BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	
WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R2008-9
CHICAGO AREA WATERWAY SYSTEM	)	(Rulemaking – Water)
AND THE LOWER DES PLAINES RIVER:	)	
PROPOSED AMENDMENTS TO 35 ILL..	)	(Subdocket C)
ADM. CODE PARTS 301, 302, 303 and 304	)	

NOTICE OF FILING

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Please take notice that on the 30th Day of June, 2011, I filed with the Office of the Clerk of the Illinois Pollution Control Board the attached **Testimony of David L. Thomas, Ph.D**, a copy of which is hereby served upon you.

By: _____
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Dated: June 30th, 2011

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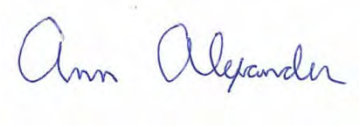
CERTIFICATE OF SERVICE

I, Ann Alexander, the undersigned attorney, hereby certify that I have served the attached **Testimony of David L. Thomas, Ph.D** on all parties of record (Service List attached), by depositing said documents in the United States Mail, postage prepaid, from 227 W. Monroe, Chicago, IL 60606, before the hour of 5:00 p.m., on this 30th Day of June, 2011.



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TESTIMONY OF DAVID L. THOMAS, PH.D

Introduction

My name is Dr. David L. Thomas, a fisheries scientist and ecologist who retired from the Illinois Natural History Survey in 2008 after 10 years as Chief of the Survey. I am testifying today, for the second time in this proceeding, on behalf of Sierra Club – Illinois Chapter, Prairie Rivers Network, Natural Resources Defense Council, Environmental Law and Policy Center, Friends of the Chicago River, Southeast Environmental Task Force, and Openlands, in support of the regulations proposed by the Illinois Environmental Protection Agency ("IEPA") amending the water quality standards applicable to the CAWS and Lower Des Plaines River. Additional information concerning my background was presented with my earlier testimony. I have been on the Chicago waterways twice, in the early 1990s with personnel from the District and in July 2009 when I toured by boat the Chicago River, Chicago Sanitary and Ship Canal (CSSC) and the Cal Sag channel.

I have reviewed the reports by LimnoTech that have been submitted to the Pollution Control Board by the Metropolitan Water Reclamation District of Greater Chicago (District) and also the testimonies of Dr. Bell, Ms. Wasik and Ms. Namura. The focus of my testimony filed in this proceeding on August 4, 2008 is on the relationship between fish and water quality. The comments below focus specifically on the conclusions in the Habitat Evaluation and Habitat Improvement reports, and on the effects of frequent extremely low dissolved oxygen (DO) levels in the Chicago Area Waterways System (CAWS) which would continue indefinitely under a proposal made by the District.

Evaluation of LimnoTech reports and testimony

Generally speaking, I found the LimnoTech Habitat Evaluation study to be a very extensive examination of the habitat provided in the CAWS. I agree that, for comparing portions of the CAWS with other portions of the CAWS, the study's habitat metrics are probably superior for the CAWS than others that have been developed for river systems. The Habitat Evaluation study, however, does not appear to have been developed for comparing the CAWS or portions of the CAWS against waters outside the system.

I also generally agree with the authors of these reports that the CAWS is not a classic river system without human alterations. However, as these authors also acknowledge, few rivers are. Anthropogenic alterations are imposed on most of our large rivers, and many are dammed, providing – as in the CAWS – stretches of water with a reservoir-like habitat for aquatic organisms.

The LimnoTech Habitat Improvement Report is not very useful. Because the Habitat Improvement Report was constrained to looking at the types of habitat improvements that could be made system-wide, it failed to examine or document the value of smaller scale improvement projects that would benefit particular fish species in the system.

