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Matthew Dvorak
Iowa Department of Natural Resources
502 E. 9th St.
Des Moines, IA 50319
Via email: matthew.dvorak@dnr.iowa.gov

Re: Comments on 2018-2020 Triennial Review, Part I: Numeric Nutrient Criteria

Dear Mr. Dvorak:

At the January 23, 2018 public hearing in Urbandale, Water Program Director Susan Heathcote delivered public comments on behalf of the Iowa Environmental Council (IEC), an alliance of approximately sixty environmental organizations with members throughout the state who hike, fish, paddle and swim, on the Iowa Department of Natural Resources' (IDNR) 2018-2020 Triennial Review process. The following written comments expand on Ms. Heathcote's January 23 comments asking that IDNR include adoption of numeric criteria for nitrogen and phosphorus as a priority for this triennial review. As stated at the public hearing, IEC is concerned that numeric nutrient criteria are not among the initial list of water quality standards developed by IDNR as the Department's priorities to address over the next three years. Our concerns are explained below.

I. Numeric Nutrient Criteria

IEC requests that IDNR include adoption of numeric criteria for nitrogen and phosphorus as a priority for this triennial review. Numeric criteria establishing protective thresholds to protect Iowa's lakes, reservoirs, rivers and streams from excessive nutrients (phosphorus and nitrogen) and algae are needed and long overdue. In 1998, EPA set a goal that all states adopt numeric standards by the end of 2003.[i] Although Iowa, like many other states in the region, did not meet the deadline, IDNR finalized its criteria development plan in 2006, stating that numeric criteria for lakes would be adopted in 2007, with stream criteria being developed the following year.[ii] Significant progress was made through two IDNR-led initiatives towards establishing numeric nutrient criteria for certain classes of lakes, reservoirs and streams between 2009-2013; however, in recent years, IDNR has backtracked on these efforts and the IDNR web page tracking progress on the criteria development plan has been taken down. Meanwhile, impairments due to nutrient pollution are increasing. Establishing water quality standards for nutrients that are focused on protecting Iowa water bodies, as required by the Clean Water Act, must be a part of IDNR's work plan for the next triennial review period (2018-2020). As a starting point, IDNR should initiate rulemaking to adopt the recommended nutrient criteria already developed.

Iowa's Nutrient Reduction Strategy is Not a Substitute for Waterbody-Specific Standards

Under the Clean Water Act, states are required to develop water quality standards for their waters that protect the public health or welfare, enhance the quality of the water, and serve the purposes of the Act. CWA § 303(c)(2)(A). The Iowa Nutrient Reduction Strategy's (NRS) goal of statewide reductions in total nitrogen and total phosphorus loads reaching the Mississippi River[iii] is not a substitute for waterbody-specific standards, which is why it is an insufficient and ineffective approach for addressing the problems of nutrient pollution *in Iowa*. Water quality standards define water quality goals for individual water bodies by taking into account their uses by Iowans, in addition to protecting downstream uses. The Clean Water Act provides that when states revise or adopt new water standards, "[s]uch standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes…." CWA § 303(c)(2)(A). Using water quality standards to identify and prioritize nutrient pollution problems and to drive planning and restoration efforts will enhance the health of aquatic life and increase the recreational potential of Iowa waters.

Nutrients are causing serious impairments of beneficial uses in Iowa waters.

The harmful effects of nutrient pollution are well known. As the NRS explains, while nitrogen and phosphorus are natural parts of aquatic ecosystems, "at excessive levels these nutrients can lead to water quality problems and interfere with beneficial uses."[iv] Studies of nutrient pollution by EPA and numerous other entities have demonstrated that excess nutrients cause large growths of algae called algal blooms, resulting in reduced spawning grounds and nursery habitats for aquatic organisms and even fish kills caused by severely reduced oxygen in the water. Certain types of algal blooms, known as harmful algal blooms or "HABs," generate toxins and elevated bacteria levels that can make people and animals sick if they come into contact with polluted water, or consume fish or water contaminated with these harmful pollutants.[v] In addition to these problems, nitrate pollution in surface and groundwater used as drinking water sources can be harmful even at low levels.[vi] According to a new report from the Center for Rural Development at Iowa State University (attached as Appendix A), the costs to Iowans from nutrient pollution—from nitrate removal costs for drinking water sources (both public and private), lost recreation benefits, and adverse human health impacts—are significant.[vii]

