

Draft Report of Subcommittee #2, for inclusion in the PA12-155 Report to the Legislature

1. Background – The Clean Water Act regulates and contains requirements that must be met for discharges that contain phosphorus. In October 2010, U.S. EPA approved the methods proposed by the Connecticut Department of Energy and Environmental Protection (“DEEP”) to establish water quality based phosphorus limits in non-tidal freshwaters for industrial and municipal water pollution control facilities (WPCF) National Pollutant Discharge Elimination System (NPDES) permits. DEEP has proposed these approaches as an interim strategy until numeric nutrient criteria are established in Connecticut's Water Quality Standards (WQS). This Interim Strategy was the topic of numerous discussions between DEEP, stakeholders, and U.S. EPA.

In 2012, the Connecticut General Assembly passed Public Act 12-155 which requires the Commissioner of DEEP, and the chief elected officials of the cities of Danbury, Meriden and Waterbury and the towns of Cheshire, Southington and Wallingford, and the chief elected official of any other municipality impacted by the state-wide strategy to reduce phosphorus, to collaboratively evaluate and make recommendations regarding a state-wide strategy to reduce phosphorus loading in inland non-tidal waters in order to comply with standards established by the United States Environmental Protection Agency. The evaluation and recommendations are to include (1) a state-wide response to address phosphorus nonpoint source pollution, (2) approaches for municipalities to use in order to comply with standards established by the United States Environmental Protection Agency for phosphorus, including guidance for treatment and potential plant upgrades, and (3) the proper scientific methods by which to measure current phosphorous levels in inland non-tidal waters and to make future projections of phosphorous levels in such waters.

To implement PA 12-155, DEEP and the participating municipalities¹ established a Coordinating Committee and three Workgroups. Each workgroup was charged with evaluating one of the three elements identified in PA 12-155 and report its findings to the Coordinating Committee.

This is the report of the workgroup tasked with evaluating and making recommendations regarding the proper scientific methods by which to measure current phosphorous levels in inland non-tidal waters and to make future projections of phosphorous levels in such waters (“the Science Methods Workgroup” or “the Workgroup”).

2. Workgroup Composition - The Science Methods Workgroup consisted of a diverse group of members from state, federal and municipal government, non-governmental organizations, and private consultants (Table A, attached). The Workgroup was co-chaired by Roger Dann from the Town of Wallingford Water and Sewer Division and Mary Becker from the Monitoring and Assessment Program of DEEP’s Bureau of Water Protection and Land Reuse.² Ten workgroup meetings were held over the course of a two year time period (Table A, attached). Minutes from

¹ Of the municipalities listed in PA 12-155, Meriden, Danbury, Southington and Wallingford participated. Cheshire and Waterbury did not.

² For a time, Chris Bellucci, from the Monitoring and Assessment Program of DEEP’s Bureau of Water Protection and Land Reuse served as a co-chair for Mary Becker. Also, during the course of its work, George Adair from the Town of Wallingford, assisted by Fred Andes, an attorney with Barnes and Thornburg, LLP, replaced Roger Dann as co-chair of the Workgroup.

the workgroup meeting can be found on the DEEP website at <http://www.ct.gov/deep/phosphorus>.

3. Methodology - The Science Methods Workgroup's charge was to evaluate the proper scientific methods by which to measure current phosphorous levels in inland non-tidal waters and to make future projections of phosphorous levels in such waters. Of primary concern was the method to measure phosphorus that DEEP had used and relied upon in developing the Interim Strategy. A variety of viewpoints were expressed by group members.

The Workgroup engaged the Connecticut Academy of Science and Engineering ("CASE"), a non-profit institution patterned after the National Academy of Sciences, to provide unbiased expert guidance on scientific issues of concern. The CASE Study Committee consisted of 17 members and staff (Table B, attached). The study was led by Dr. Peter Raymond from the Yale School of Forestry and Environmental Studies at Yale University who served as study manger and Richard Strauss, the Executive Director of CASE.

The Science Methods Workgroup held a number of meetings aimed at framing the tasks for CASE's consideration and came to a consensus on the following four tasks:

Task 1: How does phosphorus impact water quality in general and what factors are important in Connecticut?

