

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF: )  
)  
TRIENNIAL REVIEW OF WATER QUALITY ) R11-18  
STANDARDS FOR BORON, FLUORIDE ) (Rulemaking – Water)  
AND MANGANESE: AMENDMENTS )  
TO 35 ILL. ADM. CODE 302.Subparts B, C, E )  
and F and 303.312) )

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PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Illinois Pollution Control Board the Illinois Environmental Protection Agency's TESTIMONY OF BRIAN KOCH for the above-captioned proceeding, a copy of which is herewith served upon you.

ILLINOIS ENVIRONMENTAL  
PROTECTION AGENCY

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TESTIMONY OF BRIAN KOCH

Qualifications/Introduction

My name is Brian Koch and I have been employed by the Illinois Environmental Protection Agency (“Illinois EPA or “Agency”) for five years. I work as a toxicologist in the Water Quality Standards section of the Division of Water Pollution Control. I have a B.A. and M.S. in Zoology from Southern Illinois University Carbondale, with specialization in fisheries ecology and aquatic toxicology, respectively. My primary responsibility at the Agency is to derive water quality standards and criteria through the implementation of USEPA and Illinois EPA methodologies. My testimony will discuss procedures utilized in the derivation of new boron, fluoride and manganese water quality standards for General Use, Lake Michigan Basin and Public and Food Processing Water Supply designated uses. I will also discuss the corrections proposed to the General Use zinc water quality standard. The proposed water quality standards revisions for boron, fluoride, and manganese are the culmination of new toxicity data generated by the Illinois Natural History Survey (INHS) and Great Lakes Environmental Commission (GLEC), with oversight provided by Illinois EPA and USEPA. A detailed, technical discussion of the water quality standards derived from this data, as well as previously existing data compiled through an extensive literature search, is provided in the technical support

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document entitled “Facts in Support of Changing Water Quality Standards for Boron, Fluoride, and Manganese”. This technical support document was provided as Attachment 1 of the Agency’s proposal filed December 2, 2010. My testimony will serve as an abbreviated summary of information provided within the technical support document.

Aquatic Life-Based Water Quality Standards for Boron, Fluoride, and Manganese

The existing General Use and Lake Michigan Basin standards for boron, fluoride and manganese were adopted in the Board’s first standards rulemaking in 1972. In the years since their adoption, the quantity and quality of toxicity data for each substance has greatly increased, and a standardized methodology for developing scientifically based water quality standards is now available. The USEPA document entitled *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, 1985 (“the Guidelines”, Attachment 1, Exhibit F of the Agency’s proposal) is used in standards development by USEPA and other states and was used by Illinois EPA to develop the proposed water quality standards for boron, fluoride, and manganese. The Guidelines is also used as a basis for procedures in 35 Ill. Adm. Code Part 302 Subpart E and Subpart F of the Board’s rules used in deriving water quality criteria. The proposed standards were derived using toxicity data conducted on appropriate test organisms using acceptable test methods, appropriate laboratory waters, and proper endpoints. Test organisms were restricted to those meeting Illinois data requirements, as specified in 35 Ill. Adm. Code 302.612 (General Use waters) and 302.553 (Lake Michigan Basin waters). General Use and Lake Michigan Basin water quality standards are typically developed independent of one another, as Family

Salmonidae data is required in Lake Michigan Basin derivations but is excluded from General Use derivations. However, given the tolerance of salmonids to each substance and the intricacies of the mathematical equations within the Guidelines, the resulting Lake Michigan Basin standards were found to be less stringent than the standards developed using General Use data requirements. Given that Lake Michigan Basin methodology is intended to provide further protection to salmonids (a sensitive taxon), it is impractical to regulate Lake Michigan Basin waters with standards that are relaxed in comparison to General Use standards. Thus, we are proposing that the revised General Use standards be applied to both categories of waters.

