
# Interim Report - In Situ Strategies for Nutrient Management in Falls and Jordan Lakes

Presented to:
Environmental Review Commission,
Joint Legislative Oversight Committee on Agriculture
& Natural & Economic Resources,
and Fiscal Research Division
of the General Assembly

March 1, 2017

## SUMMARY

North Carolina S.L. 2016-94 § 14.13, which establishes a reevaluation process for the Jordan and Falls Lake nutrient strategies, tasks the N.C. Department of Environmental Quality (DEQ) to study alternative in-lake approaches to nutrient management in these two lakes. Among the approaches, DEQ is to include algaecides and phosphorous-locking technologies. This interim report provides the status of DEQ's investigation into additional, potentially useful in situ technologies, building on the subject coverage provided in a May 2016 report to the ERC. The final report is due March 2018.

Investigation to date has identified several additional technologies for fuller evaluation. These technologies use one or more of biological, chemical or physical removal mechanisms. Correspondence will continue with experts in the field including lake management experts, vendors, and researchers.

The final report on this study will include assessment of likely efficacy and cost-effectiveness for use in Jordan and Falls Lakes.

*To reduce chlorophyll A we can*

- reduce excess nutrients in the lake
- reduce the growth of microscopic algae in the lake by blocking its nutrient uptake
- remove excess microscopic algae from the lake

## CONTEXT

Section 14.13(e) of Session Law 2016-94 states in relevant part:

> *"The Department of Environmental Quality shall study alternative technologies for in situ approaches to nutrient management in Falls Lake and Jordan Lake. In its study, the Department shall consider in situ treatments, including algaecide and phosphorus-locking technologies, that have been certified by the United States Environmental Protection Agency for use in drinking water sources. … The study shall determine whether these treatments would provide improvements in water quality and whether the improvements would be more cost-effective than more conventional nutrient mitigation strategies. The Department shall submit an interim report no later than March 1, 2017, and a final report no later than March 1, 2018, to the Environmental Review Commission, the Joint Legislative Oversight Committee on Agriculture and Natural and Economic Resources, and the Fiscal Research Division. If the Department finds these strategies to be effective, it shall incorporate them into the Nutrient Strategies readoption required by subsection (d) of this section. …"*

Regarding knowledge to date on this subject, the Division of Water Resources has in recent years evaluated a number of in situ strategies. Results of those evaluations are compiled in the May 2016 report, Survey of In Situ Strategies for Mitigation of Water Quality Impairments in North Carolina,

*The following technologies were surveyed in DEQ's May 11, 2016 report*

- Epilimnetic Mixing (including SolarBees®)
- Hypolimnetic Withdrawal
- Dilution
- Phosphorous Inactivation using Alum
- Dredging
- Food web manipulation
- Floating wetland islands
- Algal Turf Scrubber®
- Algae Wheel®
- AquaFiber Aqualutions®™

developed for the ERC by the department in response to Section 14.5(d) of SL 2015-241. That report evaluated nine in situ technologies for potential use in Falls and Jordan Lakes, as listed in the left sidebar.

In terms of the relevance of this current charge to other elements of the Jordan/Falls strategies reevaluation, the North Carolina Policy Collaboratory may find the results of this investigation useful. The Collaboratory was established by the General Assembly in 2016 with the mission of utilizing and disseminating the environmental research expertise of the University of North Carolina for practical use by state and local government. The Collaboratory was also charged under Section 14.13(c) of S.L. 2016-94 with broadly evaluating the Jordan and Falls Lake nutrient strategies, including in situ strategies specifically. Along with the DEQ May 2016 report, the final report under this effort may be useful to the Collaboratory as a reference to help guide research focus.

## *TECHNOLOGIES UNDER EVALUATION*

As background on the nature of the in-lake problems being targeted, nutrient-driven impairments in lakes and other North Carolina waters are gauged using chlorophyll A levels. The overabundance of chlorophyll A in these lakes takes the form of suspended microscopic algae, also known as phytoplankton. This phytoplankton differs markedly in physical presence from visible rooted or floating plant forms of algae that can inhabit waterways, and consequently necessitates different types of intervention than may be useful on mats of plants. The technologies being investigated are designed to reduce chlorophyll A by any of several methods: reducing the concentrations or availability of in-lake nutrients; interfering with algal production; or removing algae that has proliferated from the water column.

The department is following several lines of investigation to gain new insights on in situ options. In addition to evaluating algaecides and phosphorous locking technology as directed by session law, DWR staff is reviewing proprietary technologies brought to us by private firms, obtaining new findings being published by fellow watershed and lake managers in other states, and conducting internet searches for potential leads.

