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MC 2822-IT  
1200 Pennsylvania Ave. NW  
Washington, DC 20460

ATTN: Docket No. EPA-HQ-OW-2004-0019; FRL-9931-21-OW

Via email to: [ow-docket@epa.gov](mailto:ow-docket@epa.gov)

Dear Mr. Kopocis,

The Kentucky Division of Water (KDOW) is pleased to provide the U.S. Environmental Protection Agency (EPA) with comments regarding EPA's request for scientific review on the Draft Recommended Aquatic Life Ambient Water Quality Chronic Criterion for Selenium – Freshwater 2015.

As you are aware, Kentucky was the first state to include selenium criteria based on fish tissue levels in its Water Quality Standards (WQSS). KDOW firmly believes water quality standards must be based on sound scientific rationale and appreciates EPA's recognition of this important tenant of water quality standards.

KDOW conditionally supports EPA's approach to developing the chronic criterion for selenium with respect to establishing a preference to the use of a fish tissue criterion over a water column criterion. The science is clearly leading in this direction. However, KDOW is concerned that EPA has not followed its own guidance (Stephan, *et al.* 1985) in the development of the criterion, because EPA has relied on at least one study (Linville, 2006) that does not meet the appropriate standard of rigor. KDOW is also concerned that EPA's methodology for calculating the water column criterion from fish tissue is subject to significant uncertainties and is unprecedented. In addition, the criterion includes qualifiers in footnote 3 that are not based on scientifically derived numeric values, include conditions for implementation that are not appropriate to a water quality standard, and present significant challenges to states that would adopt and implement the criterion.

### Deference to Tissue Based Criterion

The toxic effects of selenium in fish are not a response to water column concentrations, but result from accumulation of selenium in fish tissue from dietary uptake (USEPA 1998). The base of the food web (plants, bacteria and invertebrates) is relatively insensitive to selenium; however, fish are exposed to potentially chronically

toxic concentrations through dietary uptake (Chapman *et al.* 2010). KDOW believes a water-column threshold which prompts a collection of fish tissue is an appropriate and protective action with regard to aquatic life. However, KDOW does not believe it is necessary to use a water column number independent of available fish tissue data unless fish tissue data are unavailable.

EPA proposes egg/ovary data take precedence over whole-body, muscle or water column data when available. KDOW believes this is an appropriate application of the criterion since selenium toxicity is particularly manifested in fish reproduction and embryo development. However, the reliance on whole-body or muscle tissue residue concentration is equally sound and provides a protective, real-time implementation of a reliable tissue-based alternative when egg/ovary tissue data are unavailable. This approach parallels that of Kentucky's in recognizing that tissue bioaccumulation is an indicator of potential toxicity in the aquatic environment and provides the most reliable medium for monitoring selenium and protecting aquatic habitat.

The proposed national criterion and its elements appropriately do not include a criterion for acute toxicity since the mode of action for toxicity in the aquatic habitat is dietary driven; the pronounced toxic effects of concern are lethality and embryonic teratogenicity driven by the cellular incorporation of seleno-amino acids. Thus, the mode of toxicity is unlike oral ingestion or dermal sorption that may lead to system lethality in developed organisms. Therefore, short-lived, high water-column concentration exposure is not indicative of a toxicity problem.

### **Use of Appropriate and Peer Reviewed Science**

The EPA appropriately reviewed the body of available scientific literature when it developed its database for criterion formulation, which resulted in a pertinent subset of studies based on the understanding of the mode of selenium toxicity. However, the final chronic value of this draft criterion is based in-part on reliance on a study that was not peer reviewed and for which the results obtained were driven only partly by dietary uptake. EPA's reliance on the bioassay results from the Linville (2006) study is concerning from the standpoint of the use of this data in the development of the tissue-based Final Chronic Value (FCV) from which to recommend 304(a) Se criteria.

The Linville (2006) study results were based in-part on data gleaned from test offspring where the larval uptake (exposure) of selenium was not solely through dietary uptake; rather, the larval yolk sacs were **injected** with seleno-L-methionine directly. This is not the pathway in the aquatic habitat by which fish are exposed to selenium, but more importantly the study does not account for complex processes in dietary exposure and subsequent cellular incorporation, including ratios and forms of other chemical compounds and elements in the natural environment that may affect the incidence of teratogenicity; therefore this exposure is not considered empirical.