Task 2: What is Connecticut's current approach to addressing phosphorus to comply with water quality standards?

Task 3: How can phosphorus impacts be measured in non-tidal waters such that relevant contributing stressors are considered to comply with water quality standards?

Task 4: What methodologies are appropriate for use in Connecticut to measure phosphorus impacts on water quality and aquatic life and other designated uses?

4. The CASE Report

The CASE Study Committee conducted a comprehensive literature review, interviews and held eight meetings. At each meeting an expert made a presentation to the subcommittee. Details and presentations from those meetings can be found on the CASE website at <http://www.ctcase.org/reports/phosphorus/EXTERNAL%20APPENDIX%20COMMITTEE%20MEETINGS%2002%2020%2015.pdf> . The Science Methods Workgroup members were invited to attend and participate in the CASE Study Committee meetings and were provided with an opportunity to comment on drafts of the CASE reports as it was being developed. The Science Methods Workgroup members provided extensive comments throughout the entire study timeframe.

CASE issued its Report, entitled "Methods to Measure Phosphorus and Make Future Projections" in December 2014 ("the Case Report"). The Report reviews all of the tasks noted above and includes nine recommendations. The full CASE report can be found in Appendix A or on the CASE website at <http://www.ctcase.org/reports/phosphorus/phosphorus.pdf>.

The CASE Report begins with a recognition that "[h]uman induced additions of phosphorus to inland waters is one the leading causes of stream impairment in the United States and globally." CASE Report, p. 6. CASE recognizes that "[p]hosphorus pollution can cause fluctuations in the

overall productivity of an ecosystem, and alterations to the biomass and composition of shellfish, aquatic plants, algae, and fish, such as desirable finfish species.” CASE Report, p. 6, citing Dodds and Welch, 2000 and Smith, 2003. CASE’s Report notes that alterations to the environment from phosphorus can “threaten endangered species and impact the food production and breeding habits for a wide range of animal and plant species.” CASE Report, p.6, citing Carpenter et al, 1998 and Mainstone and Parr, 2002.

With respect to measuring phosphorus levels to establish standards, the CASE Report finds that “[t]he variation between the amount of phosphorus entering the watercourse and the degree of impairment, coupled with the large amount of variation in stream phosphorus concentration, makes setting a single numeric phosphorus standard inappropriate.”

CASE Report, Executive Summary p. x. Accordingly, the CASE Report committee members rule out establishing a single numeric phosphorus standard applicable statewide. The Report then reviews and discusses the four approaches commonly used by the regulatory community and recommended by EPA to develop numeric criteria: reference, mechanistic models, stressor-response models and scientific literature. After reviewing the pros and cons of each method, the CASE Report recommends use of the stressor-response approach. CASE Report, p 33. The model that DEEP used in developing the Interim Strategy is a stressor-response model.

After reviewing the approach used by DEEP, the CASE Report concludes that DEEP’s “Interim Strategy was a reasonable and justified approach for setting numeric criteria” that “aligns with the guidance provided by the EPA”. *Id.*, p. xiii. The CASE Report notes that:

Connecticut has performed an initial analysis of the use of diatoms for determining a concentration based-nutrient criteria in streams, including statistical approaches to evaluate the relationship between diatoms species and phosphorus concentrations. DEEP should continue to utilize this approach and the Interim Phosphorus Reduction Strategy for Connecticut Freshwater Non-Tidal Waste-Receiving Rivers and Streams (Interim Strategy)...derived therefrom while continuing to collect data to implement this report’s recommendations.

CASE Report, Executive Summary, p. x.

In making this recommendation the CASE Report pointed out that “[a] critical component of the stressor response model is the selection of proper response parameters to measure the impact of phosphorus pollution.” CASE Report, p. 33. CASE recommended use of two response parameters, dissolved oxygen and diatom species, in developing numeric criteria, or future response parameter standards, for phosphorus. (CASE Report, p. 34). Since DEEP has been sampling the diatom community, CASE recommended that the State continue those efforts and that it add diurnal dissolved oxygen to its sampling regime. CASE Report, p. 36. The goal of the State, CASE recommends, “should be to move from the Interim Strategy to a decision framework that includes phosphorus concentrations and these response parameters.” CASE Report, Executive Summary, p. xi.