Impacts from nutrient pollution are particularly acute at Iowa's recreational lakes, where excess nitrogen and phosphorus can produce unsightly algal blooms and reduced water clarity. Blue-green algae blooms are a type of HAB that is of particular concern in Iowa lakes. When conditions are right (excess nutrients in warm, slow-moving waters), these blooms can form within a few days, quickly turning clear water scummy and foul-smelling. Blue-green algae, also called cyanobacteria, can produce a toxin called microcystin that is dangerous to humans and pets. Exposure to microcystin by swimmers can result in rashes, hives, skin blisters, vomiting, severe headaches, fever, cough, sore throat, and asthma-like symptoms. Exposure to microcystin in drinking water can cause liver damage in humans and animals, which can be fatal.[viii]

Recent studies have identified climate change as a contributing factor to cyanobacterial blooms, due to its effect on the environmental conditions that promote the growth of blue green algae.[ix] These conditions include warmer water temperatures and changes in rainfall patterns. For example, intense rainfall events can increase the runoff of nutrients from land to water bodies, while longer dry periods between these more frequent concentrated bursts—the projected pattern—may result in water bodies retaining the nutrients for longer periods; EPA therefore expects the potential for HAB development to increase as a result of these changes.[x] Unfortunately, this appears to already be the trend in Iowa, with the number of beach advisories issued for Iowa state park beaches due to high levels of microcystin increasing in recent years. IDNR's summer public beach monitoring program issued unprecedented numbers of advisories in 2013, 2015, and 2016. The 34 beach advisories issued in 2015 included six state beaches that had *never* had a warning for microcystin before 2015.[xi] The growing problem of HABs extends beyond Iowa's lakes. For example, late last summer, the City of North Liberty posted a warning sign at a creek near a public park after residents observed green scum on the surface that was toxic algae.[xii] In 2016, Des Moines Water Works detected microcystin produced by cyanobacteria in the Raccoon River and in treated drinking water from that source.[xiii]

In addition to the problem of an increasing incidence of HABs in Iowa waters, the overall trend for impairments of beneficial uses caused by nutrient pollution is also increasing. For example, Iowa's 2012 Integrated Report identified a total of 62 impairments of beneficial uses (such as primary contact recreation) due to Algal Growth in lakes, reservoirs and wetlands.[xiv] In the most recent 2016 Integrated Report, that number has jumped to 91.[xv] Although IDNR does not assess waters for impairments based on concentration of nutrients found in the water (because Iowa has no numeric nutrient standards), as the 2012 Integrated Report explains, "identification of an impairment due to algae implies a nutrient impairment as well."[xvi] Relying only on Iowa's narrative standards to identify nutrient impairments is especially concerning because, while an impairment determined on the basis of exceeding a *numeric* threshold for a pollutant generally does "not indicate severe or grossly polluted conditions," according to IDNR, the same is not true for waters assessed as impaired based on violating Iowa narrative standards.[xvii]

Iowa needs water quality standards that address the causes of impairments, not just the effects.