EPA has rejected the use of studies based on this method of exposure (*i.e.* direct injection); in prior drafts of selenium criteria documents (e.g. see page 6, Appendix G, EPA 2004 draft selenium criteria [*e.g.* Doroshov, 1992]) as a matter of misapplication of procedures to derive water quality criteria (Stephan, *et al.* 1985). KDOW recognizes that the long ovarian cycle may make it difficult and/or expensive to study teratogenicity effects in white sturgeon, however that is not a scientifically valid reason to go forward with the a study utilizing inappropriate methodology. Therefore, results obtained through short-term exposure of seleno-L-methionine via injection into larval fish yolk sacs are not environmentally relevant and do not correlate to environmental dietary exposure during the period of embryonic development. To adequately control the experiment and shadow exposure to selenium in the natural habitat, parental female exposure to selenium through dietary uptake followed by contaminant transfer from the parental female to the eggs is required.

Furthermore, the stress of handling and injecting the selenium on the test fishes was not thoroughly accounted, and the sample size was inadequate to allow for statistical comparability. Additionally, the high mortality rate (45 to 70 percent) of the larvae that underwent injection does not meet the rigor and test acceptability standards outlined in guidance (Stephan, *et al.* 1985). Therefore, this study should also be rejected due to insufficient control performance.

The exclusion of bioassay studies using only water-column exposure is appropriate. Chapman, *et al.* (2010) found

the measurement of selenium in fish tissue appropriate given its close ties to chronic toxicity, namely embryo mortality and teratogenic effects.

### **Appropriate Endpoint and Criterion Calculations**

KDOW agrees with the EPA's selection of the EC<sub>10</sub> (Effective Concentration) in preference of the EC<sub>20</sub> (the observed or measured effect concentration at 10 or 20 percent, respectively) to measure a chronic end-point (*e.g.*, growth, development effects or reproduction). Previous national toxicity criteria were derived using the EC<sub>20</sub>. This approach mirrors that taken by KDOW when developing its chronic criterion for selenium. Calculations were also made from appropriate studies for the NOEC (No Observed Effect Concentration) and LOEC (Lowest Observed Effect Concentration) with preference given to the EC<sub>10</sub>.

Acceptable study data representing twelve fish species were available to calculate the SMCV (Species Mean Chronic Value) and nine fish genera to calculate the Genus Mean Chronic Value (GMCV). The EPA considered fourteen genera to calculate the GMCV, but because the data indicate invertebrates are tolerant of high selenium concentrations, the invertebrate values were not included in deriving the FCV which is determined from the four most sensitive GMCVs.

The EPA also incorporated the 1985 Guidance (Stephan, *et al.* 1985) recommendations which include consideration of a commercially or recreationally important warm water species when determining appropriate data to calculate the GMCVs. This important consideration was also essential in developing Kentucky's selenium criteria. Like Kentucky, the EPA concluded that the Doroshov, *et al.* (1992) catfish (*Ictaluridae*) study contained unusable data because the mode of exposure was injection of the test fishes, rather than through diet (*cf.* the inclusion of Linville, 2006)

### **Water Column Criterion**

KDOW believes that EPA's approach to deriving water column elements, considering lotic and lentic waters separately, appropriately considers how aquatic habitat affects selenium speciation, water residence time, and selenium accumulation in the food chain. However, EPA has not adequately explained its approach to deriving the water column criteria for lentic and lotic waters from the fish-tissue values. As much as any aspect of this proposed criterion the method for deriving the water-column values should be transparent and fairly scrutinized. Using the (extremely low) water-column values as proposed by EPA, many waters currently meeting their intended uses and that do not have selenium concentrations in fish tissue at a level of concern would otherwise be deemed as not meeting designated uses, if based solely on water chemistry. That empirical disconnect may be the result, in part, of the inappropriate inclusion of the Linville (2006) study. However, as the methodology for deriving water column values has not been adequately explained any conclusion is speculative.

### **Intermittent Exposure**

The element of the criterion which addresses intermittent exposure in the water column is presumably intended to mitigate exposure to high concentration pulses or "spikes" in selenium entering a waterbody and accumulating in food particles at a concentration that may cause chronic toxicity to the aquatic habitat. The calculated intermittent criterion is to be determined site-specifically and depends on the frequency and magnitude of selenium "spikes" over a 30-day period. To account for variability in the selenium concentrations, the mathematical average is used as the input data. The calculated intermittent criterion would be applied to the mathematical average of the spike concentrations. While the formula EPA provided for "Intermittent Exposure" is sufficiently understandable, the implementation of this criterion is not practical.

On its face, the Intermittent Exposure criterion element appears to have been developed and is intended to apply to a narrow range of discharge scenarios or types. In so doing the criterion unnecessarily complicates implementation as a "national" criterion. There are a wide variety of discharge in which the intermittent exposure criterion could otherwise potentially be interpreted to be applied if adopted and implemented by states. Consequently, this proposed EPA approach is cumbersome and impractical to implement. EPA's contract peer review also concludes

that “the intermittent approach proposed is unnecessarily complicated if the simpler approach continues to achieve the same objective.”

