	90.99	91.25	91.50	91.76	92.02	92.27
3850	2313	88.62	88.89	89.16	89.44	89.71	89.98	90.26	90.53	90.80	91.08	91.35	91.62	91.90	92.17
4050	2513	88.30	88.59	88.88	89.17	89.46	89.75	90.04	90.33	90.62	90.91	91.20	91.49	91.78	92.07
4250	2713	88.00	88.31	88.62	88.92	89.23	89.53	89.84	90.15	90.45	90.76	91.06	91.37	91.68	91.98
4450	2913	87.72	88.04	88.36	88.68	89.00	89.32	89.64	89.97	90.29	90.61	90.93	91.25	91.57	91.89
4650	3113	87.44	87.78	88.11	88.45	88.79	89.12	89.46	89.79	90.13	90.47	90.80	91.14	91.47	91.81
4850	3313	87.18	87.53	87.88	88.23	88.58	88.93	89.28	89.63	89.98	90.33	90.68	91.03	91.38	91.73
5050	3513	86.93	87.29	87.65	88.02	88.38	88.74	89.11	89.47	89.83	90.20	90.56	90.93	91.29	91.65
5250	3713	86.68	87.06	87.44	87.81	88.19	88.57	88.94	89.32	89.70	90.07	90.45	90.83	91.20	91.58
5450	3913	86.45	86.84	87.23	87.62	88.01	88.40	88.79	89.17	89.56	89.95	90.34	90.73	91.12	91.51
5650	4113	86.23	86.63	87.03	87.43	87.83	88.23	88.63	89.03	89.44	89.84	90.24	90.64	91.04	91.44
5850	4313	86.01	86.43	86.84	87.25	87.66	88.08	88.49	88.90	89.31	89.72	90.14	90.55	90.96	91.37
6050	4513	85.81	86.23	86.65	87.08	87.50	87.92	88.35	88.77	89.19	89.62	90.04	90.46	90.89	91.31

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UAA SUBDOCKET D
PCB R08-09(D)

MIDWEST GENERATION'S POST–HEARING COMMENTS

ATTACHMENT E

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August 9, 2007

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Chicago, IL 60605

Dear Julia:

At your request, I have reviewed the August 2007 report, entitled "Development of Biologically Based Thermal Limits for the Lower Des Plaines River," prepared for Midwest Generation by EA Engineering, Science and Technology, Inc. (the "EA Report"). This letter provides my views and opinions concerning the methodology, findings and recommendations contained in the EA report.

I understand I was asked to review the EA report as an independent expert who was not involved with its preparation (other than providing editorial comments for clarity of earlier drafts). My expertise in the subject includes a long career that emphasized thermal effects on fish and other aquatic life. I retired in 2005 from the Oak Ridge National Laboratory. I was principal author of the Heat and Temperature chapter of the National Academy of Sciences/National Academy of Engineering report Water Quality Criteria-1972, and a co-author of the US EPA's 1977 interagency guidance for implementing Section 316(a) of the Clean Water Act. I am familiar with the Lower Des Plaines River from my work as co-chair of the Upper Illinois Waterway Ecological Study Task Force in the early 1990s, which involved stakeholder groups including US EPA, IEPA, IDNR, MWRDGC, USFWS, Sierra Club and Commonwealth Edison.

The EA report is, in my opinion, technically sound and directed appropriately at the issue of setting biologically based water temperature standards in the Lower Des Plaines River. I base this opinion on the following points:

• I agree that carefully developed and thoughtfully analyzed field data are scientifically superior to extrapolations from laboratory-derived temperature requirements for evaluating fish community responses to temperature. Having been involved with both the laboratory-based Academy report and the heavily field oriented 316(a) guidance, I can objectively view the relative merits of laboratory and field data for developing thermal criteria and standards. The report provides both scientific and administrative justification for emphasizing the field approach in this situation.

• The technical analyses are appropriate and well done. Species richness and the IWBmod are two widely accepted indices of fish community health. It is reasonable to compare each index with temperatures at time of fish collections. The author uses two analytical methods for these indices, pair-wise ANOVA and Loess regression, to provide useful weight of evidence, rather than relying on one technique alone. The Loess regression is a particularly innovative way to obtain an second, independent evaluation. The results are shown in tables and in well-prepared figures.

• The analysis of winter thermal limits is consistent with EPA guidance, my own development of cold kill guidance for power plants (reference below), and the wintertime conditions of the Lower Des Plaines River.

• I agree with the EA report's discussion of the need for verification of data (for validity and suitability) used for establishing water quality criteria and standards. The examples provided from the Midwest Biodiversity Institute (MBI) report are clearly unacceptable scientifically. To the degree that data evaluation and verification have not been done for the database used by MBI for their recommendations to US EPA Region V and Illinois EPA, I would put more credence on the field data and analyses given in the EA report.

• The EA report is consistent with my reading of US EPA's overall guidance for water quality criteria, whereby full protection of all species (including the most sensitive) is not required and field studies are preferred (US EPA 1985, cited in the EA report).

• The EA report's numerical conclusions are supported by the technical analyses.

In summary, I found the EA report to be sound, consistent with recognized scientific literature and administrative guidance, and with appropriate discussion justifying the approach. It is a valuable contribution toward development of rational thermal standards for the Lower Des Plaines River.

Sincerely,

Charles C. Coutant, Ph.D.

Coutant, C. C. 1977. Cold shock to aquatic organisms: guidance for power-plant siting, design, and operation. Nucleaar Safety 18(3):329-342.