

# Dissolved Oxygen

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## Rule

### Surface Water Quality Criteria for Cold Water Aquatic Life Use Designations (IDAPA 58.01.02.250.02)

*Waters designated for cold water aquatic life are not to vary from the following characteristics due to human activities:*

- a. *Dissolved Oxygen Concentrations exceeding six (6) mg/l at all times [emphasis added]. In lakes and reservoirs this standard does not apply to:*
  - i. *The bottom twenty percent (20%) of water depth in natural lakes and reservoirs where depths are thirty-five (35) meters or less.*
  - ii. *The bottom seven (7) meters of water depth in natural lakes and reservoirs where depths are greater than thirty-five (35) meters.*
  - iii. *Those waters of the hypolimnion in stratified lakes and reservoirs.*

## Discussion

Idaho's current dissolved oxygen criteria are 1) out of date, and 2) do not account for natural variability and modern monitoring capabilities.

Dissolved oxygen (DO) criteria are among the oldest criteria in Idaho's water quality standards (WQS). Though Idaho's adoption of DO criteria was based on EPA's 1986 Gold Book recommended criteria, the state did not incorporate all elements of those criteria. For example, EPA's recommendation coupled a minimum of 4.0 mg/L with a 30-day mean of 6.5 mg/L to protect cold water aquatic life. Although a legitimate reading of Idaho's current criteria is that the 6.0 mg/L minimum is a 1-day average value, it has been applied as an instantaneous minimum. Idaho also did not incorporate EPA's recommended language allowing for naturally low DO<sup>1</sup>. The amount of dissolved oxygen present in a body of water is known to be dependent on temperature, salinity, atmospheric pressure and biological and chemical processes<sup>2</sup>. Thus, under certain environmental conditions (i.e. high altitude during the warm summer months), DO can be naturally quite low and yet successfully support cold water aquatic life<sup>3</sup>.

A provision is needed in Idaho's water quality standards which allows excursions from the numeric criteria in waters that have the potential to exhibit naturally low DO concentrations (e.g., depletion of DO under long winter ice-over conditions in lakes; waters that are naturally highly productive such as shallow weedy ponds, sloughs and aforementioned high elevation

waters). The effect of temperature and atmospheric pressure on DO saturation is overlooked, or even contravened, by the current criteria. High elevation lakes in summer may not be able to meet numeric criteria, even though saturated with DO. In addition, the natural variability of DO is becoming more apparent with modern monitoring techniques that allow high sampling frequency (e.g., hourly or less). This new abundance of data, at temporal fineness not seen before, gives rise to new questions about how short durations of low DO really affect the support of aquatic life.

Low DO concentrations that are naturally occurring and fleeting may have little impact on beneficial use support although they are in contradiction to a simple application of “never to exceed” criteria, and could potentially result in a 303(d) listing. On the other hand, DO is part of a set of criteria for which EPA deferred ESA consultation in the mid 1990’s when they took up consultation on Idaho’s criteria for toxic substances. The results of completed consultations in the Region 10 sister states of Oregon and Washington has resulted in those states adopting more stringent DO criteria to protect listed salmonid species.

Oregon’s water quality standards (WQS) include a breakdown of dissolved oxygen criteria depending on the class of aquatic life present in the system including: salmonid spawning, cold water, cool water, and warm water. Oregon’s rules further delineate a 30-day average concentration or 7-day average concentration, a 7-day minimum and an absolute minimum concentration for DO, depending on the aquatic life use to be protected; the absolute minimum being equal to 4.0 mg/L (cool and warm water aquatic life uses). Oregon’s DO criteria for protecting salmonid spawning includes an absolute minimum of 8.0 mg/L (for inter-gravel spatial medium) and 9.0 mg/L (water column) unless altitude, barometric pressure or temperature preclude achievement of the criterion (in which case, 95% saturation applies instead).

By comparison, Washington’s WQS also allow for a range of DO concentrations acceptable for various aquatic life uses, but include only a 1-day minimum for each aquatic life use category; the absolute minimum being equal to 6.5 mg/L (salmonid rearing and migration ONLY, and warm water aquatic life uses). Washington’s DO criteria for the protection of salmonid spawning is 9.5 mg/L (for char spawning and rearing, and core summer salmonid habitat) and 8.0 mg/L (for salmonid spawning, rearing and migration, and non-anadromous interior Redband trout).

## References

- 1) Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Freshwater). US EPA. 1986. Accessed on July 15, 2014.  
<http://nepis.epa.gov/Exe/ZyPDF.cgi/00001MSS.PDF?Dockey=00001MSS.PDF>
- 2) *Dissolved Gases – Oxygen*. Lecture. Accessed July 15, 2014.  
<http://www.esf.edu/efb/schulz/Limnology/Oxygen.html>
- 3) Fondriest Environmental, Inc. “Dissolved Oxygen.” *Fundamentals of Environmental Measurements*. Fondriest Environmental, 19 Nov. 2013. Accessed July 15, 2014.  
<http://www.fondriest.com/environmental-measurements/parameters/water-quality/dissolved-oxygen/>