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SENT ELECTRONICALLY
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RE: Comments on MPCA 2017 Triennial Standards Review

Dear Ms. Neuschler, Ms. O'Dell,

Thank you for the opportunity to provide comments on the Minnesota Pollution Control Agency (MPCA) 2017 Triennial Standards Review scope and schedule for changes in water quality standards. The following comments and attached references are submitted on behalf of WaterLegacy, the Sierra Club North Star Chapter, Northeastern Minnesotans for Wilderness, Friends of the Cloquet Valley State Forest and the Wisconsin Resources Protection Council.

We believe that the Minnesota Pollution Control Agency (MPCA) should take the following actions to protect aquatic life and human health and to comply with the federal Clean Water Act:

1. The MPCA must postpone its proposed changes to eliminate, weaken or convert to a narrative various Minnesota Class 3 (Industrial) and Class 4 (Agricultural and Wildlife) water standards in order to avoid impairments of fish and other aquatic biota in violation of the federal Clean Water Act and its implementing regulations.

2. The MPCA must prioritize setting a Class 2 (Aquatic Life and Recreation) water quality standard for specific conductivity to protect fish and other aquatic biota. MPCA data and detailed analysis by the U.S. Environmental Protection Agency (EPA) are sufficient to proceed with rulemaking and to set specific conductivity limits to protect aquatic life in Minnesota.

3. The MPCA must prioritize setting a Class 2 (Aquatic Life and Recreation) water quality standard for sulfate to prevent methylation of mercury and bioaccumulation of methylmercury in the aquatic food chain. Discharge of sulfate contributes to violations of numeric criteria for mercury and threatens the developing brains of human fetuses, infants and children as well as wildlife that consume fish.

The need for these actions is discussed in more detail below.

1. The MPCA Must Postpone Proposed Changes to Class 3 and Class 4 Standards.

In its 2017 timeline for Triennial Review,[1] the MPCA proposes to revise standards for waters designated for Class 3 (Industrial) and Class 4 (Agricultural and Wildlife) uses as a Group 1A project. Proposed changes to Class 3 and Class 4 water quality standards are highly significant for fish and other aquatic biota, since most Minnesota waters are classified and protected for multiple beneficial uses.[2] Thus, a Class 2 (Aquatic Life and Recreation) lake or stream will also be classified as a Class 3 and Class 4 water, and water quality standards applicable to the Class 3 or Class 4 beneficial uses will also protect the use of waters for aquatic life and recreation.

The MPCA's proposal to revise Class 3(Industrial) and Class 4 (Agricultural and Wildlife) standards is, in large part, a set of recommendations for deregulation on the grounds that industry and agriculture do not require the level of protections reflected in existing rules. Class 3 numeric limits on chlorides, hardness and pH would be replaced with a narrative standard. Class 4 limits on salinity would be removed and limits for total dissolved salts would be removed for irrigation waters and made less protective for waters used for livestock. The water quality standard for specific conductivity, which is an efficient test of ionic pollution resulting from various salts, would also be weakened under the proposed Class 3 and Class 4 provisions.

The Technical Support Document Summary from the University of Minnesota posted by the MPCA implies that, if Class 3 and Class 4 standards were eliminated, weakened or replaced with an indefinite narrative standard, Class 2 standards would protect aquatic life. The TSD Summary states, "Another option available is to modify the current water quality standards such that they directly relate back to current Class 2 aquatic life-recreational use water quality standards. This option would remove current Class 3 water chemistry parameters (pH, total hardness, and chloride) and substitutes a narrative standards citing back to the Class 2 standards."[3]

The expectation or assumption that Class 2 standards would protect aquatic-life and recreation if water quality standards for industrial, agricultural and wildlife beneficial uses were removed is incorrect.

Comparisons between existing Class 2 (Aquatic Life and Recreation) water quality standards and both existing and proposed Class 3 (Industrial) and Class 4 (Agricultural and Wildlife) standards are provided in the Water Quality Standards Comparison worksheet attached to these comments.