The Guidelines allows for water quality standards to be developed independent or dependent of water quality parameters such as pH, temperature, and hardness. Literature reviews and additional laboratory tests (conducted by INHS and GLEC) studying the influence of water chemistry on boron toxicity had confounding results, therefore boron standards were developed independent of water chemistry. The acute and chronic boron standards were derived using the Final Acute Value (FAV) and Acute Chronic Ratio (ACR) methodology, respectively. The FAV is an estimation of a toxicant concentration that would be protective of at least 95% of species at the LC50 level of effect over an acute exposure period. The FAV is then divided by 2 in order to derive the acute water quality standard. This additional step is necessary to convert the FAV from an LC50 level of protection to a level that is protective at the No Observable Adverse Effect Level (35 Ill. Adm. Code 302.603). When assessing chronic toxicity, the ACR approach can be used as a means to develop a chronic standard that is linked to the corresponding acute standard. An ACR is calculated by dividing the acute LC50 of a species by the

Maximum Acceptable Toxicant Concentration (MATC, 35 Ill. Adm. Code 302.603) of the same species derived from a chronic test conducted in the same laboratory under test conditions identical to the acute test. A Final Acute-Chronic Ratio (FACR) is then calculated by taking the geometric mean of all available ACRs for each species. A chronic standard can then be obtained by dividing the FAV of a substance by the FACR of that substance. Upon compiling all of the valid boron toxicity data and following the Guidelines methodology, the resulting acute and chronic standards for boron are 40.1 mg/L and 7.6 mg/L, respectively. A thorough documentation of the toxicity data and resulting derivation of the proposed acute and chronic boron standards have been included within the narrative of Attachment 1 and Exhibits G, H, I and J of the Agency's proposal.

Given that fluoride and manganese toxicity is known to be influenced by the hardness of test water, standards for these substances were developed to account for hardness-dependent relationships. The acute standards for these substances were derived in a similar manner to the acute boron standard, with the only exception being that FAVs and resulting acute standards are hardness-based and therefore must be expressed as equations. The numerous procedures required to derive water quality dependent standards are fairly complex. However, a simplified explanation of the procedures used in deriving the acute fluoride and manganese standards is as follows. Toxicity data for each substance (from laboratory tests conducted at variable hardness) was quantified in order to determine a slope which signifies the influence of hardness on toxicity. These slopes are denoted as "*B*" in the equations that express each standard. Using the available datasets for each substance, the sensitivities of tested species were then normalized to a

hardness concentration of 50 mg/L and were ranked in order to derive an FAV at that hardness concentration. The FAV was then divided by 2 in order to derive the acute standards at 50 mg/L hardness. These values (acute standards at 50 mg/L hardness) were mathematically simplified and expressed as the intercepts “*A*” in the equations used to calculate each standard. Therefore, when a hardness of 50 mg/L is plugged into the equations for each acute standard, the resulting standards will be equal to the results of the “FAV / 2” calculations that were initially solved for each substance at a hardness of 50 mg/L. It is important to note that the hardness concentration selected for data normalization has no effect on the resulting standards, as it is merely used to normalize the data so that organism sensitivities can be ranked. A detailed documentation of the toxicity data and mathematical procedures used in deriving the proposed acute fluoride and manganese standards is provided within the narrative of Attachment 1 and Exhibits K, L, M, N, O and Q of the Agency’s proposal.

Similar to boron, the chronic standard for fluoride was developed using the ACR approach, but the resulting standard is hardness-based and is expressed as an equation. The hardness-dependent chronic standard was obtained by dividing the FAV (normalized at 50 mg/L hardness) by the FACR, which gives the chronic fluoride standard at a hardness of 50 mg/L. The chronic standard equation is similar to the acute standard equation, with the one exception being that the intercept “*A*” is an expression of the chronic toxicity of fluoride rather than acute toxicity. The slope “*B*”, which expresses the influence of hardness on toxicity, is the same slope that was used in the acute standard. In addition to the hardness-based chronic fluoride standard, a limit of 4.0 mg/L fluoride (on a chronic basis) has been proposed for protection of wildlife and livestock that may

utilize General Use or Lake Michigan Basin waters for watering sources. The 4.0 mg/L limit is equivalent to the safe exposure level of fluoride to humans as determined by USEPA and further detailed in the Integrated Risk Information System. The 4.0 mg/L limit would be applicable in most Illinois waters given that the hardness-based chronic standard would exceed 4.0 mg/L when calculated using average hardness concentrations of Illinois waters. Further discussion regarding the 4.0 mg/L chronic limit, as well as detailed documentation of the toxicity data and mathematical procedures used in deriving the chronic fluoride standard equation is provided within the narrative of Attachment 1 and Exhibits M and P of the Agency's proposal.

