

Pros and Cons of Whole-Lake Aeration

Lake Carmi Implementation Team
Thursday, October 18, 2018

Aeration as a Management Tool

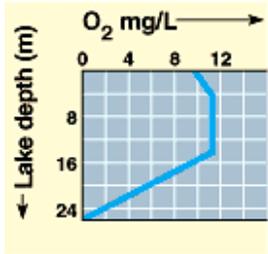
Aeration is an in-lake management tool used to increase the concentration of dissolved oxygen to address symptoms of eutrophication.

Increasing the concentration of dissolved oxygen can:

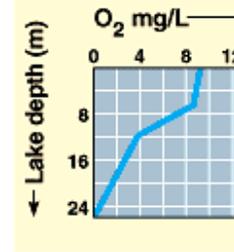
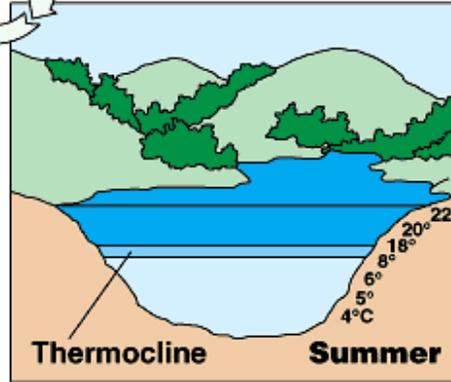
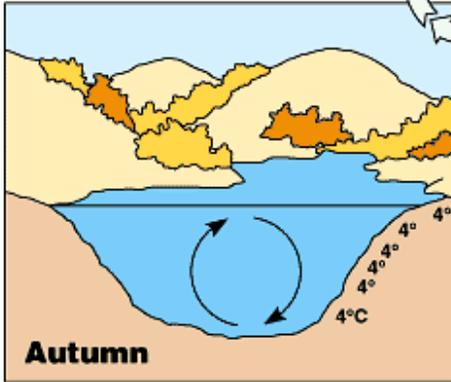
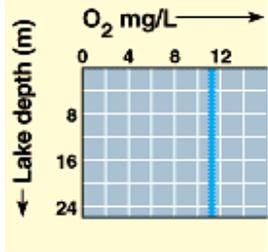
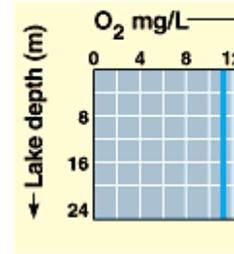
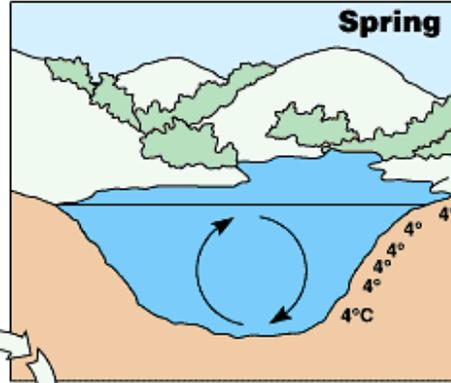
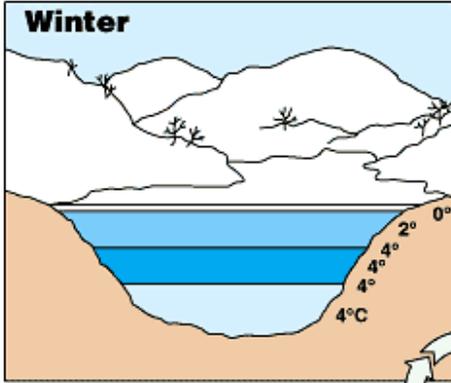
Improve fish habitat in waterbodies suffering from low dissolved oxygen;

Homogenize water quality and pH levels to help reduce treatment costs in drinking water reservoirs; and

Manage algae blooms through a variety of mechanisms, depending on the characteristics of the waterbody.



