GREAT BAY MUNICIPAL COALITION

September 30, 2019

Mr. Dennis Deziel
Regional Administrator
USEPA Region I
5 Post Office Square
Suite 100
Boston, MA 02109-3912

Mr. David Ross
Assistant Administrator for Water
US EPA Headquarters
1200 Pennsylvania Avenue, N.W. (4101M)
Washington, D.C. 20460

RE: Peer Review Request for Great Bay Estuary Regarding New Nutrient Loading and Modeling Approach for Eelgrass Restoration

Dear Regional Administrator Deziel and Assistant Administrator Ross:

The Great Bay Municipal Coalition hereby requests that EPA conduct an independent peer review of the areal loading methodology and target (100 kg/ha-yr) that EPA Region I has proposed to utilize to derive total nitrogen (TN) reduction requirements for the entire Great Bay watershed. As discussed in the Attachment, the use of this method to dictate systemwide nitrogen reduction requirements is unprecedented, and contrary to numerous published EPA Section 304(a) Guidance documents on proper derivation of nutrient criteria and limitations for estuaries. Those published Section 304(a) criteria specify that a protective ambient concentration must be identified, not an areal loading applicable regardless of system characteristics such as volume, flushing rate, form of nitrogen and tidal hydrodynamics. See. e.g., *Nutrients in Estuaries*, USEPA 2010, at 12 and 27. Consequently EPA's action seeks to implement a fundamental change in accepted scientific methodology for regulating nutrients in estuaries and therefore constitutes "influential scientific information" that must first undergo peer review.

Based on the load reduction documents distributed by EPA Region I, the cost impacts on the communities throughout the Great Bay watershed will be widespread and severe. The communities of Dover and Rochester alone would need to spend in excess of $100 million for the combined cost of the upgrades to the POTWs and the non-point source requirements in an attempt to comply with the load reductions proposed; however, it is likely not possible to fully reduce TN loads to the level proposed without reductions from sources outside of the communities' control, such as atmospheric deposition. Moreover, we recently became aware that an earlier technical review, conducted by EPA Region I for Long Island Sound in 2015, determined that the methodology at issue (developed by Latimer and Rego, 2010) was *not* considered appropriate for establishing TN load limitations to protect eelgrass resources. See ***Statement of the Case***, attached. *Under the circumstances, our Coalition cannot accept any general or individual permits issued in reliance on that methodology, unless a detailed, independent technical review confirms its applicability and reasonableness for the Great Bay Estuary.*

We would note in closing that, in similar circumstances (*e.g.*, Long Island Sound, Massachusetts Estuaries Program, Narragansett Bay Estuary, and Cape Cod Nutrient Reduction Strategy), EPA has funded and participated in an independent peer review process to ensure that the methods being employed were scientifically defensible and appropriate to resolve the impairment of concern. As the earlier peer review for Long Island Sound, conducted by EPA Region I, *specifically rejected the methodology* that EPA Region I is now planning to utilize for the Great Bay Estuary, the need for independent peer review in this matter is manifest. We respectfully request that the same procedure and courtesy be accorded to the communities of the Great Bay system.

We look forward to discussing this matter further with your offices.

Sincerely,

**CITY OF DOVER, NH**

Karen Weston, Mayor

Michael Joyal, City Manager

**CITY OF ROCHESTER, NH**

Caroline McCarley, Mayor

Blaine Cox, City Manager

Enclosures

cc: Governor Sununu
United States Senators Shaheen and Hassan
United States Congressman Pappas
New Hampshire State Senators Gray and Watters
NHDES Commissioner Robert Scott
NHDES Assistant Commissioner Clark Friese
Great Bay Coalition Representatives

# Request for EPA Peer Review
# Statement of the Case

**Background on Peer Review Request**

Over the past 10 months, EPA Region I has met with the Great Bay Municipal Coalition on several occasions and expressed its intent to stringently regulate TN throughout the watershed, either through the issuance of a "General Permit" or "individual" NPDES permits. The claimed purpose of these more restrictive TN limitations is to restore eelgrass beds to the condition that existed from 1992-2005, when the system was not considered "impaired." A prior independent peer review (2014)[1] concluded that the New Hampshire 2009 analysis of data for the Great Bay system did not demonstrate that TN was the cause of the decline in eelgrass acreage occurring after 2005. In response to this peer review conclusion, the NH Department of Environmental Services (DES) withdrew the 2009 Numeric Nutrient Criteria it had developed and the TN impairment listing for Great Bay, Little Bay and the Piscataqua River.

In the absence of a scientifically defensible numeric nutrient criteria, EPA Region I concluded that it will now use a "new scientific approach" to set "annual load effluent limits based on scientific literature concerning the effects of total nitrogen [TN] *loading* on estuaries." This TN loading target and approach is based largely on a 2010 study completed by Latimer and Rego.[2] Based on Latimer, *et al*, the maximum acceptable TN areal loading target that EPA now claims is required to protect eelgrass propagation in the Great Bay Estuary is 100 kg/ha-yr. However, discussions with Dr. Latimer and review of his approach revealed that it is actually a preliminary screening tool, focused on a very narrow set of ecological conditions that are not relevant to the Great Bay system. A detailed review of this methodology by Dr. Steven Chapra (**Attachment 1**), an internationally recognized expert on water quality modeling and nutrient dynamics, concluded that the methodology was neither scientifically defensible nor consistent with approaches EPA had previously identified as acceptable for setting nutrient limitations in estuarine waters. Moreover, both Drs. Chapra and Latimer acknowledged that the proper derivation of nitrogen reduction requirements must account for the hydrodynamic and related factors influencing

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[1] February 13, 2014 Joint Report of Peer Review Panel for Numeric Nutrient Criteria for the Great Bay Estuary New Hampshire Department of Environmental Services - June, 2009 by Dr. Robert Diaz, Dr. Victor Bierman, Dr. Jud Kenworthy, Dr. Kenneth Reckhow.

[2] Latimer, J.S. and Rego, S.A. 2010. Empirical relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries. Estuarine, Coastal and Shelf Science, 90 (2010) 231-240. *See also*, Valiela, I. and Cole, M.L. 2002. Comparative Evidence that Salt Marshes and Mangroves May Protect Seagrass Meadows from Land-derived Nitrogen Loads. Ecosystems (2002) 5:92-102.

nutrient dynamics that render an estuary either more or less susceptible to eutrophication. EPA's published Section 304(a) guidance for estuaries expressly supports this approach:

> …the extent to which various symptoms are expressed depends on the rate of nutrient loading, its composition, seasonality of the loads relative to the growth state of the resident organisms, status of higher trophic levels, residence time, stratification and many other abiotic factors, such as suspended sediment load (e.g., Figure 2.2). One of the important factors determining the expression of eutrophication symptoms is the composition of the nutrient pool. Nutrients can be delivered to an ecosystem from riverine sources, groundwater, atmospheric, marine and other sources. Each source can vary in the amount of specific nutrients they contribute (N, P or Silicon [Si]), as well as their proportional ratio to other nutrients in that source. They can also vary in the chemical form of those nutrients, inorganic or organic, or, in the case of N, oxidized ($NO_3^-$ or $NO_2^-$) or reduced ($NH_4^+$) forms.
>
> … Estuaries can respond to similar levels of nutrient loading in very different ways. As described throughout this report, this disparity can be ascribed to fundamental differences in the way the respective waterbodies receive and process inputs.
>
> Nutrients in Estuaries, USEPA 2010, at 12 and 27.

"Drowned River Valley" estuaries, such as that present in Great Bay, differ dramatically in physical characteristics from the "enclosed embayment" systems evaluated by Dr. Latimer, as all critical factors that may affect nutrient impacts differ radically for these systems. EPA Region I's "new scientific approach," however, is to ignore all of these factors and assert that Dr. Latimer's screening tool establishes the maximum amount of TN that is acceptable for the Great Bay Estuary, regardless of how different that system may be from those assessed by Dr. Latimer or the resulting ambient TN concentration created by that areal loading.

EPA Region I's technical claims are unprecedented and lack a rational scientific basis. The utilization of an areal nutrient loading approach that fails to consider any of the relevant hydrodynamic characteristics of a system, or the form of nutrient or how it is delivered, and fails to identify the ambient TN concentration necessary to protect eelgrass propagation, is contrary to decades of EPA research and nutrient regulatory decision making. As recent as 2015, EPA Region I itself determined that Dr. Latimer's 100 kg/ha-yr areal loading approach should not be applied to protect eelgrass in the Long Island Sound embayments, instead applying an average ambient TN concentration to protect eelgrass resources. *See*, **Attachment 2**. Moreover, EPA Region I expressly determined that the simplified areal loading nomograph created by Dr. Latimer should *not* be applied to systems that have major riverine sources of nitrogen. *See*, **Attachment 2** - Technical Fact Sheets. Great Bay Estuary is dominated by such major riverine systems. Dr. Latimer was part of the Long Island Sound peer review group that made this determination and concluded that a hydrodynamic model and consideration of a systems algal response was the defensible methodology to employ in setting rational, protective TN restrictions. Given the disparity in the Region's decision making, conflict with its own experts, and inconsistency with the Agency's published nutrient guidance for estuarine systems (as well as Dr. Chapra's expert analysis), an independent peer review is not simply justified, as discussed below, it is required under federal law.

