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Comments on the Draft Selenium Federal Environmental Quality Guideline (June 2021)

Prepared by the North American Metals Council Selenium Working Group

Section	Page	Comment	Recommendation
General	Title and all pages	The Federal Environmental Quality Guideline (FEQG) document does not indicate that it is a draft document, besides what is indicated on the main FEQG website. This could create confusion in the future when the document (and release date) is referenced.	Please ensure future draft FEQG is published as a draft document by adding draft to the document header or a watermark.
General		It is understood that the FEQG guideline for selenium is related to the risk management plan for selenium under the Chemicals Management Plan. The environmental quality guidelines published by the Canadian Council of Ministers of the Environment **(**CCME), however, are a key central repository of quality work and collectively brings together the interests and environmental conditions of all provinces and territories in Canada. Continuing to provide FEQGs will further wedge a divide between the various provinces. Furthermore, focusing on one of the only jurisdictions that has resources to publish their own guidelines, which is not always in line with CCME guidance (*i.e.*, use of safety factor when minimum data requirements are met), does not reflect the interests across the rest of Canada.	We encourage the federal government to bring the provinces and territories together and facilitate and work towards common CCME environmental quality guidelines.

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General		The document should be up-to-date: • Much of the information in the FEQG is based on the ECCC/HC 2017 Screening Assessment on Selenium. • There are nearly five years of data and information available, in addition to the first rounds of sampling of fish tissues for selenium (and water) related to the *Metal and Diamond Mining Effluent Regulations (MDMER)*, that should be considered in setting the FEQG. It is imperative that guidelines be based on the most recent scientific evidence/data. • Other studies/literature references are not included (we provide some herein).	Include information and data from literature published since 2016 and from the *MDMER* fish tissue and effluent sampling. These latter data are available to Environment and Climate Change Canada (ECCC).
Introduction	1	"FEQGs are not developed for the water, sediment or soil compartments..." FEQGs are adopted for fish tissues and bird egg, but not for water, even though updated values exist (*see* DeForest *et al.*, 2017). Greater clarity is required on the water quality guidelines, as many different values from other jurisdictions are presented.	Provide clarity on the use of water quality guidelines as they vary among jurisdictions and there is no national selenium FEQG presented and the CCME guideline (*i.e.*, 1 ppb) is based on outdated science.

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Uses	2	Is there new information on production values since 2014?	Update the "Uses" section to ensure it is up-to-date with current production values.
Fate, Behaviour and Partitioning in the Environment	2	Missing word in the third paragraph of this section. It should read, "selenium cycling in the environment." Underlined word should be added.	Add the word "the" to complete the sentence.
Fate, Behaviour and Partitioning in the Environment	3	Differences between lentic and lotic environments should be mentioned specifically in this section. The U.S. Environmental Protection Agency (EPA) water quality criteria include water quality criteria for both lentic and lotic systems. Evidence supports this type of approach and should be presented and discussed.	Include the specific differences between lentic and lotic systems with regard to fate, behavior, and partitioning.
Ambient Concentrations	3	Monitoring data considered are presented in Beatty and Russo (2014). An update should be completed to include data from the last five or more years. Ambient concentrations from all provinces and territories should be considered, as this is a federal guideline.	Include more recent data in the consideration of the ambient concentrations. Data from all provinces and territories should be presented.

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Ambient Concentrations	3	It is mentioned that natural selenium sources or geologic formations may result in elevated selenium sources. It is anticipated that these natural sources could influence fish tissue and bird egg concentrations as well. How is this considered in the FEQG presented?	Explain how naturally-elevated selenium concentrations should be considered.
Federal Tissue Quality Guideline for Fish	4-5	There are examples in the published literature of fish population studies for which fish tissues were above guidelines/criteria and there were no population-related effects. Why were these studies not considered in the study? For example, *see* Miller *et al.* (2015) and Covington *et al.* (2018). For a critical review of this issue, *see* Gilron *et al.* (2021; *in review*). (NOTE: This paper will be forwarded to ECCC once it has been accepted by the journal.)	Ensure discussions present details from all types of studies to provide a well-rounded discussion of the data to provide context to these guidelines.
Federal Tissue Quality Guideline for Fish	4-5	There is no guidance on the collection of fish egg-ovary tissue or fish whole-body tissue for selenium analyses, and subsequent interpretation. Standardization of fish processing and analysis (*e.g.*, freeze-drying samples) is required to compare accurately to guidelines and ensure sample integrity. There is draft guidance for selenium assessment in fish tissue related to the *MDMER*, but no official guidance from the ECCC has been provided despite the regulations being enforced. Without proper guidance, the data collected may lack quality and comparability.	Provide consultation for the development of a fish tissue sampling guidance document to accompany both the FEQG and *MDMER* Environmental Effects Monitoring (EEM) programs.