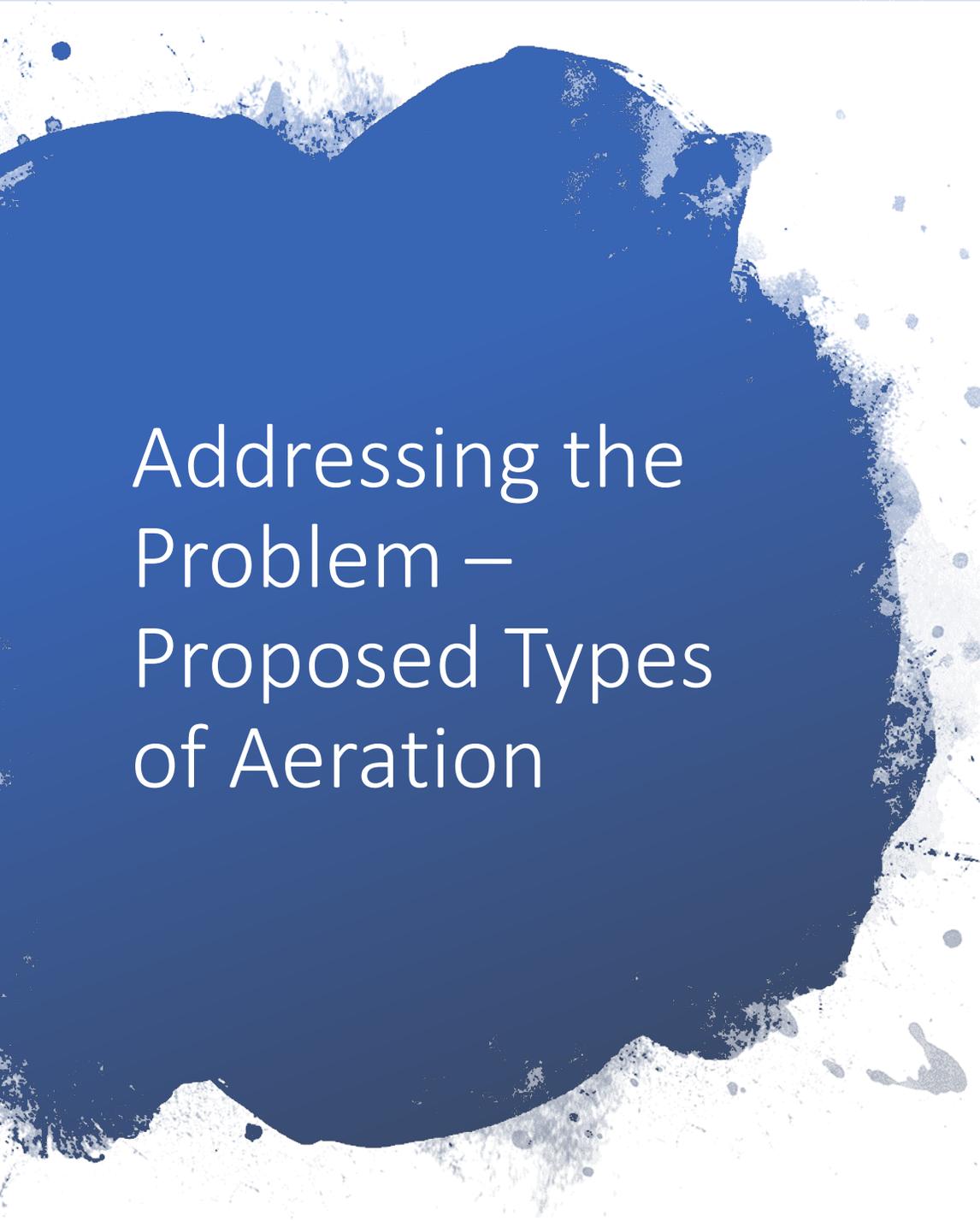
- █ High O₂ conc.
- █ Medium O₂ conc.
- █ Low O₂ conc.