Class 2 standards for chloride are far less protective than those for Class 3 industrial waters.[4] According to the MPCA, the Class 2 aquatic life standard for chloride has been slated for revision. There is new information that water softeners in wastewater and road salt in urban runoff impair aquatic life and that Minnesota's current chloride standard is based on "potentially

[1] MPCA's proposed water quality standards work plan, 2018 – 2020, https://www.pca.state.mn.us/water/mpca%E2%80%99s-proposed-water-quality-standards-work-plan-2018-2020
[2] Minn. R. 7050.0220, Subp. 1.
[3] Technical Support Document Summary: University of Minnesota Class 3 and Class 4 Water Quality Standards Review Minnesota Surface Water Quality Investigation - Industrial Supply, Irrigation and Livestock Uses, June 29, 2010, p. 115, see also p. 2. Report available at https://www.pca.state.mn.us/water/amendments-water-quality-standards-%E2%80%94-use-classifications-3-and-4
[4] See Minn. R. 7050.0220, Subp. 3a(5); Subp. 4a(5); Supb. 5a(3).

outdated science."[5] Removing Class 3 and Class 4 chloride standards prior to determining the limits needed to protect aquatic life from chloride would fail to meet the minimum requirements for changes in water quality standards under the Clean Water Act.[6]

In addition, although Class 3 industrial water quality standards limit total hardness from calcium and magnesium, Class 2 aquatic life standards do not regulate hardness or calcium.[7] Recent scientific evidence indicates that there is a calcium threshold for zebra mussel invasive species.[8] Unimpacted waters in the Lake Superior Basin and north of the Laurentian divide may have low enough calcium under natural conditions to protect many Minnesota waters against invasion by zebra mussels. The appropriate criteria for calcium needed to protect aquatic life from zebra mussel invasive species must be determined before hardness standards are removed from waters with Class 2 beneficial uses.

Several changes proposed for Class 4 (Agricultural and Wildlife) standards[9] pertain to deregulation of controls on salinity. Although a water quality standard for sulfate of 500 to 2,000 milligrams per liter (mg/L) is proposed for Class 4B waters for livestock drinking, the MPCA proposes to eliminate the 1,000 mg/L standard limiting total salinity, remove the 700 mg/L standard for total dissolved salts in Class 4A waters, substantially weaken the standard for total dissolved salts in Class 4B waters (a standard of 3,000 – 5,000 mg/L has been proposed), eliminate the 1,000 µS/cm[10] standard for specific conductance in Class 4B waters and weaken the specific conductivity standard in Class 4A waters (a standard of 1,200 -1,700 µS/cm has been proposed).

There is a wealth of scientific evidence developed during the past decade by the U.S. Environmental Protection Agency (EPA) Office of Research and Development and published in peer-reviewed literature demonstrating that removing controls on salts and ionic pollution would impair aquatic life beneficial uses. EPA's research establishes that dissolved salts, whether measured in milligrams per liter of specific ions or measured in microSiemens of conductivity, extirpate sensitive aquatic insects and adversely impact freshwater fish.[11]

As detailed in the next section of these comments, Minnesota's existing Class 4 standards for salts and ionic pollution are already insufficiently stringent to protect aquatic life throughout all ecoregions of the State. Eliminating or weakening these existing Class 4 standards in Class 2 (Aquatic Life and Recreation) waters prior to determining what standards are needed to protect

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[5] MPCA's proposed water quality standards work plan, 2018 – 2020, *supra*, Chloride- aquatic life.
[6] 40 C.F.R. §131.6(a) and (c); 33 U.S.C. §1251(a)(2).
[7] *See* Minn. R. 7050.0223 and Minn. R. 7050.0220.
[8] *See e.g*. A.N. Cohen, A. Weinstein, Zebra Mussel's Calcium Threshold and Implications for its Potential Distribution in North America, San Francisco Estuary Institute, June 2001; S.S. Hinks, G.L Mackie, Effects of pH, calcium, alkalinity, hardness, and chlorophyll on the survival, growth and reproductive success of zebra mussel (Dreissena polymorpha) in Ontario Lakes, *Can. J. Fish, Aquatic Sci*., 54:2049-2057 (1977). References attached.
[9] *See* Minn. R. 7050.0224 for existing Minnesota Class 4 water quality standards.
[10] Minnesota's measurement of conductivity in micromhos per centimeter at 25° C is equivalent to measurement of conductivity in microSiemens per centimeter at 25° C (µS/cm), the measurement used by EPA and in the published literature.
[11] See M.B. Griffith, L. Zheing, S.M. Cormier, Using Extirpation to Evaluate the Ionic Tolerance of Freshwater Fish, *Env. Tox. & Chem*., Vol. 9999, Number 9999, pp. 1013, 2017 (accepted for publication Oct. 2017) and G. Suter, U.S. EPA ORD, Micro Siemens or Milligrams: Measured of Ionic Mixtures, PowerPoint presentation Jan. 11, 2017. References attached.

sensitive benthic macroinvertebrates and freshwater fish species from excessive salts and ionic pollution would violate the Clean Water Act and its implementing regulations.[12]

The undersigned organizations express no opinion as to whether the MPCA's proposed changes to alter or deregulate water quality standards for Class 3 (Industrial) and Class 4 (Agricultural and Wildlife) are appropriate for industrial and agricultural users of Minnesota waters. However, it is clear to us that these Class 3 and Class 4 rule changes cannot proceed under the Clean Water Act unless and until the following actions have been taken:

1) MPCA must conduct a thorough scientific analysis to evaluate the effects of every proposed change that will make Class 3 and Class 4 standards less stringent or that will eliminate numeric criteria on fish and other aquatic biota.

