Statement of Consideration

Relating to Selenium Criteria proposed changes in 401 KAR 10:031

I. The public hearing on 401 KAR 10:001, 10:029 10:030 and 10:031, scheduled for September 27, 2012, at 5 p.m. at 300 Fair Oaks Lane, Conference Room 301D, Frankfort, Kentucky, was held; several members of the public did attend this public hearing. Written comments were also received regarding these administrative regulations. The agency proposed a different criterion for the acute standard for selenium and allowed an additional comment period.

II. The following people submitted written comments regarding the proposed selenium criteria:

Name and Title	Agency/Organization/Entity, Other
Margaret Janes	Senior Policy Analyst, Appalachian Mountain Advocates
Aaron Schoenman, *et al.*	Numerous web-based form-letter emails (See Appendix A)
Tarence Ray	KY Headwaters, Inc.
Tim Joice	Water Policy Director, Kentucky Waterways Alliance
Lloyd R. Cress, Jr.	Kentucky Association of Manufacturers (KAM)
John W. Myers	Director, Tennessee Valley Authority (TVA)
Joanne Benante	Environmental Protection Agency (EPA)
Robin J. Reash	American Electric Power (AEP)
Erik Hungerbuhler, *et al.*	Kentuckians for the Commonwealth (KFTC) (See Appendix B)
Virgil Lee Andrews	United States Fish and Wildlife Service (USFWS)
Jeff Auxier	Citizen
Jill Harmer	Citizen
Carey Henson	Citizen
Chad Harpole	Kentucky Chamber of Commerce
	Associated General Contractors of Kentucky
	Automotive Service Council of KY
	Coal Operators and Associates
	Homebuilders Association of Kentucky
	Kentucky Association of Manufacturers
	Kentucky Coal Association
	Kentucky League of Cities
	Kentucky Malt Beverage Council
	Kentucky Retail Federation
	Western Kentucky Coal Association

III. The following people from the promulgating administrative body responded to the written comments:

Name and Title
Peter Goodmann, Assistant Director
Randall Payne, Environmental Scientist III
Danielle Crosman, Internal Policy Analyst III

IV. Summary of Comments and Responses

401 KAR 10:031

(1) Subject Matter: Selenium is a significant problem in the coal fields of Kentucky

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates; KFTC; Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: Selenium pollution through surface coal mining is prevalent in Kentucky. The little testing that has been done in Kentucky shows a number of selenium hotspots present in communities where coal is mined.

(b) Response: As a whole, selenium does not appear to present widespread water quality concerns in Kentucky, though selenium levels above Kentucky's current chronic water quality criterion have been identified in some watersheds. The purpose of the proposed Kentucky water quality criteria is to protect water quality habitat from toxicological effects of selenium, identify where selenium problems exist, and to restore those few stream segments to meeting water quality standards. However, for the vast majority of watersheds in Kentucky selenium concentrations are within water quality and public health levels of concern.

Ambient Water Quality Data for Selenium

The Division of Water (DOW) manages an ambient water-quality monitoring program for surface water. From 2007 to 2011, ambient data for total selenium in the water column was collected at 72 monitoring sites. The monitoring sites are located at mid 8-digit and lower 8-digit Hydrologic Unit Code (HUC) watersheds and at major inflow and major outflow points of significant reservoirs (*i.e.* USACE and TVA reservoirs). These ambient data do not indicate any significant or systemic selenium issues in Kentucky 8-digit HUC watersheds. The ambient water quality data for selenium is summarized below.

Ambient monitoring sites

Total number of ambient monitoring sites: 72
Total number of ambient monitoring samples: 2029
Mean ambient value for selenium: 0.342 µg/L
Number of ambient monitoring samples > 5.0 µg/L: 5, or 0.25% of samples collected

The CHIA Phase I

The Department for Natural Resources (DNR) conducts water quality monitoring as part of its obligations under the Surface Mining Control and Reclamation Act (SMCRA) to conduct

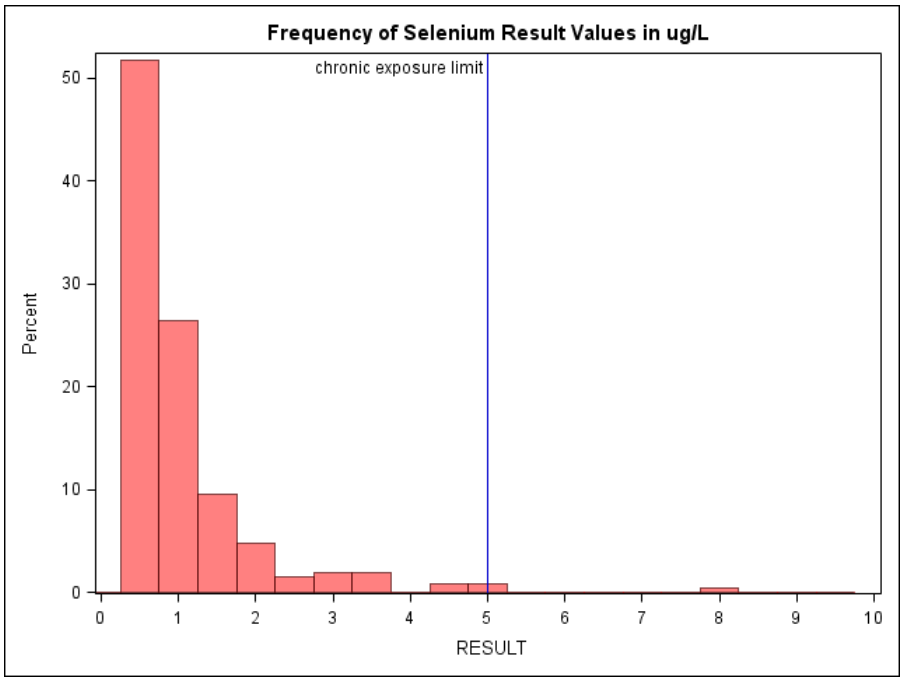
Cumulative Hydrologic Impact Analysis (CHIA) in areas where surface mining is occurring. The CHIA Phase I data collected from July 2011 through June 2012 as part of the CHIA Phase I monitoring study. Most of these monitoring stations are located at the lowermost part of 12-digit HUCs. The Cabinet has analyzed the data from the CHIA Phase I monitoring study. The average selenium value of these 253 samples was 1.040 µg/L with a maximum of 7.83 µg/L and 107 non-detections (set at 0.5 µg/L); the median result was 0.711 µg/L. Of the 253 samples, only three (3) have values at or greater than 5 µg/L, the current water quality chronic criterion for selenium and the proposed threshold for requiring testing for compliance with fish tissue criteria. These three (3) values were 5.09, 5.13, and 7.83 µg/L. The CHIA Phase I water quality data for selenium is summarized below.

Detection Summary for CHIA Selenium Data

Data Range	# Samples	Value
Non Detects	107	Set to 0.5 µg/L
< Method Detection Limit	58	Estimated Value
> Method Detection Limit	88	Actual Value

Distribution of Selenium CHIA Data

Minimum value:	0.500 µg/L
Maximum value:	7.830 µg/L
Mean value:	1.040 µg/L
Median value:	0.711 µg/L
5th Percentile	0.500 µg/L
25th Percentile	0.500 µg/L
50th Percentile	0.711 µg/L
75th Percentile	1.160 µg/L
95th Percentile	2.910 µg/L



Selenium Impairments

Only two stream segments in Kentucky are currently listed as impaired for selenium in the Clean Water Act §303(d) list for Kentucky. Black John Branch in Knott County, from stream miles 0.0 to 0.4 and Defeated Creek, also in Knott County, from stream miles 0.5 to 1.6, are listed as impaired by selenium.

Targeted Selenium Study

The Division of Water conducted monitoring of selenium in specifically selected watersheds in the Eastern Kentucky Coalfield. This study targeted headwater watersheds with geological strata that had relatively high concentrations of selenium under various land disturbances with the aim of obtaining worst case scenarios for selenium levels in both water column and fish tissue. This study included the collection of water, sediment, and fish tissue samples to determine whether bioaccumulation of selenium was occurring.

Analysis of these data indicates that there may be some headwater watersheds with elevated selenium in the water column and fish-tissue residue compared to control watersheds. The data are summarized below.

Targeted Selenium Study Data Summary

Statistic	Water Column (µg/L)	Fish Tissue (µg/g)	Sediment (µg/g)
n	44	31	25
Mean	3.24	5.38	2.30
Std. Dev.	4.07	2.95	1.61
Minimum	0.50	1.32	0.42
Maximum	21.20	14.16	6.79
Range	20.70	12.84	6.37

Water Supplies

Selenium does not appear to present a problem in Kentucky's public water systems or in private drinking water wells. Monitoring data from 519 public drinking water systems and 406 private drinking water wells statewide were collected and reviewed from years 2000 through 2011. These data indicate levels of selenium were below the Maximum Contaminant Level (MCL) for drinking water, set by EPA and EPA's Risk-based Screening Level (RSL). The RSL is EPA guidance regarding the level of a constituent that may result in elevated risks from whole-household use (*e.g.*, drinking, showering, cooking) and is based on the most recent toxicological information for selenium (2012). The current MCL for selenium is 0.05 mg/L and the RSL is 0.078 mg/L. In the data above, selenium was below the MCL and RSL in all public water systems and private well samples. In fact, selenium concentration were below the analytical detection limit of 0.002 mg/L in all the public water system samples and below detection limit in 90% of the private well samples.

(2) Subject Matter: Coal companies are doing little to nothing now to prevent or limit selenium pollution

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates; KFTC; Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: Coal companies are doing little to nothing now to prevent or limit selenium pollution from their mining operations, and have a spotty record in general on their water monitoring compliance.

(b) Response: The agency has taken substantial enforcement action on coal mining operations in Kentucky.

The Kentucky Department for Environmental Protection (DEP) actively enforces effluent limits imposed in Kentucky Pollution Discharge Elimination System (KPDES) permits, including those issued for surface coal mining facilities and has taken substantial enforcement action against wastewater discharge monitoring and

reporting violations, as well as effluent limit exceedences, by coal mining operations in Kentucky. Looking only at the period of FY2011 to present, DEP has reviewed more than 117,000 Discharge Monitoring Reports (DMRs) submitted by more than 700 permitted coal mining operations. DEP has initiated civil enforcement actions and assessed more than $2,000,000 in civil penalties against coal mining operations for these violations. (This total does not include the penalties currently in negotiation or litigation for which there are not yet final orders.)

With respect to inspections of coal-mining operations, the Department for Natural Resources (DNR) has been the lead agency on inspection and oversight of these operations since the Cabinet received delegation of the Clean Water Act §402 permitting program in 1983. In order to further enhance and improve the agency's inspection oversight, during CY2011 the agency worked to improve the Clean Water Act §402 inspection process. As a result, during CY 2012, DEP conducted training of DNR SMCRA inspection personnel on the process of conducting NPDES program compliance inspections. As a part of this process, the agency has enhanced and improved its inspection process and formal documentation of Clean Water Act §402 inspections. In addition, DEP compliance personnel may accompany DNR field personnel on an as-needed basis.

In addition, from October 2010 to August 2012 DOW performed 31 Performance Audit Inspections (PAIs) of coal facilities, including the 27 in-house or contract laboratories performing discharge sample collection and/or analysis for those facilities. The PAIs resulted in 27 Notice of Violations (NOVs) issued to the facilities. DOW initiated PAIs of coal facilities and laboratories for water sample collection and analysis because of agency concerns raised during review of DMRs. The coal PAI process requires the participation of both DOW and DNR field inspectors working together with a project coordinator, multiple DOW laboratory auditors and management from both departments. Each PAI requires a significant amount of time for coordination and between the departments prior to the inspection itself. On the day of the inspection, DOW and DNR inspectors are at the mine site to observe the collection of samples for analysis in addition to collecting their own representative samples and to observe stream conditions and the discharge from all permitted outfalls. The inspectors also perform an on site records review at the time of inspection. The field portion of the inspection can require from three hours up to a few days to perform depending upon the size of the mining operation and conditions encountered at the site.

The second part of a coal PAI takes place at the in-house or contract laboratory that performs analysis of water samples collected by the coal company's sampler. DOW personnel audit the laboratory's staffing and qualifications, quality assurance plans and laboratory standard operating procedures to assess compliance with 40 CFR Part 136. Equipment maintenance and calibration may also be reviewed. The laboratory auditors observe and evaluate analysts as they perform various analytical methodologies to determine the competency of the laboratory and staff based on the results of "blind spike samples." The laboratory portion of a PAI usually requires one day.

Finally, DMRs submitted by the permit holders that are the subject of the PAI are reviewed and compared with data collected by the Cabinet inspectors from the site during the inspection. The laboratory data is further analyzed for quality-control parameters that are reported by the laboratory. The laboratory data and the PAI report are compiled for a final determination of compliance. Failure to comply results in issuance of a Notice of Violation or other enforcement action.

As a result of the Cabinet's findings regarding laboratory practices and compliance with 40 CFR Part 136, the Cabinet proposed legislation authorizing the agency to develop a wastewater laboratory certification program for all permitted discharges. This legislation, KRS 224.10-670, was ultimately passed by the Kentucky Legislature and enacted into law in 2011. In accordance with KRS 224.10-670 and KRS Chapter 13A the Cabinet filed a proposed new Wastewater Laboratory Certification regulation (401 KAR 5:320) on March 14, 2013. The Cabinet is soliciting public comments on this proposed regulation through April 30, 2013.

(3) Subject Matter: The proposed standards violate the Clean Water Act

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates; KFTC; Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: The proposed standards violate the Clean Water Act and cede even more power to industry to continue to allow selenium pollution at levels that will exacerbate existing problems in some Kentucky waterways. DOW has stepped outside of its bounds.

(b) Response: The agency strongly disagrees with this assertion.

The proposed Kentucky-specific water quality criteria for selenium are based on the latest available science, are protective of water quality, are consistent with the requirements of the Clean Water

Act, EPA regulations, and EPA guidance, as well as with Kentucky state law and regulation. Nor do these standards cede any authority to the regulated sector to violate Kentucky's water quality standards or otherwise threaten Kentucky's environment.

The proposed criteria for selenium are developed and proposed to fulfill the Cabinet's obligations to conduct a triennial review of its water quality standards. The Clean Water Act §101(b) declares that it is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of states to prevent, reduce, and eliminate pollution. The Clean Water Act § 303; 33 U.S.C. § 1313 (hereinafter, "CWA" or "Act") makes clear that it is the states that have primary authority to establish, review and revise water quality standards for intrastate waters, and that states have the authority to propose state-specific water quality criteria, as follows:

> "The Governor of a State or the State water pollution control agency of such State shall from time to time (but at least once each three year period beginning with the date of enactment of the Federal Water Pollution Control Act Amendments of 1972) hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards." CWA § 303(a); 33 U.S.C. § 1313(a)

The Act's implementing regulations encourages states to establish numerical criteria based on: §304(a) Guidance [national recommended water quality criteria], §304(a) Guidance modified to reflect site-specific conditions, or other scientifically defensible methods. 40 CFR § 131.11 (a)(2)(b).