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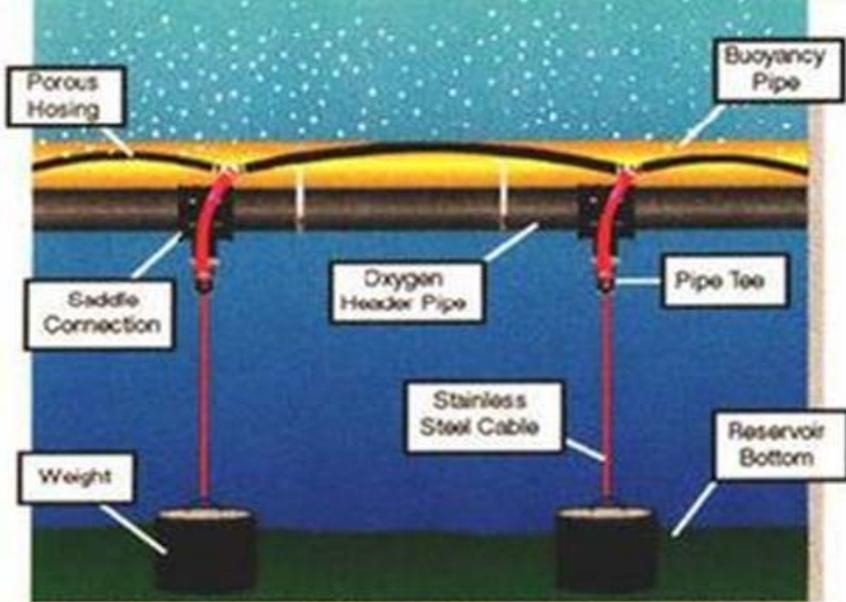
Problem Identification

Lake Carmi suffers from depleted dissolved oxygen concentrations near the lakebed sediments. This results in the release of phosphorus into the water. Dissolved oxygen concentrations are influenced by the natural stratification process.



Addressing the Problem – Proposed Types of Aeration

- Goals of the whole-lake aeration system would be to:
 - prevent oxygen depletion near the lakebed sediments during summer stratification, thereby decreasing release of legacy phosphorus from the sediments, and
 - create physical conditions that hinder cyanobacteria blooms.
- Three aeration systems were evaluated under the Phase 2 Report:
 - diffused air circulation with a line diffuser
 - diffused air circulation with disk diffusers
 - downdraft pumping