Iowa's numeric water quality criteria are the primary basis for identifying impairments (e.g., numeric thresholds for E.coli bacteria in recreational waters) and are designed to be *protective* of the beneficial uses designated for Iowa's streams, rivers, and lakes. As IDNR explains, these criteria are set to warn of potential quality problems well before anything approaching "grossly polluted conditions" occurs. "Impairments based on violations of Iowa's narrative water quality standards, however, tend to be more severe."[xviii] Because Iowa lacks protective numeric criteria for nutrients that address the causes of harmful algal blooms, waters are targeted for reduced loading only when serious problems such as "aesthetically objectionable conditions" and "nuisance aquatic life" (i.e., narrative standard violations) have already developed, making restoration more difficult. Studies of lake restorations demonstrate that lakes can often maintain clear conditions despite significant nutrient loading, in part due to underwater plants that help maintain clarity in healthy lakes, enhancing their own growing conditions.[xix] However, once a eutrophic lake does "flip" from clear to turbid—a change that can occur abruptly—the underwater vegetation dies off, beginning a self-perpetuating cycle that makes restoration

difficult to achieve through reductions in nutrient loading alone.[xx] Restoring such a lake to its unimpaired condition is an expensive and long-term proposition.

In contrast to this reactive approach, numeric criteria would enable IDNR and its partners to prevent severe water quality problems caused by nutrient pollution. For point source dischargers, permit limits for nitrogen and phosphorus would be calculated based on a standard that has been established to be protective of downstream waterbodies. For non-point sources, watershed-based planning under IDNR's TMDL program will begin at an earlier stage of impairment to identify the contributing sources and necessary reductions that will prevent a more severe impairment such as a chronic algae problem from taking hold. This planning can guide local watershed groups and other partners in implementing voluntary reductions, using the funding that becomes available for such projects through federal and state cost-sharing, EPA grants for urban and non-urban watershed restoration projects, and access to the funding under Iowa's Water Quality Initiative in support of the NRS. Although assessing waters based on numeric criteria rather than violations of narrative standards will result in more waters being assessed as impaired in the short term, these less severe impairments can be addressed more quickly and at less cost by making information, planning and funding available to communities at a point when reductions in nutrient loading will be most effective.

Nutrient Standards are Not Inconsistent with the NRS

IDNR has responded to previous comments during the Triennial Review process by pointing to the NRS as the reason for suspending work on developing numeric nutrient criteria (NNC), as if NNC are incompatible with a state NRS.[xxi] As stated in the NRS, the strategy "was developed in response to the 2008 Gulf Hypoxia Action Plan that calls for the 12 states along the Mississippi River to develop strategies to reduce nutrient loading to the Gulf of Mexico," and "follows the framework provided by EPA in 2011."[xxii] Numeric nutrient criteria are not inconsistent with an approach based on this framework. In fact, other states in the Upper Mississippi River Basin have incorporated NNC into their own nutrient reduction strategies developed in response to the Gulf Hypoxia Plan. Minnesota, for example, includes both downstream reduction targets and the local goals of nutrient standards as integral components of an overall strategy of nutrient reduction, with both acting as drivers of complementary watershed planning and reduction efforts.[xxiii]

A NRS without nutrient standards is incomplete. The EPA framework for state nutrient reduction strategies referred to above is contained in a 2011 memo that, while recognizing the need for flexibility among various states' approaches, nevertheless includes "certain minimum building blocks" that EPA believes are "necessary for effective programs to manage nitrogen and phosphorus pollution."[xxiv] One of these critical components is ***numeric nutrient criteria***: "It has long been EPA's position that numeric nutrient criteria targeted at different categories of water bodies and informed by scientific understanding of the relationship between nutrient loading and water quality impairment are ultimately necessary for effective state programs."[xxv] The recommended eight elements for state strategies include: "Develop work plan and schedule for numeric criteria development."[xxvi] As explained above, IDNR did establish such a work plan in 2006. Although recommended nutrient criteria for recreational lakes and certain classes of streams have been developed, these criteria but never adopted into Iowa's water quality

standards. The stream nutrient technical advisory committee (TAC) formed by IDNR has been disbanded.