EPA in its *Water quality standards Handbook* at Section 6.1.6 acknowledges that:

> EPA's laboratory-derived criteria may not always accurately reflect the bioavailability and/or toxicity of a pollutant because of the effect of local physical and chemical characteristics or varying sensitivities of local aquatic communities. Similarly, certain compounds may be more or less toxic in some waters because of variations in temperature, hardness, or other conditions. Setting site-specific criteria is appropriate where:

- background water quality parameters, such as pH, hardness, temperature, and color, appear to differ significantly from the laboratory water used in developing the section 304(a) criteria; or
- the types of local aquatic organisms differ significantly from those actually tested in developing the section 304(a) criteria.

  Water quality standards Handbook (Second Edition) (March 2012).

Kentucky law clearly authorizes the Cabinet to propose state-specific water quality criteria. KRS 224.10-100 provides the Cabinet the authority, power, and duty to: . . .

(4) Develop and conduct a comprehensive program for the management of water, land, and air resources to assure their protection and balance utilization consistent with the environmental policy of the Commonwealth;
(5) Provide for the prevention, abatement, and control of all water, land, and air pollution . . .
(25) Perform other acts necessary to carry out the duties and responsibilities described in this section . . .
(28) Promulgate administrative regulations not inconsistent with the provisions of law administered by the Cabinet.

Consistent with this authority, 401 KAR 10:029 Section 1(1) states: "[t]he purpose of 401 KAR 10:026 through 401 KAR 10:031 is to safeguard the surface waters of the Commonwealth for their designated uses, to prevent the creation of new pollution of these waters, and to abate existing pollution."

Once a State has reviewed and revised or adopted water quality standards, those revised and adopted standards are submitted to EPA for review. CWA § 303(c)(2)(A). EPA shall approve or disapprove the State water quality standards; if EPA determines that a revised or new standard is not consistent with the requirements of the CWA, EPA shall notify the State and specify what changes are necessary to meet those requirements. If the State doesn't adopt the specified changes, then EPA shall promulgate the standard. CWA § 303(c)(2)(A(3).

(4) Subject Matter: Likelihood of non-compliance and non-enforcement
(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates; KFTC; Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: To introduce more complex and expensive testing increases the likelihood of non-compliance and non-enforcement – and less protection for the public. The lack of enforceability of this proposal means, in most of these cases, that little to nothing will be done to address these problem areas.

(b) Response: The agency strongly disagrees.

Selenium is a parameter monitored for the protection of aquatic habitat. The Cabinet has determined that it is appropriate to use an aquatic life endpoint (*i.e.* fish) which is the aquatic life most sensitive to potential effects from elevated selenium, as a true indicator of stream, or habitat, health to determine permit compliance. This approach is, in fact, not different from other permit requirements to assess impact from discharges such as in-stream biological monitoring of invertebrates, or from the long-established methods used by the Division (and other states and EPA) to assess whether waters are meeting their designated uses, including sampling aquatic invertebrates, fish, algae and gathering other data apart from water column concentrations.

The Cabinet has also determined that the chronic threshold of 5 µg/L is adequately protective because it will trigger fish tissue assessment prior to any detrimental effects on the fish population from selenium concentration in the water column. See Appendix B of: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013).

The proposed criteria are designed to ensure that aquatic habitat and all designated stream uses are protected, including when discharges are permitted in compliance with the criteria. To implement the proposed criteria the Cabinet will analyze the reasonable potential of selenium in a discharge to violate the proposed acute criteria and the chronic water column threshold. This approach is consistent with the agency's reasonable potential analysis performed for other water quality parameters. If, for example, a discharge is determined to have a reasonable potential to violate water quality criteria for selenium, the appropriate monitoring, effluent limits, or other requirements will be imposed in the CWA § 402 permit.

While the proposed water quality criteria for selenium are based on the latest science, are protective of water quality and consistent with the procedures for establishing water quality criteria, implementation of these proposed criteria (example, in CWA §402 permits) is separately subject to public notice and comment by all

interested citizens including the permit applicant, EPA, and interested citizens/parties before finalization.

(5) Subject Matter: Political corruption

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates; KFTC; Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: The proposed criteria stinks of political corruption and money under the table.

(b) Response: The agency takes strong exception to this unfounded and inflammatory comment.

The Cabinet's proposed selenium criteria are soundly and transparently based on objective science in the legislative record. The Cabinet initially proposed to delete the current acute water quality criterion for selenium, as published in the Administrative Register of Kentucky on September 1, 2012. A public hearing was held on September 27, 2012 and comments were due by October 1, 2012. The deletion of the existing Kentucky acute criteria for selenium was proposed for several reasons.

First, the current acute criterion lacks legal and technical foundation. It is based on a single study at Belews Lake, North Carolina with a very limited database and is derived from a presumed acute to chronic ratio (ACR) from a chronic value where a 'no effects' level was identified. The acute value lacked any bioassay data to support the presumed ACR. Further, in the course of its research in preparation for the triennial review of water quality standards the Cabinet learned that on September 19, 1996 the U.S. Court of Appeals for the District of Columbia issued an order granting EPA's motion to vacate the U.S. EPA acute selenium criterion of 20 µg/L. It is apparent that this acute criterion lacks legal and technical foundation.

Secondly, a review of surrounding states' water quality standards indicated that several had already deleted their acute criterion for selenium, or had a significantly higher acute criterion, while others had retained the vacated acute criterion while waiting on EPA to revise the selenium criteria. Just within the last year ORSANCO approved the deletion of the acute water quality criterion for selenium for the entire main stem of the Ohio River.

The Cabinet received numerous comments in support of its proposal to delete the acute selenium criterion from Kentucky's water quality standards. Many commenters supported deleting both the acute and chronic criteria; some recommended that the Cabinet

consider a tissue-based chronic criterion. The agency received no comments from any other entity objecting to deletion of the existing Kentucky acute water quality criterion for selenium. Only EPA provided comments expressing concern on the proposal to remove the acute criterion.

In its December 19, 2012 comments, EPA recommended that Kentucky had three options regarding acute selenium criterion for its water quality standards. EPA recommended that the Cabinet could:

1. leave Kentucky's current acute criterion in place and wait for the release of any revisions to EPA's criteria guidance;
2. adopt the acute criterion from EPA's current national §304(a) recommended guidance; or
3. **adopt an alternate criterion based on other scientifically defensible information** (emphasis added).

In consideration of option 1 above, as discussed above, it is clear that the existing Kentucky acute criterion for selenium lacks both legal and technical basis. In addition, EPA has been working on revising the national selenium criteria for nearly 20 years without making a final revision to the existing criteria. Option 1 is therefore not an acceptable option. In consideration of option 2, the current EPA acute water quality criteria for selenium established in 1995/1996 is based on a formula that accounts for the differential toxicity of selenite and selenate, two predominant species of total selenium. However, this 17 year old EPA standard does not take into account the latest available science for selenium, including science that EPA itself had considered in subsequent efforts to revise the existing water quality criteria for selenium. Option 2 was therefore not acceptable. Therefore, the Cabinet was left to consider only option 3 from EPA to develop Kentucky-specific selenium criteria.

In evaluating option 3 the agency determined that, not only should the acute criteria be revised, but the chronic criterion should be revised as well given that the latest available science indicates that a fish tissue-based criterion is appropriate due to selenium's bioaccumulative attributes. In fact, in EPA's December 19, 2012 comments, EPA states:

> "As evidenced by the EPA's recent draft 304(a) recommendations, the EPA will likely base the new criteria guidance on bioaccumulative and developmental effects rather than classic water column toxicity. This change in

toxicological endpoints will likely mean changes to both the acute and chronic recommendations."

Kentucky concurs with EPA's evaluation of the latest available science and so proceeded with exploration of option 3, above. This decision is also consistent with and responsive to comments received by the agency to revise or delete both the Kentucky acute and chronic water quality criteria for selenium.

Therefore, in proposing the new water quality criteria for selenium, the Cabinet is being responsive to comments received which is compliant with the purpose of the triennial review, as required by CWA § 303(a); 33 U.S.C. § 1313(a). Further, the Cabinet is following EPA's recommendation to adopt criteria based on defensible scientific information. As such, the Cabinet is fulfilling its obligations under the Clean Water Act (CWA § 303(a); 33 U.S.C. § 1313(a)) to establish, review and revise water quality criteria based on appropriate science, and utilizing the state's authority to proposed state-specific water quality criteria.

Further, it is consistent with the stated intent and purpose of the Clean Water Act for states to develop state specific water quality criteria that are protective of their unique waters and aquatic life within the state, whereas EPA national criteria may not be appropriate for a given state. The current Kentucky water quality criteria for selenium are out of date and not in line with current scientific knowledge. The proposed Kentucky water quality criteria, as stated previously, are protective of water quality and consistent with applicable state and federal requirements.

(6) Subject Matter: Acute spikes in selenium can result in significant selenium loads and bioaccumulation

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: Short duration selenium spikes in discharges to streams or reservoirs lead to significant selenium bioaccumulation in macroinvertebrates and macrophytes which is readily transferred to upper trophic levels. Kentucky's current acute selenium criterion is too lenient; if the criterion is revised it must be revised downward.

(b) Response: The agency is aware of the concern but respectfully disagrees with the commenter's conclusions.

Spikes (or pulses) of selenium discharges to streams are not expected to result in significant or problematic levels of selenium bioaccumulation in the producer or primary consumer community (fish) in violation of water quality criteria. For example, for coal mining operations the hydrological setting for potential pulses is

discharge from a sediment pond at the toe of a valley fill to a stream below. Science supports the understanding that in the oxidizing conditions found in these receiving streams selenium that is not already in the selenate form is readily transformed to that species, which is the least bioavailable form of selenium. Therefore, the species of selenium least likely to result in toxicity effects. Thus, the Cabinet's utilization of total selenium is a conservative approach for assuring protection of the aquatic habitat, and adds an additional margin of safety by considering the toxicity potential for all species of selenium to be equal. The KPDES permit will require that effluents samples be analyzed for total selenium. Where chronic concerns are present, results in excess of the proposed threshold chronic concentration value of 5.0 µg/L will trigger fish-tissue sampling to ensure compliance with the proposed water quality criteria. This protective threshold is further discussed in Appendix B of: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013). along with supporting information that addresses the appropriateness and supporting data for the use of 5.0 µg/L as a screening value.

To protect against short-term exposure to selenium at toxic levels the Cabinet has proposed an acute selenium criterion that is a modification of the EPA draft 2004 criterion, which is itself a modification of EPA's current nationally recommended acute criterion (National Recommended Water Quality Criteria, accessed March 20, 2013). In its draft 2004 acute criterion EPA recognized that selenite is the most bioavailable inorganic species of selenium. Therefore, the Cabinet proposed updated acute criterion sets the Continuous Maximum Criterion (CMC) lower for that species of selenium. The Cabinet proposes an additional margin of safety by capping the acute criterion at 258 µg/L, as total selenium. In addition, the Cabinet's proposed acute criterion also assumes the entire fraction of selenium in the water column to be selenite so is thereby more protective than EPA's draft criterion.

By capping the proposed acute criterion at 258 µg/L the Cabinet limits the use of the equation in the draft 2004 EPA criterion that modifies the calculation of the CMC for selenate in the presence of sulfate in the water column. However, should a water body have a sulfate concentration that is less than 44 mg/L, the applicable acute criterion will be lower than 258 µg/L. Sulfate data from the DOW's 72-station ambient water quality network had a mean sulfate concentration of 95 mg/L for the period of 2007 though 2011. Of those 72 stations, 43 had mean sulfate concentrations less than 44 mg/L.

In contrast to EPA's 2004 draft proposal, Kentucky's proposed acute criteria for selenium partially takes into account the ameliorating effect of sulfate on selenium toxicity. In addition, per Kentucky's proposed acute criterion, the applicable acute criterion will be lower for individual water bodies that have sulfate concentrations less than 44 mg/L. The sulfate cap on the acute criterion (258 µg/L, as total selenium) provides additional protection of the aquatic habitat from acute selenium toxicity.

(7) Subject Matter: NPDES permitting challenges for coal mining operations in Kentucky

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: The variation in selenium concentrations means that single grab sample discharge data is unlikely to adequately characterize a discharge. In addition, DOW reduced the number of samples required for individual mining NPDES permit applications from 5 to 1 and allows the use of only one representative outfall which means that DOW will never do a reasonable potential analysis for any priority pollutant.

(b) Response: The agency respectfully disagrees. As previously discussed in the response to Comment (4), the agency is required to conduct a reasonable potential analysis on all applicable water quality data. For those discharges that demonstrate a reasonable potential to exceed selenium water quality standards, the discharge permit will require effluent sampling on a regular basis consistent or similar with monitoring frequencies for other constituents.

(8) Subject Matter: Public notice requirements

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates; Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: DOW provided notice to the public of the current proposed revisions on February 5, 2013, less than a week prior to the February 11, 2013 hearing before the Administrative Regulations Review Subcommittee (ARRC). *Id.* On February 12, 2013, the DOW provided notice that it would be accepting public comment on the proposed criteria through March 1, 2013, and held two "stakeholder" meetings on February 22 and 26, which were not open to the public. Those meetings do not constitute public hearings. Such a short time is insufficient to allow the public to develop complete comments on the very complex, technical issues involved in the DOW's weakening of Kentucky water quality protections. To properly develop such comments, the public needs time to solicit and incorporate the views of experts in

the complex field of selenium toxicity. DOW's action violates 40 C.F.R. § 25.5(b)'s requirements that notice of hearings on proposed revisions be given 45 days in advance and that relevant reports, documents and data be provided at least 30 days prior to the hearing. Furthermore, because the proposed revisions to the water quality standards are not properly considered "amendments after hearing," but are rather entirely new proposals, DOW has not complied with its obligations under KRS § 13A. Additionally, the process that followed DOW's submission of the proposed changes to the selenium standards to the ARRS does not constitute true public participation, as defined by EPA regulations, because DOW's decision was predetermined. The agency has not provided meaningful opportunities to incorporate and respond to the public's concerns as part of the regulation review process. According to EPA's regulation, "Public participation includes providing access to the decision-making process, seeking input from and conducting dialogue with the public, assimilating public viewpoints and preferences, and demonstrating that those viewpoints and preferences have been considered by the decision-making official." 40 C.F.R. § 25.3. The regulations make clear that "[m]erely conferring with the public after an agency decision" does not satisfy the agency's obligations to involve the public in its decision-making process. *Id.* at §25.4(d). That is precisely what has taken place here, where DOW is only accepting public comments after making its decision. This process is suspicious and prevents the full public from commenting on the change.

(b) Response: The agency respectfully disagrees with the commenters' conclusions. The Cabinet's procedures to amend the Selenium water quality criteria comply with both the Clean Water Act and its implementing regulations, and with state law.

The federal regulation addressing state review and revision of water quality standards requires at 40 CFR 131.20 (b), that:

"The State shall hold a public hearing for the purpose of reviewing water quality standards, in accordance with provisions of State law, EPA's water quality management regulation (40 CFR 130.3(b)(6)) and public participation regulation (40 CFR part 25). The proposed water quality standards revision and supporting analyses shall be made available to the public prior to the hearing."

Kentucky law governing review and revision of Kentucky water quality standards is found at KRS Chapter 13A, titled "Administrative Regulations." That Chapter prescribes Kentucky's regulation promulgation requirements in detail.

