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STATE OF ILLINOIS
Pollution Control Board

ORIGINAL

BEFORE THE POLLUTION CONTROL BOARD
OF THE STATE OF ILLINOIS

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

NOTICE

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(Via First Class Mail)

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board the Illinois EPA's Prefiled Testimony of Roy Smogor on behalf of the Illinois Environmental Protection Agency, a copy of which is herewith served upon you.

ENVIRONMENTAL PROTECTION AGENCY
OF THE STATE OF ILLINOIS

By: [signature]
Deborah Williams
Assistant Counsel
Division of Legal Counsel

DATE: 6/28/11

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THIS FILING IS SUBMITTED ON RECYCLED PAPER

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

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WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R08-09 Subdocket C
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	)	

PREFILED TESTIMONY OF ROY SMOGOR

My name is Roy Smogor. I have been employed with the Illinois Environmental Protection Agency for ten years. I previously testified in R08-09 on December 21, 2007. I have several years of experience, in the states of Virginia and Illinois, in developing ways to use information about fish and other aquatic life to determine the ecological health of streams. Currently, I am a Public Service Administrator in the Surface Water Section of the Bureau of Water. The Surface Water Section is responsible for monitoring the condition of Illinois streams and lakes. Specifically, we collect biological, chemical, and physical information from waters throughout the state and then interpret how this information represents the ecological health of Illinois surface waters. Our activities help guide the protection, management, and regulation of Illinois' aquatic natural resources.

Background

For various parts of the Chicago Area Waterway System (hereafter called "CAWS") addressed in this rulemaking, both the Illinois Environmental Protection Agency (hereafter, "Illinois EPA") and the Metropolitan Water Reclamation District of Greater Chicago (hereafter, "MWRD") propose aquatic-life uses that represent aquatic-life conditions that are less natural than the Clean Water Act goal of having balanced communities of aquatic life. Aside from this similarity, the proposals differ in important ways. For example, Illinois EPA proposes two different aquatic-life uses for the CAWS—each representing a different level of biological potential; whereas, MWRD proposes three aquatic-life uses. Also, the proposals differ regarding the parts of the CAWS in which each of the proposed uses applies. For example, the Illinois EPA proposes a more-natural aquatic-life use for Calumet-Sag Channel than does MWRD.

The aforementioned examples represent obvious ways in which the structure of the proposals differs. However, some less-obvious critical differences exist in the information and interpretations used to develop the proposals. By addressing these underlying critical differences, I try to show some of the fundamental reasons why the aquatic-life uses proposed by Illinois EPA are more justified than those proposed by MWRD. In this testimony, I present why the analyses and interpretations by or for MWRD do not clearly and sufficiently support their final proposed aquatic-life uses for various parts of the CAWS. I address fundamental shortcomings in how the physical, biological, and chemical information was used and interpreted by or for MWRD for proposing their aquatic-life uses for each part of the CAWS.

MWRD's use of physical, biological, and chemical data from the CAWS lacks a clear focus on answering this basic question:

For each part of the CAWS, assuming that balanced aquatic-life communities are attainable now or in the foreseeable future, how does the available information meet the burden for justifying a less-natural aquatic-life use to be designated?

The conclusions of the CAWS habitat-evaluation and habitat-improvement project performed for MWRD fail to directly address this primary question and thus fail to provide information that pertains directly to the primary needs of this rulemaking. MWRD's habitat-evaluation and habitat-improvement project fails in the ways addressed in the remainder of this testimony.

These include deficiencies in how MWRD used and interpreted physical-habitat data, fish data, and water-quality data.

Deficiencies in How MWRD Used Physical-Habitat Data

The CAWS habitat-evaluation report created for MWRD (Public Comment 284), did not clearly and directly address the concept of biological potential in the context of determining the most appropriate aquatic-life uses to designate for each part of the CAWS. The CAWS-specific habitat index and "*combined fish metric*" that were created do not clearly reflect biological potential because no analysis was performed to show how each of the variables that constitute each of these indexes is related to a gradient of human impact, i.e., relative degree of naturalness. Lacking such a connection, the habitat evaluation merely shows that some fish measures are related statistically to some physical-habitat measures in the CAWS; however, this finding itself does not pertain to setting biological goals in a Clean Water Act context.

Because the aquatic-life use designated for a waterbody represents the best-case future biological condition—more simply called biological potential—the habitat and biological indexes used to measure existing and potential biological condition must first be shown to be useful signals of human impacts across a range of biological conditions from imbalanced to balanced aquatic-life communities. Ability to measure across this range of biological condition establishes a frame of reference for determining if and why the Clean Water Act goal of balanced aquatic-life communities cannot be attained when assuming a best-case future for the waterbody. If the measures of existing or potential biological condition cannot or do not clearly reflect a large-enough range of biological condition, then they lack this essential frame of reference.

Neither the CAWS habitat-evaluation report (PC 284) nor the CAWS habitat-improvement report (PC 284) submitted by MWRD clearly explain what a combined-fish-metric score or a CAWS habitat-index score means in terms of the biological condition that represents the Clean Water Act goal of balanced aquatic-life communities. Without a frame of reference relative to the Clean Water Act benchmark aquatic-life condition, these CAWS-specific indexes lack usefulness in determining and justifying the most appropriate aquatic-life uses to designate in each part of the CAWS.