The chronic standard for manganese was developed in an alternative fashion compared to the chronic boron and fluoride standards. The standard was not developed using the ACR approach because the resulting standard was not protective of *Hyalella azteca*, the most sensitive species in the database. As stated in 35 Ill. Adm. Code 302.627(d), if a resident species whose presence is necessary for sustainment of a waterbody's ecosystem will not be protected by the calculated chronic standards then the MATC for that species should be used in developing the chronic standard. Given that this organism represents a class of benthic macroinvertebrates common in Illinois waters and is considered ecologically important, the chronic manganese standard was developed to protect at a concentration equivalent to the *Hyalella azteca* chronic MATC. This was done by replacing the FACR-based chronic intercept of 1.52 mg/L with the *Hyalella azteca* chronic MATC of 1.08 mg/L, which was further simplified and is expressed as "A" in the chronic standard. The slope "B" in the chronic standard is the same slope used in the acute standard. Further information detailing the derivation of the chronic

manganese standard is provided in the narrative of Attachment 1 and Exhibits L, N, and R of the Agency's proposal.

Aquatic toxicity results are typically reported as the total amount of toxicant present in a test, yet for metals, it is the dissolved fraction that is bioavailable for uptake across gill membranes and is the toxic component. Factors such as precipitation or sorption with suspended solids can reduce the dissolved fraction of a metal and reduce bioavailability, therefore it is necessary to measure total and dissolved metal concentrations when developing toxicity-based water quality standards. Because permit limits for dischargers are written in total form, the aquatic life standards are also listed in total form. For a substance that is always present in dissolved form (100% dissolved), the dissolved measurement of that substance is equivalent to the total measurement of that substance, therefore the total and dissolved standard would be equivalent. Such is the case for the proposed boron and fluoride standards. However, for metals such as manganese that can be found in the environment at dissolved concentrations much lower than total concentrations, a conversion factor multiplier must be incorporated into the standards in order to convert from the total standard to the dissolved standard. The conversion factor multiplier for manganese (0.9812) was derived from total and dissolved manganese data collected during the chronic *Hyalella azteca* test conducted by INHS. Further information detailing the derivation of the conversion factor multiplier used in the acute and chronic manganese standards is provided in the narrative of Attachment 1 and Exhibit T of the Agency's proposal.



### Public and Food Processing Water Supply and Open Waters of Lake Michigan

There are no existing Public and Food Processing Water Supply or Open Waters of Lake Michigan standards for boron or fluoride, therefore the current General Use and Lake Michigan Basin standards for these substances are applicable in these waters and are protective of their respective uses. Given that the proposed General Use and Lake Michigan Basin standards for boron and fluoride are higher than the existing standards, and the existing standards are currently protective of Public and Food Processing Water Supply and Open Water of Lake Michigan uses, we are proposing to formally adopt the existing General Use and Lake Michigan Basin standards for boron and fluoride as Public and Food Processing Water Supply and Open Waters of Lake Michigan standards, respectively. In actuality, the 1.0 mg/L boron and 1.4 mg/L fluoride standards proposed for these waters do not reflect new standards, as the existing General Use and Lake Michigan Basin boron and fluoride standards are presently enforced in these waters.