Iowa's NRS does address the issue of water quality standards for nutrients in Section 1, where the "Policy Considerations" of the strategy are discussed. Here, the NRS questions the feasibility and usefulness of NNC, concluding that due to the many difficulties involved, "legitimate concerns about the value of numeric nutrient criteria have been raised."[xxvii] The NRS omits any references to timelines or milestones for next steps on water-quality based criteria. Suspending work on the objectives of the 2006 work plan is not consistent with the 2011 EPA framework. Furthermore, the statements in the NRS purporting to explain the obstacles to developing and implementing nutrient criteria are inaccurate and/or based on out-of-date information, as explained below:

- *"There is debate on how to establish the appropriate nutrient criteria for protecting these designated stream and lake uses."*[xxviii]

This statement in the NRS is from the strategy's discussion of the difficulties that Iowa supposedly faces in trying to establish nutrient standards. One of the "factors confounding the nutrient criteria development process" cited is the "variability of nutrient responses in aquatic ecosystems, and the lack of strong linkages and clear thresholds between nutrient causal and response variables."[xxix] Certainly, the variability the NRS describes does make deriving numeric criteria for nutrients more complicated than for many other kinds of pollutants. Typically, states have managed this variability by partitioning water bodies into different descriptive categories early in the statistical analysis process, and by including response variables in their NNC. As EPA Region 7 has noted, such variability "has not prevented many other states from developing and adopting scientifically supportable and protective criteria for total phosphorus and total nitrogen."[xxx] Indeed, these statements in the NRS, which have not been updated since their inclusion in the 2012 version, do not reflect the fact that recommended numeric nutrient criteria have *already been successfully developed* for three classes of waterbody in Iowa, including wadeable warm water streams.

IDNR, assisted by a technical advisory committee, conducted an analysis of Iowa-specific nutrient data and a review of scientific literature and other relevant technical information to determine levels of nutrients and nutrient response parameters that are protective of Iowa's stream biological assemblages and designated aquatic life usages.[xxxi] The purpose of the project was to "identify benchmark values that can serve as a foundation for establishment of nutrient enrichment criteria."[xxxii] The data analysis approach used "focused on the strength of evidence connecting nutrient stressors with adverse changes in stream biological communities."[xxxiii] Using this approach, IDNR was able to establish numeric nutrient enrichment criteria for two types of wadeable, warm water streams, based on nutrient benchmarks for total nitrogen (TN) and total phosphorus (TP) combined with nutrient-response indicator benchmarks. According to IDNR's 2013 report that includes these recommendations (attached as Appendix B), the benchmark values included in the recommended NNC are supported by data and evidence that is sufficiently strong to "make them ***eligible for immediate use*** for water quality assessments and reporting purposes [emphasis added]."[xxxiv]

Although not mentioned in the NRS, recommended nutrient criteria have also been successfully developed for Iowa's Class "A," recreational use lakes.[xxxv] At the request of IDNR, in 2007 a group of scientists actively researching topics including aquatic ecology, limnology, water chemistry, and human toxicity formed the Nutrient Science Advisors. This group was convened by IDNR to study, analyze and discuss data from the Iowa Lakes Study (a cooperative effort between IDNR and Iowa State University) and IDNR's ambient water monitoring program for the purpose of making recommendations for nutrient criteria for Iowa's waters. In 2008, the Nutrient Science Advisors reported to IDNR that the group had reached consensus on criteria for two response variables, Secchi depth transparency and Chl-*a*, as well as two direct variables, TN and TP, recommended for all Class A lake uses.[xxxvi] This report is attached as Appendix C.

- *"Unlike most pollutants that currently have criteria established, no single criterion value appears to be appropriate for every water body. Therefore, numeric criteria may not be the best approach for achieving reductions in nutrient loads."*[xxxvii]