Proposed amendments to administrative regulations shall be filed with the Legislative Research Commission ("LRC") and shall identify the statutory authority for the regulation including, where applicable, federal law authorizing the regulation. The regulation shall also state why it is necessary and a summary of the functions intended to be implemented by the regulation. KRS 13A.220(1) and (4). In order to provide notice of proposed regulations, the complete text of regulations filed with LRC shall be printed in the Administrative Register, KRS 13A.050(2); each issue of the Administrative Register is required to contain notice describing the regulation review process and the methods by which the public may comment on administrative regulations. KRS 13A.080.

In addition to filing the proposed regulation with LRC, a copy of the regulation shall be e-mailed to persons who have registered requesting notice of proposed administrative regulations in accordance with KRS 13A.270 (1)(a) and has provided an e-mail address; a cover letter and statement that a copy of the proposed administrative regulation may be accessed on-line and including the web address shall be mailed to those who registered for notice but did not include an email address. KRS 13A.270 (3)(c) and (d). Both notices shall include an invitation to submit comments and instructions on how to do so.

Following notice of the proposed regulation the promulgating agency is required to hold a hearing on the regulation, open to the public. KRS 13A.270 (1)(a). Included in and filed simultaneously with the regulation "package," the agency promulgating the regulation shall state the place, time, and date of the public hearing, how interested persons shall notify the agency that they will attend the hearing, how interested persons may submit written comments on the regulation, and the deadline for submission of comments. KRS 13A.220 (6); KRS 13A.270 (2)(a) and (b). Finally, the regulation shall include the name, position, address, telephone number and facsimile number of the agency's contact person authorized to answer questions relating to the regulation, receive information on issues raised by the public, and who can negotiate changes in the language of the regulation. KRS 13A.220 (6)(d). The agency shall accept written comments on the administrative regulation beginning on the date the regulation is filed with the LRC until the end of the calendar

month in which the regulation was published in the Administrative Register. KRS 13A.270 (1)(c).

Following the last day of the public comment period, the agency is to consider comments received at the public hearing and in writing during the public comment period and shall file its 'statement of consideration' ("SOC") of the comments with the LRC. KRS 13A.280 (1) and (2). The SOC shall include, among other information, a summary of the comments received and of the agency's response to the comments, a summary of agency action in response to the comments and, if amended, a list of the changes made to the regulation. KRS 13A.280 (5). If the agency amends the regulation after receiving oral or written comments from the public (the "amended-after-comments" regulation) the agency is required to file the regulation indicating amendments to original language, the statement of consideration, and attachments with the LRC. The amended regulation shall be published in the Administrative Register and shall also be reviewed by the Administrative Regulation Review Subcommittee (ARRS) of the Kentucky General Assembly. KRS 13A.280 (6). If requested, the agency's statement of consideration and amended after comments regulation shall be made available to persons who attended the public hearing, who submitted comments, or who have requested a copy from the agency. KRS 13A.280 (7).

In compliance with the requirements of KRS Chapter 13A, above, and to conduct the Triennial Review of Kentucky's water quality standards required by the Clean Water Act, on August 14, 2012 the Cabinet filed proposed administrative regulations to amend Kentucky's water quality standards with the LRC. Among the proposed amendments was elimination of the Warm Water Aquatic Habitat acute criterion of 20 µ/L for selenium. The proposed regulations were published in the Administrative Record on September 1, 2012; publication included notice that a public hearing on the proposed regulations would be held on September 27, 2012, the location of the hearing, and notice that the public may submit comments on the proposed regulations through October 1, 2012, as well as a contact person, the Assistant Director for the Division of Water, and all other information required by KRS 13A.220 and KRS 13A.270.

The public hearing was held as scheduled and was attended by representatives of several stakeholder groups, including

environmental advocacy organizations, business and manufacturing groups, federal agencies, and by citizens. The Director of the Division of Water presided at the hearing, which was also attended by the Assistant Director and other Cabinet personnel. Written comments on all the proposed changes to water quality standards were submitted by EPA and by several stakeholder groups from both the business and environmental advocacy communities. Among all the comments submitted the Cabinet received only 4 comments regarding the Cabinet's proposal to remove the acute Selenium criterion from Kentucky water quality standards – from EPA Region 4, the Kentucky Coal Association, the Kentucky Association of Manufacturers, and the Kentucky Chamber of Commerce. There were no comments objecting to the proposal to eliminate the Selenium acute criterion. Three commenters specifically supported the proposal to eliminate the acute criterion and requested the Cabinet remove the chronic criterion, as well, "based on questionable methods used in the development of the national criteria recommendation." One commenter suggested that new evidence establishes that both Kentucky's acute and chronic criteria lack scientific credibility, and pointed out that EPA has proposed a fish tissue-based criterion in place of the current recommended national criteria, using "better science." EPA commented that the current national recommended selenium acute criterion, established in 1996, incorporates the relative proportions of selenite and selenate. EPA recommended in its December 19, 2012 comments that Kentucky had three options regarding acute selenium criterion for its water quality standards. EPA recommended that the Cabinet could:

1. leave Kentucky's current acute criterion in place and wait for the release of any revisions to EPA's criteria guidance;
2. adopt the acute criterion from EPA's current national §304(a) recommended guidance; or
3. **adopt an alternate criterion based on other scientifically defensible information** (emphasis added).

The Cabinet reviewed and considered the comments made at the hearing and comments submitted in writing and, in compliance with KRS 13A.280(1) filed its Statement of Consideration (SOC) and regulation amended after comments with LRC on November 14, 2012; the SOC and regulations were posted in the Administrative Register on December 1, 2012 and included notice of the December 17, 2012 ARRS meeting. In the agency's response to comments on its proposal

to remove the acute criterion for selenium the Cabinet noted that it would continue to evaluate the approach recommended by EPA in its national recommended guidance.

In compliance with KRS 13A.280(7) the Cabinet emailed or mailed to those persons who had registered to receive these documents notice of the Statement of Consideration for each regulation and provided a link to the Cabinet's website where the regulations, including 401 KAR 10:031 Amended After Comments, and the SOCs are available. The mailings and postings included notice of a hearing on the regulations before the Administrative Regulation Review Subcommittee (ARRS) on December 17, 2012. However, the Cabinet continued to receive comments, including final comments from EPA. By letter dated December 10, 2012 the Cabinet notified the LRC that it was continuing to work to address issues raised by stakeholders and would defer consideration of the proposed water quality standards to the February ARRS meeting.

Following its continued consideration of public comments on the proposed amendment to remove the selenium acute criterion, including EPA's final comments ultimately received on December 19, 2012, on January 2, 2013 the Cabinet again notified the LRC that it was continuing to work to address issues raised by stakeholders and would defer consideration of the proposed water quality standards to the February ARRS meeting On February 5, 2013 the Cabinet submitted a proposed agency amendment to 401 KAR 10:031 regarding the selenium water quality criteria, which was published on the ARRS Committee agenda for the date of the committee meeting. Included in the submittal was an explanation of why the Cabinet proposes the amendment including a description of the Cabinet's review and evaluation of selenium studies conducted since Kentucky adopted its criterion in 1990, and a technical document[1] describing in detail the science supporting the proposed criteria in the agency amendment. On the same day, February 5, 2013, this same material was sent to persons who had commented on the regulation, was posted on the Department for Environmental Protection blog website and was also sent electronically or by regular mail to persons who had registered with the Cabinet pursuant to KRS 13A.270(3). The distribution included notice of the February 11, 2013 ARRS meeting and specifically noted that the public

[1] Titled, *Update to Kentucky Water Quality Standards for Protection of Aquatic Life: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria*.

may be heard on the amendments at the Subcommittee hearing. As a result of the agency notification, some comments were received by the agency from interested parties on or prior to February 11, 2013, including several dozen phone calls received by the agency.

On February 11, 2013 at the ARRS public meeting in Room 149 of the Capital Annex in Frankfort members of several environmental groups prominent and active in Kentucky were heard regarding the proposed amendment. In response to their comments, the Cabinet voluntarily elected to defer consideration of the regulation by the ARRS subcommittee until the next ARRS committee meeting on March 12, 2013. On February 12, 2013 the Cabinet issued a press release describing the proposed changes to the selenium criteria, the Cabinet's rationale for the proposal and the scientific analyses supporting the proposed new criteria. The press release also included an invitation for those interested to comment further on the proposed criteria to the Division of Water through March 1, 2013 and instructions on how to do so. On February 14, 2013 the Cabinet notified a number of interested stakeholder groups that the Cabinet would hold two additional meetings at which they would again be heard and ask questions regarding the proposed amendments.

The stakeholder meetings were held on February 22 and February 26, 2013 at the Department of Environmental Protection office in Frankfort. Both meetings were attended by Cabinet personnel who could respond to questions, including the Commissioner for the Department of Environmental Protection, the Director and Assistant Director of the Division of Water, technical staff, including the author of the technical document, and other Cabinet staff. Those in attendance and participating by phone included several representatives of multiple environmental organizations that commented at the February 11 ARRS meeting, federal stakeholders including U.S Fish and Wildlife Service, EPA Region 4, and representatives of business and commercial stakeholders, and one member of the media. All persons who wished to speak present, or ask questions at these meetings had the opportunity to do so. The meetings convened at 10:00 am and 1:00 pm on February 22 and February 26, 2013, respectively, and continued for as long as people wished to speak or ask questions.

On March 8, 2013 in order to more fully consider the comments made at the February 22 and 26 stakeholder meetings as well as written comments submitted by stakeholders and other members of the public on the proposed selenium amendment, the Cabinet deferred the regulations from the March 13, 2013 ARRS hearing on the proposed selenium criteria to the April 9, 2013 ARRS meeting.

Subsequent to the February 11, 2013 ARRS public hearing, the stakeholders meetings on February 22 and 26, 2013, and review and consideration of all oral and written comments, the Cabinet re-filed the proposed amendment to the selenium criteria, statement of consideration of comments, and the supporting technical document including bibliography on April 3, 2013.

In addition to complying with KRS 13A, the procedures, above, followed by the Cabinet in conducting the Triennial Review also comply with EPA requirements for public hearings, set out at 40 CFR 25.5(b). That regulation provides that:

> (b) *Notice.* A notice of each hearing shall be well publicized, and shall also be mailed to [a list of persons and organizations who have expressed an interest in or may . . . be affected by or have an interest in the covered activity] . . . . The notice shall identify the matters to be discussed at the hearing and shall include or be accompanied by a discussion of the agency's tentative determination on major issues (if any), information on the availability of a bibliography of relevant materials . . . and procedures for obtaining further information. Reports, documents and data relevant to the discussion at the public hearing shall be available to the public at least 30 days before the hearing.

The September 27, 2012 public hearing, the February 11, 2013 public hearing before the ARRS, and the April 9, 2013 ARRS public hearing have all been well publicized and in accordance with 40 CFR 25.5(b) above, and KRS Chapter 13A. Notice of the additional meetings with stakeholders was widely disseminated to interested persons. On February 5, 2013 access to the proposed selenium criteria and the supporting technical document, including bibliography, were

provided by mail or email in the format of links to the Division of Water's website to all those who attended the public hearing or submitted written comments, and to all who had registered with the Cabinet in accordance with KRS 13A.270. In addition, this information was posted on the Department's website blog and on its web page; all in compliance with KRS Chapter 13A. A press release was issued on February 12, 2013.

The commenter is incorrect to conclude that the agency decisions were "predetermined.". In its response to comments on the original proposal to delete the chronic selenium criterion, the Cabinet acknowledged that it would continue to consider EPA's recommended option 3, that Kentucky propose a new criterion based on scientifically defensible evidence. The proposed acute and chronic criteria are a result of that consideration. Further, the Cabinet has made available the technical document detailing the steps the Cabinet took in developing the proposed criteria, has provided for and solicited public participation in the review of the proposed criteria by press release, mailings, electronic notification, website postings, stakeholder meetings, and more. The Cabinet has received no information of either a scientific or anecdotal nature tending to call into doubt either the process it used to develop the criteria, nor the criteria themselves. The Cabinet undertook exhaustive research and analysis which it has presented to the public for full review and comment.

By letter dated March 7, 2013 the Cabinet again notified the LRC that it would defer consideration of the proposed water quality standards to the April ARRS meeting as the Cabinet was continuing to work to consider and respond to issues and concerns raised by stakeholders during the comment period ending March 1, 2013. Given that the proposed changes to the selenium water quality criteria and the supporting information were widely noticed on February 5, 2013 and that the proposed changes will not be heard by ARRS until April 9, 2013, all material has been made available well in excess of 45 days before the public hearing.

Finally, should there be any conflict between Kentucky's rulemaking requirements in KRS Chapter 13A and the requirements of 40 CFR part 25, KRS Chapter 13A controls. 40 CFR part 25.10(b)("[I]n the event of conflict between [this section] and a provision of a State's administrative procedures act, the State's law shall apply").

(9) Subject Matter: Proposed acute criterion will not protect Kentucky's streams for the designated use of warm water aquatic habitat

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: The proposed acute criterion is identical to the one that the EPA proposed in 2004 but never adopted. EPA's 2004 attempt to set the acute aquatic life criterion was the first time EPA did so in conjunction with a bioaccumulative toxin and tissue based criterion. EPA was criticized by the leading scientific experts in the field for addressing neither the bioaccumulative nature of selenium nor the harm caused by large loads of the toxin entering waterways. The acute and chronic criteria should work together. Setting the acute criterion at the proposed level would inevitably lead to bioaccumulation at a toxic level greater than the proposed tissue-based criterion. DOW should consider impacts on the food web from short duration selenium loads when setting the acute selenium criterion.

(b) Response: The agency is aware of the concern but respectfully disagrees with the commenter's conclusions. The proposed acute water quality criterion for selenium is protective of Kentucky's streams for the designated use of warm water aquatic habitat. Please also refer to previous response to Comment (6).

Spikes (or pulses) of selenium discharges to streams are not expected to result in problematic levels of selenium bioaccumulation in the producer or primary consumer community (fish) in violation of water quality criteria. For example, for coal mining operations the hydrological setting for potential pulses is discharge from a sediment pond at the toe of a valley fill to a stream below. Science supports the understanding that in the oxidizing conditions as found in these receiving streams, selenium that is not already in the selenate form is readily transformed to that species, which is the least bioavailable form of selenium; therefore, the species of selenium least likely to result in toxicity effects. Thus, the Cabinet's utilization of total selenium is a conservative approach for assuring protection of the aquatic habitat, and adds an additional margin of safety by considering the toxicity potential for all species of selenium to be equal. The KPDES permit will require that effluents samples be analyzed for total selenium. Where chronic concerns are present, results in excess of the proposed threshold chronic concentration value of 5.0 µg/L will trigger fish-tissue sampling to ensure compliance with the proposed water quality criteria. This protective threshold is further discussed in Appendix B of: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013), along with supporting

information that addresses the appropriateness and supporting data for the use of 5.0 µg/L as a screening value.