The following are my specific comments concerning the LimnoTech studies' conclusions:

1. ***Limits of electrofishing***. On page 115 of the Habitat Evaluation Report, the authors list six habitat variables as having the greatest influence on fish metrics: maximum depth of channel, off-channel bays, percent of vertical wall banks in reach, percent of riprap banks in reach, manmade structures in reach, and percent macrophyte cover in reach. However, it does not appear that the authors looked at the percent of the cross-sectional area of the reach that was under 4 feet in depth. This is a significant omission, because the boat electrofishing gear that was used to sample fish is most effective to about a depth of 4 feet (particularly in somewhat turbid waters). Thus, all other variables equal, I would expect that stations that had a larger percentage of area under 4 to 5 feet in depth would have yielded a larger fish catch. While Scott Bell testified that electrofishing has an effective depth of 3 to 4 meters (9 to 12 feet) I find little evidence for this conclusion. Those fish species restricted to deeper waters of the channel would have been under-sampled or possibly missed entirely. The Illinois Department of Natural Resources (IDNR), in its October 22, 2010 submittal to the Board (PC #505), discussed the limitations of electrofishing in large deep draft channels, especially in areas with steep artificial banks. For this reason, it is hardly surprising that channel depth is found to be an important negative factor in the Habitat Evaluation Report.

2. ***Observed available habitat***. The Habitat Evaluation Report states at 124-25 that the two most important physical habitat variables in the CAWS that are positively correlated with fish populations are (i) macrophyte cover, and (ii) the quantity of areas that act as off-channel bays to provide refuge from the main channel. The Report notes at 66 that submerged aquatic macrophyte cover was nonexistent at 19 of 28 stations in 2008, and that there were no stations with observed macrophyte cover in the Cal-Sag channel. However, on July 31, 2009, I took a boat tour of the area, during which I saw both floating aquatic vegetation in the Cal-Sag channel as well as some emergent vegetation growing in the water near the shoreline. There were no barges at the time we went through the channel, and thus the aquatic vegetation may have been more noticeable. I also observed some logs and tree branches hanging in the water, which represent potential macroinvertebrate and fish habitat that the Habitat Evaluation Report said was essentially absent from the waterway.

Additionally, the Habitat Evaluation Report acknowledges the existence of "bank pocket areas" where erosion has crumbled a portion of the limestone walls, creating some small "coves" of rubble that provide habitat for both invertebrates and fish (page 84). In this regard, the Report states at 65 that "where large substrate (gravel, cobble, boulders) are present in the CAWS they appear to be important to

fish"; and further states at 84 that "small areas of refuge in the banks were measured in this study and are prevalent." This is consistent with the testimony I presented earlier in this proceeding. I agree that this type of habitat is important, and note that its presence is increasing in the CAWS. Erosion and slumping of some rock walls is creating additional habitat of this nature for aquatic organisms and this process will continue. During the boat tour referenced above, I observed some groups of mallard ducks using some of these areas for feeding. These areas could be further improved for fish habitat by the use of rip-rap or sheet pilings to provide protection from wave action from barges.

3. ***Intolerant macroinvertebrate data***. While the focus in these reports is on habitat and fish, there is some discussion of macroinvertebrates. Ephemeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies) are collectively known as EPT taxa, and are indicators of good water quality. The Habitat Evaluation Report states at 101 that "the presence of intolerant benthic EPT taxa in Hester – Dendy samples and the absence of EPT taxa in Ponar samples suggests sediment toxicity to mayfly, stonefly, and caddisfly larvae." However, this conclusion does not necessarily follow from the data. There is a more basic reason why EPT taxa would show up in Hester-Dendy samples but not in Ponar samples. Hester-Dendy samplers are a hard substrate that is put into the water for a limited period of time (sometimes one or two months). These substrates provide a surface where algae and macroinvertebrates can colonize and grow. These samplers replicate in a way the hard substrates provided by rocks, rubble, logs, submerged objects and even pilings – although unlike the samplers, these structures are in the system throughout the year and thus allow more time for colonization and succession of plants and animals to occur. In large rivers, it is these substrates that often are the major habitats for many of our invertebrate species. Ponar samples, on the other hand, are taken from soft substrates and the sampler does not work effectively where there is gravel, rocks or hard substrate. My experience on the Kaskaskia River with Ponar samples was that there were relatively few macroinvertebrates in the soft substrates in the river. However, logs, rocks and other hard substrates provided the substrate necessary for many of the macroinvertebrates in the river, particularly the EPT taxa. While toxic sediments may have played a role in the low abundance of macroinvertebrates in the soft sediments of the CAWS, another explanation is that this is an unstable substrate in large river systems that generally has few invertebrates (other than oligochaetes and midges). Most EPT taxa are absent from the soft shifting substrates in large rivers.