**Federal Peer Review Requirements**

USEPA's *Peer Review Handbook*[3] ("Handbook") provides guidance for the use of peer reviews in policy and regulatory decision-making. According to the Handbook, influential scientific information (ISI) should be peer reviewed. ISI includes products that (1) "establish[] a significant precedent, model, or methodology," (2) "[are] likely to have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy [] or state, tribal or local governments or communities," or (3) "consider[] an innovative approach for a previously defined problem, process, or methodology." Handbook at 41-42. Moreover, "if a site-specific decision is supported by ISI or a HISA [highly influential scientific assessment] generated for that site-specific decision, then that work product should be peer reviewed." Handbook at 48. As discussed in detail below, all of these criteria are met with respect to EPA Region I's intended action.

Moreover, as also noted in the Handbook, "new applications or modifications of existing, adequately peer-reviewed methodologies or models that significantly depart from the situations for which they were originally designed may require additional peer review." … "The extent to which additional peer review is needed for an article that has been peer reviewed by a credible refereed scientific journal depends upon EPA's use of the article. For example, EPA may determine that an additional and more rigorous or transparent review process is needed if a particular journal review process did not address questions that EPA determines should be addressed before using or disseminating the information."   Handbook at 42 and 48.

EPA Region I's approach is clearly a "new application" of the Latimer method that would establish a significant regulatory precedent, model or methodology for establishing total nitrogen reductions in the Great Bay Estuary and adversely affect in a material way the economy of local governments and communities. This new application is also not part  of the original peer review for the paper he published, because (1) it was not intended to be applied without consideration of a systems physical characteristics which alter susceptibility to nutrient impacts (2) was focused only on dissolved forms of nitrogen and (3) did not address systems where the riverine inputs and non-inorganic forms of nitrogen dominate the loading sources. Thus, the published methodology had no direct application to the Great Bay Estuary and additional peer review

[3] USEPA. October 2015. Peer Review Handbook, 4th Ed.

would apply to its present application.

EPA's proposed Strengthening Transparency in Regulatory Science rule (April 30, 2018, 83 FR 18768) further supports a peer review of this new scientific approach (emphasis added):

> Today, EPA is proposing to establish a clear policy for the transparency of the scientific information used for significant regulations: Specifically, the dose response data *and models* that underlie what we are calling "pivotal regulatory science." "Pivotal regulatory science" is the studies, *models*, and analyses that drive the magnitude of the benefit-cost calculation, *the level of a standard*, or point-of-departure from which a reference value is calculated. In other words, *they are critical to the calculation of a final regulatory standard or level, or to the quantified costs, benefits, risks and other impacts on which a final regulation is based*. […] *EPA shall conduct independent peer review on all pivotal regulatory science used to justify regulatory decisions, consistent with the requirements of the OMB Final Information Quality Bulletin for Peer Review* (70 FR 2664) and the exemptions described therein.

Lastly, from an equal protection perspective, EPA may not treat similarly situated communities differently with respect to whether and when independent peer review will occur. EPA has previously determined that where substantial systemwide nutrient reductions are necessary, a peer review should be conducted to ensure sound decision making (*see e.g.*, Long Island Sound, Massachusetts Estuary Program, Narragansett Bay Estuary Program, Chesapeake Bay Estuary Program and Cape Cod Nutrient Reduction Strategy). Under the circumstances, EPA should undertake the same independent peer review protection to ensure sound decision making for the Great Bay communities.

**Application of the Factual Circumstances to EPA's Peer Review Guidance**

The proposed use of Latimer and Rego, 2010 as support for the "New Science Approach" to establish nutrient limitations in either a general or individual NPDES permit meets the qualifications for federal peer review for the following reasons:

1. **The Region's Approach Constitutes Influential Scientific Information and Is Required to Undergo Independent Peer Review Because It (1) Departs from Established Peer-Reviewed Methodologies for a Previously Defined Problem by Its Failure to Consider Estuarine Characteristics and Failure to Identify the Acceptable Ambient TN Concentration (2) Is Contrary to Published Section 304(a) Nutrient Criteria Documents, (3) Establishes a Significant Precedent for Setting Nutrient Limitations in Estuaries For Eelgrass Protection based on an Unverified Model, (4) Is Directly at Odds with an Earlier Peer Review Regarding the Use of the New**

**Methodology and (5) Imposes Estuarine Nutrient Limitations Independent of Site-Specific Estuarine Characteristics, Which is Unprecedented**

The factual circumstances that support this position follow:

- The new approach is not contained in any EPA guidance documents and is based on an acceptable loading applicable to all waters rather than an acceptable ambient nutrient concentration, contrary to EPA's published Section 304(a) Guidance.
- The new loading approach does not consider any of the physical characteristics of the system, which all EPA-published nutrient criteria and TMDL/NPDES evaluation documents designate as an essential component of a defensible nutrient analysis.
- There is no published scientific method anywhere in the literature that states the use of an areal nutrient loading without consideration of physical characteristics (such as flow, depth, detention time, hydrodynamics, etc.), is an accurate indicator of expected nutrient impacts or reduction benefits for estuarine surface waters.
- All other loading approaches that EPA has used, including those in TMDL/NPDES decision making, account for physical characteristics of the receiving water and how that would impact the analysis. *See, e.g.,* *Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Marine Waters* (EPA-822-B-01-003).
- EPA's published Section 304(a) nutrient criteria document for estuaries expressly concluded that all estuaries must be assessed individually. Therefore, EPA's rote application of the Latimer paper to define the nutrient reduction requirements of Great Bay Estuary is unprecedented.
- Other EPA approved methods for the development of nutrient limitations for the protection of eelgrass in New England Estuaries all utilized a nutrient concentration basis, instream, after mixing and accounted for system hydrodynamics. *See*, Massachusetts Estuary Program TMDLs.
- This approach is contrary to EPA's 2010 peer review of the Stressor-Response Guidance document (and the final published Section 304(a) guidance) because the Latimer paper is a stressor-response method that completes none of the required analysis to show that it may be utilized (*i.e.*, consideration of confounding factors, accounting for relevant site specific physical conditions, based on data for the system in question, based on actual data, not assumed data or presumed plant growth levels).
- An internationally recognized expert, Dr. Steven Chapra, who EPA has historically relied upon in the development of guidance documents for nutrient control, concluded the Latimer loading approach was not a scientifically defensible method. *See* **Attachment 1**.
- The New Hampshire Estuary Project Technical Advisory Committee concluded in 2007 that Dr. Latimer's approach is not scientifically defensible for the Great Bay Estuary because the physical conditions of this estuary are so different from the one's Dr. Latimer was evaluating. *See* **Attachment 3**.

- In 2015, EPA Region I expressly determined that the simplified loading nomograph created by Dr. Latimer should *not* be applied to systems that have major riverine sources of nitrogen. *See*, **Attachment 2** - Technical Fact Sheets. Great Bay is a "drowned river" estuarine system that is dominated by major riverine inputs.
- The 2017 Long Island Sound peer review panel determined that full consideration of system hydrodynamics is essential and the degree of nutrient control for the protection of eelgrasses should be based on the effect nutrients have on light transmission in specific embayments.[4]

As detailed above, all substantive technical criteria for independent peer review of EPA Region I's new and unprecedented scientific approach are met. Therefore, peer review of this approach is mandated.

**2. Monetary Impact on Local Communities Will Be Severe**

Federal peer review should be triggered when the Agency's new technical approach "adversely affect in a material way the economy or state, tribal or local governments or communities." The following verifies that major impacts on the impacted communities are anticipated:

- The maximum acceptable loading selected (100 kg-TN/ha-yr) is anticipated to cost in excess of $100 million dollars for the Dover and Rochester communities alone. If the cost to the other Great Bay Estuary communities are included, it is certainly many millions of dollars more. The communities simply cannot afford this level of economic expenditure.
- EPA has stated that compliance at the POTWs will be based on meeting an annual average TN of 8 mg/l under historical wastewater flow conditions (2012-2016 average flows). Such limitations do not account for growth over the last few years that has increased flows to POTWs, do not allow for currently permitted design flows, do not allow flexibility during colder months when TN removal efficiencies are reduced, and are, therefore, anticipated to require immediate implementation of limits of technology TN reduction treatment processes at POTWs. Significant and costly POTW upgrades would be necessary for most of the Great Bay communities.
- EPA Region I's proposed approach will freeze any future growth in the area, and therefore, will have a major adverse economic impact on all local economies in Southeastern New Hampshire.

[4] Summary Report Technical Review of Select Memorandums Supporting the Development of Nitrogen Endpoints for Three Long Island Sound Watershed Groupings: 23 Embayments, 3 Large Riverine Systems, and Western Long Island Sound Open Water, *Prepared for*: U.S. Environmental Protection Agency Region 1, U.S. EPA Contract Number 68HE0118A0001, January 29, 2019

- If the 100 kg-TN/ha-yr was applied to all New England estuaries to protect eelgrass resources, the impact would likely be in excess of $100 million dollars annually.

