TITLE 327 WATER POLLUTION CONTROL DIVISION

Proposed Rule
LSA Document #14-58

DIGEST

Amends 327 IAC 2-1-6 and 327 IAC 2-1.5-8 concerning revisions to Indiana's aquatic life and human health surface water quality criteria (WQC) for select metals to reflect updates based on current science and National Recommended Water Quality Criteria (NRWQC) at Section 304(a) of the Clean Water Act (CWA). Effective 30 days after filing with the Publisher.

HISTORY

First Notice of Comment Period: March 5, 2014, Indiana Register (DIN: 20140305-IR-327140058FNA).

Second Notice of Comment Period: November 15, 2017, Indiana Register (DIN: 20171115-IR-327140058SNA).

Notice of Public Hearing: November 15, 2017, Indiana Register (DIN: 20171115-IR-327140058PHA).

Continuation of Second Notice of Comment Period: December 20, 2017, Indiana Register (DIN: 20171220-IR-327140058SCA).

Change in Notice of Public Hearing: January 8, 2020, Indiana Register (DIN: 20200108-IR-327140058CHA).

Change in Notice of Public Hearing: January 22, 2020, Indiana Register (DIN: 20200122-IR-327140058CHA).

Change in Notice of Public Hearing: April 8, 2020, Indiana Register (DIN: 20200408-IR-327140058CHA).

Change in Notice of Public Hearing: September 23, 2020, Indiana Register (DIN: 20200923-IR-327140058CHA).

Date of First Hearing: November 18, 2020.

PUBLIC COMMENTS UNDER IC 13-14-9-4.5

IC 13-14-9-4.5 states that a board may not adopt a rule under IC 13-14-9 that is substantively different from the draft rule published under IC 13-14-9-4, until the board has conducted a third comment period that is at least 21 days long.

REQUEST FOR PUBLIC COMMENTS

Portions of this proposed rule are substantively different from the draft rule published on November 15, 2017, at DIN: 20171115-IR-327140058SNA. The Indiana Department of Environmental Management (IDEM) is requesting comment on the following portions of the proposed (preliminarily adopted) rule that are substantively different from the language contained in the draft rule.

The numeric water quality criteria for the protection of aquatic life, with the exception of the criteria discussed below, that were in Table 6-1 and Table 6-2 at 327 IAC 2-1-6(a)(3) of the draft rule published on November 15, 2017, are not different in the proposed rule from what they were in the draft rule. However, the complete strike out of Table 6-1 and Table 6-2 with replacement by new Table 6-1 makes the layout of the proposed rule language look different enough that IDEM wants to assure understanding of the changed formatting.

IDEM removed the numeric aluminum criteria for the protection of aquatic life for both the waters within and outside of the Great Lakes System from the draft rule after it was posted in the Indiana Register for Second Notice of Comment Period and before it was presented to the Environmental Rules Board (ERB) for consideration of preliminary adoption and will consider adopting criteria for this metal in a future rulemaking.

For copper and lead aquatic life criteria in the waters outside of the Great Lakes System, IDEM revised the existing criteria when the draft rule was published on November 15, 2017, but removed those revisions before the draft rule was presented to the ERB for consideration of preliminary adoption with the result being that the copper and lead criteria remain unchanged from the existing rule.

The selenium aquatic life criteria in the draft rule's Table 6-2a at 327 IAC 2-1-6(a)(3) have changed and been moved to Table 6-1a and Table 6-1b at 327 IAC 2-1-6(a)(4) in the proposed rule with the addition of a site-specific criterion for selenium in waters outside of the Great Lakes System where a determination is made by IDEM and approved by U.S. EPA that fishes in the Order Acipenseriformes (sturgeon and paddlefish) do not occur at the site.

The silver acute aquatic life criterion for waters outside of the Great Lakes System that was published in the draft rule on November 15, 2017, mistakenly omitted the denominator (/2) in the formula. This omission has been corrected in the proposed rule. The proposed rule silver acute aquatic life criterion is the NRWQC at Section 304(a) of the CWA.

The numeric water quality criteria for the protection of human health that were in Table 6-1 at 327 IAC 2-1-6(a)(3) of the draft rule are in Table 6-4 at 327 IAC 2-1-6(a)(7) of the proposed rule. In the draft rule, IDEM

removed the Arsenic III human health criteria. In the proposed rule, IDEM has retained the existing Arsenic III criteria. Otherwise, the numeric criteria for the protection of human health have not changed from the criteria in the draft rule, but the new placement in subdivision (7) is different so IDEM is opening this portion of the proposed rule for public comment.

The numeric criteria for fluoride that were in Table 6-1 at 327 IAC 2-1-6(a)(3) in the draft rule are unchanged but have been moved to a separate subdivision in the proposed rule at 327 IAC-2-1-6(a)(9).

The complete strike out of Table 8-1 at 327 IAC 2-1.5-8(b)(3) in the proposed rule with replacement by new Table 8-1 is a changed layout of the rule language from the draft rule, and IDEM wants to assure understanding of the changed formatting. For the Great Lakes System rule at 327 IAC 2-1.5-8, the human health criteria have always been in a separate table so there is no change of formatting for these human health criteria.

When the draft rule was published on November 15, 2017, IDEM added aquatic life criteria for lead for waters within the Great Lakes System, but IDEM revised that lead criteria before it was presented to the ERB for consideration of preliminary adoption. The lead criteria in the proposed rule for waters within the Great Lakes System are the NRWQC and are the same as the criteria for waters outside of the Great Lakes System.

The following citations of the proposed rule are substantively different from the draft rule:

327 IAC 2-1-6(a)(3)
327 IAC 2-1-6(a)(4)
327 IAC 2-1-6(a)(7)
327 IAC 2-1-6(a)(9)
327 IAC 2-1.5-8(b)(3)

This notice requests the submission of comments on the citations of the rule listed above, including suggestions for specific amendments to those citations. These comments and the department's responses thereto will be presented to the board for its consideration at final adoption under IC 13-14-9-6. Comments on additional citations of the proposed rule that the commentor believes are substantively different from the draft rule may also be submitted for the consideration of the board. Comments may be submitted in one of the following ways:

(1) By mail or common carrier to the following address:

LSA Document #14-58 Metals Criteria
MaryAnn Stevens
Rules Development Branch
Office of Legal Counsel
Indiana Department of Environmental Management
Indiana Government Center North
100 North Senate Avenue
Indianapolis, IN 46204-2251

(2) By electronic mail to mstevens@idem.in.gov. To confirm timely delivery of your comments, please request a document receipt when you send the electronic mail. **PLEASE NOTE: Electronic mail comments will NOT be considered part of the official written comment period unless they are sent to the address indicated in this notice.**

Contact Karla Kindrick at kkindric@idem.in.gov or (317) 232-8922 if another method of submitting comments within the comment period is desired. Regardless of the delivery method used, in order to properly identify each comment with the rulemaking action it is intended to address, each comment document must clearly specify the LSA document number of the rulemaking.

COMMENT PERIOD DEADLINE

All comments must be postmarked or time stamped not later than May 12, 2021.

Additional information regarding this action may be obtained from MaryAnn Stevens, Rules Development Branch, Office of Legal Counsel, at mstevens@idem.in.gov, (317) 232-8635 or (800) 451-6027 (in Indiana).

ABOUT THIS PROPOSED RULE NOTICE

The Summary/Response to Comments from the Second Comment Period included in this notice is the same as the document of the same name that was included in the board packet for the November 18, 2020, ERB meeting. The Summary/Response to Comments Received at the First Public Hearing immediately follows the portion from the Second Comment Period and includes responses to comments made at the November 18, 2020, ERB meeting. The proposed rule language that is included in this notice after the comments and responses is unchanged from the draft rule that was preliminarily adopted on November 18, 2020, by the ERB.

SUMMARY/RESPONSE TO COMMENTS FROM THE SECOND COMMENT PERIOD

IDEM requested public comment from November 15, 2017, through February 1, 2018, on IDEM's draft rule language. IDEM received comments from the following parties:

American Electric Power (AEP)
Biomonitor, Inc. (BIO)
CWA Authority, Inc. (CWA)

Duke Energy (DUKE)
Greensburg, City of, represented by Bingham Greenebaum Doll (GRB)
Hoosier Environmental Council (HEC)
Indiana Coal Council (ICC)
Indiana Energy Association (IEA)
Indiana Manufacturers Association, Inc. (IMA)
Indianapolis Power and Light Company (IPL)
Northern Indiana Public Service Company (NIPSCO)
Peabody Energy (PE)
Sierra Club Hoosier Chapter (SC)
United States Environmental Protection Agency Region 5 (EPA5)

Following is a summary of the comments received and IDEM's responses thereto:

Extended Comment Period Request

Comment: The proposed metal criteria changes, especially for selenium, need to be reviewed for their appropriateness for Indiana. Additional data and information should be evaluated. The amount of material to review and its complex nature makes for a time consuming process. An extension of 30 days to the comment period is requested. (ICC, PE)

Response: IDEM agreed to extend the original comment period end date by an additional 30 days, to February 1, 2018.

Workgroup Requested

Comment: IDEM should convene a workgroup to discuss the draft rule, especially guidance for the implementation of the selenium criteria. (ICC, IEA, IMA, CWA, AEP, NIPSCO, DUKE, IPL)

Response: IDEM appreciates this suggestion and acknowledges the challenges that a fish tissue criterion presents in water quality-based permitting. In lieu of a workgroup, IDEM is working with specific interested parties and state agency partners, including Indiana Department of Natural Resources biologists, Illinois Environmental Protection Agency, and IDEM's Office of Water Quality biologists, to develop draft guidance documents to assist with the collection of fish tissue for implementation of the selenium criteria and for implementation of the intermittent water column element.

Support for the Draft Rule

Comment: Opinion about the scientific validity of any proposed change in pollutant criteria may vary; however, it is in Indiana's best interest to keep up with the latest generally accepted values for these criteria. The proposed criteria, based on current science and National Recommended Water Quality Criteria (NRWQC), achieve that goal. (SC, HEC)

Response: IDEM appreciates the comments supporting the metals rulemaking.

Rule Formatting Suggestions

Comment: The draft rule language at 327 IAC 2-1-6(a)(1)(E) should be revised by:

(1) deleting the lead in line that has been added in bold font at the end of clause (E) that read, **"The following apply where applicable:";**

(2) deleting the existing rule language at the end of item (i)(BB) that reads, "which ~~table~~ incorporates subdivision (4), Table 6-3; and";

(3) adding a new subitem (CC) to read, **"subdivision (4), Table 6-3; and";**

(4) moving the draft rule's subitem (CC) to new subitem (DD); and

(5) ending item (ii) with **"for substances for which an AAC is not specified in item (i)."** and deleting the three subitems that follow.

(GRB)

Response: The following are IDEM's responses to the formatting suggestions in the same number order as presented in the comment:

(1) According to the Indiana Rules Drafting Manual, there must be a lead in line connecting clause (E) with the item and subitems that follow it.

(2), (3), and (4) these suggested formatting revisions have been considered; however, since the referenced table (which is now subdivision 5, Table 6-2) does not establish new criteria and is included in the rule to provide examples of the equation-based criteria established in Table 6-1 at different hardness levels, the requested change was not made.

(5) In the draft rule language of item (ii), the connecting conjunction between subitem (BB) and (CC) is "or" not "and" as shown in the commenter's letter. If item (ii) ended with **"for substances for which an AAC is not specified in item (i)."** it would mean that all of the subitems of item (i) apply rather than as the draft rule language uses "or" to indicate that only one of the subitems of item (ii) need be applicable. The draft rule at 327 IAC 2-1-6(a)(1)(E)(ii) has been revised since the draft rule was posted in the Indiana Register for the Second Notice of Comment Period, but the reason for using "or" rather than "and" between subitems (AA) and (BB) is the same as described in this response.

Comment: At 327 IAC 2-1-6(a)(5)(D) and (E) and 327 IAC 2-1-6(a)(6)(C), Table 6-3a, 6-3b, and 6-3c each

has a footnote [1] that includes the rule language that reads, "instead of the criteria in this clause". The commenter suggests that clarity would be improved by deleting "clause" and inserting "table". (GRB)

Response: The suggestion to use "clause" instead of "table" at these various locations has been included in the draft rule for consideration of preliminary adoption though the citations have changed since the draft rule was posted for second notice comment period.

Comment: At 327 IAC 2-1-6(a)(1)(C), the language "or otherwise impairs the designated uses of the surface waters" should be added after "to an extent that creates a nuisance." (HEC)

Response: IDEM relies on these narrative standards to try to address unsightly or deleterious conditions, whether they impair the designated use or not.

Comment: The label that applies to metals in Table 6-1 currently reads, "(total recoverable)". However, not all of the metals criteria for aquatic life in the table are expressed as total recoverable. IDEM needs to update the label that applies to metals contained in Table 6-1 to be consistent with Tables 6-2 and 6-2a. (EPA5)

Response: The concern and possible confusion noted in this comment is being addressed in this rulemaking.

In order to provide clarity for metals criteria that apply to waters outside of the Great Lakes System, IDEM is creating separate tables for aquatic life criteria and human health criteria currently listed together in Table 6-1. In the draft rule for consideration of preliminary adoption, the aquatic life criteria table (new Table 6-1) incorporate the acute and chronic criteria equations shown in Table 6-2 in the current rule; human health criteria in Table 6-1 are moved to a new table, Table 6-4. This reformatting for numeric criteria that apply to waters outside of the Great Lakes System mirrors the formatting for corresponding tables for aquatic life and human health criteria for waters within the Great Lakes System. Selenium criteria are included in stand-alone tables Table 6-1a and Table 6-1b in 327 IAC 2-1-6 (waters outside the Great Lakes System), and Table 8-1a in 327 IAC 2-1.5-8 (waters within the Great Lakes System).

Compliance Schedule

Comment: At the same time that IDEM is proposing the revisions to the water quality standards for metals, similar criteria are being considered as part of the federal Steam Electric Power Effluent Limitations Guidelines (ELG) Rule, which is currently being reviewed by U.S. EPA. Compliance technology required to meet a new water quality standard could also contribute to meeting a new ELG standard. IDEM should develop a guidance document that addresses possible coordination of the water quality standards and the ELG standards, timing of implementation of the new standards, and options such as compliance schedules for meeting the new standards. (NIPSCO)

Response: The proposed metal criteria in the draft rule for consideration of preliminary adoption are intended to protect designated uses for all waters of the state, are applied across a variety of industrial and municipal discharges, and are no more stringent than U.S. EPA's NRWQC. IDEM is open to discussing the need to develop guidance for affected dischargers once U.S. EPA revises the ELG Rule.

Aluminum

Comment: The Indiana Coal Council (ICC) supports the application of the hardness based aluminum criteria, but IDEM must remove the use of the total recoverable form of aluminum and move to a more representative analysis method. According to research (He and Ziemkiewicz 2016), the use of total recoverable methods can dissolve aluminosilicate clay particles, which biases results. The New Mexico Environment Department recognized this bias when it implemented the hardness based standard by adding the following statement to its regulations: "the criteria are based on analysis of total recoverable aluminum in a sample that is filtered to minimize mineral phases as specified by the department." ICC recommends the use of the dissolved form of aluminum, which would be consistent with 327 IAC 2-1-8.1(b), which states, "The use of dissolved metal to set and measure compliance with water quality standards for aquatic life is the recommended approach because dissolved metal more closely approximates the bioavailable fraction of the metal in the water column than does total recoverable metal." Alternately, ICC recommends the use of the acid soluble form of aluminum originally recommended by U.S. EPA in the 1988 criteria document. (ICC)

Comment: IDEM has proposed criteria for total aluminum. This analytic method will ultimately measure nontoxic forms of aluminum present in suspended sediments and will overestimate the actual toxicity of the aluminum present in the sample. IDEM needs to change the analytic method to a less rigorous acid digestion, such as the dissolved analytic method or allow for prefiltration of the sample to remove the nontoxic forms of aluminum associated with suspended sediments in the sample. (PE)

Comment: The WER-based aluminum criteria using a total recoverable analytical measurement is a straightforward analytical method, but there is a concern that a moderately acidified sample would result in the detection of both toxic and nontoxic aluminum forms (Santore et al., 2017). Recent research suggests that a more vigorous acidification step, termed "acid extractable" aluminum, would yield only the forms of aluminum that contribute to toxicity. Therefore, IDEM should delay adopting either the proposed WER-based or the U.S. EPA's currently recommended aquatic life criteria for aluminum. (AEP)

Comment: At 327 IAC 2-1-6(a)(3), in Table 6-2, IDEM needs to explain the derivation of the equations (especially the source of the underlying toxicity data) that are proposed in the draft rule for new aquatic life criteria for aluminum. Both the maximum (acute aquatic concentration) and average (chronic aquatic concentration) are

expressed as WER values that are normalized presumably by the total hardness of a receiving stream. It would be an acceptable approach if the applicable maximum and average ambient aluminum criteria are based on site-specific information. (AEP)

Comment: IDEM is urged to withdraw the proposed WERs-based aluminum criteria and consider adopting the U.S. EPA's revised criteria when it is finalized. U.S. EPA issued draft revised aquatic life criteria for aluminum in 2017 that indicates the pH, dissolved organic carbon (DOC), and total hardness have an effect on the bioavailability and, therefore, the toxicity of aluminum. U.S. EPA accounted for the joint effect of these three variables by developing a multiple linear regression model, normalized at standard pH, DOC, and hardness values. Based on the water quality characteristics at a given site, the applicable freshwater acute and/or freshwater chronic criteria may be either less stringent or more stringent than the default criteria. (AEP)

Comment: In 2017, U.S. EPA released a draft aluminum 304(a) criteria document, which found that aluminum bioavailability and toxicity are influenced by pH and dissolved organic carbon in addition to hardness. The relationship between pH and aluminum toxicity to aquatic life is nonlinear, meaning aluminum is least toxic to aquatic organisms at values around neutral pH and increases as pH either increases or decreases. The U.S. EPA's 2017 draft aluminum document includes newly published toxicity data for aluminum, including new chronic data for the unionid mussel, fatmucket (*Lampsilis siliquoidea*), which is ranked as the third most sensitive genus in the draft 304(a) aluminum chronic dataset when normalized to pH 7, hardness of 100 mg/l as $CaCO_3$, and dissolved organic carbon of 1.0 mg/l. According to the U.S. Fish and Wildlife Service website of federally-listed threatened, endangered, and proposed species (revised July 25, 2017), there are ten endangered or threatened mussel species and critical habitat for one mussel species in Indiana. U.S. EPA recommends that IDEM revise its aluminum proposed criteria to incorporate the most current scientific information about aluminum toxicity to aquatic organisms. This may be accomplished by adopting the U.S. EPA 2017 draft document or by modifying its proposal based on IDEM's work to address the technical recommendations of the U.S. EPA 2017 draft document. (EPA5)

Comment: Footnotes in tables 6-2 and 8-1 state, "The applicable pH range for determining the aluminum criterion is within 6.5 and 9.0." These footnotes imply there are no aluminum water quality criteria if the waterbody pH is above 9.0 or below 6.5. If this is not IDEM's intent, then the footnotes need clarification. (EPA5)

Response: IDEM removed the proposed criterion for aluminum for both the waters within and outside of the Great Lakes System from the draft rule for consideration of preliminary adoption. Since the time IDEM initiated this rulemaking to update certain metals water quality criteria, U.S. EPA published aluminum aquatic life ambient water quality criteria for freshwaters under Section 304(a)(1) of the Clean Water Act (NRWQC) on December 14, 2018. The NRWQC reflects the latest scientific knowledge about aluminum toxicity to aquatic life. Bioavailability is the measure of whether a substance in the environment is available to affect living organisms, and the bioavailability of aluminum is dependent on the chemistry of the water. The more bioavailable the aluminum is, the more likely it is to cause a toxic effect. The water chemistry parameters that have the greatest impact on aluminum's bioavailability are pH, total hardness, and dissolved organic carbon (DOC) (U.S. EPA, 2018).

The 2018 NRWQC applies a multiple linear regression model using a site's pH, DOC, and hardness to derive its aluminum criterion. IDEM's aluminum criterion initially proposed in the draft rule at second notice of comment period does not reflect the current scientific knowledge that incorporates bioavailability considerations. IDEM is evaluating the implementation issues related to the 2018 NRWQC for aluminum and will consider adopting the 2018 NRWQC in a future rulemaking.

Arsenic

Comment: It is of concern that IDEM is removing arsenic (III) from Indiana's WQC for the protection of human health. While the national criteria are still under revision, it seems advisable to retain the existing criteria until the national criteria have been released. (HEC)

Response: IDEM is retaining the current arsenic (III) criteria for the protection of human health in Indiana's WQC for surface waters outside of the Great Lakes System in the draft rule for consideration of preliminary adoption.

Comment: U.S EPA supports adoption of IDEM's proposed criteria for arsenic, which is U.S. EPA's existing 304(a) criteria recommendations for arsenic (U.S. EPA, 1996). (EPA5)

Response: IDEM appreciates this comment supporting the metals rulemaking. IDEM is retaining the arsenic (III) criteria for human health for waters outside of the Great Lakes System in the draft rule for consideration of preliminary adoption. IDEM is not adopting the U.S. EPA 304(a) NRWQC for total arsenic.

Comment: For arsenic, IDEM is proposing to remove the "Outside the Mixing Zone" and "Point of Water Intake" human health criteria. Even though all drinking water use waters must also meet the Safe Drinking Water Act's Maximum Contaminant Level after conventional treatment, this does not protect the organism-only human health use (Outside the Mixing Zone). U.S. EPA recommends maintaining the arsenic criteria update as proposed in the table that accompanied the First Notice of Comment Period which changed the current older criteria to be consistent with the most recent 304(a) recommendations. (EPA5)

Response: IDEM is retaining the arsenic (III) criteria for the protection of human health in Indiana's WQC for waters outside of the Great Lakes System in the draft rule for consideration of preliminary adoption.

Beryllium

Comment: It is of concern that IDEM is removing beryllium from Indiana's WQC for the protection of human health. While the national criteria are still under revision, it seems advisable to retain the existing criteria until the national criteria have been released. (HEC)

Response: U.S. EPA has not issued 304(a) NRWQC for "organism only (Indiana's "outside of the mixing zone")" or "water + organism (Indiana's "point of water intake")" for beryllium, so IDEM removed these criteria from the draft rule for consideration of preliminary adoption. However, U.S. EPA has published a Maximum Contaminant Level (MCL) for beryllium under the U.S. EPA's National Primary Drinking Water Regulations.

Cadmium

Comment: U.S EPA supports adoption of IDEM's proposed criteria for cadmium, which is U.S. EPA's 2016 304(a) criteria recommendations for cadmium. (EPA5)

Response: IDEM appreciates this comment supporting the metals rulemaking.

Comment: It is of concern that IDEM is removing cadmium from Indiana's WQC for the protection of human health. While the national criteria are still under revision, it seems advisable to retain the existing criteria until the national criteria have been released. (HEC)

Response: U.S. EPA has not issued 304(a) NRWQC for "organism only (Indiana's "outside of the mixing zone")" or "water + organism (Indiana's "point of water intake")" for cadmium, so IDEM removed these criteria from the draft rule for consideration of preliminary adoption. However, U.S. EPA has published a Maximum Contaminant Level (MCL) for cadmium under the U.S. EPA's National Primary Drinking Water Regulations.

Chromium (III)

Comment: U.S EPA supports adoption of IDEM's proposed criteria for chromium (III), which is U.S. EPA's existing 304(a) criteria recommendations for chromium (III) (U.S. EPA, 1996). (EPA5)

Response: IDEM appreciates this comment supporting the metals rulemaking.

Comment: It is of concern that IDEM is removing chromium (III) from Indiana's WQC for the protection of human health. While the national criteria are still under revision, it seems advisable to retain the existing criteria until the national criteria have been released. (HEC)

Response: U.S. EPA has not issued 304(a) NRWQC for "organism only (Indiana's "outside of the mixing zone")" or "water + organism (Indiana's "point of water intake")" for chromium (III), so IDEM removed these criteria from the draft rule for consideration of preliminary adoption. However, U.S. EPA has published a Maximum Contaminant Level (MCL) for chromium (III) under the U.S. EPA's National Primary Drinking Water Regulations.

Chromium (VI)

Comment: It is of concern that IDEM is removing chromium (VI) from Indiana's WQC for the protection of human health. While the national criteria are still under revision, it seems advisable to retain the existing criteria until the national criteria have been released. (HEC)

Response: U.S. EPA has not issued 304(a) NRWQC for "organism only (Indiana's "outside of the mixing zone")" or "water + organism (Indiana's "point of water intake")" for chromium (VI), so IDEM removed these criteria from the draft rule for consideration of preliminary adoption. However, U.S. EPA has published a Maximum Contaminant Level (MCL) for chromium (VI) under the U.S. EPA's National Primary Drinking Water Regulations.

Copper

Comment: U.S. EPA recommends that IDEM adopt the U.S. EPA's 2007 304(a) recommendations for copper, which is the biotic ligand model (BLM), rather than the hardness-based criteria equation, because the copper BLM represents the most current science intended to protect the biota in Indiana's waters. If IDEM adopts the copper BLM, U.S. EPA would be willing to work with IDEM to develop implementation procedures that address how the BLM would be applied where data for the BLM input parameters are not currently available or IDEM could use state-collected data to develop state-specific default input values provided such default values would result in copper criteria that are protective of the aquatic life use. New data on copper toxicity have been published subsequent to U.S. EPA's 2007 304(a) criterion recommendation, and U.S. EPA would be able to assist IDEM in locating this new data. (EPA5)

Response: IDEM is not adopting U.S. EPA's 2007 304(a) recommendations for copper for waters within and outside of the Great Lakes System at this time. IDEM is withdrawing the proposed aquatic life criteria for copper in waters outside of the Great Lakes System from the draft rule for consideration of preliminary adoption. IDEM intended to adopt the aquatic life criteria for copper within the Great Lakes System waters, which are not based on the BLM, but are more stringent than current copper criteria in waters outside of the Great Lakes System. While the current U.S. EPA 304(a) NRWQC for copper is the BLM, IDEM understands that U.S. EPA is actively evaluating the most recent data and science for certain metals, including copper, as part of a Cooperative Research and Development Agreement to re-evaluate NRWQC (U.S. EPA, 2018(a)). The Work Plan for this project, which is to develop an overarching bioavailability modeling approach to support updating U.S. EPA aquatic life water quality criteria for metals, includes a re-evaluation that could lead to revisions to the current BLM NRWQC for copper, which IDEM will evaluate for adoption when finalized.

Lead

Comment: HEC objects that the draft rule contains a less stringent criteria for lead and removes the lead criteria for human health. Lead is extremely neurotoxic. In 2012, the Center for Disease Control adopted a statement that there is no safe level of lead exposure for children. It is difficult to imagine that the science of aquatic life toxicology has found evidence that lead is less toxic than we used to believe. IDEM needs to restore the previous lead criteria. (HEC)

Response: IDEM is withdrawing the proposed acute and chronic aquatic life criteria for lead for surface waters within and outside of the Great Lakes System from the draft rule for consideration of preliminary adoption. For surface waters outside of the Great Lakes System, IDEM is retaining the current criteria, which are the 304(a) NRWQC and are more stringent than the second notice draft rule criteria. For waters within the Great Lakes System, IDEM proposes to adopt the NRWQC for lead, which are more stringent than the second notice draft rule criteria. U.S. EPA has not published human health 304(a) NRWQC for lead so IDEM is removing the current criteria for lead, for the point of water intake, for surface waters outside of the Great Lakes System. Please note that U.S. EPA has published a Maximum Contaminant Level (MCL) for lead under the U.S. EPA's National Primary Drinking Water Regulations.

Comment: IDEM is proposing hardness-based lead criteria based on additional new data published subsequent to a partial revision of U.S. EPA's 304(a) criteria. States are allowed under federal regulation at 40 CFR 131.11(b)(1)(iii) to establish numerical values based on other scientifically defensible methods, taking into account new toxicity data published to date. There are new data on lead toxicity published subsequent to U.S. EPA's 1984 304(a) criteria recommendation. Wang et al., 2010 demonstrates that enough data may be available to satisfy the 8 minimum data requirements (MDR) and derive criteria for lead consistent with U.S. EPA's preferred criteria derivation approach using least square regression. U.S. EPA is evaluating the most recent data and science for lead as part of a Cooperative Research and Development Agreement. U.S. EPA recommends that IDEM either conduct a literature review and update the lead criteria as appropriate or provide its rationale to show that the proposed criteria are based on a sound scientific rationale and protective of aquatic life uses. (EPA5)

Response: In the draft rule for consideration of preliminary adoption, IDEM is withdrawing the proposed acute and chronic aquatic life criteria for lead for waters outside of the Great Lakes System and will retain the current acute and chronic aquatic life criteria for lead, which are USEPA's current 304(a) NRWQC for lead. For waters within the Great Lakes System IDEM is proposing, in the draft rule for consideration of preliminary adoption, the current U.S. EPA 304(a) NRWQC for lead.

Nickel

Comment: The new proposed aquatic life criteria for nickel are lower than they used to be. However, according to published information regarding studying of "Acute and Chronic Toxicity of Nickel to a Cladoceran (*Ceriodaphnia dubia*) and an Amphipod (*Hyalella azteca*)" by Keithly, Brooker, DeForest, Wu, and Brix (Environmental Toxicology and Chemistry, Vol. 23, No. 3, pp.691-696, 2004), the new criteria still won't come close to keeping one of our common effluent toxicity testing animals (*Ceriodaphnia dubia*) from failing the tests. The chronic criteria suggest that 100 µg/l of nickel should protect aquatic life. But the Keithly et.al. study found chronic effects to *Ceriodaphnia* at concentrations as low as 7 µg/l. Biomonitor, Inc. has had several instances of having to explain that nickel is the cause of effluent toxicity even when the nickel limits are being met. The nickel criteria should be considered for lowering beyond the proposed criteria in the LSA Document #14-58 draft rule. (BIO, HEC)

Response: IDEM appreciates these comments. IDEM is proposing to adopt U.S. EPA's current 304(a) NRWQC for nickel. U.S. EPA is actively evaluating the most recent data and science for certain metals, including nickel, as part of a Cooperative Research and Development Agreement to re-evaluate 304(a) NRWQC. The Work Plan for this project, which is to develop an overarching bioavailability modeling approach to support updating U.S. EPA aquatic life water quality criteria for metals, includes a re-evaluation that could lead U. S. EPA to revise the current NRWQC for nickel (U.S. EPA, 2018(a)). If this happens, IDEM will consider adopting the revised NRWQC for nickel in a future rulemaking.

Comment: The proposed revisions to the nickel human health criteria are consistent with the U.S. EPA's national criteria, which were first listed as national recommended human health criteria in 1998. The City of Greensburg strongly supports the proposed revisions to the nickel human health criteria. (GRB)

Response: IDEM appreciates this comment supporting the metals rulemaking.

Comment: IDEM's proposal is to adopt criteria for nickel that is U.S. EPA's existing 304(a) criteria recommendations for nickel (U.S. EPA, 1996). Please be aware that U.S. EPA is actively evaluating the most recent data and science for these metals as part of a Cooperative Research and Development Agreement. U.S. EPA expects that this reevaluation could lead to revisions to the 304(a) recommendations for nickel. (EPA5)

Response: IDEM is aware of the Cooperative Research and Development Agreement under which certain metals, including nickel, are being evaluated.

Nitrate and Nitrite

Comment: U.S. EPA supports IDEM's revision of Table 6-1 by removing the criteria for nitrate and nitrite and placing updated nitrate and nitrite criteria based on U.S. EPA's most recent 304(a) criteria recommendations at

327 IAC 2-1-6(e)(6). (EPA5)

Response: IDEM appreciates this comment supporting the metals rulemaking.

Selenium

Comment: Selenium is particularly toxic to aquatic life, but its regulation is complicated since the toxicity is most closely related to its concentration in fish eggs and tissues. There was an extensive process at the federal level to draft the National Recommended Water Quality Criteria for selenium (USEPA 2016 NRWQC), and adoption of those recommendations is the best approach for Indiana. (HEC)

Response: IDEM appreciates this comment supporting the metals rulemaking.

Comment: ICC commissioned an analysis of appropriate selenium water quality criteria for protection of aquatic life from GEI Consultants, Inc. (GEI) of Denver, Colorado. IDEM needs to consider the GEI report (dated November 2017) and base state specific selenium criteria on the report for the following reasons:

(1) The issues identified in the GEI report are valid, use U.S. EPA methodology, and are based on scientific literature, some of which was available to U.S. EPA at the time of the NRWQC development and some of which is new.

(2) The GEI report acknowledges background water quality in Indiana and the dampening of toxicity caused by competition with sulfate.

(3) The GEI report recommends that IDEM assess waterbodies for selenium based on the presence or absence of sturgeon because the fish is ecologically relevant but also relatively rare in Indiana waters.

(4) The GEI report includes fathead minnow in the list of species considered for selenium toxicity. Including fathead minnow will add a regionally significant species for warm water streams.

(ICC, IMA, DUKE, PE)

Comment: The current IDEM proposed criteria in the draft rule would adopt the national criteria with only slight modification, which is not an appropriate approach for Indiana waters. Instead, the selenium water quality criterion recommended in the GEI report would be a more appropriate basis for an Indiana water quality standard than the national criteria. The following are scientific justifications as to why IDEM should develop a state specific selenium criterion: (ICC, IMA, NIPSCO, DUKE, PE)

- The inclusion of a White sturgeon toxicity study in the national criteria development overly influenced the data. The White sturgeon were the most sensitive species in the database even though it showed only a partial dose response relationship. Sturgeon generally do not occupy the smaller streams, which are a large proportion of the waterbodies in Indiana. If the draft selenium criterion is applied to all Indiana waters, it would be an overly conservative approach for most of the state. Therefore, IDEM is obligated to apply a two-part criteria, one for water with sturgeon present and one without sturgeon.
- U.S. EPA used several conservative assumptions that deviate from typical practice when the appropriate threshold for sturgeon was determined. IDEM should review the analysis methods used by U.S. EPA for consistency with IDEM's derivation methods.
- The national criteria did not fully include available data for fathead minnows, which are often a dominant species in smaller warm water streams. Fathead minnows are ecologically significant in Indiana, and it is important to include this species in the selenium derivation procedure.
- The national criteria included three studies for Bluegill. One of the studies showed that an increased concentration of selenium led to a decrease in toxicity, which is an inconsistent result with the other two studies and does not make sense. Therefore, the third study must be excluded from the final criteria since Bluegill are adequately protected by inclusion of the other two studies.
- The fish tissue to water column conversion method used in the national criteria was unconventional, was not adequately justified by U.S. EPA, and ignored the dynamic relationship between water concentration and uptake that have a significant influence on the resulting criteria. Scientific literature (DeForest et al., 2017) published since the national criteria were developed offers better conversion of fish tissue values to water column values and should be used by IDEM.
- IDEM should not default to U.S. EPA's methods for calculating conversion factors because U.S. EPA diverged from its typical regression-based conversion factors, which are more accurate at the high and low ranges, in developing its recommended selenium criterion.
- Sulfate levels typical of Indiana waters can significantly reduce selenium bioavailability and lessen selenium toxicity of a water column concentration. Sulfate concentrations can be elevated in coal mining regions due to the dissolution of pyrite. A sulfate dependent selenium criterion is recommended to allow for this impact on selenium toxicity.

Response: On behalf of the Indiana Coal Council (ICC), GEI Consultants, Inc. (GEI), proposed state-specific selenium criterion elements for IDEM consideration: "Recommended Updates to Indiana's Selenium Aquatic Life Standards, November 2017 (GEI, 2017)." The document proposed several approaches to modify the proposed selenium criterion. Some of these approaches are appropriate and acceptable, and others are not, as described in the multi-page comment response below. GEI has offered many of these recommendations previously to U.S. EPA during the comment period for draft selenium National Recommended Water Quality Criteria under Section 304(a) of the Clean Water Act ("NRWQC"; 2014 Draft NRWQC for External Peer Review and 2015 Draft

NRWQC), as described below. Many reviewers, including American Electric Power, Duke Energy, Indiana Coal Council, Indiana Energy Association, Indiana Manufacturers Association, Indianapolis Power and Light Company, Northern Indiana Public Service Company, and Peabody Energy, provided comments in support of the findings and recommendations presented in the GEI document.