Additional to lacking a clear frame of reference relative to the Clean Water Act aquatic-life goal, the development and interpretation of the CAWS habitat index has the following shortcomings. The process used to develop the CAWS habitat index did not ensure that the final index reflects environmental variation throughout the CAWS that is exclusively attributable to differences in physical habitat and not to other factors such as the physicochemical condition of the water—which I will call "water quality" in this testimony. The habitat evaluation did not analyze relations between water quality and physical habitat throughout the CAWS; therefore, it is unclear whether or not differences in the habitat-index scores among various parts of the CAWS simply reflect differences in water quality that happens to co-vary with the habitat measures. For example, among sites throughout the CAWS, the combined-fish-metric score was found to decrease as the percent of rip-rap along the banks increased. If a potential pollutant in the water occurs in higher amounts in the parts of the CAWS that have more rip-rap, the apparent influence of rip-rap on fish could as validly be attributed to this water-quality effect. The CAWS habitat evaluation neither clearly nor thoroughly examined such possibilities. Although the CAWS habitat evaluation interpreted that the statistical correlation between the combined fish metric and the CAWS habitat index was attributable entirely to differences in physical habitat, the evaluation did not account for how correlation between water quality or other non-habitat factors and the selected physical-habitat measures could confound such an interpretation.

Two of the final six habitat variables identified as most statistically related to the combined fish metric and thus included in the CAWS habitat index provide direct examples of such confounded interpretation. For these two habitat variables, the CAWS habitat-improvement report (PC 284) raises serious uncertainties about how to interpret these variables. The habitat-improvement report points out that the negative relationship between the combined fish metric and the habitat variable called ,"*percent of rip-rap banks*," is difficult to interpret for the CAWS. Specifically, the habitat-improvement report states on page 14, "*This lack of clarity with respect to the impact of riprap makes assessment of the role of riprap in the CAWS more difficult. It is not clear what the negative impact of riprap is, or if the negative response of fish in reaches with riprap is due to some other factor associated with those reaches and not the riprap itself.*" Despite this high degree of uncertainty in what varying amounts of riprap truly represent in parts of the CAWS, this variable was included as one of the six key habitat variables in the final CAWS-specific habitat index. Despite the possibility that this habitat variable may actually have represented "*some other factor*," this variable was included in the CAWS habitat index and thus used and interpreted as if it were a direct indication of how the amount of rip-rap influences fish conditions in the CAWS.

Similar to the variable called "*percent of rip-rap banks*," the variable called "*manmade structures*" was picked as one of the six key habitat variables in the final CAWS habitat index, despite serious doubt about its relevance and interpretability. The habitat-improvement report states, "*As with riprap, it is not clear from the available data why these structures are negatively correlated with fish or whether it is the structures themselves or some other aspect of the* *waterways at these locations that is affecting the fish.*" For the aforementioned two physical-habitat variables that were part of the CAWS habitat index, it is not clear what the variables truly represent in terms of how physical habitat and other factors may influence fish in the CAWS. Given that the habitat-evaluation report did not present a clear analysis of how each of the physical-habitat measures that constitute the CAWS habitat index related with other factors such as water quality throughout the CAWS, it is possible that the habitat variables picked to create the CAWS habitat index actually represented aspects of water quality that mattered more to the fish than the physical-habitat differences that they superficially represented.

This same fundamental shortcoming applies to the single habitat variable found to be most related to the CAWS combined fish metric: "*maximum channel depth.*" The CAWS habitat evaluation found that the parts of CAWS that had greater maximum channel depth tended to have a lower combined fish metric. The CAWS habitat-improvement report on page 10 states this finding as , "*In other words, poorer fish communities were generally observed in deeper reaches.*" The report then states that , "*While water depth itself is not necessarily detrimental to fish, it is likely indicative of a range of other factors including the lack of littoral zone and the accompanying presence of macrophyte cover, disconnection from riparian areas, and the presence of commercial navigation to name a few.*" This interpretation, which focuses only on physical-habitat impairments, does not acknowledge that the "*range of other factors*" mentioned may also include water-quality conditions that vary with maximum channel depth throughout the CAWS and thus help explain the statistical correlation found between maximum channel depth and the CAWS combined fish metric. For example, deeper parts of the CAWS may also tend to have poorer water quality for fish. These "*other factors*" may also include lesser efficiency in collecting a fish sample in deeper parts of the CAWS than in shallower parts. Fish-community samples collected in deeper reaches of the CAWS may have lower scores for the CAWS combined fish metric simply because sampling in deeper water does not as accurately represent the condition of the fish community as does sampling in shallower water.

Similar to the difficulties in interpreting the aforementioned habitat variables, such as "*manmade structures*" and "*maximum channel depth*." that were included in the CAWS habitat index. another included habitat variable may reflect the influence of factors other than the physical-habitat impairment that it superficially represents. The CAWS habitat–improvement report states on page 17, "*Overhanging vegetative cover was found to be one of the habitat variables most strongly correlated with fish in the CAWS.*" However, neither the CAWS habitat-improvement report (PC 284) nor the CAWS habitat-evaluation report (PC 284) addresses the possibility that this variable may simply reflect that in wider parts of the CAWS, the combined fish metric has a lower score due to poorer water quality or lesser fish-sampling efficiency. Because the habitat variable called "*percent overhanging vegetation*" is based on the percentage of total water-surface area covered, interpretation of it is confounded by how stream width affects its value. Even if two stream reaches have an identical amount of overhanging vegetation along their banks, this variable will be a lower percentage in the wider of the two streams. This variable does not clearly represent how overhanging vegetation along stream banks influences fish in the stream. Consequently, it remains unclear how including "*percent overhanging vegetation*" in the CAWS habitat index represents a direct and valid physical-habitat influence that is distinct from the influence of other factors not directly indicative of physical-habitat impairment, such as water quality or limited fish-sampling efficiency. Neither the habitat-improvement report nor the habitat-evaluation report addresses the shortcoming of including these difficult-to-interpret variables as part of the CAWS habitat index.