4. ***Fish species sampling***. An accurate analysis of the relationship between fish and water quality depends on an adequate and representative sampling of the fish population in each of the reaches. However, it appears that the LimnoTech reports were working with a set of fish sampling data (from electrofishing gear) that was not fully representative of the true abundance of all fish species. As shown in the IDNR testimony of October 2010, rotenone collections taken in the CSSC and Little Calumet River reveal that many species in these systems were under-sampled or not sampled at all by electrofishing (see paragraph 1 above). Twelve of the native species found in December 2009 rotenone sampling in the CSSC were not reported in the Use Attainability Analysis report for this area (CDM 2007). For the Little Calumet River, 10 species were found in the rotenone sampling that were not recorded in the Use Attainability report (CDM 2007). For example, channel catfish, which were rarely reported in the standard electrofishing studies conducted in the CAWS, were abundant in rotenone collections in the CCSC and Little Calumet River taken in December 2009 and May 2010, respectively. A number of the "new" species collected through rotenone sampling would be considered moderately intolerant. In this regard, I note that one species reported in the LimnoTech report (page 98), steelcolor shiner, is considered

by the state (Bertrand, Hite and Day 1996) to be intolerant of degraded water quality. A more representative collection of the fish in each reach could have significantly affected the results of habitat and fish metrics evaluations.

Additionally, there is an issue with sampling efficiency at each of the stations. It appears that the LimnoTech statistical analysis assumes that sampling efficiency will be very similar between all stations. On page 10 of Mr. Bell's testimony, he states that "of the half of fish data variability not explained by the key habitat variables, most is explainable by natural variation in the fish data from one sampling event to another at each location." However, some of this variation is likely due to differences in sampling efficiency between stations (electrofishing is much more efficient in shallower water). It may also be attributable to the difference in vulnerability of various fish species to sampling capture -- for instance, very small fish are under-sampled with electrofishing gear, as are some benthic species such as channel catfish.

5. ***Significance of DO***. The Habitat Evaluation Report spent significant time evaluating the variables that could best explain the fish data collected from 2001 to 2007. The Report in fact concluded – although downplaying that conclusion – that DO levels are one such variable. It states at 120 that "the regression analyses shows that physical habitat can explain 48% of the fish data collected from 2001 to 2007," but concludes at 124 that "including dissolved oxygen (DO) with the habitat variables improved the amount of fish data variability by the regression by about 4% over physical habitat alone." The Report states in addition that "fish metrics are positively correlated to dissolved oxygen, but that dissolved oxygen is a poor predictor of fish metrics." Part of the reason for this may be that fish move about significantly and they may move into and out of low DO waters to feed and in response to other environmental variables such as temperature. Still, this study did find (page 57) that "fish metrics from observations where standards were being attained were generally better than fish metrics where standards were not in attainment.…"

Additionally, increased DO at Sidestream Elevated Pool Aeration (SEPA) stations does seem to have attracted a number of species including some moderately intolerant species. In Exhibit 179, page 18, there is mention that smallmouth bass, largemouth bass, and channel catfish were attracted to higher DO waters at the SEPA stations. The Report states, "this was the first occurrence of these desirable game fish species in the Cal-Sag Channel collections. These game fish were evidently attracted by the elevated dissolved oxygen (DO) concentrations downstream of the waterfalls." Based on this conclusion, it is evident that improving water quality, particularly dissolved oxygen levels, should be beneficial to moderately intolerant species and even some tolerant species such as the largemouth bass. This continued improvement is also indicated in Exhibit 280, which shows increases in the cumulative number of fish species collected in the CAWS, particularly after TARP and SEPA operation.