The fact that, as the NRS states, when it comes to NNC, "no single criterion value appears to be appropriate for every water body" has been long recognized by EPA and the states that have successfully developed NNC (including Iowa). In fact, EPA's recommended framework for state nutrient reduction strategies suggests that a "reasonable timetable" for developing numeric criteria would include developing criteria "for at least one class of waters within the state (e.g., lakes and reservoirs, or rivers and streams) within 3-5 years … and completion of criteria development in accordance with a robust, state-specific work plan and phased schedule."[xxxviii] This *waterbody-specific approach* is the one being used in surrounding states for developing nutrient criteria (Minnesota, Wisconsin, Illinois and Missouri), and has also been the approach in Iowa. For example, in their 2008 report to DNR, the Nutrient Science Advisors explain, "Because nutrient criteria are specific to different designated uses of Iowa waters, this report recommends nutrient criteria for Class A recreational lake uses. Criteria for other lake uses and for streams and rivers may differ."[xxxix] Similarly, IDNR and the stream nutrient TAC, in developing recommended nutrient criteria for streams, distinguished various classifications of streams for analysis of relationship changepoints based on size, ecological region, and thermal regime.[xl] It simply does not follow that because no single criterion value for NNC is appropriate statewide, numeric criteria are not a feasible or effective approach to reducing nutrient pollution.

- *"Wastewater discharges that comprise a large portion of the receiving stream could be required to treat to levels that are impossible to achieve even with today's state-of-the-art treatment technologies. In addition to the issues with treatment efficacy … the treatment technology is typically beyond the financial and technical capabilities of the many small towns in Iowa."*[xli]

The section of the NRS relating to the cost and technological feasibility of implementing water quality based nutrient criteria that includes the statements quoted above is badly in need of an update. First, the Iowa NRS relies on cost data from 1998 for its estimates of nutrient removal costs for municipal wastewater treatment plants (WWTPs).[xlii] Since that time, the implementation of nutrient criteria in many parts of the US, including the communities subject to the Chesapeake Bay TMDL, has spurred innovative approaches to reducing nutrients, particularly in small towns with limited resources. EPA has documented several of these

successes in its 2015 report, *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants*. The report found that many municipalities have been able to achieve significant reductions in effluent discharges of TN and TP by implementing relatively minor operational changes in their existing WWTPs, without costly infrastructure upgrades.[xliii] Furthermore, one of the most common operational adjustments, involving cycling aerators on and off to facilitate biological nutrient removal, has resulted in energy cost *savings* for many communities.[xliv] EPA is continuing to document and publish case studies of the use of this low-cost operational approach, which it finds to be "underreported" in the literature on nutrient removal by WWTPs.[xlv]

Second, the fact that water quality trading is being used as an important tool for implementing nutrient criteria in a cost-effective manner is all but ignored in the discussion of costs to point sources in the NRS.[xlvi] Many states that have adopted nutrient standards have also adopted a regulatory framework that allows permit holders facing relatively high pollutant reduction costs to compensate another party in the same watershed to achieve less costly pollutant reduction with a greater water quality benefit.[xlvii] Water quality trading is a market-based approach that provides flexibility for regulated entities while creating economic incentives for innovation, emerging technology, and voluntary reductions.[xlviii] Now that neighboring states such as Wisconsin and Minnesota have had several years' experience in implementing both numeric nutrient standards and water quality trading, Iowa DNR has the opportunity to study the "lessons learned" of this approach and consider its potential as an effective approach to collaborative nutrient reduction in Iowa. The Iowa Environmental Council supports the implementation of a nutrient trading framework in Iowa under the essential condition that water quality is improved.

Conclusion

While other states are finding innovative technological and regulatory solutions to the problem of nutrient pollution, Iowa's continued reliance on its outdated and incomplete NRS is meeting with only limited success, despite the significant costs and efforts expended to implement its mostly voluntary approach. Implementing numeric criteria (within a water quality trading framework) would fill an important gap in Iowa's strategy, supporting and improving its implementation by supplying needed benchmarks, monitoring, and a regulatory cap to drive a true nutrient trading program. Iowa DNR should avoid further delay in implementing the nutrient standards already developed for warm water wadeable streams and recreational lakes, or risk losing the benefits of the significant time and expertise invested in the important progress made towards addressing Iowa's serious water quality problems caused by nutrient pollution. Further, Iowa DNR should commit to a workplan as part this triennial review to develop numeric nutrient criteria for all designated uses in all classes of Iowa waters.

Thank you for considering our comments.