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			Ensure that all stakeholders are included in the review (labs, environment consultants, industry, regulators, and mining associations, among others).
Federal Tissue Quality Guideline for Fish	4-5	A Canadian/U.S.-based paper published by DeForest *et al.* (2012) entitled "Species Sensitivity Distribution Evaluation for Selenium in Fish Eggs: Considerations for Development of a Canadian Tissue-Based Guideline" proposes an egg/ovary threshold; this study is based on CCME protocols for guideline derivation. This work should be included in the discussion of guidelines to provide additional context. It is important to present all lines of evidence so that the users can decide which guideline is best to use.	Include reference to DeForest *et al.* (2012) citing the fish egg/ovary selenium threshold of 20 µg/g, together with a discussion of the differences among guidelines.
Table 2	6	Formation Environmental (2011) is now published in a peer-reviewed journal, and should be cited as such. Citation is provided.	Covington. S.M., R.B. Naddy, A.L. Prouty, S.A. Werner, and M. Dunn-Lewis. 2018. Effects of *in situ* selenium exposure

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			and maternal transfer on survival and deformities of brown trout (*Salmo trutta*) fry. *Environmental Toxicology and Chemistry*, 37(6): 1396 - 1408.
Federal Tissue Quality Guideline for Bird Egg	5	EPA proposed the standard on December 13, 2018, with a comment period extending to February 11, 2019, and on February 12, 2019, it extended the comment period to March 28, 2019 (https://www.epa.gov/wqs-tech/water-quality-standards-establishment-numeric-criterion-selenium-fresh-waters-california). The standard has not, therefore, been adopted yet. It should be made clear that the USEPA 2019 reference is to a draft rather than final document.	Revise the USEPA 2019 reference to reflect accurately the title of the document, the publication date, its status, and that it is a California-based versus a national criterion document.
Federal Tissue Quality Guideline for Bird Egg	5-8	The bird egg guideline only relies on mallard ducks rather than multiple species of birds, like the fish tissue guideline. Stating that this a bird egg guideline may be overstating the applicability as it may be overly conservative for bird species that feed less on aquatic insects. It is generally recognized that the mallard (as a representative duck species) is relatively sensitive to the reproductive impairment effects of selenium. The most	Consider stating that this is an aquatic bird egg guideline or mallard bird egg guideline to ensure the applicability of the guideline is

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		extensive comparisons are available for field studies comparing ducks and shorebirds (such as black-necked stilts and American avocets). This is discussed on pp. 676-683 of Ohlendorf and Heinz (2011).	representative of the species considered in the derivation process. The guideline may be overly conservative for non-waterfowl species.
Federal Tissue Quality Guideline for Bird Egg	5-8	Discussion on methods of sampling bird egg should be provided. Weech *et al.* (2012) noted high inter-clutch variability, so sampling a single egg from a nest may not be representative of other eggs from nests in the area. Guidance should be developed as to the appropriate sampling methods, sample size requirements, etc., and on whether decisions are to be based on geometric mean concentrations of a specified size of eggs, etc. This requires understanding of the variability in egg selenium concentrations and other factors. For example, after extensive study and consultation, the State of Utah adopted a selenium water quality standard of 12.5 mg/kg (dry weight) in bird eggs for Great Salt Lake and EPA approved it in 2011 (https://deq.utah.gov/legacy/programs/water-quality/standards-technical-services/docs/2012/03Mar/1c-2011UTGilbertBaySeEPAApprovalFinal.pdf). This is a tissue-based standard using the complete egg/embryo of aquatic-dependent birds based upon a minimum of five samples over the nesting season. (NOTE: If exposures are variable, larger sample sizes may be required at particular sites.) Similar findings are reported for mallards and tree swallows at high-selenium sites by Weech *et al.* (2012). Variability was found in the egg selenium concentrations of several bird	Provide consultation for the development of a bird egg sampling guidance document to accompany the FEQG. Ensure that all stakeholders are included in the review (labs, environment consultants, industry, regulators, and mining associations, among others).

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		species at Kesterson Reservoir in 1983-1985, as shown in Table 26.1 of Ohlendorf and Hothem (1995). There was less variation among the egg selenium concentrations at the reference sites. This variability at high-selenium sites is probably the result of different resident periods before egg-laying, food choices, and other factors.	
Federal Tissue Quality Guideline for Bird Egg	5-8	A study by Weech *et al.* (2012) observed and reported that tree swallow hatchability was not affected at concentrations similar to those presented by USEPA (2019). There may be the potential for false positives when concentrations are above the presented guideline. Additionally, the bird egg guideline may not be applicable to bird species that rely less on aquatic insects as a main food source.	As false positives (exceedance of the guideline with an absence of effect) may be common in such assessments, please provide guidance for exceeding the bird egg guideline or other guidelines in the Introduction section of the document. For example, the guideline egg concentration could be used as a "trigger" if exceeded and may then lead to

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			a site-specific evaluation of whether reproductive effects are detected in locally abundant and representative species, if deemed necessary.
Federal Tissue Quality Guideline for Bird Egg	7	Headers and page numbers are missing on pages 6 and 7. Two periods are included in the fourth paragraph on page 7.	Add headers and page numbers throughout and remove redundant period.
Recent Water-based guidelines from other Jurisdictions	9	The footnote of the summary Table 1-1 of proposed criteria in USEPA 2019 states that "Bird Egg supersedes translated water column elements for that taxon when both are measured." This statement should be added to the FEQG to ensure consistency with the USEPA 2019 guidance.	State that the bird egg guideline supersedes the water guidelines where both are measured.
Recent Water-based guidelines from other Jurisdictions	8-9	The USEPA guidance for California has pointed to the use of deriving site-specific water column data rather than using the USEPA 2016 values for lentic and lotic environments. This is missing from the discussion on guidelines from other jurisdictions and should be added to provide clarity as to why a water-based FEQG is not presented.	Provide additional clarity on the rationale for not proposing a water-based FEQG based on USEPA 2019.