Therefore, EPA Region I's proposed approach also satisfies the "major economic impact" prong of EPA's peer review guidance. Due to the serious concerns detailed above, the Coalition requests that this new scientific approach be peer-reviewed, consistent with federal and EPA guidance, to determine its scientific validity prior to its application in the Great Bay Estuary.

# Attachment #1

TUFTS UNIVERSITY
School of Engineering

**Professor and Louis Berger Chair in Computing and Engineering**

Mr. Dean Peschel
Great Bay Municipal Coalition
c/o City of Portsmouth
680 Peverly Hill Road
Portsmouth, NH 03801

March 22, 2019

Re: Analysis of Technical Justification for Proposed Watershed TN Load Limitations for Great Bay Estuary

Dear Mr. Peschel:

In March 2019, I was contacted by the Great Bay Municipal Coalition (GBMC) to provide technical input on a "new scientific approach" being proposed by USEPA and NHDES to prescribe nitrogen load reductions for the Great Bay Estuary and its watershed. Based on the information provided, I understand that the state and federal agencies are proposing to utilize a 100 kg/ha-yr TN loading cap as necessary for the entire Great Bay watershed to protect eelgrass growth in the system. This nitrogen target was developed primarily from an eelgrass loss-TN loading nomograph created by Latimer and Rego in 2010.[1] This "load cap" is being proposed to form the basis of new nitrogen reduction requirements for wastewater facilities, stormwater contributions, and other non-point sources (such as septic systems). Because I had previously provided analyses of the prior state and federal regulatory efforts (see Chapra 2013[2]) and contributed to the 2014 Great Bay independent peer review, you have requested my opinion on the validity of the new approach being suggested by the regulatory authorities.

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[1] Latimer, J.S. and Rego, S.A. 2010. Empirical relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries. *Estuarine, Coastal and Shelf Science*, 90:231-240.

[2] Chapra, S.C. 2013. Assessment of whether the department of environmental service's approach to nutrient criteria derivation for the great bay estuary used reliable, scientifically defensible methods to derive numeric nutrient criteria. Declaration before the Environmental Appeals Board of the United States Environmental Protection Agency.

## Materials Reviewed and Questions Presented

In addition to Latimer and Rego, 2010, I was provided the following documents:

- March 8, 2019 DES PPT Slides – "Adaptive Management Permitting for Great Bay" (see slides 4-10)
  - Valiela and Cole (2002)[3] – source for % Seagrass cover lost vs. nitrogen loading figure (slide 6)
- 2007 Technical Advisory Committee (including Dr. Latimer as a participant) meeting notes which considered this simplified TN-loading eelgrass loss approach
- A list of technical questions submitted to Dr. Latimer by the Coalition regarding application of Latimer and Rego (2010) nitrogen targets to the Great Bay system
- Dr. Latimer's responses to technical questions and a Word document organizing Dr. Latimer's responses with the corresponding inquiries
- A Great Bay Municipal Coalition letter to EPA/DES dated November 19, 2018 Re: Inapplicability of Latimer and Rego, 2010 to Great Bay
- 2014 Great Bay Peer Review report

You have suggested that I prepare my analysis of Latimer and Rego's approach (as well as the related technical studies) considering the following questions:

1. Is the Latimer and Rego, 2010 approach consistent with accepted scientific methods for assessing TN impacts on estuarine systems?
2. Is the Latimer and Rego, 2010 approach applicable to Great Bay Estuary and does the approach provide reasonable confirmation that TN has impaired eelgrass growth in Great Bay or is preventing its recovery?
3. Is the Latimer and Rego, 2010 method contrary to the 2014 Peer Review and EPA's 2010 Stressor Response peer review?

## Analysis of the Latimer and Rego, 2010 Approach

The approach employed by Latimer and Rego (2010) is a generalized and greatly simplified approach (e.g., a screening tool) based upon limited data, hypothetical eelgrass loss/coverage assumptions, and a limited set of ecological/estuarine conditions (primarily small embayments, subject to significant groundwater loading influences and minimal riverine inputs). The results of the nomograph, on its face, suggest an extreme variation of eelgrass "responses" for similar TN system loadings. If this paper was based on "real," not assumed, eelgrass losses and TN loading was the true cause of reported eelgrass "losses" (due to excessive plant growth precluding eelgrass growth as assumed in the paper) this extreme variation in results would not be expected.

As noted in Dr. Latimer's responses to the questions posed, this was a theoretical analysis with no apparent applicability to managing the Great Bay system. The analysis, being generalized and assumption-based, made no effort to scientifically confirm the report conclusions or to claim that it should be universally applied to other systems with significantly different physical, hydrodynamic and/or biochemical conditions governing the occurrence or loss of eelgrass

[3] Valiela, I. and Cole, M.L. 2002. Comparative Evidence that Salt Marshes and Mangroves May Protect Seagrass Meadows from Land-derived Nitrogen Loads. Ecosystems (2002) 5:92-102.

populations in complex ecosystems such as the Great Bay Estuary. Thus, this paper cannot be used to reasonably or reliably forecast eelgrass responses to TN loading for the Great Bay system without explicit confirmation that (1) the predicted eelgrass losses exist and (2) the excessive phytoplankton or macrophyte growth is, in fact, preventing eelgrass recovery in this system.

With respect to other analyses presented such as Valiela and Cole, 2002, those authors also focused on small, protected embayments that had confirmed, extreme macroalgae growth, due to nutrient enrichment. The extreme macroalgae growth prevented eelgrass recovery due to smothering of the eelgrass shoots. These conditions have no apparent relevance to the Great Bay system where such smothering has not been documented as the cause of the existing eelgrass condition.

**Responses to Specific Questions Posed**

1. Is the Latimer and Rego, 2010 approach consistent with accepted scientific methods for assessing TN impacts on estuarine systems?

   No. This simplified analysis does not address the numerous physical, chemical, or biological factors that need to be considered to produce a scientifically defensible conclusion that nitrogen is impairing a specific estuarine system. There is no EPA-approved or "generally accepted by the scientific community" method for TN loading/eelgrass response that is applicable to estuarine systems, as there can be for lakes assuming sufficient observed response data (not unverified data points) are available to relate nutrient loading to a form of excessive plant growth that may be detrimental to the system.

2. Is the Latimer and Rego, 2010 approach applicable to Great Bay Estuary and does the approach provide reasonable confirmation that TN has impaired eelgrass growth in Great Bay or is preventing its recovery?

   No. For the reasons expressed by Dr. Latimer himself, this approach has no apparent applicability to the Great Bay system. In fact, the data for the Great Bay system confirm it is inapplicable as TN loadings have greatly exceeded the upper TN loading Latimer and Rego indicate will eradicate all eelgrass growth (100 kg/ha-yr) while robust eelgrass growth was maintained in the 1990s through 2005. These data for the Great Bay system are a direct, unambiguous empirical indicator of the "safe" systemwide TN loading at this time, particularly as excessive macrophyte or phytoplankton growth did not occur with those loadings. The more recent data for Great Bay suggest an eelgrass loss of about 30% from historical levels, not the 100% loss expected if the Latimer model was applicable. That would place Great Bay among the least impacted systems assessed by Latimer. Moreover, the factors that would suggest a linkage to TN are not reflected in present measurements. In comparison with the earlier period, phytoplankton levels are essentially unchanged, and epiphytes are not reported to be excessive. Macrophytes are present, but apparently are not preventing eelgrass regrowth each year.

3. Is the Latimer and Rego, 2010 method contrary to the 2014 Peer Review and EPA's 2010 Stressor Response peer review?

   Yes to both aspects of this question. The 2014 Peer Review determined that the available system data did not confirm that TN was the cause of eelgrass decline or periodic low dissolved oxygen readings. The Latimer and Rego, 2010 analysis is not "new" nor is it "data" for this system nor is it reflective of the conditions controlling nutrient dynamics in the Great Bay Estuary. Thus, it cannot be used to demonstrate that the prior peer review conclusions are, in any way, in error.

   EPA's 2010 Stressor-Response methodology specifically requires consideration of the relevant factors (sometimes called "confounding factors") affecting an ecological response of concern when developing system wide nutrient criteria. This analysis fails to consider any of those relevant physical, chemical, or biological factors.

I hope that you find my observations helpful in determining the best path forward for protecting eelgrass resources in the Great Bay system. At this point, I do not see any scientifically defensible basis presented for asserting that additional TN reductions are currently required to protect or restore eelgrass resources. As noted by the 2014 Peer Review, it would be best to focus on the other factors known to affect that form of plant growth to better understand eelgrass dynamics for this system.

Sincerely,

Steven C. Chapra, Ph.D., F.ASCE, F.AEESP

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**617 627-3654**
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**Attachment #2**

**EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY**
**DECEMBER 2015**

## Overview

### Background

Hypoxia, defined as dissolved oxygen (DO) levels of less than 3 mg/l, is a common occurrence in Long Island Sound (LIS) bottom waters during the summer, affecting up to half of its area in some years (Figure 1). In LIS, nitrogen is the primary limiting nutrient for algal growth. Impairments linked to excess discharges of nitrogen (N) include harmful algal blooms, low DO, poor water clarity, loss of submerged aquatic vegetation and tidal wetlands, and coastal acidification.