In order to facilitate a response to comments that reference this document, IDEM is providing the following general response (starting with "BACKGROUND") to the major recommendations presented in the GEI report. U.S. EPA provides guidance for modifying NRWQC, and IDEM evaluated if GEI's comments proposed acceptable methodologies for deriving an Indiana-specific criterion.

BACKGROUND

Selenium toxicity to aquatic life and aquatic-dependent wildlife

Selenium is a naturally occurring metal that is nutritionally essential in small amounts, but toxic at higher concentrations. Of all aquatic taxa, fishes are the most sensitive to elevated concentrations of selenium. Although selenium may cause acute toxicity at high concentrations, the most adverse effect on aquatic organisms is due to its bioaccumulative properties; these chronic effects are found at lower concentrations than acute effects (U.S. EPA, 2016(a)). The most sensitive adverse effects of selenium are reproductive effects on the exposed offspring (larval deformity and mortality) because of maternal transfer of selenium to eggs. In Belews Lake, North Carolina, where these impacts were first observed and described in the U.S. (1977), selenium toxicity was identified as the cause of deformities to the spine, head, fins, and eyes of larval fish, and the subsequent reproductive failure that decimated 29 resident species in the lake (Young et al., 2010). Movement of selenium through the aquatic food web (e.g., aquatic plants, invertebrates and fish) has also been shown to lead to selenium bioaccumulation in aquatic-dependent wildlife. Numerous studies have documented adverse ecosystem impacts, not only to fishes and other aquatic life, but to aquatic-dependent wildlife, especially birds (Young et al., 2010, U.S. EPA, 2018(b)).

U.S. EPA National Recommended Water Quality Criteria for the Protection of Aquatic Life under Section 304(a) of the Clean Water Act

U.S. EPA publishes National Recommended Water Quality Criteria under Section 304(a) of the Clean Water Act (NRWQC). Aquatic life criteria for toxic chemicals are the highest concentration of specific pollutants or parameters in water that are not expected to pose a significant risk to most species in a given environment. When U.S. EPA develops NRWQC, they follow a prescribed methodology (Stephan et al., 1985). State and tribal governments may use these NRWQC or use them as guidance in developing their own criteria.

U.S. EPA regulations at 40 CFR 131.11(b)(1)(ii) provide that states and authorized tribes may establish water quality criteria that are "modified to reflect site-specific conditions". The site-specific criteria must be based on sound scientific rationale, protect designated uses, and are subject to U.S. EPA approval or disapproval under Section 303(c) of the Clean Water Act. Recalculated site-specific criteria should provide the same level of protection intended for aquatic life as the national criteria (for example, protect 99% of individuals in 95% of the species in aquatic communities from acute and chronic effects of the chemical or stressor, or both) but at a specific site.

U.S. EPA defines a "site" as all waters in the state, region, or watershed or as a specific waterbody or segment of waterbody. The Water Quality Standards Handbook (U.S. EPA, 2017) summarizes the following procedures for deriving site-specific criteria:

- Recalculation Procedure. This method is intended to consider relevant differences between the sensitivity of species in the national dataset and those at the site. However, recalculation can consist of any updates or revisions in the data set (not necessarily site-specific updates) and, therefore, be conducted such that it is effectively an update to the national WQC.
- Water-Effect Ratio Procedure. This method provides for the use of a water-effect ratio to consider observed differences between the toxicity of a chemical in laboratory dilution water and in site water.
- Resident Species Procedure. This method is intended to consider differences for both the aquatic organisms present at a site and differences in toxicity of site water and lab water.

U.S. EPA details the first of these procedures in *Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria* (U.S. EPA, 2013). Any corrections to the national dataset must be approved by U. S. EPA. Any additions to the national dataset must be approved by U.S. EPA. The deletion process may be applied if appropriate, meaning a taxonomic group is not present at the site.

While states and stakeholders can provide comments on the interpretation of toxicity studies and toxicological endpoints proposed during the comment period for draft NRWQC, U.S. EPA does not approve modification of toxicological endpoints (for example, species or genus mean acute or chronic values) in the species sensitivity distribution of a final NRWQC based on re-interpretation of studies used to derive the criteria.

U.S. EPA's *Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater 2016* (U.S. EPA, 2016(a)) selenium criterion document recommends that states and authorized tribes adopt a multi-media criterion into their water quality standards. The criterion has four elements and U.S. EPA recommends that states include all four elements into their standards. Two elements are based on the concentration of selenium in fish tissue

(eggs and ovaries, and whole-body or muscle) and two elements are based on the concentration of selenium in the water column [two 30-day chronic values for lentic ("still water") and lotic ("flowing water") aquatic systems, and an intermittent chronic value]. Aquatic communities are expected to be protected by this chronic criterion from any potential acute effects of selenium, so the NRWQC does not include acute criterion elements.

GEI CONSULTANTS: RECOMMENDED UPDATES TO INDIANA'S SELENIUM AQUATIC LIFE STANDARDS, NOVEMBER 2017

GEI recommended that IDEM amend the selenium 2016 NRWQC to reflect a more appropriate criterion for Indiana. Their recommendations included: (1) amending selected toxicity studies and data used for the species sensitivity distribution for U.S. EPA criteria development; (2) using amended toxicity endpoints to derive alternate fish tissue and water column criteria elements; and (3) proposing criteria for portions of the state where sturgeon are not resident species in surface water. Additionally, GEI proposed that IDEM adopt or allow alternative approaches for deriving conversion factors and water column elements, including for acute criteria, which would deviate from those proposed in the 2016 selenium NRWQC. IDEM's comments regarding these GEI recommendations are as follows:

1. **GEI Review of Selected Toxicity Studies and Egg-Ovary Data Used for U.S. EPA NRWQC**

GEI proposed modifying the egg-ovary toxicity endpoints for three genera/species included in the species sensitivity distribution ("SSD") that U.S. EPA developed to calculate the egg-ovary criterion element for the 2016 selenium NRWQC. GEI's recommended modifications for White sturgeon (*Acipenser transmontanus*) and Bluegill (*Lepomis macrochirus*) toxicity endpoints result in a less stringent egg-ovary criterion element (17.3 milligrams/kilogram dry weight, "mg/kg dw") than the 2016 selenium NRWQC (15.1 mg/kg dw).

For the fathead minnow (*Pimephales promelas*), GEI stated it was not one of the fish species included in the selenium NRWQC SSD and proposed that Indiana include a species mean chronic value from their 2008 study. However, U.S. EPA cites a fathead minnow toxicity study as one of the acceptable maternal transfer reproductive studies used to derive the NRWQC for selenium (Table 3.1, U.S. EPA 2016(a)), as discussed below, and includes it in the SSD (Section 3.1.6, U.S. EPA 2016(a)).

IDEM has determined that these GEI recommendations are not acceptable, as described below.

White Sturgeon (*Acipenser transmontanus*): Of the taxa used to derive the 2016 selenium NRWQC, White sturgeon, representing the taxonomic Family Acipenseridae, Order Acipenseriformes, are the most sensitive to the toxic effects of selenium. For a proposed Indiana state-specific criterion, GEI proposed a less stringent egg-ovary chronic value endpoint for White sturgeon (17.8 mg/kg dw) than U.S. EPA derived for the NRWQC SSD (15.6 mg/kg dw). U.S. EPA considered a 17.8 mg/kg dw chronic value endpoint in a draft criterion document distributed for external peer review, but upon review and consideration of comments, determined that 15.6 mg/kg dw was the appropriate chronic endpoint for the White sturgeon toxicity study used for deriving the 2016 selenium NRWQC (U.S. EPA, 2015(b)).

During the comment period for the 2015 draft selenium criterion, GEI recommended, on behalf of the Colorado Wastewater Utility, that U.S. EPA retain the 17.8 mg/kg dw chronic toxicity endpoint that was proposed in the 2014 draft selenium criterion document distributed for external peer review. GEI disagreed with the model U.S. EPA used to derive the EC_{10} chronic toxicological endpoint for White sturgeon proposed for the 2015 draft criterion.[1]

[1] "The EC_{10} is the concentration of a chemical that is estimated to result in a 10 percent effect in a measured chronic endpoint (e.g., growth, reproduction, or survival). For selenium, in all cases, the effect endpoint used in the estimation of chronic values (e.g., EC_{10}s) is an effect on offspring (with exposure via maternal transfer) from parents exposed to selenium via diet. (U.S. EPA 2016a)."

U.S. EPA did not accept GEI's recommendation (U.S. EPA 2016(b), p. 154-155) and defended the model approach used to derive the White sturgeon egg-ovary EC_{10} (for combined edema and deformities) of 15.6 mg/kg dw. Further, U.S. EPA noted that White sturgeon is a commercially and recreationally important fish species in the Pacific Northwest, serves as a surrogate for other sturgeon species in the United States, and has a population listed as endangered in the Kootenai River in Idaho and Montana. Given these factors, a conservative species mean chronic value is appropriate.

While White sturgeon is not a resident species in Indiana, three Acipenseriformes species (Shovelnose sturgeon, Lake sturgeon, and American paddlefish) reside in Indiana waters. In Indiana, Lake sturgeon (*Acipenser fulvescens*) is a state-endangered species (IDNR, 2019(a)).

GEI's recommendation is not based on new information or updates to the SSD data set; it is based on an alternate interpretation of existing data. GEI's proposed data modification does not reflect updated toxicity findings. It does not conform to the Recalculation Procedure, and it does not result in a fish tissue criterion specific to Indiana waters that provides the same level of protection intended for aquatic life as the national criteria. The GEI recommendation would result in a less stringent chronic value endpoint for a fish taxon that is sensitive to selenium toxicity and includes an Indiana state-endangered species.

Bluegill (*Lepomis macrochirus*): GEI disagreed with U.S. EPA's inclusion of the Hermanutz et al. (1992, 1996) studies to derive one of the toxicological endpoints (EC_{10} for larval edema) for Bluegill sunfish. Bluegill sunfish is the species second most sensitive to the toxic effects of selenium in the NRWQC SSD. Removing the Hermanutz et al. studies would result in a less stringent egg-ovary species mean chronic value (24.4 mg/kg dw) for Bluegill sunfish than the final species mean chronic value (20.6 mg/kg dw) published in the 2016 NRWQC. U.S. EPA and peer reviewers reviewed and vetted the Hermanutz et al. studies for the 2016 final NRWQC document (U.S. EPA 2016(a), pp. 40-44), and they determined that both studies are important and appropriate for understanding selenium toxicity.

GEI's recommendation is not based on new information or updates to the SSD data set; it is based on a disagreement with U.S. EPA's inclusion of a primary study used in the NRWQC SSD. GEI's proposed data modification does not reflect updated toxicity findings. It does not conform to the Recalculation Procedure, and it does not result in a fish tissue criterion specific to Indiana waters that provides the same level of protection intended for aquatic life as the national criteria. Applying the GEI recommendation will result in a less stringent chronic value endpoint for a fish taxon that is sensitive to selenium toxicity and is widely distributed in Indiana surface waters.

Fathead Minnows (*Pimephales promelas*): U.S. EPA selected a study by Schultz and Hermanutz (1990) to support inclusion of fathead minnows (*Pimephales promelas*) into the 2016 selenium NRWQC SSD. U.S. EPA did not derive a specific chronic value from the toxicological endpoint, larval edema and lordosis, because of uncertainty in the data set but, U.S. EPA did estimate a genus mean chronic value ("< 25.6 mg/kg dw").

GEI proposed that Indiana include a species mean chronic value (60.2 mg/kg dw egg-ovary) from their authored 2008 fathead minnow maternal selenium transfer study (GEI Consultants, 2008) for an Indiana-specific SSD. U.S. EPA reviewed but did not include GEI's 2008 study for the NRWQC SSD. U.S.EPA does, however, cite the study as supporting U.S. EPA findings that fathead minnows are not as sensitive to the effects of selenium as other species (U.S. EPA 2016 (a), p.106). A summary of the study is included in Appendix E ("Other Data") of the NRWQC (U.S. EPA, 2016(a) p 644-645). U.S. EPA noted the following: "Although there is an indication of effect due to selenium exposure in both the embryonic and larval endpoints, there is too much variation in the responses observed with the embryos and insufficient response observed with the larvae to derive a reasonable estimate of effect levels."

GEI stated that modifying the NRWQC SSD to include their 2008 fathead minnow study "results in a slightly revised database from that presented in the 2016 selenium NRWQC, now consisting of ten species in nine genera." This is not correct. Although EPA did not derive a precise toxicity endpoint, the fathead minnow is already included in EPA's SSD used in NRWQC calculations. Fathead minnow toxicity information is shown on Table 3.1, "Maternal Transfer Reproductive Studies," (U.S. EPA, p 45-46). The fathead minnow estimated genus mean chronic value (< 25.6 mg/kg dw egg-ovary) ranks seventh of the nine fish genera mean chronic values. The tenth fish genera in the SSD, *Gambusia*, is viviparous (live-bearing, versus egg-laying), so a genus mean chronic value was not derived for the egg-ovary criterion element calculation.

The total number of genus mean chronic value toxicity endpoints available to derive the selenium chronic criterion is 15. These include ten fish genera (*Acipenser*, *Salmo*, *Lepomis*, *Micropterus*, *Oncorhynchus*, *Pimephales*, *Gambusia*, *Esox*, *Cyprinodon*, and *Salvelinus*). Added to these are the tested invertebrate genera *Centroptilum*, *Brachionus*, and *Lumbriculus*, and two waived genera (crustaceans) (U.S. EPA 2016(a), Section 3.1.6, p 60).

Including GEI's data would not impact the egg-ovary criterion element. U.S. EPA's estimated genus mean chronic value ("< 25.6 mg/kg dw) and GEI's proposed alternate genus mean chronic value (60.2 mg/kg dw) do not change the relative sensitivity rank for the four most sensitive genera used in the egg-ovary criterion element calculations (Stephan et al., 1985); these ranged from 15.6 mg/kg dw egg-ovary (*Acipenser*) to 25.3 mg/kg dw egg-ovary (*Oncorhynchus*).

GEI's recommendation is not based on new information or updates to the SSD data set; it is based on an alternate interpretation of existing data. GEI's proposed data modification does not reflect updated toxicity findings. It does not conform to the Recalculation Procedure, and it does not result in a fish tissue criterion specific to Indiana waters that provides the same level of protection intended for aquatic life as the national criteria.

2. **Conversion Factors:** U.S. EPA and the United States Geological Survey (USGS) developed an equation based on a mechanistic model of bioaccumulation to translate the egg-ovary elements to whole-body, muscle, and water column elements for the 2016 selenium NRWQC. The equation includes a species-specific trophic transfer factor (TTF) value, a species-specific egg-ovary to whole body conversion factor (CF), and a site-specific enrichment factor. The TTF represents the transfer of selenium from one trophic level to the next higher trophic level.

GEI disagreed with U.S. EPA's application of median-derived conversion factors to translate the egg-ovary criterion element to the whole fish/muscle and water column criterion elements. GEI, instead, proposed a regression-based approach. GEI provided this comment during the 2015 draft selenium NRWQC. U.S. EPA provided the following response: "EPA noted that both GEI and NAMC commented that conversion factors (CFs) derived using a median were inappropriate; GEI comments did not provide specific reasons for why medians were inappropriate, but rather, that regressions would be more appropriate (U.S. EPA 2016(b), p. 188)."

For the 2016 final selenium NRWQC, U.S. EPA retained the use of the median to derive CFs in the criteria document for several reasons, including that (1) the median is a non-parametric measure of central tendency that does not require an assumption of linearity; (2) it is direct and simple analysis that can easily be verified and replicated with simple spreadsheet tools; and (3) more complex analyses did not yield results that were different or superior (U.S. EPA 2016(b), p. 188-189). A chart comparing the CFs derived by each method is shown in Appendix N of the 2016 selenium NRWQC (U.S. EPA, 2016(a), Table N-3, p N-15).

GEI's proposed modification of the conversion factor methodology does not conform to the Recalculation Procedure, and it does not result in a fish tissue criterion specific to Indiana waters that provides the same level of protection intended for aquatic life as the national criteria.

3. **Non-Sturgeon Waters criterion:** GEI proposed using the Recalculation Procedure described above to propose a "non-sturgeon waters" criterion for portions of Indiana. Applying the Recalculation Procedure is an acceptable approach to derive a site-specific criterion (SSC) for portions of Indiana.

To support their argument for a "sturgeon absent" selenium criterion, GEI stated "sturgeon in Indiana are generally found in larger waterbodies and would not be expected to be present in smaller creeks and streams; therefore, it is not necessary to retain *Acipenser* in the selenium database to be protective of waterbodies that do not support sturgeon." GEI did not provide specific sturgeon distribution or abundance data.

There is precedence for a "non-sturgeon waters" selenium SSC. The State of Idaho promulgated the 2016 selenium NRWQC into its state water quality standards and included justification for an SSC for non-sturgeon waters (State of Idaho, November 2017). IDEM evaluated GEI's recommendation to modify the selenium criterion for portions of the state that are non-sturgeon waters. This request is consistent with provisions in the recalculation procedure (U.S. EPA, 2013) to modify the SSC in the NRWQC for portions of the state where these species, or species for which they are a surrogate in the NRWQC SSD, do not occur at the site.

According to U.S. EPA's Recalculation Procedure (U.S. EPA, 2013), because some tested species might be needed to represent untested species that occur at the site, the deletion process does not provide for simplistic deletion of all species that do not occur at the site. Rather, the deletion process is designed to ensure that each species, genus, family, order, class, and phylum that occurs both at the site and in the national toxicity dataset is retained in the site-specific toxicity dataset.

White sturgeon (*Acipenser transmontanus*), representing the Family Acipenseridae, Order Acipenseriformes, is the aquatic organism most sensitive to the effects of selenium in the 2016 NRWQC SSD. While this species is not found in Indiana, it serves as a surrogate in Indiana for two sturgeon species (Lake sturgeon (*Acipenser fulvescens*) and Shovelnose sturgeon (*Scaphirhynchus platorynchus*)) and one paddlefish species (American paddlefish (*Polyodon spathula*)) in the Order Acipenseriformes (U.S. EPA, 2013; see Appendix 1), which are not included in the SSD. The taxonomic relationship among these species is shown in

Table 1, below. Shading indicates shared taxonomic rank.

Table 1. Acipenseriformes taxonomic classification for Indiana species: White sturgeon as a surrogate species for Lake sturgeon, Shovelnose sturgeon, and American paddlefish in the Species Sensitivity Distribution (SSD) used to derive the 2016 NRWQC for selenium. Shading indicates shared taxonomic rank.

	White Sturgeon	Lake Sturgeon	Shovelnose Sturgeon	American Paddlefish
Phylum	Chordata	Chordata	Chordata	Chordata
Class	Actinopterygii	Actinopterygii	Actinopterygii	Actinopterygii
Order	Acipenseriformes	Acipenseriformes	Acipenseriformes	Acipenseriformes
Family	Acipenseridae	Acipenseridae	Acipenseridae	Polyodontidae
Genus	*Acipenser*	*Acipenser*	*Scaphirhynchus*	*Polyodon*
Species	*transmontanus*	*fulvescens*	*platorynchus*	*spathula*
Resident?	No	Yes	Yes	Yes
Tested?	Yes	No	No	No

IDEM is including a selenium site-specific criterion for "Non-Acipenseriformes Waters" outside of the Great Lakes System in the draft rule for consideration of preliminary adoption.
• IDEM is not including a selenium site-specific criterion for "Non-Acipenseriformes Waters" within the Great Lakes System. Lake sturgeon (*Acipenser fulvescens*) are resident in Lake Michigan and are actively being reintroduced (after being extirpated) into Lake Erie. IDEM has determined that all waters in Indiana's Great Lakes System will be classified as "Acipenseriformes Waters".
• Certain upstream waters outside of the Great Lakes System where Acipenseriformes are not expected to be found but may serve as habitat or spawning areas, or contribute to downstream water quality, will be evaluated, and may be classified as "Acipenseriformes Waters."

Sturgeon and Paddlefish (Order Acipenseriformes) Occurrence and Habitat:
IDEM consulted with IDEM and Indiana Department of Natural Resources (IDNR) fisheries biologists regarding the occurrence, distribution, and abundance of sturgeon and paddlefish species in Indiana and also consulted with the Ohio River Valley Sanitation Commission (ORSANCO) and Illinois biologists regarding species occurrence and distribution in interstate waters. IDEM also consulted scientific literature documenting species occurrence and distribution in Indiana (Blatchey, 1938; Bruch et al., 2016; Gerking, 1945; Phelps et al., 2011; Simon, 2011; Wallus, 1990).

Order Acipenseriformes
Acipenseriformes (sturgeon and paddlefish) are primitive, ray-finned fishes whose evolution dates back 250 to 300 million years ago. They retain the physiological traits of their ancient ancestors, such as a cartilaginous endoskeleton and hetero-caudal fin, and are considered "relic fish". While there are inherent differences among species, Acipenseriformes are one of the largest, longest lived, and slowest growing freshwater fishes in the world. Species within the Order Acipenseriformes spawn many times during their lifetimes but have protracted spawning that spans from every couple of years up to nine years, depending upon the species. The eggs of many species are harvested for processing into caviar. Because of the value of caviar, Acipenseriformes are particularly vulnerable to overexploitation in addition to other threats, including pollution and habitat fragmentation. Many species are considered to be at risk of extinction. In order to prevent further decline of sturgeon resources, all species in the Order Acipenseriformes were placed under the species protection system of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Convention in 1997 (Ctarci, 2004).

Indiana has three resident species of Acipenseriformes:
• *Acipenser fulvescens* (Lake sturgeon) was once widespread in the Great Lakes and in Indiana's larger rivers and streams prior to overharvesting and hydrologic modification (dams) that blocked river spawning habitat. Lake sturgeon are slow-growing, long-lived fish, with males living up to 50 years and females living up to 150 years. Females begin reproducing between 14 and 33 years of age and, then, only produce eggs every three to twelve years. Mature Lake sturgeon can reach lengths of greater than six feet and weights over 100 pounds. The current Lake sturgeon population is estimated to be one percent of its historic abundance. Lake sturgeon currently occur in Lake Michigan and are being restocked into Lake Erie (USFWS, 2019). Indiana Lake sturgeon found in the Lower Wabash and White River are the species' last known naturally reproducing population in the Ohio River basin. They are an Indiana State Endangered Species (IDNR 2019(a)). In Indiana, harvesting or taking of Lake Sturgeon is illegal (IDNR, 2019(b)).

• *Scaphirhyncus platorynchus* (Shovelnose sturgeon) are common in Indiana rivers. This is the smallest species of freshwater sturgeon native to North America, reaching only two feet in length, with an average weight of 5.5 pounds, and with life spans of up to thirty years. Shovelnose sturgeon begin spawning between five to seven years of age, and females do not produce eggs every year (IDNR 2012(a)). Like other Acipenseriformes species, Shovelnose sturgeon eggs are harvested for caviar production. IDNR biologists have observed a decline in their population in recent years due to overharvesting and poaching. As with other Acipenseriformes, the historic occurrence and distribution of this species has been impacted by hydrological modifications of large rivers, specifically, the construction of dams. IDEM and IDNR biologists have documented the presence of Shovelnose sturgeon in the following state and interstate waters: Eel River, Lake Michigan, Mississinewa River, Ohio River, Salamonie River, Sugar Creek, Tippecanoe River, Wabash River, and White River (East Fork and West Fork). Shovelnose sturgeon spawn in tributaries to these waters.
• *Polyodon spathula* (American paddlefish) are rare to occasional in Indiana. They occur in Indiana's large rivers, including the Ohio River and its tributaries. American paddlefish is the only extant species worldwide in the paddlefish family, Polyodontidae; the Chinese paddlefish (*Psephurus gladius*) was declared extinct in December 2019 (Zhang et al., 2019). American paddlefish are often referred to as primitive fish or relict species because they retain some morphological characteristics of their early ancestors, including a skeleton that is almost entirely cartilaginous, and a paddle-shaped rostrum (snout) that extends nearly one-third their body length. American paddlefish can reach a length of seven feet and a weight of 160 pounds. They may live 30 to 60 years, and are slow to mature, with males first spawning at seven years of age, and females at nine to ten years of age. During most of its life, a paddlefish lives in quiet or slow-flowing waters, but for spawning, this species must have access to a large, free-flowing river with gravel bars that frequently flood (IDNR, 2012(b)). To protect the declining population in Indiana, it is illegal for anglers to take a paddlefish in state waters, and commercial fishermen cannot take paddlefish from the Ohio River (IDNR, 2019). IDEM and IDNR biologists have documented the presence of American paddlefish in similar waters as the Shovelnose sturgeon, plus the interstate Ohio River and its tributaries, and the interstate Greater Miami River watershed.

Determining the resident fish species that occur at the site:
For its analysis, IDEM did not consider the removal of other genera from the site-specific data set for the purposes of recalculating the selenium criterion for non-Acipenseriformes waters for portions of Indiana. The remaining NRWQC SSD nine fish genera include many Indiana resident genera/species or stocked species, in addition to those reviewed previously: *Oncorhynchus* (Rainbow trout, Chinook salmon, and Coho salmon), *Salmo* (Brown trout), *Salvelinus* (Lake trout), *Micropterus* (Largemouth bass, Smallmouth bass, and Spotted bass), and *Esox* (Northern pike, Muskellunge, Grass pickerel, and Tiger muskie). Other Indiana species represented in the genus *Lepomis*, represented in the SSD by Bluegill sunfish *(Lepomis macrochirus*), include Green sunfish, Orange spotted sunfish, Redear sunfish, and Warmouth (IDNR, 2018(a)). These species may be present in waters where Acipenseriformes do not occur at the site.

Recalculating the Selenium criterion elements based on resident fish species
IDEM used the Recalculation Procedure and U.S. EPA methodologies (Stephan et al., 1985) to derive site-specific egg-ovary, whole-fish, and muscle criterion elements for portions of Indiana outside the Great Lakes System where fishes in the Orders Acipenseriformes do not occur at the site. IDEM has determined that there are no other Order Acipenseriformes species in Indiana other than *Acipenser fulvescens* (Lake sturgeon), *Scaphirynchus platorynchus* (Shovelnose sturgeon) and *Polyodon spathula*,(American paddlefish) for which *Acipenser transmontanus* (White sturgeon) serves as a surrogate species in the NRWQC SSD. For the recalculation, IDEM used genus mean chronic values (GMCVs) included in the national toxicity dataset for each of the fish tissue criterion elements. IDEM removed the *Acipenser* GMCV from the national toxicity dataset, then recalculated the selenium criterion elements based on the remaining GMCVs in the national dataset. To do this, we arranged the remaining GMCVs from lowest to highest, as shown on Table 2, for the egg-ovary toxicity dataset. We applied this ranking and calculation process for each criterion element, using the GMCVs from the national toxicity dataset for each criterion element. Given that there are species-specific conversion factors for selenium bioaccumulation in different fish tissue types, this hierarchy changes depending upon the tissue type analyzed (U.S. EPA, 2016a). Per the Stephan et al (1985) methodology, we used the GMCVs from the four most sensitive genera, and the revised number of genera ("N") to calculate the egg-ovary criterion element (Table 3), whole-body criterion element (Table 4) and muscle criterion element (Table 5) to calculate site-specific criterion elements for non-Acipenseriformes waters.

Table 2. Egg-Ovary Species Sensitivity Distribution for Selenium: Ranked fish egg-ovary genus mean chronic values (GMCVs) for waters of the state within and outside of the Great Lakes System ("Waters") and site-specific criterion elements outside of the Great Lakes system where Acipenseriformes do not occur at the site ("Site-Specific").

"Waters" N = 15[a]			"Site-specific" N = 14[a]		
Rank	GMCV[b](mg Se/kg dw egg-ovary)[c]	Species	Rank	GMCV[b](mg Se/kg dw egg-ovary)[c]	Species
9	56.2	Dolly Varden *Salvelinus malma*			
8	34	Northern pike *Esox lucius*	8	56.2	Dolly Varden *Salvelinus malma*
7	27	Desert pupfish *Cyprinodon macularius*	7	34	Northern pike *Esox lucius*
6	26.3	Largemouth bass *Micropterus salmoides*	6	27	Desert pupfish *Cyprinodon macularius*
5	<25.6[d]	Fathead minnow *Pimephales promelas*	5	26.3	Largemouth bass *Micropterus salmoides*
4	25.3	Cutthroat trout *Oncorhynchus clarkii*	4	<25.6[d]	Fathead minnow *Pimephales promelas*
		Rainbow trout *Oncorhynchus mykiss*	3	25.3	Cutthroat trout *Oncorhynchus clarkii*
3	21.0	Brown trout *Salmo trutta*			Rainbow trout *Oncorhynchus mykiss*
2	20.6	Bluegill sunfish *Lepomis macrochirus*	2	21.0	Brown trout *Salmo trutta*
1	15.6	White sturgeon *Acipenser transmontanus*	1	20.6	Bluegill sunfish *Lepomis macrochirus*

[a]N: number of species in the Species Sensitivity Distribution. The table includes egg-ovary data for fishes in the SSD. *Gambusia,* an additional fish species in the national dataset, has a reproductive value expressed as an adult whole-body fish since it is an oviparous genus (live-bearer versus egg-layer). Also in the national dataset are the tested invertebrate genera *Centroptilum*, *Brachionus*, and *Lumbriculus*, and two waived genera (crustaceans).

[b]GMCV: genus mean chronic value.

[c]mg Se/kg dw: milligrams of selenium per kilogram, dry weight

[d]GMCV not calculated, but estimated, due to variability in the observations among replicates in toxicity studies. The chronic value in this table is included to show it is in the range of selenium effects concentrations (U.S. EPA, 2016 (a), p 46). The estimated GMCV was not used in the calculation of either the NRWQC or the Indiana site-specific criterion for waters outside of the Great Lakes System.

Table 3. Calculation of the Indiana site-specific egg-ovary criterion element for selenium

Genus	Rank	GMCV[a]	ln(GMCV)	ln(GCMV)[2]	P=R/(N+1)[b]	Sqrt(P)
Micropterus	4	26.3	3.27	10.69	0.27	0.52
Oncorhynchus	3	25.3	3.23	10.44	0.20	0.45
Salmo	2	21	3.04	9.27	0.13	0.37
Lepomis	1	20.6	3.03	9.15	0.07	0.26
		sum	12.57	39.55	0.67	1.59
					N[c]	14
					S^2[d]	1.28
					S	1.13
					L[e]	2.69

	A[f]	2.95
	FCV[g]	**19.0**

Notes:
[a]Selenium concentration in mg/kg dw. See Table 2, above, and U.S. EPA 2016(a), p 45-49 for egg-ovary toxicity data.
[b]Cumulative probability
[c]Total number of GMCVs in data set

$$^{d}S^2 = \frac{\sum(\ln GMCV)^2 - (\sum \ln GMCV)^2/4}{\sum P - (\sum\sqrt{P})^2/4}$$

$$^{e}L = [\sum \ln GMCV - S(\sum\sqrt{P})]/4$$

$$^{f}A = S(\sqrt{0.05}) + L$$

[g]FCV = Final chronic value in mg/kg dw; FCV = e^A

Table 4. Calculation of the Indiana site-specific whole-body criterion element for selenium

Genus	Rank	GMCV[a]	ln(GMCV)	ln(GCMV)[2]	P=R/(N+1)[b]	Sqrt(P)
Esox	4	14.2	2.65	7.04	0.27	0.52
Salmo	3	13.2	2.58	6.66	0.20	0.45
Oncorhynchus	2	11.6	2.45	6.01	0.13	0.37
Lepomis	1	9.9	2.29	5.26	0.07	0.26
		sum	9.98	24.96	0.67	1.59
					N[c]	14
					S^2[d]	2.03
					S	1.42
					L[e]	1.93
					A[f]	2.25
					FCV[g]	**9.5**

Notes:
[a]Selenium concentration in mg/kg dw. See U.S. EPA 2016(a) p 49-51 for whole-body toxicity dataset.
[b]Cumulative probability
[c]Total number of GMCVs in data set

$$^{d}S^2 = \frac{\sum(\ln GMCV)^2 - (\sum \ln GMCV)^2/4}{\sum P - (\sum\sqrt{P})^2)/4}$$

$$^{e}L = [\sum \ln GMCV - S(\sum\sqrt{P})]/4$$

$$^{f}A = S(\sqrt{0.05}) + L$$

[g]FCV = Final chronic value in mg/kg dw; FCV = e^A

Table 5. Calculation of the Indiana site-specific muscle criterion element for selenium

Genus	Rank	GMCV[a]	ln(GMCV)	ln(GCMV)[2]	P=R/(N+1)[b]	Sqrt(P)
Esox	4	21.7	3.08	9.47	0.27	0.52
Salmo	3	18.5	2.92	8.51	0.20	0.45
Lepomis	2	15.9	2.77	7.65	0.13	0.37
Oncorhynchus	1	14.3	2.66	7.08	0.07	0.26

	sum	11.42	32.71	0.67	1.59
				N[c]	14
				S^2[d]	2.68
				S	1.64
				L[e]	2.21
				A[f]	2.57
				FCV[g]	**13.1**

Notes:
[a]Selenium concentration in mg/kg dw. See U.S. EPA 2016(a) p 52-54 for muscle toxicity dataset.
[b]Cumulative probability
[c]Total number of GMCVs in data set

[d] $$S^2 = \frac{\sum(\ln GMCV)^2 - (\sum \ln GMCV)^2/4}{\sum P - (\sum \sqrt{P})^2)/4}$$

[e] $$L = [\sum \ln GMCV - S(\sum \sqrt{P})]/4$$

[f] $$A = S(\sqrt{0.05}) + L$$

[g]FCV = Final chronic value in mg/kg dw; FCV = e^A

Indiana fish tissue criterion elements for waters outside of the Great Lakes System where fishes in the Order Acipenseriformes (sturgeon and paddlefish) do not occur at the site
IDEM's recalculated criterion elements are presented in Table 6, below, and are compared to U.S. EPA 2016 NRWQC, IDEM's 2nd Notice Metals Rulemaking, and GEI's Proposed IN State-Specific Criteria.

Criteria presented in the draft rule for consideration of preliminary adoption include the 2016 NRWQC chronic criterion numeric fish tissue elements for waters within and outside of the Great Lakes System ("Waters"). IDEM's Draft Rule for consideration of preliminary adoption includes site-specific selenium criterion elements with less stringent numeric fish tissue elements for those waters outside of the Great Lakes System where neither sturgeon nor paddlefish occur ("Site-specific"). The criteria include the footnotes included in the 2016 NRWQC for selenium, with clarifying modifications specific to Indiana rules and processes.

Upon receipt of an application for a site-specific determination that fishes in the Order Acipenseriformes do not occur at the site, IDEM will review available species occurrence and distribution information for Lake sturgeon (*Acipenser fulvescens*), Shovelnose sturgeon (*Scaphirynchus platorynchus*) and paddlefish (*Polyodon spathula*) Site-specific criterion elements apply only after IDEM has determined, and U.S. EPA approves IDEM's determination, that fishes in the Order Acipenseriformes do not occur at the site.

Table 6. Summary Comparison Table: U.S. EPA 2016 NRWQC, GEI, and Indiana proposed selenium fish tissue criterion elements for waters of the state within and outside the Great Lakes System ("Waters") and site-specific criterion elements where Acipenseriformes do not occur at the site ("Site-Specific").

Source	Egg-ovary mg/kg dw		Whole-Body mg/kg dw		Muscle mg/kg dw	
	Waters	**Site-specific***	**Waters**	**Site-specific***	**Waters**	**Site-specific***
U.S. EPA 2016 NRWQC	15.1		8.5		11.3	
IN 2017 2nd Notice Metals Rulemaking Proposed	15.1		8.5		11.3	
GEI 2017 IN State-Specific Proposed	17.3	20.7	9.0	9.6	12.3	13.1
IN 2020 Draft Rule	**15.1**	**19.0**	**8.5**	**9.5**	**11.3**	**13.1**

*These criteria are applicable to surface waters of the state for which the department has made a site-specific determination, and U.S. EPA has approved, that fishes in the Order Acipenseriformes (sturgeon, paddlefish) do not occur at the site, as defined at 327 IAC 2-1-9(37).