2) MPCA must adopt Class 2 (Aquatic Life and Recreation) water quality standards consistent with current science to protect aquatic life from chlorides, calcium and hardness, salts and ionic pollution prior to proceeding with changes to Class 3 and Class 4 standards for these parameters.

The Clean Water Act thus requires that the MPCA alter the priority and schedule for proposed rule changes that will weaken or deregulate numeric criteria for Class 3 or Class 4 waters. Until the above analysis and rulemaking have been completed, proposed changes to Class 3 and Class 4 standards are untimely and fail to meet minimum requirements for rulemaking under the Clean Water Act.

2. The MPCA Should Prioritize Adoption of a Class 2 Standard for Specific Conductivity and Apply Hazardous Concentration Values Developed by EPA.

MPCA currently identifies as a "possible revision" the development of a specific conductivity standard that would protect aquatic life. This "possible revision" doesn't even make MPCA's Group 2B list of priorities.

We believe that the MPCA has sufficient data and analysis from its own research, as well as that of the EPA, to promulgate as a Group 1A priority a rule limiting specific conductivity and to apply hazardous concentration values for specific conductivity to protect aquatic life, particularly in northeastern Minnesota.

A field-based method of determining aquatic life numeric criteria for specific conductivity was finalized by the EPA in 2011.[13] Since 2011, environmental and other stakeholders have requested that the MPCA both protect aquatic life from toxic wastewater discharge by limiting specific conductivity in wastewater discharge permits and that the MPCA also conduct rulemaking to set numeric criteria for specific conductivity to protect aquatic life.

In 2015, retired Minnesota regulators Bruce Johnson and Maureen Johnson undertook a review

[12] 40 C.F.R. §131.6(a) and (c); 33 U.S.C. §1251(a)(2).
[13] EPA, A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams, Final Report, EPA/600/R-10/023F, March 2011 ("EPA 2011 Conductivity Benchmark Report"), available at https://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=233809 or on request.

of background levels of specific conductivity in a portion of Northeastern Minnesota's Ecoregion 50, along with data pertaining to benthic invertebrates (aquatic insects) in both impacted and unimpacted waters in the ecoregion.[14] They concluded that the EPA protocols for field-based specific conductivity criteria were applicable to Northeast Minnesota surface waters. In addition, they recommended adoption of a numeric criterion of 300 µS/cm as a chronic value of year-round application in order to protect benthic macroinvertebrates according to the criteria (prevent 5% extirpation of invertebrate genera/protect 95% of genera) set by the EPA.[15]

The EPA's Office of Research and Development reviewed the Johnson & Johnson Specific Conductance Evaluation and concluded in a memorandum dated February 4, 2016, that the weight of evidence supported the inference that effluents that increase specific conductivity to more than 300 µS/cm are likely to extirpate more than 5% of genera common to both Minnesota and Appalachia, the ecoregion EPA initially studied, and have adverse effects in northeast Minnesota waters.[16]

The EPA secured a broader set of data on benthic invertebrates and water quality from the MPCA to independently validate the conclusions reached in the Johnson & Johnson Evaluation. The EPA concluded as follows:

> [T]he inference that 5% extirpation of benthic invertebrates would occur at similar conductivity levels in central Appalachia and Ecoregion 50 in Minnesota was supported by analysis of an independent data set of paired benthic invertebrate and SC data from Ecoregion 50 in Minnesota. We estimated that more than 5% of genera would be extirpated in streams greater than 320 µS/cm. [17]

In December 2016, after extensive peer-review, the EPA released for public review its field-based methods for States (and Tribes with Treatment as a State authority) to use in developing aquatic life criteria for specific conductivity in regions outside central Appalachia.[18] Appendix D to the EPA's 2016 Field-Based Methods report detailed the method that should be used by states to develop a numeric criterion for specific conductance where there is sufficient water chemistry and biological data to calculate extirpation concentrations and hazardous concentrations.