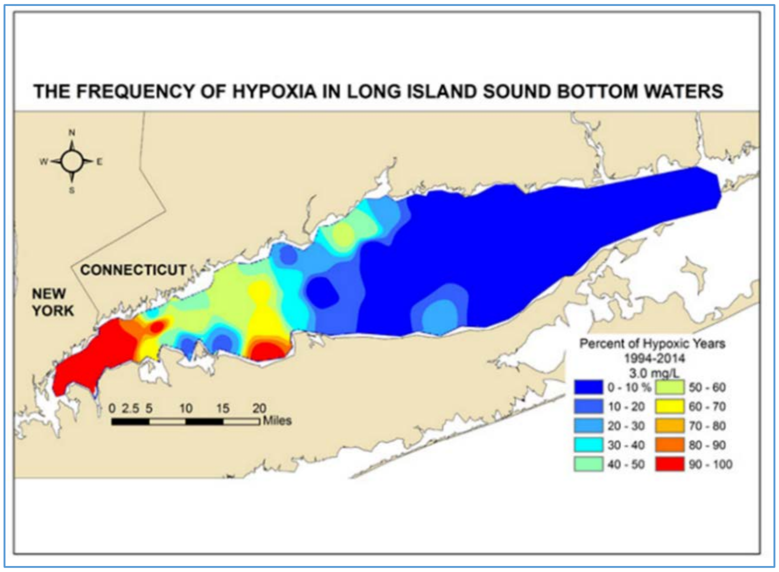


*Figure 1. Hypoxia can affect as much as half of LIS.*

The Long Island Sound Study (LISS) has focused on understanding the drivers to hypoxia and developing tools to support N management. The LISS developed and, in 1998, adopted a plan entitled *Phase III Actions for Hypoxia Management* that identified the sources and loads of N to LIS and recommended N reduction targets. In 2000, Connecticut and New York incorporated these targets into a *Total Maximum Daily Load to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound* (LIS TMDL). The LIS TMDL allocated a 58.5 percent N reduction to in-basin sources of enriched N (with a 10 percent reduction allocated to nonpoint sources and the remainder assigned to point sources). In addition, the LIS TMDL identified actions and schedules to reduce N from tributary sources (25 percent reduction to point sources, 10 percent reduction to nonpoint sources) and atmospheric sources (an 18 percent reduction), and to implement non-treatment alternatives (e.g. bioextraction, aeration, etc.) necessary to fully attain DO water quality standards.

### TMDL Implementation Progress

Over the past 15 years, the LIS TMDL has resulted in significant progress toward mitigating N impairments in Long Island Sound.

- Upgrades to 106 wastewater treatment facilities in Connecticut and New York have decreased the annual discharge of N by 40 million pounds, attaining 94 percent of the LIS TMDL wasteload allocation (full attainment is expected by 2017).
- Continued Clean Air Act controls have reduced atmospheric deposition in the watershed by an average of 25 percent for total N and 50 percent for nitrate.
- Reductions in agricultural activity in the watershed and improved management have reduced fertilizer applications by 25 percent and livestock numbers by 40 percent.

The waters of Long Island Sound and its tributaries are responding to these N load reductions.

- Flow-normalized nutrient concentrations and fluxes from tributaries draining to Long Island Sound have decreased from 1974 to 2013 and from 2001 to 2013.
- Inorganic N concentrations in Long Island Sound have decreased.

# EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY
# DECEMBER 2015

## Overview

- Over the past decade the severity of hypoxia (or low dissolved oxygen levels) in LIS has moderated (Figure 2). The maximum areas of hypoxia in summer 2015 was the second smallest recorded over the 28-year monitoring record.
- Eelgrass beds, a rooted underwater plant sensitive to water quality conditions, have increased in extent by 4.5 percent between 2009 and 2012 and 29 percent between 2002 and 2012.

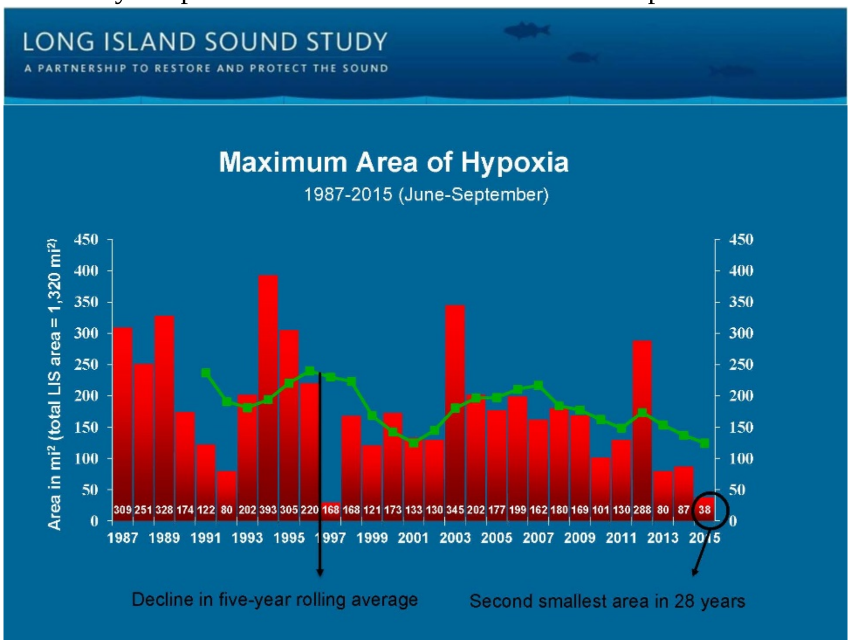


*Figure 2. Hypoxia Areal Trends 1987-2015*

Despite this progress, it is clear based on monitoring and modeling that current and planned actions by the states will fall short of fully implementing the 2000 TMDL and in addition will be insufficient to attain other applicable water quality standards in Long Island Sound. First, despite the progress in addressing some N sources, an assessment[1] of stormwater and nonpoint sources of N suggests that loads from urban storm water, on-site wastewater treatment systems, and turf fertilizer have remained steady or increased. Second, alternatives to control of N sources (such as aeration or bioextraction) have not been implemented to the scale needed. In addition, excess N can contribute to harmful algal blooms, loss of tidal wetlands and eelgrass, coastal acidification, and hypoxia in embayments. Some of these adverse impacts can result in coastal communities less resilient to climate change and sea level rise[2].

To make further progress in reducing N loads to LIS, the watershed states have developed a set of enhanced actions to implement the LIS TMDL. EPA has informed the states that, while it supports enhancement of N reduction efforts, the proposed level of activity, timeframes, and specificity are insufficient to result in water quality standards attainment.

### Evolving the Nitrogen Reduction Strategy

EPA and the states need to continue to identify and implement programs and policies to address the adverse impacts in LIS caused by N loading and to attain water quality standards.

> **Recommendation: Complement LIS TMDL N management initiatives with efforts to address other eutrophication-related impacts. These initiatives can provide incentives for state collaboration and community engagement to address sources of N where progress has been more limited. Resulting actions to reduce N will help alleviate local impacts and open-water hypoxia in western LIS.**

While implementation of the LIS TMDL continues, complementary efforts to address other eutrophication-related impacts can provide opportunities to advance N reduction locally and regionally. They can increase stakeholder involvement around local impacts to water quality and build awareness of threats to the resiliency of coastal communities. This approach is consistent with EPA's December 5, 2013 memo announcing a new framework for implementing the Clean Water Act 303(d) program[3].

> **Recommendation: Address eutrophication-related impacts by translating existing narrative nutrient criteria into numeric N thresholds that are protective of designated uses.**

Numeric thresholds can set either ambient N concentrations or N loading rates that are protective of designated uses. Thresholds can be adopted from 1) general relationships established in the scientific literature or already applied to other coastal water bodies in the region, or 2) derived specifically for Long Island Sound. The loading of N from watershed and direct point source discharges can then be evaluated against levels needed to attain these thresholds.

> **Recommendation: Customize the application of N thresholds for each of three watershed groupings:**
> 1. **Coastal watersheds that directly drain to embayments or nearshore waters.**
> 2. **Tributary watersheds that drain inland reaches.**
> 3. **WLIS coastal watersheds with large, direct discharging wastewater treatment facilities.**

The full drainage basin of LIS can be broken into three watershed groupings. Common to each grouping would be the development of N thresholds, identification of where N watershed loading results in exceedances of the thresholds, and assessments of options for the load reductions from point and nonpoint sources that would be needed to remain below thresholds. Customizing the application of N thresholds for each grouping recognizes their distinct watershed and receiving water characteristics. Each grouping also presents different challenges and opportunities for setting priorities and making progress. For example, coastal watersheds draining to embayments offer opportunities to work with communities to address local water quality impacts, leveraging existing initiatives such as those for Suffolk County, New York or the Saugatuck River in Connecticut.

