NUTRIENT MANAGEMENT

Circulation

STRATEGY SCALE

THREATS ADDRESSED

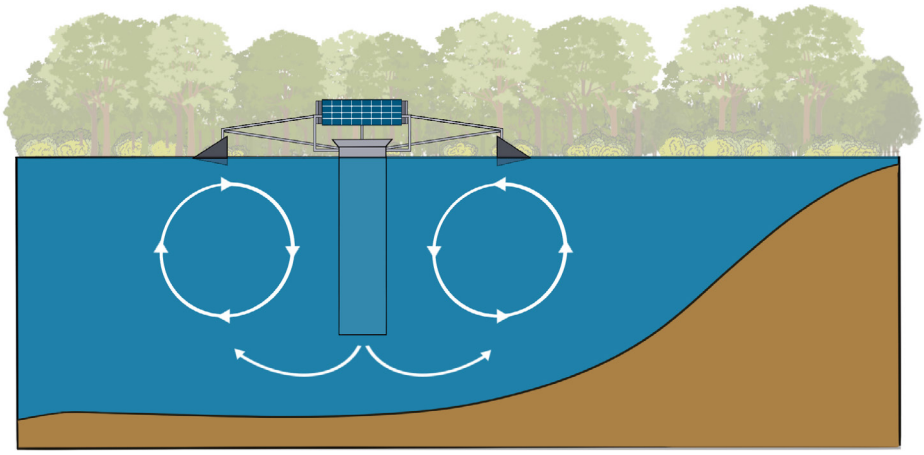
- ✓ Excess Nutrients
- ✗ Pollutant Inputs
- ✓ Algal Blooms
- ✗ Erosion
- ✗ Invasive/Nuisance Species

STRATEGY GOALS

Protect	Manage	Rehabilitate
○	✓	✓

STRATEGY CO-BENEFITS

Habitat	Aesthetics	Recreation
⊖ Neutral	⊖ Neutral	⊖ Neutral



- ✓ **Permittable in Massachusetts**
  Local review through the Conservation Commission required. List of potential permits available here.
- ✓ **Implemented on Cape Cod**
  See examples of pond projects implemented on Cape Cod here.
- ✓ **Listed in 208 Plan Technologies Matrix**
  Learn more about the nutrient management strategies in the Tech Matrix here.
- ✓ **Can be Performed at Homeowner Scale**
  In small, private ponds. Local review and permitting may be required.
- ✗ **Nature-based Solution**

DURATION OF BENEFITS

Less than one month	One season or year	Multiple seasons or years
●	○	○

MAINTENANCE REQUIREMENTS

Monthly	Annually	Infrequent
●	○	○

DESCRIPTION

Circulation describes any process that initiates or enhances the horizontal and vertical movement of pond water. The objective of circulation is to mix water to break up or prevent stratification, delivering oxygen-rich surface water to deeper oxygen-poor waters. Circulation can also induce turbulence which may reduce risk of algal blooms. Methods of circulation include mechanical, using solar or electric powered circulators, or air-driven which includes bubblers or pneumatic circulators, to extend the depth or duration of water circulation. Specific circulation may be used to meet different objectives, including impellers that circulate water both vertically (updraft) and laterally; pumps to force water downward to break up stratification; and surface water fountains to draw the water from the pond bottom and spray water over the water body to promote mixing and oxygen exchange with the atmosphere. The type of aeration should be specific to the characteristics of the pond.

ADVANTAGES

- May promote conditions less favorable to cyanobacteria blooms
- May prevent internal phosphorus release and reduce nuisance algae
- Few negative impacts expected to non-target species
- May enhance fish habitat through improving dissolved oxygen levels
- May work to destratify systems
- Duration of benefits extended with ongoing operations and maintenance
- Effective when properly sized, distributed and operated

CONSTRAINTS

- Reliance on systems in constant operation creates potential for failure during unplanned system outages
- For some methods (e.g., surface spray systems including fountains), the benefits are very limited
- Some methods may bring poor water quality from the bottom to the surface
- May increase turbidity and decrease water clarity
- Highly sensitive to sizing, sediment composition, external nutrient loads
- When misapplied or lacking adequate diagnostics, engineering, or power, artificial circulation is neither reliable nor applicable and can sometimes do harm

Circulation

CAPE COD COMMISSION

IMPLEMENTATION

POTENTIAL ACTORS

- **Towns:** Towns may propose circulation in town-managed ponds
- **Pond Groups:** May propose circulation in public or private ponds and provide a supportive role through education
- **Private Landowners:** May propose circulation in private ponds
- **Land Trusts:** Land trusts may provide a supportive role through education

SITING REQUIREMENTS

- Ponds with limited stratification or where preventing/breaking stratification has limited potential for adverse impacts
- Scalable, most suited for small ponds
- Updraft pumps most applicable for ponds that stratify seasonally
- Surface fountains are best for small, shallow ponds

INFORMATION NEEDS

- Water quality profiles (temp, DO, nutrients)
- Volume of water that must be moved weekly
- Oxygen demand
- Thermal structure
- Need enough power to overcome thermal gradient

IMPLEMENTATION EXAMPLES

- Several circulation projects have been implemented on Cape Cod as identified in the *Pond Restoration Projects Viewer*. A compressed air diffuser/diffused air circulator was deployed in Lovells Pond, Barnstable, and updraft pumps have been deployed in Skinequit and Flax Ponds, Harwich, Santuit Pond, Mashpee, Schoolhouse Pond, Barnstable, and Stillwater Pond, Chatham.
- There are many small pond surface spray (i.e., fountain) applications in MA. Layer aeration systems have been installed in CT and NJ (e.g., *Lake Waramaug, CT*). Downdraft pumps are generally not used in the U.S., but have seen more use in other parts of the world (e.g., Australia).

RESOURCES

- For more information on aeration and oxygenation techniques, see the *Spring 2015 Lakeline article "Aeration and Oxygenation Methods for Stratified Lakes and Reservoirs"*
- The Massachusetts' Department of Conservation and Recreation's *Lakes and Ponds Program* provides related resources.

COST ESTIMATE

**$$$**$

Relative to other in-pond strategies

For all aeration/circulation strategies, costs vary substantially by pond volume and technology

ADDITIONAL FINANCIAL CONSIDERATIONS

Assessment: Planning, design, permitting, including required studies (e.g., water quality and oxygen studies)

Implementation: Equipment (pumps, pipes, diffusers), and installation

Maintenance: Annual operating and maintenance including power costs and real time data collection, if applicable

POTENTIAL FUNDING SOURCES

- **Community Preservation Act**
- **Capital Budget**
- **Grants**
- **Private Funding**

Additional information regarding potential funding sources is available ***here***.