To protect against short-term exposure to selenium at toxic levels the Cabinet has proposed an acute selenium criterion that is a modification of the EPA draft 2004 criterion, which is itself a modification of EPA's current nationally recommended acute criterion (National Recommended Water Quality Criteria, accessed March 20, 2013). In its draft 2004 acute criterion EPA recognized that selenite is the most bioavailable inorganic species of selenium. Therefore, the Cabinet proposed updated acute criterion sets the Continuous Maximum Criterion (CMC) lower for that species of selenium. The Cabinet proposes an additional margin of safety by capping the acute criterion at 258 µg/L, as total selenium. In addition, the Cabinet's proposed acute criterion also assumes the entire fraction of selenium in the water column to be selenite so is thereby more protective than EPA's draft criterion.

By capping the proposed acute criterion at 258 µg/L, the Cabinet limits the use of the equation in the draft 2004 EPA criterion that modifies the calculation of the CMC for selenate in the presence of sulfate in the water column. However, should a water body have a sulfate concentration that is less than 44 mg/L, the applicable acute criterion will be lower than 258 µg/L. Sulfate data from the DOW's 72-station ambient water quality network had a mean sulfate concentration of 95 mg/L for the period of 2007 though 2011. Of those 72 stations, 43 had mean sulfate concentrations less than 44 mg/L.

In 2002 and 2004 the EPA presented the research results it considered when revising the acute criterion. This revision maintained the CMCs for selenite and selenate in recognition of the differential toxicity of the two species of selenium. The draft criterion also incorporated data from assays that support water column sulfate as a modifier of selenate toxicity, and recognizes the dietary pathway for chronic toxicity of selenium (Canton 1999; Brix *et al.* 2001a,b; EPA 2002 and 2004). The draft acute criterion accounted for the modifying effect of sulfate in the water column on acute toxicity of selenate due to the competition for the two substances in aquatic animals (Brix, *et al.* 2001a; Ogle and Knight 1989; Riedel and Sanders 1996). This relationship is similar to the effect hardness has on the toxicity of certain metals (*e.g.* copper, lead and cadmium); as hardness increases toxicity of these metals decrease. This relationship reflects the sulfate-selenate acute toxicity effect wherein there is an inverse relationship between sulfate and selenate as related to acute toxicity. Sulfate competes

with selenate in the uptake into aquatic organisms (Ogle and Knight 1989; Riedel and Sanders 1996; Bailey *et al.* 1995; Hansen *et al.* 1993). Since the uptake of selenate into organisms is reduced as sulfate concentration increases, this reduces the toxicity of selenate to the organisms (Brix *et al.* 2001a). Thus, sulfate is used for correction to the toxicity of selenate. When developing the sulfate correction equation, the EPA took into account the variability of selenate toxicity to different life stages and test conditions of the studies used to determine the sulfate slope that contribute to the uncertainty of the sulfate correction. The regression analysis (a statistical tool for the investigation of relationships between variables) showed significant, positive slope for five of six species that had precisely determined acute values. An F-test (statistical test) indicated that the null hypothesis could not be rejected. "Analysis of covariance thus confirmed it is correct to assume there is no significant variation in slopes among species and that the overall slope is a reasonable estimate of the relationship between sulfate concentration and selenate toxicity" (EPA 2004). Note, an analysis of covariance is a measure of how much two variables change together and the strength of the relationship between them.

Given the new and additional studies that went into development of the Cabinet's proposed acute criterion the Cabinet considers adoption of this formula, as updated with more recent acute selenite and selenate data, to be a scientifically sound.. Furthermore, acute criteria are developed to protect the aquatic habitat from short duration concentrations that lead to lethality; the toxicity effects of selenium exposure to acutely toxic levels are not a result of bioaccumulation. Rather, exposure to waterborne concentrations of a toxin at acutely toxic levels may result in mortality. Both the acute and chronic criteria in fact work as intended, the former to protect against high concentrations of a short duration that lead to lethality and the latter to protect against long duration at low concentrations to protect against chronic toxicity effects (*e.g.* teratogenic effects). Additionally, the acute and chronic criteria were developed through data generated by appropriate methods that account for the different modes of selenium toxicity. The chronic toxicity effects are primarily teratogenic that result from relatively long exposures to low-levels of selenium that are cycled through the food web via a dietary pathway. Through implementation of the criteria, ultimately the chronic criteria will be the regulatory driver for protection of water bodies.

(10) Subject Matter: Sulfate will not reduce bioaccumulation of selenium in ecological

settings

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: DOW erroneously claims that "the presence of sulfate in the water column modifies or attenuates the potential acute toxicity effects of selenite." The USFWS in its Technical Review: Smoky Canyon Mine Site-Specific Selenium Criterion Report in January 2012 explains that sulfate has not been shown to mitigate selenium toxicity in the field. The inclusion of a sulfate factor in Kentucky's proposed acute selenium criterion is not scientifically defensible and must be withdrawn.

(b) Response: The agency recognizes the concern of the commenter but respectfully disagrees with the commenter's understanding of Kentucky's proposed acute water quality criteria for selenium.

In contrast to EPA's 2004 draft proposal, Kentucky's proposed acute criteria for selenium partially takes into account the ameliorating effect of sulfate on selenium toxicity in Kentucky's proposed acute criteria for selenium. The Cabinet proposes an additional margin of safety by capping the acute criterion at 258 µg/L. The Cabinet proposes an additional margin of safety by capping the acute criterion at 258 µg/L~~, as total selenium~~. In addition, the Cabinet's proposed acute criterion also assumes the entire fraction of selenium in the water column to be selenite so is thereby more protective than EPA's draft criterion.

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(11) Subject Matter: DOW's proposed whole-body fish tissue criterion of 8.6 µg/g is too high

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: DOW is proposing a whole body fish tissue criterion of 8.6 µg/g that is even higher than the scientifically flawed and highly criticized EPA proposal from 2004. In a peer reviewed critique of EPA's 2004 proposed whole body fish tissue criterion (7.91 µg/g) experts explained that a while body fish tissue concentration "approaching 5.8 µg/g – although considerably lower than the proposed criterion value and innocuous in summer – became a

grave risk in winter conditions." In other words, for a criterion to be protective in the winter months when fish are stressed, the whole body criterion has to be less than 5.8 µg/g.

(b) Response: The agency is aware of the concern but respectfully disagrees with the commenter's conclusions.

The Cabinet adhered to the EPA's *Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses* (Stephan *et al.* 1985). This is the same guidance used by EPA to derive numeric toxicity criteria. Criteria for the protection of the aquatic habitat is developed under conditions that either mimic natural conditions, such as a microcosm, or under well-established protocol for conducting bioassay tests in the laboratory.

The following is an overview of the factors involved in the EPA's 1985 guidance for deriving numerical water quality criteria document (Stephan *et al.* 1985) hereinafter "Guidelines"). The salient factors are:

(1) Acute toxicity test data are gathered from all suitably developed studies. Data need to be available for species representing eight families from a diverse assemblage of taxa;

(2) The Final Acute Value (FAV) is derived by extrapolation or interpolation to a "hypothetical genus" (*N.B*. Per the 1985 Guidance, which taxon being considered is not critical. The data from the SMAV derivations is used to derive GMAVs. From that range of the four most sensitive genera, the FAV that represents the 5th percentile is considered as a "hypothetical genus," which is more sensitive than 95 percent of a diverse assemblage. See Section 2.1 of *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria*; Payne 2013.) The FAV represents the LC_{50} (concentration having lethal effect on 50 percent of the study population) or EC_{50} (concentration causing observed toxicity effects on 50 percent of a test population).The FAV is divided by two to obtain an acute criterion protective of nearly all individuals in such a genus;

(3) Chronic toxicity test data (those test exposing taxa to longer-term survival, growth and reproductive success) require at least three taxa. The common approach to determine a chronic criterion is accomplished through an appropriate acute-chronic ratio (the ratio of acutely toxic concentrations to the chronically toxic concentrations) and applying that ratio to the FAV determined from factor (2) above; and

(4) When necessary, the acute and/or chronic criterion may be lowered to protect critically important species (*e.g.* endangered species).

The primary chronic toxicity pathway for selenium is by bioaccumulation through diet, a different pathway than many toxicants. Because of this dietary pathway for selenium toxicity Step (3), above, is not the appropriate approach to determine chronic criterion for a substance like selenium. The Guidelines incorporate language allowing for "appropriate modifications" of the procedures if necessary to obtain criteria that are based on sound science.

Applying the Guidelines, the DOW incorporated appropriate data from studies used in EPA's 2004 draft criteria development and additional data from 82 more recent studies. The Cabinet evaluated fish data from a number of studies relating to the chronic toxicity of selenium to fish. Calculations were made for chronic values such as the no-effect concentration (NOEC), low-effect concentrations (LOEC) and the EC_{10} (point estimate of effect concentration at the 10 percent level). Additionally, toxicity data summarized by Ohlendorf (2008), DeForest and Adams (2011) and DeForest *et al.* (2012) were considered to ensure the data were complete.

In order to use as many qualifying data points as possible, the available data was translated from whole body to egg/ovary and vice versa. Data were converted from whole body to egg/ovary and vice versa using the translation equations from: (1) EPA (2004) for bluegill, (2) GEI (2008) for fathead minnow, and (3) GEI *et al.* (2008) for bluegill, cutthroat trout and both species combined to derive an all-species equation.

With regard to winter stress, the Cabinet considered a comprehensive body of the published references on the subject. When EPA presented its draft criterion in 2004 there was one study published by Lemly (1993) that had observed a potential seasonal effect. Recently, EPA conducted a similar study (McIntyre *et al.* 2008) using water temperatures of 4°C and 9°C and reported EC_{10} of 9.56 and 13.3 µg/g whole body dry wt, respectively. Additional studies evaluated selenium exposure in outdoor microcosms that commenced in late summer and continued through winter and spawning in the spring (Hermanutz *et al.* 1996, Hamilton 2002). These data include a winter conditions component in natural environments, which is closer to

representing real-life conditions than modeling winter stress conditions in the laboratory. Each study exposed test organisms to multiple water and dietary selenium concentrations; however, neither study reported excessive additional mortality of selenium-exposed test organisms during winter months. The results of these studies do not support sole application of the Lemly (1993) "winter stress" study to Kentucky waters. Furthermore, a temperature regime of 4° C for 180 consecutive days is not representative of Kentucky streams, rivers and lakes.

When deriving the chronic criteria the Cabinet considered all appropriately derived chronic data to calculate the species mean chronic value (SMCV) for relevant fish species in keeping with the Guidelines. Many values were derived from other sources that represent offspring mortality endpoints, often considered more sensitive endpoints than juvenile or adult mortality for many species (Gillespie and Baumann 1986; Schultz and Hermanutz 1990; Coyle *et al.* 1993; Holm *et al.* 2003).

The Cabinet derived GMCVs for 10 species (Table 2, *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria*; Payne 2013). Based on this analysis of relevant Kentucky-specific data, the bluegill remains the most sensitive taxa of species in Kentucky when whole-body data are considered whereas the brook trout is the most sensitive taxa based on egg/ovary data.

In making comparisons among the taxa considering sensitivity rank between whole-body and egg/ovary chronic values, the Salmonidae or Centrarchidae each had a taxon that ranked one or two, depending on the tissue residue considered. In addition to these two families representing the most sensitive taxa of Kentucky fishes, species in these families are arguably representative of some of the most recreational, and by extension economically, valuable fishes in the Commonwealth. The white sucker is distributed statewide and is found in wadeable streams, excluding the lowland streams of the coastal plain in western Kentucky; note, the Western Mosquitofish is found in the streams of that province. The fathead minnow is ubiquitous in a large portion of Kentucky's headwater streams, which is important with regards to distributional and aquatic community composition.

Based on the latest available science and accounting for species present in Kentucky, the fish-tissue chronic criteria for selenium of 8.6 µg/g is protective of the aquatic habitat stream-use designation

in Kentucky waters and is consistent with state and federal requirements.

(12) Subject Matter: DOW's proposed egg/ovary criterion of 19.3 µg/g is too high

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: DOW is proposing an egg/ovary fish tissue criterion of 19.33 µg/g that is even higher than the scientifically flawed EPA proposal from 2010. The result is a criterion that will not protect selenium-sensitive species important to Kentucky such as bluegill and catfish.

(b) Response: The agency is aware of the concern but respectfully disagrees with the conclusions of the comment.

The egg/ovary criterion (19.3 µg/g dry wt) is directly proportional to the whole body criterion discussed in response to Comment (11), but calculated on a tissue-appropriate equation. Therefore, much of the response as provided in the discussion to Comment (11) above is directly applicable to this question.

The exposure method for this test using catfish from Doroshov *et al.* (1992) was from direct injection. This method is not considered to be empirical; EPA has rejected use of all studies based on this method of exposure in prior drafts of their selenium criteria document (*e.g.,* see page 6 of Appendix G, EPA 2004).

The LC_{50} calculations Doroshov *et al*. (1992) made in their report were based from data in Table 10 which only focused on the survival from fertilization through day 28. However, they summarized the data from the study in Table 9 (Doroshov *et al*. 1992) using different control data than were used for the LC_{50} calculations in Table 10 (Doroshov *et al.*1992). In Table 9, Doroshov *et al*. listed data for five different egg sacks for the control which they included when calculating average survival for all egg sacks in Table 9 (Doroshov *et al*. 1992). Doroshov *et al*. list survival as 78 percent, but the control data used were for LC_{50} calculations (Table 10, Doroshov *et al*. 1992) and only used data from one of the five batches. The control data (97 percent) used to calculate the LC_{50} was skewed lower than it would be if the lower control survival data (78%) were used, suggesting that the results would have been different if all control data were used, which also suggests significant differences in control survival among the egg sacks.

More importantly, the 78 percent control survival value reported in Table 9 (Doroshov *et al*. 1992) is not considered passing based on EPA chronic methods. Regardless of the fact the exposure method

(*i.e.* direct injection) did not follow EPA's test acceptability guidance (*i.e.* direct injection), this study would potentially have been rejected due to insufficient control performance.

The Doroshov *et al*. study focused on larval mortality; no effect could be seen on larval growth. The authors of the study mentioned that the lack of effects on growth might be due to less "loading" (*e.g*., numbers and weight of fish per volume of test water) due to mortality in the higher concentrations. While possible, their loading rate in the controls was still well below the loading requirements for Whole Effluent Toxicity (WET) tests; therefore, it is not clear if loading would have affected weights in this test, suggesting the lack of effects on growth may be real.

Bluegill (*Lepomis*) is the most sensitive taxon of fish to chronic selenium toxicity effects at low levels as determined by EPA (2004). The Cabinet's derivation of chronic criterion for whole body using the studies considered by EPA in 2004 and subsequently published study data also considered bluegill as the most sensitive taxon. EPA did not include chronic values from Lemly (1993) of >6.0 µg/g, Cleveland *et al.* (1993) and Hermanutz *et al.* (1996) in the *Lepomis* SMCV calculation; EPA provide detailed a explanation of why these chronic values were excluded. The reason for the exclusion of the Lemly data point was that the other reported tissue value from the same study at which a significant effect was observed, was in the database and used in the SMCV calculations. The explanation given regarding the exclusion of Cleveland *et al.* (1993) data was that the exposure of the fishes to aqueous concentrations of selenium did not include the important dietary exposure relevant to a bioaccumulative toxicant. The reasoning behind exclusion of the Hermanutz *et al.* (1996) data was not so apparent given their values were well within the range reported for this species. One of the toxicological endpoints was larval edema (abnormal fluid accumulation); commonly a selected manifestation used by the EPA over other data used from fish species for calculations of the SMCV (*e.g*. fathead minnows). For this reason and to maintain consistency, the Hermanutz *et al.* (1996) data point was included in the calculation of a revised SMCV for bluegills. The Lemly (1993) and McIntyre *et al.* (2008) usable data were translated to whole-body concentrations using the bluegill ovary-to-whole body translation equation found in GEI *et al.* (2008); this equation updated the Equation II used in EPA (2004).