Even if one were to assume the validity of the habitat variables that constitute the CAWS-specific habitat index and to assume that the index is a valid measure of biological potential with a clear frame of reference relative to the Clean Water Act aquatic-life goal, the aquatic-life uses proposed by MWRD for each part of the CAWS do not clearly reflect the results of the habitat-evaluation report (PC 284) and the habitat-improvement report (PC 284). The habitat-improvement report addresses potential ways in which physical habitat in the CAWS could be improved in the foreseeable future. The report presents measures of this future improvement in Table 4-1 on page 57 as a variable called, "*Potential Index Score After Habitat Improvement.*" Based on the logic and interpretations presented in the CAWS habitat evaluation, these measures of habitat potential represent possible future habitat conditions in the CAWS, which presumably provide the template for predicting biological potential for each part of the CAWS. However, the aquatic-life uses proposed by MWRD do not clearly reflect the relative differences in potential that these habitat scores represent among the parts of the CAWS.

Attachment A to this testimony (*CAWS Habitat Index: Potential Score After Habitat Improvement*) shows the scores of habitat potential for each part of the CAWS. These scores suggest three groupings of aquatic-life use for CAWS waters. Beginning with the two leftmost scores in Attachment A, both Upper and Lower North Shore Channel have relatively similar potential as indicated by scores of 80 and 71; these two waters form one possible aquatic-life-use group. Both Upper and Lower North Branch Chicago River plus Little Calumet River—the score farthest to the right in Attachment 1—have similar potential as indicated by a narrow range of scores from 56 to 58; these three waters form a second group. The remaining parts of CAWS have similar potential scores that range narrowly from 43 to 48. These waters form a third aquatic-life-use group that represents the least-natural potential of the three groups.

Counter to the pattern in Attachment A, MWRD proposes three aquatic-life uses that do not group waters consistent with their potential habitat scores. Despite South Fork South Branch Chicago River—called "Bubbly Creek" by MWRD—having a slightly higher score than four other parts of the CAWS, MWRD proposes a uniquely least-natural aquatic-life use for this waterbody. Information in the CAWS habitat-evaluation report or in the CAWS habitat-improvement report does not clearly support this designation for South Fork South Branch Chicago River. Also inconsistent with the three groupings indicated by the scores of habitat potential shown in Attachment A, MWRD proposes that Little Calumet River and Upper North Branch Chicago River be grouped in the same aquatic-life use as the much higher-scoring Upper North Shore Channel and Lower North Shore Channel. MWRD reports and testimony lack a clear and well-justified explanation for why such large differences in potential among these waters justifies proposing the same aquatic-life use for all of them. Lastly, although Lower North Branch Chicago River has a relatively high habitat potential—scoring a 55—MWRD proposes that Lower North Branch Chicago River be designated for the same aquatic-life use as four other waters that have much lower scores that range from 43 to 48.

Despite habitat potential in Lower North Branch Chicago River being similar to that in Upper North Branch Chicago River and Little Calumet River, MWRD proposes a different, less-natural aquatic-life use for Lower North Branch Chicago River than for the latter two waters. Testimony for MWRD (Exhibit 461) indicates that the presence of commercial navigation and evidence of sediment toxicity are reasons for grouping Lower North Branch Chicago River with the other four waters that had lower potential. However, the following inconsistencies exist in this reasoning.

Whereas. commercial navigation and evidence of sediment toxicity occur in Lower North Branch Chicago River. both also occur in Little Calumet River, for which MWRD proposes a different. more-natural aquatic-life use. Sediment-toxicity data attached to Attachment 1 of MWRD testimony (Exhibit 461) indicates relatively low percent survival of the test organisms for multiple locations in Little Calumet River as well as in Lower North Branch Chicago River. Based on this information, it seems inconsistent to allow commercial navigation and evidence of sediment toxicity in Lower North Branch Chicago River to preclude designation of a more natural use for this part of CAWS. Despite Lower North Branch Chicago River having potential similar to that of Little Calumet River—which also has commercial navigation and evidence of sediment toxicity—MWRD proposes a less-natural use for Lower North Branch Chicago River than for Little Calumet River.

Additional to the inconsistencies between MWRD's proposed uses and the potential of these waters as indicated by the CAWS habitat-index scores in Attachment A to this testimony, a fundamental shortcoming exists in the structure of the CAWS habitat index itself. Although at first appearing to be based on objective statistical analysis, the final CAWS habitat index includes five of eleven variables for which the inclusion is based primarily on subjective judgment alone. Only six of the eleven habitat variables were included in the index based on statistical relations with the CAWS combined fish metric. Five habitat variables were added despite the preceding analysis failing to show sufficient reason for including them. For example, the variable called "*percent overhanging vegetation*" was initially excluded from further consideration via the principal-components analysis. Nonetheless, the habitat-evaluation report (PC 284) on page 130 states—without any supporting analysis—that this variable was added back into the final CAWS habitat index because it is "*...an important habitat variable and should* *be included in the index.*" Given MWRD's emphasis and reliance on the statistical analysis and associated procedures to identify the few habitat variables that were most related to fish in the CAWS, this post-analysis addition of five variables to the CAWS habitat index seems inconsistently and unnecessarily subjective. It seems inconsistent to rely on subjective judgment as the primary basis for including variables that were already excluded during a preceding and presumably more objective process.