Sincerely,

Clare Kernek

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[i] US EPA. *National Strategy for the Development of Regional Nutrient Criteria*. "EPA expects all States and Tribes to adopt and implement numerical nutrient criteria into their water quality standards by Dec. 31, 2003." 63 Fed. Reg. 34648 (June 25, 1998), at 34649.
[ii] IDNR. *Iowa's Plan for Adoption of Nutrient Water Quality Standards 3rd Draft—2/3/06.*
[iii] *Iowa Nutrient Reduction Strategy: A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico*, at 1 (Updated December 2017).
[iv] *Iowa Nutrient Reduction Strategy: A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico*, at 7 (Updated December 2017).
[v] See generally, US EPA. *Nutrient Pollution: The Problem*, at https://www.epa.gov/nutrientpollution/problem.
[vi] See Iowa Environmental Council, *Nitrate in Drinking Water: A Public Health Concern for All Iowans* (September 2016), available online at http://www.iaenvironment.org/news-resources/fact-sheets/water-and-land-fact-sheets.
[vii] Chuan Tang et al. Center for Agricultural and Rural Development, Iowa State University. Report. *Economic Benefits of Nitrogen Reductions in Iowa* (Feburary 2018). Attached as Appendix A, and available online at https://www.card.iastate.edu/products/publications/texts/water-quality-report.pdf.
[viii] Iowa Department of Public Health. *Harmful Algal Blooms*, at https://idph.iowa.gov/ehs/algal-blooms.
[ix] US EPA Office of Water. *Impacts of Climate Change on the Occurrence of Harmful Algal Blooms* (EPA 820-S-13-001, May 2013).
[x] Id.
[xi] Iowa Environmental Council. *Toxic Blue Green Algae: A Threat to Iowa Beachgoers,* available at http://www.iaenvironment.org/our-work/clean-water-and-land-stewardship/swimming-advisories.
[xii] City of North Liberty. Press release. *Blue-green algae identified in Beaver Kreek; migrating to Muddy Creek* (July 28, 2017), available at http://northlibertyiowa.org/2017/07/28/blue-green-algae-identified-in-beaver-kreek-migrating-to-muddy-creek/.
[xiii] Des Moines Water Works. Advisory. *Des Moines Water Works Detects Microcystin in Des Moines Water System* (Aug. 3, 2016), available at http://www.dmww.com/about-us/announcements/advisory.aspx.
[xiv] IDNR, *Fact Sheet for the final 2012 list of impaired waters*, at 7. Available online at http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Monitoring/Impaired-Waters.
[xv] IDNR, 2016 305(b) Assessment Summary: Summary Statistics, at https://programs.iowadnr.gov/adbnet/Assessments/Summary/2016.
[xvi] IDNR, *Fact Sheet for the final 2012 list of impaired waters*, at 6.
[xvii] IDNR, *Fact Sheet for the final 2012 list of impaired waters*, at 4.
[xviii] Id.
[xix] Marten Scheffer et al., *Catastrophic shifts in ecosystems (review article)*, 413 Nature 591, 592 (2001).
[xx] *Id.; see also* Joy M. Ramstack Hobbs et al., *The legacy of large regime shifts in shallow lakes*, 0(0) Ecological Applications 1 (2016).
[xxi] *See* IDNR, "Responsiveness Summary: Triennial Review 2012-2014" at 13 (February 9, 2012). ("Nutrient issues will be addressed under the interagency Nutrient Strategy team, with cooperative efforts from IDALS, DNR, and other groups. … Therefore, direct action references will be removed from the Triennial Review Work Plan.")
[xxii] IDALS, IDNR, and ISU College of Natural Resources, *Nutrient Reduction Strategy* (Updated Dec. 2017), "Preparation and Presentation of the Iowa Nutrient Reduction Strategy;" *see also*, Section 1.1., "Policy Considerations and Strategy," at 6. Hereinafter *Nutrient Reduction Strategy.* Available online at http://www.nutrientstrategy.iastate.edu/sites/default/files/documents/1%202017%20INRS%20Executive%20Summary%20and%20Section%201_Policy.pdf.
[xxiii] *See* State of Minnesota, *The Minnesota Reduction Strategy*, at 1-2, 1-3. (E.g., "A successful NRS will support and work within the Minnesota Water Management Framework, total maximum daily loads (TMDLs), Agricultural
[xxiv] Nancy Stoner, US EPA. Memo. *Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions* (March 16, 2011), at 2. Hereinafter, Stoner Memo.
[xxv] Stoner Memo at 2-3.
[xxvi] Stoner Memo, "Recommended Elements of a State Framework for Managing Nitrogen and Phosphorus Pollution," at 2.