4. **GEI's Derivation of Water Column Criterion Elements**
GEI proposed alternate approaches to derive alternate water column criterion elements for lentic waters, lotic waters, and intermittent discharges.

Sulfate acute toxicity: GEI noted high sulfate waters have the potential to reduce acute selenium toxicity and, therefore, the water column elements developed on a national scale may be overprotective of some Indiana waters that have high sulfate. GEI proposed that site or regional water column criteria may be appropriate depending on ambient sulfate concentrations. However, the 2016 selenium NRWQC does not define a relationship between selenium concentrations and sulfate and does not include acute criterion elements.

U.S. EPA notes that "including any type of sulfate relationship in the national criterion would necessitate having sulfate measurements to accompany all observed selenium water concentrations included in the derivation database. The absence of an accompanying sulfate observation would necessitate excluding the water observation. The resulting reduction in the number of sites included in the database would reduce the confidence in its ability to represent the nation's waters. For the above reasons, U.S. EPA has not included a sulfate relationship in the 2016 selenium criterion. (U.S. EPA 2016 (a), p. 130-131)."

Furthermore, the 2016 selenium NRWQC does not include acute criterion elements. U.S. EPA notes (U.S. EPA 2016(a). p xii) the following:

> Although selenium may cause acute toxicity at high concentrations, the most deleterious effect on aquatic organisms is due to its bioaccumulative properties. These chronic effects are found at lower concentrations than acute effects. Organisms in aquatic environments exposed to selenium accumulate it primarily through their diets and not directly through water (Chapman et al., 2010). The best science also indicates that selenium toxicity occurs primarily through transfer to the eggs and subsequent reproductive effects. Consequently, in harmony with the recommendations of expert panels (U.S. EPA 1998; Chapman et al., 2010) and with peer review and public comments on previous U.S. EPA (2004, 2014, 2015) drafts, U.S. EPA developed a chronic criterion reflective of the reproductive effects of selenium concentrations on fish species.

Considering sulfate acute toxicity to derive Indiana selenium water quality criteria is not supported by the NRWQC or Indiana-specific data.

Regression based approach to derive water column criteria elements:
GEI recommended a regression approach proposed by DeForest et al. (2017) to calculate the water column criteria for lentic and lotic waters. U.S. EPA noted that this approach, outlined in a 2014 study, yields similar results as the U.S. EPA approach, which is based on an equation that includes a species-specific trophic transfer factor (TTF) value, a conversion factor, and an enrichment factor.

> The water column values calculated using this are strikingly similar to EPA's water column recommendations of 3.1 µg/l and 1.5 µg/l for lotic and lentic systems. This result further substantiates and supports U.S. EPA's water column values, despite the use of different analytic methods in the two approaches (U.S. EPA, 2016 (b), p. 54).

However, GEI's proposed water column criterion elements of 4.2 µg/l in lotic system and 2.2 µg/l in lentic systems are less stringent than U.S. EPA's NRWQC (3.1 µg/l in lotic systems and 1.5 µg/l in lentic systems). This is because GEI used the less stringent (higher) proposed egg-ovary criterion element value (17.3 mg/kg dw vs 15.1 mg/kg dw) that resulted from their revisions to the genus mean chronic value toxicity endpoints (GMCV) for White sturgeon (17.7 mg/kg versus 15.6 mg/kg) and Bluegill sunfish (24.4 mg/kg dw versus 14.7 mg/kg dw). Applying these revised GMCVs resulted in the less stringent egg-ovary criterion element, and thus less stringent water column criterion elements. Using the model of DeForest et al. with U.S. EPA's 2016 selenium NRWQC egg-ovary criterion element (15.1 mg/kg dw) calculated at the 75^{th} quartile derives water column criteria elements of 2.8 µg/l for lotic waters and 1.7 µg/l for lentic waters. These values are equivalent to the NRWQC criterion elements calculated using the TTF methodology at the 20th percentile. IDEM agrees that since U.S. EPA has determined that this methodology provides equivalently protective water column criterion elements as their analytic methodology, the regression-based approach may be considered for deriving site specific criterion elements.

Acute intermittent exposure criterion element: GEI proposed an acute criterion element ("site-specific") to replace the intermittent exposure element, based on a biokinetic model for one-day and four-day pulses. The 2016 selenium NRWQC does not include acute criterion elements. U.S. EPA's intermittent water column

criterion is derived to protect against chronic impacts, which occur at lower concentrations than acute impacts. Therefore, this recommendation is inconsistent with NRWQC recommendations, and IDEM does not support it (see comment regarding sulfate, above).

Selenate-dominated waters: For selenate-dominated waters, GEI proposed a sulfate-dependent model for the proposed site-specific water column criteria. U.S. EPA responded to this comment (U.S. EPA, 2016(b), p. 117) as follows:

> EPA decided not to include a sulfate correction factor in the 2016 selenium criterion due to uncertainties in the science. The Deforest et al. 2014 report referred to in the NAMC and API 2015 public comments notes that a sulfate-dependent selenium criteria would apply only to selenate-dominated, well-oxygenated streams, which is a small subclass of waters in the U.S. The publication discussed experiments to assess influence of sulfate on selenate uptake on only one species of macrophyte (*Lemna minor*) and one algal species (*Pseudokirchnella subcapitata*), a very limited data set of primary producers. The authors themselves note that, "It does need to be emphasized here, however, the analysis currently does not include Se data for periphyton and benthic diatoms, as these data are not available." The authors also note that "due to methodological challenges and high costs, it is difficult to comprehensively evaluate the influence of sulfate on bioconcentration and transfer up the food chain." Similarly, EPA describes effects of mercury on aquatic life, but did not adjust the chronic criterion."

GEI did not provide Indiana specific data to support development of a selenate-dominated criterion, and IDEM does not support GEI's proposed model.

Indiana site-specific water column criterion elements for waters outside of the Great Lakes System where fishes in the Order Acipenseriformes do not occur at the site.

IDEM used the DeForest et al. (2017) regression model to calculate water column elements for non-Acipenseriformes waters using the recalculated egg-ovary criterion element (19 mg/kg dw). As noted above, U.S. EPA concurred that this approach yields similar results as the U.S. EPA approach, which is based on an equation that includes a species-specific trophic transfer factor (TTF) value, a conversion factor, and an enrichment factor. This approach yields water column criterion elements of 5.5 µg/l for lotic waters and 2.7 µg/l for lentic waters at the 75th quartile.

Criteria in the draft rule to be presented for consideration of preliminary adoption include the 2016 NRWQC chronic criterion numeric water column elements for waters within and outside of the Great Lakes System ("Waters"). The draft rule for consideration of preliminary adoption also includes site-specific selenium criterion elements with less stringent numeric water column elements for those waters outside of the Great Lakes System where neither sturgeon nor paddlefish (Order Acipenseriformes) occur at the site ("Site-specific"). The criteria include the footnotes included in the 2016 NRWQC for selenium, with clarifying modifications specific to Indiana rules and processes.

Upon receipt of an application for a site-specific determination that fishes in the Order Acipenseriformes do not occur at the site, IDEM will review available species occurrence and distribution information for Lake sturgeon (*Acipenser fulvescens*), Shovelnose sturgeon (*Scaphirynchus platorynchus*) and paddlefish (*Polyodon spathula*) Site-specific criteria apply only after IDEM has determined, and U.S. EPA approves IDEM's determination, that Acipenseriformes do not occur at the site.

Table 7. Summary Comparison Table: U.S. EPA 2016 NRWQC, GEI, and Indiana proposed lotic ("flowing") and lentic ("still") water column criterion elements for waters of the state within and outside the Great Lakes System ("Waters") and site-specific criterion elements where Acipenseriformes do not occur at the site ("Site-Specific").

Source	Lotic µg/l		Lentic µg/l	
	Waters	Site-specific*	Waters	Site-specific*
U.S. EPA NRWQC 2016	3.1		1.5	
IN 2017 2nd Notice Metals Rulemaking Proposed	3.1		1.5	
GEI 2017 IN State-Specific Proposed	4.2	7.2	2.2	3.2
IN 2020 Draft Rule	**3.1**	**5.5**	**1.5**	**2.7**

*These criteria are applicable to surface waters of the state for which the department has made a site-specific determination, and U.S. EPA has approved, that fishes in the Order Acipenseriformes (sturgeon, paddlefish) do not occur at the site, as defined at 327 IAC 2-1-9(37).

Comment: The draft rule includes a water quality criterion for selenium that is based on the NRWQC at Section 304(a) of the Clean Water Act. IDEM needs to develop a state specific criterion for selenium based on regional water quality and biological conditions and that incorporates advances in the science that have occurred since the release of the U.S. EPA's NRWQC. U.S. EPA's guidance documents state that the NRWQC are only recommendations and a state can pursue a state criterion that is independent of the national recommended criterion. (ICC, IMA, AEP, NIPSCO, DUKE, PE)

Comment: The U.S. EPA's 2016 national criteria for selenium are based on a select number of data usage decisions that are focused on a national scale and not necessarily appropriate criteria for Indiana waters. In fact, the U.S. EPA data set is limited in sampling locations and does not contain data from Indiana. (NIPSCO)

Response: U.S. EPA publishes NRWQC on a national scale using species representative of organisms present nationally. As discussed in the GEI response section, the selenium 2016 NRWQC SSD fish genera include Indiana resident genera/species or stocked species, or taxa that represent these species, and, thus, is protective of taxa in Indiana waters. Most fish genera in the NRWQC SSD are represented in Indiana, for example: *Acipenser* (Lake sturgeon, Shovelnose sturgeon, American paddlefish); *Oncorhynchus* (Rainbow trout, Chinook salmon, and Coho salmon); *Salmo* (Brown trout), *Salvelinus* (Lake trout), *Micropterus* (Largemouth bass, Smallmouth bass, and Spotted bass), *Esox* (Northern pike, Muskellunge, Grass pickerel, and Tiger muskie); *Lepomis*, (Bluegill sunfish, Green sunfish, Orange spotted sunfish, Redear sunfish, and Warmouth (IDNR, 2018(a)).

In the draft rule for consideration of preliminary adoption, IDEM is proposing a site-specific criterion for those waters of the state outside of the Great Lakes System where fishes in the Order Acipenseriformes do not occur at the site. To propose additional Indiana site-specific chronic criteria for selenium based on regional water quality and biological conditions that incorporate advances in the science used to publish the 2016 selenium NRWQC, IDEM would require sufficient paired water column and fish tissue data representing regional water conditions or toxicity studies specific to species in Indiana, or both. These data are lacking.

Comment: IDEM's 2016 fish tissue sampling program provides ambient fish tissue selenium concentrations (fillets) within the White River basin. These data did not exceed the proposed fish tissue WQC for selenium when converted to a dry weight basis. In addition, Indiana has not identified waters where beneficial uses are impaired by the presence of selenium. Therefore, Indiana's current selenium chronic aquatic criterion (CAC) of 35 µg/l, except at water intakes where the criterion is 10 µg/l, appears to be protective of beneficial uses in the White River. These data would support IDEM adopting the U.S. EPA's 2016 fish tissue-based WQC but continuing to use the current water column criteria or one that is recalculated to be appropriate for Indiana waters. (IPL)

Response: While 2016 fish tissue sampling in the White River did not show exceedances of the proposed selenium fish tissue criterion element, these samples were not paired with selenium surface water samples. Indiana's current selenium chronic aquatic criterion (CAC) for waters outside of the Great Lakes System of 35 µg/l date from U.S. EPA's first NRWQC (U.S. EPA, 1980), which did not consider the bioaccumulative properties of selenium, because they were not well understood at that time. U.S. EPA has revised this criterion several times (1987 and 1998-1999), but Indiana has not updated its rules to incorporate these updates. The chronic water column criterion elements proposed in the draft rule for consideration of preliminary adoption are derived from the egg-ovary criterion element in accordance with the latest science and U.S. EPA's 2016 selenium NRWQC.

Comment: The current IDEM proposed criteria in the draft rule would adopt the national criteria with only slight modification, which is not an appropriate approach for Indiana waters. Instead, the selenium water quality criterion recommended in the GEI report would be a more appropriate basis for an Indiana water quality standard than the national criteria. The following are scientific justifications as to why IDEM should develop a state specific selenium criterion: (ICC, IMA, NIPSCO, DUKE, PE)

• The national criteria contain water column concentrations that are approaching the analytical limits of testing methods and are further complicated by interference from other parameters.

Response: The sensitivity of available analytical methods is not a factor that is used in the development of a water quality criterion. Instead, this issue is addressed when a water quality criterion is implemented.

• The sedimentary geology that dominates Indiana is known to be a natural source of elevated selenium. Therefore, IDEM will need to implement a standard that protects the aquatic life in this type of geology without imposing overly stringent criteria.

Response: U.S. EPA publishes NRWQC on a national scale using species representative of organisms present nationally, over a range of geological and ecological conditions. IDEM is proposing a site-specific criterion for those waters of the state outside of the Great Lakes System, where Order Acipenseriformes do not occur at the site. To propose additional Indiana site-specific chronic criteria for selenium, based on regional water quality and biological conditions that incorporate advances in the science used to publish the 2016 selenium NRWQC, IDEM would require sufficient paired water column and fish tissue data representing water conditions impacted by regional geology for prescribed areas in Indiana. These data are lacking. However, stakeholders may develop these data and propose site-specific criteria using the procedures established in the rules.

• U.S. EPA's method of determining potential impacts from intermittent discharges is an oversimplification that essentially applies the chronic criterion adjusted based on the number of days of discharge. This method

does not account for the changes in selenium biodynamics that would occur during intermittent pulses. Another method of determining acute criteria resulting from short-term pulses of water is to use a biokinetic model to predict fish tissue concentrations resulting from intermittent pulses of selenium into the water column.

Response: Like the lentic and lotic criterion elements, the intermittent-exposure criterion element protects against cumulative exposure of selenium from multiple short-term discharges that may cause an excursion of the fish tissue criterion element. U.S. EPA derived the intermittent exposure criterion element directly from the chronic water criterion element by algebraically rearranging the chronic water criterion element to establish a limit on an intermittent elevated concentration occurring over a specified percentage of time, while simultaneously accounting for background concentrations. The intermittent exposure criterion was developed to protect aquatic life from chronic selenium impacts, while the biokinetic model was designed to protect against acute selenium impacts. According to the 2016 NRWQC for selenium, although selenium may cause acute toxicity at high concentrations, the most deleterious effects on aquatic organisms are due to its bioaccumulative properties from chronic exposures. These chronic effects are found at lower concentrations than acute effects. IDEM concluded that U.S. EPA's intermittent selenium exposure criterion element was derived appropriately to protect aquatic taxa from adverse chronic impacts.

Comment: The water column values are nearing the limit of analytical accuracy regarding current test methods. Therefore, without developing state-specific selenium criteria, the national criteria in the draft rule will require unnecessary resources and expenditures for the regulated community. (IEA, NIPSCO)

Comment: The proposed selenium water column criteria for lentic waterbodies is so low as to approach the limit of analytical accuracy of current testing methods. For example, the minimum reporting limit for selenium measured using U.S. EPA's Method 200.8 is 1.0 µg/l, as reported by our contract laboratory, and this minimum reporting level is attainable only in the absence of routinely present chemical interferences detected by the instrument. The presence of inter-element interferences will likely make proof of compliance challenging, if not impossible. IDEM needs to implement criteria that are realistic relative to analytical determinations and do not cause noncompliance due to analytical uncertainty. (NIPSCO)

Response: The sensitivity of available analytical methods is not a factor that is used in the development of a water quality criterion. Instead, this issue is addressed when a water quality criterion is implemented.

Comment: The development of site-specific WQC under 327 IAC 2-1-13 uses a procedure that depends on calculations based on data requirements from multiple taxa. The U.S. EPA's 2016 selenium WQC were developed based on a different approach using fish tissue-based effects data. Aqueous WQC for selenium were then back-calculated from tissue concentrations associated with threshold effects using a broad data set. Fish are the most sensitive species to effects from selenium, and other taxa are not necessary for developing site-specific criteria that are protective of all aquatic organisms. IDEM should clarify that the recalculation procedure can be used with available and relevant fish tissue toxicity data and selenium uptake models, for example, as described in U.S. EPA 2016, or based on the best available science. An improvement on U.S. EPA's model could be made by including the interaction between selenium and sulfate (DeForest et al., 2017). (IPL)

Response: U.S. EPA used selenium toxicity data that expressed the adverse impacts to aquatic biota. For selenium, the most adverse impacts are reproductive effects, expressed in maternal egg and ovary tissue. While the 2016 NRWQC for selenium used genus mean chronic value (GMCV) toxicity endpoints based on egg-ovary data rather than water column data, U.S. EPA used methodologies to calculate criterion elements consistent with standard NRWQC methodologies including statistical procedures as described by Stephan et al (1985). EPA did use a trophic transfer approach to calculate GCMV toxicity endpoints for the other fish tissue criterion elements, but separately ranked each set of GMCV, then calculated each criterion element per statistical procedures outlined by Stephan et al (1985).

The total number of GMCV toxicity endpoints available to derive the selenium chronic criterion elements is 15. These include ten fish genera (*Acipenser*, *Salmo*, *Lepomis*, *Micropterus*, *Oncorhynchus*, *Pimephales*, *Gambusia*, *Esox*, *Cyprinodon*, and *Salvelinus*). Added to these are the tested invertebrate genera *Centroptilum*, *Brachionus*, and *Lumbriculus*, and two waived genera (crustaceans) (U.S. EPA 2016(a), Section 3.1.6, p 60). While fish taxa are more sensitive to the chronic effects of selenium than other aquatic taxa, it is not acceptable per U.S. EPA methodologies to eliminate aquatic species from the Species Sensitivity Distribution because they are less sensitive to a chemical than other aquatic species; rather, the methodology prescribes that acceptable toxicity data from a distribution of aquatic taxa must be included. Please note that eliminating taxa from the SSD reduces the number of taxa or "N" for the statistical calculation, potentially resulting in more stringent criterion elements.

The recalculation procedure is an acceptable method for calculating a site-specific criterion for the fish tissue criterion elements (U.S. EPA 2016(a), p 103), and IDEM used these procedures in combination with guidance from U.S. EPA (2013) to derive site-specific selenium fish tissue criterion elements for portions of Indiana outside of the Great Lakes System where Acipenseriformes do not occur at the site. IDEM determined that it is not acceptable to use the recalculation procedure to derive fish tissue criterion elements for Great Lakes System waters, since most of the genera in the NRWQC SSD would occur at the site, or represent resident species that

occur at the site. However, either of the mechanistic modeling or empirical bioaccumulation factor methodologies (U.S. EPA 2016(a), Appendix K) are acceptable procedures for deriving a site-specific water column criterion element for waters within and outside of the Great Lakes System.

Regarding sulfate concentrations in Indiana waters, and their impact on selenium, U.S. EPA noted in the 2016 NRWQC that "including any type of sulfate relationship in the national criterion derivation would necessitate having sulfate measurements to accompany all observed selenium water concentrations included in the derivation database. That is, the absence of an accompanying sulfate observation would necessitate excluding the water observation. The resulting reduction in the number of sites included in the database would reduce the confidence in its ability to represent the nation's waters. For the above reasons, EPA has not included a sulfate relationship in the 2016 selenium criterion." (U.S. EPA. 2016(a), p. 130-131)

Comment: In 327 IAC 2-1-6, table 6-2a, the CAC are differentiated on the basis of "lentic" and "lotic" aquatic systems and exposure duration. The lentic criteria will result in pervasive reasonable potential to exceed for all industries. IDEM needs to consider Indiana specific data and/or alternative models to derive selenium criteria representative of Indiana waters. Additionally, a footnote should be added to this table defining lentic and lotic aquatic systems as non-flowing surface waters and flowing surface waters, respectively. (IEA, IPL)

Response: IDEM does not anticipate that the lentic water column criterion element will result in pervasive reasonable potential to exceed for many industries, given the limited industries with processes that have the potential to discharge elevated concentrations of selenium. IDEM has not added a footnote defining lotic and lentic aquatic systems to the selenium criterion for waters outside of the Great Lakes System (327 IAC 2-1-6(a)(1)(4)(A), Table 6-1a) and within the Great Lakes System (327 IAC 2-1.5-8(a)(3)(B), Table 8-1a) or the site-specific criterion for Non-Acipenseriformes waters outside of the Great Lakes System (327 IAC 2-1-6(a)(1)(4)(B)), but will include a definition in implementation guidance.

Comment: The proposed selenium criteria are overly stringent and do not represent actual thresholds of adverse effects based on field studies. U.S. EPA's criterion document does not demonstrate adverse effects to sensitive aquatic life when lentic and lotic waterbodies have water column selenium concentrations about 1.3 micrograms per liter (µg/l) and 3.1 µg/l, respectively. Instead of the proposed selenium criteria that would put facilities discharging a detectable amount of selenium into a pervasive reasonable potential to exceed condition, IDEM should adopt the current Great Lakes Water Quality Guidance average selenium water quality criterion of 5 µg/l. This criterion is based on measured water selenium concentrations in a lentic setting where the unaffected portion of the lake had healthy and sustaining fish populations. (AEP)

Comment: The selenium water quality criteria that U.S. EPA selected for lotic and lentic systems are based on a probability distribution curve for the water column concentrations attained from the egg-ovary tissue criterion. This methodology is very prescriptive for such a wide range of environments. The data actually demonstrate that water concentrations protective of the tissue criterion can range from 0.27 µg/l to 52.0 µg/l for lentic sites and 0.11 µg/l to 55.3 µg/l for lotic sites, depending on the site-specific factors. This range supports studies and standards specific to Indiana waters. IDEM needs to consider alternative methodologies that will better represent site-specific conditions in Indiana for establishing water quality standards. (NIPSCO)

Response: IDEM lacks statewide paired fish tissue and water column data to support and use alternate approaches to develop state-specific selenium water quality criterion elements for Indiana surface water. Without enough scientifically qualified Indiana-specific data, modifications to the NRWQC cannot be supported.

Comment: In 327 IAC 2-1-6, table 6-2a, footnotes [2] and [3], which indicate that the fish tissue elements take precedence over the proposed water column criteria for selenium when both elements are measured, are acceptable. However, the last sentence of footnote [5] talks about "...in the absence of steady-state condition fish tissue data." There is a concern that permits could be issued using this provision to incorporate water quality-based effluent limitations (WQBELs) for selenium in NPDES permits before a permittee would be allowed to submit fish tissue data. Neither U.S. EPA nor IDEM has defined what constitutes "steady state condition fish tissue data." (AEP)

Response: U.S. EPA has defined a "steady state" condition as an existing discharge that has not received new or increasing inputs of selenium and will provide further clarification when they publish final implementation guidance documents. In the draft rule for consideration of preliminary adoption, IDEM is including the following footnote in the selenium criterion table to clarify this term: "Fish tissue elements are expressed as steady-state; the aquatic system should not be experiencing new or increasing inputs of selenium." IDEM implementation guidance will include additional clarifying information. Generally, when any major changes to water column selenium concentrations occur, IDEM will require a minimum duration of 12 months before fish tissue may be sampled to assess bioaccumulation in the resident fish population. IDEM will consider site-specific factors that could shorten or lengthen this estimated time frame. IDEM is developing a guidance document that will detail how to collect paired fish tissue and water column data that can be used for reasonable potential determinations for water column permit limits, and to develop site-specific water column criterion elements where warranted. Entities have the option to use these methodologies to collect paired data to evaluate site-specific selenium concentrations in surface water and biota and to consult with IDEM to determine if an application for site-specific water column criterion elements may or not be warranted.

Comment: Fish tissue sampling plans are largely new and may not be well understood by the NPDES-regulated community. Therefore, IDEM should establish specific guidelines for fish tissue sampling requirements in order to support consistent and appropriate implementation of the fish tissue criteria. (NIPSCO)

Comment: Footnote 1 of tables 6-2a and 8-1a states: "Egg or ovary supersedes any whole-body, muscle, or water column element when fish egg or ovary concentrations are measured." The footnote clearly states that fish tissue criterion take precedence over water column criterion provided fish tissue data are available. For this reason, IDEM should develop implementation guidance to encourage and assist the regulated community to evaluate the fish tissue criterion. (NIPSCO)

Response: IDEM is in the process of developing guidance for the collection of fish tissue data, water column data, or both for implementation of the selenium aquatic life criteria. IDEM will consider the comment and suggestion during the development of implementation guidance.

Comment: Footnote 3 of Tables 6-2a and 8-1a states: "Fish whole-body or muscle tissue supersedes water column element when both fish tissue and water concentrations are measured." Fish tissue concentration, on its own, is sufficient to assess compliance with the selenium WQC regardless of surface water concentrations. U.S. EPA derives its aqueous WQC directly from fish toxicity data. Therefore, measuring selenium in the tissues of fish inhabiting receiving waters is a direct and reliable approach to assessing compliance with selenium WQC and protection of beneficial uses without the need for water concentration data. IDEM should revise footnote 3 to delete the need for measuring water concentrations when fish whole-body or muscle tissues are collected or clarify why selenium measurements in water are needed to evaluate compliance with the WQC when fish whole-body or muscle tissues are collected. This would also be consistent with the requirements associated with fish egg or ovary tissues. (IPL)

Response: The NRWQC is derived to protect aquatic life, including fish, the most sensitive receptors, from the harmful effects of selenium. Indiana NPDES permit regulations at 327 IAC 5-2-11(d) require that, for continuous discharges, all permit limits shall, unless impracticable, be stated as maximum daily and average monthly limitations. Harvesting fish to measure selenium in the tissues of fish inhabiting receiving waters on a weekly or monthly basis as a permit condition would adversely impact the resident fish community. This would conflict with Indiana's rules at 327 IAC 2-1-3(a)(1)(2), which provide that surface waters of the state will be capable of supporting a well-balanced, warm water aquatic community, and where temperatures permit, put-and-take trout fishing.

IDEM is developing a guidance document that will detail how to collect paired fish tissue data and water column data that can be used for reasonable potential determinations for water column permit limits and to develop site-specific water column criterion elements where warranted.

Comment: Footnotes 6 and 7 of Tables 6-2a and 8-1a use the term "elevated", but there is no definition of this term. In this case, the term "elevated" is not describing exceedances, potential adverse effects, or impairment. The term is describing the number of days when there is a discharge or other anthropogenic activity potentially increasing selenium concentrations. The term "elevated selenium concentration" in footnotes 6 and 7 should be replace with "discharge" or otherwise defined. (IPL)

Response: U.S. EPA uses "elevated" to define the f_{int} variable used in the intermittent exposure equation. The variable represents the fraction of any 30-day period during which selenium concentrations in an intermittent discharge exceed the applicable lentic or lotic water column criterion element. Retaining "elevated" to define the f_{int} variable is appropriate. IDEM will address implementation of the intermittent criterion element in a future guidance document.

Comment: Implementation guidance describing fish collection and analysis methodologies are necessary to provide a reliable and consistent basis for determining compliance with the proposed selenium WQC. An implementation guidance document should be developed with the following considerations:

- Target species for selenium tissue analysis should be relatively abundant and commonly encountered at the target sampling location so they are available during successive sampling efforts and selenium analysis results can be compared among locations. Species to be samples should have a known and sufficiently small home range. The sampled species should not be listed as threatened, endangered, or rare by the Indiana Department of Natural Resources or the U.S. Fish and Wildlife Service. The sampled species should be easy to identify and be a species that may accumulate high concentrations of selenium.
- Tissues should be composited from multiple, for example three to ten, individual fish of the same species, especially if smaller fish are caught, to be consistent with standard practice for collecting fish data used in regulatory reporting (IDEQ 2017, WVDEP 2017, U.S. EPA 2016, OEHHA 2005, U.S. EPA 2000). Composited whole fish or fillets should also follow the 75 percent rule where fish are of similar size so that the length of the smallest fish should be at least 75 percent of the length of the largest fish of a species.
- A minimum number of composite samples or locations, or both, should be targeted in waters to be analyzed. Hitt and Smith (2014) reported that sample sizes of fewer than five fish did not achieve 80% power to detect near-threshold values and that larger sample sizes may be necessary if tissue concentrations are near the criterion.
- Averaging tissue results from individual fish for comparison to the criterion should be acceptable if data can

be obtained from individual fish.

• Fish collection methods that have minimal impact on non-target species are preferred. WVDEP (2017) and KDEP (2014) provide sampling guidance that includes fish collection by standard electroshocking methods over at least 100 meters starting as close as possible to the source.

• Reference sites may be included in fish tissue sampling programs to establish background selenium concentrations, where practical.

• Quality control samples for chemical analysis of selenium in tissues should include standard reference materials, duplicates, and matrix spike samples, consistent with U.S. EPA methods (2016), for quality assurance.

• Freeze drying of fish tissues minimizes selenium losses and should be the standard for selenium analysis along with closed vessel microwave digestion to minimize selenium losses. Alternatively, wet tissue analysis can be conducted with dry weight values calculated based on a tissue moisture determination. Freeze drying allows for the moisture content and selenium analyses to be conducted on the same tissue, but analyses of wet tissues require separate tissues to be analyzed to estimate moisture content to convert measurements to dry weight.

• Frequency of fish tissue collection must be established in an implementation guidance. Monthly sampling of fish tissue, as the typical NPDES permit requirement for metals analysis, would be costly and, likely, unnecessary since fish tissue concentrations respond slowly to changing water concentrations. Kentucky (KDEP 2014) adopted an approach where fish tissue samples are only required if aqueous selenium concentrations exceed the WQC. Less frequent fish tissue analysis might be required as, for example, U.S. EPA recommends biennial sampling of fish tissues to evaluate compliance with U.S. EPA's 2001 NRWQC for mercury, if resources allow or a minimum of every five years (U.S. EPA 2010).

• Compliance with selenium criteria must be described in guidance, especially a determination as to whether compliance is met if quarterly water samples exceed the aqueous WQC but annual fish tissue samples do not exceed the tissue-based WQC.

• IDEM should clarify how multiple fish tissue samples, for example, five composite fish tissue concentrations, would be compared to the fish tissue WQC. Each of these samples would be considered a contemporaneous replicate, for example, consisting of the same species collected at roughly the same location and at the same time, so a statistical measure of the data would be appropriate for comparison with the fish tissue WQC. Presumably, an exceedance would need to be statistically significant for any action to occur.

(IPL)

Response: IDEM is in the process of developing guidance for the collection of fish tissue data, water column data, or both kinds of data for implementation of the selenium aquatic life chronic criterion, and for development of a site-specific water column criterion element using the bioaccumulation factor modeling method performance-based approach described in Appendix K of the 2016 NRWQC for selenium. IDEM appreciates the comments and suggestions and is considering them during the development of implementation guidance. IDEM has shared a preliminary draft implementation guidance with entities interested in using it to conduct paired fish tissue and water column samples. IDEM will use results and feedback to refine and finalize this guidance. IDEM is also developing a separate guidance document for implementation of the intermittent water column criterion element; this guidance document is in an earlier stage of development.

Comment: U.S. EPA's draft "Technical Support for Adopting and Implementing EPA's 2016 Selenium Criterion in Water Quality Standards" discusses the use of a performance-based approach for adopting site-specific water column elements. This is described as a set of procedures to facilitate translation of the fish tissue criterion to a water column criterion. IDEM should apply a performance-based approach to site-specific selenium standards development for Indiana waters. The GEI report discusses three methods for determining appropriate water column concentrations. The most defensible method for chronic selenium criteria derivation is the quantile regression approach discussed in detail in the GEI report and DeForest et al. (2017). Another valid method for chronic exposures that may be appropriate on a site-specific basis is implementation of a sulfate-dependent criteria, outlined in both the GEI report and DeForest et al. (2017). For intermittent pulses of selenium (for example, acute criteria) the GEI report recommends use of a selenium biokinetic model based on DeForest et al. (2016). Although it oversimplifies selenium biodynamics, the U.S. EPA's mechanistic model that is outlined in Appendix K of the U.S. EPA national criteria document may be adequate and appropriate in limited situations. A performance-based approach to site-specific criteria development should allow these discussed methodologies for site-specific criteria development. This will streamline the site-specific standards process and avoid requiring U.S. EPA approval of every individual site-specific standard that may be developed. (ICC, IMA, PE)

Response: IDEM includes provisions for using either the empirical bioaccumulation factor or mechanistic modeling methodologies provided in Appendix K of the 2016 NRWQC for selenium to derive site-specific criterion water column criterion elements. However, because these are site-specific criterion elements, they were written to be consistent with the provisions for site-specific criteria in rule at 327 IAC 2-1-8.9 for waters outside of the Great Lakes system and 327 IAC 2-1.5-16 for waters within the Great Lakes system. U.S. EPA approval would be

needed for every site-specific selenium criterion that is developed.

The use of the three methods cited and described in the GEI report is not acceptable, as described previously and summarized herein. There is a lack of Indiana-specific fish tissue and water column paired data to provide a scientifically defensible model for the quantile regression approach. Use of sulfate-dependent criteria to derive alternate water column elements or the selenium biokinetic model for an intermittent water column criterion element is not acceptable because both are used to derive acute criterion elements, and the NRWQC only includes chronic criterion elements. U.S. EPA noted as such in its response to GEI comments regarding these two approaches. Because the most sensitive adverse effects of selenium are reproductive effects (larval deformities and mortality) on the offspring of exposed fish, U.S.EPA evaluated chronic effects from long term exposure, and the NRWQC include only chronic criterion elements. U.S. EPA concluded that shorter-term intermittent or pulsed exposures to elevated levels of selenium may also result in bioaccumulation through the aquatic food web and may subsequently adversely affect fish reproduction. U.S. EPA derived the intermittent exposure criterion element directly from the chronic water criterion element, not an acute criterion element, by algebraically rearranging the chronic water criterion element. The intermittent criterion element establishes a limit on an intermittent elevated concentration occurring over a specified percentage of time, while accounting for the selenium background concentration (U.S. EPA 2016(a) p 32-33).

Comment: U.S. EPA's draft technical support documents are imperfect and need consideration before being made final, but they can still be a resource to an IDEM-led workgroup for developing implementation guidance for fish tissue sampling. The chief concern is U.S. EPA's decision not to give primacy of the fish tissue criteria over the new stringent water criteria for NPDES permitting purposes. (IEA, DUKE, IPL)

Comment: In addition to U.S. EPA's draft technical support documents, the U.S. EPA's 2010 Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion may also be a helpful resource for describing how a tissue-based WQC can be implemented. (IPL)

Response: IDEM appreciates the comments and suggestions.

Comment: U.S. EPA supports IDEM's proposal to adopt the U.S. EPA's 2016 304(a) criteria recommendations for selenium (U.S. EPA 2016); however, there are some significant omissions in IDEM's proposal from the U.S. EPA recommendations for selenium. These include the following omissions from Tables 6-2a and 8-1a:

(1) In footnote 1, "fish tissue elements are expressed as steady-state" has been removed.

(2) Footnote 4 no longer includes the sentence, "water column values are the applicable criterion element in the absence of steady-state fish tissue data."

(3) In footnote 6, "fish tissue data provide instantaneous point measurements that reflect integrative accumulation of selenium over time and space in fish populations at a given site", has been removed.

(4) In Tables 6-2a and 8-1a and corresponding footnotes, "Monthly average exposure" is not specified for the criterion element for lentic and lotic aquatic systems. IDEM has simply referred to a "(30 day)". U.S. EPA recommends a monthly average exposure and duration of 30 days.

