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External Peer Review Draft Aquatic Life Ambient Water Quality Criterion For Selenium – Freshwater 2014

Summary

EPA is updating its national recommended chronic aquatic life criterion for selenium in freshwater to reflect the latest scientific information, which indicates that toxicity to aquatic life is driven by dietary exposures. As an initial step toward developing a final updated criterion recommendation, EPA is now accepting written scientific views from the public on an external peer review draft criterion document for 30 days. Following closure of the public comment period, the draft criterion will undergo an independent, contractor-led, external peer review. Hence, this version of the criterion document is referred to as the "external peer review draft." Following peer review of the draft selenium criterion, EPA will consider the peer reviewer and public comments, revise the document as necessary, and publish a Federal Register notice announcing the availability of the draft proposed selenium criterion and soliciting scientific views for 30 days from the public. EPA will then revise the document and issue a final selenium criterion.

The external peer review draft criterion has four elements, consisting of two fish tissue-based and two water column-based elements. The external peer review draft criterion document contains a recommendation that states and authorized tribes adopt into their water quality standards a selenium criterion that includes all four elements. The draft criterion document goes on to recommend that (because fish tissue-based concentration is a more direct measure of selenium toxicity to aquatic life than water column concentrations) the criterion affirms that fish tissue elements will be given precedence over the water column elements when both types of data are available.

What are aquatic life criteria?

Ambient water quality criteria for the protection of aquatic life are numeric concentrations of pollutants, with recommended duration and frequency, in surface waters that are protective of aquatic life designated uses. Under Clean Water Act section 304(a), EPA is required to develop and publish and, from time to time, revise, criteria for protection of water quality and human health that accurately reflect the latest scientific knowledge. EPA develops water quality criteria based solely on data and scientific information about the relationship between pollutant concentrations and environmental and human health effects. EPA's recommended water quality criteria are not rules, nor do they automatically become part of a state's water quality standards. States must adopt into their standards water quality criteria that protect the designated uses of the water bodies within their area. These can include scientifically defensible site-specific criteria that are different from EPA's national recommended criteria, as long as the site-specific criteria are protective of the designated use. Water quality criteria are not effective under the Clean Water Act until they have been adopted into a state's water quality standards and approved by EPA.

What is selenium?

Selenium is a naturally occurring chemical element that is nutritionally essential in small amounts, but can be toxic to aquatic life (such as fish and invertebrates) in higher concentrations. It can also be toxic to birds that consume aquatic organisms contaminated with excessive amounts of selenium. Selenium is a bioaccumulative pollutant, meaning that it accumulates in tissues of aquatic organisms at levels greater than water column concentrations.

How does selenium enter surface waters?

Selenium occurs naturally and usually enters surface water when it is mobilized by human activities. Cases of excessive waterborne selenium are mostly related to irrigation of soils that are naturally high in selenium, ash pond discharges from coal-fired power plants, petroleum refinery effluents, and runoff or discharges from certain mining activities.

How does selenium affect aquatic life?

Risks to aquatic life are mostly from contamination of the food they consume rather than from direct exposure to selenium dissolved in water. Selenium accumulates in tissues of aquatic organisms. However, the concentration of selenium in animal tissues does not significantly increase (biomagnify) at successively higher levels in the food web except when the food web is primarily mollusk-based (i.e., the fish eat mostly clams or mussels). Fish are the most sensitive taxa in the aquatic community and bioaccumulate selenium through diet via algae and primary/secondary producers. The key effects are reduced hatching success and deformities in offspring of exposed female fish and birds.

What is the history of EPA's development of selenium criteria?

