

## **A DISCUSSION OF THE PROPOSED WATER QUALITY STANDARD FOR SELENIUM FOR THE OPEN WATER OF GREAT SALT LAKE AND ITS ASSOCIATED FOOTNOTE**

Given the uncertainties of the current understanding of selenium cycling in Great Salt Lake, the bio-accumulative nature of selenium, the need to incorporate both waterborne and tissue-based selenium concentrations, and the desire to proactively protect and manage the water quality of Great Salt Lake, the Great Salt Lake Selenium Science Panel and the Great Salt Lake Selenium Steering Committee proposed a tiered approach to implement the selenium water quality standard. This approach uses the Bioaccumulation Model developed as part of the standard development effort to relate water, diet and egg concentrations. The objectives of the approach are to:

- Monitor Great Salt Lake to assess trends in selenium concentrations and determine whether they are approaching or exceeding the water quality standard in eggs, using water and diet (measured in brine shrimp and estimated in brine flies by a “translation factor”) as indicators of whether the standard is likely to be exceeded in the egg;
- Address current uncertainty in modeled bioaccumulation relationships by validating expected bioaccumulation with new data for water or diet concentrations and, if appropriate, egg selenium and hatchability;
- Evaluate trigger selenium concentrations in the egg tissue that trigger various monitoring and management actions identified in the assessment framework; and
- Initiate steps to mitigate further increases in selenium concentration if an upward trend is observed.

The Proposed water quality standard for selenium is as follows:

*Selenium (14)*

*Gilbert Bay (Class 5A)*

*Great Salt Lake*

*Geometric mean of egg concentrations*

*over the nesting season (mg/kg dry wt)*

12.5

*(14) The selenium water quality standard of 12.5 mg/kg (dry weight) for Gilbert Bay is a tissue-based standard using the complete egg/embryo of aquatic-dependent birds that use the waters of Gilbert Bay based upon a minimum of five samples over the nesting season. Increasing bird egg concentrations and Division of Water Quality responses are indicated below:*

**SELENIUM TRIGGERS AND REGULATORY RESPONSES TO OBSERVED INCREASES OF SELENIUM IN AQUATIC BIRDS OF GREAT SALT LAKE.**

<i>Egg Concentration Trigger</i>	<i>DWQ Responses</i>
<i>5.0 mg/kg and below</i>	<i>Routine monitoring with sufficient intensity to evaluate whether selenium concentrations within the Great Salt Lake ecosystem are increasing</i>
<i>5.0 mg/kg</i>	<i>Increased monitoring to address data gaps and areas of uncertainty identified from initial Great Salt Lake selenium studies</i>
<i>6.4 mg/kg</i>	<i>Initiation of Level II Antidegradation reviews for all permit renewals or new permits to Great Salt Lake</i>
<i>9.8 mg/kg</i>	<i>Initiation of preliminary TMDL studies to evaluate all selenium loading sources</i>
<i>12.5 mg/kg and above</i>	<i>Declare impairment; formalize and implement the TMDL</i>

End of the proposed water quality standard for selenium

## Rationale of the Selenium Triggers and Division of Water Quality Responses

Thresholds of selenium concentrations in the eggs of aquatic-dependent birds that use Great Salt Lake as habitat for nesting or feeding were established and “trigger” specific regulatory responses as selenium concentration in eggs increase in the lake. Each trigger value represents a scientifically defensible point, as recognized by the Great Salt Lake Selenium Science Panel. There are two overarching aims of these tiered regulatory responses. First, the triggers are intended to ensure that scientific uncertainties do not result in degradation of beneficial uses. Second, the proactive, adaptive management process established by these procedures allows steps to be taken to avoid selenium-related impairments to the Great Salt Lake by preventing the standard from being exceeded.