Implementation can be tailored to local conditions using multiple Clean Water Act authorities and tools to encourage holistic approaches to N reduction. Details on how thresholds could be developed and applied for each grouping are described in separate fact sheets.

> **Recommendation: Continue to pursue opportunities to monitor, model, and research the link between N loading and bottom-water DO conditions in the open waters of the Sound through multiple funding sources, including the Long Island Sound Study.**

While the strategy focuses on the near-term development and application of N thresholds, longer term development of technical tools to support assessment of DO criteria can be pursued concurrently. Continued technical work to understand how LIS responds to N reductions will strengthen the underlying science, help build public support, and lay the groundwork for N management policies at the local and Sound-wide scales. It is consistent with the objective of moving forward now based on existing information while increasing the confidence in predictions of water quality improvements and progress towards water quality standards attainment.

Supplemental Fact Sheets
1. Technical Approach Fact Sheet #1: Coastal Watersheds
2. Technical Approach Fact Sheet #2: Large Riverine Watersheds
3. Technical Approach Fact Sheet #3: WLIS Coastal Watersheds with Large, Direct Discharging Wastewater Treatment Facilities

# EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY DECEMBER 2015

## Overview

[1] NEIWPCC. 2014. Watershed Synthesis Section. In: A preliminary and qualitative evaluation of the adequacy of current stormwater and nonpoint source nitrogen control efforts in achieving the 2000 Long Island Sound Total Maximum Daily Load for Dissolved Oxygen.
http://www.neiwpcc.org/neiwpcc_docs/LIS%20TMDL_Watershed%20Synthesis%20Section.pdf

[2] New York State. 2014 Coastal Resiliency and Water Quality in Nassau and Suffolk Counties.
http://www.dec.ny.gov/docs/water_pdf/lireportoct14.pdf

[3] EPA Office of Water. 2013. A Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program. Nancy Stoner, Acting Assistant Administrator, December 5, 2013 Memo.

**EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY**
**DECEMBER 2015**

## Technical Approach Fact Sheet #1
## Coastal Watersheds

### A. Application of Established Threshold

For small to medium-sized coastal embayments, relatively robust empirical relationships between nitrogen (N) loads and eelgrass health can be used to set threshold total N loads[1]. Latimer and Rego (2010) analyzed 62 watershed-estuary systems in New England and concluded that N input rates greater than 50 kg per hectare of receiving embayment per year are likely to have a significant deleterious effect on eelgrass habitat extent. This loading rate can be compared to estimates of current loading rates from LIS coastal watersheds. EPA-funded work by Vaudrey et al., due to be completed in fall 2015, will apply the Nitrogen Loading Model[2] (NLM) to develop estimates of the total N load apportioned by source for 116 coastal watersheds to LIS[3] (Figure 1). Source apportionment for each coastal watershed will put into perspective the relative importance of centralized and individual on-site wastewater treatment, agriculture, turf fertilizer, and atmospheric deposition sources. Figure 2 provides an example of outputs from the project. The loading from coastal watersheds could be compared to the area of receiving waters. Watersheds exceeding the 50 kg/ha/yr loading rate would be targeted for action. Watersheds could be prioritized by assessing those for which point source reductions, in combination with nonpoint source reductions, could result in potential eelgrass recovery. Numeric limits for permitted point sources and nonpoint source reductions consistent with attaining the cap and complying with applicable water quality standards could be identified. Current N removal performance at wastewater treatment facilities would be considered in setting effluent limits with schedules for implementation. Where appropriate, a two-step process could phase in limits with compliance schedules.

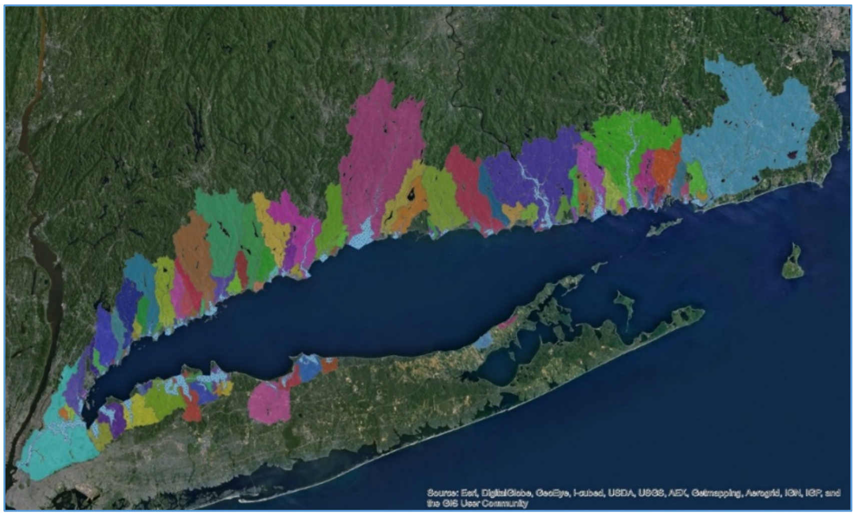


*Figure 1.Coastal watersheds for which nitrogen load will be apportioned by source.*

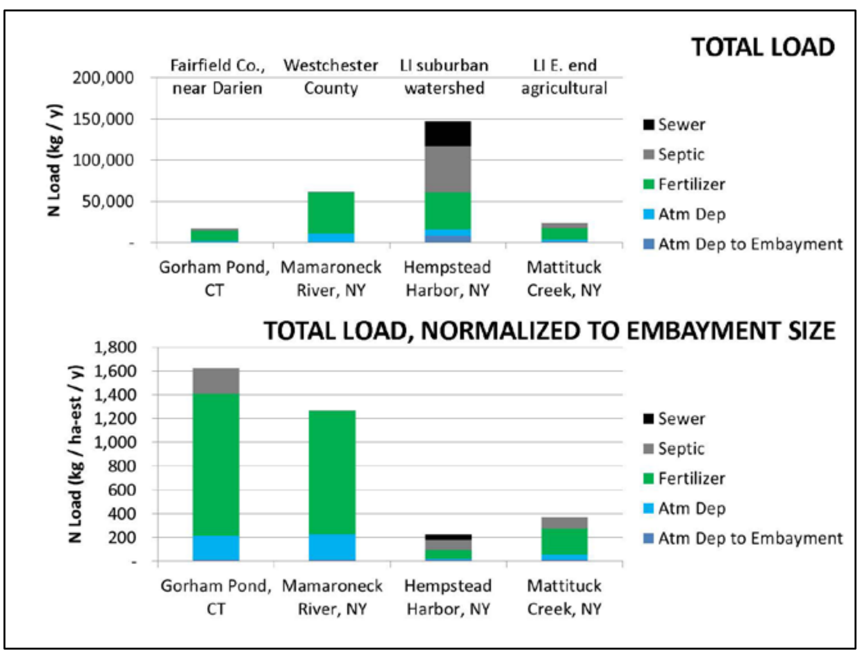


*Figure 2. N load by source to LIS embayments (Vaudrey et al.).*



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## Technical Approach Fact Sheet #1
## Coastal Watersheds

A phase one limit that can be attained at lower cost would initially be applicable along with watershed source reductions. The timing and magnitude of the second phase of municipal wastewater point source upgrades would depend on the progress documented relative to achieving the necessary reductions in nonpoint source/storm water point sources. If sufficient progress is being made in reducing nonpoint source/storm water point sources, the second phase of municipal wastewater point source upgrades could be delayed for one or more permit cycles. Any reductions achieved in nonpoint source/storm water point sources would reduce the magnitude of the necessary municipal wastewater reductions required in the second phase with the potential for eliminating the need for a second phase of wastewater upgrades. If tracking of actions watershed-wide determines that sufficient progress is not being made on the watershed reductions, then more stringent phase two N limits would become applicable. Since the permitting in coastal watersheds is delegated to Connecticut and New York, EPA will need to work with the states in implementing the numeric limits in NPDES permitting.

| Implementing Tasks | | |
|---|---|---|
| Action | Funding | Timeframe |
| Review coastal embayment loading estimates | In-house | 1/2016 – 3/2016 |
| Evaluate 50 kg/ha/yr loading rate threshold and adjust as appropriate based on new data or specific application to LIS | In-house | 1/2016 – 3/2016 |
| Identify coastal watersheds a) exceeding the loading threshold, b) with a wastewater discharge that can be tightened. | In-house | 3/2016 – 5/2016 |
| Select priority watersheds to initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the watershed loading threshold. | In-house | 5/2016 – 9/2016 |

### B. Derivation and Application of LIS-Specific Threshold

The revised Long Island Sound Comprehensive Conservation and Management Plan includes a target to increase eelgrass extent in LIS by 2,000 acres. Achieving this goal will require reductions in N loading to near-shore waters. Using the approach applied in Tampa Bay, FL (figure 3), light requirements for eelgrass established for Long Island Sound[4,5] can be used to derive allowable N loading that would not result in chlorophyll concentrations that would attenuate light below requirements for eelgrass[6]. The EPA-funded *Long Island Sound GIS-based Eelgrass Habitat Suitability Index Model*[7] can be applied to identify local factors limiting the growth of eelgrass and where restoration is possible with improved water quality. The EPA-funded project providing estimates of the total N load apportioned by source for all coastal watersheds to LIS would be used to identify current loadings. In combination, these tools can be used with local water quality data to derive total allowable N loads by coastal watershed that are protective of water quality. Using an approach similar to the one used in Tampa Bay (Figure 3), the relationship between N loads and chlorophyll-a would be empirically modeled. A key requirement is to establish a relationship between chlorophyll-a and N loads (Figure 4). While there are chlorophyll-a data at each LISS water quality monitoring program station, such data in nearshore and embayment areas are less common. The total allowable N loads can be allocated to sources through locally-driven planning. This point and nonoint source allocation by coastal subwatershed to achieve numeric N targets consistent with attaining water quality standards can be implemented through a variety of tools including NPDES permitting.