Three other studies for bluegill, Doroshov *et al.* (1992) and Coyle *et al.* (1993) and McIntyre *et al.* (2008) were also determined to be

usable. The recent studies from the West Virginia Department of Environmental Protection (WVDEP,2010) were not usable due to lack of matched adult and egg/ovary tissue concentrations and larval response.

Based on the latest available science and accounting for species present in Kentucky, the fish-tissue chronic criteria for selenium of 19.3 µg/g is protective of the aquatic habitat stream-use designation in Kentucky waters and is consistent with state and federal requirements.

(13) Subject Matter: The proposed tiered approach would allow harmful bioaccumulation of selenium and would not protect all aquatic life

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates; Casey Henson

Comment: In addition to relying on fish tissue criteria that are too high, the tiered approach is flawed for a number of other reasons:

- It exempts fishless streams from the criterion so that other aquatic organisms such as salamanders, crayfish, or insects have no protection from chronic selenium toxicity;
- If sensitive species have already been extirpated, the tiered approach will miss that extreme impairment;
- The approach calls for composite samples of an entire species that will miss the variation and individual differences and toxicity within a species depending on, among other things, age, individual diet, areas of forage and duration of stay in polluted waters. Use of a composite sample is not scientifically defensible for evaluation of impacts on a given species. If a composite sample exceeds the proposed criteria it will help assure that the reproductive capabilities of sensitive species will collapse. This is illustrated by selenium's sharp toxicity curve, which shows that once significant bioaccumulation of selenium occurs, tiny increases in selenium will result in total collapse of reproduction.

(b) Response: The agency understands the concern but respectfully disagrees with the comment conclusions.

Water quality criteria are developed to protect the designated uses of waters. Whether a waterbody contains fish or other species sensitive to the parameter for which criteria have been developed, the criteria are designed to protect the habitat and its inhabitants. Whether a waterbody contains fish or other species, the criteria are designed to protect the most sensitive aquatic species, thereby protecting all the species in the waterbody. If fish or other species are extirpated from a waterbody due to water quality, the stream is impaired and the Cabinet would take appropriate actions (*e.g.*

TMDLs, controls in KPDES permits, watershed based plans) to restore the waterbody to its designated uses.

Fish have been determined to be the aquatic organisms most sensitive to selenium toxicity. The toxic effects of chronic selenium exposure are primarily from dietary uptake. Therefore, consideration has been given to organisms that fish prey on. However, that approach ultimately proved inappropriate for two reasons, (1) the concentration of selenium in the diet is an indirect measure of effects observed in the test species and this type of criterion does not consider feeding variables of the target species, and (2) the selection of appropriate organisms to monitor for protection of the fish community is problematic given the variability of the range of prey species that are represented across the diverse fish community.

To provide assurance that the aquatic habitat is protected from potential chronic toxicity effects of selenium, a two-step monitoring approach is proposed. The most sensitive organisms in the aquatic environment are egg-laying vertebrates (Chapman *et al.* 2010); therefore, for fish, there should be two levels of protection from chronic selenium toxicity:

1) an appropriate level of protection that will provide reasonable certainty there will be no deleterious effects, (*e.g.* water quality criteria); and
2) a lower level of protection that if exceeded, will trigger focused monitoring to determine whether there is reason to expect that there may be adverse effects in advance of the primary level of protection (*e.g.* screening value) (Chapman 2005).

Based on the current science, the Cabinet concludes that a tiered chronic selenium standard is advisable.

Tiering is itself a two-step strategy. Tiering provides an additional margin of safety and confidence that there are no adverse effects to fish occurring due to chronic selenium toxicity. If the threshold value of 5.0 µg/L total selenium in the water column is not exceeded, then the water body is in attainment of the selenium chronic criteria. Additionally, as a screening threshold that if exceeded will trigger fish-tissue analyses, exceeding the 5.0 µg/L threshold does not indicate adverse effects are occurring or are likely to occur. Rather, exceeding the threshold only indicates that the selenium concentrations in the environment are reaching a point where the margin of safety is reduced to a point where an additional level of assurance is warranted. If the total selenium

concentrations in fish tissue are below the applicable criteria, 8.6 µg/g dry wt whole body or 19.3 µg/g dry wt egg/ovary, the chronic criteria have been met. This margin of safety is achieved by utilizing the most sensitive fish species to derive chronic criteria (Stephan *et al.* 1985).

Study data utilized in the Cabinet's derivation of chronic selenium criteria were produced under qualifying rigor and repeatable conditions. Fish species that are native to Kentucky, naturalized or serve as appropriate species surrogates were used to develop state-specific criteria that would be protective of Kentucky's aquatic habitats. The most sensitive fish species with available data meeting the necessary level of study design rigor for derivation of chronic criteria is the bluegill. Bluegill is the most sensitive species on a national level and was the driver in EPA's 2004 draft criteria. The Cabinet adhered to EPA's *Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses* (Stephan, *et al.* 1985) Utilizing the four most sensitive species to calculate the final chronic value (FCV) ensures that the entire range of fish species in the Commonwealth is protected. In fact, the Cabinet took additional steps to increase the margin of safety with regard to setting chronic and acute criteria. In addition to the safety margin built into the equations to derive the FCV, the EC_{10} (point estimate of effect concentration at the 10 percent level) was utilized rather than the acceptable EC_{20} level EPA used in the 2004 draft criterion. To illustrate the safety margins built into the Cabinet's approach, the GMCV for the most sensitive taxa, bluegill, was 8.92 µg/g whole body dry wt; however, the derived FCV is 8.6 µg/g whole body dry wt and is the criterion proposed by the Cabinet.

To assure comparability of intra- and inter-specific fish-tissue data the Cabinet will develop a Standard Operating Procedure for collection and analysis of fish tissue samples. The EPA has a nationally recommended methylmercury criterion for the protection of human health associated with fish consumption. In the implementation guidance for the methylmercury criterion (EPA 823-R-10-001, April 2010), use of composite samples is recommended. Among the important points for consideration is maintaining composites of the same species and size; size is related to length and all composite samples should contain only individuals that have lengths within 75 percent of the total length of the largest individual per composite sample.

(14) Subject Matter: The proposed chronic fish tissue criteria are effectively

unenforceable and are not compatible with meaningful development of effluent limitations in KPDES permits

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: DOW has not explained how it intends to incorporate the proposed criteria into enforceable measures needed for KPDES permit limits, TMDLS, and other pollution control decisions required by the Clean Water Act.

(b) Response: The agency understands the concern but respectfully disagrees with the comment conclusions.

Much of the discussion with stakeholders at the two meeting held February 22 and 26, 2013 was about implementation. Nevertheless, implementation is a separate consideration from the technical evaluation of the proposed standard. The Cabinet will propose measures to implement the proposed criteria in compliance with KRS Chapter 13A and all applicable law, including procedures for public notice and comment by all interested parties.

The selenium criteria, like other standards, will be enforced through effluent limits in KPDES permits. If a KPDES permit application indicates reasonable potential for a discharge to exceed the chronic water quality standard for selenium, the permit will include a threshold of 5 µg/L total selenium which if exceeded will require fish tissue sampling. The permit limit for whole-body fish tissue will be 8.6 µg/L total selenium (dry weight) or 19.3 µg/L total selenium (dry weight) for egg/ovary tissue. If the application indicates reasonable potential for a discharge to exceed the acute selenium water quality standard the permit will include an acute limit for selenium of 258 µg/L total selenium.

Similarly, the selenium criteria will be applied in implementing a TMDL like any other water quality criteria.

(15) Subject Matter: The proposed criteria will not protect wildlife dependent on aquatic habitat for survival

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: Because DOW's proposed chronic criteria only look at fish tissue concentrations, they fail to protect other wildlife that depend on aquatic habitat for food sources other than fish.

(b) Response: While the Cabinet recognizes the concern and interest in protecting avian and terrestrial communities, the goal of the Clean Water Act is to restore waters to be fishable and swimmable. Every Kentucky water quality standard is designed to protect human health and the environment by implementation of criteria that protect our public drinking water sources that prevent tainting of fish flesh that may

be consumed by humans, or that protect habitat for aquatic species. In fact, EPA's *Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses* (Stephan, *et al.* 1985) address bioassays for aquatic species. The U.S. Fish and Wildlife Service and the Cabinet have discussed information and data that the two agencies possessed regarding aquatic and terrestrial toxicity effects from selenium. The U.S. Fish and Wildlife Service reports that they have no Kentucky-specific data, observed or empirical, that raises a concern about selenium toxicity within the avian or mammalian communities. The DOW and U.S. Fish and Wildlife agreed to share any future data that may indicate selenium toxicity concerns in the environment and address those concerns as appropriate.

(16) Subject Matter: EPA will not be able to approve the criteria because of their impacts on threatened and endangered species

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: Although, the Cabinet does not have obligations under the Endangered Species Act related to its revision of water quality standards, EPA's approval of those standards, required by 40 C. F. R § 131.21, does trigger the requirements of the ESA. EPA, USFWS, and the National Marine Fisheries Service have a Memorandum of Agreement (MOA) that governs protection of endangered and threatened species under Section 7 of the Endangered Species Act, 16 U.S.C. § 1536 in regard to, among other things, revisions to water quality standards. As USFWS's strident criticism of EPA's proposed and withdrawn standards shows, DOW's proposed criteria fail to adequately protect organisms that depend on aquatic habitat for survival. Those criteria are likely to jeopardize threatened and endangered species and thus cannot be approved by EPA.

(b) Response: The USFWS criticisms of EPA's 2004 proposed criteria did not relate to the proposed Kentucky-specific standard, but rather to a proposed national water quality criteria for selenium primarily with regard to chronic concerns. By letter dated March 7, 2013, the USFWS commended the DOW for considering fish tissue selenium concentrations as criteria in regulating Kentucky's water quality. USFWS noted that: "We agree with DOW that some selenium models do not apply to Kentucky, and that fish tissue concentrations will be a strong standard by which designated uses can be maintained."

The proposed criteria are based on the most selenium-sensitive species of fish native or naturalized to Kentucky or which serve as appropriate surrogates for Kentucky species and are available for study. Threatened and endangered species are generally not

available for such studies because of their protected status. However, there are waters in Kentucky that provide habitat for threatened and endangered species; these waters are automatically designated as Outstanding State Resource Waters which are provided additional water quality protections that also serve to protect the threatened and endangered species.

The Division of Water is required to submit new and revised water quality criteria to EPA for approval. EPA will review Kentucky's submittal pursuant to authority granted it by the Clean Water Act.

(17) Subject Matter: DOW's calculation of final chronic values for selenium will not protect sensitive and recreationally important species in Kentucky's waters

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: Data on the effects of selenium on channel-catfish were not included in the development of the criterion, and the GMCV for bluegill (Lepomis) was skewed as a result of DOW's inappropriate inclusion of some studies and flawed interpretation of others. DOW's calculation of the FCVs for both whole body and egg/ovary is inappropriately lax because it is not derived to protect the most sensitive recreationally-important species in Kentucky's waterways.

(b) Response: The agency respectfully disagrees with the comments.

The Cabinet is unaware of any published studies of toxicity effects on channel catfish exposed to selenium that meet the EPA's Guideline and the criteria set forth by the Cabinet. A report to the State of California Water Resources Control Board by Doroshov, *et al.* (1992) was not considered valid by EPA in the 2004 draft selenium criteria update, nor is it listed in the forthcoming national draft selenium criteria (Aquatic Life Criteria for Selenium: References for Selenium Chronic Toxicity Data Obtained Since 2004, accessed March 22, 2013). The study on catfish which the commenter suggests be included as a part of Kentucky's development of water quality criteria for selenium was based on selenium artificially injected into aquatic species. Injection of toxicants has been dismissed in every version of EPA's analysis of selenium that the Cabinet has reviewed as exposure not relevant for toxicity-based evaluations. To derive scientifically defensible and approvable criteria, data used for criteria development must meet the minimum requirements identified in EPA's *Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses* (Stephan, *et al.* 1985) along with additional parameters described in the technical paper: *Update to Kentucky Aquatic Life Standards: Acute Selenium*

Criterion and Tissue-Based Selenium Chronic Criteria (Payne 2013). Those additional parameters are as follows:

- Exclusion of tests using only aqueous selenium exposure given the irrelevance of those data for derivation of chronic criteria based on the known dietary pathway for exposure to chronic levels of selenium toxicity (GEI *et al.* 2008, DeForest and Adams 2011).

- The EC_{10} values were used to err on the side of conservative values and for consistency with recent approaches (DeForest and Adams 2011).

- When both egg and ovary data were available for a study, the geometric mean of the two values was used to calculate the chronic value for egg/ovary tissue.

The DOW did review the Doroshov *et al.* (1992) paper but could not use the results because the study did not use established protocols under test conditions and the mode of exposure of the catfish brood stock was injection with organoselenium. Finally, there was no accounting for how or whether the stress of repeated handling affected the brood stock.

EPA (2004) has determined that bluegill (*Lepomis*) is the taxon of fish most sensitive to chronic selenium toxicity effects at low levels.The Cabinet's derivation of chronic criterion for whole body using the studies considered by EPA in 2004 and subsequently published study data also considered bluegill as the most sensitive taxon. EPA did not include chronic values from Lemly (1993) of >6.0 µg/g, Cleveland *et al.* (1993) and Hermanutz *et al.* (1996) in the *Lepomis* SMCV calculation; EPA provided a detailed explanation of why these chronic values were excluded. The reason for the exclusion of the Lemly data point was that the other reported tissue value from the same study at which a significant effect was observed, was in the database and used in the SMCV calculations. The explanation given regarding the exclusion of Cleveland *et al.* (1993) data was that the exposure of the fishes to concentrations of selenium in the water column did not include the important dietary exposure relevant to a bioaccumulative toxicant. The reasoning behind exclusion of the Hermanutz *et al.* (1996) data was not so apparent given their values were well within the range reported for this species. One of the toxicological endpoints was larval edema (abnormal fluid accumulation); commonly selected the EPA over other data used from fish species used for calculations of the SMCV (*e.g*. fathead minnows). For this reason

and to maintain consistency, the Hermanutz *et al.* (1996) data point was included in the calculation of a revised SMCV for bluegills. The Lemly (1993) and McIntyre *et al.* (2008) usable data were translated to whole-body concentrations using the bluegill ovary-to-whole body translation equation found in GEI *et al.* (2008); this equation updated the Equation II used in EPA (2004).

Three other studies for bluegill, Doroshov *et al.* (1992) and Coyle *et al.* (1993) and McIntyre *et al.* (2008) were also determined to be usable. The recent studies from the WVDEP (2010) were not usable due to lack of matched adult and egg/ovary tissue concentrations and larval response.