The manganese Public and Food Processing Water Supply and Open Waters of Lake Michigan standards are presently set at 0.15 mg/L. Open Waters of Lake Michigan standards are based on background conditions of Lake Michigan rather than protection of human health or aquatic life, therefore we are not proposing to modify the existing manganese standard for these waters. Public and Food Processing Water Supply standards are intended to represent the maximum allowable concentration of a substance at the point of surface water intake that will allow for attainment of the finished drinking water Maximum Contaminant Level (MCL) for that substance following conventional treatment. The existing Public and Food Processing Water Supply and finished drinking water MCL for manganese are both set at 0.15 mg/L, therefore the existing regulations do

not account for any removal of manganese from surface waters that may occur during conventional treatment. The March 7, 1972 Board opinion (R71-14, slip opinion at page 9) provides justification for this decision, as the information available at that time did not conclude that manganese could be “substantially affected by ordinary water supply treatment”. However, it is now well known that manganese can be effectively removed from surface waters via conventional treatment. Based on removal estimates within published literature, as well as data collected from conventional treatment plants in Illinois, it is apparent that >90% of manganese can be removed through conventional treatment. The newly proposed manganese Public and Food Processing Water Supply standard of 1.0 mg/L will allow for attainment of the 0.15 mg/L finished drinking water MCL for manganese following conventional treatment and will therefore be protective of Public and Food Processing Water Supply Use. Detailed documentation of the effectiveness of conventional treatment on manganese removal is provided in the narrative of Attachment 1 and Exhibit E of the Agency’s proposal.

#### Correction to the Chronic Zinc Water Quality Standard

The existing General Use chronic aquatic life standard for zinc is hardness-based (See 35 Ill. Adm. Code 302.208(e)) and was adopted in the R02-11 rulemaking. Unbeknownst at that time, the data initially filed with the Board and used in deriving the standard contained an error. The MATC for *Hyaella azteca* was erroneously calculated as 42.25 µg/L rather than 67.59 µg/L, as percent survival values were mistakenly used in the MATC calculation rather than the actual treatment concentrations that resulted in the percent survival effects. Given that *Hyaella azteca* was listed as the most sensitive organism in the chronic database, the erroneous MATC value had a substantial affect on

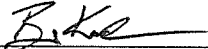
the resulting standard. At a hardness of 50 mg/L, the current standard is 12.16 µg/L, whereas the corrected standard would be 17.62 µg/L. Because the current chronic zinc standard is not representative of the true dataset, we are proposing to correct the standard by applying the proper MATC for *Hyalella azteca*. Given this recalculation, the equation representing the standard must be modified to include the appropriate intercept (“*A*” = -0.4456), while the slope (“*B*” = 0.8473) remains unchanged. A detailed documentation of the error and associated correction to the existing standard is provided within the narrative of Attachment 1 as well as the associated Exhibits V, W, and X.

#### Conclusions and Recommended Standards

The Agency does not believe this rulemaking will result in the need to implement additional treatment technologies beyond those required by the existing regulations; therefore it is technically feasible and economically reasonable. This rulemaking does not seek to establish any specific effluent standards or other requirements targeted at specific facilities or classes of facilities. There will be no impact on those facilities currently in compliance with the existing standards for boron, fluoride, manganese, and zinc. Several facilities that cannot comply with existing standards for boron, fluoride manganese and zinc have the potential to benefit from the rulemaking. The Agency sufficiently conducted outreach to stakeholders by sharing a draft of the rulemaking proposal, holding a meeting to present the components of the draft rulemaking and interacting in a question and answer session, accepting written comments, and emailing updates on modifications to the proposal.

The Agency believes that implementation of the proposed numeric standards for boron at 35 Ill. Adm. Code 302.208(g) and 302.504(a) and the hardness-dependent

standards for fluoride and manganese at 35 Ill. Adm. Code 302.208(e) and 302.504(a) will provide appropriate protection for the designated uses of General Use and Lake Michigan Basin waters. Likewise, modification of the chronic zinc standard to reflect the true chronic database will now allow for proper regulation of this substance in General Use waters. Additionally, appropriate protection of Public and Food Processing Water Supply use and Open Waters of Lake Michigan use will be achieved by inclusion of the proposed boron, fluoride, and manganese standards at 35 Ill. Adm. Code 302.304 and 302.504(c), respectively. The Agency believes that all proposed standards are scientifically justified and will serve to effectively protect the designated uses of all associated waters. This concludes my pre-filed testimony. I will be supplementing the testimony as needed during the hearing and would be happy to address any questions.

By:  \_\_\_\_\_

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May 19, 2011

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