The language that was removed from footnotes 1 and 4 needs to be reinserted into the Tables 6-2a and 8-1a because these statements are critical components to ensuring that aquatic life is adequately protected from new discharges of selenium into a waterbody until a steady state is achieved. New inputs are defined as anthropogenic activities that result in an increased load of selenium being released into a lentic or lotic waterbody. New anthropogenic inputs likely increase the selenium in the food web, resulting in increased bioaccumulation of selenium in fish over time. It could take months to years for selenium concentrations in fish tissue to fully reflect ambient water concentrations depending on many site-specific factors including site dynamics, hydrology, and the complexities of a specific food web at a given site. Assessing waterbodies that have new selenium inputs using fish tissue that is not in steady state may not appropriately identify an impairment in a waterbody and will delay corrective actions for that waterbody. (EPA5)

Response: IDEM has incorporated all of these comments either directly into the criterion table (Comment (4)) or into the footnotes (Comments (1), (2) and (3)) of the draft rule for consideration of preliminary adoption for waters within (327 IAC 2-1.5-8(b)(3)(B), Table 8-1a) and outside of the Great Lakes System (327 IAC 2-1-6(a)(4)(A), Table 6-1a) and the site-specific criterion for Non-Acipenseriformes waters outside of the Great Lakes System (327 IAC 2-1-6(a)(4)(B), Table 6-1b).

Comment: IDEM needs to clarify its decision to remove the language in footnote 6. U.S. EPA's criterion recommendation for selenium recognizes that appropriately representative fish tissue data are a valid and defensible method to assessing condition and attainment where loadings of selenium are not changing. U.S. EPA also acknowledges that a single fish tissue data point may not constitute a representative sample for a site for purposes of assessing attainment. For these reasons, U.S. EPA recommends that the language removed from footnote 6 be reinserted. (EPA5)

Response: IDEM has incorporated footnote 6 of the 2016 selenium NRWQC back into the footnotes of the draft rule for consideration of preliminary adoption for waters within and outside of the Great Lakes System and the site-specific criterion for Non-Acipenseriformes waters outside of the Great Lakes System. The footnote reads as follows: "Fish tissue data provide instantaneous point measurements that reflect integrative accumulation of

selenium over time and space in fish assemblages at a given site".

Comment: In Tables 6-2a and 8-1a and corresponding footnotes, IDEM needs to more specifically define what "30 day" means in the context of the duration of its proposed selenium criterion. The proposed rule language seems to indicate that the inclusion of "(30 day)" for both the lotic and lentic aquatic systems means that IDEM sees these values as either a 30-day average or that they have a 30-day duration. U.S. EPA recommends that these criterion elements are monthly average exposures and that the duration for these criterion elements are 30 days. (EPA5)

Response: In the draft rule for consideration of preliminary adoption, IDEM has included within the criterion tables, for waters within and outside of the Great Lakes System and the site-specific criterion for Non-Acipenseriformes waters outside of the Great Lakes System, a monthly average exposure of a 30-day duration for the lentic and lotic water column criterion elements, as expressed in the 2016 selenium NRWQC.

Comment: U.S. EPA recommends that IDEM changes the selenium proposed criteria to be consistent with U.S. EPA's 2016 selenium criteria document or provide rationale to show that the proposed changes to the 2016 selenium criteria are based on a sound scientific rationale and protective of aquatic life uses in Indiana with regard to the following:

(1) Tables 6-1 and 8-1 and footnote 1 in Table 8-1 specify a 4-day average duration for selenium; however, Tables 6-2a and 8-1a specify instantaneous and 30-day durations. U.S. EPA believes IDEM intends the durations specified in Tables 6-2a and 8-1a.

(2) Table 8-1 lists selenium as "selenium (dissolved)"; however, Table 8-1a specifies that water column values are based on dissolved total selenium in water. U.S. EPA believes IDEM intends that the water column values are based on dissolved total selenium in water.

(EPA5)

Response: IDEM has incorporated these recommendations into the draft rule for consideration of preliminary adoption. The duration and frequency of the fish tissue and water column criterion elements in the selenium criterion tables for waters within the Great Lakes System, waters outside of the Great Lakes System, and Non-Acipenseriformes waters outside of the Great Lakes System incorporate the 2016 selenium NRWQC recommendations for duration and frequency. The draft rule for consideration of preliminary adoption includes a footnote to each table that states, "Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling."

Selenium Implementation Guidance

Comment: U.S. EPA has issued four draft guidance documents focused on implementation of the selenium standard. However, because the documents are only drafts, IDEM and stakeholders cannot rely on them for guidance. Implementation of the selenium criteria affects water quality standards, water quality-based effluent limitations (WQBELs) in NPDES permits, 303(d) and 305(b) analyses, and proper sampling and implementation of a fish tissue based criterion. Without implementation guidance explaining how the selenium criteria will apply to these aspects, a selenium criteria should not be adopted. IDEM has developed no implementation guidance to accompany the selenium criteria in the draft rule that has been published for Second Notice of Comment Period. If selenium criteria are adopted, IDEM should immediately begin work on implementation guidance with stakeholder input and postpone use of the adopted selenium criteria in developing WQBELs in NPDES permits until the implementation guidance is finalized. (ICC, IMA, CWA, DUKE)

Response: IDEM believes that implementation of this rule is better addressed in a subsequent guidance document. IDEM is currently developing draft guidance for collection of fish tissue data, water column data, or both, for implementing Indiana's selenium aquatic life criterion. IDEM is also evaluating the need for subsequent guidance documents pertaining to various topics.

Comment: U.S. EPA has addressed in draft guidance documents and in the recommended selenium criteria the application of the criteria on streams with no fish and on new discharges. Both of these application issues are directly related to implementation of the selenium criteria in NPDES permits and assessment of streams for attainment of the criteria in the 303(d) process of assessing waterbody impairment. IDEM needs to address these two issues in implementation guidance and should not adopt selenium criteria until this is accomplished. (ICC, IMA)

Response: IDEM is evaluating the need for subsequent guidance documents pertaining to various topics. IDEM is currently developing draft guidance for collection of fish tissue data, water column data, or both, for implementing Indiana's selenium aquatic life criterion.

Silver

Comment: IDEM is proposing U.S. EPA's existing 304(a) hardness-based equation for silver. However, this criterion is based on the 304(a) aquatic life criterion issued in 1980. The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. A criterion maximum concentration (CMC) derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the criteria should be divided by 2 to obtain a value that is

more comparable to a CMC derived using the 1985 Guidelines (U.S. EPA 2002). Because IDEM's acute criterion for silver is expressed as an acute aquatic criterion (AAC) which equals the FAV/2, the proposed equation must be divided by 2. Footnote 3 in Table 6-2 is proposed to be deleted; however, footnote 3, "One half (1/2) of the FAV as calculated by procedures developed by U.S. EPA in 1980..." should be retained because it applies to silver. Please be aware that U.S. EPA is evaluating the most recent data and science for silver as part of a Cooperative Research and Development Agreement. (EPA5)

Response: The CMC for silver has been corrected in the draft rule for consideration of preliminary adoption to reflect the current U.S. EPA NRWQC at 304(a) of the CWA.

Zinc

Comment: IDEM's proposal is to adopt criteria for zinc that is U.S. EPA's existing 304(a) criteria recommendations for zinc (U.S. EPA 1996). Please be aware that U.S. EPA is actively evaluating the most recent data and science for this metal as part of a Cooperative Research and Development Agreement. U.S. EPA expects that this reevaluation could lead to revisions to the 304(a) recommendations for zinc. (EPA5)

Response: IDEM is aware that U.S. EPA is evaluating metal data through the Cooperative Research and Development Agreement.

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SUMMARY/RESPONSE TO COMMENTS RECEIVED AT THE FIRST PUBLIC HEARING

On November 18, 2020, the Environmental Rules Board (board) conducted the first public hearing/board meeting concerning the development of amendments to 327 IAC 2-1-6 and 327 IAC 2-1.5-8 concerning revisions to Indiana's aquatic life and human health surface water quality criteria (WQC) for select metals to reflect updates based on current science and National Recommended Water Quality Criteria (NRWQC) at Section 304(a) of the Clean Water Act (CWA). Comments were made by the following parties:

Honda Manufacturing of Indiana (HMIN)
Indiana Coal Council (ICC)
Indiana Manufacturers Association (IMA)
Indianapolis Power and Light, an AES Company (IPL)

Following is a summary of the comments received and IDEM's responses thereto:

Support for the rulemaking

Comment: Honda Manufacturing of Indiana (HMIN) has been located in Greensburg, Indiana, since 2008, employs over 2,500 associates, represents a $1.1 billion capital investment in Indiana, and, in addition to the direct employment, is home to 51 suppliers that support the HMIN efforts. HMIN recognizes that the draft rule revises aquatic life and human health ambient water quality criteria (WQC) for metals to reflect updates to the National Recommended Water Quality Criteria (NRWQC) as required by Section 304(a) of the Clean Water Act (CWA) and current science. HMIN supports the rule revisions because environmental programs should be based on the best available science. HMIN urges the prompt approval and finalization of the rule so the updates can meaningfully benefit those regulated by metals WQC. (HMIN)

Response: IDEM appreciates the support for the rulemaking.

Aluminum

Comment: Indiana Coal Council (ICC) supports IDEM's intention not to adopt the 2018 NRWQC for aluminum at this time. IDEM should not adopt an aluminum WQC until the U.S. EPA's 2019 Draft Technical Support Document addresses all the concerns and comments raised regarding issues in need of guidance, including how states can address the significant fraction of nontoxic aluminum that is associated with clays and other sedimentary particles, which could have significant impact in Indiana where sedimentary geology and thick soils often lead to elevated ambient concentrations of suspended sediment in waterbodies. (ICC)

Response: IDEM appreciates the support for IDEM's decision regarding the adoption of aluminum criteria as part of this rulemaking. IDEM is aware of the concerns ICC and other stakeholders have raised regarding implementing the 2018 NRWQC for aluminum. U.S. EPA is finalizing guidance for implementing the 2018 NRWQC for aluminum. Additionally, IDEM understands that U.S. EPA is in the process of approving an analytical method for aluminum that utilizes a higher pH for acid extraction than the current method. IDEM intends to consider adopting the 2018 NRWQC for aluminum in a future rulemaking after these tools are available for stakeholders.

Selenium

Comment: Selenium water quality data in Indiana is somewhat limited. IDEM has collected selenium in fish tissue as part of the statewide sampling and assessment program. Results of that sampling indicate that selenium concentrations in fish tissue rarely reach high enough levels to adversely impact the fish population. Of the 260 sites sampled, only 3 showed exceedances of the 2016 EPA criteria. The sample sites where these exceedances occurred were located at sites not affected by mining discharges. Similarly, of the 1,997 fish tissue samples collected, only 14 showed exceedances, which equates to a 99.3% compliance rate. This sampling demonstrates that selenium toxicity is not occurring on a widespread scale in Indiana. (ICC)

Response: IDEM conducted a similar evaluation of long-term monitoring data at fixed station and probabilistic monitoring sites and agrees that the monitoring data from fixed stations and probabilistic sites do not indicate that selenium in concentrations that exceed the draft rule selenium water column criterion elements is a widespread problem in Indiana surface waters. Some of the test methods for surface water in the legacy data, however, had method detection limits that exceed the proposed selenium water column criterion elements. IDEM also conducted an analysis of fish tissue sampling data and agrees that concentrations of selenium in fish tissue exceeding draft rule fish tissue criterion elements is not a widespread issue in Indiana surface water but instead has been associated with a limited number of cooling ponds for coal fired power plants and in a limited number of rivers and streams.

While IDEM's review of available data did not identify a widespread occurrence of selenium in Indiana's waters, IDEM believes it is important to have appropriate, science-based criteria adopted into Indiana's water quality standards to ensure protection of Indiana's aquatic life use.

Indiana's selenium surface water quality criteria for aquatic life for waters outside of the Great Lakes System (downstate) were adopted in 1990. Indiana's selenium aquatic life criteria for waters within the Great Lakes System were adopted in 1997. Indiana's current criteria do not reflect the current science for selenium toxicity and may not be protective of the aquatic life designated use.

As an example, elevated selenium concentrations in surface water resulted in adverse impacts to fish and aquatic dependent wildlife at the Cane Ridge Wildlife Management Area (WMA) at the Patoka Wildlife Refuge. This wildlife management area was constructed by Duke Energy adjacent to the Gibson Generating Station, a coal-burning, electricity-generating facility. The Cane Ridge WMA is part of a Globally Important Bird Area due to the presence of the largest nesting colony of federally endangered interior least terns (*Sternula antillarum*) east of the Mississippi River. The Gibson Generating Station cooling pond center dike had become the least tern's primary nesting area, but terns also nested on the ash ponds, dredge flats, landfill, and surrounding roads. In consultation with the U.S. Fish and Wildlife Service (USFWS), Duke Energy entered a Habitat Conservation Plan on July 2, 1999, to protect and manage interior least terns at the Gibson Generating Station.

Initially, water from the Gibson Generating Station cooling pond provided source water for Cane Ridge WMA, and this source water, which is impacted by coal combustion residuals at an average of 13 µg/L selenium in 2007,

contributed to elevated levels of selenium that resulted in increasing levels of selenium in biota, including zooplankton, dragonflies, frogs, and fish. Over several years, selenium uptake and bioconcentration in the food web resulted in reduced hatch rates in fish. Reduced hatch rates and chick deaths in aquatic-dependent wildlife (least tern, red-winged blackbird, black-necked stilt) were observed.

Reported selenium detections in surface water at Cane Ridge WMA (11-14 µg/L) were below Indiana's current downstate chronic selenium criterion (35 µg/L) but would exceed the proposed selenium lentic criterion element (1.5 µg/L). These detections would also exceed the site-specific lentic criterion recently proposed and adopted by Montana for Lake Koocanusa (0.8 µg/L), a reservoir straddling the U.S and Canadian border (State of Montana Newsroom, 2020).

In 2008, Duke and USFWS took extraordinary measures to remedy the situation at the Cane Ridge WMA, including draining the water from the management area, disking sediment to redistribute and bury the higher concentration of selenium in surficial sediment, and installing an alternate water supply for Cane Ridge WMA from the Wabash River. Each spring beginning in 2009, Duke Energy has stocked 60,000 ready-to-spawn Fathead minnows in the Cane Ridge WMA tern pool to provide a clean alternative food source for the least terns in hopes of attracting terns away from Threadfin shad in the Gibson Generating Station cooling pond because these shad have elevated levels of selenium in fish tissue. (Sparks, 2012; USFWS, 2012).

IDEM does not believe that adopting the 2016 NRWQC for selenium will have a widespread impact on the regulated community but will provide protection for aquatic life and aquatic-dependent wildlife where the potential to exceed these criteria exists.

Comment: U.S. EPA guidance generally suggests that state-specific criteria may be appropriate for waterbodies where background water quality is different from the laboratory water used and where the types of species in the region differ from those actually tested in developing the criteria. In addition to using fish species more representative of Indiana's waterbodies, for example, including available data for Fathead minnows, which are often a dominant species in Indiana streams but were not fully included in U.S. EPA's NRWQC development, the proposed criteria should also recognize that Indiana is dominated by sedimentary geology known to be natural sources of elevated selenium. In addition, it has been shown that sulfate at levels typical of Indiana waters can significantly lessen selenium toxicity in water columns. IDEM needs to recognize this when adopting state-specific standards for selenium. (IMA)

Response: IDEM will address each of the points in this comment separately.

• IDEM monitoring data from fixed stations and probabilistic sites do not indicate that selenium in concentrations exceeding the proposed rule selenium water column criterion elements is a widespread problem in Indiana surface waters such that statewide, site-specific, water column criterion elements are warranted.

• IDEM does not agree that the toxicity endpoints for the U.S. EPA Species Sensitivity Distribution (SSD) used to derive the 2016 NRWQC for selenium neglected to include data for Fathead minnows in the criterion calculations or that the 2016 NRWQC SSD lacks fish species representative of Indiana's water bodies.

° Fathead minnow toxicity information is shown on Table 3.1 of, "Maternal Transfer Reproductive Studies," (U.S. EPA 2016 (a), p 45-46). The Fathead minnow estimated genus mean chronic value (< 25.6 mg/kg dw egg-ovary) ranks seventh of the nine egg-laying fish genera mean chronic values. Please consult U.S. EPA's methodology (Stephen et al, 1985) for more detail regarding the statistical procedure for calculating aquatic life criteria utilizing the SSD GMCVs.

° White sturgeon (*Acipenser transmontanus*), representing the Family Acipenseridae, Order Acipenseriformes, is the aquatic organism most sensitive to the effects of selenium in the 2016 NRWQC SSD. While this species is not found in Indiana, it serves as a surrogate in Indiana for two sturgeon species (Lake sturgeon (*Acipenser fulvescens*) and Shovelnose sturgeon (*Scaphirhynchus platorynchus*)) and one paddlefish species (American paddlefish (*Polyodon spathula*)) in the Order Acipenseriformes (IDNR, 2012(a), 2012(b), 2019(a) and 2019(b)), which are not included in the SSD (U.S. EPA, 2013; see Appendix 1). Indiana species represented in the genus *Lepomis*, the second most sensitive species in the 2016 NRWQC for selenium, represented in the SSD by Bluegill sunfish *(Lepomis macrochirus*), which is widely distributed in Indiana, include other *Lepomis* species, such as Green sunfish, Orange spotted sunfish, Redear sunfish, and Warmouth. The remaining 2016 NRWQC SSD fish genera include many Indiana resident genera/species or stocked species, in addition to those reviewed previously: *Oncorhynchus* (Rainbow trout, Chinook salmon, and Coho salmon), *Salmo* (Brown trout), *Salvelinus* (Lake trout), *Micropterus* (Largemouth bass, Smallmouth bass, and Spotted bass), *Esox* (Northern pike, Muskellunge, Grass pickerel, and Tiger muskie) and *Pimephales* (Fathead minnow and numerous closely related minnow species in the family Cyprinidae) (IDNR, 2018).

• As noted in the previous comment and response, elevated concentrations of selenium over the criterion elements proposed in the draft rule are not a widespread issue in Indiana surface waters, based on a review of Indiana monitoring data at fixed stations and probabilistic sites. However, there are locations in Indiana where adverse impacts from selenium toxicity have been detected and observed. IDEM does not believe that adopting the 2016 NRWQC for selenium will have a widespread impact on the regulated community, but this

criterion will provide protection for Indiana's aquatic life and aquatic-dependent wildlife where the potential to exceed these criteria exists.

• GEI noted high sulfate waters have the potential to reduce acute selenium toxicity and that the water column elements developed on a national scale may be overprotective of some Indiana waters that have high sulfate. However, the 2016 NRWQC does not include acute selenium criterion elements or define a relationship between selenium concentrations and sulfate. Adverse impacts of selenium occur at the chronic levels, which are at lower concentrations in the water column. U.S. EPA is not recommending a separate acute criterion derived from the results of toxicity tests having water-only exposure because selenium is bioaccumulative and toxicity primarily occurs through dietary exposure. (U.S. EPA 2016(a), p 100).

Comment: ICC believes there are many deficiencies with U.S. EPA's NRWQC for selenium, and, instead, supports the alternative proposal developed by GEI that was discussed in the ICC comments submitted on the draft rule during the Second Notice of Comment Period. IDEM's response to comments indicates that many of GEI's recommendations regarding interpretation of the underlying scientific studies of the NRWQC are not allowed in adoption of a site-specific or state-specific standard. Specifically, IDEM states that "While states and stakeholders can provide comments on the interpretation of toxicity studies and toxicological endpoints proposed during the comment period for draft NRWQC, U.S. EPA does not approve modification of toxicological endpoints (for example, species or genus mean acute or chronic values) in the species sensitivity distribution of a final NRWQC based on reinterpretation of studies used to derive the criteria." ICC is not aware of, and IDEM does not cite to, any federal regulation that prohibits reinterpretation of studies and endpoints used to derive the criteria, particularly where the NRWQC used interpretation methods that may not be appropriate for a state. (ICC)

Response: U.S. EPA publishes official guidance for implementing various programs authorized by the Clean Water Act. For example, U.S. EPA published procedures for deriving acute and chronic aquatic life criteria (Stephan et al, 1985) used to derive National Recommended Water Quality Criteria (NRWQC) for aquatic life.

U.S. EPA has published a series of guidance for modifying a NRWQC to consider state-specific and site-specific conditions. The most recent, *Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria* (U.S. EPA, 2013) involves editing the composition of a SSD of tested species used to derive a site-specific aquatic life criterion in order to allow it to better reflect the taxonomy of species that reside at the site. The process does not include modifying individual Genus Mean Chronic Value (GMCV) toxicity endpoints in the NRWQC SSD for the species that will be retained in the SSD.

GEI's recommendations to modify several of U.S. EPA's toxicity endpoints, specifically the GMCVs for White sturgeon and Bluegill were also provided to U.S. EPA during the comment period for the draft NRWQC for selenium. U.S. EPA considered but did not agree with or incorporate GEI's recommendations for the final NRWQC for selenium (IDEM, 2020(a), pp 12-15).

GEI's recommended changes for the White sturgeon and Bluegill GMCV toxicity endpoints would result in a less protective criterion for the taxa these species represent in Indiana. These are the two most sensitive species in the SSD, and the GMCVs are directly included in the statistical calculations. GEI's proposed change to include Fathead minnow data does not impact the criterion calculation, as the Fathead minnow is already included in the SSD. Fathead minnows are ranked seventh in sensitivity of the nine egg-laying fish and 15 aquatic species in the NRWQC SSD, see Table 3.1, "Maternal Transfer Reproductive Studies," (U.S. EPA 2016(a), p 45-46).

In conclusion, these recommendations provided by GEI do not follow U.S. EPA's implementation guidance for deriving site specific criteria so are not defensible for developing a site-specific selenium criterion for Indiana.

Comment: ICC still does not support IDEM's adoption of the U.S. EPA NRWQC for waters with sturgeon or paddlefish. As was detailed in previous ICC comments, there are numerous issues with the U.S. EPA NRWQC that result in a water column concentration that is more stringent than necessary for protection of aquatic life. These included, but were not limited to, data usage decisions employed in derivation of the criteria that may not be appropriate for Indiana, criteria calculation methods that deviate from traditionally accepted methods, and scientific literature published since the NRWQC that emphasizes complexities regarding selenium uptake and interference from other pollutants that were not accounted for in the NRWQC. Again, ICC does not agree that states cannot consider these differences when developing state-specific standards. (ICC)

Response: The 2016 NRWQC for selenium represents the best available science at the time of its publication for the protection of aquatic life from the bioaccumulative properties of selenium in the aquatic environment. U.S. EPA evaluated GEI's comments in the development of the NRWQC. The 2016 NRWQC for selenium better protects aquatic life than Indiana's current selenium criteria, which do not consider its bioaccumulative properties. While scientific literature published since the NRWQC might emphasize complexities regarding selenium uptake and interference from other pollutants that were not accounted for in the NRWQC, it is not clear from this comment how these findings specifically apply to Indiana surface waters.

Regarding data usage, the toxicity studies included in the NRWQC SSD are representative of species in Indiana, as noted previously. It is important to acknowledge that the data usage decisions for the development of this criterion were necessarily unique, given the criterion, which unlike any other NRWQC, is based on egg-ovary fish tissue concentrations, and that selenium bioaccumulates and bioconcentrates in the aquatic food web. U.S. EPA applied trophic transfer factors to derive whole fish/fillet and water column toxicity endpoints from the

egg-ovary fish tissue criterion element. IDEM does not agree that U.S. EPA deviated from its criterion calculation methods for calculating criterion elements, which apply a statistical procedure (Stephan et al, 1985) to each set of genus-mean chronic values to calculate each of the criterion elements. This methodology is used to derive other NRWQC for aquatic life.

Comment: ICC is supportive, in concept, of IDEM's site-specific component for waters without sturgeon or paddlefish present for the following reasons. When U.S. EPA finalized the NRWQC, the derivation included a white sturgeon toxicity study. The white sturgeon is the most sensitive species in the U.S. EPA database with regard to selenium toxicity. Therefore, the inclusion of this study specifically has a significant impact in the resulting criteria concentrations. The U.S. EPA also admittedly diverged from its traditional data interpretation methods for the white sturgeon, which resulted in an overly conservative toxicity value for the white sturgeon and ultimately drove the criterion to significantly lower concentrations. Because the sturgeon has limited geographical presence and is typically restricted to larger mainstem rivers, IDEM has taken a sensible approach to bifurcate the standard into two, that which applies to waters with sturgeon or paddlefish and that which applies to waters without sturgeon or paddlefish. A similar approach was taken by Idaho and approved by U.S. EPA, where the NRWQC was implemented in waters with sturgeon and a recalculation was completed for waters without sturgeon. However, the aforementioned GEI report also proposed a non-sturgeon standard and contained water column and fish tissue elements that were less stringent than those currently proposed by IDEM. ICC again requests that IDEM utilize an approach consistent with the GEI report and reinterpret the underlying studies and endpoints of the NRWQC according to Indiana practice. (ICC, IMA)

Response: IDEM appreciates the support for the Acipenseriformes-absent selenium criterion. As stated previously, GEI's recommendations for modifying the toxicity endpoints are not defensible or acceptable (IDEM 2020(a), pp 12-15). As a result, Indiana's proposed rule Acipenseriformes-absent selenium fish tissue criterion elements are the same as those calculated by Idaho Department of Environmental Quality (IDEQ), since both IDEM and IDEQ applied the U.S. EPA Recalculation Procedure (2013) to the remaining toxicity endpoints in the 2016 NRWQC SSD to derive the fish tissue criterion elements. IDEQ did not propose water column criterion elements for their sturgeon-absent criterion; instead, these will be site-specific. IDEM applied GEI's recommended regression-based approach (DeForest et al, 2017) to derive the proposed rule Acipenseriformes-absent water column criterion elements.

Comment: The draft rule states that an application to IDEM must be submitted to request a determination on the presence or absence of the Order *Acipenseriformes* (sturgeon and paddlefish). The state must then make a tentative determination, publish the notice in the Indiana Register, submit the determination to U.S. EPA for approval, and then incorporate the modification into the standards during the next revision. This is an extremely lengthy process that will result in permit delays and expenditure of significant resources on behalf of both permittees and IDEM. For example, if a permittee were seeking an "absence" determination, the IDEM approval process would likely take a minimum of one year to account for the application development, IDEM review, written determination, public notice, and comment response. Receiving U.S. EPA's final approval would likely take another year. Lastly, incorporation into the standards during the next review process would likely take three to five years. In total, this is a minimum of 5 years to receive a determination that *Acipenseriformes* are not present, during which time the permittee will likely be required to comply with the more stringent U.S. EPA NRWQC. (ICC)

Response: It is IDEM's opinion that stakeholders will have more flexibility if they are given the opportunity to demonstrate, on a case-by-case basis, that the Acipenseriformes-absent site-specific criterion is appropriate for their individual site. A performance-based approach entails applying a fixed buffer around the large rivers and streams where adult Acipenseriformes occur to protect upstream waters used for spawning and to protect downstream water quality, based on the Idaho site-specific criterion, which was approved by U.S. EPA in consultation with the U.S. Fish and Wildlife Service. Because Acipenseriformes are widespread in downstate waters, a performance-based approach will not be a useful tool for stakeholders. IDEM prepared a map that shows the distribution of Acipenseriformes (Sturgeon and Paddlefish) waters with a buffer at the hydrologic unit code (HUC) 8 watershed level. The map is available on IDEM's web site under the heading of "Active Projects" at:

https://www.in.gov/idem/cleanwater/2329.htm

IDEM disagrees that applying for an Acipenseriformes-absent determination is necessarily a lengthy process. Once IDEM makes a determination that Acipenseriformes are absent, IDEM will provide a minimum 30-day comment period. U.S. EPA has committed to approving WQS within 90 days. Once U.S. EPA has approved a site-specific Acipenseriformes-absent determination, IDEM can immediately apply the site-specific criterion. IDEM will not need to wait until the SSC is adopted into rule before implementing the SSC in a NPDES permit.

Comment: The draft rule's process for seeking an absence determination regarding Order *Acipenseriformes* does not explain how anti-backsliding policies would allow for permit limit relaxation based on the absence determination. There is no indication of what is being considered in this determination, and there is no clear process for a discharger to refute a determination. For example, if IDEM makes a tentative determination that *Acipenseriformes* are present, it is unclear whether a permittee must accept this determination or if there is a method to confirm or refute this determination. (ICC)

Response: The water quality standards in 327 IAC 2 specify the applicable water quality criteria and

procedures to modify them, along with mixing zone policies. The application of the water quality criteria in NPDES permits is addressed in 327 IAC 5. The site-specific selenium criterion option is not unique in that the Article 5 regulations determine how the state anti-backsliding provisions would apply to the potential relaxation of a permit limit for selenium. The anti-backsliding provisions under 327 IAC 5-2-10(a)(11) would be applied on a permit-by-permit basis considering the backsliding options available for the relaxation of a limit based on a state water quality standard.

IDEM plans to publish distribution maps and references for sturgeon and paddlefish species in Indiana on IDEM's website, in addition to implementation guidance for collecting fish tissue and water column data for implementing the criterion, as part of a packet of implementation tools available for permittees. A permittee will have the option to refute that Acipenseriformes are present by consulting available resources and references or presenting site-specific information, or both, and including this information in an application for a site-specific determination. If IDEM disagrees with the permittee's conclusion and denies the application, this determination is an agency action that is subject to appeal under IC 4-21.5-3.

Entities also have the option to derive a site-specific water column criterion element utilizing the U.S. EPA-approved bioaccumulation factor approach (BAF) or the mechanistic modeling methodology provided in Appendix K and included in the rulemaking, in addition to or instead of, applying for the Acipenseriformes-absent designation.

Comment: U.S. EPA provided opportunities for states to take a more streamlined approach to incorporation of site-specific standards, such as the performance-based approach. The performance-based approach was originally outlined in the final rule *EPA Review and Approval of State and Tribal Water Quality Standards* (65 Federal Register 24641-24653) and referenced in both the NRWQC and the draft *Technical Support for Adopting and Implementing EPA's 2016 Selenium Criterion in Water Quality Standards* (EPA 820-F-16-010). This method of site-specific standards adoption requires the state to outline the set of procedures to develop the site-specific standard. This procedure must ensure "repeatable predictable outcomes" that protect the designated use. Once the state adopts those procedures and U.S. EPA approves them, each resulting site-specific criteria does not need to be adopted or approved by U.S. EPA. Instead, the state only needs to maintain a list of the site-specific criteria on its website and available to the public. The performance-based approach would significantly streamline the process for developing and adopting site-specific standards and provide the needed regulatory certainty for permittees. (ICC).

Response: GEI recommended that IDEM develop a site-specific criterion for portions of the state where sturgeon do not occur. Removing the toxicity endpoint for White sturgeon (*Acipenser transmontanus*) from the NRWQC SSD and then recalculating the criterion elements results in less stringent fish tissue criterion elements.

U.S. EPA rescinded all four draft Technical Support Guidance for selenium, including the draft *Technical Support for Adopting and Implementing EPA's 2016 Selenium Criterion in Water Quality Standards* (EPA 820-F-16-010) in September 2019 and has not reissued them. U.S. EPA has published a draft technical support document to translate selenium tissue criterion elements into water column criterion elements for California's proposed selenium criterion (U.S. EPA, 2018).

IDEM considered adopting a performance-based approach for the Acipenseriformes-absent site-specific criterion for waters outside of the Great Lakes System ("Downstate"). Indiana Acipenseriformes species in Downstate waters include the state endangered Lake sturgeon (*Acipenser fulvescens*), American paddlefish (*Polyodon spathula*), and Shovelnose sturgeon (*Scaphirhynchus platorynchus)*. While mature Acipenseriformes species reside in larger streams and rivers, they move upstream to smaller tributaries to spawn, and the early life stages develop in these tributaries. The Acipenseriformes taxonomic group includes an Indiana state-endangered species (Lake sturgeon). Two of the species occur in interstate waters (Shovelnose sturgeon and American paddlefish). U.S. EPA regulations at 40 CFR 131.10(b) provide that "in designating uses of a waterbody and the appropriate criteria for those uses, the state shall take into consideration the water quality standards of downstream waters and ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters." (U.S. EPA, 2016(a), p 102).

For an appropriately protective performance-based approach for Acipenseriformes-absent waters, IDEM would have to include a buffer of upstream watersheds at a consistent hydrologic unit code (HUC) scale. The purpose of this buffer is to protect waters where these species spawn and juveniles mature and to protect downstream water quality. The State of Idaho was the first state to adopt the 2016 NRWQC. White sturgeon (*Acipenser transmontanus*), the species in the SSD that is most sensitive to the adverse impacts of selenium, is native to Idaho. Idaho's U.S. EPA-approved performance-based sturgeon-absent criterion includes a buffer at the HUC 8 scale to the larger rivers and streams where mature sturgeon occur. The rule includes a list of the watersheds where the site-specific criterion is applicable (IDEQ, 2018).

To evaluate the spatial extent of a U.S. EPA-approved list of Acipenseriformes-absent waters (which is needed for the performance-based approach that allows the preclusion of U.S. EPA review of each site-specific application), IDEM developed a map for Indiana that shows the distribution of sturgeon and paddlefish species including a buffer at the HUC 8 scale. The use of a HUC 8 scale buffer for a performance-based approach leaves very few waters presumed Acipenseriformes-absent. Therefore, requiring a site-specific analysis that will require

agency review and approval by both IDEM and U.S. EPA provides more flexibility to stakeholders.

Distribution maps and a list of scientific references will be posted on the IDEM website under the Office of Water Quality, Water Quality Standards web page.

In conclusion, it is IDEM's opinion that stakeholders have more flexibility to demonstrate that the Acipenseriformes-absent site-specific criterion is appropriate for their individual site than providing a U.S. EPA-approved list of watersheds, per the performance-based approach, that would include a fixed buffer at the HUC 8 scale.

Comment: In the case of this rulemaking, IDEM could adopt a two-pronged performance-based approach to site-specific standards. For the site-specific standard that is already developed, IDEM would need to define the procedures for determining whether *Acipenseriformes* are present or absent for a given stream reach. For this process, IDEM can add a footnote to the standard for waters with *Acipenseriformes* absent that states:

> "The procedure for determining presence or absence of *Acipenseriformes* and applicability of this criteria should be based on existing or site-specific fish population studies of receiving waters."

For waters where an alternative site-specific standard is being developed, IDEM needs to define the procedures for developing that standard. For example, IDEM can add a footnote to the standard for waters with *Acipenseriformes* present that states:

> "Site-specific water column criteria elements will be derived using a performance-based approach from fish tissue values via either the mechanistic model or empirical bioaccumulation factor (BAF) method and associated procedures laid out in appendix K of Aquatic Life Ambient Water Quality Criterion for Selenium–Freshwater 2016."

Use of the performance-based approach ensures data-driven reproducible results that are protective of the instream beneficial uses. Furthermore, it will lessen the delay associated with administrative review of site-specific standards for selenium. (ICC)

Response: For the reasons stated in the response to the previous comment, IDEM does not propose to adopt a performance-based approach for the Acipenseriformes-absent criterion element.

The procedure for determining presence or absence of *Acipenseriformes* is not solely based on existing or site-specific fish population studies of receiving waters, but on the definition at 327 IAC 2-1-9(37) and 327 IAC 2-1.5-2(62) for "occur at the site" that reads as follows:

> "Occur at the site" includes the species, genera, families, orders, classes, and phyla that:
>
> (A) are usually present at the site;
>
> (B) are present at the site only seasonally due to migration;
>
> (C) are present intermittently because they periodically return to or extend their ranges into the site;
>
> (D) were present at the site in the past, are not currently present at the site due to degraded conditions, and are expected to return to the site when conditions improve; or
>
> (E) are present in nearby bodies of water, are not currently present at the site due to degraded conditions, and are expected to be present at the site when conditions improve.
>
> The taxa that occur at the site cannot be determined merely by sampling downstream and upstream of the site at one (1) point in time. The term does not include taxa that were once present at the site but cannot exist at the site now due to permanent physical alteration of the habitat at the site, for example, alterations resulting from dams.