The Cabinet reviewed data from the EPA (2004) draft and data published subsequent to the EPA study for fish families that are resident in Kentucky, or expected to occur in Kentucky (*e.g.* economically and recreationally important species) (Thomas 2011). Once the GMCVs were calculated, the most sensitive taxon based on whole body data was the bluegill; whereas the most sensitive taxon using egg/ovary data was brook trout, with the muskellunge and bluegill ranking second and third, respectively. All of these taxa are recreationally and economically important species in the Commonwealth.

(18) Subject Matter: DOW inappropriately picked some studies used to calculate the criteria and misinterpreted others.

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates, KFTC

Comment: At least 8 of the 15 studies used by DOW to calculate genus mean chronic values were either misinterpreted or should not have been used at all. For example, DOW relied on the conclusions in the McIntyre *et al.* 2008 study, even though that study was fatally flawed. Further, DOW wrongly concluded that the Hermanutz *et al.* 1996 and Hamilton *et al.* 2002 studies mimic the conditions of the winter stress study. KFTC state the proposal is based on bad science, as has been well-documented since the EPA first offered it in 2004. DOW cites research that has been found to be flawed, and ignores other important peer-reviewed research when it does not fit with DOW's intended outcomes.

(b) Response: The agency respectfully disagrees with the comments.

The Cabinet used the methods and guidance for derivation of toxic criteria published in EPA's Guidelines. The Cabinet also used additional parameters as documented in: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013) to ensure an appropriate level of rigor to its review.

The Cabinet reviewed the McInyre *et al.* 2008 study for its relevance to the topic of a possible winter stress condition. Regarding the Hermanutz *et al.* 1996 and Hamilton 2002 studies, they were conducted under conditions closely resembling natural environments and real-life conditions as opposed to modeling winter conditions in a laboratory. The Cabinet included relevant data used in derivation of the 2004 draft criteria presented by EPA in addition to the body of research with Kentucky-specific species that have been published since then.

(19) Subject Matter: DOW's criteria for study inclusion
(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates
Comment: Generally, the screening criteria used by DOW to include or exclude studies are adequate. However, the criterion based simply on whether a control was used is insufficient. A classic control is a zero exposure group. That is inappropriate for selenium because selenium is an essential nutrient.
(b) Response: The commenter is correct, selenium is an essential micronutrient. With that in mind refer to the document: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013), page 18, Section 2.2.2, first paragraph. There it is noted that control conditions considered were those conditions that reflect natural concentrations of the toxin (*i.e.* micronutrient). This was employed by the EPA as they considered only those studies that followed controls that had natural concentrations of selenium in the 2004 draft criteria document.

(20) Subject Matter: Conditions in Kentucky are sufficient to induce winter stress
(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates
Comment: DOW rejected the Lemly winter stress study as the driver of criteria based on several scientifically unjustified claims. DOW must consider the role of selenium related to winter stress as a driver in setting criteria in order to protect bluegill as an important recreational species.
(b) Response: The agency did evaluate winter stress concerns.

The Lemly (1993) study was the first to evaluate possible winter stress (water temperature at 4° C for 180 days) or seasonal variation on selenium toxicity. The EPA conducted a similar study (McIntyre *et al.* 2008) using water temperatures of 4°C and 9°C and reported EC_{10} of 9.56 and 13.3 µg/g whole body dry wt, respectively. In addition, other studies have evaluated selenium exposure in outdoor microcosms that commenced in late summer and continued through winter and spawning in the spring

(Hermanutz *et al.* 1996, Hamilton *et al.* 2002). These studies include a winter conditions component in natural environments, which is closer to real-life conditions than modeling winter stress conditions in the laboratory. Each study exposed test organisms to multiple water and dietary selenium concentrations; however, neither study reported excessive additional mortality of selenium-exposed test organisms under winter stress conditions. Therefore, these studies do not support application of the Lemly (1993) "winter stress" study to Kentucky waters.

The design of Lemly's study did not conform to the EPA's Guideline or the Cabinet's criteria for acceptable toxicity studies (*e.g.*, the Lemly study used only one treatment concentration, not a minimum of four). Secondly, the treatment exposure of elevated selenium in water, in addition to a temperature regime of 4° C for 180 days, is not representative of Kentucky streams, rivers and lakes.

(21) Subject Matter: DOW's reliance on fish tissue sampling in streams does not account for species already extirpated or protect stream uses

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: Compliance with DOW's criteria requires site-specific species composite fish-tissue data. This approach will obviously not protect species that have already been extirpated from a site due to selenium or other mining related pollution. Nor will it allow sensitive fish to re-colonize those streams.

(b) Response: See the response to Comment (13).

Water quality criteria are developed to protect the designated uses of waters. If the designated use of a water body is aquatic habitat, the criteria are designed to protect that use, whether or not aquatic organisms reside in the water body. The criteria are designed to protect the most sensitive aquatic species, thereby protecting all the species in the waterbody. If fish or other species are extirpated from a waterbody because of water quality the stream is impaired and the Cabinet would take appropriate actions (*e.g.* TMDLs, controls in KPDES permits, watershed based plans) to restore the waterbody to its designated uses.

The procedures required by EPA Guidance (1985) to develop numeric water quality criteria are predicated on protection of the most sensitive taxa. The most sensitive fish species with available data meeting the level of study design rigor for derivation of chronic criteria is the bluegill. That is the most sensitive species on a national level and was the driver in EPA's 2004 draft criteria.

(22) Subject Matter: Proposed acute criterion

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: The use of traditional guidelines for criteria development intended for non bioaccumulative toxins is inappropriate for selenium because that method does not consider additional toxicant loads to a watershed or incorporate the food web as the route of exposure. The methodology used by EPA and DOW is inappropriate.

(b) Response: The agency is aware of the concern but respectfully disagrees with the commenter's conclusions.

The Cabinet adhered to the EPA's *Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses* (Stephan *et al.* 1985) which is the same guidance used by EPA to derive numeric toxicity criteria. Criteria for the protection of the aquatic habitat are developed under conditions that either mimic natural conditions, such as a microcosm, or under well-established protocol for conducting bioassay tests in the laboratory.

The following is an overview of the factors identified in the EPA's 1985 Guidelines for deriving numerical water quality. The salient factors are:

(1) Acute toxicity test data are gathered from all suitably developed studies. Data need to be available for species representing eight families from a diverse assemblage of taxa;

(2) The Final Acute Value (FAV) is derived by extrapolation or interpolation to a "hypothetical genus" (*N.B*. Per the 1985 Guidance, which taxon being considered is not critical. The data from the SMAV derivations is used to derive GMAVs. From that range of the four most sensitive genera, the FAV that represents the 5th percentile is considered as a "hypothetical genus," which is more sensitive than 95 percent of a diverse assemblage. See Section 2.1 of *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria*; Payne 2013.) The FAV represents the LC_{50} (concentration having lethal effect on 50 percent of the study population) or EC_{50} (concentration causing observed toxicity effects on 50 percent of a test population).The FAV is divided by two to obtain an acute criterion protective of nearly all individuals in such a genus;

(3) Chronic toxicity test data (those test exposing taxa to longer-term survival, growth and reproductive success) require at least three taxa. The common approach to determine a chronic criterion

is accomplished through an appropriate acute-chronic ratio (the ratio of acutely toxic concentrations to the chronically toxic concentrations) and applying that ratio to the FAV determined from factor (2) above; and

(4) When necessary, the acute and/or chronic criterion may be lowered to protect critically important species (*e.g.* endangered species).

The primary chronic toxicity pathway for selenium is bioaccumulation through diet, a different pathway than many toxicants. Because of this dietary pathway for selenium toxicity Step (3) above from the Guidelines is not the appropriate approach to determine chronic criterion for a substance like selenium. The Guidelines incorporate language allowing for "appropriate modifications" of the procedures if necessary to obtain criteria that are based on sound science.

The procedures followed are presented in Sections 2.2.1 and 2.2.2 in Payne (2013). Therefore, studies that exposed organisms only to water column concentrations of selenium were not considered. Those studies of exposure of organisms to selenium through diet only or via the water column and diet were considered valid in the derivation of a chronic value. Additionally, the chronic criteria are based on EC_{10} which is more conservative than the acceptable observed response determined from the EC_{20} level.

(23) Subject Matter: Impacts of selenium on aquatic species other than fish
(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates
Comment: DOW's exclusive focus on fish impermissibly leads to criteria that fail to protect a diverse aquatic community or the mammals and birds that rely on that community for food.
(b) Response: See also response to Comment (11).

Since fish (egg-laying vertebrates (Chapman *et al.* 2010) are believed to be the aquatic organisms most sensitive to selenium toxicity, and the chronic toxic effects are diet-born, consideration was given to organisms that fish prey on. That ultimately proved inappropriate for two reasons, (1) the concentration of selenium in the diet is an indirect measure of effects observed in the test species and this type of criterion does not consider feeding variables of the target species and (2) the selection of appropriate organisms to monitor for protection of the fish community is problematic given the variability of the range of prey species that are represented across the diverse fish community.

While the Cabinet recognizes the interest in protecting avian and terrestrial communities, the Cabinet is charged under the Clean Water Act with developing and implementing water quality criteria primarily for protection of aquatic habitats. The U.S. Fish and Wildlife Service and the Cabinet have discussed information and data that the two agencies possess regarding aquatic and terrestrial toxicity effects from selenium. The U.S. Fish and Wildlife Service report that they have no Kentucky-specific data, observed or empirical, that raises a concern about selenium toxicity within the avian or mammalian communities. The DOW and U.S. Fish and Wildlife agreed to share any future data that may indicate selenium toxicity concerns in the environment and address those concerns as appropriate.

(24) Subject Matter: In-stream selenium levels of 5 µg/L can lead to significant impacts on aquatic life

(a) Commenter(s): Margaret Janes, Appalachian Mountain Advocates

Comment: A number of leading experts promote reducing the existing national water column criterion to a level lower than 5 µg/L. EPA researchers found significant effects in bluegill progeny with instream selenium concentrations of 2.5 µg/L. DOW's proposed screening level of 5 µg/L is not protective and does not comply with the Clean Water Act.

(b) Response: The Cabinet has determined that the proposed threshold or screening value of 5 µg/L is adequate to ensure that if exceeded there should be no chronically toxic impacts to fish, and to ensure that further investigation is initiated so that fish are not effected by selenium levels in the water.

The screening value of 5 µg/L is employed as a two-step, or tiered, process to assure that the aquatic habitat is protected from potential chronic toxicity effects of selenium. The most sensitive organisms in the aquatic environment are egg-laying vertebrates (Chapman et al. 2010). Therefore, for fish, two levels of protection from chronic selenium toxicity:

1) an appropriate level of protection that will provide reasonable certainty there will be no deleterious effects, (e.g. water quality criteria) and
2) a lower level of protection that if exceeded, will trigger focused monitoring to determine whether there is reason to expect that there may be adverse effects in advance of the primary level of protection (e.g. screening value) (Chapman 2005).

The proposed threshold value of 5.0 µg/L total selenium (Payne 2013) has been used elsewhere as a screening value, and recently

was considered within the acceptable range of threshold values by U.S. EPA (2009). With the biogeochemical processes, the presented data and the proposed two-step monitoring approach presented, the Cabinet's threshold adds an additional margin of safety to both implement the tissue-based criteria and assure the protection of Kentucky's aquatic habitats from potential adverse effects of selenium toxicity.

Since the current nationally recommended chronic criterion was established at 5.0 µg/L total selenium, that value has been used in studies and monitoring of spills as a screening value, for example the Kingston, Tennessee coal-ash spill (EPA 2009). The current body of literature regarding selenium chronic toxicity for both threshold and ambient water quality criteria (DeForest and Adams 2011; EPA 2002 and 2004) are based on total selenium concentrations. Given that dietary exposure is the primary route for chronic toxicity effects, a low water column concentration threshold will provide additional assurance triggering tissue monitoring prior to potential bioaccumulation levels that may result in chronic toxicity on fish populations and exceedence of the standard.

As a response to the 2008 Kingston coal-ash spill, the EPA (2009) prepared a Science Panel Review paper for briefing the U.S. Senate Environment and Public Works Committee staff. Two areas of particular focus addressed in this paper are:

- testing and monitoring to determine the fate and transport of selenium released from this incident (water and wildlife) considering both short- and long-term endpoints; and

- the evaluation of possible chronic selenium toxicity levels of concern for response action.

In order to respond to the committee staff and inform the public regarding any environmental toxicity from selenium as a result of the spill, the EPA proposed a risk-based tiered monitoring approach to provide answers to these questions and concerns.

Fish tissue samples were collected subsequent to the coal-ash spill between January 9, 2009 and February 12, 2009 immediately downstream of the spill site in the Emory River. The mean muscle tissue concentrations of total selenium in fishes sampled were 2.9 µg/g (dry wt) Tennessee Valley Authority (TVA) data (January 9), and 2.6 µg/g (dry wt) Tennessee Department of Environment and Conservation (TDEC) data (February 12) in largemouth bass.

Channel catfish at this location had a mean total selenium residue in muscle tissue of 1.7 and 1.2 µg/g (whole body dry wt). A second monitoring point near the mouth of the Emory River (mile point 0.5) indicated muscle tissue concentrations of total selenium in largemouth bass were little changed for the same period, 2.9 and 2.8 µg/g dry wt whole body, respectively. The EPA (2009) concluded that the selenium levels in the aquatic habitat did not reach a level toxic to aquatic life utilizing water column screening values ranging from 1 to 5 µg/L (EPA 2009).

The tissue concentrations reported above were associated with water column total selenium concentrations that ranged between 1.3 µg/L to 3.6 µg/L (of the TDEC analyzed water samples, 32 of 353 samples collected had concentrations in this range, the remaining were below detection). The TDEC laboratory established a Method Detection Limit (MDL) of 1.3 µg/L and a Method Quantification Limit (MQL) of 5.0 µg/L. The TVA collected 919 water column samples from December 22, 2008 through July 1, 2009. At time of the EPA (2009) report the TVA had validated results for 285 samples and verified the rest. The TVA MDLs ranged from 0.1 µg/L to 3 µg/L and MQLs ranged from 1 µg/L to 20 µg/L. Dissolved selenium was detected in 6 of 916 samples; concentrations ranged from 2.3 µg/L to 5.12 µg/L. All of these results were from samples collected in early January, except one that was collected on March 25, 2009. The MDL for samples where selenium was detected was reported as 0.3 µg/L with an MQL of 2 µg/L (EPA 2009). While the water quality and fish-tissue data sets are limited, these data indicate a threshold value of 5.0 µg/L would have been protective of the aquatic life in the Emory River.

The Cabinet has articulated its rationale for using the 5 µg/L threshold as an appropriate screening level in Appendix B of: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013).

(25) Subject Matter: Acute criterion

(a) Commenter(s): Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: Current selenium standards in Kentucky for acute criterion of 20 µg/L in streams. These are supported by scientific evidence and even these may be too weak to protect aquatic life. Selenium is toxic to aquatic life at very low levels and at higher levels it can be toxic to humans. The Department proposes to severely weaken the standard by increasing the acute criterion to 258 µg/L in streams or

higher based on the presence of sulfate. The proposed change to the acute criteria from 20 parts per billion (ppb) to 258 ppb is over 12 times the existing limit for selenium. The proposed acute selenium standard is unsupported by available science and will harm aquatic life. Above natural levels, it can become extremely toxic and cause severe deformities in fish. It also travels up the food chain, and becomes even more of a problem. This proposed standard is based on an EPA recommendation, one which was heavily criticized by scientists, and one that EPA eventually chose not to adopt.