The proposed trigger values and associated regulatory responses were developed using various scientific arguments and by evaluating all existing data. Due to uncertainty inherent in all scientific inquiry and the desired level of protection, it was difficult to derive a single value from these analyses as a recommended standard. Instead, a range of numbers was generated from different inquiries that were both higher and lower than the proposed standard. The proposed threshold or “trigger” values proposed represent scientifically defensible values that were lower than the proposed standard. A summary of the sources of trigger values and rationale for the regulatory responses is provided below. For additional details, see *Developing a Selenium Standard for the Open Waters of the Great Salt Lake* and associated supporting literature at: [http://www.deq.utah.gov/Issues/GSL\\_WOSC/index.htm](http://www.deq.utah.gov/Issues/GSL_WOSC/index.htm).

- ***5 mg/kg: Increase Monitoring***

After a thorough review of available data, some Science Panel and Steering Committee members proposed a selenium concentration of 5.0 mg/kg as a No Effect Concentration (NEC). A NEC represents the predicted concentration that results in no harm to a species. Should this trigger be reached, it is unlikely that biological responses would occur. Nonetheless, it would represent an increase over existing concentrations (mean egg selenium concentration of 2.7 mg/kg), which would mean that more intensive evaluations of selenium was warranted.

If this threshold is reached, existing sampling procedures will be evaluated to see if existing collection methods are sufficient to fully

understand the scope, scale, and reasons for observed selenium increases. The proposed regulatory response allows monitoring approaches to be developed that best balance data needs with available monitoring resources.

- ***6.4 mg/kg: Antidegradation Level II Review***

This trigger value is the Lower Confidence Level (LCL) of the compilation of 6 studies that were used to estimate the EC10 values. The proposed selenium standard of 12.5 mg/kg standard is the average value in the range and 95% of possible EC10 values are expected to be lower than this threshold.

When this trigger is reached, an Antidegradation Level II Review will be initiated for all new permits or permit renewals. This review could impose requirements upon a potential or existing discharger, including the limitation of further loadings, or reductions in loadings as the review may determine. Level II reviews require that costs of all potential treatment processes are presented along with the anticipated environmental benefit. This requirement will provide the data necessary to thoroughly evaluate treatment processes and associated permit limits that provide the highest environmental benefit at a reasonable cost. While such reviews are exacting, the cost incurred in collecting the requisite information for a Level II review will likely be useful to meet TMDL limits should the site become impaired.

- ***9.8 mg/kg: Initiate Preliminary TMDL Study***

This threshold value represents the NEC of an alternative analytical technique that was conducted to estimate selenium toxicity to birds.

If this trigger value is reached a preliminary TMDL study will be initiated to evaluate the relative contribution of selenium sources to those areas in Great Salt Lake with egg selenium concentrations exceeding 9.8 mg/kg. The intended goal of these studies would be to determine possibilities for loading reductions from point and non-point sources alike. Data obtained from these analyses could help identify the most cost-effective way to prevent further selenium increases in the lake. This may generate a variety of management options, including the possibility of trading among sources to reduce the selenium loading to Great Salt Lake.

- ***12.5 mg/kg: Declare impairment, formalize and implement TMDL***

This value is the maximum likelihood EC10 of a meta-analysis of selenium toxicity to mallards. This proposed standard was recommended by 6 members of the Science Panel and 10 members of

the Steering Committee. Depending on the methods employed, this value could be considered a No Observed Effect Concentration (NOEC) because effects of concentrations below this number would be impossible to measure in the environment. This also represents the maximum likely EC10 value obtained from another independent study of selenium toxicity.

If concentration of selenium in bird eggs were ever to reach the standard, the Division of Water Quality would declare impairment, require the finalization of the preliminary TMDL, and place the waterbody on the 303(d) list of impaired waters. Most of the studies necessary for TMDL implementation would already have been conducted based on the response to previous triggers, so implementation of TMDL recommendations would be quickly employed to move toward the elimination of the selenium impairment.

In summary, the egg concentration triggers and associated regulatory responses proposed in this approach are designed to evaluate any observed increases in concentration of selenium that are observed in the populations of shorebirds of Great Salt Lake. The proposed regulatory responses assure that immediate attention is applied to any observed increase in selenium in the ecosystem. If Great Salt Lake selenium levels begin increasing, the thresholds discussed here will also be a valuable management tool because the causes of increases and potential solutions to prevent further increases will continue to manifest themselves.