Regarding the recommendation for the second footnote, the proposed rule includes a provision for applying either of the Appendix K procedures, the BAF or mechanistic modeling methodologies, to derive site-specific water column criterion elements as provided at 327 IAC 2-1-6(a)(4)(C) for waters outside of the Great Lakes System and 327 IAC 2-1.5-8(b)(3)(C) for waters within the Great Lakes System. It is important to include the mechanistic modeling methodology as it can be used in fishless waters to derive a site-specific water column criterion element. If fish are present, either the BAF or mechanistic modeling can be used to derive a site-specific water column criterion element. While the inclusion of these procedures will preclude the need to conduct an Indiana rulemaking for each decision, U.S. EPA approval will still be required before a modified criterion can be used for Clean Water Act purposes. U.S. EPA approval for site-specific modifications to water quality criteria is also required under 327 IAC 2-1-8.9 and 327 IAC 2-1.5-16, even when using the recalculation procedure.

Comment: The term "steady-state" used in the tables for the chronic aquatic criterion for selenium is described as an aquatic system that is not experiencing any new or increasing inputs of selenium. In the mining industry, operations are continuously adding and removing stormwater driven outfalls as the mine advances and areas are reclaimed. IDEM's approach of applying a conservative water column-based limit effective immediately to a newly constructed outfall is not sensible when the fish tissue concentration, which takes precedent over the water column concentration, should be the determining factor for compliance. Other states that have adopted selenium criteria have taken different approaches to this issue. For example, as explained in previous ICC comments, West Virginia considers a non-steady-state condition to be any new discharge that changes the concentration of selenium in the stream. However, for new discharges that maintain the preexisting concentration, the stream is considered to retain the "steady-state" condition. The determination of steady state should be based on predicted change in selenium concentrations, rather than the mere presence of a new or increased discharge.

(ICC)

Response: IDEM's draft implementation guidance (IDEM 2020(a)) includes a provision for considering site-specific factors, such as presented in these scenarios, when determining if a receiving stream is "steady state". However, for the mining-specific situation described, the intermittent criterion element would apply. The intermittent criterion element is calculated based on the background concentration of the receiving water and the number of times the facility discharges in a 30-day period with a concentration that exceeds the applicable water column criterion element. Because the discharge is intermittent and not continuous, a higher water column criterion element may be applicable, depending on the site. Kentucky and West Virginia adopted their respective fish-tissue based selenium criteria before U.S EPA published the 2016 NRWQC, and neither set of criteria includes an intermittent water column criterion element.

Comment: IDEM's application of the selenium water column value to fishless waters is not a practical approach. Water quality standards are intended to protect the designated use. If there are waters without fish, which is typically due to low or no-flow conditions, the water quality standard should be applied where the designated use of the stream actually exists, which for aquatic life use is where the fish and macroinvertebrates are present. This is a similar idea to application of water supply standards at the point of intake, rather than throughout a stream reach. Fishless waters are another issue that several states have been grappling with and have adjusted the language to accommodate more practical approaches. Idaho instituted a footnote for fishless waters that allows selenium concentrations in fish from the nearest downstream waters to be used to assess compliance. West Virginia requires that the fish tissue sampling location be as close as practical to the source of selenium but allows it to be downstream of the outfall at the point of fish presence. Kentucky uses an approach that allows fish from the nearest 500 meters downstream to be used to assess compliance. These approaches are sensible because, in the vast majority of cases, streams are fishless due to limited flow or habitat, which is independent of the selenium concentration. Indiana must take a similar approach, allowing dischargers to sample further downstream in situations with fishless waters. This issue is especially important in Indiana, where there is a large number of streams with low-flow or no-flow conditions that prevent the persistence of fish in headwater reaches. Prohibiting the application of the fish tissue element of the standard on these streams is not a practical approach to regulation, particularly considering the large spatial extent of headwater streams in the state. The implementation guidance must address this issue with a more reasonable approach prior to finalization of the rule. (ICC)

Response: IDEM will address these comments separately.

- All Indiana surface waters are designated for the aquatic life use, and Indiana's aquatic life criteria apply to all surface waters, regardless of the complexity or lack of complexity of the aquatic life assemblage. While fish are the aquatic species most sensitive to the adverse impacts of selenium's bioaccumulative impacts, the selenium criterion was derived to protect the entire aquatic life assemblage, and the SSD includes fauna other than fish. While it is true that certain low flow and intermittent streams may not have sufficient flow to support an aquatic life assemblage that includes fish, it is also true that impaired water quality can adversely impact an aquatic life assemblage so that fish are not present.
- U.S. EPA recommends that, when states adopt the four-part criterion for selenium reflecting the 2016 NRWQC, states use the default monthly average exposure water column elements of the criterion when implementing the criterion under the National Pollutant Discharge Elimination System (NPDES) permits program and to assist with implementation of other Clean Water Act programs (U.S. EPA 2016(a)). If an entity believes that the default water column element is not appropriate for a waterbody, it can develop a site-specific water column element using the procedures provided in Appendix K, Translation of a Selenium Fish Tissue Criterion Element to a Site-Specific Water Column Value, in EPA's *Aquatic Life Ambient Water Quality Criterion for Selenium–Freshwater 2016*.

Consistent with the U.S. EPA recommendation, IDEM plans to issue NPDES permits with limits based on the water column criterion element and not require monitoring of fish tissue for compliance purposes. IDEM's draft implementation guidance (IDEM 2020(b)) does describe a procedure whereby fish tissue may be used for reasonable potential to exceed (RPE) determinations if specific requirements are met.

- For facilities with intermittent discharges, such as the mining-specific situation described, the intermittent criterion element would apply. The intermittent criterion element is calculated based on the background concentration of the receiving water and the number of times the facility discharges in a 30-day period with a concentration that exceeds the applicable water column criterion element. Because the discharge is intermittent and not continuous, a higher water column criterion element may be applicable, depending on the site. It is not necessary to collect fish tissue samples to develop the site-specific intermittent criterion element. However, the facility would have the option to develop a site-specific criterion element by collecting surface water and fish tissue samples, as described in Indiana's draft implementation guidance (IDEM 2020(a)) or using the mechanistic modeling methodology in Appendix K for fishless waters.
- IDEM's draft implementation guidance (IDEM 2020(b)) describes the procedures for collecting fish tissue and water column data for implementation of the selenium criterion, including reach and sub-reach distances for collection of fish tissue samples.

In lotic systems, the upper limit of the sample reach for fish collection should begin immediately below the effluent outfall. When collecting fish for RPE determinations, the sample distance is limited to the first sub-reach length, based on the drainage area of the lotic system (Table 1). When collecting fish tissue for a site-specific BAF, if the target fish tissue samples are not collected in the first sub-reach, proceed to the next downstream sub-reach and continue sampling, up to the maximum sample reach length, only until the target fish tissue samples are collected.

Table 1. Maximum sampling reach and designated sub-reach lengths for collecting fish tissue samples for lotic waterbody categories

Waterbody Category	Drainage Area (mile^2)	Maximum Sample Reach Length (meters)	Sub-reach Length (meters)
Headwater Stream	< 20 mile^2 wadeable	400	100
Wadeable Stream	>20 -1000 mile^2) wadeable	500	100
Large River	1000-2000 mile^2 not wadeable	1000	250
Great River	Drainage Area < 2000 mile^2 not wadeable	1000	250

Comment: IDEM modified the dilution calculation methods for selenium away from current reliance on the 7Q10, which is the seven-day average low flow that occurs every ten years. On smaller streams, the 7Q10 is typically zero, which negates the consideration of dilution in NPDES permits. IDEM has modified this to apply the 30Q10 for selenium, which is the thirty-day average low flow that occurs every ten years. While this is movement in the right direction, it continues to ignore the dilution that is available on smaller streams during the spring or following rain events. Basing the low flow determination on a ten-year recurrence interval essentially prohibits mixing and dilution on all ephemeral and intermittent streams and many of the smaller perennial streams. All of these types of streams have had a 30-day low flow or no-flow period at some point in the last ten years. Other states have taken more practical approaches to allow consideration of wet weather mixing following rain events on these smaller streams. For example, Illinois has instituted a provision that applies to discontinuous discharges that allows the agency to apply mixing based on the stream flow available in the receiving stream at the time of discharge. While ICC supports the change from the 7Q10 to the 30Q10, IDEM needs to consider additional methods of increasing flexibility for mixing on smaller streams, such as the allowance of wet-weather mixing. (ICC)

Response: Using the 7Q10 for the allowable mixing zone dilution is specified in rule in 327 IAC 5. Using the 7Q10 flow is not appropriate for implementing the selenium criterion, so IDEM included a requirement to use the 30Q10 instead of the 7Q10 in a footnote of each of the following proposed selenium criteria:

For downstate waters, the requirement at 327 IAC 2-1-6(a)(4)(A), footnote 5, and 327 IAC 2-1-6(a)(4)(B), footnote 6, states: **"Water column values are the applicable criterion element in the absence of steady-state condition fish tissue data and for fishless waters. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Instead of the requirements in 327 IAC 5-2-11.1(b)(2), the allowable mixing zone dilution will be determined by applying the guideline in 327 IAC 2-1-4 to the thirty (30) day, ten (10) year ($Q_{30,10}$) low flow of the receiving stream for the chronic aquatic criterion (CAC) water column criterion element applicable to lotic aquatic systems, in the absence of site-specific mixing zone data."**

For waters within the Great Lakes System, the requirement at 327 IAC 2-1.5-8(b)(3)(B), footnote 5, states: **"Water column values are the applicable criterion element in the absence of steady-state condition fish tissue data and for fishless waters. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Instead of the requirement in 327 IAC 5-2-11.4(b)(3)(A)(i)(CC), the thirty (30) day, ten (10) year stream design flow ($Q_{30,10}$) must be used for deriving TMDLs, WLAs in the absence of TMDLs, and preliminary WLAs for tributaries of the Great Lakes system that exhibit appreciable flows relative to their volumes for the criterion continuous concentration (CCC) water column criterion element applicable to lotic aquatic systems unless data exist to demonstrate that an alternate stream design flow is appropriate for stream-specific and pollutant-specific conditions."**

For intermittent or controlled discharges, the use of an alternate stream flow is allowed if the alternate stream flow will ensure compliance with water quality criteria (327 IAC 5-2-11.1(b)(7) and 327 IAC 5-2-11.4(b)(3)(A)(iii)).

Additional modifications to the procedures in the NPDES implementation rules at 327 IAC 5 to calculate the allowable mixing zone to address scenarios suggested in this comment is outside the scope of this rulemaking. IDEM will consider these suggestions for a future rule change.

Comment: The general process related to obtaining a site-specific water-quality criterion at 327 IAC 2-1-6(a)(4)(C) is an appropriate idea; however, instead of including in rule language the specific methods for obtaining the site-specific criteria, the methods to be used should be included in a guidance document with permit applicants having the ability to suggest other methods as well if they can show that those methods are appropriate. The methods provided in the proposed rule are listed in a draft U.S. EPA document from 2016. Applicants should not be limited to using only those methods. U.S. EPA may modify its draft 2016 guidance to allow other methods. IDEM may allow other methods in its own guidance that is being developed now. And, as science develops, applicants may be able to show that other methods are scientifically defensible allowing alternative ways to derive a site-specific criterion. Specifying only the two methods currently listed by U.S. EPA would prohibit facilities from using other methods without going through a rigorous and lengthy rulemaking process. This could result in a facility utilizing an outdated method that may not provide the facility the ability to utilize its fish tissue sampling results appropriately when developing site-specific criterion. Even worse, it could result in a facility having to default to the water column criteria for permitting purposes because the U.S. EPA-specified methods did not provide the full flexibility to use the fish tissue sampling results in a proper scientific manner. This, in turn, could result in the need for unnecessary actions, such as costly treatment. IPL requests that the proposed language of 327 IAC 2-1-6(a)(4)(C)(i) be revised as follows:

(C) Modification of the selenium water column criterion element must be achieved according to the following:

(i) Site-specific water column criterion elements must be derived using ~~empirical bioaccumulation factor (BAF) or mechanistic modeling method provided in Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater, EPA-822-R-16-006, Appendix K: Translation of a Selenium Fish Tissue Criterion Element to a Site-specific Water Column Value (June 2016)*~~ **methods included in relevant guidance issued by U.S. EPA or IDEM or another method that IDEM determines is scientifically defensible.** (IPL)

Response: IDEM does not agree that it is appropriate to remove the U.S. EPA pre-approved Appendix K methods for deriving site-specific criterion elements from the criterion footnote. U.S. EPA's Appendix K methods are pre-approved methodologies for deriving site-specific criterion water column criterion elements, including in fishless waters. IDEM did consider whether it would be acceptable to add IPL's suggested language to 327 IAC 2-1-6(a)(4)(C)(i) to allow for approval of an alternate method. The statutory provision governing incorporation by reference in rule prevents IDEM from including a general reference to a future guidance document. In addition, state rule standards require clear, specific criteria by which proposed alternative methods could be evaluated by IDEM on a consistent basis. Based on discussions with the Indiana Attorney General's Office, it was determined that IPL's suggested language, as well as other language contemplated by IDEM to give consideration to IPL's request for alternate methodologies, was not specific enough to meet this requirement. If U.S. EPA does approve an alternative method in the future, IDEM will consider adopting it into rule.

Comment: The proposed requirement to obtain a site-specific modification for waters that do not contain sturgeon and paddlefish as included in 327 IAC 2-1-6(D)(ii)-(iv), is not necessary or appropriate. The water quality criteria for non-sturgeon and paddlefish waters are already included in Table 6-1(B). IPL believes that the only requirement necessary for a facility to be able to utilize such water quality criteria is to provide IDEM with the necessary information to demonstrate that sturgeon and paddlefish do not occur at the site, as included in 327 IAC 2-1-6(a)(4)(D)(i). If information is provided to IDEM to render a successful demonstration, IDEM can simply provide an approval to the facility such that the respective facility can then utilize the water quality criteria included in Table 6-1(B) without the need to obtain a site-specific modification to the criteria. This will allow facilities to be able to move forward with compliance based on criteria that are reflective of their sites' water conditions for non-sturgeon and paddlefish in a reasonable manner. They should not be delayed due to more rigorous and unnecessary actions, such as additional rulemaking, that could place the facility in jeopardy of having to comply with more stringent water quality criteria than necessary. (IPL)

Response: The location where a site-specific application for a water quality criterion is proposed is subject to U.S. EPA approval. As discussed in previous responses to similar comments, it is IDEM's opinion that stakeholders will have more flexibility to demonstrate that the Acipenseriformes-absent site-specific criterion is appropriate for their individual sites than by adopting a U.S. EPA-approved performance-based approach. However, U.S. EPA will have to approve each of these individual determinations. For a performance-based approach that would not require U.S. EPA approval of each individual determination, IDEM would need to apply a defined fixed buffer, at the HUC 8 scale, to the larger rivers and streams where mature Acipenseriformes are usually found. This buffer will protect downstream water quality and waters where Acipenseriformes spawn and juveniles mature.

Comment: Concerning rule language at 327 IAC 2-1-6(a)(4)(D) (page 13 of 46 of the draft rule), both item (ii) and item (iii) apply to situations where *Acipenseriformes* do not occur. ICC believes that item (ii) is intended to apply to where they do occur and item (iii) is to apply where they do not occur. (ICC)

Response: Items (ii) and (iii) outline the formal public notice process for the site-specific criterion determination and approval for the Acipenseriformes-absence determination. Item (ii) states that IDEM must publish on IDEM's website information that supports the preliminary determination that Acipenseriformes do not

occur at the site. IDEM must provide notice of this posting and solicit comments. After the comment period required by item (ii)(BB), if the determination that Acipenseriformes do not occur at the site is confirmed, IDEM, according to item (iii), then publishes a notice in the Indiana Register for another comment period and submits the site-specific determination to U.S. EPA for approval.

Development of guidance

Comment: IDEM must develop guidance regarding permit implementation, fish tissue sampling, target species, and fish analysis before this rule is brought to the Environmental Rules Board for final adoption. Implementation of the selenium criterion into permits will be particularly important to regulated industries. It is important to maintain flexibility that allows a discharger to use water column-based sampling due to its simplicity and reduced costs. However, in the event of an exceedance of a water column value, a discharger should be allowed to use fish tissue data to verify whether the water column exceedance has resulted in an actual impact to the aquatic community. Experiences from other states indicate that, often times, occasional exceedances of the water column criteria do not manifest into fish tissue concentrations above the criteria. In these cases, there should be no compliance or enforcement against a discharger. (ICC)

Response: IDEM has developed a draft implementation guidance document with feedback from key stakeholders and U.S. EPA. This guidance will be finalized after rule adoption, as provisions in the guidance must necessarily conform to the criteria in the final rule.

IDEM worked with U.S. EPA and researched other states' approaches to selenium criterion implementation. The draft guidance (IDEM 2020(b)) provides direction for collecting fish tissue and water column samples to investigate selenium in fish tissue and the water column and conduct a reasonable potential to exceed (RPE) determination or derive a site-specific water column criterion element using the bioaccumulation factor (BAF) approach, or both. BAFs are used to relate chemical concentrations in aquatic organisms to concentrations in the ambient media of aquatic ecosystems where both the organism and its food are exposed and the ratio does not change substantially over time. IDEM has posted this guidance on the IDEM website and is both soliciting feedback and clarifying the guidance based on the feedback already received.

Since the adverse impacts of selenium are the reproductive impacts and these occur during maternal transfer of selenium during egg development, the appropriate timing for fish tissue sampling and selection of species appropriate for Indiana is critical in assessing if adverse impacts have occurred. Any plan to sample fish or collect water column data, or both, to assess selenium impacts or to derive a site-specific water column criterion element must be pre-approved by IDEM.

Exceeding a selenium permit limit will not "trigger" a requirement to immediately sample fish tissue to verify whether the water column exceedance has resulted in an adverse impact to the aquatic community. This is not consistent with the 2016 NRWQC, which is a chronic criterion element, nor is it protective of the aquatic assemblage in the receiving water. Such an approach is not the scientifically appropriate methodology for assessing chronic selenium impacts.

If exceeding a newly established permit limit is a potential issue, a compliance schedule may be warranted for a permittee with an existing NPDES permit. IDEM's draft implementation guidance (IDEM 2020(b)) describes a procedure whereby fish tissue may be used for RPE determinations if specific requirements are met. In addition, the permittee will have the option to develop a site-specific water column criterion element using the bioaccumulation factor approach, or in fishless waters, the mechanistic modeling methodology provided in Appendix K. Other options, such as the use of the intermittent criterion or an alternate stream flow may be available. Finally, a water quality standards variance is another option that may be considered. The permittee could also address the underlying causes for the elevated concentrations of selenium in their effluent discharge.

Comment: In development of implementation guidance, IDEM needs to address two issues of concern in U.S. EPA's draft guidance, including the application of the selenium criterion on: (1) streams with no fish; and (2) new discharges. These issues are directly related to implementation of the criteria in NPDES permits and assessing streams for attainment of the criteria in the 303(d) process. (IMA)

Response: For streams with no fish, the applicable water column criterion element applies. This is stated in the draft rule at:

- 327 IAC 2-1-6(a)(4)(A), Table 6-1a, footnote 5, for waters outside of the Great Lakes System,
- 327 IAC 2-1-6(a)(4)(B), Table 6-1b, footnote 6, for waters within the Great Lakes System where Acipenseriformes (sturgeon and paddlefish) are absent, and
- 327 IAC 2-1.5-8(b)(3)(B), Table 8-1a, footnote 5, for waters within the Great Lakes System.

For new discharges, IDEM's draft implementation guidance provides the following regarding the application of the selenium criterion:

> "For new selenium inputs, selenium in fish tissue must be allowed to come into equilibrium with the water column before fish tissue concentration criterion elements would supersede water column concentration criterion elements (U.S. EPA 2016). When selenium inputs change, causing the concentration in the water column to increase or decrease, the fish tissue will not immediately reflect the change in water chemistry. U.S. EPA estimates that the concentration of selenium in fish tissue will not reach steady state for several

months in lotic systems and longer time periods (e.g., as long as 2 to 3 years) in lentic systems. Generally, when any major changes to water column selenium concentrations occur and for new discharges, IDEM will require a minimum duration of 12 months before fish tissue may be sampled to assess bioaccumulation in the resident fish population. IDEM will consider site-specific factors that could shorten or lengthen this estimated time frame (IDEM 2020(b), pp 2-3)."

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327 IAC 2-1-6; 327 IAC 2-1.5-8

SECTION 1. 327 IAC 2-1-6 IS AMENDED TO READ AS FOLLOWS:

327 IAC 2-1-6 Minimum surface water quality criteria

Authority: IC 13-14-8-2; IC 13-14-8-3; IC 13-18-4-3
Affected: IC 13-11-2-258; IC 13-18-4; IC 13-30-2-1; IC 14-22-9

Sec. 6. (a) The following are minimum surface water quality conditions:
(1) All surface waters, ~~at all times and at all places,~~ including waters within ~~the~~ **a** mixing zone, ~~shall meet the minimum conditions of being~~ **must be** free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:
(A) ~~Will~~ Settle to form putrescent or otherwise objectionable deposits.
(B) ~~Are~~ **Occur** in amounts sufficient to be unsightly or deleterious.
(C) Produce:
(i) color;
(ii) visible oil sheen;

(iii) odor; or
(iv) other conditions;
~~in such degree as~~ to ~~create~~ **an extent that creates** a nuisance.
(D) ~~Are~~ **Occur** in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to ~~such~~ **a** degree as to:
(i) create a nuisance;
(ii) be unsightly; or
(iii) otherwise impair the designated uses **of the surface waters.**
(E) ~~Are~~ **Occur** in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans. To ~~assure~~ **ensure** protection of aquatic life, concentrations of toxic substances ~~shall~~ **must** not exceed the final acute value (FAV = 2 (AAC)) in the undiluted discharge or the acute aquatic criterion (AAC) outside the zone of initial dilution or, if applicable, the zone of discharge-induced mixing. **The following apply where applicable:**
(i) For certain substances, an AAC is ~~established and set forth~~ **specified** in:
(AA) subdivision (3), Table 6-1, **which incorporates** subdivision ~~(3),~~ **(5),** Table 6-2; ~~which table incorporates subdivision (4), Table 6-3;~~ and
(BB) subdivision ~~(5).~~ **(6).**
(ii) ~~for substances for which an AAC is not specified in subdivision (3), Table 6-1, subdivision (3), Table 6-2, or subdivision (5),~~ An AAC ~~can~~ **may** be calculated by the commissioner using the procedures in section 8.2 of this rule ~~and~~ **for substances for which an AAC is not specified in:**
(AA) subdivision (3), Table 6-1, which incorporates subdivision (5), Table 6-2; or
(BB) subdivision (6).
(iii) The AAC determined under item (i) or (ii) may be modified on a site-specific basis to reflect local conditions in accordance with section 8.9 of this rule. ~~This~~
(F) Clause ~~shall~~ **(E) does** not apply to the chemical control of plants and animals when that control is performed in compliance with approval conditions specified by the Indiana department of natural resources as provided by IC 14-22-9.
(2) ~~At~~ All ~~times, all~~ surface waters outside of mixing zones ~~shall~~ **must** be free of substances in concentrations that, on the basis of available scientific data, are believed to be sufficient to injure, be chronically toxic to, or be carcinogenic, mutagenic, or teratogenic to humans, animals, aquatic life, or plants. ~~To assure protection against the adverse effects identified in this subdivision,~~ The ~~following~~ requirements **to ensure protection against the adverse effects identified in this subdivision** are ~~established:~~ **as follows:**
(A) A toxic substance or pollutant ~~shall~~ **must** not be present in ~~such~~ **surface** waters **outside of mixing zones** in concentrations that exceed the most stringent of the following continuous criterion concentrations (CCCs):
(i) A chronic aquatic criterion (CAC) to protect aquatic life from chronic toxic effects.
(ii) A terrestrial life cycle safe concentration (TLSC) to protect terrestrial organisms from toxic effects that may result from the consumption of aquatic organisms or water from the waterbody.
(iii) A human life cycle safe concentration (HLSC) to protect human health from toxic effects that may result from the consumption of aquatic organisms or drinking water from the waterbody.
(iv) For carcinogenic substances, a criterion to protect human health from unacceptable cancer risk of greater than one (1) additional occurrence of cancer per one hundred thousand (100,000) population.
(B) For certain substances, one (1) or more of the CCCs identified in clause (A) are ~~established and set forth~~ **specified** in:
(i) subdivision (3), Table 6-1, **which incorporates subdivision (5), Table 6-2;**
(ii) subdivision ~~(3), Table 6-2 (which table incorporates subdivision (4),~~ **(4)(A),** Table ~~6-3), and subdivision (5).~~ **6-1a;**
(iii) subdivision (4)(B), Table 6-1b;
(iv) subdivision (6); and
(v) subdivision (7), Table 6-4.
(C) ~~For substances for which one (1) or more of the CCCs identified in clause (A) are not specified in subdivision (3), Table 6-1, subdivision (3), Table 6-2, or subdivision (5), such~~ Criterion or criteria may be calculated by the commissioner using the corresponding procedures prescribed by sections 8.3 through 8.6 of this rule **for substances for which a CCC identified in clause (A) is not specified in:**
(i) subdivision (3), Table 6-1, which incorporates subdivision (5), Table 6-2;
(ii) subdivision (4)(A), Table 6-1a;
(iii) subdivision (4)(B), Table 6-1b;
(iv) subdivision (6); or
(v) subdivision (7), Table 6-4.
(D) A CCC determined under clause ~~(B)~~ **(B)(i), (B)(iv), (B)(v),** or (C) may be modified on a site-specific basis to reflect local conditions in accordance with section 8.9 of this rule.

(E) The CAC and TLSC for a substance apply in all surface waters outside **of** a mixing zone for a discharge of that substance. ~~Similarly,~~

(F) In **surface** waters where a public water system intake is not present or is unaffected by the discharge of a substance, the HLSC and the carcinogenic criterion for that substance based on consumption of organisms from the waterbody and only incidental ingestion of water ~~shall~~ apply to all surface waters outside **of** the mixing zone for a discharge of that substance.

(G) In surface waters where a public water system intake is present, the HLSC and the carcinogenic criterion for a substance based on consumption of organisms and potable water from the waterbody ~~shall~~ apply at the point of the public water system intake.

(3) ~~The following establishes~~ Surface water quality criteria **for the protection of aquatic life** for specific substances **are as follows:**

~~Table 6-1~~

~~Surface Water Quality Criteria for Specific Substances~~

~~AAC (Maximum)~~		~~CCC~~		
		~~Outside of Mixing Zone~~		~~Point of Water Intake~~
~~Substances~~		~~Aquatic Life (CAC) (4-Day Average)~~	~~Human Health (30-Day Average)~~	~~Human Health (30-Day Average)~~
~~Metals (µg/l)~~				
~~(Total recoverable)~~				
~~Antimony~~			~~45,000 (T)~~	~~146 (T)~~
~~Arsenic (III)~~	~~#~~	~~#~~	~~0.175 (C)~~	~~0.022 (C)~~
~~Barium~~				~~1,000 (D)~~
~~Beryllium~~			~~1.17 (C)~~	~~0.068 (C)~~
~~Cadmium~~	~~#~~	~~#~~		~~10 (D)~~
~~Chromium (III)~~	~~#~~	~~#~~	~~3,433,000 (T)~~	~~170,000 (T)~~
~~Chromium (VI)~~	~~#~~	~~#~~		~~50 (D)~~
~~Copper~~	~~#~~	~~#~~		
~~Lead~~	~~#~~	~~#~~		~~50 (D)~~
~~Mercury$~~	~~2.4~~	~~0.012~~	~~0.15 (T)~~	~~0.14 (T)~~
~~Nickel~~	~~#~~	~~#~~	~~100 (T)~~	~~13.4 (T)~~
~~Selenium~~	~~130*~~	~~35 ##~~		~~10 (D)~~
~~Silver~~	~~#~~			~~50 (D)~~
~~Thallium~~			~~48 (T)~~	~~13 (T)~~
~~Zinc~~	~~#~~	~~#~~		
~~Organics (µg/l)~~				
~~Acrolein~~			~~780 (T)~~	~~320 (T)~~
~~Acrylonitrile~~			~~6.5 (C)~~	~~0.58 (C)~~
~~Aldrin$~~	~~1.5*~~		~~0.00079 (C)~~	~~0.00074 (C)~~
~~Benzene~~			~~400 (C)~~	~~6.6 (C)~~
~~Benzidine~~			~~0.0053 (C)~~	~~0.0012 (C)~~
~~Carbon Tetrachloride~~			~~69.4 (C)~~	~~4.0 (C)~~
~~Chlordane$~~	~~1.2*~~	~~0.0043~~	~~0.0048 (C)~~	~~0.0046 (C)~~
~~Chlorinated Benzenes~~				
~~Monochlorobenzene~~				~~488 (T)~~
~~1,2,4,5-Tetrachlorobenzene$~~			~~48 (T)~~	~~38 (T)~~
~~Pentachlorobenzene$~~			~~85 (T)~~	~~74 (T)~~
~~Hexachlorbenzene$~~			~~0.0074 (C)~~	~~0.0072 (C)~~
~~Chlorinated Ethanes~~				
~~1,2-dichloroethane~~			~~2,430 (C)~~	~~9.4 (C)~~
~~1,1,1-trichloroethane~~			~~1,030,000 (T)~~	~~18,400 (T)~~
~~1,1,2-trichloroethane~~			~~418 (C)~~	~~6.0 (C)~~
~~1,1,2,2-tetrachloroethane~~			~~107 (C)~~	~~1.7 (C)~~
~~Hexachloroethane~~			~~87.4 (C)~~	~~19 (C)~~
~~Chlorinated Phenols~~				
~~2,4,5-trichlorophenol~~				~~2,600 (T)~~

2,4,6-trichlorophenol			36 (C)	12 (C)
Chloroalkyl Ethers				
bis(2-chloroisopropyl) ether			4,360 (T)	34.7 (T)
bis(chloromethyl) ether			0.018 (C)	0.000038 (C)
bis(2-chloroethyl) ether			13.6 (C)	0.3 (C)
Chloroform			157 (C)	1.9 (C)
Chlorpyrifos	0.083	0.041		
DDT$	0.55*	0.0010	0.00024 (C)	0.00024 (C)
Dichlorobenzenes			2,600 (T)	400 (T)
Dichlorobenzidine			0.2 (C)	0.1 (C)
1,1-dichloroethylene			18.5 (C)	0.33 (C)
2,4-dichlorophenol				3,090 (T)
Dichloropropenes			14,100 (T)	87 (T)
Dieldrin$	1.3*	0.0019	0.00076 (C)	0.00071 (C)
2,4-dinitrotoluene			91 (C)	1.1 (C)
Dioxin (2,3,7,8-TCDD)$			0.0000001 (C)	0.0000001 (C)
1,2-diphenylhydrazine			5.6 (C)	0.422 (C)
Endosulfan	0.11*	0.056	159 (T)	74 (T)
Endrin$	0.09*	0.0023		1.0 (D)
Ethylbenzene			3,280 (T)	1,400 (T)
Fluoranthene			54 (T)	42 (T)
Halomethanes			157 (C)	1.9 (C)
Heptachlor$	0.26*	0.0038	0.0028 (C)	0.0028 (C)
Hexachlorobutadiene$			500 (C)	4.47 (C)
Hexachlorocyclohexane (HCH)				
alpha HCH$			0.31 (C)	0.09 (C)
beta HCH$			0.55 (C)	0.16 (C)
gamma HCH (Lindane)$	1.0*	0.080	0.63 (C)	0.19 (C)
Technical HCH$			0.41 (C)	0.12 (C)
Hexachlorocyclopentadiene				206 (T)
Isophorone			520,000 (T)	5,200 (T)
Nitrobenzene				19,800 (T)
Nitrophenols				
4,6-dinitro-o-cresol			765 (T)	13.4 (T)
Dinitrophenol			14,300 (T)	70 (T)
Nitrosamines				
N-nitrosodiethylamine			12.4 (C)	0.008 (C)
N-nitrosodimethylamine			160 (C)	0.014 (C)
N-nitrosodibutylamine			5.9 (C)	0.064 (C)
N-nitrosodiphenylamine			161 (C)	49 (C)
N-nitrosopyrrolidine			919 (C)	0.16 (C)
Parathion	0.065	0.013		
Pentachlorophenol	$e^{(1.005\ [pH]\ -4.830)}$	$e^{(1.005\ [pH]\ -5.290)}$		1,000 (T)
Phenol				3,500 (T)
Phthalate Esters				
Dimethyl phthalate			2,900,000 (T)	313,000 (T)
Diethyl phthalate			1,800,000 (T)	350,000 (T)
Dibutyl phthalate			154,000 (T)	34,000 (T)
Di-2-ethylhexyl phthalate			50,000 (T)	15,000 (T)
Polychlorinated Biphenyls (PCBs)$		0.014	0.00079 (C)	0.00079 (C)
Carcinogenic Polynuclear Aromatic Hydrocarbons (PAHs)			0.31 (C)	0.028 (C)
Tetrachloroethylene			88.5 (C)	8 (C)
Toluene			424,000 (T)	14,300 (T)
Toxaphene$	0.73	0.0002	0.0073 (C)	0.0071 (C)
Trichloroethylene			807 (C)	27 (C)

Vinyl Chloride			5,246 (C)	20 (C)
Other Substances				
Asbestos (fibers/liter)				300,000 (C)
Chloride (mg/l)	**	**		
Chlorine (Total Residual) (µg/l)	19	11		
Chlorine[a] (mg/l) (intermittent, total residual)		0.2		
Cyanide (Free) (µg/l)	22	5.2		
Cyanide (Total) (µg/l)				200 (D)
Nitrate-N + Nitrite-N (mg/l)				10 (D)
Nitrite-N (mg/l)				1.0 (D)

Fluoride shall not exceed two (2.0) mg/l in all surface waters outside of the mixing zone except the Ohio River and Interstate Wabash River where it shall not exceed one (1.0) mg/l outside of the mixing zone.

Sulfate shall not exceed the criteria established in subdivision (6) in all surface waters outside of the mixing zone.

#The AAC and CAC for this substance are established in Table 6-2.

*One-half (1/2) of the final acute value (FAV) as calculated by procedures developed by U.S. EPA in 1980. This value would correspond to acute aquatic values calculated using IDEM procedures or U.S. EPA procedures developed in 1985 in which the calculated FAV is divided by two (2) to reduce acute toxicity.

**The AAC and CAC for this substance are established in subdivision (5).

T derived from threshold toxicity.

C derived from nonthreshold cancer risk.

D derived from drinking water standards, equal to or less than threshold toxicity.

$This substance is a bioaccumulative chemical of concern.

[a]To be considered an intermittent discharge, total residual chlorine shall not be detected in the discharge for a period of more than forty (40) minutes in duration, and such periods shall be separated by at least five (5) hours.

