

## Oxygenation and Circulation Techniques to Improve Water Quality

Patrick Goodwin M.S., CLM, Naturalake Biosciences

This workshop is designed to train water resource managers, scientists, engineers, and any interested stakeholder in oxygenation and circulation techniques. This two-part workshop will provide a comprehensive review of both theory and practice of oxygenation and circulation techniques. Participants will be provided the tools and training to be able to properly select and design oxygenation and/or circulation system to address a particular water quality issue(s).

This half-day workshop will focus on fundamentals and will be a series of PowerPoint presentations and excel exercises covering a range of topics, including:

- Reasons for oxygenation and circulation
- Types and proper selection of oxygenation and circulation techniques
- Caveats and lessons learned from oxygenation and circulation techniques
  - Sediment features
  - External nutrient loading
- Life cycle costs
- Methods for calculating oxygen demands
  - Incoming oxygen demands
    - Biological oxygen demands
    - Chemical oxygen demands
  - In-lake oxygen demands
    - Sediment oxygen demands
    - Dissolve oxygen and temperature profile data
- Oxygenation and circulation system sizing
  - Freshwater Vs. brackish/saltwater Vs. wastewater
  - Models (“rule of thumb”) Vs. site-specific data
  - Sizing to pollutant reduction and setting oxygen levels
- Quantifying thermal structure and determining target waters
- Calculating theoretical Vs. actual oxygen transfer rates
- Calculating water movement from air
- Remote monitoring and system calibration



Patrick Goodwin holds a B.S. in Biology from the University of North Florida and an M.S. in Lake Management from SUNY Oneonta. Patrick is a certified lake manager with over ten years of experience in water resource management. Patrick specializes in using the Lake Loading Response Model (LLRM) and field data collection to evaluate nutrient loading and the consequences of that loading in terms of algal blooms and water clarity. He has written numerous comprehensive lake management plans and has unique industry insight into applied restoration techniques, where he has conducted numerous experiments evaluating restoration techniques. He has successfully restored multiple water bodies and is considered an

expert in oxygenation and circulation techniques.