Using only the six key habitat variables that were picked in the CAWS habitat evaluation (PC 284) as being most statistically related to the CAWS combined fish metric, Attachment B to this testimony (*CAWS Habitat Index: Current Conditions [Based on Six Habitat Variables Only]*) shows the six-variable CAWS habitat-index scores derived for each part of the CAWS. Attachment B shows the relative differences in habitat-index scores that represent current conditions in the CAWS. Even if, as MWRD assumes, these current habitat conditions represent the best-case future conditions for the CAWS, the aquatic-life uses and groupings proposed by MWRD are still not consistent with this clear and simple depiction. Based on current habitat-index scores as a measure of biological potential, three possible aquatic-life-use groupings exist. Upper North Shore Channel has a CAWS habitat index score of 77, which represents a unique, most-natural use relative to all other CAWS waters. At the least-natural end of the range of condition, South Branch Chicago River, Chicago Sanitary and Ship Canal, and Calumet-Sag Channel score similarly low, from 31 to 36, in a single aquatic-life-use grouping. The remaining waters score intermediately, from 41-58, and form a possible third aquatic-life-use grouping.

In contrast, MWRD proposes a unique, least-natural aquatic-life use for South Fork South Branch Chicago River even though its six-variable habitat-index score is 46, which is higher than the scores of four other parts of the CAWS for which MWRD proposes more-natural aquatic-life uses. Also. contrary to the aquatic-life-use groupings suggested by these habitat-index scores, MWRD proposes a more-natural aquatic-life use for Upper North Branch Chicago River and a less-natural use for Lower North Branch Chicago River and Chicago River despite the latter two waters scoring slightly higher than Upper North Branch Chicago River. The aquatic-life uses proposed by MWRD are not consistent with this clear and simple interpretation based on the six habitat variables found to be most related with fish in the CAWS.

Deficiencies in How MWRD Used Fish Data

Testimony and associated information submitted by MWRD does not clearly establish that the CAWS combined fish metric represents increments of biological condition, as a response to human impact, along a continuum from imbalanced to balanced aquatic-life communities. Specifically, the CAWS habitat evaluation lacks an analysis that shows that higher scores of the CAWS combined fish metric represent a less-impacted biological condition than do lower scores and vice versa. Moreover, the CAWS habitat evaluation does not address how the scoring range of the CAWS combined fish metric relates to the Clean Water Act goal of balanced aquatic-life communities. Also, the statistical relations evidenced between fish and habitat data in the CAWS do not provide clear and readily interpretable measures of existing biological condition or biological potential. To be useful for justifying why the Clean Water Act goal of balanced communities cannot be attained and then for determining the most appropriate aquatic-life uses to designate, each measure of existing biological condition and each measure of future biological potential must have such a demonstrated ability and contextual meaning. Lacking such responsiveness and context in the CAWS combined fish metric, the CAWS habitat-evaluation report (PC 284) and the CAWS habitat-improvement report (PC 284) do not provide a sound technical basis for the alternative aquatic-life uses proposed by MWRD for these waters.

The CAWS combined fish metric is not a valid index of biological integrity (IBI), nor is it valid to interpret it as a measure of biological condition that can indicate a relative amount of fish-community balance or imbalance relevant to the Clean Water Act aquatic-life goal. The CAWS habitat-evaluation report states on page 106, "*A fish index of biological integrity (IBI) was not available...although the process used to select the fish metrics was exactly the same process used in many fish IBI studies.*" The CAWS habitat-evaluation report on page 32 also states, "*The process of reviewing and screening the fish metrics followed the process used in development of many fish IBIs.*" Whereas these statements may be technically accurate in a limited sense, they do not mean that the CAWS combined fish metric is similar to an IBI in substantive ways. Nor do they mean that the CAWS combined fish metric is a valid and useful measure of biological condition. On the contrary, the CAWS combined fish metric differs in fundamental ways from a valid IBI, and therefore it lacks the ability to measure a range of biological condition that is broad enough to serve the needs of this rulemaking.

A first fundamental step in selecting the multiple fish metrics that make up a fish IBI is to show that each fish metric responds in a sensible way to a gradient of human impact. The CAWS habitat evaluation does not include this essential step; the fish variables that constitute the CAWS combined fish metric were not tested for such responsiveness. On page 46 in the 1999 book titled, *Restoring Life in Running Waters. Better Biological Monitoring*, the authors James R. Karr—who created the first fish IBI—and Ellen W. Chu explain this first step as follows: "*Only a Few Biological Attributes Provide Reliable Signals About Biological Condition... Choosing from the profusion of biological attributes (Figure 9) that could be measured is a winnowing process, in which each attribute is essentially a hypothesis to be tested for its merit as a* [IBI] *metric. One accepts or rejects the hypothesis by asking, 'Does this* *attribute vary systematically through a range of human influence?'...Successful biological monitoring depends most on demonstrating that an attribute has a reliable empirical relationship—a consistent quantitative change—across a range, or gradient, of human influence. Unfortunately this crucial step is often omitted in many local, regional, and national efforts to develop multimetric indexes...*" The CAWS habitat-evaluation report does not address how each fish variable that was included in the CAWS combined fish metric is a useful signal of human impact. The CAWS combined fish metric lacks this fundamental property of a valid fish IBI and therefore lacks utility as a measure of biological condition. The CAWS habitat evaluation picked a subset of habitat variables that appeared to be most statistically related to a preselected subset of fish variables. However, the preselected set of fish variables were not examined for how well they represented a gradient of biological condition over a large-enough range of human influence. Simply, the CAWS habitat index and the CAWS combined fish metric from which the habitat index directly derives lack sufficient focus and frame of reference to be useful in this rulemaking.

