

**Selenium Criterion for Aquatic Life Information Sheet**  
**IDEM Office of Water Quality**  
**April 2021**

**1. Why has U.S. EPA updated the National Recommended Water Quality Criterion under section 304(a) of the Clean Water Act (NRWQC) for selenium?**

Selenium is a naturally occurring metal that is nutritionally essential in small amounts, but toxic at higher concentrations. Numerous studies have documented adverse ecosystem impacts, not only to fishes and other aquatic life, but to aquatic-dependent wildlife, especially birds. The updated NRWQC for selenium address some of these adverse impacts.

The current science indicates that of all aquatic taxa, fishes are the most sensitive to elevated concentrations of selenium. 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. Although selenium may cause acute toxicity at high concentrations, adverse effects on aquatic organisms are due to its bioaccumulative properties; these chronic effects are found at lower concentrations than acute effects.

Movement of selenium through the aquatic food web (e.g., aquatic plants, invertebrates, and fish) has also been shown to lead to selenium bioaccumulation and adverse impacts in aquatic-dependent wildlife, especially to birds.

**2. Why is IDEM updating Indiana's water quality criteria for selenium?**

Under the Clean Water Act (CWA), states have the primary responsibility for establishing, reviewing, and revising water quality standards. The CWA requires states to develop criteria to protect designated uses and to adopt criteria for which EPA has published recommended criteria under section 304(a) of the CWA. States have the discretion to adapt USEPA's criteria recommendations to reflect state or site-specific conditions or criteria based on other scientifically defensible methods.

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.

A comparison of the current and proposed water column criterion elements is below:

*Indiana's current and proposed selenium water column criteria for protection of aquatic life use*

			Current criteria (µg/L)	Proposed criteria-lotic (flowing water) (µg/L)	Proposed criteria-lentic (still water) (µg/L)
Downstate		acute	130	none	none
		chronic	35	3.1	1.5
Great Lakes System		acute	none	none	none
		chronic	5	3.1	1.5

In reviewing the criteria for updates after the March 5, 2014 First Notice of Comment Period for the metals rulemaking, IDEM planned to change the downstate criteria to be the same as the Great Lakes System criteria. However, when USEPA published an updated recommended water quality criterion for selenium in June 2016, stakeholders requested the agency to consider this updated criterion, instead.

**3. What is the 2016 NRWQC for selenium and how does it compare to Indiana's current selenium criteria?**

EPA's 2016 national recommended water quality criterion for selenium is a complex, four-element, 3 level hierarchy chronic criterion based on the accumulative properties of selenium in fish tissue. The elements are, in hierarchical order:

- (1) a fish egg-ovary element;
- (2) a fish whole-body and/or muscle element;
- (3a) a water column element which includes one value for lentic (still water) and one value for lotic (flowing water) aquatic systems; or
- (3b) a water column intermittent element to account for potential chronic effects from short-term exposures (one value for lentic and one value for lotic aquatic systems).

The fish tissue elements supersede the water column elements, and the egg-ovary element supersedes all other tissue elements.

**4. Why did IDEM include a site-specific "sturgeon absent" downstate criterion in the draft rule?**

Of the 15 species in the national dataset USEPA used to derive its 2016 recommended water quality criterion for selenium, White sturgeon (*Acipenser transmontanus*, Family Acipenseridae, Order Acipenseriformes) was the most sensitive to the effects of selenium. USEPA allows a state or entity to calculate a site-specific criterion by removing a species from the national dataset if it does not "occur at the site" or represent other untested closely related taxa that occur at the site. Removing the White sturgeon toxicity endpoint from the national dataset and recalculating the criterion using the remaining toxicity endpoints results in less stringent selenium criterion elements.

To provide flexibility, IDEM did include a site-specific “sturgeon absent” criterion in the proposed rule for waters outside of the Great Lakes System (“downstate”). Indiana has three species of Acipenseriformes (sturgeon and paddlefish) in downstate waters: the state-endangered Lake sturgeon, American paddlefish, and Shovelnose sturgeon. Shovelnose sturgeon are harvested in Indiana for their eggs, which are used to produce caviar.

Lake sturgeon occur in Lake Michigan and are actively being reintroduced into Lake Erie and its tributaries. Therefore, IDEM considers all watersheds in the Great Lakes System to be “sturgeon waters.” IDEM did not propose a site-specific “sturgeon absent” criterion for the Great Lakes System rule.

**5. Does IDEM have distribution information and historical references for the distribution of Acipenseriformes (sturgeon and paddlefish) species in Indiana?**

To understand the distribution, IDEM developed a map of the distribution of sturgeon and paddlefish species in Indiana waters. That map includes the large river and streams where the mature fishes occur. IDEM also prepared separate maps that include the upstream watersheds where these species spawn and juveniles of species develop.