EPA published the current national recommended chronic selenium water quality criterion for the protection of aquatic life in 1987 (Table 1). EPA sponsored an expert workshop on selenium in 1998 that recommended the fish-tissue criterion approach as more reliable than a water criterion. In 1999, EPA published the current recommended acute water column selenium criterion and reaffirmed the 1987 chronic criterion (Table 1). In 2004, EPA published in the Federal Register a draft criterion expressed as a whole-body fish tissue concentration. Based on findings from the 2009 International Expert Workshop on selenium and collaboration with the U.S. Geological Survey on a bioaccumulation model, EPA revised the 2004 draft to include criteria based on egg-ovary tissue concentration and water column concentrations.

What is the 2014 external peer review draft selenium criterion?

The external peer review draft criterion has four elements, consisting of two fish tissue-based and two water column-based elements. EPA recommends that states and tribes adopt all four elements of the recommended selenium criterion into water quality standards:

1) Fish Egg-Ovary Chronic Element

Available toxicity data suggest that the most robust and consistent measurement endpoint directly tied to adverse aquatic effects is the selenium concentration in fish eggs and ovaries. As a result, one element of the criterion is a concentration in fish eggs and ovaries.

2) Fish Whole-Body or Muscle Chronic Element

EPA also intends to recommend a fish whole-body or muscle element for ease of implementation. Fish egg or ovary tissue from females may only be available at certain times of the year, and states more commonly collect samples of whole-body fish tissue.

3) Water Column Chronic Monthly Element for Lentic and Lotic Waters

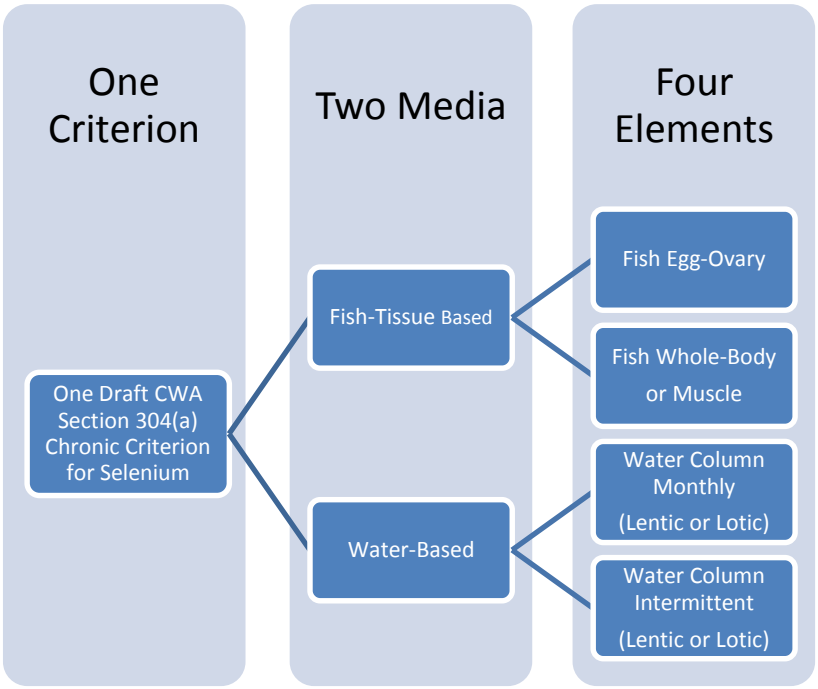
Because obtaining fish tissue may be challenging, EPA recommends a water column element derived from conservative translations of the egg-ovary element concentration for lotic (flowing) and lentic (still) waters, two categories of waters where selenium tends to bioaccumulate differently. This water column element is intended to ease implementation, particularly for developing water quality-based effluent limits for National Pollutant Discharge Elimination System (NPDES) permits. A water column element is also essential where fish are absent from a water body or where it is difficult to collect and analyze fish tissue.

4) Water Column Intermittent Exposure Element

This element is intended to be protective against chronic effects of selenium from short-term or intermittent water column exposures in either a lentic or lotic water, as appropriate.

With regard to the duration and frequency of the selenium criterion, the fish tissue element concentrations are never to be exceeded; the water column element concentrations are based on a 30-day average and are not to be exceeded more than once in three years on average. See Table 1 for more details, and for comparison of the 2014 draft external peer review criterion to the current recommended criteria for selenium.