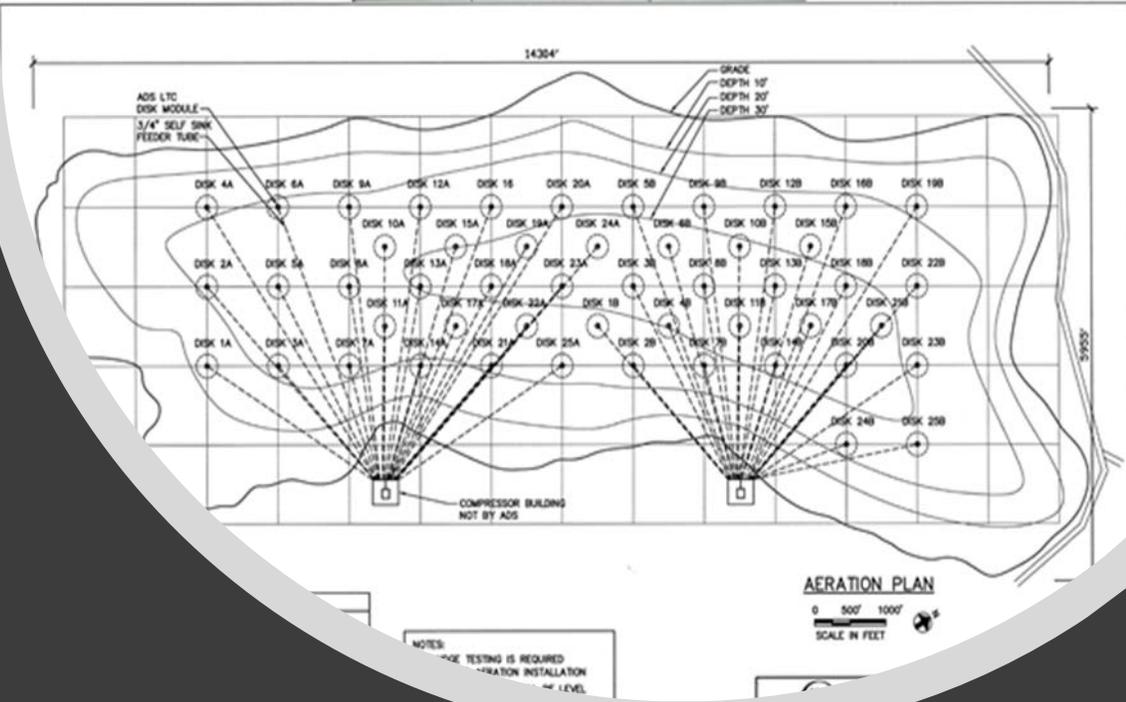


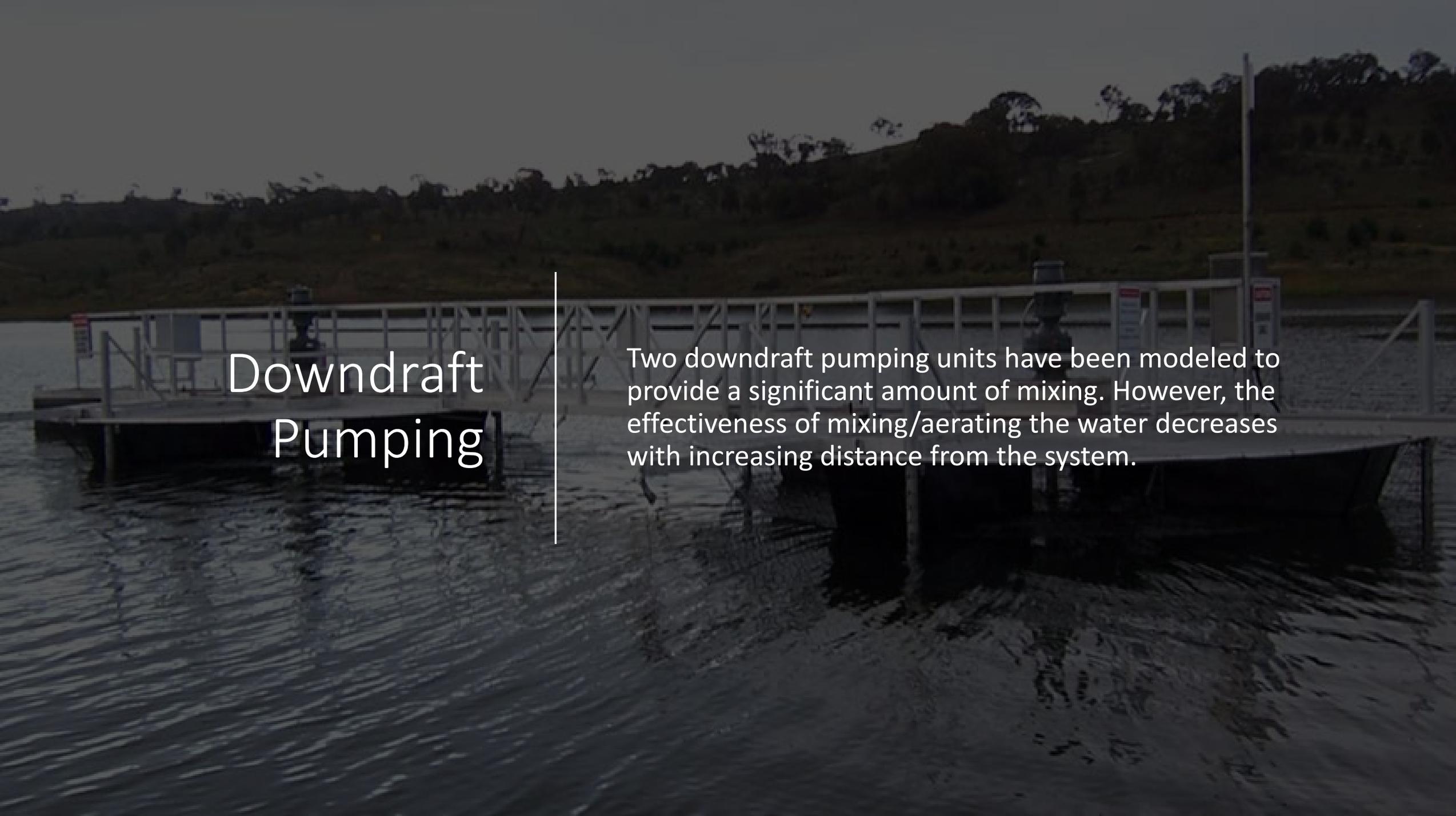
Diffused Air Circulation with a Line Diffuser