Table 6-2
Surface Water Quality Criteria for Specific Substances

Substances	AAC (Maximum) (µg/l)	AAC Conversion Factors	CAC (4-Day Average) (µg/l)	CAC Conversion Factors
Metals (dissolved)[1]				
Arsenic (III)	$WER^{[2]}(360)$	1.000	$WER^{[2]}(190)$	1.000
Cadmium	$WER^{[2]}(e^{(1.128[\ln(\text{hardness})] - 3.828)})$	1.136672 - [(ln hardness) (0.041838)]	$WER^{[2]}(e^{(0.7852[\ln(\text{hardness})] - 3.490)})$	1.101672 - [(ln hardness) (0.041838)]
Chromium (III)	$WER^{[2]}(e^{(0.819[\ln(\text{hardness})]+3.688)})$	0.316	$WER^{[2]}(e^{(0.8190[\ln(\text{hardness})]+1.561)})$	0.860
Chromium (VI)	$WER^{[2]}(16)$	0.982	$WER^{[2]}(11)$	0.962
Copper	$WER^{[2]}(e^{(0.9422[\ln(\text{hardness})] - 1.464)})$	0.960	$WER^{[2]}(e^{(0.8545[\ln(\text{hardness})] - 1.465)})$	0.960
Lead	$WER^{[2]}(e^{(1.273[\ln(\text{hardness})] - 1.460)})$	1.46203 - [(ln hardness) (0.145712)]	$WER^{[2]}(e^{(1.273[\ln(\text{hardness})] - 4.705)})$	1.46203 - [(ln hardness) (0.145712)]

~~Nickel~~	~~$WER^{[2]}(e^{(0.8460[\ln(hardness)]+3.3612)})$~~	~~0.998~~	~~$WER^{[2]}(e^{(0.8460[\ln(hardness)]+1.1645)})$~~	~~0.997~~
~~Silver~~	~~$WER^{[2]}(e^{(1.72[\ln(hardness)] - 6.52)}/2^{[3]})$~~	~~0.85~~		
~~Zinc~~	~~$WER^{[2]}(e^{(0.8473[\ln(hardness)]+0.8604)})$~~	~~0.978~~	~~$WER^{[2]}(e^{(0.8473[\ln(hardness)]+0.7614)})$~~	~~0.986~~

~~[1]The AAC and CAC columns of this table contain total recoverable metals criteria (numeric and hardness-based). The criterion for the dissolved metal is calculated by multiplying the appropriate conversion factor by the AAC or CAC. This dissolved AAC or CAC shall be rounded to two (2) significant digits, except when the criteria are used as intermediate values in a calculation, such as in the calculation of water quality-based effluent limitations (WQBELs).~~

~~[2]A value of one (1) shall be used for the water-effect ratio (WER) unless an alternate value is established under section 8.9 of this rule.~~

~~[3]One-half (1/2) of the FAV as calculated by procedures developed by U.S. EPA in 1980. This value would correspond to acute aquatic values calculated using IDEM procedures or U.S. EPA procedures developed in 1985 in which the calculated FAV is divided by two (2) to reduce acute toxicity.~~

Table 6-1
Surface Water Quality Criteria for the Protection of Aquatic Life

CAS Number	Substances	Acute Aquatic Criteria (AAC) (Maximum) (µg/l)	AAC Conversion Factors (CF)	Chronic Aquatic Criteria (CAC) (4-Day Average) (µg/l)	CAC Conversion Factors (CF)
	Metals				
7440382	**Arsenic[1]**	**WER(340)(CF)**	**1.000**	**WER(150)(CF)**	**1.000**
7440439	**Cadmium[1][2]**	**$WER(e^{(0.9789[\ln H] - 3.866)})(CF)$**	**1.136672 - [lnH]0.041838**	**$WER(e^{(0.7977[\ln H] - 3.909)})(CF)$**	**1.101672 - [lnH]0.041838**
16065831	**Chromium (III)[1][2]**	**$WER(e^{(0.819[\ln H] + 3.7256)})(CF)$**	**0.316**	**$WER(e^{(0.819[\ln H] + 0.6848)})(CF)$**	**0.860**
18540299	**Chromium (VI)[1]**	**WER(16)(CF)**	**0.982**	**WER(11)(CF)**	**0.962**
7440508	**Copper[1][2]**	**$WER(e^{(0.9422[\ln H] - 1.464)})(CF)$**	**0.960**	**$WER(e^{(0.8545[\ln H] - 1.465)})(CF)$**	**0.960**
7439921	**Lead[1][2]**	**$WER(e^{(1.273[\ln H] - 1.460)})(CF)$**	**1.46203 - [lnH]0.145712**	**$WER(e^{(1.273[\ln H] - 4.705)})(CF)$**	**1.46203 - [lnH]0.145712**
7439976	**Mercury[3][4]**	**2.4**	**NA**	**0.012**	**NA**
7440020	**Nickel[1][2]**	**$WER(e^{(0.846[\ln H] + 2.255)})(CF)$**	**0.998**	**$WER(e^{(0.846[\ln H] + 0.0584)})(CF)$**	**0.997**
7440224	**Silver[1][2][5]**	**$WER(e^{(1.72[\ln H] - 6.59)}/2)(CF)$**	**0.85**		
7440666	**Zinc[1][2]**	**$WER(e^{(0.8473[\ln H] + 0.884)})(CF)$**	**0.978**	**$WER(e^{(0.8473[\ln H] + 0.884)})(CF)$**	**0.986**
	Organics				
309002	**Aldrin[4][5]**	**1.5**	**NA**		**NA**
57749	**Chlordane[4][5]**	**1.2**	**NA**	**0.0043**	**NA**
2921882	**Chlorpyrifos**	**0.083**	**NA**	**0.041**	**NA**
50293	**DDT[4][5]**	**0.55**	**NA**	**0.0010**	**NA**
60571	**Dieldrin[4][5]**	**1.3**	**NA**	**0.0019**	**NA**
	Endosulfan[5]	**0.11**	**NA**	**0.056**	**NA**
72208	**Endrin[4][5]**	**0.09**	**NA**	**0.0023**	**NA**

76448	Heptachlor[4][5]	0.26	NA	0.0038	NA
58899	Gamma HCH (Lindane)[4][5]	1.0	NA	0.080	NA
56382	Parathion	0.065	NA	0.013	NA
87865	Pentachlorophenol	$e^{(1.005[pH] - 4.830)}$	NA	$e^{(1.005[pH] - 5.290)}$	NA
	Polychlorinated Biphenyls (PCBs)[4]		NA	0.014	NA
8001352	Toxaphene[4]	0.73	NA	0.0002	NA
	Other Substances				
7782505	Chlorine (Total Residual)	19	NA	11	NA
	Chlorine (intermittent, total residual)[6]		200	NA	
57125	Cyanide (free)	22	NA	5.2	NA

Selenium CAC are specified in subdivision (4).

Chloride AAC and CAC are specified in subdivision (6).

[1]Aquatic life criteria for these metals are expressed as a dissolved concentration and are calculated using the water-effect ratio (WER) and the specified conversion factor (CF). The AAC and CAC for a dissolved metal are calculated by multiplying the WER by the criterion value or formula, and then by the appropriate CF. A value of one (1) must be used for the WER unless an alternate value is established under section 8.9 of this rule. The dissolved AAC and CAC must be rounded to two (2) significant digits, except when the criteria are used as intermediate values in a calculation, such as in the calculation of water quality-based effluent limitations (WQBELs).

[2]The hardness values used in the equations for these criteria must not be greater than 400 mg/l as calcium carbonate ($CaCO_3$), and the criteria at a hardness of 400 mg/l as $CaCO_3$ are used for a water hardness above 400 mg/l as $CaCO_3$. The term "lnH" is the natural log of hardness.

[3]Aquatic life criteria for this metal are expressed as a total recoverable concentration.

[4]These substances are bioaccumulative chemicals of concern.

[5]The AAC for these substances is one-half (1/2) of the FAV as calculated by procedures developed by U.S. EPA in 1980. This value would correspond to acute aquatic values calculated using procedures of the department or U.S. EPA procedures developed in 1985 in which the calculated FAV is divided by two (2) to reduce acute toxicity.

[6]To be considered an intermittent discharge, total residual chlorine must not be detected in the discharge for a period of more than forty (40) minutes in duration, and these time periods must be separated by at least five (5) hours.

(4) Surface water quality criterion for selenium must meet the following:

(A) The surface water quality criterion for selenium, except for waters where the department has made, and U.S. EPA has approved, a site-specific determination that the criterion in Table 6-1b are applicable, is as follows:

Table 6-1a

Surface Water Quality Aquatic Life Criterion for Selenium (CAS # 7782492) Chronic Aquatic Criterion (CAC)

Media Type	Fish Tissue[1]		Water Column[5][7]	
Criterion Element	Egg/Ovary[2]	Fish Whole-Body or Muscle[3]	Monthly Average Exposure	Intermittent Exposure[6]
Magnitude	15.1 mg/kg dw	8.5 mg/kg dw whole-body or 11.3 mg/kg dw muscle (skinless, boneless filet)	1.5 µg/l in lentic aquatic systems 3.1 µg/l in lotic aquatic systems	$WQC_{int} = \frac{WQC_{30\text{-}day} - C_{bkgrnd}(1 - f_{int})}{f_{int}}$

Duration	**Instantaneous measurement[4]**	**Instantaneous measurement[4]**	**30 days**	**Number of days per month with an elevated concentration**
Frequency	**Not to be exceeded**	**Not to be exceeded**	**Not more than once in three (3) years on average**	**Not more than once in three (3) years on average**

[1]Fish tissue elements are expressed as steady-state; the aquatic system should not be experiencing new or increasing inputs of selenium.
[2]Egg or ovary supersedes any whole-body, muscle, or water column element when fish egg or ovary concentrations are measured. Any proposal to sample egg or ovary fish tissue must be submitted to the department for review and approval prior to initiation of sampling, and the department will evaluate all representative egg or ovary fish tissue data to determine compliance with this criterion element.
[3]Fish whole-body or muscle tissue supersedes the water column element when both fish tissue and water concentrations are measured. Any proposal to sample fish whole-body or muscle tissue must be submitted to the department for review and approval prior to initiation of sampling, and the department will evaluate all representative fish whole-body or muscle tissue data to determine compliance with this criterion element.
[4]Fish tissue data provide instantaneous point measurements that reflect integrative accumulation of selenium over time and space in fish populations at a given site.
[5]Water column values are the applicable criterion element in the absence of steady-state condition fish tissue data and for fishless waters. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Instead of the requirements in 327 IAC 5-2-11.1(b)(2), the allowable mixing zone dilution will be determined by applying the guideline in 327 IAC 2-1-4 to the thirty (30) day, ten (10) year ($Q_{30,10}$) low flow of the receiving stream for the chronic aquatic criterion (CAC) water column criterion element applicable to lotic aquatic systems, in the absence of site-specific mixing zone data.
[6]Intermittent Exposure Equation variables mean the following:
***WQC*$_{int}$ is the water column intermittent element.**
***WQC*$_{30\text{-}day}$ is the water column monthly element for either lentic or lotic waters.**
***C*$_{bkgrnd}$ is the average background selenium concentration.**
***f*$_{int}$ is the fraction of any 30-day period during which elevated selenium concentrations occur, with *f*$_{int}$ assigned a value ≥0.033 (corresponding to one (1) day).**
[7]The water column criterion element may be modified on a site-specific basis in accordance with clause (C).

(B) The surface water quality criterion for selenium, where the department has made, and U.S. EPA has approved, a site-specific determination that fishes in the Order Acipenseriformes (Order includes sturgeon and paddlefish) do not occur at the site, is as follows:

Table 6-1b				
Site-specific Surface Water Quality Aquatic Life Criterion for Selenium (CAS # 7782492) in Non-Acipenseriformes (No Sturgeon or Paddlefish) Waters[1]				
Chronic Aquatic Criterion (CAC)				
Media Type	**Fish Tissue[2]**		**Water Column[6][8]**	
Criterion Element	**Egg/Ovary[3]**	**Fish Whole-Body or Muscle[4]**	**Monthly Average Exposure**	**Intermittent Exposure[7]**
Magnitude	**19.0 mg/kg dw**	**9.5 mg/kg dw whole-body or 13.1 mg/kg dw muscle (skinless, boneless filet)**	**2.7 µg/l in lentic aquatic systems** **5.5 µg/l in lotic aquatic systems**	$WQC_{int} = WQC_{30\text{-}day} - C_{bkgrnd}(1 - f_{int})$ f_{int}
Duration	**Instantaneous measurement[5]**	**Instantaneous measurement[5]**	**30 days**	**Number of days per month with an elevated**

Frequency	**Not to be exceeded**	**Not to be exceeded**	**Not more than once in three (3) years on average**	**Not more than once in three (3) years on average**

[1]This criterion is applicable to surface waters for which the department has made, and U.S. EPA has approved, a site-specific determination that fishes in the Order Acipenseriformes do not occur at the site. In making this determination, the department must comply with the procedures in clause (D).
[2]Fish tissue elements are expressed as steady-state; the aquatic system should not be experiencing new or increasing inputs of selenium.
[3]Egg or ovary supersedes any whole-body, muscle, or water column element when fish egg or ovary concentrations are measured. Any proposal to sample egg or ovary fish tissue must be submitted to the department for review and approval prior to initiation of sampling, and the department will evaluate all representative egg or ovary fish tissue data to determine compliance with this criterion element.
[4]Fish whole-body or muscle tissue supersedes the water column element when both fish tissue and water concentrations are measured. Any proposal to sample fish whole-body or muscle tissue must be submitted to the department for review and approval prior to initiation of sampling, and the department will evaluate all representative fish whole-body or muscle tissue data to determine compliance with this criterion element.
[5]Fish tissue data provide instantaneous point measurements that reflect integrative accumulation of selenium over time and space in fish populations at a given site.
[6]Water column values are the applicable criterion element in the absence of steady-state condition fish tissue data and for fishless waters. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Instead of the requirements in 327 IAC 5-2-11.1(b)(2), the allowable mixing zone dilution will be determined by applying the guideline in 327 IAC 2-1-4 to the thirty (30) day, ten (10) year ($Q_{30,10}$) low flow of the receiving stream for the chronic aquatic criterion (CAC) water column criterion element applicable to lotic aquatic systems, in the absence of site-specific mixing zone data.
[7]Intermittent Exposure Equation variables mean the following:
***WQC*$_{int}$ is the water column intermittent element.**
***WQC*$_{30\text{-}day}$ is the water column monthly element for either lentic or lotic waters.**
***C*$_{bkgrnd}$ is the average background selenium concentration.**
***f*$_{int}$ is the fraction of any 30-day period during which elevated selenium concentrations occur, with *f*$_{int}$ assigned a value ≥0.033 (corresponding to one (1) day).**
[8]The water column criterion element may be modified on a site-specific basis in accordance with clause (C).

(C) Modification of the selenium water column criterion element must be achieved according to the following:

(i) Site-specific water column criterion elements must be derived using either the empirical bioaccumulation factor (BAF) or mechanistic modeling method provided in Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater, EPA-822-R-16-006, Appendix K: Translation of a Selenium Fish Tissue Criterion Element to a Site-Specific Water Column Value (June 2016)*.

(ii) Any proposal to derive a site-specific water column criterion element must be submitted to the department for review and approval of the methodology and sampling plan prior to initiation of sampling. The department shall evaluate and approve the applicability of and use of all representative data used to derive a site-specific water column criterion element.

(iii) Any proposal to derive a site-specific water column criterion element must be protective of downstream designated uses for aquatic life and human health.

(iv) Upon receipt of an application for a site-specific water column criterion element, the department shall do the following:

(AA) Publish on the department's website all pertinent information about the proposed site-specific modification.

(BB) Provide notice and request comment on the application.

(v) Upon approval of a site-specific water column criterion element, the department shall do the following:

(AA) Publish a notice in the Indiana Register.

(BB) Place on the department's website all pertinent information about the approved site-specific modification.

(CC) Submit the site-specific modification to U.S. EPA for approval.

(DD) If approved by U.S. EPA, incorporate the site-specific modification into the water quality standards during the next revision of the water quality standards.

(vi) Site-specific modifications of this criterion must not be incorporated into a final NPDES permit or used for other Clean Water Act purposes until approved by U.S. EPA.

(D) Upon receipt of an application for a site-specific determination that fishes in the Order Acipenseriformes (Order includes sturgeon and paddlefish) do not occur at the site, the department shall do the following:

(i) Review available species occurrence and distribution information and do one (1) of the following:

(AA) Make a tentative determination that fishes in the Order Acipenseriformes do not occur at the site.

(BB) Make a determination that fishes in the Order Acipenseriformes occur at the site and deny the application.

(ii) Upon a tentative determination that fishes in the Order Acipenseriformes do not occur at the site, the department shall do the following:

(AA) Publish on the department's website all pertinent information about the proposed site-specific determination.

(BB) Provide notice and request comment on the tentative decision.

(iii) Upon a final determination that fishes in the Order Acipenseriformes do not occur at the site, the department shall do the following:

(AA) Publish a notice in the Indiana Register.

(BB) Place on the department's website all pertinent information about the approved site-specific modification.

(CC) Submit the site-specific modification to U.S. EPA for approval.

(DD) If approved by U.S. EPA, incorporate the site-specific modification into the water quality standards during the next revision of the water quality standards.

(iv) Site-specific modifications of this criterion must not be incorporated into a final NPDES permit or used for other Clean Water Act purposes until approved by U.S. EPA.

~~(4)~~ **(5)** The ~~following establishes~~ dissolved AAC and CAC for certain metals at selected hardness values calculated from the equations and conversion factors in subdivision (3), Table ~~6-2 and using~~ **6-1, with** a value of one (1) **used** for the WER **are as follows:**

Table ~~6-3~~ **6-2**

Metals Concentrations in Micrograms Per Liter; Hardness in Milligrams Per Liter $CaCO_3$ [1]

	Arsenic ~~(III)~~		Cadmium		Chromium (III)		Chromium (VI)		Copper	
Hardness	AAC	CAC	AAC	CAC	AAC	CAC	AAC	CAC	AAC	CAC
50	~~360~~ **340**	~~190~~ **150**	~~1.7~~ **0.94**	~~0.62~~ **0.43**	~~310~~ **320**	~~100~~ **42**	16	11	8.9	6.3
100	~~360~~ **340**	~~190~~ **150**	~~3.7~~ **1.8**	~~1.0~~ **0.72**	~~550~~ **570**	180 **74**	16	11	17	11
150	~~360~~ **340**	~~190~~ **150**	~~5.7~~ **2.6**	~~1.4~~ **0.97**	~~760~~ **790**	~~250~~ **100**	16	11	25	16
200	~~360~~ **340**	~~190~~ **150**	~~7.8~~ **3.4**	~~1.7~~ **1.2**	~~970~~ **1,000**	~~310~~ **130**	16	11	33	21
250	~~360~~ **340**	~~190~~ **150**	~~10~~ **4.2**	~~2.0~~ **1.4**	1200	~~380~~ **160**	16	11	40	25
300	~~360~~ **340**	~~190~~ **150**	~~12~~ **5.0**	~~2.3~~ **1.6**	~~1300~~ **1,400**	~~440~~ **180**	16	11	48	29
350	~~360~~ **340**	~~190~~ **150**	~~14~~ **5.8**	~~2.6~~ **1.8**	~~1500~~ **1,600**	~~500~~ **210**	16	11	55	33
400	~~360~~ **340**	~~190~~ **150**	~~17~~ **6.5**	~~2.9~~ **2.0**	~~1700~~ **1,800**	~~550~~ **230**	16	11	63	37
~~450~~	~~360~~	~~190~~	~~19~~	~~3.1~~	~~1900~~	~~610~~	~~16~~	~~11~~	~~70~~	~~41~~
~~500~~	~~360~~	~~190~~	~~21~~	~~3.4~~	~~2100~~	~~670~~	~~16~~	~~11~~	~~78~~	~~45~~

	Lead		Nickel		Silver		Zinc	
Hardness	AAC	CAC	AAC	CAC	AAC	CAC	AAC	CAC
50	30	1.2	~~790~~ **260**	~~87~~ **29**	~~0.52~~ **0.49**	–	~~64~~ **65**	~~58~~ **66**
100	65	2.5	~~1400~~ **470**	~~160~~ **52**	~~1.7~~ **1.6**	–	~~110~~ **120**	~~100~~ **120**
150	100	3.9	~~2000~~	~~220~~ **73**	~~3.5~~ **3.2**	–	~~160~~	~~150~~

								170
200	140	5.3	~~2500~~ **840**	~~280~~ **93**	~~5.7~~ **5.3**	–	210	~~190~~ **210**
250	170	6.7	~~3100~~ **1,000**	~~340~~ **110**	~~8.3~~ **7.8**	–	250	~~230~~ **260**
300	210	8.1	~~3600~~ **1,200**	~~400~~ **130**	11	–	~~290~~ **300**	~~270~~ **300**
350	240	9.5	~~4100~~ **1,400**	~~450~~ **150**	~~15~~ **14**	–	~~330~~ **340**	~~300~~ **340**
400	280	11	~~4600~~ **1,500**	~~510~~ **170**	~~19~~ **17**	–	~~370~~ **380**	~~340~~ **380**
~~450~~	~~320~~	~~12~~	~~5100~~	~~560~~	~~23~~	~~–~~	~~410~~	~~37~~
~~500~~	~~350~~	~~14~~	~~5500~~	~~610~~	~~27~~	~~–~~	~~450~~	~~410~~

[1] The dissolved metals criteria in this table have been rounded to two (2) significant digits in accordance with subdivision (3), ~~Table 6-2.~~ **Table 6-1.** The equations and conversion factors in subdivision (3), ~~Table 6-2 shall~~ **Table 6-1 must** be used instead of the criteria in this table when ~~dissolved metals~~ **these** criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

~~(5) The following establishes~~ **(6)** Surface water quality criteria for chloride for protection of aquatic life **are as follows:**

(A) The ~~following provides the~~ AAC for chloride as a function of hardness (in mg/l as $CaCO_3$) and sulfate (in mg/l) in surface waters **is calculated using the following formula:**

$C = 287.8 (hardness)^{0.205797} (sulfate)^{-0.07452}$

Where: C = chloride AAC (maximum) in mg/l.

(B) The ~~following provides the~~ CAC for chloride as a function of hardness (in mg/l as $CaCO_3$) and sulfate (in mg/l) in surface waters **is calculated using the following formula:**

$C = 177.87 (hardness)^{0.205797} (sulfate)^{-0.07452}$

Where: C = chloride CAC (4-day average) in mg/l.

(C) ~~The following~~ **This clause** applies to the AAC and CAC for chloride provided in this subdivision, **as follows:**

(i) Chloride criteria may only be established based on a sulfate concentration greater than the water quality criterion for sulfate, as established under subdivision ~~(6),~~ **(8),** where the water quality criterion for sulfate has been modified on a site-specific basis in accordance with either the:

(AA) variance provisions under section 8.8 of this rule; or ~~the~~

(BB) site-specific criteria provisions under section 8.9 of this rule.

(ii) The AAC and CAC for chloride calculated from the equations in this subdivision ~~shall~~ **must** be rounded to the nearest whole numbers, except when the criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(D) The ~~following establishes the~~ AAC for chloride in mg/l at selected concentrations of hardness **(in mg/l as $CaCO_3$)** and sulfate ~~with the understanding that the equation in clause (A) shall be used instead of the criteria in this clause when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs:~~ **is as follows:**

Table 6-3a[1]

Sulfate (mg/l)	Hardness (mg/l) 50	100	150	200	250	300	350	400	450	500
15	526	607	660	700	733	761	785	807	827	845
20	515	594	646	685	717	745	769	790	809	827
25	506	584	635	674	705	732	756	777	796	813
50	481	555	603	640	670	695	718	738	756	773
100	457	527	573	608	636	660	682	701	718	734
150	443	511	556	589	617	641	661	680	697	712
200	434	500	544	577	604	627	647	665	682	697
250	427	492	535	567	594	617	637	654	671	685
300	421	485	528	560	586	609	628	646	661	676
350	416	480	522	553	579	602	621	638	654	668
400	412	475	516	548	574	596	615	632	647	662
450	408	471	512	543	569	590	609	626	642	656

500	405	467	508	539	564	586	605	622	637	651

[1] The equation in clause (A) must be used instead of the criteria in this table when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(E) The ~~following establishes the~~ CAC for chloride in mg/l at selected concentrations of hardness **(in mg/l as $CaCO_3$)** and sulfate ~~with the understanding that the equation in clause (B) shall be used instead of the criteria in this clause when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs:~~ **is as follows:**

Table 6-3b[1]

	Hardness (mg/l)									
Sulfate (mg/l)	50	100	150	200	250	300	350	400	450	500
15	325	375	408	433	453	470	485	499	511	522
20	318	367	399	423	443	460	475	488	500	511
25	313	361	392	416	436	453	467	480	492	503
50	297	343	373	395	414	430	444	456	467	477
100	282	326	354	375	393	408	421	433	444	453
150	274	316	343	364	381	396	409	420	430	440
200	268	309	336	357	373	388	400	411	421	431
250	264	304	331	351	367	381	394	404	414	423
300	260	300	326	346	362	376	388	399	409	418
350	257	297	322	342	358	372	384	394	404	413
400	255	294	319	339	355	368	380	391	400	409
450	252	291	316	336	351	365	377	387	397	405
500	250	289	314	333	349	362	374	384	394	402

[1] The equation in clause (B) must be used instead of the criteria in this table when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(7) Surface water quality criteria for protection of human health for specific substances are as follows:

Table 6-4

Surface Water Quality Criteria for Protection of Human Health[1]

CAS Number	Substances	Continuous Criterion Concentrations	
		Outside of Mixing Zone (µg/l)	Point of Water Intake (µg/l)
	Metals (total recoverable)		
7440360	Antimony	640 (T)	5.6 (T)
	Arsenic III	0.175 (C)	0.022 (C)
7440393	Barium		1,000 (D)
7440508	Copper		1,300 (D)
7439976	Mercury[2]	0.15 (T)	0.14 (T)
7440020	Nickel	4,600 (T)	610 (T)
7782492	Selenium	4,200 (T)	170 (T)
7440280	Thallium	48 (T)	13 (T)
7440666	Zinc	26,000 (T)	7,400 (T)
	Organics		
107028	Acrolein	780 (T)	320 (T)
107131	Acrylonitrile	6.5 (C)	0.58 (C)
309002	Aldrin[2]	0.00079 (C)	0.00074 (C)
71432	Benzene	400 (C)	6.6 (C)
92875	Benzidine	0.0053 (C)	0.0012 (C)
56235	Carbon Tetrachloride	69.4 (C)	4.0 (C)
57749	Chlordane[2]	0.0048 (C)	0.0046 (C)

	Chlorinated Benzenes			
108907		**Monochlorobenzene**		**488 (T)**
95943		**1,2,4,5-Tetrachlorobenzene[2]**	**48 (T)**	**38 (T)**
608935		**Pentachlorobenzene[2]**	**85 (T)**	**74 (T)**
118741		**Hexachlorobenzene[2]**	**0.0074 (C)**	**0.0072 (C)**
	Chlorinated Ethanes			
107062		**1,2-dichloroethane**	**2,430 (C)**	**9.4 (C)**
71556		**1,1,1-trichloroethane**	**1,030,000 (T)**	**18,400 (T)**
79005		**1,1,2-trichloroethane**	**418 (C)**	**6.0 (C)**
79345		**1,1,2,2-tetrachloroethane**	**107 (C)**	**1.7 (C)**
67721		**Hexachloroethane**	**87.4 (C)**	**19 (C)**
	Chlorinated Phenols			
95954		**2,4,5-trichlorophenol**		**2,600 (T)**
88062		**2,4,6-trichlorophenol**	**36 (C)**	**12 (C)**
	Chloroalkyl Ethers			
		bis(2-chloroisopropyl) ether	**4,360 (T)**	**34.7 (T)**
542881		**bis(chloromethyl) ether**	**0.018 (C)**	**0.000038 (C)**
111444		**bis(2-chloroethyl) ether**	**13.6 (C)**	**0.3 (C)**
67663		**Chloroform**	**157 (C)**	**1.9 (C)**
50293		**DDT[2]**	**0.00024 (C)**	**0.00024 (C)**
		Dichlorobenzenes	**2,600 (T)**	**400 (T)**
		Dichlorobenzidine	**0.2 (C)**	**0.1 (C)**
75354		**1,1-dichloroethylene**	**18.5 (C)**	**0.33 (C)**
120832		**2,4-dichlorophenol**		**3,090 (T)**
		Dichloropropenes	**14,100 (T)**	**87 (T)**
60571		**Dieldrin[2]**	**0.00076 (C)**	**0.00071 (C)**
121142		**2,4-dinitrotoluene**	**91 (C)**	**1.1 (C)**
1746016		**Dioxin (2,3,7,8-TCDD)[2]**	**0.0000001 (C)**	**0.0000001 (C)**
122667		**1,2-diphenylhydrazine**	**5.6 (C)**	**0.422 (C)**
		Endosulfan	**159 (T)**	**74 (T)**
72208		**Endrin[2]**		**1.0 (D)**
100414		**Ethylbenzene**	**3,280 (T)**	**1,400 (T)**
206440		**Fluoranthene**	**54 (T)**	**42 (T)**
		Halomethanes	**157 (C)**	**1.9 (C)**
76448		**Heptachlor[2]**	**0.0028 (C)**	**0.0028 (C)**
87683		**Hexachlorobutadiene[2]**	**500 (C)**	**4.47 (C)**
		Hexachlorocyclohexane (HCH)		
319846		**alpha HCH[2]**	**0.31 (C)**	**0.09 (C)**
319857		**beta HCH[2]**	**0.55 (C)**	**0.16 (C)**
58899		**gamma HCH (Lindane)[2]**	**0.63 (C)**	**0.19 (C)**
608731		**Technical HCH[2]**	**0.41 (C)**	**0.12 (C)**
77474		**Hexachlorocyclopentadiene**		**206 (T)**
78591		**Isophorone**	**520,000 (T)**	**5,200 (T)**
98953		**Nitrobenzene**		**19,800 (T)**
	Nitrophenols			
534521		**4,6-dinitro-o-cresol**	**765 (T)**	**13.4 (T)**
25550587		**Dinitrophenol**	**14,300 (T)**	**70 (T)**

	Nitrosamines			
55185		**N-nitrosodiethylamine**	**12.4 (C)**	**0.008 (C)**
62759		**N-nitrosodimethylamine**	**160 (C)**	**0.014 (C)**
924163		**N-nitrosodibutylamine**	**5.9 (C)**	**0.064 (C)**
86306		**N-nitrosodiphenylamine**	**161 (C)**	**49 (C)**
930552		**N-nitrosopyrrolidine**	**919 (C)**	**0.16 (C)**
87865		**Pentachlorophenol**		**1,000 (T)**
108952		**Phenol**		**3,500 (T)**
	Phthalate Esters			
131113		**Dimethyl phthalate**	**2,900,000 (T)**	**313,000 (T)**
84662		**Diethyl phthalate**	**1,800,000 (T)**	**350,000 (T)**
84742		**Dibutyl phthalate**	**154,000 (T)**	**34,000 (T)**
117817		**Di-2-ethylhexyl phthalate**	**50,000 (T)**	**15,000 (T)**
		Polychlorinated Biphenyls (PCBs)[2]	**0.00079 (C)**	**0.00079 (C)**
		Carcinogenic Polynuclear Aromatic Hydrocarbons (PAHs)	**0.31 (C)**	**0.028 (C)**
127184		**Tetrachloroethylene**	**88.5 (C)**	**8 (C)**
108883		**Toluene**	**424,000 (T)**	**14,300 (T)**
8001352		**Toxaphene[2]**	**0.0073 (C)**	**0.0071 (C)**
79016		**Trichloroethylene**	**807 (C)**	**27 (C)**
75014		**Vinyl Chloride**	**5,246 (C)**	**20 (C)**
	Other Substances			
1332214		**Asbestos (fibers/liter)**		**300,000 (C)**
57125		**Cyanide (Total)**		**200 (D)**
[1]The human health criteria are thirty (30) day average criteria.				
T-derived from threshold toxicity				
C-derived from nonthreshold cancer risk				
D-derived from drinking water standards, equal to or less than threshold toxicity				
[2]This substance is a bioaccumulative chemical of concern.				

~~(6) The following establishes~~ **(8)** Surface water quality criteria for sulfate that ~~shall~~ **must** not be exceeded in ~~all~~ surface waters outside of ~~the~~ **a** mixing zone **are as follows:**

(A) The ~~following provides~~ surface water quality criteria for sulfate in mg/l for the specified ranges of hardness (in mg/l as $CaCO_3$) or chloride (in mg/l), or both, **are as follows:**

(i) If the hardness concentration of surface waters is greater than or equal to one hundred (100) mg/l but less than or equal to five hundred (500) mg/l, and if the chloride concentration of surface waters is greater than or equal to five (5) mg/l but less than twenty-five (25) mg/l, then:

C = [-57.478 + 5.79 (hardness) + 54.163 (chloride)] × 0.65

Where: C = sulfate criterion in mg/l.

(ii) If the hardness concentration of surface waters is greater than or equal to one hundred (100) mg/l but less than or equal to five hundred (500) mg/l, and if the chloride concentration of surface waters is greater than or equal to twenty-five (25) mg/l but less than or equal to five hundred (500) mg/l, then:

C = [1276.7 + 5.508 (hardness) - 1.457 (chloride)] × 0.65

Where: C = sulfate criterion in mg/l.

(iii) If the hardness concentration of surface waters is less than one hundred (100) mg/l and the chloride concentration of surface waters is less than or equal to five hundred (500) mg/l, the sulfate criterion is five hundred (500) mg/l.

(iv) If the hardness concentration of surface waters is greater than five hundred (500) mg/l and the chloride concentration of surface waters is greater than or equal to five (5) mg/l, but less than or equal to five hundred (500) mg/l, the sulfate criterion ~~shall be~~ **is** calculated using a hardness concentration of five hundred (500) mg/l and the equation in item (i) or (ii) that applies to the chloride concentration.

(v) If the chloride concentration of surface waters is less than five (5) mg/l, the sulfate criterion is five hundred (500) mg/l.

(B) ~~The following~~ **This clause** applies to the surface water quality criteria for sulfate provided in clause (A), **as follows:**

(i) Sulfate criteria may only be established based on a chloride concentration greater than the CAC for chloride established under subdivision ~~(5)~~ **(6)** where the CAC for chloride has been modified on a site-specific basis in accordance with either the:

(AA) variance provisions under section 8.8 of this rule; or ~~the~~

(BB) site-specific criteria provisions under section 8.9 of this rule.

(ii) The surface water quality criteria for sulfate calculated from equations in clause (A) ~~shall~~ **must** be rounded to the nearest whole numbers, except when the criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(C) The ~~following establishes~~ surface water quality criteria for sulfate in mg/l at selected concentrations of hardness **(in mg/l as $CaCO_3$)** and chloride ~~with the understanding that the equations in clause (A) shall be used instead of the criteria in this clause when sulfate criteria~~ are ~~used as intermediate values in a calculation, such as in the calculation of WQBELs:~~ **as follows:**

Table 6-5[1]

	Hardness (mg/l)										
Chloride (mg/l)	<100	100	150	200	250	300	350	400	450	500	>500
<5	500	500	500	500	500	500	500	500	500	500	500
5	500	515	703	891	1080	1268	1456	1644	1832	2020	2020
10	500	691	879	1067	1256	1444	1632	1820	2008	2196	2196
15	500	867	1055	1243	1432	1620	1808	1996	2184	2372	2372
20	500	1043	1231	1419	1608	1796	1984	2172	2360	2549	2549
25	500	1164	1343	1522	1701	1880	2059	2238	2417	2596	2596
50	500	1141	1320	1499	1678	1857	2036	2215	2394	2573	2573
100	500	1093	1272	1451	1630	1809	1988	2167	2346	2525	2525
150	500	1046	1225	1404	1583	1762	1941	2120	2299	2478	2478
200	500	998	1177	1356	1535	1715	1894	2073	2252	2431	2431
250	500	951	1130	1309	1488	1667	1846	2025	2204	2383	2383

[1]The equations in clause (A) must be used instead of the criteria in this table when sulfate criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(9) Fluoride must not exceed two (2.0) mg/l in surface waters outside of a mixing zone except in the Ohio River and Interstate Wabash River where it must not exceed one (1.0) mg/l outside of a mixing zone.

(b) ~~This subsection establishes minimum surface water quality for aquatic life.~~ In addition to subsection (a), ~~subdivisions (1) through (5) are established to ensure~~ **the following minimum** conditions ~~necessary for the maintenance of a well-balanced aquatic community The following~~ are applicable ~~at any point~~ in the **surface** waters outside of ~~the~~ **a** mixing zone **to ensure conditions necessary for the maintenance of a well-balanced aquatic community:**

(1) There ~~shall~~ **must** be no ~~substances~~ **substance** that:

(A) ~~impart~~ **imparts** unpalatable flavor to food fish; or

(B) ~~result~~ **results** in offensive odors in the vicinity of the water.

(2) No pH values below six (6.0) or above nine (9.0) **are permitted,** except daily fluctuations that:

(A) exceed pH nine (9.0); and

(B) are correlated with photosynthetic activity.