Additional to this lack of focus, the choice of the twelve individual fish variables that constitute the CAWS combined fish metric seems logically inconsistent. Page 19 in Appendix A of the CAWS habitat-evaluation report (PC 284) states that the process for picking fish variables to include in the CAWS combined fish metric was based mainly on considering candidate variables from existing IBIs in Wisconsin, Ohio, and Illinois. Table 5-1 on page 34 of Appendix A of the CAWS habitat-evaluation report reflects this emphasis; at least eight of the twelve fish variables that make up the CAWS combined fish metric match fish metrics from existing fish IBIs in Wisconsin, Ohio, or Illinois. Given this high reliance on fish variables borrowed from existing fish IBIs, it seems inconsistent that a new CAWS fish index was developed without first testing the usefulness in the CAWS of each of the existing IBIs from which the fish variables were borrowed. The CAWS habitat evaluation does not provide an analysis of how the existing fish IBI from Wisconsin, Ohio, or Illinois relates to measures of human impact throughout the CAWS. The habitat evaluation did not show how each of these existing state-based fish IBIs was not a useful indicator of biological condition in the CAWS and why an alternative fish index was even needed. Given this logical inconsistency of creating a new CAWS fish index from metrics of existing IBIs without testing the efficacy of those existing IBIs, the usefulness of the CAWS combined fish index for this rulemaking remains questionable if not altogether lacking.

Even if one were to assume the potential usefulness of the CAWS combined fish metric for this rulemaking, additional problems exist in how the index scores were quantified. Although the CAWS combined fish metric includes individual fish variables that were borrowed from existing fish IBIs of Illinois, Ohio, or Wisconsin, it is not clear that these fish variables were quantified according to the protocols of those state indexes. Therefore, each fish variable of the CAWS combined fish metric does not contribute quantitatively to the overall score of the CAWS combined-fish-metric as originally designed and intended in those state-based fish IBIs. These methodological shortcomings confound the interpretation and accuracy of the final CAWS combined-fish-metric scores.

A typical fish IBI requires that each fish species be categorized based on its feeding habits, its reproductive habits, and its relative tolerance to human impact. Because variation can exist among fish populations of the same species across the species' entire geographic range of distribution, these ecological categorizations are not universally fixed. Rather, each state-based IBI categorizes the feeding habits, the reproductive habits, and the relative tolerance of each fish species based on the habits of that species in that particular state. The accuracy and usefulness of the IBI score then depends directly on applying these state-based specifications. Each of the three IBIs from Wisconsin, Ohio, and Illinois has a unique set of such specifications—albeit with many species categorized similarly among the states, as one might expect. To work properly as designed, each IBI metric must be quantified based on these specifications. For example, Wisconsin, Ohio, and Illinois fish IBIs uniformly categorize channel catfish as being neither tolerant nor intolerant for IBI purposes. Accordingly, all individual channel catfish captured as part of a fish-community sample are not counted as "Tolerant" or "Intolerant" when quantifying the individual fish metrics that require such tallies of tolerant or intolerant individuals or species.

Of the 25 fish species rated as "Tolerant" for calculating the CAWS combined fish metric, 12 of them are rated by the Wisconsin, Ohio, and Illinois IBIs as being of intermediate tolerance rather than "Tolerant". This is just one example of how the CAWS combined fish metric does not accurately reflect the specific fish categorizations required by the state IBIs from which it borrowed most of its individual fish variables. This type of inconsistent methodology creates inaccuracy and ambiguity in how to interpret the CAWS combined fish metric.

Similar problems in quantification exist for other variables that constitute the CAWS combined fish metric. Table 5-1 on page 34 of Appendix A of the CAWS habitat-evaluation report indicates that several fish variables are percentages that depend on a count of individual fish or a combined weight of individual fish as the baseline. For example, the fish variable , "*% insectivores by count*," requires counting the number of individual fish that eat primarily insects and dividing that number by a baseline count of fish in the sample. However, for these types of variables that are based on ratios or percentages, the Illinois, Ohio, and Wisconsin IBIs do not always use a count of every fish in the sample as the baseline. Rather, these state IBIs require excluding some individuals—such as hybrids or tolerants—from the baseline count. The quantification of fish variables that results in a final score of the CAWS combined fish metric does not clearly incorporate these exclusions to the baseline counts and weights. Lack of quantifying the individual fish variables in these specified ways can create inaccuracy and ambiguity in the resulting CAWS combined-fish-metric score.

An additional inconsistency in how the individual fish variables are quantified further hampers the accuracy and interpretability of the CAWS combined fish metric. For fish samples that have few total individuals captured, each of the established fish IBIs from Wisconsin, Ohio, and Illinois require specific adjustments when deriving a numeric score for each component metric. Specifically, for fish samples that have fewer than a total of 50 individual fish captured, each of the state-based fish IBIs uses scoring adjustments to help minimize inaccuracies in the final IBI score. The fish variables used in the CAWS combined fish metric do not clearly incorporate such scoring adjustments despite several CAWS fish samples having a total of 50 individual fish or fewer. For example, for fish samples with fewer than 50 individuals, the Ohio fish IBI requires assigning an adjusted value to several of the component fish metrics. Similarly, the Ohio fish IBI requires some scoring adjustments for fish samples that have between 50 and 200 individuals, which is true for many CAWS fish samples. Even though the CAWS combined fish metric comprises individual fish variables that were borrowed from existing state-based fish IBIs, these borrowed metrics were not quantified according to such specifications in each state's IBI protocols. Consequently, the accuracy of the CAWS combined fish metric remains questionable, and the interpretation of a combined-fish-metric score remains ambiguous.