Modeling has shown that a 1,600-m line diffuser system would meet the goals of the project.

Diffused Air Circulation with Disk Diffusers

A 55 to 100 disk system would be required to be functionally equivalent to the line diffuser system. However, the system would require extended operational periods or greater pumping capacity to mix the water column.





Downdraft Pumping

Two downdraft pumping units have been modeled to provide a significant amount of mixing. However, the effectiveness of mixing/aerating the water decreases with increasing distance from the system.

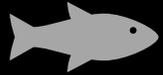


The Pros of Whole-Lake Aeration

Reduce the frequency and intensity of cyanobacteria blooms by:

- reducing anoxic conditions
- creating a physical environment better suited for other diatoms and algae species

The Potential Cons* of Whole-Lake Aeration



Changing the communities of phytoplankton, zooplankton and other primary food sources that larval and juvenile fish species rely on



Making nutrients more available to phytoplankton and aquatic plants, increasing their rate of growth



Decreasing the availability of still water to those species that need it



Increasing temperature throughout the water column due to the mixing of warm surface water downward



CLEAR IDENTIFICATION OF THE PROBLEM



CLEAR, CONCISE SHORT AND LONG-TERM GOALS, WATER QUALITY TARGETS, AND EXPECTATIONS ACHIEVED BY AN IN-LAKE TREATMENT



THE CHOSEN AERATION SYSTEM WILL ADDRESS THE IDENTIFIED PROBLEM



THE CHOSEN AERATION SYSTEM WILL NOT ADVERSELY AFFECT THE PUBLIC GOOD



IMPLEMENT WATERSHED MANAGEMENT PRACTICES

Whole-Lake Aeration – Project Planning

Pros and Cons In Sum



WHILE THE FREQUENCY AND INTENSITY OF CYANOBACTERIA BLOOMS WILL DECREASE, BLOOMS ARE RARELY ELIMINATED. CYANOBACTERIA ARE NATIVE AND BLOOMS NATURALLY OCCUR UNDER CERTAIN CONDITIONS.



WHOLE-LAKE AERATION IS A SHORT-TERM IN-LAKE MANAGEMENT TOOL USED TO ALLEVIATE IMMEDIATE WATER QUALITY ISSUES. IT DOES NOT ADDRESS THE UNDERLYING CAUSES OF EUTROPHICATION. WORK IN THE WATERSHED NEEDS TO CONTINUE.

Moving Forward

The three proposed aeration systems are encroachments into public water. The system that is chosen will require a Lake Encroachment Permit.



To issue a Lake Encroachment Permit, the chosen aeration system must not adversely affect the public good.



The public good determination reviews how an encroachment affects the public good (weighing pros and cons). This further refines a project to ensure that the encroachment will minimize potential cons to the greatest extent possible.