(b) Response: The agency respectfully disagrees with the comments. See previous response to Comments (6) and (9).

The 20 µg/L acute selenium criterion was recommended by the EPA as a national criterion in 1987. The national recommended chronic criterion was based on field observations from Belews Lake, North Carolina and the acute standard was determined by applying an acute-to-chronic ratio in reverse from the chronic value (Canton 1999). That is not an appropriate method of deriving acute criteria. The Cabinet concluded it appropriate to propose an acute aquatic life criteria for selenium based on current available data gleaned from species that reside in Kentucky.

Further, the 20 µg/L acute criterion was subject to litigation in federal court. In *American Iron and Steel Institute v. EPA*, D.C. Cir. No. 95-1348 (1997) the District of Columbia Circuit Court considered a challenge to the "Final Water Quality Guidance for the Great Lakes System" promulgated by EPA in 1995. In the course of the litigation EPA moved the court to remand the acute selenium criterion. On September 19, 1996 the court issued an order vacating the criterion. Following this decision, EPA re-examined the criterion and proposed a new recommended national water quality criterion for acute selenium that accounts for the differing toxicities of the fractions of selenite and selenate to aquatic life in a waterbody.

The acute criterion the Cabinet has proposed for adoption is a modification of the EPA draft 2004 criterion, which is itself a modification of EPA's current nationally recommended acute criterion (National Recommended Water Quality Criteria, accessed March 20, 2013). The current nationally recommended criterion was revised in the draft 2004 criterion by the recognition that selenite is the most bioavailable inorganic species of selenium. The Kentucky updated acute criterion now has the Continuous Maximum Criterion (CMC) set lower for that species of selenium. The Cabinet has added an additional margin of safety by capping

the acute criterion at 258 µg/L, as total selenium. In addition, the Cabinet's proposed acute criterion assumes the entire fraction of selenium in the water column to be selenite and is thereby more protective than EPA's draft criterion.

Further, by capping the proposed acute criterion at 258 µg/L the Cabinet limits the use of the mechanism in the draft 2004 EPA criterion that includes a sulfate modifier equation to calculate the CMC for selenate. However, should a water body have a sulfate concentration that is less than 44 mg/L, the applicable acute criterion will be lower than 258 µg/L. Sulfate data from the DOW's 72-station ambient water quality network had a mean sulfate concentration of 95 mg/L for the period of 2007 though 2011. Of those 72 stations, 43 had mean sulfate concentrations less than 44 mg/L. The draft 2004 EPA acute criteria is less protective than Kentucky's proposed acute criteria for selenium given that EPA's proposed sulfate modifier equation which would result in an increasing final acute value as the sulfate concentration increases in a water body.

In contrast to EPA's 2004 draft proposal, Kentucky's proposed acute criteria for selenium partially takes into account the ameliorating effect of sulfate on selenium toxicity in Kentucky's proposed acute criteria for selenium. In addition, per Kentucky's proposed acute criterion, the applicable acute criterion will be lower for individual water bodies that have sulfate concentrations less than 44 mg/L. The sulfate cap on the acute criterion (258 µg/L, as total selenium) provides additional protection of the aquatic habitat from acute selenium toxicity.

The Cabinet has promulgated in regulation (401 KAR 10:031, Table 1) the EPA National Recommended Criteria for human health. The human health criterion for domestic water supplies is 170 µg/L total selenium. The human health criterion for consumption of fish-tissue is 4,200 µg/L total selenium. There are no known incidences of either drinking water supplies or fish tissue residue approaching these applicable criteria.

(26) Subject Matter: Chronic criterion

(a) Commenter(s): Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: Current selenium standards in Kentucky for chronic criterion are 5 µg/L in streams. These are supported by scientific evidence and even these may be too weak to protect aquatic life. It does not protect other aquatic life in streams already devoid of fish as it only indicated toxicity after it had already occurred. The proposed

chronic criterion will allow a waterway to be contaminated to an unacceptable level before anything is done. If the proposed chronic standard is adopted, it will be expensive to enforce for DOW. The chronic standard is unenforceable and it cannot be used to set permit levels.

(b) Response: The agency respectfully disagrees with the comment. See previous responses to Comments (13), (21) and (24).

Water quality criteria are developed to protect the designated uses of waters. Whether a waterbody contains fish or other species sensitive to the parameter for which criteria have been developed, the criteria are designed to protect the habitat and its inhabitants. Whether a waterbody contains fish or other species, the criteria are designed to protect the most sensitive aquatic species, thereby protecting all the species in the waterbody. If fish or other species are extirpated from a waterbody because of selenium or because of other factors, the stream is impaired and the Cabinet would take appropriate actions (*e.g.* TMDLs, controls in KPDES permits, watershed based plans) to restore the waterbody to its designated uses.

The Cabinet has determined that the proposed threshold or screening value of 5 µg/L is adequate to ensure that if exceeded there should not be chronically toxic impacts to fish, however concentrations of selenium in the water column warrant further investigation to ensure fish are not effected by the selenium levels in the water. See Appendix B of: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013).

The national recommended chronic criterion was based on field observations from Belews Lake, North Carolina, and this procedure of setting toxic criteria did not follow EPA guidelines (*i.e.* not based on sound scientific procedures).

States are given the option in Section 303(c) of the Clean Water Act to adopt national recommended standards or to develop site-specific water quality standards that are protective of the local aquatic resources and the resident biota that inhabit or depend on those aquatic resources. The Commonwealth's current criteria of 20 µg/L (acute) and 5.0 µg/L (chronic), expressed as water column concentrations, were published by EPA in 1987 and are now over 25 years old. There have been considerable published data regarding selenium toxicity since these criteria were derived more than 25 years ago, and much of it meeting EPA Guidelines for developing water quality criteria. It is appropriate and in the best

interest of Kentucky citizens to develop criteria based on the latest science.

The dataset from the 2004 draft document published by EPA is also available for review. These data derive from bioassays that are scientifically defensible for use in updating acute and chronic selenium criteria for Kentucky standards. With regard to chronic toxicity, in addition to those toxicology studies in the 2004 draft, more published chronic tissue-based data are available since publication of the 2004 draft document.

The Cabinet has determined that the assessment of fish tissue for selenium is the best approach to ensuring that all aquatic life are properly protected by assessing the species most sensitive to selenium. In fish, excess selenium tends to concentrate in egg/ovary tissue and, in fact, egg/ovary tissue is where the chronic effects of selenium toxicity in fish occur. However, as a practical matter, it is not always feasible to collect egg/ovary tissue. Therefore, the Cabinet proposed chronic criteria for both whole-body and egg/ovary tissue. The whole body or egg/ovary tissue concentration criterion for total selenium are based on the calculated FCVs (Final Chronic Values). This tiered approach will follow the steps outlined below and provides guidance for implementation into Kentucky Pollutant Discharge Elimination System (KPDES) permits:

Step 1. Determine whether the water quality at the site is attaining a concentration of 5.0 µg/L threshold.

- If the water column concentration for total selenium is ≤5.0 µg/L the water body is meeting its aquatic life use.
- If the water column concentration for total selenium is >5.0 µg/L proceed to Step 2.

Step 2. Determine whether the site is in attainment of the tissue criteria ([8.6 µg/g whole body dry wt] or egg/ovary tissue [19.3 µg/g dry wt]).

- If each species-composite of fish tissue has a selenium concentration less than the appropriate tissue-based criterion, the water body is meeting the chronic standard for selenium.
- If a species-composite fish tissue has a selenium concentration that exceeds the appropriate tissue criterion the site is considered in non-attainment of the water quality standard.

(27) Subject Matter: Permit limits
(a) Commenter(s): Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: The proposed fish tissue criteria are not suitable for designing permits that will protect stream health. How will this translate into discharge permit limits for selenium?

(b) Response: The agency understands the concern but respectfully disagrees with the comment conclusions. See previous response to Comment (14).

Similar to other discharge permits, if, for example, the reasonable potential analysis for the proposed discharge(s) in a KPDES permit application indicates that the permit should include chronic discharge limits for selenium the permit will include a threshold of 5 µg/L total selenium which if exceeded will require fish tissue sampling in stream at a compliance point (identified in the permit) at which fish tissue can be sampled. The permit limit for whole-body fish tissue will be 8.6 µg/L total selenium (dry weight) or 19.3 µg/L total selenium (dry weight) for egg/ovary tissue. If the reasonable potential analysis for the discharge(s) dictates that the permit should include acute discharge limits for selenium the permit will include a limit of 258 µg/L total selenium. These permit limits and sampling requirements would apply for all outfalls where reasonable potential was identified.

(28) Subject Matter: 2012 Triennial Review

(a) Commenter(s): Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance

Comment: The 2012 draft triennial review back in July 2012 didn't even propose to change the selenium criteria. DOW then proposed to remove the "acute limit" for selenium in waterways.

(b) Response: The Division of Water filed the proposed amendments to 401 KAR 10:031 with the Legislative Research Commission on August 14, 2012 in accordance with KRS 13A. The proposed amendments were published in the September 1, 2012 Administrative Register of Kentucky and the Cabinet received public comments regarding the proposed amendments until October 1, 2012. The amendment to 401 KAR 10:031 filed on August 14, 2012 proposed to remove the acute selenium criterion on the basis that newly developed evidence established that the acute criteria lack scientific credibility. In fact, the U.S. Court of Appeals for the District of Columbia Circuit issued an order on September 19, 1996 granting EPA's motion to vacate its selenium regulations, as "seriously deficient." (American Iron and Steel Institute v. EPA, D.C. Cir. No. 95-1348 and consolidated cases).

Indeed, neighboring states and other states in the region have no acute selenium standard (FL, GA, OH) or have significantly different acute standards, including IN (130 µg/L), IL (1000 µg/L)

and SC (current National criteria), and ORSANCO has removed the acute criterion for similar reasons. The Cabinet received comments supporting withdrawal of both the acute and chronic criteria, citing newly developed evidence that establishes that both the acute and chronic criteria lack scientific credibility. The Cabinet also received a recommendation that the Cabinet propose a fish tissue-based criterion to replace the existing chronic criterion. EPA submitted the only comments concerned with the withdrawal of the acute selenium aquatic life criterion. In its comments, EPA recommended as an alternative to removing the acute criterion that Kentucky "adopt an alternate criteria (*sic*) based on other scientifically defensible information." Given that Kentucky's current criteria of 20 µg/L and 5.0 µg/L were published by EPA in 1987 and are now over 25 years old and that the latest available science establishes that the current acute and chronic criteria lack scientific credibility, the Cabinet concluded it was appropriate for Kentucky to develop criteria based on modern, scientifically defensible information, in keeping with EPA's recommended options and 304(a) Guidance.

(29) Subject Matter: Opposes measuring selenium in fish

(a) Commenter(s): Jeff Auxier

Comment: A mine tailings pile or reworked ground that no longer has its impermeable layers intact is subject to acidic rain water seeping through it for millennia, leeching chemicals including selenium from the rock. To employ a standard to measure the chemicals leached from those tailings or that reworked ground, said standard requiring live fish to measure, is not scientifically sound.

(b) Response: A discharge from the land use described may require a KPDES permit.

Similar to other discharge permits, if the reasonable potential analysis for the discharge(s) proposed in a KPDES permit application dictates that the permit would include chronic discharge limits for selenium the permit will include a threshold of 5 µg/L total selenium which, if exceeded, will require fish tissue sampling in stream at a nearest downstream point (identified in the permit) at which fish tissue can be sampled. The permit limit for whole-body fish tissue will be 8.6 µg/L total selenium (dry weight) or 19.3 µg/L total selenium (dry weight) for egg/ovary tissue. If the reasonable potential analysis for the discharge(s) dictates that the permit should include acute discharge limits for selenium the permit will include a limit of 258 µg/L total selenium. These permit limits and sampling requirements would apply for all discharges where reasonable potential is demonstrated.

(30) Subject Matter: Opposes raising selenium standards
(a) Commenter(s): Tarence Ray, KY Headwaters, Inc.
Comment: Cannot see how raising selenium standards to levels that have been systematically and scientifically proven to cause physical and reproductive harm in wildlife (in not only fish, but avian species as well) can be considered the least bit responsible, much less excusable.
(b) Response: The agency respectfully disagrees with the conclusions of the comment. See previous response to Comment (24).

The Cabinet has demonstrated the scientific basis for its conclusion that the proposed criteria are protective of the aquatic species most sensitive to selenium. The criteria are consistent with the requirements of the Clean Water Act, other applicable federal statutes, and with state law.

(31) Subject Matter: Full endorsement of proposed changes
(a) Commenter(s): Lloyd R. Cress, KAM
Comment: It is clear that the criteria, including the use of fish tissue/egg criterion for chronic, are based on the best available science for Kentucky.
(b) Response: The agency concurs with the comment.

(32) Subject Matter: Approves of proposed changes
(a) Commenter(s): John W. Myers, TVA
Comment: Believes DOW's recommendations are based on the best available science pertaining to the toxicity of selenium and will be protective of Kentucky's warm water habitats and the aquatic life they support.
(b) Response: The agency concurs with the comment.

(33) Subject Matter: In accordance with 40 CFR § 131.11 (a)(2)(b)
(a) Commenter(s): Joanne Benante, EPA
Comment: These criteria are based on an evaluation of recent studies of selenium toxicity to aquatic species and the database of acute tests to developed state-specific water quality criteria in accordance with 40 CFR § 131.11 (a)(2)(b).
(b) Response: The agency concurs with EPA's assessment that these criteria were established appropriately based on 304(a) Guidance in accordance with 40 CFR § 131.11 (a)(2)(b).

(34) Subject Matter: Intermittent discharges
(a) Commenter(s): Joanne Benante, EPA
Comment: May have concerns that waters affected by intermittent discharges might not be protected by these criteria and, therefore, could have

further questions concerning the implementation of these criteria in National Pollutant Discharge Elimination System permits.

(b) Response: While the proposed water quality criteria for selenium are based on the latest science, and are protective of water quality and consistent with the procedures for establishing water quality criteria, implementation of these proposed criteria (example, in CWA § 402 permits) is separately subject to public notice and comment by all interested citizens including the permit applicant, EPA, and interested citizens/parties before finalization

The Cabinet intends that similar to other discharge permits, if analysis of the discharge(s) proposed in a KPDES permit application indicates reasonable potential for the discharges to exceed the chronic selenium criterion the permit will include as a limit a threshold of 5 µg/L total selenium which, if exceeded, will require fish tissue sampling in stream at a compliance point (identified in the permit) at which fish tissue can be sampled. The permit limit for whole-body fish tissue will be 8.6 µg/L total selenium (dry weight) or 19.3 µg/L total selenium (dry weight) for egg/ovary tissue. If the analysis indicates reasonable potential analysis for the discharge(s) to exceed the acute selenium criterion the permit will include a limit of 258 µg/L total selenium. These permit limits and sampling requirements would apply for all discharges where reasonable potential to exceed selenium water quality standards is demonstrated.

