International Zinc Association

Dear Department of Ecology:

Thank you for the opportunity to provide input to the Department of Ecology on the Triennial Review of Washington Surface Water Quality Standards, Chapter 173-201A WAC. The International Zinc Association (IZA) is a non-profit industry association dedicated to supporting the global market for zinc and the role of zinc in sustainable development. IZA actively supports research programs on the fate and effects of zinc in the environment and supports the adoption of regulatory standards for zinc that reflect the current state-of-the science.

Our attached submittal provides recommendations for the 2025 Triennial Review of Water Quality Standards (WQS) for Washington. Specifically, the recommendations provided here are related to revision of the numeric zinc criteria for protection of freshwater aquatic life to more accurately incorporate bioavailability.

Consistent with our support in other jurisdictions, we are happy to work as a technical resource for Washington as Ecology advances appropriately protective bioavailability-based ALC for zinc.

Please let us know if you have any questions or if you would like to discuss our recommendations.

Sincerely,
Adam Ryan
Senior Manager - Environment

ZINC | international zinc association

1000 Park Forty Plaza, Ste 130
Durham, NC 27713 USA
Tel: +1 919 361 4647
Web: www.zinc.org

April 21, 2025

Marla Koberstein
Department of Ecology, Water Quality Program
PO Box 47600
Olympia, WA 98504-7600

Subject: Comments on Triennial Review of Washington Surface Water Quality Standards, Chapter 173-201A WAC

Dear Department of Ecology:

Thank you for the opportunity to provide input to the Department of Ecology (hereinafter, Ecology) on the Triennial Review of Washington Surface Water Quality Standards, Chapter 173-201A WAC. The International Zinc Association (IZA) is a non-profit industry association dedicated to supporting the global market for zinc and the role of zinc in sustainable development. IZA actively supports research programs on the fate and effects of zinc in the environment and supports the adoption of regulatory standards for zinc that reflect the current state-of-the science.

This submittal provides recommendations for the 2025 Triennial Review of Water Quality Standards (WQS) for Washington. Specifically, the recommendations provided here are related to revision of the numeric zinc criteria for protection of freshwater aquatic life to more accurately incorporate bioavailability. The biotic ligand model (BLM) or multiple linear regression (MLR) models allow for derivation of freshwater criteria based on the effects of site-specific intensities of toxicity modifying factors (TMFs) such as pH, dissolved organic carbon (DOC), and hardness or major ions. Both approaches have been demonstrated to be more accurate than the hardness equation (DeForest et al. 2023). Given the general recognition of the effectiveness of the BLM- and MLR-based approaches for addressing site-specific bioavailability of metals (U.S. EPA 2022), our recommendations below include relevant information for the triennial review process.

The basis for the current hardness-based acute and chronic zinc aquatic life criteria (ALC) for protection of freshwater aquatic life in Washington is a recently modified version of the zinc ALC equation described in U.S. EPA (1996). The modified zinc acute and chronic ALC equations adopted by Washington[1] have not yet been federally approved – and they rely on outdated science. The U.S. EPA acknowledges that metal bioavailability is a function of many modifying factors that affect the speciation, bioavailability, and toxicity of metals, and that pH, hardness, and DOC are generally

[1] Washington State Department of Ecology. 2025. Water Quality Standards for Surface Wates of the State of Washington Chapter 173-201A WAC. Revised March 2025. Water Quality Program. Olympia, Washington. Publication 06-10-091. https://apps.ecology.wa.gov/publications/SummaryPages/0610091.html

most important (U.S. EPA 2022). The substantial amount of data generated since 1995 has overwhelmingly demonstrated that multiple TMFs, in addition to hardness, influence the bioavailability and toxicity of zinc to freshwater organisms (DeForest et al. 2023). Therefore, modifying the existing nationally recommended hardness equation by adjusting the sensitivity parameter (i.e., intercept) is not sufficient.