The EPA reviewed biological and specific conductivity for 62 Level III Ecoregions, including four ecoregions in Minnesota: Ecoregion 47 (Western Corn Belt Plains), Ecoregion 50 (Northern Lakes and Forests), Ecoregion 51 (North Central Hardwood Forests) and Ecoregion 52 (Driftless Area). The EPA map below shows these Minnesota ecoregions, along with paired biological and

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[14] B.L. Johnson & M.K. Johnson, An Evaluation of a Field-Based Aquatic Life Benchmark for Specific Conductance in Northeastern Minnesota, November 2015. Reference attached with Table 1.
[15] *Id*., p. 42.
[16] S. M. Cormier, Ph.D., Review Memorandum for "An Evaluation of a Field-Based Aquatic Benchmark for Specific Conductance in Northeast Minnesota" (November 2015) Prepared by B. L. Johnson and M. K. Johnson for WaterLegacy, Feb. 4, 2016, ("EPA Review Memo"), p. 2. Reference attached.
[17] *Id*., p. 10.
[18] EPA, Field-Based Methods for Developing Aquatic Life Criteria for Specific Conductivity, Public Review Draft, EPA-822-R-07-010 December 2016. This "EPA 2016 Field-Based Methods" document, along with its Appendices A through G and the 2014 and 2015 Peer Review Reports and EPA Responses pertinent to the Field-Based Methods are available at https://www.epa.gov/wqc/draft-field-based-methods-developing-aquatic-life-criteria-specific-conductivity or on request.

water quality sampling sites.[19]

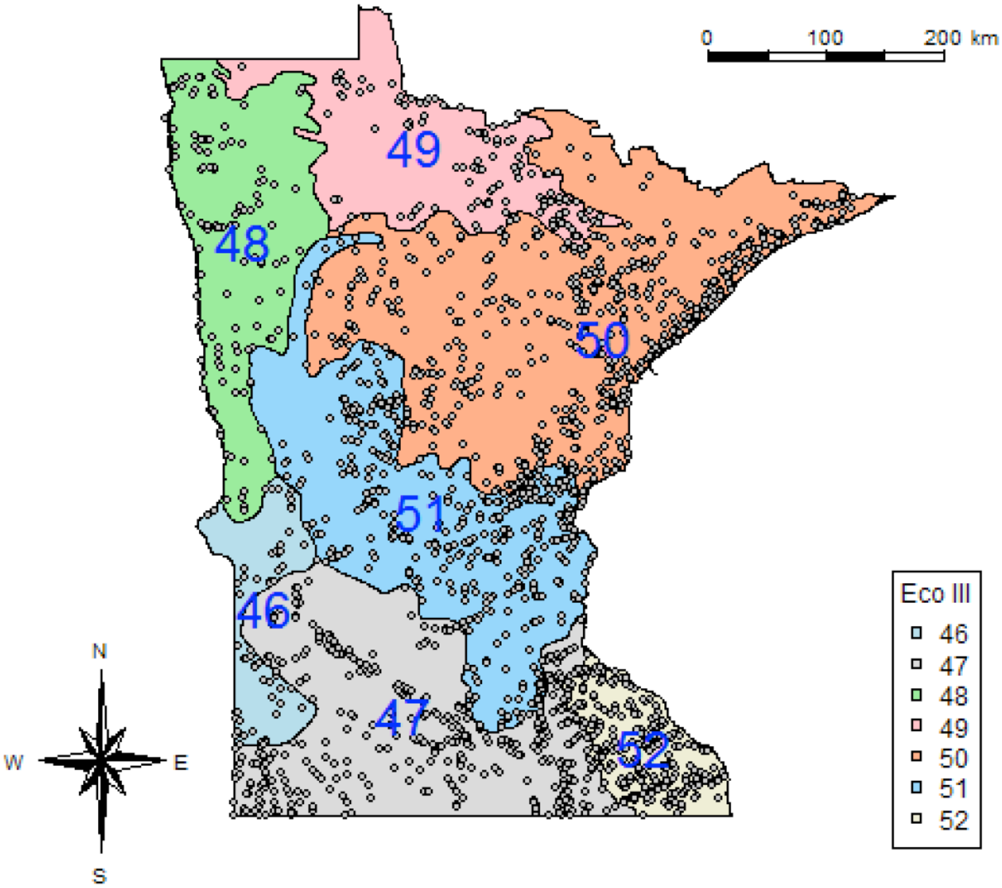

Figure 2. **Ecoregion 50 is contained in the orange area in the northeast portion of Minnesota.** Circles represent paired biological and water quality sampling sites. There are fewer samples in the area bordering Canada, often referred to as the boundary waters, which are less accessible for sampling.