I note, in addition, that on page 21 of the Fish and Water Quality Report the authors state that the DO metric that exhibited the strongest correlations with fish metrics was the percent of time DO was less than 5mg/l between June and September. There is a rationale in the literature for the 5 mg/l DO level having a biological significance. Dowling and Wiley (1986) did a review of the literature related to the effects of dissolved oxygen, temperature and low stream flow on fishes. In discussing minimum oxygen standards they cite the work of Ellis (1937) who concluded that a minimum summer dissolved oxygen

concentration of 5 mg/l was necessary to support good, mixed fish faunas. They also cited the work of Coble (1982), who's work in Wisconsin showed that daytime or average DO values of 5 mg/l could be identified as a point of departure between good and poor fish populations. Chapman (1986), in a discussion of field studies, cited the above two references plus a study by Brinley (1944) who conducted a two year biological survey of the Ohio River Basin. Brinley concluded that his field results showed that a concentration of dissolved oxygen of 5 mg/l seemed to represent a general dividing line between good and bad conditions for fish. Thus while most fish species have a fairly wide tolerance to a range of DO levels, good diverse fish populations are best in waters where dissolved oxygen stays predominately over 5mg/l.

6. ***Species tolerance classification***. Attachment B in the LimnoTech "Fish Metrics" report lists smallmouth bass as intolerant and channel catfish as tolerant. The channel catfish in my opinion should be classified as having "moderate" tolerance. This species requires better oxygenated waters, and embryonic and larval stages have reduced survival below about 5 mg/l (Yoder, 1996, Fig. 11). While largemouth bass are more tolerant of lower oxygen waters, their populations will still likely be adversely affected by prolonged or frequent periods of low DO.

7. ***Statistical versus biological significance***. The reports at times fail to account for the difference between statistical and biological significance. While short term comparisons of fish to habitat and water quality variables may be statistically insignificant, nonetheless, they may be biologically significant over a longer period. In the LimnoTech appendix entitled "Analysis of the Relationship Between Fish and Water Quality," the authors state that "fish are mobile, and may be exposed to dissolved oxygen concentrations significantly different than the ones reflected at the oxygen monitoring location during the time of the fish collection." (p. 30). This mobility of fish brings them into contact with a variety of DO levels in the system, and thus there may be a fairly large variation in the DO levels where a species is captured. While this larger variability makes finding a statistical significance more difficult it does not mean that smaller changes in DO will not have a biological significance, particularly over time. That is the point of some of the studies referenced in the paragraph above that talk about good fish populations tending to be in waters where DO generally remains above 5 mg/l.

In this regard, I note that on page 15 at the end of Dr. Bell's testimony, he discusses the difficulty of showing statistical significance with a highly variable database. He concludes, "in most cases, the coefficient of variation of the fish data is an order of magnitude greater than the percent change in habitat index scores, suggesting that the natural variability of the fish data may overshadow any potential change in fisheries that might result from habitat improvement." Thus, while habitat improvements that have been suggested might not result in a statistical "improvement" in the fish population, particularly system wide, they might be biologically significant for some species, especially for local populations.

8. ***Data indicating rich species variety***. The Habitat Evaluation Report states at 94 that the CAWS was constructed for the conveyance of treated wastewater and urban drainage away from Lake Michigan and also to support commercial navigation, and concludes that "these conditions impose a significant limitation on the potential of the CAWS to support fish communities different than what presently exists there." The conclusion by the LimnoTech reports and the District's witnesses that CAWS

habitat severely limits the potential range of fish species is both unsupported and contradicted by other research data, some from the District itself, as follows:

- *District's fisheries report*. The District report on fisheries resources and water quality in the CAWS from 1974 through 1996 (Dennison et al. 1998: Exh. 179) documented that the "abundance and species richness of the fish populations have increased in every one of the seven waterway segments of the Chicago Waterway system" in conjunction with improvements made to water quality. The District's report also documented that a number of game fish species had increased in the waterways, and that harvestable sized game fish included northern pike, white bass, white perch, rock bass, green sunfish, pumpkinseed sunfish, bluegill, smallmouth bass, largemouth bass, white crappie, black crappie, and yellow perch.