To prepare the distribution maps, IDEM consulted:

- IDEM fisheries biologists and Indiana Department of Natural Resources (IDNR) fisheries biologists regarding the occurrence, distribution, and abundance of sturgeon and paddlefish species in Indiana.
- Ohio River Valley Sanitation Commission (ORSANCO) fisheries biologists, and Illinois Natural History Survey biologists regarding the occurrence, distribution, and abundance of sturgeon and paddlefish species in interstate waters (Wabash River and Ohio River).
- Scientific literature documenting current and historic species occurrence and distribution in Indiana. These references note mature sturgeon and paddlefish occur in large streams and rivers and move into upstream tributaries to spawn.
- Distribution maps prepared for historic literature and *Fishes of Indiana* (Thomas P. Simon, 2011).
- The State of Idaho’s EPA-approved “sturgeon-absent” site-specific criterion.

**6. Did IDEM consider including the distribution maps to define a state-specific criterion for Acipenseriformes-absent waters in the draft rule?**

Yes. IDEM recognized that including the distribution maps in the rule could possibly eliminate the need for U.S. EPA approval when the criteria are applied to specific sites and therefore considered including maps in the rule. However, for EPA approval and to appropriately protect the species, the distribution maps would need to include a buffer on the larger streams and rivers where mature sturgeon and paddlefish occur. 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’s USEPA-approved sturgeon absent criterion applied a buffer at the HUC 8 watershed scale to rivers and streams where sturgeon occur.

To evaluate the impact of a buffer, IDEM created a map that applies a buffer using the HUC 8 watershed scale to waters where mature sturgeon and paddlefish occur; IDEM's map is similar to the distribution maps for these species documented in Fishes of Indiana (Thomas P. Simon, 2011, pp 104-105). Because the buffer indicates few downstate Acipenseriformes-absent watersheds, IDEM believes not including distribution maps of Acipenseriformes-present watersheds in the rule will allow stakeholders more flexibility to demonstrate that the Acipenseriformes-absent site-specific criterion are appropriate for their individual site.

With this approach, EPA approval will be needed for each site-specific application of the Acipenseriformes-absent criterion. However, because the Acipenseriformes-absent criterion is included in rule, the site-specific application of the Acipenseriformes-absent criterion may be used immediately on EPA approval and does not have to wait for rulemaking to add the site-specific location.

**7. How does one establish that site-specific application of the Acipenseriformes-absent criterion is appropriate for their site?**

IDEM recommends those that want to request IDEM's and EPA's review and determination of an Acipenseriformes-absent water consult the literature listed in question 5 above to determine if it includes information detail regarding the site. Additionally, the request may include information that supports an Acipenseriformes-absent determination including information on the size, flow, physical characteristics and biology of the discharge receiving stream. IDEM suggests the following types of relevant information also be provided:

- The presence of any dams or other hydrological modifications that would prevent sturgeon/paddlefish from moving upstream into the receiving stream.
- If the outfall is to a receiving stream that is an intermittent or ephemeral stream in the headwaters of the watershed.

**8. Has IDEM developed implementation guidance for application of the proposed selenium criteria?**

Yes. IDEM has developed a draft guidance document with feedback from key stakeholders (those most likely to need to use the guidance). IDEM worked with U.S. EPA and researched other states' approaches to selenium criteria implementation. The "Guidance for the Collection of Fish Tissue and/or Water Column Data for Implementation of Indiana's Selenium Chronic Aquatic Life Criteria (DRAFT)" provides direction for collecting fish tissue and water column samples to investigate selenium in fish tissue and the water column, conduct a reasonable potential to exceed determination and/or to derive a site-specific water column criterion element using the bioaccumulation factor (BAF) approach. 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 more widely circulated the draft and posted it on the IDEM website. IDEM is soliciting feedback from stakeholder and U.S. EPA and clarifying the guidance based on the feedback already received.

**9. What is IDEM’s strategy for evaluating intermittent discharges, like those from stormwater management ponds at coal mines?**

The 2016 NRWQC for selenium and IDEM’s proposed rule include an intermittent water column element for noncontinuous discharges, such as stormwater management ponds (e.g., mining industries). This site-specific criterion calculation uses the applicable selenium lentic or lotic criterion element, the receiving stream background selenium concentration, and the average number of days the pond discharges selenium in concentrations above background over a thirty-day period. A table showing example criteria calculations for discharges to lotic (flowing) systems is below.

*Selenium Intermittent criterion element: Calculated values of the selenium intermittent water column criterion element for discharges to lotic systems.*

Selenium Background Concentration $\mu\text{g/L}$	Discharges over background in a 30-day period						
	1 day	1.5 days	3.0 days	6 days	10 days	15 days	30 days
0.5	79.3	53	26.8	13.6	8.4	5.8	3.1
1	64	43	22	11.5	7.4	5.2	3.1
2	35	24	13	7.5	5.3	4.2	3.1
2.5	20.5	14.5	8.5	5.5	4.3	3.7	3.1
3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1

IDEM is evaluating tools and resources to establish industry specific and/or regional specific information for background selenium concentrations and for stormwater management pond discharge rates that may be used to calculate an intermittent water column element for noncontinuous discharges.