The EPA noted that for Minnesota regions other than Ecoregion 50 in northeastern Minnesota the data had some discrepancies between State and EPA surveys of background levels of specific conductance that required further analysis. EPA developed examples for a specific conductivity hazardous concentration value in Ecoregions 47 and 51, a provisional specific conductivity value of 603 µS/cm for Ecoregion 52 in southeast Minnesota, and a provisional specific conductivity value of 320 µS/cm for Ecoregion 50, the Northern Lakes and Forests region in northeast Minnesota to protect aquatic life.[20]

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[19] EPA Review Memo, *supra*, p. 7.
[20] EPA 2016 Field-Based Methods, *supra*, Appendix D. Development of a Background-to-Criterion Regression Model, at D-4, D-23, D-27. As noted at D-29, the EPA concluded that the number of samples completed in the Northern Minnesota Wetlands Ecoregion 49 was insufficient to calculate a hazardous concentration of specific conductivity for this region.

Minnesota Level III Ecoregion		Number of MPCA		EPA Hazardous Concentration Specific Conductivity (µS/cm)	
Number	Name	Samples	Sites	Example	Provisional
47	Western Corn Belt Plains	473	404	688	
50	***Northern Lakes and Forests***	*734*	*596*		***320***
51	Northern Central Hardwood Forests	583	437	494	
52	***Driftless Area***	344	277		***603***

Since December 2016, the EPA has published in peer-reviewed journals the scientific basis for establishing the proposed specific conductivity hazardous concentrations based on the weight-of-evidence process, the use of extirpation to evaluate tolerance of specific conductivity, and the step-by-step calculation to predict specific conductivity levels that extirpate freshwater aquatic benthic invertebrates. The EPA has also developed spreadsheet tools to conduct this analysis and predict stressor levels that extirpate genera and species.[21]

Adoption of a water quality standard to protect aquatic life from hazardous concentrations of specific conductivity is a compelling priority in Minnesota, particularly in the Lake Superior Basin. The MPCA's St. Louis River Watershed Stressor Identification Report identified specific conductivity as a potential stressor in multiple water bodies.[22] The Stressor Identification Report recommended that state water quality standards for conductivity and sulfate be established both to improve confidence in stressor diagnosis and to support the development of TMDL limits when waters have been identified as impaired as a result of assessments for fish or benthic invertebrates.[23]

Proposed changes in land use to develop Minnesota's first copper-nickel mines in northeast Minnesota and to undertake frac sand mining in southwest Minnesota also underscore the priority for recognizing the impact of specific conductivity on aquatic life.

Section 303 of the Clean Water Act requires that State water quality standards enhance the quality of water, serve the purposes of the Act, and protect the propagation of fish and wildlife.[24] Federal regulations implementing the Clean Water Act require that effluent limitations in permits achieve water quality standards adopted under the Act, including State narrative criteria for water

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[21] G. Suter, S.M. Cormier, M. Barron, A Weight of Evidence Framework for Environmental Assessments: Inferring Qualities, *Int. Env. Assess. & Mgt.,* Vol. 13: 6, pp. 1038–1044; G. Suter, S.M. Cormier, M. Barron, A Weight of Evidence Framework for Environmental Assessments: Inferring Quantities, *Int. Env. Assess. & Mgt.* Vol. 13:6, pp. 1045–1051; M.B. Griffith, L. Zheing, S.M Cormier, Using Extirpation to Evaluate Ionic Tolerance of Freshwater Fish, *Env. Tox. & Chem.,* Vol. 9999: 9999, pp. 1–13, 2017 (accepted for publication Oct., 2017); S.M. Cormier, L. Zheing, E.W. Leppo, A. Hamilton, Step-by-step calculation and spreadsheet tools for predicting stressor levels that extirpate genera and species, *Int. Env. Assess. & Mgt*., Vol. 9999: 9999, pp. 1–7 (accepted for publication Oct., 2017). Published references attached; spreadsheet tools available on request.

[22] MPCA, St. Louis River Watershed Stressor Identification Report, wq-ws5-04010201a, Dec. 2016, available at https://www.pca.state.mn.us/sites/default/files/wq-ws5-04010201a.pdf. *See e.g*. pp. 7-8, 22, 32-36, 289-292, 299-305, 343-347, 379-386, 398, 400, 408-412, 419, 447.427-434.

[23] *Id*., p. 8.