~~shall be permitted.~~

(3) Concentrations of dissolved oxygen ~~shall:~~ **must:**

(A) average at least five (5.0) milligrams per liter per calendar day; and

(B) not be less than four (4.0) milligrams per liter at any time.

(4) ~~The following are~~ Conditions for temperature **are as follows:**

(A) ~~There shall be no~~ Abnormal temperature changes that may adversely affect aquatic life **are prohibited** unless caused by natural conditions.

(B) The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes ~~shall~~ **must** be maintained.

(C) The maximum temperature rise at any time or place above natural temperatures ~~shall~~ **must** not exceed:

(i) five (5) degrees Fahrenheit (two and eight-tenths (2.8) degrees Celsius) in streams; and

(ii) three (3) degrees Fahrenheit (one and seven-tenths (1.7) degrees Celsius) in lakes and reservoirs.

(D) Water temperatures ~~shall~~ **must** not exceed the maximum limits in the following table:

(i) during more than one percent (1%) of the hours in the twelve (12) month period ending with any month; ~~At no time shall the water temperature at such locations exceed the maximum limits in the following table~~ **and**

(ii) by more than three (3) degrees Fahrenheit (one and seven-tenths (1.7) degrees Celsius):

Table ~~6-4~~ **6-6**

	Ohio River Main Stem °F(°C)	Other Indiana Streams °F(°C)
January	50 (10.0)	50 (10.0)
February	50 (10.0)	50 (10.0)
March	60 (15.6)	60 (15.6)
April	70 (21.1)	70 (21.1)
May	80 (26.7)	80 (26.7)
June	87 (30.6)	90 (32.2)
July	89 (31.7)	90 (32.2)
August	89 (31.7)	90 (32.2)
September	87 (30.7)	90 (32.2)
October	78 (25.6)	78 (25.5)
November	70 (21.1)	70 (21.1)
December	57 (14.0)	57 (14.0)

(5) The following criteria ~~will~~ **must** be used to regulate ammonia:

(A) Except for waters covered in clause (B), ~~at all times, all~~ surface waters outside of mixing zones ~~shall~~ **must** be free of substances in concentrations that, on the basis of available scientific data, are believed to be sufficient to ~~(i)~~ injure, ~~(ii)~~ be chronically toxic to, or ~~(iii)~~ be carcinogenic, mutagenic, or teratogenic to:

(i) humans;

(ii) animals;

(iii) aquatic life; or

(iv) plants.

(B) For ~~those~~ waters listed in subsection (c), the following ammonia criteria ~~will~~ apply outside ~~the~~ **of a** mixing zone:

Table 6-7

Maximum Ammonia Concentrations (Unionized Ammonia as N)***

(mg/l) Temperature (°C)

pH	0	5	10	15	20	25	30
6.5	0.0075	0.0106	0.0150	0.0211	0.0299	0.0299	0.0299
6.6	0.0092	0.0130	0.0183	0.0259	0.0365	0.0365	0.0365
6.7	0.0112	0.0158	0.0223	0.0315	0.0444	0.0444	0.0444
6.8	0.0135	0.0190	0.0269	0.0380	0.0536	0.0536	0.0536
6.9	0.0161	0.0228	0.0322	0.0454	0.0642	0.0642	0.0642
7.0	0.0191	0.0270	0.0381	0.0539	0.0761	0.0761	0.0761
7.1	0.0244	0.0316	0.0447	0.0631	0.0892	0.0892	0.0892
7.2	0.0260	0.0367	0.0518	0.0732	0.1034	0.1034	0.1034
7.3	0.0297	0.0420	0.0593	0.0837	0.1183	0.1183	0.1183
7.4	0.0336	0.0474	0.0669	0.0946	0.1336	0.1336	0.1336
7.5	0.0374	0.0528	0.0746	0.1054	0.1489	0.1489	0.1489
7.6	0.0411	0.0581	0.0821	0.1160	0.1638	0.1638	0.1638
7.7	0.0447	0.0631	0.0892	0.1260	0.1780	0.1780	0.1780
7.8	0.0480	0.0678	0.0958	0.1353	0.1911	0.1911	0.1911
7.9	0.0510	0.0720	0.1017	0.1437	0.2030	0.2030	0.2030
8.0	0.0536	0.0758	0.1070	0.1512	0.2135	0.2135	0.2135
8.1	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
8.2	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
8.3	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
8.4	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
8.5	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
8.6	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137

8.7	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
8.8	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
8.9	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137
9.0	0.0537	0.0758	0.1071	0.1513	0.2137	0.2137	0.2137

***To calculate total ammonia, divide the number in ~~the~~ Table **6-7** by the value determined by: $1/(10^{pK_a - pH} + 1)$.

Where: pK_a = 0.09018 + (2729.92/(T + 273.2))
pH = pH of water
T = °C

Table 6-8
24-Hour Average Ammonia Concentrations (Unionized Ammonia as N)***
(mg/l) Temperature (°C)

pH	0	5	10	15	20	25	30
6.5	0.0005	0.0008	0.0011	0.0015	0.0015	0.0015	0.0015
6.6	0.0007	0.0010	0.0014	0.0019	0.0019	0.0019	0.0019
6.7	0.0009	0.0012	0.0017	0.0024	0.0024	0.0024	0.0024
6.8	0.0011	0.0015	0.0022	0.0031	0.0031	0.0031	0.0031
6.9	0.0014	0.0019	0.0027	0.0038	0.0038	0.0038	0.0038
7.0	0.0017	0.0024	0.0034	0.0048	0.0048	0.0048	0.0048
7.1	0.0022	0.0031	0.0043	0.0061	0.0061	0.0061	0.0061
7.2	0.0027	0.0038	0.0054	0.0077	0.0077	0.0077	0.0077
7.3	0.0034	0.0048	0.0068	0.0097	0.0097	0.0097	0.0097
7.4	0.0043	0.0061	0.0086	0.0122	0.0122	0.0122	0.0122
7.5	0.0054	0.0077	0.0108	0.0153	0.0153	0.0153	0.0153
7.6	0.0068	0.0097	0.0136	0.0193	0.0193	0.0193	0.0193
7.7	0.0086	0.0122	0.0172	0.0242	0.0242	0.0242	0.0242
7.8	0.0092	0.0130	0.0184	0.0260	0.0260	0.0260	0.0260
7.9	0.0098	0.0138	0.0196	0.0276	0.0276	0.0276	0.0276
8.0	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.1	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.2	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.3	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.4	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.5	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.6	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.7	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.8	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
8.9	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294
9.0	0.0103	0.0146	0.0206	0.0294	0.0294	0.0294	0.0294

***To calculate total ammonia, divide the number in ~~the~~ Table **6-8** by the value determined by: $1/(10^{pK_a - pH} + 1)$.

Where: pK_a = 0.09018 + (2729.92/(T + 273.2))
pH = pH of water
T = °C

(c) ~~This subsection establishes surface water quality~~ **Waters designated by the Indiana department of natural resources for put-and-take trout fishing are designated as salmonid waters and must be protected** for cold-water fish. In addition to subsections (a) and (b), the following criteria are ~~established to ensure conditions necessary for the maintenance of a well-balanced, cold-water fish community and are~~ applicable ~~at any point in the waters~~ outside of ~~the~~ **a** mixing zone **in the surface waters designated as salmonid waters to ensure conditions necessary for the maintenance of a well-balanced, cold-water fish community:**

~~(1) Waters:~~

~~(A) designated as salmonid waters; and~~

~~(B) that shall be protected for cold-water fish;~~

~~are those waters designated by the Indiana department of natural resources for put-and-take trout fishing.~~ ~~(2) In the waters listed in subdivision (1),~~

(1) Dissolved oxygen concentrations ~~shall~~ **must** not be less than:

(A) six (6.0) milligrams per liter at any time; and

(B) seven (7.0) milligrams per liter in areas where spawning occurs during the spawning season and in areas used for imprinting during the time salmonids are being imprinted.

~~(3) In those waters listed in subdivision (1),~~ **(2)** The maximum temperature rise above natural ~~shall~~ **must** not exceed two (2) degrees Fahrenheit (one and one-tenth (1.1) degrees Celsius) at any time or place and, unless due to natural causes, the temperature ~~shall~~ **must** not exceed the following:

(A) Seventy (70) degrees Fahrenheit (twenty-one and one-tenth (21.1) degrees Celsius) at any time.

(B) Sixty-five (65) degrees Fahrenheit (eighteen and three-tenths (18.3) degrees Celsius) during spawning and imprinting periods.

(d) ~~This subsection establishes~~ Bacteriological quality for recreational uses during the recreational season **is** as follows:

(1) The recreational season is defined as the months of April through October, inclusive.

(2) In addition to subsection (a), the criteria in this subsection are to be used to do the following:

(A) Evaluate waters for full body contact recreational uses.

(B) Establish wastewater treatment requirements.

(C) Establish effluent limits during the recreational season.

(3) For full body contact recreational uses, E. coli bacteria ~~shall~~ **must** not exceed the following:

(A) One hundred twenty-five (125) **colony forming units (cfu) or most probable number (MPN)** per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period.

(B) Two hundred thirty-five (235) **cfu or MPN** per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period, except that, in cases where there are at least ten (10) samples at a given site, up to ten percent (10%) of the samples may exceed two hundred thirty-five (235) cfu or MPN per one hundred (100) milliliters where the:

(i) E. coli exceedances are incidental and attributable solely to E. coli resulting from the discharge of treated wastewater from a wastewater treatment plant as defined at IC 13-11-2-258; and

(ii) criterion in clause (A) is met.

However, a single sample ~~shall be~~ **is** used for making beach notification and closure decisions.

If a geometric mean cannot be calculated because five (5) equally spaced samples are not available, then the criterion stated in clause (B) must be met.

(4) For demonstrating compliance with wastewater treatment requirements, sanitary wastewater dischargers shall ensure the following:

(A) The concentration of E. coli in the undiluted discharge does not exceed one hundred twenty-five (125) cfu or MPN per one hundred (100) milliliters as a geometric mean of the effluent samples taken in a calendar month.

(B) Not more than ten percent (10%) of all samples when not less than ten (10) samples are taken and analyzed for E. coli in a calendar month exceed two hundred thirty-five (235) cfu or MPN per one hundred (100) milliliters as a daily maximum. Under this clause, the calculation of ten percent (10%) of the samples taken ~~shall~~ **must** be limited to the lowest whole number result.

(5) Effluent limits to implement the criteria in subdivision (3) during the recreational season ~~shall~~ **must** be established in NPDES permits by incorporating the following that are to be applied to the undiluted discharge:

(A) The concentration of E. coli in the undiluted discharge ~~shall~~ **must** not exceed one hundred twenty-five (125) cfu or MPN per one hundred (100) milliliters as a geometric mean of the effluent samples taken in a calendar month.

(B) Not more than ten percent (10%) of all samples in a calendar month exceed two hundred thirty-five (235) cfu or MPN per one hundred (100) milliliters as a daily maximum. Under this clause, the calculation of ten percent (10%) of the samples taken ~~shall~~ **must** be limited to the lowest whole number result.

(e) ~~This subsection establishes surface water quality for public water supply.~~ In addition to subsections (a) and (d), the ~~following~~ criteria ~~are established~~ to protect the surface water quality at the point at which water is withdrawn for treatment for public **water** supply **are as follows:**

(1) The coliform bacteria group ~~shall~~ **must** not exceed the following:

(A) Five thousand (5,000) **cfu or MPN** per one hundred (100) milliliters as a monthly average value (either MPN or **membrane filter** (MF) count).

(B) Five thousand (5,000) **cfu or MPN** per one hundred (100) milliliters in more than twenty percent (20%) of the samples examined during any month.

(C) Twenty thousand (20,000) **cfu or MPN** per one hundred (100) milliliters in more than five percent (5%)

of the samples examined during any month.

(2) Taste and odor producing substances, other than naturally occurring, ~~shall~~ **must** not interfere with the production of a finished water by conventional treatment consisting of the following:

(A) Coagulation.

(B) Sedimentation.

(C) Filtration.

(D) Disinfection.

(3) The concentrations of either chloride or sulfate ~~shall~~ **must** not exceed two hundred fifty (250) milligrams per liter unless due to naturally occurring sources.

(4) The concentration of dissolved solids ~~shall~~ **must** not exceed seven hundred fifty (750) milligrams per liter unless due to naturally occurring sources. A specific conductance of one thousand two hundred (1,200) micromhos per centimeter (at twenty-five (25) degrees Celsius) may be considered equivalent to a dissolved solids concentration of seven hundred fifty (750) milligrams per liter.

(5) Surface waters ~~shall be considered~~ **are** acceptable for public water supply if radium-226 and strontium-90 are present in amounts not exceeding three (3) and ten (10) picocuries per liter, respectively. In the known absence of strontium-90 and alpha emitters, the water supply is acceptable when the gross beta concentrations do not exceed one thousand (1,000) picocuries per liter.

(6) The:

(A) combined concentration of nitrate-N and nitrite-N must not exceed ten (10) milligrams per liter as a thirty (30) day average value; and

(B) concentration of nitrite-N must not exceed one (1) milligram per liter as a thirty (30) day average value.

~~(6)~~ **(7)** Chemical constituents in the waters ~~shall~~ **must** not be present ~~in such~~ **at** levels ~~as to~~ **that** prevent, after conventional treatment, meeting the drinking water standards contained in 327 IAC 8-2, due to other than natural causes.

(f) ~~This subsection establishes surface water quality for industrial water supply.~~ In addition to subsection (a), ~~the criterion to ensure protection of water quality at the point at which water is withdrawn for use (either with or without treatment) for industrial cooling and processing is that, other than from naturally occurring sources, the~~ dissolved solids ~~shall~~ **must** not exceed seven hundred fifty (750) milligrams per liter at any time **other than from naturally occurring sources to ensure protection of water quality at the point at which surface water is withdrawn for use, either with or without treatment, for industrial cooling and processing.** A specific conductance of one thousand two hundred (1,200) micromhos per centimeter (at twenty-five (25) degrees Celsius) may be considered equivalent to a dissolved solids concentration of seven hundred fifty (750) milligrams per liter.

(g) ~~This subsection establishes surface water quality for agricultural uses.~~ The criteria to ensure **surface** water quality conditions necessary for agricultural use are the same as those in subsection (a).

(h) ~~This subsection establishes surface water quality for limited uses.~~ The quality of **surface** waters ~~classified~~ **designated** for limited uses under section ~~3(a)(5)~~ **11(a)** of this rule ~~shall,~~ **must,** at a minimum, meet the ~~following~~ criteria ~~(1) The criteria~~ contained in ~~subsection~~ **subsections** (a), ~~(2) The criteria contained in subsection~~ (d), ~~(3) The criteria contained in subsection (f),~~ **and** where applicable, ~~(4) The waters must~~ **(f), and** be aerobic at all times. ~~(5) Notwithstanding subdivisions (1) through (4), the quality of a limited use stream~~ **However, the water must meet the criteria that are applicable to the higher use water** at the point where ~~it~~ **a limited use water:**

(1) becomes physically or chemically capable of supporting a higher use; or ~~at its interface~~

(2) interfaces with a higher use water segment. ~~shall meet the criteria that are applicable to the higher use water.~~

***This document is incorporated by reference. Copies may be obtained from the Government Publishing Office, www.gpo.gov, U.S. EPA National Service Center for Environmental Publications (www.epa.gov/nscep), or are available for review at the Indiana Department of Environmental Management, Office of Legal Counsel, Indiana Government Center North, Thirteenth Floor, 100 North Senate Avenue, Indianapolis, Indiana 46204.**

(Water Pollution Control Division; 327 IAC 2-1-6; filed Sep 24, 1987, 3:00 p.m.: 11 IR 581; filed Feb 1, 1990, 4:30 p.m.: 13 IR 1020; errata, 13 IR 1861; errata filed Jul 6, 1990, 5:00 p.m.: 13 IR 2003; filed Feb 26, 1993, 5:00 p.m.: 16 IR 1725; errata filed May 7, 1993, 4:00 p.m.: 16 IR 2189; filed Jan 14, 1997, 12:00 p.m.: 20 IR 1348; errata filed Aug 11, 1997, 4:15 p.m.: 20 IR 3376; filed Feb 14, 2005, 10:05 a.m.: 28 IR 2047; errata filed Apr 6, 2006, 2:48 p.m.: 29 IR 2546; errata, 29 IR 3027; filed Mar 18, 2008, 2:26 p.m.: 20080416-IR-327060573FRA; filed May 22, 2008, 10:40 a.m.: 20080618-IR-327070185FRA; filed Jul 9, 2012, 2:54 p.m.: 20120808-IR-327110320FRA;

filed Nov 10, 2014, 1:51 p.m.: 20141210-IR-327130290FRA)

SECTION 2. 327 IAC 2-1.5-8 IS AMENDED TO READ AS FOLLOWS:

327 IAC 2-1.5-8 Minimum surface water quality criteria

Authority: IC 13-14-8-2; IC 13-14-8-3; IC 13-18-4-3
Affected: IC 13-11-2-258; IC 13-18-4; IC 13-30-2-1; IC 14-22-9

Sec. 8. (a) All surface water quality criteria in this section, except those provided in subsection (b)(1), ~~will cease to be~~ **are not** applicable when the stream flows are less than the applicable stream design flow for the particular criterion as determined under 327 IAC 5-2-11.4.

(b) The following are minimum surface water quality conditions:
(1) All surface waters within the Great Lakes system, ~~at all times, and at all places,~~ including waters within ~~the~~ **a** mixing zone, ~~shall meet the minimum conditions of being~~ **must be** free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges that do any of the following:
(A) ~~Will~~ Settle to form putrescent or otherwise objectionable deposits.
(B) ~~Are~~ **Occur** in amounts sufficient to be unsightly or deleterious.
(C) Produce:
(i) color;
(ii) visible oil sheen;
(iii) odor; or
(iv) other conditions;
~~in such degree as~~ to ~~create~~ **an extent that creates** a nuisance.
(D) ~~Are~~ **Occur** in concentrations or combinations that will cause or contribute to the growth of aquatic plants or algae to ~~such~~ **a** degree as to:
(i) create a nuisance;
(ii) be unsightly; or
(iii) otherwise impair the designated uses **of the surface waters.**
(E) ~~Are~~ **Occur** in amounts sufficient to be acutely toxic to, or to otherwise severely injure or kill, aquatic life, other animals, plants, or humans. To ~~assure~~ **ensure** protection of aquatic life, the **surface** waters ~~shall~~ **must** meet the following requirements:
(i) Concentrations of toxic substances ~~shall~~ **must** not exceed the CMC or SMC outside the zone of initial dilution or the final acute value (FAV = 2 (CMC) or 2 (SMC)) in the undiluted discharge unless, for a discharge to a receiving stream or Lake Michigan, an alternate mixing zone demonstration is conducted and approved in accordance with 327 IAC 5-2-11.4(b)(4), in which case, the CMC or SMC ~~shall~~ **must** be met outside the applicable alternate mixing zone. **The following apply where applicable:**
(AA) For certain substances, a CMC is ~~established and set forth~~ **specified** in:
(aa) subdivision (3), Table 8-1, which ~~table~~ incorporates subdivision (4), Table 8-2; and
(bb) subdivision (5).
(BB) For substances for which a CMC is not specified in subdivision (3), Table 8-1, **subdivision (4), Table 8-2,** or subdivision (5):
(aa) a CMC ~~shall~~ **must** be calculated by the commissioner using the procedures in section 11 of this rule; or
(bb) if the minimum data requirements to calculate a CMC are not met, an SMC ~~shall~~ **must** be calculated using the procedures in section 12 of this rule. ~~and~~
(CC) The CMC or SMC determined under subitem (AA) or (BB) may be modified on a site-specific basis to reflect local conditions in accordance with section 16 of this rule.
(ii) A discharge ~~shall~~ **must** not cause acute toxicity, as measured by whole effluent toxicity tests, at any point in the waterbody. Compliance with this criterion ~~shall be~~ **is** demonstrated if a discharge does not exceed one and zero-tenths (1.0) TU_a in the undiluted discharge. For a discharge into a receiving stream or Lake Michigan, for which an alternate mixing zone demonstration is conducted and approved in accordance with 327 IAC 5-2-11.4(b)(4), compliance with this criterion ~~shall be~~ **is** demonstrated if three-tenths (0.3) TU_a is not exceeded outside the applicable alternate mixing zone. ~~This~~
(F) Clause ~~shall~~ **(E) does** not apply to the chemical control of plants and animals when that control is performed in compliance with approval conditions specified by the Indiana department of natural resources as provided by IC 14-22-9.
(2) ~~At~~ All ~~times, all~~ surface waters outside of the applicable mixing zones determined in accordance with

section 7 of this rule ~~shall~~ **must** be free of substances in concentrations that, on the basis of available scientific data, are believed to be sufficient to injure, be chronically toxic to, or be carcinogenic, mutagenic, or teratogenic to humans, animals, aquatic life, or plants. To ~~assure~~ **ensure** protection against the adverse effects identified in this subdivision, a toxic substance or pollutant ~~shall~~ **must** not be present in ~~such~~ **surface** waters **outside of the applicable mixing zones determined in accordance with section 7 of this rule** in concentrations that exceed the most stringent of the following:

(A) A CCC or ~~an~~ SCC to protect aquatic life from chronic toxic effects, **which is determined** as follows:

(i) For certain substances, a CCC is ~~established and set forth~~ **specified** in:

(AA) subdivision (3), Table 8-1, which ~~table~~ incorporates subdivision (4), Table 8-2;

(BB) subdivision (3), Table 8-1a; and

(CC) subdivision (5).

(ii) For substances for which a CCC is not specified in subdivision (3), Table 8-1, **subdivision (3), Table 8-1a, subdivision (4), Table 8-2,** or subdivision (5):

(AA) a CCC ~~shall~~ **must** be calculated by the commissioner using the procedures in section 11 of this rule; or

(BB) if the minimum data requirements to calculate a CCC are not met, an SCC ~~shall~~ **must** be calculated using the procedures in section 12 of this rule.

(iii) The CCC or SCC determined under item ~~(i)~~ **(i)(AA), (i)(CC),** or (ii) may be modified on a site-specific basis to reflect local conditions in accordance with section 16 of this rule.

(iv) To ~~assure~~ **ensure** protection of aquatic life, a discharge ~~shall~~ **must** not cause chronic toxicity, as measured by whole effluent toxicity tests, outside of the applicable mixing zone. Compliance with this criterion ~~shall be~~ **is** demonstrated if the waterbody does not exceed one and zero-tenths (1.0) TU_c at the edge of the mixing zone.

(B) An HNC or HNV to protect human health from adverse noncancer effects that may result from the consumption of aquatic organisms or drinking water from the waterbody, **which is** determined as follows:

(i) For certain substances, an HNC is ~~established and set forth~~ **specified** in subdivision (6), Table 8-3.

(ii) For substances for which an HNC is not specified in subdivision (6), Table 8-3:

(AA) an HNC ~~shall~~ **must** be calculated by the commissioner using the procedures in section 14 of this rule; or

(BB) if the minimum data requirements to calculate an HNC are not met, an HNV ~~shall~~ **must** be calculated using the procedures in section 14 of this rule.

(iii) The HNC or HNV determined under item (i) or (ii) may be modified on a site-specific basis to reflect local conditions in accordance with section 16 of this rule.

(iv) The HNC **for** nondrinking **water** or HNV **for** nondrinking **water** for a substance ~~shall apply~~ **applies** to all surface waters outside the applicable mixing zone for a discharge of that substance. The HNC **for** drinking **water** or HNV **for** drinking ~~shall apply~~ **water for a substance applies** at the point of the public water system intake.

(C) For carcinogenic substances, an HCC or HCV to protect human health from unacceptable cancer risk of greater than one (1) additional occurrence of cancer per one hundred thousand (100,000) population, **which is determined** as follows:

(i) For certain substances, an HCC is ~~established and set forth~~ **specified** in subdivision (6), Table 8-3.

(ii) For substances for which an HCC is not specified in subdivision (6), Table 8-3:

(AA) an HCC ~~shall~~ **must** be calculated by the commissioner using the procedures in section 14 of this rule; or

(BB) if the minimum data requirements to calculate an HCC are not met, an HCV ~~shall~~ **must** be calculated using the procedures in section 14 of this rule.

(iii) The HCC or HCV determined under item (i) or (ii) may be modified on a site-specific basis to reflect local conditions in accordance with section 16 of this rule.

(iv) The HCC **for** nondrinking **water** or HCV **for** nondrinking **water** for a substance ~~shall apply~~ **applies** to all surface waters outside the applicable mixing zone for a discharge of that substance. The HCC **for** drinking **water** or HCV **for** drinking ~~shall apply~~ **water applies** at the point of the public water system intake.

(D) A WC to protect avian and mammalian wildlife populations from adverse effects that may result from the consumption of aquatic organisms or water from the waterbody, **which is determined** as follows:

(i) For certain substances, a WC is ~~established and set forth~~ **specified** in subdivision (7), Table 8-4.

(ii) For substances for which a WC is not specified in subdivision (7), Table 8-4:

(AA) a WC ~~shall~~ **must** be calculated by the commissioner using the procedures in section 15 of this rule; or

(BB) if the minimum data requirements to calculate a WC are not met, a WV may be calculated using the procedures in section 15 of this rule.

(iii) The WC or WV determined under item (i) or (ii) may be modified on a site-specific basis to reflect local conditions in accordance with section 16 of this rule.

(3) ~~The following establishes~~ Surface water quality criteria for protection of aquatic life **are as follows:**

~~Table 8-1~~

~~Surface Water Quality Criteria for Protection of Aquatic Life[1]~~

~~CAS Number~~	~~Substances~~	~~CMC (Maximum) (µg/l)~~	~~CMC Conversion Factors~~	~~CCC (4-Day Average) (µg/l)~~	~~CCC Conversion Factors~~
	~~Metals (dissolved)[2]~~				
~~7440382~~	~~Arsenic (III)~~	~~WER[3](339.8)~~	~~1.000~~	~~WER[3](147.9)~~	~~1.000~~
~~7440439~~	~~Cadmium~~	~~WER[3](e(1.128 [ln(hardness)] 3.6867))~~	~~1.136672 [(ln hardness) (0.041838)]~~	~~WER[3](e(0.7852 [ln(hardness)] 2.715))~~	~~1.101672 [(ln hardness) (0.041838)]~~
~~7440473~~	~~Chromium (III)~~	~~WER[3](e(0.819 [ln(hardness)] + 3.7256))~~	~~0.316~~	~~WER[3](e(0.819 [ln(hardness)] + 0.6848))~~	~~0.860~~
~~7440473~~	~~Chromium (VI)~~	~~WER[3](16.02)~~	~~0.982~~	~~WER[3](10.98)~~	~~0.962~~
~~7440508~~	~~Copper~~	~~WER[3](e(0.9422 [ln(hardness)] 1.700))~~	~~0.960~~	~~WER[3](e(0.8545 [ln(hardness)] 1.702))~~	~~0.960~~
~~7439976~~	~~Mercury~~	~~WER[3](1.694)~~	~~0.85~~	~~WER[3](0.9081)~~	~~0.85~~
~~7440020~~	~~Nickel~~	~~WER[3](e(0.846 [ln(hardness)] + 2.255))~~	~~0.998~~	~~WER[3](e(0.846 [ln(hardness)] + 0.0584))~~	~~0.997~~
~~7782492~~	~~Selenium~~			~~5~~	~~0.922~~
~~7440666~~	~~Zinc~~	~~WER[3](e(0.8473 [ln(hardness)] + 0.884))~~	~~0.978~~	~~WER[3](e(0.8473 [ln(hardness)] + 0.884))~~	~~0.986~~
	~~Organics (total)~~				
~~60571~~	~~Dieldrin~~	~~0.24~~	~~NA~~	~~0.056~~	~~NA~~
~~72208~~	~~Endrin~~	~~0.086~~	~~NA~~	~~0.036~~	~~NA~~
~~56382~~	~~Parathion~~	~~0.065~~	~~NA~~	~~0.013~~	~~NA~~
~~87865~~	~~Pentachlorophenol[4][6]~~	~~e(1.005[pH] 4.869)~~	~~NA~~	~~e(1.005[pH] 5.134)~~	~~NA~~
	~~Other Substances~~				
	~~Chloride~~	~~[6]~~	~~NA~~	~~[6]~~	~~NA~~
	~~Chlorine (total residual)~~	~~19~~	~~NA~~	~~11~~	~~NA~~
	~~Chlorine (intermittent, total residual)[5]~~	~~200~~	~~NA~~		~~NA~~
~~57125~~	~~Cyanide (free)~~	~~22~~	~~NA~~	~~5.2~~	~~NA~~

~~[1]Aquatic organisms should not be affected unacceptably if the four (4) day average concentration of any substance in this table does not exceed the CCC more than once every three (3) years on the average and if the one (1) hour average concentration does not exceed the CMC more than once every three (3) years on the average, except possibly where a commercially or recreationally important species is very sensitive.~~

~~[2]The CMC and CCC columns of this table contain total recoverable metals criteria (numeric and hardness based). The criterion for the dissolved metal is calculated by multiplying the appropriate conversion factor by the CMC or CCC. This dissolved CMC or CCC shall be rounded to two (2) significant digits, except~~

~~when the criteria are used as intermediate values in a calculation, such as in the calculation of water quality-based effluent limitations (WQBELs).~~

~~[3] A value of one (1) shall be used for the WER unless an alternate value is established under section 16 of this rule.~~

~~[4] A CMC and CCC calculated for pentachlorophenol using the equation in this table shall be rounded to two (2) significant digits, except when the criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.~~

~~[5] To be considered an intermittent discharge, total residual chlorine shall not be detected in the discharge for a period of more than forty (40) minutes in duration, and such periods shall be separated by at least five (5) hours.~~

~~[6] The CMC and CCC for this substance are established in subdivision (5).~~

(A) The surface water quality criteria for the protection of aquatic life for specific substances are as follows:

Table 8-1

Surface Water Quality Criteria for Protection of Aquatic Life[1]

CAS Number	Substances	Criterion Maximum Concentration (CMC) (Maximum) (µg/L)	CMC Conversion Factors (CF)	Criterion Continuous Concentration (CCC) (4-Day Average) (µg/L)	CCC Conversion Factors (CF)
Metals (dissolved) [2][3]					
7440382	Arsenic	WER(340)(CF)	1.000	WER(150)(CF)	1.000
7440439	Cadmium	WER($e^{(0.9789\ [\ln H] - 3.866)}$)(CF)	1.136672 - [lnH] 0.041838	WER($e^{(0.7977[\ln H] - 3.909)}$)(CF)	1.101672 - [ln H]0.041838
7440473	Chromium (III)	WER($e^{(0.819\ [\ln H] + 3.7256)}$)(CF)	0.316	WER($e^{(0.819\ [\ln H] + 0.6848)}$)(CF)	0.860
7440473	Chromium (VI)	WER(16)(CF)	0.982	WER(11)(CF)	0.962
7440508	Copper	WER($e^{(0.9422[\ln H] - 1.700)}$)(CF)	0.960	WER($e^{(0.8545[\ln H] - 1.702)}$)(CF)	0.960
7439921	Lead	WER($e^{(1.273[\ln H] - 1.460)}$)(CF)	1.46203 - [lnH]0.145712	WER($e^{(1.273[\ln H] - 4.705)}$)(CF)	1.46203 - [lnH]0.145712
7439976	Mercury	WER(1.694)(CF)	0.85	WER(0.9081)(CF)	0.85
7440020	Nickel	WER($e^{(0.846\ [\ln H] + 2.255)}$)(CF)	0.998	WER($e^{(0.846\ [\ln H] + 0.0584)}$)(CF)	0.997
7440666	Zinc	WER($e^{(0.8473\ [\ln H] + 0.884)}$)(CF)	0.978	WER($e^{(0.8473\ [\ln H] + 0.884)}$)(CF)	0.986
Organics (Total)					
60571	Dieldrin	0.24	NA	0.056	NA
72208	Endrin	0.086	NA	0.036	NA
56382	Parathion	0.065	NA	0.013	NA
87865	Pentachlorophenol[4]	$e^{(1.005[pH] - 4.869)}$	NA	$e^{(1.005[pH] - 5.134)}$	NA
Other Substances					
	Chlorine (total residual)	19	NA	11	NA
	Chlorine (intermittent, total residual)[5]	200	NA		NA

57125	Cyanide (free)	22	NA	5.2	NA

Selenium CCC are specified in clause (B)

Chloride CMC and CCC are specified in subdivision (5)

[1]Aquatic organisms should not be affected unacceptably if the four (4) day average concentration specified in this table for a substance does not exceed the CCC more than once every three (3) years on the average and if the one (1) hour average concentration does not exceed the CMC more than once every three (3) years on the average, except possibly where a commercially or recreationally important species is very sensitive.

[2]Aquatic life criteria for these metals are expressed as a dissolved concentration and are calculated using the water-effect ratio (WER) and the specified conversion factor (CF). The CMC and CCC for a dissolved metal are calculated by multiplying the WER by the criterion value or formula and then by the appropriate CF. A value of one (1) must be used for the WER unless an alternate value is established under section 16 of this rule. The dissolved CMC and CCC must be rounded to two (2) significant digits, except when the criteria are used as intermediate values in a calculation, such as in the calculation of water quality-based effluent limitations (WQBELs).

[3]The hardness values used in the equations for these criteria must not be greater than 400 mg/l as calcium carbonate ($CaCO_3$), and the criteria at a hardness of 400 mg/l as $CaCO_3$ are used for a water hardness above 400 mg/l as $CaCO_3$. The term "lnH" is the natural log of hardness.

[4]A CMC and CCC calculated for pentachlorophenol using the equation in this table must be rounded to two (2) significant digits, except when the criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

[5] To be considered an intermittent discharge, total residual chlorine must not be detected in the discharge for a period of more than forty (40) minutes in duration, and these time periods must be separated by at least five (5) hours.

(B) The surface water quality criterion for the protection of aquatic life for selenium is as follows:

Table 8-1a

Surface Water Quality Aquatic Life Criterion for Selenium (CAS # 7782492)

Criterion Continuous Concentration (CCC)

Media Type	Fish Tissue [1]		Water Column[5][7]	
Criterion Element	Egg/Ovary[2]	Fish Whole-Body or Muscle[3]	Monthly Average Exposure	Intermittent Exposure[6]
Magnitude	15.1 mg/kg dw	8.5 mg/kg dw whole-body or 11.3 mg/kg dw muscle (skinless, boneless filet)	1.5 µg/l in lentic aquatic systems 3.1 µg/l in lotic aquatic systems	$WQC_{int} = WQC_{30\text{-}day} - C_{bkgrnd}(1\text{-}f_{int})$ f_{int}
Duration	Instantaneous measurement[4]	Instantaneous measurement[4]	30 days	Number of days per month with an elevated concentration
Frequency	Not to be exceeded	Not to be exceeded	Not more than once in three (3) years on average	Not more than once in three (3) years on average

[1]Fish tissue elements are expressed as steady-state; the aquatic system should not be experiencing new

or increasing inputs of selenium.

[2]Egg or ovary supersedes any whole-body, muscle, or water column element when fish egg or ovary concentrations are measured. Any proposal to sample egg or ovary fish tissue must be submitted to the department for review and approval prior to initiation of sampling, and the department will evaluate all representative egg or ovary fish tissue data to determine compliance with this criterion element.

[3]Fish whole-body or muscle tissue supersedes the water column element when both fish tissue and water concentrations are measured. Any proposal to sample fish whole-body or muscle tissue must be submitted to the department for review and approval prior to initiation of sampling, and the department will evaluate all representative fish whole-body or muscle tissue data to determine compliance with this criterion element.

[4]Fish tissue data provide instantaneous point measurements that reflect integrative accumulation of selenium over time and space in fish populations at a given site.

