OPTIMAL WATER QUALITY VALUES for AQUATIC ECOSYSTEMS

This brief guide to water quality pertains to rivers and streams in the Pacific Northwest. These general water quality values refer to conditions preferred by salmon. This guide should be helpful for teachers and students to gain a better understanding of the needs of aquatic ecosystems, and for understanding the significance of their water quality test results.

Temperature

Fish, insects, plankton, and other aquatic organisms all have a preferred temperature range. But, as temperatures get too far above or below this preferred range, few individuals can survive. For fish, no other environmental factor affects their development and growth more than water temperature. Many life cycle stages such as spawning and egg hatching are timed to annual temperature changes.

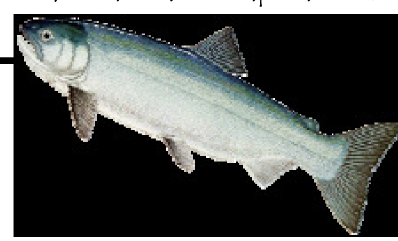
Optimal Levels:

Hatching Salmon	Adult Salmon	Aquatic Insects	Not Acceptable
< 48°F or 9°C	< 54°F or 12°C	< 50°F or 10°C	>65°F or 18°C

< less than, > greater than

Dissolved Oxygen (DO)

Like land animals, aquatic plants and animals use oxygen to breathe. Dissolved oxygen is the amount of oxygen gas in water which can be breathed by fish and other aquatic life. If the amount of oxygen is too low, living organisms may not survive and decreased oxygen is often a sign of water pollution. Temperature and dissolved oxygen are linked; when water temperature increases, the amount of oxygen gas in the water decreases as it evaporates into the air. Colder water can hold more oxygen.



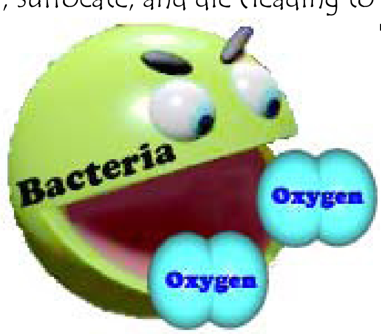
Optimal Levels:

Optimal	Acceptable	Poor	Fatal
> 9 mg/l	7-8 mg/l	3.5—6 mg/l	< 3.5

Generally, a DO level below 3 mg/l is stressful to most forms of aquatic life.

Biochemical Oxygen Demand (BOD)

BOD is a measure of the amount of oxygen consumed by the respiration (breathing) of microorganisms in the water. Microorganisms decompose dead plants (like algae) and animals while feeding on them. More nutrients in the water act as food for microorganisms which then multiply and use up more oxygen. The more they use, the less oxygen there is for fish and other aquatic life. The BOD is calculated by performing a DO test on water taken from a stream or river that has set for 5 days and subtracting that number from the amount of DO taken originally before the 5 days. The consequences of high BOD are the same as those for low DO: aquatic organisms become stressed, suffocate, and die (leading to massive fish kills).

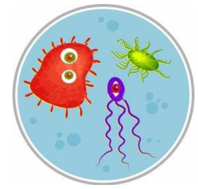


Optimal Levels:

Acceptable DO level after BOD Test
> 6.0 mg/l

Fecal Coliform

Fecal Coliform bacteria indicate the likely presence of water-borne pathogenic (disease causing) bacteria or virus. Fecal Coliform bacteria are used as indicators of these more harmful bacteria or virus. Fecal Coliform bacteria are present in the intestines of warm blooded animals, including humans. Fecal Coliform is measured in # of colonies per 100 ml of water. (FC/100 ml)



<u>Human Sanitation Levels:</u>
Drinking water 0 FC/100ml
Swimming 100 FC/100ml

Fecal Coliform Optimal Level: < 50 FC/100ml

(ml = milliliter)

Note: Shellfish such as clams and oyster filter up to 25 gallons of water per/day while feeding. Thus, they can concentrate bacteria leading to a human health threat. High levels of bacterial pollution can lead to the closure of shellfish harvesting.

pH

A measure of the relative acidity or alkalinity of water (the concentration of hydrogen ions in water.) pH stands for percent hydrogen and is measured on a scale from 0 to 14, with 0 being most acidic, 7 neutral; and 14 most basic or alkaline. The scale is logarithmic, there is a tenfold change in acidity or alkalinity per unit change. For example, water with a pH of 6 is ten times more acidic than water with a pH of 7.

pH Optimal Levels: pH values between 7 and 8 are optimal. A pH range between 6.5 and 8.5 is generally suitable. If pH declines below 6.5, fewer salmon eggs hatch and aquatic insect levels drop.

The pH Scale

Nutrients Nitrates and Phosphates

Too many phosphates and nitrates in water can be from many nonpoint sources, such as livestock or pet wastes, soap, failing septic systems and synthetic fertilizers. Unlike on land, excessive nutrients in water can accelerate algae growth resulting in algal blooms which can lower dissolved oxygen levels, often leading to fish kills.

Optimal Levels: Nitrates levels in unpolluted water bodies should generally be below 1 mg/l. Phosphates in unpolluted water bodies should generally be below .025 mg/l.

Turbidity

Turbidity is the measurement of the clarity or how cloudy the water is. Sediment, silt and particles like dirt, mud, sand, algae, etc. can make it harder for sunlight to travel through the water. Very cloudy water can make it hard for underwater plants to survive, harm the gills of bottom-dwelling organisms and even affect the ability of juvenile fish to catch prey. The particles and sediment in highly turbid water will absorb sunlight causing the water to warm, this leads to decreased oxygen levels. Turbidity is measured in Jackson Turbidity Units or JTU's.

Optimal Levels: Since salmon rely greatly on their visual abilities, the lower the turbidity the better. Less than 20 JTU's are optimal. Salmon will avoid water with high silt loads which cloud the water, and will cease to move through water where visibility is extremely low. High turbidity can delay salmon migration.

References
Modified from Optimal Water Quality Standards for Aquatic Ecosystems Guide prepared by Chris Maun (Nisqually River Education Project) and Peter Moulton (Nisqually River council); "Optimal Water Quality Values" updated 1/2011 by Maggie Bell-McKinnon, Washington State Department of Ecology, biologist, Environmental Assessment Program and modified from Optimal Water Quality Standards for Aquatic Ecosystems, Pierce County Public Works and Utilities, WA.