[24] 33 U.S.C. §1313(c)(2)(A).

quality. They also require that NPDES permits control all pollutants that may be discharged at a level that has the reasonable potential to cause or contribute to an exceedance of State narrative criteria.[25]

Minnesota's water quality standards contain narrative criteria requiring protection of aquatic life from the toxic effects of pollutants through site-specific numeric criteria in the absence of broadly applicable numeric standards in order to "protect class 2 waters for the propagation and maintenance of aquatic biota."[26] Minnesota's rules define "protection of the aquatic community from the toxic effects of pollutants" to mean "the protection of no less than 95 percent of all of the species in any aquatic community."[27] This is the same extirpation standard used by the EPA to develop the hazardous concentrations of specific conductivity detailed in its 2016 Field-Based Methods report and peer-reviewed publications.

For the reasons discussed above, the MPCA should take the following actions to protect aquatic life from specific conductivity, particularly in Minnesota's Ecoregion 50, the Northern Lakes and Forests ecoregion, where there is sufficient and consistent data to determine the hazardous concentration of specific conductivity that would result in toxicity to benthic invertebrates:

1) MPCA must make adoption of a Class 2 (Aquatic Life and Recreation) water quality standard for specific conductivity a Group 1A rulemaking priority, consistent with current science, MPCA data, and EPA analysis of hazardous concentration values that would protect 95% of benthic invertebrate genera.

2) MPCA must interpret its narrative criteria and provide site-specific water quality criteria for specific conductivity to protect 95% of benthic invertebrate genera in any NPDES permit in Ecoregion 50 where proposed discharge to surface waters has a reasonable potential to exceed 320 µS/cm.

3) <u>The MPCA Must Prioritize Rulemaking and Limit Sulfate Loading to Prevent Exceedance of Mercury Criteria and to Protect Wildlife and Human Health.</u>

In its 2017 timeline for Triennial Review, the MPCA proposes to develop Class 2 (Aquatic Life and Recreation) standards for sulfate some time in the indefinite future (will not move into the next phase before 2020) as a Group 2B priority.[28] The MPCA has identified sulfate, in some cases in combination with specific conductivity and other parameters, as a stressor leading to extirpation of benthic invertebrates and impairment of waters to support diverse and abundant fish species.[29]

There is evidence that background sulfate levels in northeastern Minnesota, like background specific conductivity levels, are far below the levels discharged by mining facilities and that

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[25] 40 C.F.R. §122.44(d)(1), specifically (d)(1)(i) and (d)(1)(vi); 40 C.F.R. §123.25(a)(15).
[26] Minn. R. 7050.0217, Subp. 1.
[27] Minn. R. 7050.0217, Subp. 2.
[28] MPCA's proposed water quality standards work plan, 2018 – 2020, available at https://www.pca.state.mn.us/water/mpca%E2%80%99s-proposed-water-quality-standards-work-plan-2018-2020
[29] See e.g. MPCA, St. Louis River Watershed Stressor Identification Report, *supra*, pp. 7-8, 36-40, and multiple references in evaluation of individual impaired water bodies.

levels of sulfate downstream of mining discharges may be toxic to sensitive benthic invertebrates.[30] However, as distinguished from specific conductivity, there is no definitive authority already developed that is sufficient to set specific numeric criteria to protect fish and benthic invertebrates from sulfate toxicity. Particularly if specific conductivity water quality standards are implemented in site-specific standards in Ecoregion 50 and prioritized for rulemaking, the MPCA's time frame proposed to set sulfate standards to protect sensitive fish and benthic invertebrate taxa may be reasonable.

However, the MPCA must not take a similar temporizing approach to establish Class 2 water quality standards for sulfate to prevent release of mercury, methylation of mercury, and increased bioaccumulation of toxic methylmercury in aquatic biota and fish.

The MPCA first acknowledged more than 11 years ago the need to develop specific sulfate concentration limits or other regulatory responses to the scientific evidence that sulfate loading can increase methylmercury production. In 2006, the MPCA committed to a "multi-year data collection effort combined with ongoing data analysis" so that "sensitive areas of the state will be identified and appropriate controls on sulfate discharge will be developed if necessary."[31] Yet, it appears from MPCA's Triennial Review timeline and work plan that MPCA has yet made no progress controlling sulfate discharge, and that no progress is contemplated by the Agency in the foreseeable future.