- *IDNR conclusions*. IDNR, in its October 2010 submittal to the Board, listed significant numbers of the following game fish for the CSSC: channel catfish, white perch, largemouth bass, bluegill, freshwater drum and pumpkinseed sunfish. In the Little Calumet River near T.J. O'Brien Lock and Dam, IDNR reported significant numbers of the above sport fish as well as black crappie, smallmouth bass, white bass, white crappie, and yellow perch. The submittal by IDNR concluded (page 4) that "the December 2009 and May 2010 sampling demonstrated that the CSSC is capable of supporting a diverse, healthy, and reproducing population of fish comprised of a high percentage of moderately tolerant species in adult and early life stages."

- *Early life stages*. Ms. Wasik states in her testimony at 11 that "IEPA's proposed DO criteria for 'early life stage present' are not included in the District proposal", presumably because "fish species that require higher DO are limited by the scarcity of spawning habitat in the CAWS rather than DO conditions." She further states at 18 that "the permanent physical habitat in the CAWS limits spawning of fish species like smallmouth bass and channel catfish." This statement is contradicted by the statement by Dr. Pescatelli of IDNR, in which he stated that the December 2009 rotenone collection in the CSSC yielded a very high abundance of young-of-the-year channel catfish. He stated that the evidence indicates that this species is spawning commonly, and that young from other species including the emerald shiner, bluegill, and largemouth bass suggest these species are also successfully reproducing in the CSSC. I note, in this regard, that Ms. Wasik also states at 13 of her testimony regarding fish spawning that ". . . the majority of physical habitat in the CAWS is not and cannot become conducive for spawning of most fish species." However, the LimnoTech report did not reach this conclusion, and there is no other basis for making this statement. Spawning of a number of species presently occurs in the CAWS and there is no reason to believe that the physical habitat could not be made more conducive to the spawning of a number of fish species. Spawning of many river fish occur in relatively small areas of suitable habitat so system wide improvements are not needed to provide spawning areas for fish.

- *Potential for further improvement*. Ms. Wasik stated under cross examination (Tr. 5/17/11P at 53-54) that "if you put in more [SEPA] stations and increased the DO further than current conditions, it wouldn't be likely to help the current fish community because they're more limited by the habitat." The crux of the argument would appear to be that while the fish community has improved with improvements in water quality over the last few decades, we have now reached the limit of possible improvement due to water quality alone. However, I find no demonstration in the record that additional improvements in water quality will not have a positive effect on fish populations. While the system will likely remain dominated by tolerant species, further improvements in water quality will help many of the intolerant and moderately tolerant species in the system, and improvements in their populations will improve the overall diversity of the fish population in the CAWS. Two of the intolerant species that should be most helped by an improvement in water quality are the smallmouth bass and the rock bass (this species was found quite commonly in IDNR rotenone collections but was not mentioned by Ms. Wasik as one of the intolerant species in the system).

- *Top five current species*. In cross examining Ms. Wasik, Mr. Ettinger asked if the top five species in the Illinois River might also be tolerant species (as they are in the CAWS). Ms. Wasik responded (Tr. 5/17/11P at 40) that she would not think that was true. I received random site collection data taken by the Illinois Natural History Survey staff for AC (alternating current) electrofishing gear from 2005 to 2007 for the Dresden pool, and Marseilles and Starved Rock pools in the upper Illinois River. The top five species by number for Dresden were the bluegill (489 specimens), bluntnose minnow (261), gizzard shad (234), orange spotted sunfish (50), and green sunfish (49). For the Marseilles pool the top species were bluegill (78), gizzard shad (46), emerald shiner (37), spotfin shiner (36), and bluntnose minnow (24). For the Starved Rock pool the top species were gizzard shad (161), bluegill (110), emerald shiner (75), spotfin shiner (62), and bluntnose minnow (43). All of these species are listed in the LimnoTech reports as tolerant.