## Technical Approach Fact Sheet #1
## Coastal Watersheds

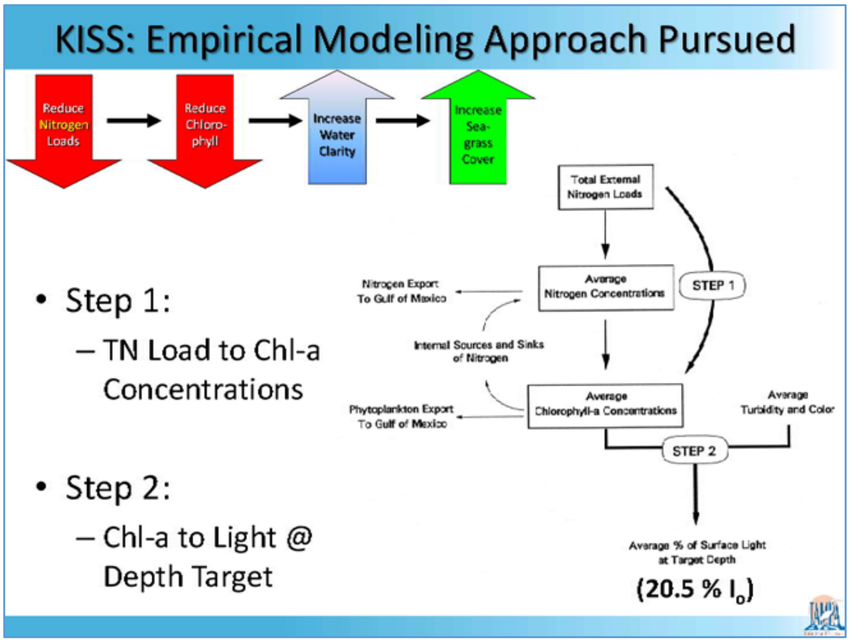


*Figure 3. Use of sea grass restoration goals to establish N caps in Tampa Bay, FL.*

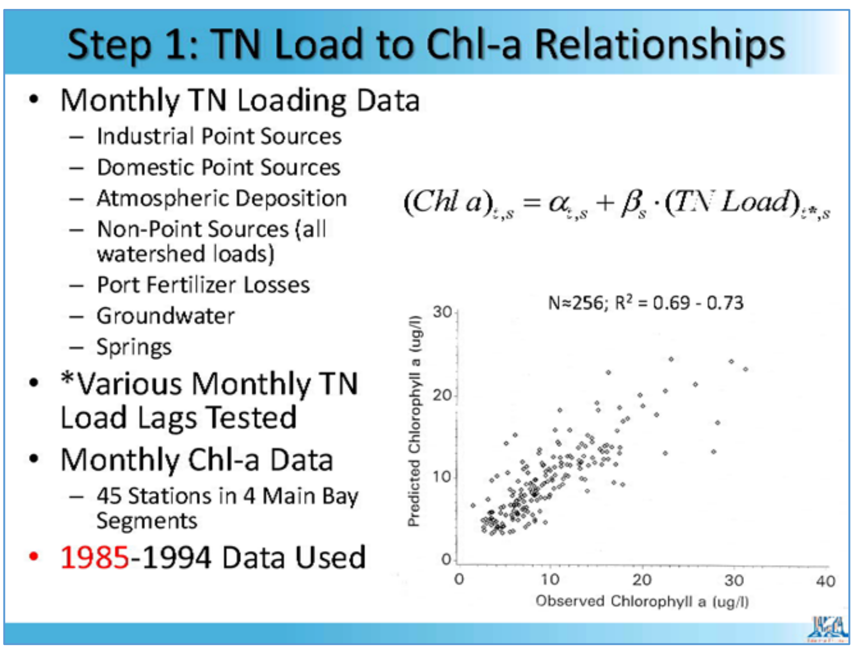


*Figure 4. Relationship between N load and chlorophyll-a in Tampa Bay, FL.*

Watersheds would be prioritized first by identifying those that contribute N to areas targeted for eelgrass recovery, and second by those with point source dischargers that, in combination with nonpoint source reductions, could result in eelgrass recovery. This strategy can be piloted in one or more locations in New York and Connecticut. For example, existing planning efforts by Suffolk County and New York State to address eutrophication of coastal waters can be leveraged to both set the local watershed N caps and execute locally-driven planning to apportion the caps among sources. New York State resources available to support planning in Suffolk County can be used to support this effort, and Suffolk County has already identified this type of work in N management planning. Similar subwatershed efforts exist in Connecticut (e.g. Niantic and Saugatuck River watersheds). Implementation of numeric limits for permitted point sources and nonpoint source reductions consistent with attaining the cap and complying with applicable water quality standards would be done similarly to the option using an established threshold.

| Implementing Tasks | | |
|---|---|---|
| Action | Funding | Timeframe |

## Technical Approach Fact Sheet #1
## Coastal Watersheds

| | | |
|---|---|---|
| Establish technical team to apply available tools to identify target areas to increase eelgrass coverage by 2,000 acres. | In-house | 1/2016 – 4/2016 |
| Relate TN load to chlorophyll-a and chlorophyll-a to light at depth targets to develop LIS-specific TN load thresholds protective of eelgrass. | LISS $100,000 | 10/2016 – 10/2017 |
| Apply TN load threshold to coastal watersheds that contribute to current or potential eelgrass areas to identify those that a) exceed the loading threshold, b) with a wastewater discharge that can be tightened. | In-house | 10/2017 – 12/2017 |
| Pilot approach through partnership with existing planning efforts (e.g. Suffolk County, Saugatuck River watershed) to both set the local watershed N caps and execute locally-driven planning to apportion the caps among sources. | LISS and partner resources | 10/2015 – 12/2017 |
| Select priority watersheds to initiate permitting strategy, identify level of complementary nonpoint source reductions needed to meet the watershed loading threshold. | In-house | 1/2018 – 4/2018 |

[1] Latimer, J.S. S.A. Rego. (2010). Empirical relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries. Estuarine, Coastal and Shelf Science. 90: 231-240.
[2] Valiela, I., M. Geist, J. W. McClelland, and G. Tomasky. 2000. Nitrogen loading from watersheds to estuaries: verification of the Waquoit Bay nitrogen loading model. Biogeochemistry 49: 277-293.
[3] Vaudrey, J. M. P. and Yarish C. (in prep.) Comparative Analysis of Eutrophic Condition and Habitat Status in Connecticut and New York Embayments of Long Island Sound. Final Grant Report to the Connecticut Sea Grant and the U.S. Environmental Protection Agency.
[4] Vaudrey, J. M. P. (2008) Establishing Restoration Objectives for Eelgrass in Long Island Sound, Part I: Review of the Seagrass Literature Relevant to Long Island Sound. Department of Marine Sciences, University of Connecticut. Final Grant Report to the Connecticut Department of Environmental Protection, Bureau of Water Protection and Land Reuse and the U.S. Environmental Protection Agency. Cooperative Agreement: LI-97107201, CDFA#66-437 (UCONN FRS#542190 ). 64pp.
[5] Vaudrey, J. M. P. (2008) Establishing Restoration Objectives for Eelgrass in Long Island Sound, Part II: Case Studies. Department of Marine Sciences, University of Connecticut. Final Grant Report to the Connecticut Department of Environmental Protection, Bureau of Water Protection and Land Reuse and the U.S. Environmental Protection Agency. Cooperative Agreement: LI-97107201, CDFA#66-437 (UCONN FRS#542190). 64pp.
[6] Harding, L.M. et al. (2014). Scientific Bases for Numerical Chlorophyll Criteria in Chesapeake Bay. Estuaries and Coasts. 37:134-148.
[7] Vaudrey, J.M.P., J. Eddings, C. Pickerell, L. Brousseau., C. Yarish. (2013). Development and application of a GIS-based Long Island Sound Eelgrass Habitat Suitability Index Model. Final report submitted to the New England Interstate Water Pollution Control Commission and the Long Island Sound Study. 171 p. + appendices.

# EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY
# DECEMBER 2015

## Technical Approach Fact Sheet #2
## Large Riverine Watersheds

### A. Application of Established Threshold

The empirical relationships between N loads and eelgrass health[1] established for small coastal watersheds may not be valid for larger river systems. Therefore, using nitrogen (N) ambient concentrations is recommended for establishing N thresholds. Two numeric total N threshold concentration levels will be evaluated, one consistent with achieving dissolved oxygen criteria and one consistent with restoration of eelgrass habitat. Due to the absence of numeric total N criteria or an evaluation of reference based sites within Long Island Sound, these numeric total N concentration thresholds would be established from the scientific literature. EPA Region 1 has considered total N threshold concentrations of 0.45 mg/l as protective of DO standards and 0.34 mg/l as protective for eelgrass[2,3,4]. Which threshold is applied would depend on the location of discharge. In areas where receiving waters support or have the potential to support eelgrass such as the Thames or Connecticut Rivers the lower threshold would apply. For areas unlikely to support eelgrass but close to areas subject to hypoxia, the higher threshold would apply.

For perspective, the Long Island Sound monitoring program provides a multi-decadal time series on total nitrogen (TN) concentrations in LIS. Sampling is performed monthly, year round, at the stations underlined in Figure 6. The TN concentrations at the Narrows (station A4) range from 1.1-0.7 mg/l, significantly greater than either the DO or **eelgrass** thresholds. At station C2 in the western LIS, however, TN concentrations generally vary from 0.7-0.3 mg/l. In the open waters of the central LIS, as represented by station H4, TN concentrations vary from 0.3-0.15 mg/l, well below the N thresholds, but open water depths are too deep to be suitable for eelgrass. Nearshore and embayment TN concentrations in both the central and eastern LIS may exceed the thresholds, but TN data is limited.

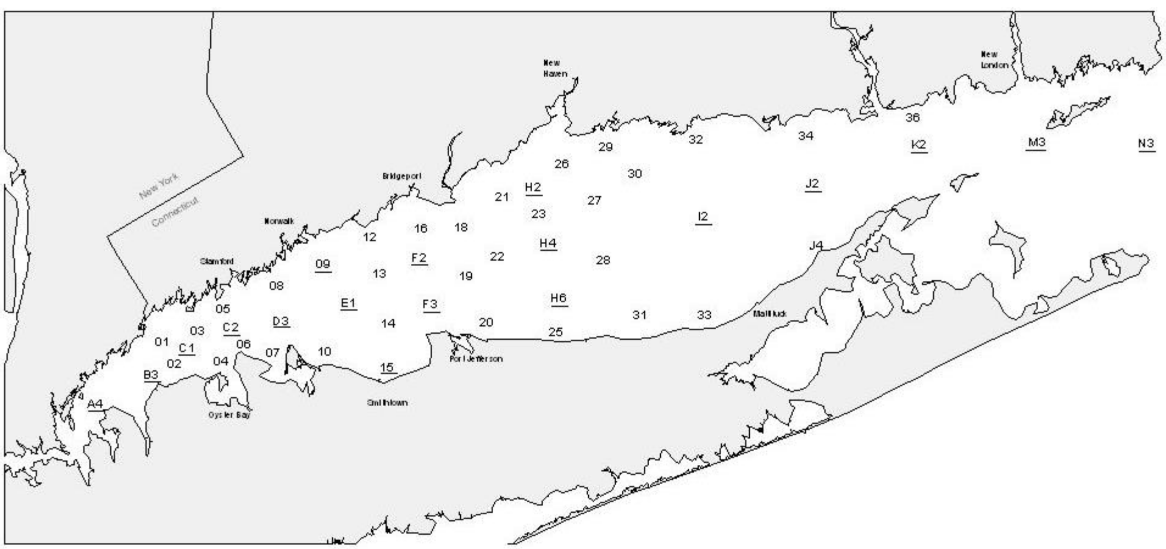


*Figure 6. Station locations of LIS monitoring program.*

Ambient data on N concentrations in Long Island Sound affected by the three large river systems could be supplemented from modeled N concentrations from the Systemwide Eutrophication Model (SWEM). Total N concentrations in different model segments would be accessed from saved SWEM model runs and compared to ambient threshold concentrations for total N. Total N loads consistent with achieving the thresholds could be inferred from the multiple SWEM loading scenarios.

**Technical Approach Fact Sheet #2**
**Large Riverine Watersheds**

If the tributary N loads contribute to N concentrations in excess of the thresholds, numeric limits for permitted point sources and nonpoint source reductions consistent with attaining the cap and complying with applicable water quality standards could be identified. Watersheds would be prioritized first by identifying those that contribute N to areas targeted for eelgrass recovery, and second by those with point source dischargers that, in combination with nonpoint source reductions, could result in eelgrass recovery. Current N removal performance at wastewater treatment facilities would be considered in setting effluent limits with schedules for implementation. Compliance schedules for municipal wastewater point sources would allow for implementation in two phases. A phase one limit that can be attained at lower cost would initially be applicable along with watershed source reductions. The timing and magnitude of the second phase of municipal wastewater point source upgrades would depend on the progress documented relative to achieving the necessary reductions in nonpoint source/storm water point sources. If sufficient progress is being made on reducing nonpoint source/storm water point sources, the second phase of municipal wastewater point source upgrades could be delayed for one or more permit cycles. Any reductions achieved in nonpoint source/storm water point sources would reduce the magnitude of the necessary municipal wastewater reductions required in the second phase with the potential for eliminating the need for a second phase of wastewater upgrades. If tracking of actions watershed-wide determines that sufficient progress is not being made on the watershed reductions, then more stringent phase 2 N limits would become applicable. EPA would work with both authorized states and non-authorized states in implementing the numeric limits in NPDES permitting.

| Implementing Tasks | | |
|---|---|---|
| Action | Funding | Timeframe |
| Assess existing ambient data on TN concentrations. | In-house | 1/2016 – 3/2016 |
| Assess SWEM TN concentration model outputs for a range of loading scenarios and TN monitoring data. | LISS $100,000 | 10/2016 – 12/2016 |
| Review, adjust, and apply TN concentration thresholds geographically to model outputs. | As above | 10/2016 – 12/2016 |
| Identify TN riverine load necessary to meet applicable TN concentration threshold. | As above | 10/2016 – 12/2016 |
| Initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the riverine watershed loading threshold. | In-house | 1/2017 – 4/2017 |

## B. Derivation and Application of LIS-Specific Threshold

The same procedure outlined for deriving site-specific N thresholds for coastal watersheds can be used to set caps for the major tributaries (Connecticut, Housatonic, and Thames). These large inland watersheds will affect water quality beyond their point of discharge into LIS. Past water quality monitoring and modeling can identify areas of discharge influence. USGS has published estimates of N loads from tributaries to LIS.[5] Once chlorophyll levels supportive of meeting eelgrass restoration objectives have been set, N caps for tributary discharges that influence near-shore water quality in areas targeted for eelgrass restoration can be derived. Existing or new water quality models of LIS can be used to evaluate the influence of each tributary on N concentrations and chl-a.

Implementation of the LIS-specific threshold would follow the same steps as outlined in the application of existing thresholds.

## Technical Approach Fact Sheet #2
## Large Riverine Watersheds

| Implementing Tasks | | |
|---|---|---|
| Action | Funding | Timeframe |
| Establish technical team to apply available tools to identify target areas to increase eelgrass coverage by 2,000 acres. | In-house | 1/2016 – 4/2016 |
| Assess monitoring data and SWEM TN concentration model outputs for a range of loading scenarios to identify tributary influence on eelgrass restoration areas. | LISS $100,000 | 10/2016 – 12/2016 |
| Relate TN load to chl-a and chl-a to light at depth targets to develop LIS-specific TN load thresholds protective of eelgrass. | LISS $100,000 | 10/2016 – 10/2017 |
| Identify TN riverine load necessary to meet applicable TN concentration threshold. | As above | 10/2016 – 12/2016 |
| Initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the riverine watershed loading threshold. | In-house | 1/2017 – 4/2017 |

[1] Latimer, J.S. S.A. Rego. (2010). Empirical relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries. Estuarine, Coastal and Shelf Science. 90: 231-240.
[2] State of New Hampshire Department of Environmental Services. 2009. Numeric Nutrient Criteria for the Great Bay Estuary. http://des.nh.gov/organization/divisions/water/wmb/wqs/documents/20090610_estuary_criteria.pdf
[3] Benson, JL, Schlezinger, D, Howes, BL. 2013. Relationship between nitrogen concentration, light, and *Zostera marina* habitat quality and survival in southeastern Massachusetts estuaries. Journal of Environmental Management. Volume 131: 129-137.
[4] Howes, BL, Samimy, R, Dudley, B. 2003. Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators Interim Report. Prepared by Massachusetts Estuaries Project for the Massachusetts Department of Environmental Protection. http://yosemite.epa.gov/OA/EAB_WEB_Docket.nsf/Verity%20View/DE93FF445FFADF1285257527005AD4A9/$File/Memorandum%20in%20Opposition%20...89.pdf
[5] Mullany, J.R., Schwarz, G.E. 2013. Estimated nitrogen loads from selected tributaries in Connecticut drainages to Long Island Sound, 1999-2009. U.S. Geological Survey Scientific Investigations Report 2013-5171, 65 pp. http://dx.doi.org/10.3133/sir20135171

**EVOLVING THE LONG ISLAND SOUND NITROGEN REDUCTION STRATEGY**
**DECEMBER 2015**

**Technical Approach Fact Sheet #3**
**WLIS Coastal Watersheds with Large, Direct Discharging Wastewater Treatment Facilities**

## Application of Established Threshold

As is the case for the larger river systems, empirical relationships between nitrogen (N) loads and eelgrass health that were established for small coastal watersheds may not be valid as a threshold for the open waters of WLIS primarily affected by hypoxia. Therefore, the use of N ambient concentrations is recommended for establishing N thresholds. Due to the absence of numeric total N criteria or an evaluation of reference based sites within Long Island Sound, these numeric total N concentration thresholds would be established from the scientific literature. EPA Region 1 has considered total N threshold concentrations of 0.45 mg/l as protective of DO standards and 0.34 mg/l as protective for eelgrass[1,2,3]. It is not clear how extensive natural beds of eelgrass would have existed in the WLIS, in part because of a large tidal range. Therefore, a threshold concentration protective of DO would be established.