Recent peer-reviewed research authored by Amy Myrbo, Ph.D., in conjunction with the MPCA's wild rice sulfate standards studies, has demonstrated that increased sulfide production resulting from sulfate loading both increases release of inorganic mercury from sediments into the water and increases the proportion of mercury that is converted to toxic methylmercury.[32]

Dr. Myrbo found that sulfate loading to mesocosms of either 100 mg/L or 300 mg/L increased methylmercury by a factor of 5.9 as compared to the control experiment where no sulfate was added.[33] Sulfate loading also increased release of inorganic mercury from sediments to the water, with a maximum increase of 2.2 times over the experimental control under conditions of sulfate loading of 300 mg/L.[34]

Both the increased release of mercury from sediments and wetlands and the increased production of methylmercury are significant concerns. Bioaccumulation of methylmercury in fish tissue and excessive mercury in the water column are major causes of water quality impairments in Minnesota.

According to the MPCA's draft 2018 Impaired Waters List, there are 1,662 water bodies or stream segments that have been identified as impaired for Aquatic Consumption as a result of

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[30] *See* EPA 2011 Conductivity Benchmark Study, *supra*, Appendix A; Johnson & Johnson, Specific Conductivity Report, *supra*, pp. 12-13, 28-29, Attachment A Table 1.
[31] MPCA Strategy to Address Indirect Effects of Elevated Sulfate on Methylmercury Production and Phosphorus Availability, Final, Oct. 19, 2006. Reference attached.
[32] Myrbo, et al., Increase in nutrients, mercury, and methylmercury as a consequence of elevated sulfate reduction to sulfide in experimental wetland mesocosms (2017*), J. Geophys. Research: Biogeosciences*, 122, 2769-2785.
[33] *Id*., Table 1, p. 2775.
[34] *Id*. Dr. Myrbo also concluded at p. 2771 that local inhibitory effects of sulfide on mercury methylation would only apply where sulfide concentrations exceeded 300-3000 μg/L.

mercury in the water column or mercury in fish tissue.[35] Mercury in fish tissue is the single largest category of impairments in Minnesota's draft 2018 inventory, representing 31% of the total inventory of impaired waters.[36] Although 111 water bodies are identified in the draft 2018 Impaired Waters List as delisted in compliance with water quality standards, there is not a single mercury-impaired Minnesota water body that has been delisted or proposed for delisting.[37]

Bioaccumulation of methylmercury in the aquatic food chain harms piscivorous (fish-eating) mammals and birds and insectivorous bats.[38] Vulnerable wildlife may include species protected by the Endangered Species Act and as well as under state law.

The harmful effects of methylmercury contamination of fish to human health are well-known. Dr. Margaret Saracino, a Duluth child and adolescent psychiatrist has explained the particular vulnerability of fetuses, infants and children to morbidity resulting from methylmercury exposure:

> When pregnant women eat fish high in methylmercury, the fetus is then exposed to this lipophilic heavy metal. The placenta is not protective and the blood brain barrier is not well formed until after age two years, which makes fetuses, infants and young children most vulnerable to methylmercury's neurotoxic effects. Neurons in the developing brain multiply at a rapid rate and are particularly vulnerable to toxic effects of heavy metals, hence brain damage is more likely to occur during this vulnerable time. Neurotoxicity is also transferred to the infant through breast milk.
>
> The adverse effects of methylmercury depend on timing and amount of exposure. Methylmercury is a strong toxin that influences enzymes, cell membrane function, causes oxidative stress, lipid peroxidation and mitochondria dysfunction, affects amino acid transport and cellular migration in the developing brain. Exposure in utero can cause motor disturbances, impaired vision, dysesthesia, and tremors. Even lower level exposure can result in lower intelligence, poor concentration, poor memory, speech and language disorders, and decrease in visual spatial skills in children exposed to methylmercury in utero. Fetuses, infants, and young children are four to five times more sensitive to the adverse effects of methylmercury exposure than adults.[39]

From 2007-2011, the Minnesota Department of Health (MDH) conducted a study of "Mercury in Newborns in the Lake Superior Basin."[40] This was a large study testing a total of 1,465 babies in