A final way in which the CAWS combined fish metric differs fundamentally from a valid IBI pertains to how the values of each individual fish variable are aggregated to yield a final index score. In a typical fish IBI, each component metric has the potential to contribute equally to the final IBI score; no single metric is allowed to contribute more than any other metric to the final aggregate IBI score. For example, for a fish IBI that includes ten individual fish metrics and can range from a possible score of 0 to 100, each fish metric is designed to contribute from 0 to 10 points to the overall IBI score. This design property helps to balance the responsiveness of the index across all of its component metrics. In contrast, the CAWS habitat-evaluation report (PC 284) does not clearly explain how the individual fish variables combine quantitatively to yield a final score for the CAWS combined fish metric. It is not clear that each individual fish variable is allowed to contribute equally to the final score, which creates additional ambiguity in interpreting the CAWS combined fish metric.

Deficiencies in How MWRD Used Water-Quality Data

The CAWS habitat-evaluation report (PC 284) and habitat-improvement report (PC 284) neither clearly nor sufficiently address how existing or potential water-quality conditions in the CAWS can influence the biological interpretations necessary for this rulemaking. Specifically, these reports do not provide sufficient analysis of how existing water quality relates to existing biological condition in the CAWS. Also, the reports do not provide sufficient analysis of how best-case future water-quality conditions can help determine future biological potential throughout the CAWS. Although the CAWS habitat evaluation reported an apparent lack of relations between water quality and fish data in the CAWS, this analysis and MWRD's interpretations of it lack clarity and relevance for the following primary reasons.

Among the many variables that reflect water quality that can influence fish in the CAWS, only two of them were examined for statistical relations with fish: dissolved oxygen and temperature. However, the CAWS habitat evaluation provided no clear analysis of how either of these two water variables correlated with physical habitat throughout the CAWS. Moreover, the

CAWS habitat evaluation did not provide analysis of how dissolved oxygen and temperature interact to potentially influence fish in the CAWS. Despite having data for other water-quality variables such as specific conductivity, pH, and ammonia, no analysis was provided of how fish in the CAWS varied with these other variables. No analysis was provided of how these other water variables varied with physical-habitat conditions throughout the CAWS. By excluding all but two water variables from direct analysis and by not accounting for how water quality related to physical habitat throughout the CAWS, potentially important relations between fish and the water in which they live were not sufficiently accounted for by the CAWS habitat evaluation. Consequently, MWRD's conclusion that physical habitat is more important to CAWS fish than water conditions is incomplete and unjustified.

The MWRD finding that fish in the CAWS do not appear to be as statistically related to water quality as to physical habitat may simply be attributable to insufficiently accounting for the true range of water-quality conditions throughout the CAWS. Water variables potentially important to fish were left out of the analysis altogether. Also, correlation between water-quality and physical-habitat variables was not explicitly accounted for, and thus all correlation between physical habitat and fish was misinterpreted as being attributable solely to physical habitat. The true amount of variability in water-quality conditions throughout the CAWS was underrepresented or misinterpreted in the statistical analyses. Because regression analysis capitalizes on variability, underrepresenting the true variability in water quality relative to that of physical habitat can inhibit an analysis from revealing the actual amount of relation between fish and water quality. The CAWS habitat evaluation did not sufficiently account for this possible reason for the apparent relative lack of correlation between fish and water quality in the CAWS.

Similarly, because the CAWS habitat evaluation was constrained to the assumption of a linear relation between fish and the two water variables that were analyzed, it did not account for possible non-linear relations—such as threshold effects—between fish and water quality. The inability of a statistical analysis, such as linear regression, to reveal a stronger linear relationship between fish and individual measures of water quality than between fish and physical habitat does not constitute strong scientific evidence that water quality has less influence on fish than does physical habitat. In Attachments B and C of Appendix C of the CAWS habitat-evaluation report, several of the plots of relations between fish variables and dissolved oxygen or temperature show that better fish conditions tend to occur under better water conditions, even if a strong linear relationship is not readily apparent. The CAWS habitat-evaluation report acknowledges this relationship; it states on page 57, "*Fish metrics from observations where standards were being attained were generally better than fish metrics where standards were not in attainment, but most differences were not statistically significant.*" For example, on page C-1 of Attachment C to Appendix C of the CAWS habitat-evaluation report, the plot on the lower right of the page shows that a greater ratio of non-tolerant coarse-substrate spawners occurs under the coolest temperature conditions. Similarly, on page C-2 of the same Attachment C, the second plot down on the right side of the page shows that a greater percentage of intolerant fish occur under the coolest temperature conditions. These relationships are evident despite the low linear-regression R-squared value of 0.006 for both cases. Although the CAWS habitat-evaluation report seems to rely heavily on a lack of "*statistical significance*," it does not address the biological and practical significance of these types of patterns. These examples show that simplistic reliance on the *R*-squared statistic and associated *p* value does not account for how water quality can affect fish in non-linear ways. A finding of "*not statistically significant*" lacks practical worth if it is not carefully interpreted in the context of how such a finding is subject to the constraints, assumptions, and limitations of the chosen statistical analysis. Inability to find "*statistical significance*" is weak scientific justification that no meaningful relationship exists. When testing a null hypothesis of "no relation" between variables, failure of the data to represent evidence against the null does not constitute evidence that the null is true, only that the null could not be "falsified" with the available data.

