WASHINGTON STATE DEPARTMENT OF ECOLOGY

Focus

Dissolved Oxygen and the Water Quality Standards

Issue

The level of dissolved oxygen (DO) present in lakes and streams is commonly used as an indicator of water quality. Maintaining adequate concentrations of DO is vitally important for supporting fish, invertebrates and other aquatic life.

Why is DO important?

Like people, fish and other aquatic organisms need oxygen to live. As air or water moves past an animal's breathing apparatus (gills or lungs), oxygen is transferred to their blood. It is more difficult to transfer oxygen from water to blood than it is to transfer oxygen from air to blood. Therefore, it is critical that an adequate amount of oxygen is maintained in the water for this transfer to take place efficiently and sustain aquatic life.

In addition to being required by aquatic organisms for respiration, oxygen is necessary to help decompose organic matter in the water and bottom sediments. It is also necessary for other biological and chemical processes.

Washington's Water Quality Standards

The federal Clean Water Act requires the states to ensure waterbodies are healthy for such uses as fish and wildlife habitat, domestic and agricultural water supplies, boating, and swimming. States adopt standards for dissolved oxygen and other parameters, such as temperature, bacteria and nutrients, to make sure a waterbody is clean enough for its designated use. The Washington State DO standards are shown in the table at the right.

Dissolved Oxygen Standards in Washington State	
Class AA - Extraordinary	> 9.5 mg/l
Class A -Excellent	> 8.0 mg/l
Class B - Good	> 6.5 mg/l
Class C - Fair	> 4.0 mg/l
Class Lakes and Reservoirs	No change from natural conditions

The Department of Ecology (Ecology) sets standards for each waterbody, according to the uses of the water and to protect the needs of the creatures it supports. Certain life stages of salmon and other aquatic species require higher concentrations of DO.

What affects DO levels?

Oxygen is produced during photosynthesis and consumed during plant and animal respiration and decomposition. While photosynthesis occurs only during daylight hours, respiration and decomposition continue throughout the night. Therefore, DO levels can greatly fluctuate throughout the day with the lowest levels occurring at night. Oxygen also enters water where it contacts air.

DO concentrations increase in surface water wherever the water flow becomes turbulent, such as in a riffle area or waterfall. This turbulence brings more water into contact with the air thus increasing the amount of oxygen dissolved into the water.

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Elevation: Elevation can also affect the amount of DO in water. As you go up in elevation the pressure exerted by the atmosphere is reduced. When this pressure is reduced less oxygen is forced into the water. At lower elevations more DO may be present in the water due to the greater atmospheric pressure.

Temperature: Too warm of water can decrease the amount of DO in a lake or river. Cold water can hold more DO than warm water. Therefore, during the summer months when stream water is warmer, oxygen can be limited by the ability of the water to "soak up" more oxygen gas. Warmer summer temperatures also cause increased biological activity – plant and animal growth, productivity, respiration, and decomposition – which increases the rate of DO consumption by aquatic creatures and plants.

Water flow: During late summer, stream flows can get very low in some streams. Some of the tributaries that provide water, with typically good supplies of oxygen, to the main stream dry up. When there is less water in a stream it heats up more rapidly causing it to lose more DO. When water moves more slowly over the riffles or rapids than it did in earlier months, the water receives less exposure to air and therefore, oxygen.

Pollution: Pollution tends to decrease DO concentrations. Stormwater runoff and wastewater discharges often carry oxygen-demanding wastes to streams and lakes. When a watershed becomes developed, greater quantities of these pollutants are released and the total volume of stormwater runoff increases. Most conventional pollutants (sediments, nutrients, and organic matter) require oxygen for decomposition or for chemical reactions. Consequently, DO concentrations often decrease in streams located in a developed or developing watershed.

Animal wastes and other nutrients in streams or riparian areas feed aquatic plants just as they would fertilize a farm or garden. Plants especially algae, grow faster and more densely because of the presence of high amounts of minerals and organic nutrients. These well-fed plants require more oxygen for respiration and deplete oxygen levels when they decompose.

What can be done?

Anyone who lives in a watershed – and that means all of us – may take certain actions to reduce polluted runoff from their property, thereby increasing oxygen concentrations in nearby lakes and streams. Here are some things you can do:

- Cover and store manure, yard waste, fertilizers, and other chemicals away from the water.
- Maintain or enhance vegetation alongside streams, to shade the water and filter pollutants from the run-off. Shaded streams are cooler, allowing the water to hold more oxygen. Never remove the natural riparian vegetation that protects these waterbodies.
- If you have large animals, keep them away from the lake or stream. Otherwise, the animals will trample the stream banks, destroy the vegetation along the water, and directly add nutrients to the stream.
- Road construction, land clearing, and grading must be done in a way to prevent erosion and the depositing of sediments (dirt with contaminants) into waterways.
- If you use a septic system, inspect it regularly to make sure it's functioning properly.
- Reduce your use of fertilizers and pesticides on your lawn and garden. Rain may carry these pollutants into the nearest waterbody, indirectly reducing the oxygen in the water.

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