EPA recommends that states and tribes adopt all four elements of the recommended selenium criterion into water quality standards, expressing the four elements as a single criterion composed of multiple parts, in a manner that explicitly affirms the primacy of the whole-body and/or muscle elements over the water column elements, and the egg-ovary element over any other element. The fish egg-ovary element is derived from analysis of the available toxicity data. The fish whole-body and fish muscle elements are derived from the egg-ovary element coupled with data on concentration ratios among tissues. The water column elements are derived from the egg-ovary element coupled with bioaccumulation considerations. Adoption of the fish whole-body and/or muscle element into water quality standards ensures the protection of aquatic life when fish egg or ovary tissue measurements are not available, and adoption of the water column element ensures protection when neither fish egg-ovary nor fish whole-body or muscle tissue measurements are available.



What happens after the public comment period closes?

Following closure of the 30-day public comment period, the draft criterion will undergo an independent, contractor-led, external peer review. All public comments received during the comment period will be provided to the peer reviewers. Following peer review of the draft selenium criterion, EPA will revise the document and publish a Federal Register notice announcing the availability of the draft proposed selenium criterion and soliciting scientific views for 30 days from the public. EPA will then revise the document again and issue a final updated selenium criterion document.

How to View the Criterion Document and Supporting Information

EPA has established an official public docket for this action under Docket ID No. EPA-HQ-OW-2004-0019, accessed at www.regulations.gov. You may also download the document and supporting information from http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/selenium/index.cfm.

For More Information

Contact Kathryn Gallagher by telephone at (202) 564-1398, by email at gallagher.kathryn@epa.gov, or by mail at U.S. EPA, MC: 4304T, 1200 Pennsylvania Ave., N.W., Washington, D.C. 20460.

Table 1. Comparison of EPA's current recommended criteria and the updated 2014 external peer review draft criterion for selenium.

	Current Recommended Criterion		2014 External Peer Review Draft Criterion	
	Magnitude	**Duration**	**Magnitude**	**Duration**
Chronic	5 ug/L	4-day average	15.2 mg/kg dw in fish eggs or ovaries[2]	Instantaneous measurement[7]
			8.1 mg/kg dw in fish whole-body, or 11.8 mg/kg dw in fish muscle (skinless, boneless fillet)[3]	Instantaneous measurement[7]
			1.3 µg/L in lentic aquatic systems 4.8 µg/L in lotic aquatic systems[4]	30-day average
			$WQC_{int} = \frac{WQC_{30-day} - C_{bkgrnd}(1 - f_{int})}{f_{int}}$	Intermittent Exposure[6]: Number of days fewer than 30 with an elevated concentration
Acute	CMC = 1/[(f1/CMC1) + (f2/CMC2)][1]	1-hr average	None[5]	
Criteria Frequency: Water column criteria not to be exceeded more than once in three years on average. Fish tissue criteria are never to be exceeded.				

[1] Where f1 and f2 are the fractions of total selenium that are selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 ug/l and 12.82 µg/l, respectively.
[2] Overrides whole-body, muscle, or water column elements when egg/ovary concentrations are measured.
[3] Overrides any water column element when both fish tissue and water concentrations are measured.
[4] Water column values are based on dissolved total selenium in water.
[5] EPA is not recommending an acute water column-based criterion because selenium is bioaccumulative and toxicity primarily occurs via dietary (chronic) exposure.
[6] Where $WQC_{30\text{-}day}$ is the water column monthly element, for either a lentic or lotic system, as appropriate. C_{bkgrnd} is the average background selenium concentration, and 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 1 day).
[7] Instantaneous measurement. Fish tissue data provide point measurements that reflect integrative accumulation of selenium over time and space in the fish at a given site. Selenium concentrations in fish tissue are expected to change only gradually over time in response to environmental fluctuations.