[xxvii] *Nutrient Reduction Strategy* (Updated Dec. 2017), Section 1.2, at 9. Available online at http://www.nutrientstrategy.iastate.edu/sites/default/files/documents/1%202017%20INRS%20Executive%20Summary%20and%20Section%201_Policy.pdf.
[xxviii] *Nutrient Reduction Strategy,* Section 1.2, at 7.
[xxix] *Nutrient Reduction Strategy,* Section 1.2, at 7-8.
[xxx] Letter from Karen Flournoy, EPA Region 7, to John Madras, Missouri DNR, dated May 12, 2016. Available online at http://moenvironment.org/environment-blog/wp-content/uploads/2017/12/2017-11-20-Exhibit-B-to-Opp.pdf.
[xxxi] IDNR. Report. *Development of Nutrient Enrichment Criteria* (Draft, Aug. 23, 2013). Attached as Appendix A.
[xxxii] IDNR. Report. *Development of Nutrient Enrichment Criteria* (Draft, Aug. 23, 2013) at i.
[xxxiii] Id.
[xxxiv] IDNR. Report. *Development of Nutrient Enrichment Criteria* (Draft, Aug. 23, 2013) at iv-v.
[xxxv] Nutrient Science Advisors. Report. *Nutrient Criteria for Iowa Lakes: Recommended Criteria for Class "A" Recreational Uses* (Feb. 14, 2008). Attached as Appendix B.
[xxxvi] Nutrient Science Advisors. Report. *Nutrient Criteria for Iowa Lakes: Recommended Criteria for Class "A" Recreational Uses* (Feb. 14, 2008) at 4.
[xxxvii] *Nutrient Reduction Strategy* at Section 1.2, at 7.
[xxxviii] Stoner Memo, "Recommended Elements of a State Framework for Managing Nitrogen and Phosphorus Pollution," at 2.
[xxxix] Nutrient Science Advisors. Report. *Nutrient Criteria for Iowa Lakes: Recommended Criteria for Class "A" Recreational Uses* (Feb. 14, 2008) at 3.
[xl] IDNR. Report. *Development of Nutrient Enrichment Criteria* (Draft, Aug. 23, 2013) at i.
[xli] *Nutrient Reduction Strategy* at Section 1.2, at 8.
[xlii] Id.
[xliii] US EPA. Report. *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants* (August 2015) at 10-11.
[xliv] *See* US EPA. Report. *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants* (August 2015) at 12-13, Table 1; 24-25.
[xlv] US EPA. Report. *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants* (August 2015) at 11; *see also* US EPA, "National Study of Nutrient Removal and Secondary Technologies" at https://www.epa.gov/eg/national-study-nutrient-removal-and-secondary-technologies.
[xlvi] *Nutrient Reduction Strategy* at Section 1.2, at 9. (Trading briefly mentioned as one of several "implementation flexibilities" being explored by EPA that "may or may not be possible depending on case-specific circumstances.")
[xlvii] *See e.g.,* Wisconsin DNR Bureau of Water Quality Program Guidance. Guidance Number: 3800-2013-04 (August 21, 2013). *Guidance for Implementing Water Quality Trading in WPDES Permits*. Available at https://dnr.wi.gov/topic/surfacewater/waterqualitytrading.html.
[xlviii] *See* Minnesota Pollution Control Agency, "Water quality trading," at https://www.pca.state.mn.us/water/water-quality-trading.