Oxygenation & Circulation Systems

WHY ADD OXYGEN TO LAKES AND PONDS?

LOW OXYGEN LEVELS CAN

Promote poor water quality:

- Elevate metals (*e.g.,* iron, manganese)
- Accumulate ammonium, hydrogen sulfide
- Release phosphorus from sediment

HIGH OXYGEN LEVELS CAN

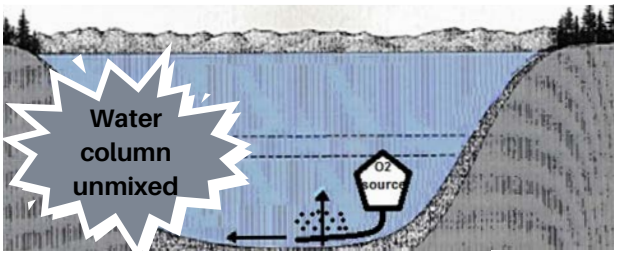
Improve water quality:

- Reduce or change composition of algae
- Provide consistent water quality
- Improve habitat for fish & invertebrates

TYPES OF SYSTEMS

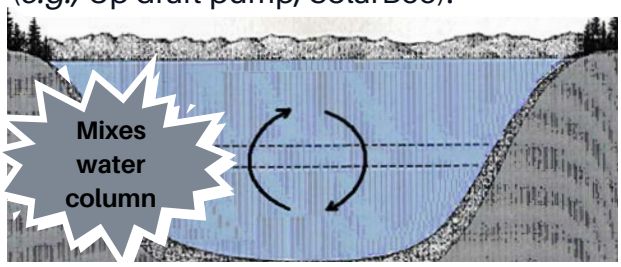
OXYGENATION

Process of adding oxygen to the bottom of the water column without mixing and disrupting any existing temperature gradient (*e.g.,* oxygen saturation technology, OST).



CIRCULATION

Process of mixing & delivering oxygen-rich surface water mechanically or with air to deeper oxygen-depleted waters (*e.g.,* Up draft pump, SolarBee).



FACTORS THAT DICTATE SYSTEM CHOICE

- **Waterbody characteristics:** oxygen demand, nutrients, shape, depth, stratification, rate of water flow
- **Local weather patterns:** particularly sun and wind
- **Technical factors:** source & cost of oxygen and power, installation & maintenance logistics
- **Public needs:** does system meet stakeholder needs or create burdens (*e.g.,* noise, socioeconomic)

USING DECISION FLOW CHARTS TO GUIDE SYSTEM CHOICE

- Identify main goal(s): algae control, water quality improvement, habitat support.
- Utilize goal-specific flow charts: use waterbody characteristics to guide system choice (Figures 5.1-5.3 in *Wagner 2015*).
- Factors not covered in flowcharts: hybrid systems can be applicable and cost may be an overriding factor that dictates system choice.

Waquoit Bay Reserve Coastal Training Program

Information and images adapted from "Oxygenation and Circulation to Aid Water Supply Reservoir Management", by Dr. Kenneth J. Wagner, published in 2015 and "The Practical Guide to Lake Management in Massachusetts", by Dr. Kenneth J. Wagner *et. al.*, in preparation

Adapted for CTP Pond Oxygenation Workshop: Learning through case studies, November 8, 2023

Oxygenation & Circulation Systems

RELATIVE SUCCESS OF OXYGENATION & CIRCULATION TECHNOLOGIES

OXYGENATION

Adding oxygen to the bottom of the water column without mixing.

CIRCULATION

Mixing & delivering oxygen-rich surface water to deeper waters.

Hypolimnetic aeration chamber	Oxygen diffusers	Downflow bubble contact chamber	Oxygen saturation technology (super saturated side stream)	SYSTEM NAME	Diffused air circulation	Up draft pump	Down draft pump
HAC	**DOX**	**DBC**	**OST** (SSS)	**ABBREVIATION**	**DAC**	**UDP**	**DDP**
22%	91%	75%	80%	**FULLY***	57%	15%	56%
68%	9%	25%	20%	**PARTIALLY***	29%	39%	45%

***PERCENT OF PROJECTS THAT FULLY OR PARTIALLY ACHIEVED WATER QUALITY GOALS.**
Relative comparisons are compiled from 70 case studies and are analyzed in *Wagner 2015*.

CHALLENGES THAT LIMIT SYSTEM SUCCESS

- Determining & meeting oxygen demand
- Properly sizing & placing systems
- Accounting for temporal & spatial oxygen demands
- Thorough monitoring of oxygen indicators & biological variables before & after implementation

RELATIVE COST OF OXYGENATION & CIRCULATION TECHNOLOGIES

Capital & maintenance costs depend on the size & design of the systems that are dictated by pond morphology & ecological goals. Costs are too variable within and across technologies to be generalized. Rather, cost assessments for specific ponds are the only reliable method to compare costs among systems.

Waquoit Bay Reserve Coastal Training Program

Information and images adapted from "Oxygenation and Circulation to Aid Water Supply Reservoir Management", by Dr. Kenneth J. Wagner, published in 2015 and "The Practical Guide to Lake Management in Massachusetts", by Dr. Kenneth J. Wagner *et. al.*, in preparation

Adapted for CTP Pond Oxygenation Workshop: Learning through case studies, November 8, 2023