KDOW requests that EPA defer to its contractor peer review which indicates that while the proposed method for addressing intermittent and time-varying discharges may be reasonable if adequate data are available, given that limited bio-kinetic data are available, it is premature to implement such an approach for setting water quality criteria. As such, KDOW urges EPA to reconsider this approach and to rely on what KDOW and EPA agree is the appropriate endpoint: fish tissue data. As with Kentucky’s chronic criterion, requiring tissue sampling in the event the water column concentration exceeds a given threshold (*i.e.* 5.0 µg/L) protects the critical aquatic endpoint, which are monitored to detect any potential toxicity concerns. EPA has clearly articulated and developed tissue based chronic criteria for the purpose of protecting against chronic endpoints that the Intermittent Exposure criterion is also intended to protect. EPA must ultimately succinctly and definitively answer the question: Are technically sound tissue-based criterion protective or not, to which the science supports an affirmation in response.

### **Exceptions to Tissue-Based Criterion**

KDOW has several serious concerns regarding footnote 3 in Table 1. EPA does not define, by magnitude of concentration, frequency, or by duration, the discharges that should be considered “new or increased inputs of selenium.” There are countless scenarios that create implementation challenges for states. EPA also does not define, by aquatic conditions or by duration, the term “equilibrium.” Attempting to define and defend when a stream is in equilibrium or steady-state in order to determine when and what criterion should apply creates a legally and technically unworkable, and unnecessary, requirement for states. Without such terms being clearly defined, states cannot determine in a scientifically defensible manner when such “new or increased inputs” should cause water column values to have primacy over fish tissue values. A water quality standard, or a permit condition based on a water quality standard, that relied upon such “new or increased inputs” and “equilibrium” in order to determine when water column values would have primacy over fish tissue values would create legal jeopardy for states implement this requirement. As such, a standard or permit relying on this approach as proposed would routinely be found as arbitrary and capricious and thus would likely be invalidated.

Essentially these same site-specific concerns were identified during external peer review of the draft criterion. Dr. Kevin V. Brix commented: “[t]he issue of generating pulse loads of [selenium] that may ultimately result in [selenium] accumulation in sensitive downstream systems (*e.g.*, pulse loads in a river that discharges to a wetland) is a legitimate concern. However, in my opinion, this is a site-specific issue and it is not reasonable to establish national WQC that ensure protection of these sites....”

KDOW believes that the “Fishless Waters” language in footnote 3 is unnecessary given that footnotes 1 and 2 address the order of criterion element primacy. Furthermore, use of “(waters where fish have been extirpated, or where physical habitat and/or flow regime cannot sustain fish)” is unnecessary and inadvisably seems to establish and thereby limit the conditions by which there would be a lack of available fish tissue, which KDOW does not believe is EPA’s intention.

KDOW believes that footnote 5 is not entirely accurate and this issue warrants more thorough explanation in the document. The statement: “selenium concentrations in fish tissue are expected to change only gradually over time in response to environmental fluctuations” does not reflect the variations of selenium concentrations in fish tissue resulting from reproduction and depuration.

### **Summary**

For the reasons provided above, KDOW supports EPA’s taking the following approach to developing selenium criteria and encourages EPA in the formal selenium criteria proposal to:

1. Exclude the Linville (2006) study from the EPA selenium criterion calculations for similar reasons that EPA has excluded other studies.

2. Adopt the statement that fish tissue data should take precedence over water column data in assessing selenium levels (July 27, 2015 80 FR No. 143 at 44352).
3. Delete the following phrase from footnotes 1 and 2 (July 27, 2015 80 FR No. 143 at 44352): "except in certain situations. See footnote 3."
4. Delete the following phrase from footnote 3 (July 27, 2015 80 FR No. 143 at 44352): "Water column values have primacy over fish tissue values under two circumstances: 1) "Fishless Waters" (waters where fish have been extirpated, or where physical habitat or flow regime cannot sustain fish); and 2) New or increased inputs of selenium until equilibrium is reached."
5. Delete footnote 4 (July 27, 2015 80 FR No. 143 at 44352) and the "Intermittent Exposure" criterion as this criterion is scientifically premature and is impractical to implement.
6. Delete footnote 5 (July 27, 2015 80 FR No. 143 at 44352) as this is not entirely accurate and should otherwise be addressed more appropriately elsewhere in the document.
7. Establish that the chronic selenium criterion is sufficient to protect streams and aquatic habitats, and forego any recommendation for state adoption of an acute criterion.

KDOW appreciates the opportunity to comment on this proposed criterion, and remains ready to answer any questions or provide further information regarding these comments.

Sincerely,



Peter Goodmann, Director  
Kentucky Division of Water

c: R. Bruce Scott, Commissioner

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