It is the responsibility of the State to develop and implement water quality criteria (CWA § 303(a); 33 U.S.C. § 1313(a)). It is also the responsibility of the state to determine reasonable potential.
The burden to demonstrate compliance is on the permit holder. Where multiple permits provide for discharges to a common stream each permit holder is responsible for complying with the terms and conditions of the permit.

(35) Subject Matter: Support changes to 401 KAR 10:031

(a) Commenter(s): Associated General Contractors of Kentucky; Coal Operators and Associated; Kentucky Association of Manufacturers; Kentucky Coal Association; Kentucky Malt Beverage Council; Western Kentucky Coal Association; Automotive Service Council of KY; Homebuilders Association of Kentucky; Kentucky Chamber of Commerce; Kentucky League of Cities; Kentucky Retail Federation

Comment: Strongly support the changes offered by the Kentucky Division of Water to 401 KAR 10:031, Kentucky's selenium standards. This is a Kentucky solution for a Kentucky problem. By developing this proposal now, it allows Kentucky to retain control of its own water

quality programs. Appreciate DOW's consideration and support on the changes to Kentucky's selenium standards.

(b) Response: The agency concurs with the comment.

(36) Subject Matter: Expression of Protective Criterion as a Tissue Concentration

(a) Commenter(s): Robin J. Reash, AEP

Comment: Believe that the Department's choice to replace the existing water column chronic criterion with fish tissue criteria is scientifically astute and is consistent with the most recent knowledge of how selenium affects aquatic receptors.

(b) Response: The agency concurs with the comment.

(37) Subject Matter: Winter Stress Syndrome

(a) Commenter(s): Robin J. Reash, AEP

Comment: Believe that the Department's choice to not include the results of the Lemly (1993) "winter stress syndrome" article is appropriate, for two principal reasons. First, the design of this study did not conform to the Department's criteria for acceptable toxicity studies (*e.g.*, the Lemly study used only one treatment concentration, not a minimum of four). Secondly, the treatment exposure of elevated selenium in water, in addition to a temperature regime of 4° C for 120 consecutive days, is not representative of Kentucky streams, rivers and lakes.

(b) Response: The agency concurs with the comment and also points out that the Lemly (1993) "winter stress syndrome" study indicated the duration of winter stress as 180 days.

(38) Subject Matter: Expression of Water and Fish Tissue Criteria

(a) Commenter(s): Robin J. Reash, AEP

Comment: Because chronic aquatic life criteria presuppose a chronic exposure duration (*e.g.* 30 days or longer), the Utilities recommend that the delineation of 5 µg/L "trigger" water threshold, and the two tissue criteria, be expressed as average values. Recommend that the final language in revised 401 KAR 10:031 clearly specify that the water concentration threshold and fish tissue criteria are ambient criteria.

(b) Response: These comments relate to implementation of the proposed water quality criteria of selenium. While the criteria are ambient water quality criteria, implementation will be consistent with that of other water quality criteria.

It is the intent of the agency to impose the proposed acute criterion as a maximum limit for those discharges to which the acute criterion apply are demonstrated to have reasonable potential to exceed the acute selenium criterion. It is the intent of the agency that the chronic threshold of 5 µg/L would be imposed as an average monitoring requirement for those discharges where the

discharge has been demonstrated to have reasonable potential to exceed the chronic threshold. It is the intent of the agency that the threshold would be footnoted, indicating that if the average exceeds the 5 µg/L threshold fish tissue sampling shall be required to determine compliance with the permit.

The process of deriving the fish-tissue criteria considers the central distribution of the toxicological effects. Therefore, it is intended that the permit language identify the fish tissue values as a maximum permit requirements.

The review and establishment of the proposed water quality criteria for selenium is based on the latest science, and is protective of water quality and consistent with the procedures for establishing water quality criteria, implementation of these proposed criteria (for example, in CWA §402 permits and TMDL implementation) is separately subject to public notice and comment by all interested citizens including the permit applicant, EPA, and interested citizens/parties before finalization.

(39) Subject Matter: Implementation
(a) Commenter(s): Robin J. Reash, AEP
Comment: Envision the need for the Department to develop implementation guidance for the (expected to be) promulgated fish tissue criteria. Recommend that the Department not reinvent the wheel" and rely, at least in part, on language in EPA's implementation guidance of its human healthy methylmercury fish tissue criterion (EPA, 2010). Suggest that at least two species be analyzed for whole body or egg/ovary selenium, content at a site where tissue monitoring is required, and if multiple fish of a given species (or multiple composite samples) are collected at a site, a geometric mean selenium concentration be calculated for the species-specific replicates. It may be appropriate for the Department to firm a technical working group to discuss implementation issues.
(b) Response: The Cabinet is aware of this concern. The Cabinet envisions that during review and approval of the proposed criteria by EPA, the Cabinet will develop a guidance document to assist permit holders with compliance monitoring of fish tissue. Guidance is likely to rely on appropriate, existing protocols. The Cabinet may convene a workgroup of knowledgeable people to assist in the development of such guidance.

(40) Subject Matter: Enforceability
(a) Commenter(s): KFTC
Comment: Polluters need to be held accountable, especially when their pollution has significant negative public health and economic

impacts. The overriding purpose of this proposal seems to be to lessen that accountability by creating a standard that is largely unenforceable.

(b) Response: The agency agrees that enforcement action in response to violations of water quality and public health criteria is essential. See also response to Comments (2) and (49). With respect to the proposed water quality criteria for selenium, the agency's approach to developing the proposed criteria is consistent with EPA guidance, reflects the latest available science, and is scientifically defensible. The proposed criteria are designed to protect aquatic life and are enforceable as discussed elsewhere in this document.

(41) Subject Matter: EPA water quality standards

(a) Commenter(s): KFTC; Jill Harmer

Comment: The EPA is expected to come out with its own updated water quality standard for selenium within a year, with the expectation that it will be an enforceable standard with the goal of protecting people and the environment; therefore, it makes no sense for the state to implement a new standard that is unlikely to meet a new national standard, but could allow significant additional damage to Kentucky's waterways in the interim.

(b) Response: The EPA has not indicated a clear path forward or a definite timeframe regarding its efforts to update the national recommended criteria for selenium. The amendment to 401 KAR 10:031 filed on August 14, 2012 proposed to remove the acute selenium criterion because the Cabinet concluded based on newly developed evidence, that the acute criteria lack scientific credibility. In fact, the U.S. Court of Appeals for the District of Columbia Circuit issued an order on September 19, 1996 granting EPA's motion to vacate its selenium regulations, as "seriously deficient." (American Iron and Steel Institute v. EPA, D.C. Cir. No. 95-1348 and consolidated cases).

Neighboring states and other states in the region have no acute standard (FL, GA, OH) or have significantly different acute standards, including IN (130 µg/L), IL (1000 µg/L) and SC (current National criteria); and ORSANCO has withdrawn its acute criterion for similar reasons. The Cabinet received comments supporting withdrawal of both the acute and chronic criteria, citing latest available science that establishes that both criteria lack scientific credibility. The Cabinet also received a recommendation that the Cabinet propose a fish tissue-based criterion to replace the existing chronic criterion. EPA submitted the only comments concerned with the withdrawal of the acute selenium aquatic life criterion. In its comments, EPA recommended as an alternative to removing the acute criterion that Kentucky "adopt an alternate

criteria (*sic*) based on other scientifically defensible information." Kentucky's current criteria were published by EPA more than 25 years ago. The latest available science, much of it meeting EPA's guidelines for developing water quality criteria and including considerable public data regarding selenium toxicity establishes that Kentucky's current acute and chronic criteria lack scientific credibility. For these reasons, the Cabinet concludes it appropriate for Kentucky to develop criteria based on modern, scientifically defensible information, in keeping with EPA's recommended options and with 304(a) Guidance.

(42) Subject Matter: Commends the consideration of fish tissue criteria
(a) Commenter(s): Virgil Lee Andrews, Fish and Wildlife
Comment: Agree that some selenium models do not apply to Kentucky, and that fish tissue concentrations will be a strong standard by which designated uses can be maintained.
(b) Response: The agency concurs with the comment.

(43) Subject Matter: Peer review
(a) Commenter(s): Virgil Lee Andrews, USFWS; Numerous web-based form-letter emails; Tim Joice, Kentucky Waterways Alliance
Comment: Recommend that the Department seek independent peer review at a national scale for the criteria since tissue-based criteria for selenium is unprecedented in the United States.
(b) Response: Peer review of the proposed criteria is not appropriate or necessary. The Cabinet is not introducing original research for purposes of scientific publication. Rather, the Cabinet has reviewed and utilized existing peer-reviewed scientific research to develop appropriate and protective water quality criteria for purposes of implementing the Clean Water Act. EPA will scrutinize the science relied on by the Cabinet as part of its review of the criteria.

(44) Subject Matter: Implementation
(a) Commenter(s): Virgil Lee Andrews, USFWS
Comment: Believe that the criteria and their implementation should be developed as a complementary package to ensure that all parts mesh and are acceptable by all stakeholders.
(b) Response: The agency is aware of the questions regarding implementation of the proposed water quality criteria for selenium and has given these matters substantial consideration in the development of the proposed criteria. The agency has attempted to answer those implementation questions both in verbal discussions, stakeholder meetings, and in this response document. The agency is confident that all issues related to implementation will be properly addressed and will continue to work with interested and oversight parties to

that end; however, water quality criteria are typically developed independent of implementation. This approach ensures that water quality criteria are developed based on what is necessary to protect designated uses.

While the review and establishment of the proposed water quality criteria for selenium is based on the latest science, and is protective of water quality and consistent with the procedures for establishing water quality criteria, implementation of these proposed criteria (for example, in CWA §402 permits or TMDLs) is separately subject to public notice and comment by all interested citizens including the permit applicant, EPA, and interested citizens/parties before finalization.

(45) Subject Matter: Wildlife
(a) Commenter(s): Virgil Lee Andrews, USFWS
Comment: Concerned that water birds and other aquatic dependent wildlife may be exposed to excessive dietary selenium if fish tissue concentrations ever approach the proposed whole body chronic criterion.
(b) Response: The agency is aware of this concern. The U.S. Fish and Wildlife Service and the Cabinet have discussed information and data that the two agencies have regarding aquatic and terrestrial toxicity effects from selenium. The U.S. Fish and Wildlife Service reports that they have no Kentucky-specific data, observed or empirical, that raises a concern about selenium toxicity within the avian or mammalian communities. The Cabinet and U.S. Fish and Wildlife Service agreed to share any future data that may indicate selenium toxicity concerns in the environment and address those concerns as appropriate.

(46) Subject Matter: Effect on various species
(a) Commenter(s): Jill Harmer
Comment: Since selenium is known to bioaccumulate, it can affect various species (*i.e.* including fowl that eat any aquatic life like "Fish, bacteria, fungi, algae, aquatic insects, other aquatic invertebrates, reptiles, amphibians, and fishes" per 401 KAR 10:001 (40). Mussels and Indiana bats are disappearing. The current KDOW proposal appears contrary to protecting our waterways and the above mentioned species. KDOW is continually degrading our streams now with more selenium.
(b) Response: The agency respectfully disagrees with the commenter's conclusion.

The proposed criteria were derived on the most sensitive aquatic species, in this case, fish. In this regard, the Cabinet has

determined that its approach to developing the proposed criteria is consistent with EPA guidance and is scientifically defensible. The Cabinet is not aware of any Kentucky-specific data, observed or empirical, that raises a concern about selenium toxicity within avian or mammalian communities in Kentucky.

(47) Subject Matter: EPA
(a) Commenter(s): Jill Harmer
Comment: KDOW needs more EPA oversight. Maybe EPA needs to assess what species should be tested.
(b) Response: EPA has an oversight role with regards to the proposed criteria via the review and approval process required by the Clean Water Act and its implementing regulations. The Cabinet has determined that its approach to developing the proposed criteria is consistent with EPA guidance and is scientifically defensible.

(48) Subject Matter: Tiered approach
(a) Commenter(s): Casey Henson
Comment: A selenium reading of 5µg/L in the water column triggers tissue sampling does not ensure immediate cessation of selenium discharge. Because fish tissue testing will not occur immediately, continued discharge of selenium into streams will allow bioaccumulation and by the time fish tissue accumulation has exceeded the proposed standard, damage to the stream has already occurred. Selenium build-up in sediment and the food chain will continue to affect the ecosystem even if discharge is then stopped.
(b) Response: The proposed threshold value of 5.0 µg/L total selenium has been used elsewhere as a screening value, and recently was considered within the acceptable range of threshold values by EPA (2009). The Cabinet gave consideration to the biogeochemical processes of selenium and reviewed available studies to evaluate the effectiveness of the 5.0 µg/L threshold to protect fish from the toxicological effects of selenium. The Cabinet has determined that the 5.0 µg/L threshold adds an additional margin of safety to implement the tissue-based criteria and assures the protection of Kentucky's aquatic habitats from potential adverse effects of selenium toxicity.

(See Appendix B of: *Update to Kentucky Aquatic Life Standards: Acute Selenium Criterion and Tissue-Based Selenium Chronic Criteria* (Payne 2013)).

(49) Subject Matter: Violations
(a) Commenter(s): Casey Henson
Comment: A challenge to a violation could arise based on the mobility of fish. It could be argued that the fish was not exposed to selenium at that

discharge point, but somewhere else. If tissue samples are taken downstream from multiple discharge points, no single mining company can be charged with a violation.

(b) Response: By applying for and receiving a permit, the permit holder, *i.e.* the discharger, agrees to abide by the terms and conditions of the permit. As discussed in this document, if the fish tissue values exceed the chronic criterion the permit holder is in violation of the permit limit. Failure to comply with the permit constitutes a violation for which enforcement action may be taken.

(50) Subject Matter: Whole-body and egg/ovary tissue

(a) Commenter(s): Casey Henson

Comment: The whole body and egg/ovary tissue criteria are too high. A technical analysis showed that the EPA level of 7.9 µg/g whole-body and 17 µg/g egg/ovary were miscalculated and are too high. The KDOW's proposal of 8.6 µg/g and 19.33 µg/g are even higher than the EPA's proposal. Guidelines recommended in the technical analysis are 4-6 µg/g whole body tissue and <14.8 µg/g egg/ovary tissue.

(b) Response: The agency respectfully disagrees with the commenter's conclusion.

The Cabinet has determined that its approach to developing the proposed criteria is consistent with EPA guidance and is scientifically defensible. The Cabinet proposed Kentucky-specific chronic criteria that are not comparable to the formerly proposed EPA chronic criteria (EPA, 2004). The Cabinet developed these proposed chronic criteria based on fish that are endemic to Kentucky, naturalized to Kentucky, or that serve as appropriate surrogates for fish that are found in Kentucky waters. Since the fish used in the derivations are somewhat different from the fish used to derive the EPA-proposed national chronic criteria the Kentucky-specific criteria should be expected to differ somewhat from a national criteria.

The Cabinet is aware of the analyses and criticisms of the derivation of EPA's formerly proposed criteria. The Cabinet has scrutinized its calculations and has concluded that the values derived are appropriately calculated.

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