Progress to date is limited due in part to staffing availability that has recently improved. Nevertheless, several technologies not previously addressed are under evaluation and new information is being obtained on certain technologies previously reported. By treatment mechanism, those not previously addressed include:

**Biological Treatment:**

Enzymes and Bacteria to limit nutrient uptake by algae (Gettys 2014)

These market products are based on the theory that bacteria are better than algae at competing for nutrients. Increasing the bacterial population will theoretically preempt algal nutrient assimilation, thereby decreasing the overall algae population. This is a new field of study with little research and mixed results.

**Physical treatment:**

Hypolimnetic Aeration Oxygenation

This process oxygenates the deeper zone of lake water, allowing for an aerobic environment which may increase nutrient-sediment binding, reducing the nutrients available to algae in the water column.

**Chemical Treatment:**

- Phosphorous Locking or Inactivation

  The addition of materials to a water body to bind or lock phosphorous, stripping it from the water column and/or sequestering it in the sediment to make it unavailable to algae in the water above. Alum was previously reviewed. Proprietary products including SePRO Phoslock® are currently under review.

- Open-cell Foam by OPFLEX®

This product is placed in the water in the form of large mop-like structures anchored in the lake bottom or sponge-like blankets towed behind boats. The product removes algal nutrients and algae itself by binding it. The saturated foam is removed and replaced with fresh product as needed. It is used in conjunction with SOLO™ Ionic Flocculation™.

- SOLO™ Ionic Flocculation™

  The effluent collected from the Open-cell Foam by OPFLEX® is treated through a patented water and soil remediation technology.

- Sediment Oxidation

  Like hypolimnetic aeration, sediment oxidation can reduce the nutrients available to algae in the water. This is achieved by injecting chemical compounds into lake sediment, causing reactions which limit phosphorous release into the water.

- Algaecides

  Algaecides are herbicides used to kill algae. These chemicals act in different ways to disrupt algal biology. Algaecides under evaluation include:
  - Amine salts/endothall, including Hydrothol® and Aquathol®
  - Peroxides, including PAK 27®
  - Copper

## STATUS UPDATE

Prompted by the US EPA certification criterion contained in the session law charge, DWR sought and obtained guidance from Region 4 of US EPA. The response from the Regional Water Director, attached as Appendix B, included the explanation that *"The EPA does not maintain lists of certified treatment technologies for in situ nutrient management nor is it the Agency's policy to endorse a particular vendor of any such technologies."* Staff of DWR is further investigating the federal pesticide registration program to clarify the nature of designations or constraints placed on algaecides and other products regarding use in aquatic environments.

## NEXT STEPS

The Division of Water Resources will continue to explore and evaluate these and potentially additional strategies. The final report in March 2018 will provide full recommendations on the technologies addressed. Those recommendations will include an assessment of feasibility of the resulting set of strategies in the Jordan and Falls Lakes environments. Working from the session law charge, criteria we have identified for characterizing feasibility of a strategy include site suitability, potential effectiveness, extent and nature of prior testing, scaling considerations, technical challenges, cost considerations and permitting considerations.

## *REFERENCES*

American Water Works Association. Managing Cyanotoxins in Drinking Water: A Technical Guidance Manual for Drinking Water Professionals. 2016, September.

Gettys, Lyn A. Haller, William T. and Petty, David G. editors. Biology and Control of Aquatic Plants. A Best Management Practices Handbook: Third Edition. 2014.

Giattina, James D. Director. Water Protection Division. US Environmental Protection Agency. Letter to Jay Zimmerman. Director. Division of Water Resources. NC Department of Environmental Quality. 2016, November 3.

Lewtas, Kimberly. Roy, Dimple, Paterson, Michael. Manitoba Prairie Lakes: In-Lake remediation treatment summary. International Institute for Sustainable Development. 2016.

Massachusetts, Commonwealth of. Executive Office of Environmental Affairs. Phosphorus Precipitation & Inactivation. Eutrophication and Aquatic Plant Management in Massachusetts. Final Generic Environmental Impact Report. 2004

North Carolina Department of Environmental Quality. Survey of In Situ Strategies for Mitigation of Water Quality Impairments in North Carolina. 2016, May 11.

Richardson, R.J. Getsinger, K.D. 2016 North Carolina Agricultural Chemicals Manual. Aquatic Weed Control. North Carolina State University. 2016

Wilson, Rick. Brattebo, Shannon. Gibbons, Harry. Understanding Nutrient Issues Affecting Ohio's Inland Lakes. US Environmental Protection Agency Watershed Academy. 2016, November 30.