How Illinois EPA Used Measures of Physical Habitat, Fish Communities, and Water Quality

In contrast to the MWRD approach, Illinois EPA used well-established indicators of physical habitat and biological condition to justify why each waterbody in the CAWS cannot attain balanced aquatic-life communities in its foreseeable future. Then, for each of the CAWS waters, Illinois EPA assumed best-case future chemical and physical conditions of the CAWS to propose aquatic-life uses that represent corresponding best-case biological conditions. Illinois EPA used the Ohio EPA fish Index of Biotic Integrity (Ohio fish IBI) as a measure of biological condition. This index was developed to represent a wide range of biological condition from highly imbalanced to even more natural than the Clean Water Act aquatic-life goal. Illinois EPA also used the Ohio EPA habitat index as a measure of biological potential. This habitat index, called the Qualitative Habitat Evaluation Index, was designed to reflect habitat features that best predict key attributes—called metrics—of the fish community that constitute the Ohio fish IBI. Because the Ohio fish IBI provides a clear and direct measure of biological condition that covers a sufficient range from imbalanced to balanced, and because the Ohio habitat index is designed to reflect aspects of physical habitat that best predict the fish attributes that constitute the Ohio fish IBI, the Ohio habitat index provides a directly relevant way to measure the biological potential of a waterbody. Specifically, Ohio EPA examined and established predictive relationships between their habitat index and their fish IBI. Based on these relationships. Ohio EPA uses scores of their habitat index to indicate a stream's biological potential, including its potential to attain the Clean Water Act goal of balanced aquatic-life communities. For example, as a general guide. if the habitat index scores below 45, then the stream is likely unable to attain this goal.

No such clear relationships or frame of reference relative to the Clean Water Act aquatic-life goal were established for the CAWS-specific fish and habitat indexes created for MWRD. Unlike the largely untested CAWS-specific indexes, use of these Ohio EPA indexes has a proven record of meeting the analytical burdens of use-attainability analysis, as required by the Clean Water Act and associated regulations. Accordingly, the Ohio fish IBI and habitat index provide a well-established, stronger foundation for this rulemaking than do the unproven and less focused CAWS habitat and fish indexes created for and used by MWRD. Consequently, the aquatic-life uses proposed by Illinois EPA for the CAWS provide a better regulatory framework than do those proposed by MWRD.

I thank the Board for the opportunity to provide this pre-filed testimony. I am available to try to answer questions or help clarify this testimony.