The CASE Report also recognizes that the approach for setting numeric criteria for phosphorus is “a rapidly evolving area of scientific inquiry,” that “statistical methods used to derive numeric criteria will continue to improve with time and new data” and that “the response parameters used

to set criteria will also change with scientific and methodological advancements.” CASE Report, Executive Summary, p. xiii. Also, “response variables can also now be used directly in decision making, which overcomes some of the problems associated with the standard set using statistical methods.” As such, CASE recommends that DEEP re-evaluate its approach to establishing numeric criteria for phosphorus every three 3-5 years.

The CASE Report also recommends the following for the state’s consideration:

1. Continue sampling diatom community assemblage, but add diurnal dissolved oxygen.
2. Add sites to the state’s sampling regime, allowing for further refining criteria via stratification/classification.
3. Consider using diatom data and newly collected dissolved oxygen data to develop response parameter standards in addition to numeric criteria standards to allow for a decision framework approach (Table 5-3).
4. Develop a stratification/classification system.
5. Pursue and collect a set of secondary measurements that will further help isolate phosphorus as the cause of impact and potentially help with the stratification process.
6. Statistical analysis of data to relate response parameters to phosphorus concentrations should be conducted on a rolling basis and reported to the general public.
7. Consider collaborating with neighboring states that use diatoms and dissolved oxygen.
8. For impaired watersheds, continue and accelerate the process of creating stream management plans similar to those in the Connecticut Integrated Water Quality Report, incorporating these plans into a GIS, and perform response parameter measurements more frequently.
9. Begin to collect data on phosphorus import into watersheds and consider collecting additional economic/recreational use data.

The Report states that those recommendations should be pursued by the State over the next 3-5 years, with the following considerations:

- Utilize new oxygen optodes, which have made the accurate measurement of dissolved oxygen during multi-day deployments possible at a relatively low cost.
- In addition to including dissolved oxygen in the current rotation of sites, DEEP should consider more frequent measurements of response indicators at phosphorus-impacted sites to ascertain when an acceptable level of phosphorus abatement has been achieved.
- Strive to increase the number of sites within their database by increasing the number of sites visited, or partnering with neighboring states that already have an active program with similar measurements.

- Similar to current practices, collect a greater percentage of the measurements in the summer when impacts are greatest. Shoulder season measurements, however, still provide data needed to ascertain range of conditions.
- During the next five years, progress on recommendations #5 and #8 can be pursued.
- In 3-5 years, DEEP should re-evaluate the Interim Strategy depending on the status of the data sets.
- The state should consider mechanisms to facilitate the data collection necessary for recommendation #9.

Other than highlighting the importance of adding diurnal dissolved oxygen to the state's sampling regimen, the CASE Report does not prioritize these recommendations.

5. The Science Methods Workgroup Recommendations to the Coordinating Committee

The Science Methods Workgroup endorses the CASE Report. The CASE Report identifies: 1) phosphorus pollution as a problem, 2) the current water quality standards relative to phosphorus; 3) the methods to measure the impacts of phosphorus in non-tidal waters; and 4) the methodologies appropriate for use in Connecticut to measure phosphorus impacts on water quality and aquatic life and other designated uses.

The Workgroup also endorses the nine recommendations made in the CASE Report although the Workgroup recognizes that additional fiscal and staffing resources may be needed to implement certain recommendations. No other recommendations were offered by any Workgroup members and other than recognizing the importance of adding diurnal dissolved oxygen to its sampling efforts, the Workgroup did not prioritize implementation of these recommendations. Finally, the Workgroup also recommends that DEEP develop a conceptual implementation plan and that it periodically post on its website a detailed progress report on the efforts being undertaken to implement CASE's recommendations.

