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west virginia department of environmental protection

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## **Scientific Justification of Revision of Selenium Standard**

While selenium is a naturally-occurring and essential micronutrient, it can become toxic to fish when its concentration in water is elevated and it bioaccumulates in fish tissues. Because of the complexity of selenium toxicity, a more detailed approach to water quality standards is recommended for this element, taking into consideration both water column concentrations and accumulation of selenium in fish muscular and reproductive tissues.

Research has shown organisms in aquatic environments accumulate selenium primarily through diet, and that selenium toxicity occurs primarily through maternal-egg transfer. Because of this, it has been determined that an appropriate approach to selenium criteria is to use fish tissue and/or egg/ovary concentration to determine selenium toxicity in water. With this revised standard, when the existing four-day average (chronic) water column limit of 5 µg/l is exceeded, fish tissue and/or egg/ovary tissue concentrations may be assessed to make a final determination of exceedance. This approach is consistent with methods recently drafted by EPA that are expected to be implemented as recommended nationwide criteria.

The West Virginia Department of Environmental Protection (DEP) has used the “External Peer Review Draft Aquatic Life Ambient Water Quality Criterion for Selenium” (EPA 2014), the “Updated Freshwater Aquatic Life Criteria for Selenium” (GEI Consultants 2015 Attachment C), as well as further internal analysis of available research, in order to arrive at the concentrations of fish tissue and egg/ovary tissue proposed in in the 2015 revision to Requirements Governing Water Quality Standards (47CSR2).

In making a determination on the use of data to develop an appropriate aquatic life criterion for selenium in West Virginia, DEP took into consideration details of available research that were interpreted differently by EPA and GEI Consultants. First, in a selenium study conducted on brown trout (Formation Environmental 2011), during which a tank overflow event killed a portion of study fish, DEP decided on the interpretation which concluded the same rate of deformity/death among fish that were subject to the overflow as fish remaining in the tanks, whereas EPA used the interpretation which assumed 100% of overflowed fish were deformed/dead. Furthermore, regarding a bluegill study which was used in EPA analysis, conducted by Hermanutz (1992), DEP decided to omit study data due to unexplained irregularities which resulted in fish tissue selenium concentrations in the 10 µg/L exposure group higher than in the 30 µg/L exposure group. As in the EPA peer review draft (EPA 2014), DEP took into consideration 14 genus mean chronic values (GMCV) (studies referenced below), including invertebrates as well as fish species in this aquatic life criterion. Finally, DEP determined that genus-specific median conversion factors used in the EPA peer review draft (EPA 2014) were appropriate for this analysis, as opposed to the regression-based conversion factors used by GEI Consultants (2015, Attachment C).

DEP interpreted available selenium research as described above, using EPA Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms (EPA 1985). In doing so, DEP developed this revised criteria for selenium concentration in whole body fish tissue of 8.3 µg/g, and 20.0 µg/g in egg/ovary tissue.



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