

Dissolved Oxygen State-of-Practice Study

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Report Background

- Report is a response to GCDAMP stakeholder concerns about low DO effects on the rainbow trout fishery.
 - Reminder: Colorado River is re-aerated after passing through the Paria Riffle at Lees Ferry (RM 0.2).
- TSC reviewed a wide range of technologies currently used. Selected a couple based on perceived likelihood of success.

Low dissolved oxygen (DO) concentrations are a common water quality problem downstream of hydropower facilities

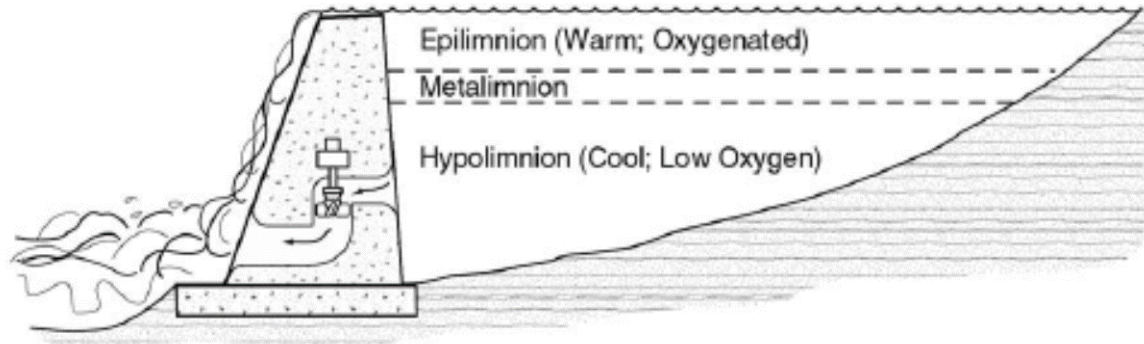
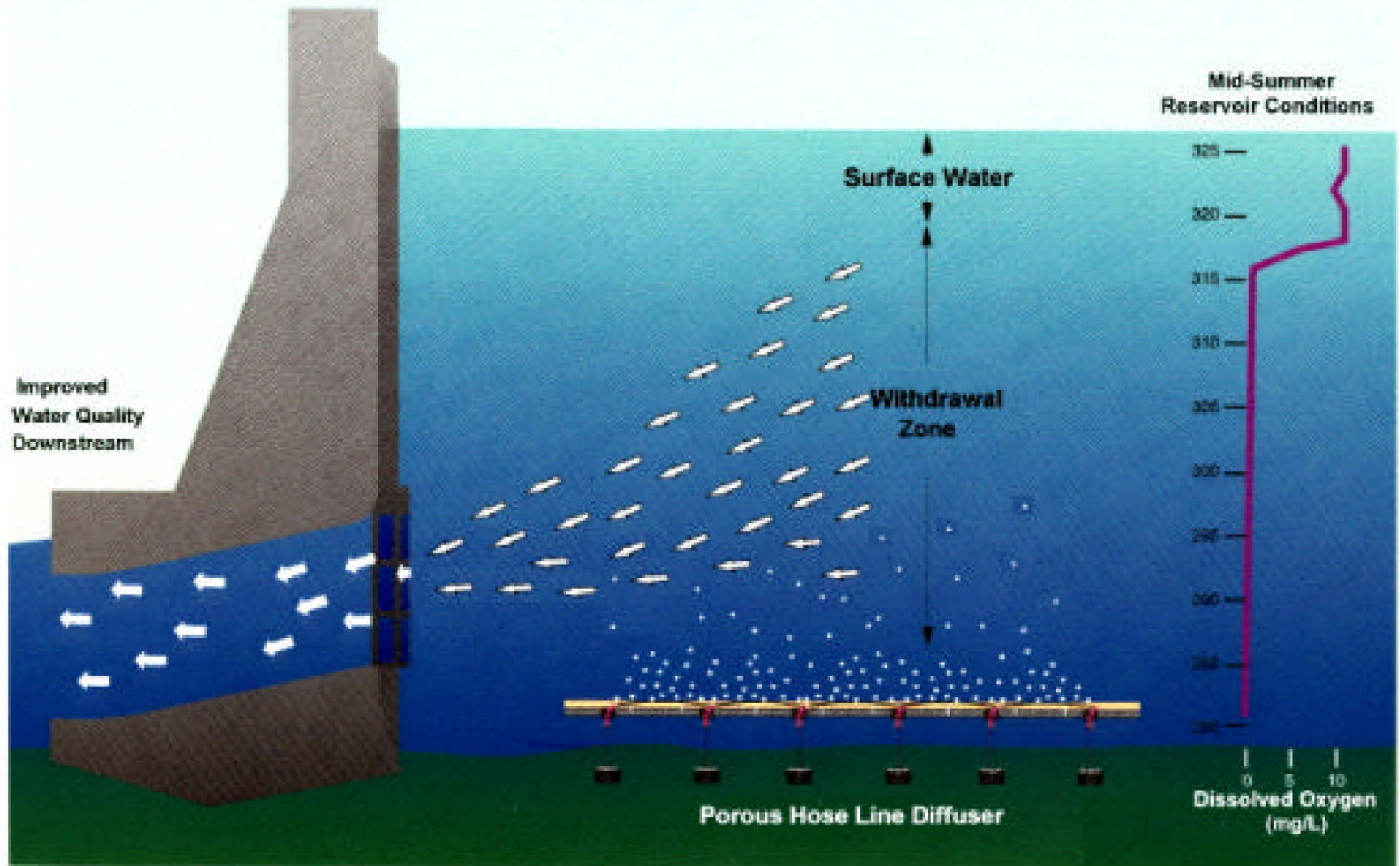