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[35] MPCA, Draft Impaired Waters Excerpts (2018), including three worksheets "2018 Mercury Impaired Waters " "2018 List Summary" and "Delisted" is provided in attached references. Data sorted from MPCA 2018 Draft Impaired Waters List available at https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list.
[36] *Id*., 2018 List Summary worksheet.
[37] *Id*., Delisted worksheet.
[38] *See e.g*. M.F. Wolfe, et al., Effects of Mercury on Wildlife: A Comprehensive Review, *Env. Tox. & Chem.*, Vol.17: 2, pp. 146-160, 1998; D.E. Yates et al., Mercury in bats from the northeastern United States, *Ecotoxicology* 23:45-55 (2014); K. Syaripuddin et al, Mercury accumulation in bats near hydroelectric reservoirs in Peninsular Malaysia, *Ecotoxicology*, 23:1164-1171 (2014). References attached.
[39] M. Saracino, Summary Opinion regarding Morbidity Associated with Methylmercury Exposure and other Neurotoxic Chemicals Potentially Released by the PolyMet NorthMet Copper-nickel Mine Project, Dec. 7, 2015, p. 2. Reference attached.
[40] MDH, Mercury in Newborns in the Lake Superior Basin summary in attached references. The full report is available at http://www.health.state.mn.us/divs/eh/hazardous/topics/studies/newbornhglsp.html.

Minnesota, Wisconsin and Michigan. About 30% of the Minnesota babies born in the study area were tested. In this study, 10% of the newborns in Minnesota's Lake Superior region had mercury levels above the EPA mercury dose limit, 3% of the Wisconsin newborns were above the mercury dose limit, and none of the Michigan samples exceeded the mercury limit. Babies born during the summer months were more likely to have an elevated mercury level, which, the MDH explained, suggests that increased consumption of locally caught fish during the warm months is an important source of pregnant women's mercury exposure in this region.[41]

The Clean Water Act and its implementing regulations require that NPDES permits comply with State water quality standards, including both numeric criteria and narrative standards.[42] Minnesota rules set numeric criteria for both mercury in the water column and mercury in edible fish tissue.[43] The scientific evidence shows that sulfate loading increases both release of mercury from sediments to the water column and mercury methylation that results in bioaccumulation. This means that the MPCA lacks discretion to permit sulfate loading to Class 2 waters without evaluating the reasonable potential of sulfate loading to cause or contribute to exceedance of numeric criteria for mercury.

Minnesota's water quality standards also contain narrative standards requiring protection of Class 2 waters for "the consumption of fish and edible aquatic life by humans."[44] Under Minnesota rules, "Protection of human consumers of fish, other edible aquatic organisms and water for drinking from surface waters means that exposure from noncarcinogenic chemicals . . . must be below levels expected to produce known adverse effects."[45] Given the Minnesota Department of Health study of mercury in newborns in Minnesota's Lake Superior region, the MPCA similarly must ensure that any NPDES/SDS or air quality permit affecting waters impaired for mercury, particularly in the Lake Superior basin,[46] affirmatively determines that the proposed sulfate loading will not cause or contribute to an increase exposure from methylmercury consumption.

The MPCA has clear evidence of the relationship of sulfate discharge to mercury releases from sediments to the water column and to mercury methylation. The Agency also has clear evidence of the threat that methylmercury bioaccumulation in the food chain poses to human health as well as to wildlife. MPCA should take the following actions:

1) MPCA must make adoption of a Class 2 (Aquatic Life and Recreation) water quality standard for sulfate to protect wildlife and human health from toxic effects of mercury release and mercury methylation its highest priority for rulemaking.

2) MPCA must, in permitting, ensure that no sources of sulfate loading to surface waters cause or contribute to exceedances of numeric or narrative criteria, increase impairments of water bodies due to mercury in the water column or in fish tissue, or cause or

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[41] *Id*., all facts in this paragraph are referenced in the MDH summary.
[42] See 33 U.S.C. §1313(c)(2)(A); 40 C.F.R. §122.44(d); 40 C.F.R. §123.25(a)(15).
[43] Minn. R. 7050.0220, Subp. 3a (B)(16) and (17); Subp. 4a (B)(16) and (17), Subp. 5a (B)(11) and (12).
[44] Minn. R. 7050.0217, Subp. 1.
[45] Minn. R. 7050.0217, Subp. 2 (B).
[46] Note that under Minn. R. 7052.0110, Subp. 4(A) human health standards for mercury in the Lake Superior basin are specifically based on the human consumption of fish in Minnesota.

contribute to human exposures expected to produce adverse affects.

Thank you for the opportunity to comment regarding Minnesota rulemaking and protection of aquatic life and the protection of human consumers of fish from adverse health effects. We would welcome the opportunity to discuss the scientific evidence or the legal bases for our comments and concerns.

Respectfully submitted,

/s/ Paula Maccabee, Advocacy Director/Counsel
WaterLegacy

Sierra Club North Star Chapter

Northeastern Minnesotans for Wilderness

Friends of the Cloquet Valley State Forest

Wisconsin Resources Protection Council

Attachments:
Water Quality Standards Comparison worksheet
References.

cc: U.S. EPA Region 5