# APPENDIX A

**NC Session Law 2016-94 SECTION 14.13. (c)**

Of the funds appropriated to the Board of Governors of The University of North Carolina, the sum of five hundred thousand dollars ($500,000) for each of the fiscal years from 2016-2017 through 2021-2022 is allocated to the Chief Sustainability Officer at the University of North Carolina at Chapel Hill to designate an entity to oversee a continuing study and analysis of nutrient management strategies (including in situ strategies) and compilation of existing water quality data specifically in the context of Jordan Lake and Falls Lake. As part of this study, the entity shall (i) review data collected by the Department of Environmental Quality and by other stakeholders from water sampling in areas subject to the Falls Lake or Jordan Lake Water Supply Nutrient Strategies and compare trends in water quality to the implementation of the various elements of each of the Strategies and (ii) examine the costs and benefits of basinwide nutrient strategies in other states and the impact (or lack of impact) those strategies have had on water quality. The entity shall report to the Environmental Review Commission, the Environmental Management Commission, and the Department of Environmental Quality as set forth below:

(1) With respect to Jordan Lake, the final results of its study and recommendations for further action (including any statutory or regulatory changes necessary to implement the recommendations) no later than December 31, 2018, with interim updates no later than December 31, 2016, and December 31, 2017.

(2) With respect to Falls Lake, the final results of its study and recommendations for further action (including any statutory or regulatory changes necessary to implement the recommendations) no later than December 31, 2021, with interim updates no later than December 31, 2019, and December 31, 2020.

No indirect or facilities and administrative costs shall be charged by the University against the funds allocated by this section. The Department of Environmental Quality shall provide all necessary data and staff assistance as requested by the entity for the duration of the study required by this subsection. The Department shall also designate from existing positions an employee to serve as liaison between the Department and the entity to facilitate communication and handle data requests for the duration of the project.

**NC Session Law 2016-94 SECTION 14.13. (e)**

The Department of Environmental Quality shall study alternative technologies for in situ approaches to nutrient management in Falls Lake and Jordan Lake. In its study, the Department shall consider in situ treatments, including algaecide and phosphorus-locking technologies, that have been certified by the United States Environmental Protection Agency for use in drinking water sources. Of the funds

appropriated in this act to the Department of Environmental Quality, the sum of one million three hundred thousand dollars ($1,300,000) for the 2016-2017 fiscal year may be used to implement a trial of these technologies. If the Department decides to implement a trial, it shall enter into a contract for the trial by December 31, 2016. Any contract entered into under this subsection shall not be subject to Article 3 or Article 8 of Chapter 143 of the General Statutes. The study shall determine whether these treatments would provide improvements in water quality and whether the improvements would be more cost-effective than more conventional nutrient mitigation strategies. The Department shall submit an interim report no later than March 1, 2017, and a final report no later than March 1, 2018, to the Environmental Review Commission, the Joint Legislative Oversight Committee on Agriculture and Natural and Economic Resources, and the Fiscal Research Division. If the Department finds these strategies to be effective, it shall incorporate them into the Nutrient Strategies readoption required by subsection (d) of this section. Funds allocated by this subsection shall remain available until the conclusion of the study, and any funds unused at that time shall revert to the General Fund.

# Appendix B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

NOV 03 2016



Mr. Jay Zimmerman
Director
Division of Water Resources
North Carolina Department of Environment
and Natural Resources
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

Dear Mr. Zimmerman:

The U.S. Environmental Protection Agency Region 4 has received your letter regarding in situ approaches to nutrient management, dated July 14, 2016. Your letter specifically requests the EPA to advise the State on where to find a list of certified treatment technologies for use in drinking water sources.

The EPA does not maintain lists of certified treatment technologies for in situ nutrient management nor is it the Agency's policy to endorse a particular vendor of any such technologies. The EPA encourages you to consider exploring technologies that controls pollutants at the source rather than treating them in downstream receiving waters. The State of Florida has explored in situ treatment for nutrient management such as phosphorus-locking technologies on smaller lakes and the treatment has had some success in reducing the occurrence of harmful algal blooms. We would encourage you to contact staff at Florida Department of Environmental Protection for their perspective on the effectiveness of phosphorus-locking technologies or other in situ treatment options they explored to control nutrients in their lakes.

If you have any questions, please contact me or Ms. Denisse Diaz at (404) 562-9610.

Sincerely,

James D. Giattina
Director
Water Protection Division