[5]Water column values are the applicable criterion element in the absence of steady-state condition fish tissue data and for fishless waters. Water column values are based on dissolved total selenium in water and are derived from fish tissue values via bioaccumulation modeling. Instead of the requirement in 327 IAC 5-2-11.4(b)(3)(A)(i)(CC), the thirty (30) day, ten (10) year stream design flow ($Q_{30,10}$) must be used for deriving TMDLs, WLAs in the absence of TMDLs, and preliminary WLAs for tributaries of the Great Lakes system that exhibit appreciable flows relative to their volumes for the CCC water column criterion element applicable to lotic aquatic systems unless data exist to demonstrate that an alternate stream design flow is appropriate for stream-specific and pollutant-specific conditions.

[6]Intermittent Exposure Equation variables mean the following:

***WQC*$_{int}$ is the water column intermittent element.**

***WQC*$_{30\text{-}day}$ is the water column monthly element for either lentic or lotic waters.**

***C*$_{bkgrnd}$ is the average background selenium concentration.**

***f*$_{int}$ is the fraction of any 30-day period during which elevated selenium concentrations occur, with *f*$_{int}$ assigned a value ≥0.033 (corresponding to one (1) day).**

[7]The water column criterion element may be modified on a site-specific basis in accordance with clause (C).

(C) Modification of the selenium water column criterion element must be achieved according to the following:

(i) Site-specific water column criterion elements must be derived using either the empirical bioaccumulation factor (BAF) or mechanistic modeling method provided in Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater, EPA-822-R-16-006, Appendix K: Translation of a Selenium Fish Tissue Criterion Element to a Site-Specific Water Column Value (June 2016)*.

(ii) Any proposal to derive a site-specific water column criterion element must be submitted to the department for review and approval of the methodology and sampling plan prior to initiation of sampling. The department shall evaluate and approve the applicability of and use of all representative data used to derive a site-specific water column criterion element.

(iii) Any proposal to derive a site-specific water column criterion element must be protective of downstream designated uses for aquatic life and human health.

(iv) Upon receipt of an application for a site-specific water column criterion element, the department shall do the following:

(AA) Publish on the department's website all pertinent information about the proposed site-specific modification.

(BB) Provide notice and request comment on the application.

(v) Upon approval of a site-specific water column criterion element, the department shall do the following:

(AA) Publish a notice in the Indiana Register.

(BB) Place on the department's website all pertinent information about the approved site-specific modification.

(CC) Submit the site-specific modification to U.S. EPA for approval.

(DD) If approved by U.S. EPA, incorporate the site-specific modification into the water quality standards during the next revision of the water quality standards.

(vi) Site-specific modifications of this criterion must not be incorporated into a final NPDES permit or used for other Clean Water Act purposes until approved by U.S. EPA.

(4) The ~~following establishes~~ dissolved ~~CMCs~~ **CMC** and ~~CCCs~~ **CCC** for certain metals at selected hardness values calculated from the equations and conversion factors in subdivision (3), Table 8-1 ~~and using~~ **with** a value of one (1) **used** for the WER ~~where applicable,~~ **are as follows:**

Table 8-2

Metals Concentrations in Micrograms Per Liter; Hardness in Milligrams Per Liter $CaCO_3$ [1]

	Arsenic ~~(III)~~		Cadmium		Chromium (III)		Chromium (VI)		Copper	
Hardness	CMC	CCC	CMC	CCC	CMC	CCC	CMC	CCC	CMC	CCC
50	340	150	~~2.0~~ **0.94**	~~1.3~~ **0.43**	320	42	16	11	7.0	5.0
100	340	150	~~4.3~~ **1.8**	~~2.2~~ **0.72**	570	74	16	11	13	9.0
150	340	150	~~6.6~~ **2.6**	~~3.0~~ **0.97**	790	100	16	11	20	13
200	340	150	~~9.0~~ **3.4**	~~3.7~~ **1.2**	1,000	130	16	11	26	16
250	340	150	~~12~~ **4.2**	~~4.4~~ **1.4**	1,200	160	16	11	32	20
300	340	150	~~14~~ **5.0**	~~5.0~~ **1.6**	1,400	180	16	11	38	23
350	340	150	~~17~~ **5.8**	~~5.6~~ **1.8**	1,600	210	16	11	44	26
400	340	150	~~19~~ **6.5**	~~6.2~~ **2.0**	1,800	230	16	11	50	29
~~450~~	~~340~~	~~150~~	~~22~~	~~6.8~~	~~2,000~~	~~250~~	~~16~~	~~11~~	~~55~~	~~32~~
~~500~~	~~340~~	~~150~~	~~24~~	~~7.3~~	~~2,100~~	~~280~~	~~16~~	~~11~~	~~61~~	~~35~~

	Lead		Mercury		Nickel		~~Selenium~~		Zinc	
Hardness	**CMC**	**CCC**	CMC	CCC	CMC	CCC	~~CMC~~	~~CCC~~	CMC	CCC
50	**30**	**1.2**	1.4	0.77	260	29	~~–~~	~~4.6~~	65	66
100	**65**	**2.5**	1.4	0.77	470	52	~~–~~	~~4.6~~	120	120
150	**100**	**3.9**	1.4	0.77	660	73	~~–~~	~~4.6~~	170	170
200	**140**	**5.3**	1.4	0.77	840	93	~~–~~	~~4.6~~	210	210
250	**170**	**6.7**	1.4	0.77	1,000	110	~~–~~	~~4.6~~	250	260
300	**210**	**8.1**	1.4	0.77	1,200	130	~~–~~	~~4.6~~	300	300
350	**240**	**9.5**	1.4	0.77	1,400	150	~~–~~	~~4.6~~	340	340
400	**280**	**11**	1.4	0.77	1,500	170	~~–~~	~~4.6~~	380	380
~~450~~			~~1.4~~	~~0.77~~	~~1,700~~	~~190~~	~~–~~	~~4.6~~	~~420~~	~~420~~
~~500~~			~~1.4~~	~~0.77~~	~~1,800~~	~~200~~	~~–~~	~~4.6~~	~~460~~	~~460~~

[1] The dissolved metals criteria in this table have been rounded to two (2) significant digits in accordance with subdivision (3), Table 8-1. The equations and conversion factors in subdivision (3), Table 8-1 ~~shall~~ **must** be used instead of the criteria in this table when ~~dissolved metals~~ **these** criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(5) ~~The following establishes~~ Surface water quality criteria for chloride for protection of aquatic life **are as follows:**

(A) The ~~following provides the~~ CMC for chloride as a function of hardness (in mg/l as $CaCO_3$) and sulfate (in mg/l) in surface waters **is calculated using the following formula:**

$C = 287.8 (hardness)^{0.205797} (sulfate)^{-0.07452}$

Where: C = chloride CMC (maximum) in mg/l.

(B) The ~~following provides the~~ CCC for chloride as a function of hardness (in mg/l as $CaCO_3$) and sulfate (in mg/l) in surface waters **is calculated using the following formula:**

$C = 177.87 (hardness)^{0.205797} (sulfate)^{-0.07452}$

Where: C = chloride CCC (4-Day Average) in mg/l.

(C) The CMC and CCC for chloride calculated from the equations in this subdivision ~~shall~~ **must** be rounded to the nearest whole numbers, except when the criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(D) The ~~following establishes the~~ CMC for chloride in mg/l at selected concentrations of hardness **(in mg/l as $CaCO_3$)** and sulfate ~~with the understanding that the equation in clause (A) shall be used instead of the criteria in this clause when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs:~~ **is as follows:**

Table 8-2a **[1]**

	Hardness (mg/l)									
Sulfate (mg/l)	50	100	150	200	250	300	350	400	450	500
15	526	607	660	700	733	761	785	807	827	845
20	515	594	646	685	717	745	769	790	809	827
25	506	584	635	674	705	732	756	777	796	813
50	481	555	603	640	670	695	718	738	756	773

100	457	527	573	608	636	660	682	701	718	734
150	443	511	556	589	617	641	661	680	697	712
200	434	500	544	577	604	627	647	665	682	697
250	427	492	535	567	594	617	637	654	671	685
300	421	485	528	560	586	609	628	646	661	676
350	416	480	522	553	579	602	621	638	654	668
400	412	475	516	548	574	596	615	632	647	662
450	408	471	512	543	569	590	609	626	642	656
500	405	467	508	539	564	586	605	622	637	651

[1] The equation in clause (A) must be used instead of the criteria in this table when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(E) The ~~following establishes the~~ CCC for chloride in mg/l at selected concentrations of hardness **(in mg/l as $CaCO_3$)** and sulfate ~~with the understanding that the equation in clause (B) shall be used instead of the criteria in this clause when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs:~~ **is as follows:**

Table 8-2b[1]

	Hardness (mg/l)									
Sulfate (mg/l)	50	100	150	200	250	300	350	400	450	500
15	325	375	408	433	453	470	485	499	511	522
20	318	367	399	423	443	460	475	488	500	511
25	313	361	392	416	436	453	467	480	492	503
50	297	343	373	395	414	430	444	456	467	477
100	282	326	354	375	393	408	421	433	444	453
150	274	316	343	364	381	396	409	420	430	440
200	268	309	336	357	373	388	400	411	421	431
250	264	304	331	351	367	381	394	404	414	423
300	260	300	326	346	362	376	388	399	409	418
350	257	297	322	342	358	372	384	394	404	413
400	255	294	319	339	355	368	380	391	400	409
450	252	291	316	336	351	365	377	387	397	405
500	250	289	314	333	349	362	374	384	394	402

[1] The equation in clause (B) must be used instead of the criteria in this table when chloride criteria are used as intermediate values in a calculation, such as in the calculation of WQBELs.

(6) ~~The following establishes~~ Surface water quality criteria for protection of human health **are as follows:**

Table 8-3

Surface Water Quality Criteria for Protection of Human Health[1]

		Human Noncancer Criteria (HNC)		Human Cancer Criteria (HCC)	
CAS Number	Substances	Drinking **Water** (µg/l)	Nondrinking **Water** (µg/l)	Drinking **Water** (µg/l)	Nondrinking **Water** (µg/l)
	Metals (total recoverable)				
7439976	Mercury (including methylmercury)	0.0018	0.0018		
	Organics (total)				
71432	Benzene	19	510	12	310
57749	Chlordane	0.0014	0.0014	0.00025	0.00025
108907	Chlorobenzene	470	3,200		
50293	DDT	0.002	0.002	0.00015	0.00015
60571	Dieldrin	0.00041	0.00041	6.5×10^{-6}	6.5×10^{-6}
105679	2,4-dimethylphenol	450	8,700		
51285	2,4-dinitrophenol	55	2,800		
118741	Hexachlorobenzene	0.046	0.046	0.00045	0.00045

67721	Hexachloroethane	6	7.6	5.3	6.7
58899	Lindane	0.47	0.5		
75092	Methylene chloride	1,600	90,000	47	2600
1336363	PCBs (class)			6.8×10^{-6}	6.8×10^{-6}
1746016	2,3,7,8-TCDD (dioxin)	6.7×10^{-8}	6.7×10^{-8}	8.6×10^{-9}	8.6×10^{-9}
108883	Toluene	5,600	51,000		
8001352	Toxaphene			6.8×10^{-5}	6.8×10^{-5}
79016	Trichloroethylene			29	370
	Other Substances				
57125	Cyanide (total)	600	48,000		

[1]The HNC and HCC are thirty (30) day average criteria.

(7) ~~The following establishes~~ Surface water quality criteria for protection of wildlife **are as follows:**

Table 8-4
Surface Water Quality Criteria for Protection of Wildlife[1]

CAS Number	Substances	Wildlife Criteria (µg/l)
	Metals (total recoverable)	
7439976	Mercury (including methylmercury)	0.0013
	Organics (total)	
50293	DDT and metabolites	1.1×10^{-5}
1336363	PCBs (class)	1.2×10^{-4}
1746016	2, 3, 7, 8-TCDD (dioxin)	3.1×10^{-9}

[1]The WC are thirty (30) day average criteria.

(c) ~~This subsection establishes minimum surface water quality criteria for aquatic life.~~ In addition to ~~the criteria in~~ subsection (b), ~~this subsection ensures~~ **the following minimum** conditions ~~necessary for the maintenance of a well-balanced aquatic community. The following conditions~~ are applicable ~~at any point~~ in the **surface** waters outside of the applicable mixing zone, as determined in accordance with section 7 of this rule, **to ensure conditions necessary for the maintenance of a well-balanced aquatic community:**

(1) There ~~shall~~ **must** be no ~~substances~~ **substance** that:
(A) ~~impart~~ **imparts** unpalatable flavor to food fish; or
(B) ~~result~~ **results** in offensive odors in the vicinity of the water.

(2) No pH values below six (6.0) or above nine (9.0) **are permitted,** except daily fluctuations that:
(A) exceed pH nine (9.0); and
(B) are correlated with photosynthetic activity.
~~shall be permitted.~~

(3) Concentrations of dissolved oxygen ~~shall:~~ **must:**
(A) average at least five (5.0) milligrams per liter per calendar day; and
(B) not be less than four (4.0) milligrams per liter at any time.

(4) ~~The following are~~ Conditions for temperature **are as follows:**
(A) ~~There shall be no~~ Abnormal temperature changes that may adversely affect aquatic life **are prohibited** unless caused by natural conditions.
(B) The normal daily and seasonal temperature fluctuations that existed before the addition of heat due to other than natural causes ~~shall~~ **must** be maintained.
(C) Water temperatures ~~shall~~ **must** not exceed the maximum limits in the following table:
(i) during more than one percent (1%) of the hours in the twelve (12) month period ending with any month; ~~At no time shall the water temperature at such locations exceed the maximum limits in the following table~~ **and**
(ii) by more than three (3) degrees Fahrenheit (one and seven-tenths (1.7) degrees Celsius):

Table 8-5
Maximum Instream Water Temperatures

Month	St. Joseph River Tributary to Lake Michigan Upstream of the Twin Branch Dam °F(°C)	All Other Indiana Streams in the Great Lakes System °F(°C)
January	50 (10)	50 (10)
February	50 (10)	50 (10)
March	55 (12.8)	60 (15.6)
April	65 (18.3)	70 (21.1)
May	75 (23.9)	80 (26.7)
June	85 (29.4)	90 (32.2)
July	85 (29.4)	90 (32.2)
August	85 (29.4)	90 (32.2)
September	84 (29.4)	90 (32.2)
October	70 (21.1)	78 (25.5)
November	60 (15.6)	70 (21.1)
December	50 (10)	57 (14.0)

(D) The following temperature criteria ~~shall~~ apply to Lake Michigan:

(i) In all receiving waters, the points of measurement normally ~~shall~~ **must** be in the first meter below the surface at ~~such~~ depths necessary to avoid thin layer surface warming due to extreme ambient air temperatures, but, where required to determine the true distribution of heated wastes and natural variations in water temperatures, measurements ~~shall~~ **must** be at a greater depth and at several depths as a thermal profile.

(ii) ~~There shall be no~~ Abnormal temperature changes ~~so as to be~~ injurious to fish, wildlife, or other aquatic life, or the growth or propagation thereof, **are prohibited.** In addition, plume interaction with the bottom ~~shall:~~ **must:**

(AA) be minimized; and

(BB) not injuriously affect fish, shellfish, and wildlife spawning or nursery areas.

(iii) The normal daily and seasonal temperature fluctuations that existed before the addition of heat ~~shall~~ **must** be maintained.

(iv) At any time and at a maximum distance of a one thousand (1,000) foot arc inscribed from a fixed point adjacent to the discharge or as agreed upon by the commissioner and federal regulatory agencies, the following ~~shall~~ apply:

(AA) The receiving water temperature ~~shall~~ **must** not be more than three (3) degrees Fahrenheit (one and seven-tenths (1.7) degrees Celsius) above the existing natural water temperature.

(BB) Thermal discharges to Lake Michigan ~~shall~~ **must** comply with the following maximum temperature requirements:

(aa) Thermal discharges to Lake Michigan ~~shall~~ **must** not raise the maximum temperature in the receiving water above those listed in the following table, except to the extent the permittee adequately demonstrates that the exceedance is caused by the water temperature of the intake water:

Table 8-6
Maximum Water Temperatures

Month	°F(°C)
January	45 (7)
February	45 (7)
March	45 (7)
April	55 (13)
May	60 (16)
June	70 (21)
July	80 (27)
August	80 (27)
September	80 (27)
October	65 (18)
November	60 (16)
December	50 (10)

(bb) If the permittee demonstrates that the intake water temperature is within three (3) degrees Fahrenheit below an applicable maximum temperature under subitem (aa), Table 8-6, then not more than a three (3) degree Fahrenheit exceedance of the maximum water temperature ~~shall be~~ **is** permitted.

(v) The **following** facilities ~~described as follows~~ that discharge into the open waters of Lake Michigan ~~shall be~~ **are** limited to the amount essential for blowdown in the operation of a closed cycle cooling facility:

(AA) All facilities that have new waste heat discharges exceeding a daily average of five-tenths (0.5) billion British thermal units per hour. As used in this item, "new waste heat discharge" means ~~a~~ **any** discharge that had not begun operations as of February 11, 1972.

(BB) All facilities with existing waste heat discharges that increase the quantity of waste heat discharged by more than a daily average of five-tenths (0.5) billion British thermal units per hour.

(vi) Water intakes ~~shall~~ **must** be designed and located to minimize entrainment and damage to desirable organisms. Requirements may vary depending upon local conditions, but, in general, intakes ~~shall:~~ **must:**

(AA) have minimum water velocity; and

(BB) not be located in spawning or nursery areas of important fishes.

Water velocity at screens and other exclusion devices ~~shall also~~ **must** be at a minimum.

(vii) Discharges other than those ~~now~~ in existence ~~shall be such that the~~ **on or before February 11, 1972, must not have** thermal plumes ~~do not~~ **that** overlap or intersect.

(viii) Facilities discharging more than a daily average of five-tenths (0.5) billion British thermal units of waste heat ~~shall:~~ **must:**

(AA) continuously record intake and discharge temperature and flow; and

(BB) make those records available to the public or regulatory agencies upon request.

(5) The following criteria ~~shall~~ **must** be used to regulate ammonia:

(A) Concentrations of total ammonia (as N) ~~shall~~ **must** not exceed the CMC outside the zone of initial dilution or the final acute value (FAV = 2 (CMC)) in the undiluted discharge unless, for a discharge to a receiving stream or Lake Michigan, an alternate mixing zone demonstration is conducted and approved in accordance with 327 IAC 5-2-11.4(b)(4), in which case, the CMC ~~shall~~ **must** be met outside the applicable alternate mixing zone. The CMC of total ammonia (as N) is determined using the following equation:

$$CMC = \frac{(0.822)(0.52)(10^{(pk_a - pH)} + 1)}{(FT)(FPH)(2)}$$

Where:

$FT = 10^{0.03(20-T)}$

$FPH = 1$; when: $8 \leq pH \leq 9$; or

$\frac{1 + 10^{(7.4 - pH)}}{1.25}$; when: $6.5 \leq pH \leq 8$

$pK_a = 0.09018 + \frac{2729}{T + 273.2}$

$T =$ Temperature in °C

(B) The CCC of total ammonia (as N) is determined using the following equation:

$$CCC = \frac{(0.822)(0.80)(10^{(pk_a - pH)} + 1)}{(FT)(FPH)(RATIO)}$$

Where:

$FT = 10^{0.03(20-T)}$

$FPH = 1$; when: $8 \leq pH \leq 9$; or

$\frac{1 + 10^{(7.4 - pH)}}{1.25}$; when: $6.5 \leq pH \leq 8$

$RATIO = 13.5$; when: $7.7 \leq pH \leq 9$; or

$\frac{(20)(10^{(7.7 - pH)})}{1 + 10^{(7.4 - pH)}}$; when: $6.5 \leq pH \leq 7.7$

$pK_a = 0.09018 + \frac{2729}{T + 273.2}$

$T =$ Temperature in °C

(C) The use of the equations in clause (A) results in the following CMCs for total ammonia (as N) at different

temperatures and pHs:

Table 8-7
Criterion Maximum Concentrations for Total Ammonia (as N) Temperature (°C)

pH	0	5	10	15	20	25	30
6.5	28.48	26.61	25.23	24.26	23.64	23.32	23.29
6.6	27.68	25.87	24.53	23.59	22.98	22.68	22.65
6.7	26.74	24.99	23.69	22.78	22.20	21.92	21.90
6.8	25.64	23.96	22.72	21.85	21.30	21.03	21.01
6.9	24.37	22.78	21.60	20.78	20.26	20.01	20.00
7.0	22.95	21.45	20.35	19.58	19.09	18.86	18.86
7.1	21.38	19.98	18.96	18.24	17.80	17.59	17.60
7.2	19.68	18.40	17.46	16.81	16.40	16.22	16.24
7.3	17.90	16.73	15.88	15.29	14.93	14.78	14.81
7.4	16.06	15.02	14.26	13.74	13.42	13.30	13.35
7.5	14.23	13.31	12.64	12.19	11.92	11.81	11.88
7.6	12.44	11.65	11.07	10.67	10.45	10.37	10.45
7.7	10.75	10.06	9.569	9.238	9.052	9.003	9.088
7.8	9.177	8.597	8.181	7.907	7.760	7.734	7.830
7.9	7.753	7.268	6.924	6.701	6.589	6.584	6.689
8.0	6.496	6.095	5.813	5.636	5.555	5.569	5.683
8.1	5.171	4.857	4.639	4.508	4.457	4.486	4.602
8.2	4.119	3.873	3.707	3.612	3.584	3.625	3.743
8.3	3.283	3.092	2.967	2.900	2.891	2.942	3.061
8.4	2.618	2.472	2.379	2.335	2.340	2.399	2.519
8.5	2.091	1.979	1.911	1.886	1.903	1.968	2.089
8.6	1.672	1.588	1.540	1.529	1.555	1.625	1.747
8.7	1.339	1.277	1.246	1.246	1.279	1.353	1.475
8.8	1.075	1.030	1.011	1.021	1.060	1.137	1.260
8.9	0.8647	0.8336	0.8254	0.8418	0.8862	0.9650	1.088
9.0	0.6979	0.6777	0.6777	0.6998	0.7479	0.8286	0.9521

(D) The use of the equations in clause (B) results in the following CCCs for total ammonia (as N) at different temperatures and pHs:

Table 8-8
Criterion Continuous Concentrations for Total Ammonia (as N) Temperature (°C)

pH	0	5	10	15	20	25	30
6.5	2.473	2.310	2.191	2.106	2.052	2.025	2.022
6.6	2.473	2.311	2.191	2.107	2.053	2.026	2.023
6.7	2.473	2.311	2.191	2.107	2.054	2.027	2.025
6.8	2.473	2.311	2.192	2.108	2.055	2.028	2.027
6.9	2.474	2.312	2.193	2.109	2.056	2.030	2.030
7.0	2.474	2.312	2.193	2.110	2.058	2.033	2.033
7.1	2.475	2.313	2.195	2.112	2.060	2.036	2.037
7.2	2.475	2.314	2.196	2.114	2.063	2.040	2.043
7.3	2.476	2.315	2.198	2.116	2.066	2.044	2.050
7.4	2.477	2.317	2.200	2.119	2.070	2.050	2.058
7.5	2.478	2.319	2.202	2.123	2.075	2.058	2.069
7.6	2.480	2.321	2.206	2.128	2.082	2.067	2.082
7.7	2.450	2.294	2.181	2.106	2.063	2.052	2.071
7.8	2.092	1.959	1.865	1.802	1.769	1.763	1.785
7.9	1.767	1.657	1.578	1.527	1.502	1.501	1.525
8.0	1.481	1.389	1.325	1.285	1.266	1.269	1.295
8.1	1.179	1.107	1.057	1.027	1.016	1.022	1.049
8.2	0.9387	0.8828	0.8450	0.8232	0.8169	0.8263	0.8531

8.3	0.7481	0.7048	0.6762	0.6610	0.6589	0.6705	0.6976
8.4	0.5968	0.5634	0.5421	0.5321	0.5334	0.5468	0.5741
8.5	0.4766	0.4511	0.4357	0.4298	0.4337	0.4485	0.4760
8.6	0.3811	0.3619	0.3511	0.3485	0.3545	0.3704	0.3981
8.7	0.3052	0.2910	0.2839	0.2839	0.2916	0.3083	0.3362
8.8	0.2450	0.2347	0.2305	0.2326	0.2417	0.2591	0.2871
8.9	0.1971	0.1900	0.1881	0.1919	0.2020	0.2199	0.2480
9.0	0.1591	0.1545	0.1545	0.1595	0.1705	0.1889	0.2170

(d) ~~This subsection establishes surface water quality for cold water fish. The~~ Waters **designated by the Indiana department of natural resources for put-and-take trout fishing and** listed in section 5(a)(3) of this rule are designated as salmonid waters and ~~shall~~ **must** be protected for cold-water fish. In addition to subsections (b) and (c), the following criteria are ~~established to ensure conditions necessary for the maintenance of a well-balanced, cold-water fish community and are~~ applicable ~~at any point in the waters~~ outside of ~~the applicable~~ **a** mixing zone, **as determined in accordance with section 7 of this rule, in the surface waters designated as salmonid waters to ensure conditions necessary for the maintenance of a well-balanced, cold-water fish community:**

(1) Dissolved oxygen concentrations ~~shall~~ **must** not be less than:

(A) six (6.0) milligrams per liter at any time; and

(B) seven (7.0) milligrams per liter in areas where spawning occurs during the spawning season and in areas used for imprinting during the time salmonids are being imprinted.

Dissolved oxygen concentrations in the open waters of Lake Michigan ~~shall~~ **must** not be less than seven (7.0) milligrams per liter at any time.

(2) The maximum temperature rise above natural ~~shall~~ **must** not exceed two (2) degrees Fahrenheit (one and one-tenth (1.1) degrees Celsius) at any time or place and, unless due to natural causes, the temperature ~~shall~~ **must** not exceed the following:

(A) Seventy (70) degrees Fahrenheit (twenty-one and one-tenth (21.1) degrees Celsius) at any time.

(B) Sixty-five (65) degrees Fahrenheit (eighteen and three-tenths (18.3) degrees Celsius) during spawning or imprinting periods.

(e) ~~This subsection establishes~~ Bacteriological quality for recreational uses during the recreational season **is** as follows:

(1) The recreational season is defined as the months of April through October, inclusive.

(2) In addition to subsection (b), the criteria in this subsection ~~shall~~ **are to** be used to do the following:

(A) Evaluate waters for full body contact recreational uses.

(B) Establish wastewater treatment requirements.

(C) Establish effluent limits during the recreational season.

(3) For full body contact recreational uses, E. coli bacteria ~~shall~~ **must** not exceed the following:

(A) One hundred twenty-five (125) **colony forming units (cfu) or most probable number (MPN)** per one hundred (100) milliliters as a geometric mean based on not less than five (5) samples equally spaced over a thirty (30) day period.

(B) Two hundred thirty-five (235) **cfu or MPN** per one hundred (100) milliliters in any one (1) sample in a thirty (30) day period, except that, in cases where there are at least ten (10) samples at a given site, up to ten percent (10%) of the samples may exceed two hundred thirty-five (235) cfu or MPN per one hundred (100) milliliters where **the:**

(i) ~~the~~ E. coli exceedances are incidental and attributable solely to E. coli resulting from the discharge of treated wastewater from a wastewater treatment plant as defined at IC 13-11-2-258; and

(ii) ~~the~~ criterion in clause (A) is met.

However, a single sample ~~shall be~~ **is** used for making beach notification and closure decisions.

If a geometric mean cannot be calculated because five (5) equally spaced samples are not available, then the criterion stated in clause (B) must be met.

(4) For demonstrating compliance with wastewater treatment requirements, sanitary wastewater dischargers shall ensure the following:

(A) The concentration of E. coli in the undiluted discharge does not exceed one hundred twenty-five (125) cfu or MPN per one hundred (100) milliliters as a geometric mean of the effluent samples taken in a calendar month.

(B) Not more than ten percent (10%) of all samples when not less than ten (10) samples are taken and analyzed for E. coli in a calendar month exceed two hundred thirty-five (235) cfu or MPN per one hundred (100) milliliters as a daily maximum. Under this clause, the calculation of ten percent (10%) of the samples

taken ~~shall~~ **must** be limited to the lowest whole number result.

(5) Effluent limits to implement the criteria in subdivision (3) during the recreational season ~~shall~~ **must** be established in NPDES permits by incorporating the following that are to be applied to the undiluted discharge:

(A) The concentration of E. coli in the undiluted discharge ~~shall~~ **must** not exceed one hundred twenty-five (125) cfu or MPN per one hundred (100) milliliters as a geometric mean of the effluent samples taken in a calendar month.

(B) Not more than ten percent (10%) of all samples in a calendar month exceed two hundred thirty-five (235) cfu or MPN per one hundred (100) milliliters as a daily maximum. Under this clause, the calculation of ten percent (10%) of the samples taken ~~shall~~ **must** be limited to the lowest whole number result.

(f) ~~This subsection establishes surface water quality for public water supply.~~ In addition to subsection (b), the ~~following~~ criteria ~~are established~~ to protect the surface water quality at the point at which water is withdrawn for treatment for public **water** supply **are as follows:**

(1) The coliform bacteria group ~~shall~~ **must** not exceed the following:

(A) Five thousand (5,000) **cfu or MPN** per one hundred (100) milliliters as a monthly average value (either MPN or **membrane filter** (MF) count).

(B) Five thousand (5,000) **cfu or MPN** per one hundred (100) milliliters in more than twenty percent (20%) of the samples examined during any month.

(C) Twenty thousand (20,000) **cfu or MPN** per one hundred (100) milliliters in more than five percent (5%) of the samples examined during any month.

(2) Taste and odor producing substances, other than those naturally occurring, ~~shall~~ **must** not interfere with the production of a finished water by conventional treatment consisting of the following:

(A) Coagulation.

(B) Sedimentation.

(C) Filtration.

(D) Disinfection.

(3) The concentrations of either chloride or sulfate ~~shall~~ **must** not exceed two hundred fifty (250) milligrams per liter unless due to naturally occurring sources.

(4) The concentration of dissolved solids ~~shall~~ **must** not exceed seven hundred fifty (750) milligrams per liter unless due to naturally occurring sources. A specific conductance of one thousand two hundred (1,200) micromhos per centimeter (at twenty-five (25) degrees Celsius) may be considered equivalent to a dissolved solids concentration of seven hundred fifty (750) milligrams per liter.

(5) Surface waters ~~shall be considered~~ **are** acceptable for public water supply if radium-226 and strontium-90 are present in amounts not exceeding three (3) and ten (10) picocuries per liter, respectively. In the known absence of strontium-90 and alpha emitters, the water supply is acceptable when the gross beta concentrations do not exceed one thousand (1,000) picocuries per liter.

(6) The:

(A) combined concentration of nitrate-N and nitrite-N ~~shall~~ **must** not exceed ten (10) milligrams per liter; and

(B) concentration of nitrite-N ~~shall~~ **must** not exceed one (1) milligram per liter.

(7) Chemical constituents in the waters ~~shall~~ **must** not be present ~~in such~~ **at** levels ~~as to~~ **that** prevent, after conventional treatment, meeting the drinking water standards contained in 327 IAC 8-2, due to other than natural causes.

(g) ~~This subsection establishes surface water quality for industrial water supply.~~ In addition to subsection (b), ~~the criterion to ensure protection of water quality at the point at which water is withdrawn for use (either with or without treatment) for industrial cooling and processing is that, other than from naturally occurring sources, the~~ dissolved solids ~~shall~~ **must** not exceed seven hundred fifty (750) milligrams per liter at any time, **other than from naturally occurring sources, to ensure protection of water quality at the point at which surface water is withdrawn for use, either with or without treatment, for industrial cooling and processing.** A specific conductance of one thousand two hundred (1,200) micromhos per centimeter (at twenty-five (25) degrees Celsius) may be considered equivalent to a dissolved solids concentration of seven hundred fifty (750) milligrams per liter.

(h) ~~This subsection establishes surface water quality for agricultural uses.~~ The criteria to ensure **surface** water quality conditions necessary for agricultural use are the same as those in subsection (b).

(i) ~~This subsection establishes surface water quality for limited uses.~~ The quality of **surface** waters designated for limited uses under section 19(a) of this rule ~~shall,~~ **must,** at a minimum, meet the ~~following~~ criteria ~~(1) The criteria~~ contained in ~~subsection~~ **subsections** (b), ~~(2) The criteria contained in subsection~~ (e), ~~(3) The criteria~~

~~contained in subsection~~ **and** (g), ~~(4) The waters must~~ **and** be aerobic at all times. ~~(5) Notwithstanding subdivisions (1) through (4), the quality of a limited use stream~~ **However, the water must meet the criteria that are applicable to the higher use water** at the point where ~~it~~ **a limited use water:**

(1) becomes physically or chemically capable of supporting a higher use; or ~~at its interface~~

(2) interfaces with a higher use water segment. ~~shall meet the criteria that are applicable to the higher use water.~~

(j) Additional requirements for the open waters of Lake Michigan are as follows:

(1) In addition to complying with all other applicable subsections, open waters in Lake Michigan ~~shall~~ **must** meet the following criteria:

Table 8-9
Additional Criteria for Lake Michigan

Parameters	Criteria
Dissolved oxygen	Dissolved oxygen concentrations ~~shall~~ **must** not be less than seven (7.0) milligrams per liter ~~at any time at all places~~ outside the applicable mixing zone.
pH	No pH values below six (6.0) or above nine (9.0) **are permitted,** except daily fluctuations that exceed pH 9.0 and are correlated with photosynthetic activity. ~~shall be permitted.~~
Chloride	250 mg/l[1]
Phenols	~~See~~ **The criteria in** subsection (c)(1)
Sulfate	250 mg/l[1]
Total phosphorus	~~See~~ **The requirements in** 327 IAC 5-10-2
Total dissolved solids	750 mg/l[1]
Fluoride	1.0 mg/l[1]
Dissolved iron	300 µg/l[1]

[1] This criterion ~~is established to minimize or prevent~~ **minimizes or prevents** increased levels of this substance in Lake Michigan. For the purposes of establishing water quality-based effluent limitations based on this criterion, it ~~shall~~ **must** be treated as a four (4) day average criterion.

(2) During each triennial review of the water quality standards, prior to preliminary adoption of revised rules, the **following must occur:**

(A) The department shall prepare a report for the ~~water pollution control~~ board on the monitoring data for the ~~constituents~~ **parameters** in ~~the following table~~ Table 8-10, as measured at the drinking water intakes in Lake Michigan.

(B) If ~~these~~ **the monitoring** data **in clause (A)** indicate that the levels of the ~~constituents~~ **parameters** are either increasing or exceed the levels in ~~the~~ Table **8-10,** the report ~~shall~~ **for the board must** provide available information on the known and potential causes of the increased levels of these parameters, the known and potential impacts on aquatic life, wildlife, and human health, and any recommended revisions of the criteria.

Table 8-10

Parameters	Levels
pH	7.5-8.5 s.u.
Chloride	
Monthly average	15 mg/l
Daily maximum	20 mg/l
Sulfate	
Monthly average	26 mg/l
Daily maximum	50 mg/l
Total phosphorus	
Monthly average	0.03 mg/l
Daily maximum	0.04 mg/l
Total dissolved solids	
Monthly average	172 mg/l

Daily maximum	200 mg/l

***This document is incorporated by reference. Copies may be obtained from the Government Publishing Office, www.gpo.gov, U.S. EPA National Service Center for Environmental Publications (www.epa.gov/nscep), or are available for review at the Indiana Department of Environmental Management, Office of Legal Counsel, Indiana Government Center North, Thirteenth Floor, 100 North Senate Avenue, Indianapolis, Indiana 46204.**

(Water Pollution Control Division; 327 IAC 2-1.5-8; filed Jan 14, 1997, 12:00 p.m.: 20 IR 1370; errata filed Aug 11, 1997, 4:15 p.m.: 20 IR 3376; filed Feb 14, 2005, 10:05 a.m.: 28 IR 2074; errata filed Apr 6, 2006, 2:48 p.m.: 29 IR 2546; filed Mar 18, 2008, 2:26 p.m.: 20080416-IR-327060573FRA; filed Jul 9, 2012, 2:54 p.m.: 20120808-IR-327110320FRA)

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