By: ROY SMOGOR
Roy Smogor

Date: 06/28/2011

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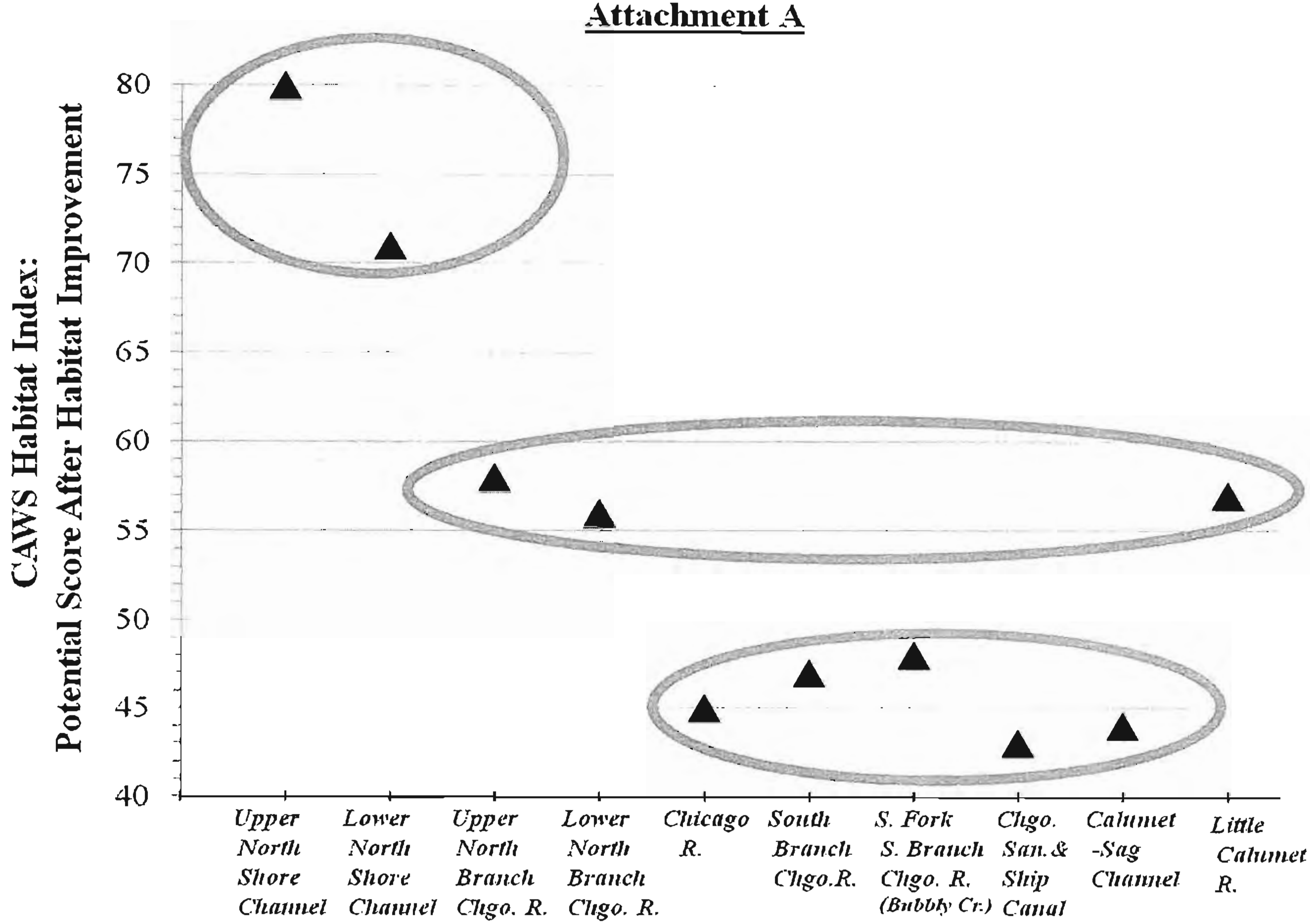
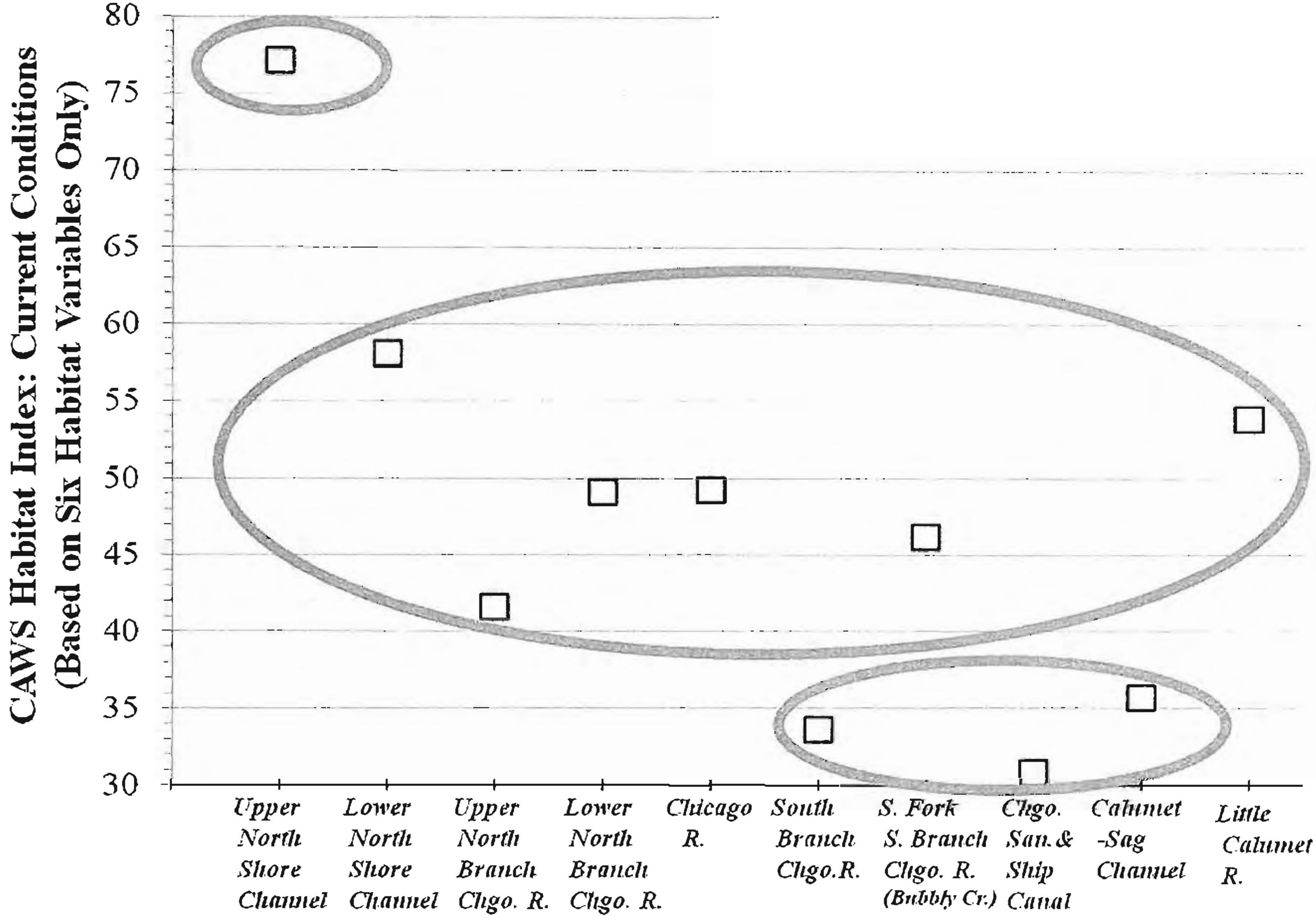
Attachment A



Attachment B



STATE OF ILLINOIS)
)
COUNTY OF SANGAMON)

PROOF OF SERVICE

I, the undersigned, on oath state that I have served the attached Pre-Filed Testimony of Roy Smogor of the Illinois Environmental Protection Agency to whom they are directed, by placing a copy of each in an envelope addressed to:

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See Attached Service List
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and mailing them from Springfield, Illinois on 6/28/11, with sufficient postage affixed as indicated above.

Meredith Kelley

SUBSCRIBED AND SWORN TO BEFORE ME
This 28th day of June, 2011
Brenda Boehner
Notary Public

"OFFICIAL SEAL"
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