As scientists, we advocate for use of the best science to establish ALC. As such, Ecology needs to move away from hardness-based equations and utilize more accurate BLM- or MLR-based approaches for zinc ALC. Both approaches are far superior to the hardness equation. Our recommendations to improve the freshwater zinc ALC in Washington – in order of scientific rigor, are to:

1. Revise the freshwater zinc ALC by using the updated unified zinc BLM (Ryan et al. *in review*). This is the most scientifically robust approach for characterizing zinc bioavailability in freshwaters. Since 2022, we have been a technical resource for the California State Water Resources Control Board, and we have developed a single unified zinc BLM to be used for acute and chronic water quality objectives[2]. A manuscript describing the unified zinc BLM, an implementation approach, a threatened and endangered species protectiveness evaluation, and a sensitivity analysis has been submitted to *Integrated Environmental Assessment and Management* for review, with anticipated publication in 2025. We are happy to provide Ecology with a copy of the manuscript and all supporting materials – and we are willing to work with Ecology as a technical resource.
2. Revise the freshwater zinc ALC by using the zinc MLR models described by DeForest et al. (2023). This would essentially be equivalent to Ecology's use of the Cu MLR models described by Brix et al. (2021), but with the zinc MLR models there is a much lower likelihood of acute and chronic ALC inversion (i.e., where the acute ALC are lower than the chronic ALC). Use of these zinc MLR models is nearly as defensible as using the zinc BLM, given that they perform similarly with ecotoxicity data. Again, we are willing to work with Ecology as a technical resource.
3. Revise the freshwater zinc ALC by using the zinc MLR models that will be the basis for the forthcoming nationally recommended zinc ALC that U. S. EPA will develop through the ongoing CRADA efforts[3]. The release date of the updated nationally recommended zinc ALC is currently unknown.

The metals CRADA will likely be renewed in 2025 and will remain in effect for another 5 years. However, there will likely be some lag time between when the CRADA efforts conclude and nationally recommended freshwater ALC for zinc are updated. The public's expectation is that science-based improvements to ALC be made in a timely manner, especially when the tools needed to make those improvements already exist.

[2] https://www.waterboards.ca.gov/water_issues/programs/stormwater/storms/projects/site-specific-water-quality-objectives-for-copper-zinc.html
[3] https://www.epa.gov/wqc/metals-crada-phase-1-report

Therefore, as an interim improvement, we recommend that the revised unified zinc BLM (Ryan et al. *in review*) or recent zinc MLR models (DeForest et al. 2023) become the basis for Washington's freshwater zinc ALC until the nationally recommended ALC are revised. This recommendation is based in part on the uncertainties as to when nationally recommended zinc ALC will be revised and when Ecology will conduct the next triennial review.

In summary, the IZA encourages Ecology to adopt bioavailability-based freshwater ALC for zinc. Technically robust BLM- and MLR-based approaches that are consistent with U.S. EPA guidelines for development of ALC are currently available. Additionally, we anticipate a bioavailability-based revision to the nationally recommended freshwater ALC for zinc in the near future. We believe that bioavailability-based ALC for zinc represent a fundamental advancement that will serve to achieve appropriate environmental protection and regulation.

Thank you for the opportunity to provide these recommendations for consideration during Ecology's triennial review process. Consistent with our support in California, we are happy to work as a technical resource for Washington as Ecology advances appropriately protective bioavailability-based ALC for zinc.

Please let us know if you have any questions or if you would like to discuss these recommendations further.

Sincerely,

Adam Ryan, Ph.D., DABT
Senior Manager, Environment
International Zinc Association
acryan@zinc.org

References

Brix KV, Tear L, Santore RC, Croteau K, DeForest DK. 2021. Comparative Performance of Multiple Linear Regression and Biotic Ligand Models for Estimating the Bioavailability of Copper in Freshwater. Environmental Toxicology and Chemistry 40:1649-1661.

DeForest DK, Ryan AC, Tear LM, Brix KV. 2023. Comparison of multiple linear regression and biotic ligand models for predicting acute and chronic zinc toxicity to freshwater organisms. *Environmental Toxicology and Chemistry* 42:393-413.

Ryan AC, Santore RC, Schiff K. *In review*. Updating the unified acute and chronic zinc biotic ligand model for protection of freshwater aquatic life and application for site-specific water quality objectives. Integrated Environmental Assessment and Management, submitted.

U.S. EPA. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. U.S. Environmental Protection Agency, Washington, DC. PB85-227049.

U.S. EPA. 1987. Ambient Water Quality Criteria for Zinc - 1987. U.S. Environmental Protection Agency, Washington, DC. EPA-440/5-87-003.

U.S. EPA. 1996. 1995 updates: Water quality criteria documents for the protection of aquatic life in ambient water. U.S. Environmental Protection Agency, Washington, DC. EPA-820-B-96-001.

U.S. EPA. 2022. Metals Cooperative Research and Development Agreement (CRADA) Phase I Report: Development of Overarching Bioavailability Modeling Approach to Support US EPA's Aquatic Life Quality Criteria for Metals. U.S. Environmental Protection Agency, Washington, DC. EPA-822-R-22-001.