Figure 1. Thermal stratification of a hydropower reservoir

Figure 1 taken from: Peterson, M. J. et al. 2003. Regulatory approaches for addressing dissolved oxygen concerns at hydropower facilities. U.S. Department of Energy. Energy Efficiency and Renewable Energy. Wind and Hydropower Technologies. DOE/ID-11071

- **Takeaway:** any option will require significant engineering analysis and feasibility study. No short-term, off-the-shelf fixes available.
- Best options to increased DO:
 - Hypolimnetic aeration (broad class of solutions, e.g., bubblers):
 - Hypolimnetic (deep water) aeration requires no modification to dam.
 - Expensive. Requires oxygen delivery or generation on-site.
 - Approximately 22 tons of pure oxygen per day required to achieve a 2 mg/L increase at a discharge of 8000 CFS.
 - Turbine aeration : rough zone, air injection
 - Tried turbine aeration in rough zone in 2006, it was deemed damaging and off-limits.
 - Has potential with new post-2006 turbines, operational scenario likely different.
 - Forced air injection through existing piping.

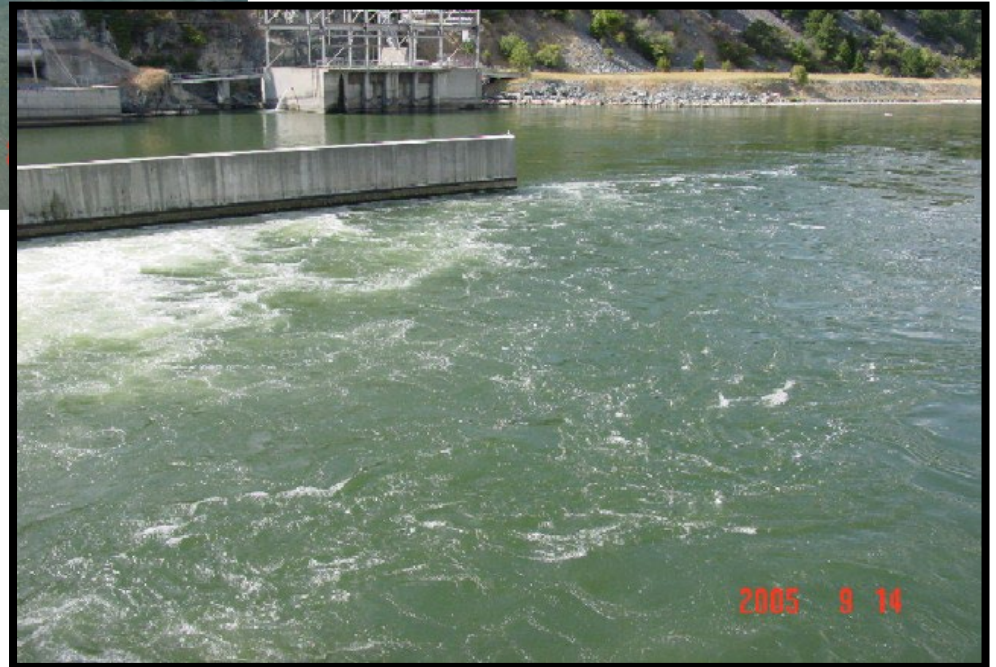
Bubble Plume Oxygenation



Introduction of air during rough zone operation



Outflows at Canyon Ferry, MT without and with forced air injection



Other options

- Bubble plumes using atmospheric oxygen (supersaturation issues, efficiency)
- Aerating turbines (significant retrofit to facility needed.)
- Aerating weir downstream (Lack of gradient and difficulty due to location)
- Speece Cone (infrastructure needed and possible scale issues)