TABLE A: SCIENCE METHODS WORKGROUP MEMBERS AND MEETINGS

Name	Organization	9/30/13	10/31/13	11/21/13	12/19/13	3/6/14	5/22/14	9/11/14	11/6/14	7/27/15	9/18/15
Adair, George	Town of Wallingford									X	X
Andes, Fredric	Barnes & Thornburg	X	X	X (phone)	X	X	X	X	X	X	X
Applefield, Dean	CT DEEP	X	X	X	X	X	X			X	X
Becker, Mary (Co-Chair)	CT DEEP	X	X	X	X			X	X	X	X
Bellucci, Christopher	CT DEEP		X	X	X	X	X	X	X		X
Bollard, Greg	Friends of the Lake / Rivers Alliance			X							
Brumback, Garry	Town of Southington	X		X							
da Silva, Allegra	CDM Smith		X	X	X			X (phone)			
Dann, Roger (Co-Chair)	Town of Wallingford	X	X	X	X	X	X	X	X		
Fisk, Andy	CT River Watershed Council		X	X		X			X	X	X
Francucci, Mario	Black & Veatch	X	X	X						X	
Gara, Betsy	CT Lobbying Group, LLC		X	X		X					
Hust, Rob	CT DEEP						X	X	X		
Iott, Traci	CT DEEP	X		X	X	X	X	X	X		
Jastremski, Mike	Housatonic Valley Association			X							
Morrison, Jon	U.S. Geological Survey					X	X				
Miner, Margaret	Rivers Alliance	X	X		X			X	X		X

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Mueller, Fred	Tighe & Bond	X	X		X	X					
Mullaney, John	U.S. Geological Survey			X		X			X	X	X
Raymond, Peter	Yale University				X						
Reynolds, Roger	CT Fund for the Environment, Save the Sound		X	X		X (phone)		X (phone)	X (phone)	X	
Stover, Toby	US EPA Region 1		X	X	X	X	X	X	X		
Strauss, Richard	CT Academy of Science and Engineering				X						
Sullivan, Chris	CT DEEP		X	X		X					
Taylor, Bob	Loureiro Engineering Associates, Inc.	X	X	X	X	X	X	X	X	X	X
Wingfield, Betsey	CT DEEP	X			X	X			X		
Weitzler, Ellen	US EPA Region 1				X				X		

Table A. Methods to Measure Phosphorus and Make Future Projections Workgroup attendees and dates of meetings. ‘X’ indicated presence at the meeting.

TABLE B: CASE STUDY GROUP MEMBERS

Name	Title and Organization
Ann G. Bertini	Assistant Director for Programs, Connecticut Academy of Science and Engineering
Robert Buchkowski, Research Team	Research Associate, Yale School of Forestry & Environmental Studies, Yale University
Terri Clark	Associate Director, Connecticut Academy of Science and Engineering
Kelly Coplin, Research Team	Research Associate, Yale School of Forestry & Environmental Studies, Yale University
Ashley Helton, PhD	Assistant Professor, Department of Natural Resources and the Environment, Center for Environmental Sciences and Engineering UConn
Gale Hoffnagle, CCM, QEP Senior Vice President and Technical Director TRC Environmental Corporation	<i>(CASE Academy Member)</i> Senior Vice President and Technical Director TRC Environmental Corporation
Kimberlee Kane, PhD	Research Scientist, Watershed Protection Programs, Bureau of Water Supply NYC Department of Environmental Protection
David A. Keiser, PhD	Assistant Professor, Department of Economics Iowa State University
Jennifer L. Klug, PhD	Associate Professor of Biology, Fairfield University
Ralph Lewis	<i>(CASE Academy Member), Chairperson</i> Professor in Residence, Marine Sciences Long Island Sound Center, UConn-Avery Point; State Geologist, Connecticut Department of Environmental Protection (ret.)
Karl M. Prewo, DrEngSc	<i>(CASE Academy Member)</i> President, Innovatech
Wendy Jastremski Smith	Formerly Environmental Protection Specialist EPA
Peter A. Raymond, PhD Research Team Study Manager	Professor of Ecosystem Ecology, Yale School of Forestry & Environmental Studies, Yale University
Jane Stahl	Consultant, Deputy Commissioner, Connecticut Department of Environmental Protection (ret.)
Richard H. Strauss	Executive Director, Connecticut Academy of Science and Engineering
Craig Tobias, PhD	Associate Professor of Marine Sciences, UConn
Lisa Weber, Research Team	Research Associate, Yale School of Forestry & Environmental Studies, Yale University

APPENDIX A

The Connecticut Academy of Science and Engineering Report
Methods to Measure Phosphorus and Make Future Projections