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Recent Water-based guidelines from other Jurisdictions	8-9	A Canadian/U.S.-based paper published by DeForest *et al.* (2017) entitled "Lentic, Lotic, and Sulfate-dependent Waterborne Selenium Screen Guidelines for Freshwater System" should be included in the discussion of guidelines to provide additional context. It is important to present all lines of evidence so that the users can decide which guideline is best to use as a single water quality guideline is not presented.	Include reference to DeForest *et al.* (2017) and the waterborne selenium screening guidelines of 6.5 µg/L and 3.0 µg/L for lotic and lentic water bodies, respectively.
Recent Water-based guidelines form other Jurisdictions	8-9	There is concern for the number of fish that may be sacrificed to determine if selenium is a concern without a water quality guideline. Typically, water samples are used to screen waterbodies for potential risk, so without a water-based guideline, there could be a tendency to sample fish tissue instead.	Consider and acknowledge the impact on fish populations in Canada with the focus on the fish tissue guideline that may result in increased fish mortalities (targeted and incidental) without a water-based selenium guideline.

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References

Beatty JM, Russo GA. 2014. Ambient water quality guidelines for selenium technical report update. BC Ministry of Environment, Victoria, BC, Canada, 254 pp. + appendices.

Covington. S.M., R.B. Naddy, A.L. Prouty, S.A. Werner, and M. Dunn-Lewis. 2018. Effects of *in situ* selenium exposure and maternal transfer on survival and deformities of brown trout (*Salmo trutta*) fry. *Environmental Toxicology and Chemistry*. 37(6): 1396 – 1408.

DeForest, D.K., Brix, K.V., Elphick, J.R., Rickwood, C.J., deBruyn, A.M.H., Tear, L.M., Gilron, G., Hughes, S.A., and W.J. Adams. 2017. Lentic, Lotic, and Sulphate-dependent Waterborne Selenium Screening Guidelines for Freshwater Systems. *Environmental Toxicology and Chemistry*. 36 (9): 2503–2513.

DeForest, D., Gilron, G., Armstrong, S., and E. Robertson. 2012. Species Sensitivity Distribution (SSD) Evaluation for Selenium in Fish Eggs: Considerations for Development of a Canadian Tissue-based Guideline. *Integrated Environmental Assessment and Management*. 8(1): 6-12.

Environment and Climate Change Canada/Health Canada (ECCC/HC). 2017b. Screening Assessment - Selenium and its compounds.

[1]Gilron, G., Garrett, R., Matheson, G., and W. Adams. 2021. Are Current Tissue-Based Selenium Guidelines and Criteria Overly Protective of Freshwater Fish Populations? A Critical Review. *Integrated Environmental Assessment and Management*, in review.

Miller, L.L., Isaacs, M.A., Martyniuk, C.J., and Munkittrick, K.R. 2015. Using molecular biomarkers and traditional morphometric measurements to assess the health of slimy sculpin (*Cottus cognatus*) from streams with elevated selenium in North-Eastern British Columbia. *Environ. Toxicol. Chem.*, 34(10), 2335-2346.

[1] NOTE: This paper will be forwarded to ECCC once it has been accepted by the journal.

Nautilus Environmental. 2011. Evaluation of the effects of selenium on early life stage development of Westslope cutthroat trout from the Elk Valley, BC. Sparwood (BC): Elk Valley Selenium Task Force. Final revised report.

Ohlendorf, H.M., and Heinz, G.H. 2011. Selenium in birds, In *Environmental Contaminants in Biota: Interpreting Tissue Concentrations*, 2nd ed., W.N. Beyer and J.P. Meador, Eds., CRC Press, Boca Raton, FL.

Ohlendorf, H.M., Hothem, R.L., Bunck, C.M., and Marois, K.C. 1990. Bioaccumulation of selenium in birds at Kesterson Reservoir, California. *Arch. Environ. Contam. Toxicol.*, 19(4), 495-507.

U.S. Environmental Protection Agency (EPA). 2016. Aquatic Life Ambient Water Quality Criterion for Selenium -- Freshwater 2016. EPA 822-R-16-006. Office of Water 4304T, Washington, D.C.

Weech, S.A., Scheuhammer, A.M., Wayland, M. 2012. Selenium accumulation and reproduction in birds breeding downstream of a uranium mill in northern Saskatchewan, Canada. *Ecotoxicology*. 21(1): 280-8.