9. ***Cost of habitat improvements***. The Habitat Improvement Report at 63 states that identified habitat improvements would probably cost in excess of $460 million dollars system-wide, and even with these improvements they would not "significantly alter the relative habitat index scoring of the CAWS reaches." The implication of these conclusions is that even with a large infusion of money, habitat in the CAWS would not significantly improve fish populations. However, the Habitat Report significantly overestimates these costs. First, it assumes that improvements must be made system-wide in order to have benefit. But fish in large river and reservoir systems often move long distances to find suitable habitats for spawning and aspects of their life history. Thus, even limited habitat creation may benefit fish throughout the system. For this reason, I am convinced that selective and limited habitat improvements could significantly help at least some of the fish species in the CAWS, and that these modest improvements could be made at a much reduced cost over what has been proposed in these reports. Some of these improvements could include creating sand and gravel beds in select sections of the CAWS for spawning areas, creating protected areas along the shoreline (through the use of rip-rap or behind sheet pilings) where fish could seek shelter for feeding and spawning, creating floating beds of vegetation such as has been done to a limited degree in the Chicago River, or creating or further developing wetlands and aquatic vegetation in coves and abandoned slips. I note, in this regard, that Scott

Bell testified (Tr. 5/16/11 at 138) that most of the habitat improvements the District looked at needed to be system wide. Thus, the District did not look at constructed wetlands, or tributaries, or making use of boat slips, or any other such low-cost geographically local habitat improvement measures. These apparent restrictions on the District's study precluded a number of habitat improvements that could have been made on a local level, and greatly increased the cost of their proposed habitat modifications. It is common in most river systems that many species will have very localized distributions based on where they can find suitable habitat. Increasing the diversity of habitats helps to increase the diversity of the fish populations in a system.

Additionally, as discussed above, natural processes (e.g., erosion of banks) are already creating additional habitats which are used by fish and macroinvertebrates. The presence of these natural processes also reduces the overall financial cost of habitat improvements. Clearly, selective improvements in habitat along with continued improvements in water quality that take advantage of these natural processes will continue to enhance the fish community in the CAWS.

Evaluation of the District's proposal for establishing DO criteria

Finally, combined sewer overflows (CSOs) presently cause a problem in maintaining DO levels. Extended periods of these low DO events probably do have a negative impact on native aquatic species, particularly EPT taxa of macroinvertebrates and intolerant and moderately tolerant fish species. Therefore, I do see a problem in "legalizing" low DO levels during wet weather conditions for the foreseeable future as this may well stop or reduce efforts to mitigate the effects of these events.

While it is not my intent to provide a detailed evaluation of the District's proposal for establishing DO criteria for the CAWS, I do have a few additional comments on the proposal and on Ms. Nemura's responses to pre-filed questions.

In the first instance, I found the triggers for implementing wet weather limited use designation to be quite low. I would assume that the number of rainfall events that exceed 0.25 inches could be significant, and certainly in a wet spring and early summer like we are having this year there could be a significant amount of time that the wet weather designation was in effect.

Additionally, I note that Ms. Nemura was asked in pre-filed questions (II 4) about the effects of DO levels below 2 mg/l on non-mobile organisms. She stated that she had not studied this. Many EPT taxa of macroinvertebrates which are found on hard substrates have limited movement, and would likely be adversely affected by extended periods of low DO. Some might drift with the current out of the area and others might die. Mobile fish might move out of the area altogether, or into refuges of higher DO such as are provided by the SEPA stations. Some fish, including many juvenile fish and larval fish, will have considerable trouble finding adequate DO during such periods of very low or extended DO. A fish kill of small, juvenile and larval fish is unlikely to be noticed at the time of the kill, and the damage to aquatic life may never be associated with the low DO event.

Ms. Nemura responded to question 11 about Mr. Zenz's testimony regarding the possibility of meeting DO standards through the use of aeration equipment by stating that she "would not make any

definitive conclusions that if the technologies that were simulated were implemented, that you could achieve full compliance with water quality standards in all hydrologic periods." But would the wet weather limited use designation preclude the District from even trying to implement this kind of technology to help raise DO levels, even if they did not fully meet DO standards? Because aeration would help provide a refuge for many fish species during stressful low DO conditions and could be important biologically, particularly for many of the intolerant and moderately tolerant species, I believe that greater efforts are needed to prevent low DO events by controlling CSOs and probably by supplementing DO levels in selected locations.

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