The same approach described for developing N thresholds for the large riverine watersheds can be applied to the open waters of western LIS subject to direct discharges from large wastewater treatment facilities. There are ample ambient data on N concentrations in WLIS. The monitoring data could be supplemented by modeled N concentrations from the Systemwide Eutrophication Model (SWEM). The ambient total N concentrations in LIS projected from SWEM under multiple loading scenarios would be compared to numeric total N threshold concentrations (e.g., 0.45 mg/l) deemed protective of narrative nutrient standards and dissolved oxygen standards. Total watershed N loads consistent with achieving the threshold concentration could be derived from the multiple SWEM loading scenarios. These loads would then be compared to the sources of N from WLIS coastal watersheds, including the permitted point source loads established to meet the TMDL wasteload allocations.

For perspective, the Long Island Sound monitoring program provides a multi-decadal time series on TN concentrations in LIS. The TN concentrations at the Narrows (station A4) range from 1.1-0.7 mg/l, significantly greater than a DO threshold of 0.45 mg/l. At station C2 in the western LIS, however, TN concentrations generally vary from 0.7-0.3 mg/l. In the open waters of the central LIS, as represented by station H4, TN concentrations vary from 0.3-0.15 mg/l, well below the N threshold.

While the wasteload allocations (WLA) for the wastewater treatment facilities in the LIS TMDL are forecasted to improve water quality, current modeling does not predict eventual attainment of water quality standards as a result of achieving these and other TMDL allocations. Since watersheds in this grouping are dominated by point sources, integrated planning could be a practical approach to setting priorities for investments in nitrogen reductions among wastewater treatment facilities, stormwater MS4 areas, and combined sewer overflow sources, with a focus on getting significant reductions in the near-term. Planning can include nonpoint sources in watersheds within this grouping where they are a significant contributor of N. Current N removal performance at wastewater treatment facilities would be considered to identify opportunities for additional actions that would help support attainment of the N threshold.

EPA will work with authorized states in implementing an integrated planning approach for NPDES permitting, including using appropriate water quality-based effluent limits, as permit renewal schedules allow. Expeditious technical refinements to assessments of water quality standards attainment resulting from continued water quality monitoring and additional modeling to link N loading to DO levels will be important in informing integrated planning priorities and should be a responsibility shared among permittees. These evaluations should consider the influence of climate change on attainment of water quality standards and the procedures for monitoring and determining compliance with thresholds or criteria. Final numeric limits would either use a concentration-based threshold or be set from additional water quality modeling that sets a total mass load.

Stakeholder engagement is a critical piece of the strategy for the WLIS. EPA, NY and CT will provide enhanced and understandable technical information concerning the individual point and nonpoint sources and their relative contributions to nitrogen loads in this area. In addition, this information will include the investments to date in nitrogen reduction technologies employed by the point sources and how these investments compare to level of technology solutions being used in other similar situations.

| Implementing Tasks | | |
|---|---|---|
| Action | Funding | Timeframe |
| Assess monitoring data and SWEM TN concentration model outputs for a range of loading scenarios. | LISS $100,000 | 10/2016 – 12/2016 |
| Review, adjust, and apply TN concentration DO thresholds geographically to model outputs. | As above | 10/2016 – 12/2016 |
| Identify wastewater discharge levels that would result in TN concentrations below the TN concentration threshold protective of DO. | As above | 10/2016 – 12/2016 |
| Initiate permitting strategy and identify level of complementary nonpoint source reductions needed to meet the TN concentration DO threshold. | In-house | 1/2017 – 4/2017 |
| Initiate additional water quality modeling and continue water quality monitoring to evaluate attainment of water quality standards. | LISS TBD | 10/1016 – 10/2018 |
| Refine permitting strategy based on additional technical work to identify nitrogen concentrations of loads that will meet water quality standards. | LISS | 10/1016 – 10/2020 |

[1] State of New Hampshire Department of Environmental Services. 2009. Numeric Nutrient Criteria for the Great Bay Estuary.
http://des.nh.gov/organization/divisions/water/wmb/wqs/documents/20090610_estuary_criteria.pdf

[2] Benson, JL, Schlezinger, D, Howes, BL. 2013. Relationship between nitrogen concentration, light, and *Zostera marina* habitat quality and survival in southeastern Massachusetts estuaries. Journal of Environmental Management. Volume 131: 129-137.

[3] Howes, BL, Samimy, R, Dudley, B. 2003. Site-Specific Nitrogen Thresholds for Southeastern Massachusetts Embayments: Critical Indicators Interim Report. Prepared by Massachusetts Estuaries Project for the Massachusetts Department of Environmental Protection.
http://yosemite.epa.gov/OA/EAB_WEB_Docket.nsf/Verity%20View/DE93FF445FFADF1285257527005AD4A9/$File/Memorandum%20in%20Opposition%20...89.pdf

**Attachment #3**

**Minutes**

**Technical Advisory Committee**

**Friday, December 7, 2007 9:30 AM to 12:30 PM**

Newington Town Hall
205 Nimble Hill Road
Newington, NH 03801

Meeting Topic: Developing Nutrient Criteria for New Hampshire's Estuaries

Attendees

Phil Trowbridge, NHEP/DES
Jennifer Hunter, NHEP
Ed Dettmann, EPA
Jeannie Brochi, EPA
Jim Latimer, EPA
Phil Colarusso, EPA
Matt Liebman, EPA
Paul Currier, DES
Ted Diers, DES
Kevin Lucey, DES
Kathy Mills, GBNERR
Eileen Miller, NHACC
Tom Irwin, CLF
Ray Konisky, TNC
Steve Jones, UNH
Rich Langan, UNH
Jonathan Pennock, UNH
Fred Short, UNH
Bill McDowell, UNH
Art Mathieson, UNH
Valerie Giguere, Underwood Eng.
Peter Rice, City of Portsmouth
David Cedarholm, Town of Durham

1. Introductions and review of the agenda
Phil Trowbridge reviewed the agenda and led a round of introductions.

2. Preliminary results from light attenuation sensors on the Great Bay buoy and hyper-spectral imagery of Great Bay
Ru Morrison gave a presentation on the relationship between light attenuation and water quality measured by the Great Bay buoy in 2007. In summary, the data analysis showed that light attenuation is largely controlled by turbidity and CDOM. Chlorophyll-a only accounts for 8% of the overall light attenuation. Turbidity in the estuary can be predicted from stream flow and wind speed. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

The group made the following comments during the presentation:

- The light availability for eelgrass survival may be 22% but more light is needed for plants to "thrive" (34%) and to protect all stages of the life cycle (>50%).
- Turbidity measured by the buoy is best described as "non algal particles". Phytoplankton measured via the chlorophyll-a sensor are subtracted from the turbidity results. Zooplankton typically do not have an optical shading effect.



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- While the results do not show a relationship between chlorophyll-a and light attenuation, it cannot be concluded that nitrogen does not have an effect on eelgrass. Rather, this study showed that the classic model of eelgrass shading by phytoplankton blooms does not describe the Great Bay Estuary. Other factors, such as proliferation of nuisance macroalgae and epiphytic shading, could still relate nitrogen loads to eelgrass loss. Some members also cited direct toxicity of ambient nitrate concentrations to eelgrass.
- The relationship between Kd, chlorophyll-a, turbidity, and CDOM in the middle of Great Bay could be used in another location in the estuary if the particle distributions were the same. However, the relationship should not be applied to other estuaries.

3. Nitrate concentration trends in the Lamprey River watershed
Bill McDowell gave a presentation on nitrogen geochemistry in the Lamprey River watershed. In summary, the data analysis showed that nitrate concentrations at the Packers Falls dam have a statistically significant, increasing trend between 2000 and 2007. The nitrate export from watersheds is best explained by human activity (e.g. population density, developed lands). However, the largest source of nitrogen to the watershed is regional atmospheric deposition. Ninety-four percent of the dissolved inorganic nitrogen that enters the watershed is retained or released to the atmosphere via denitrification. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

The group made the following comments during the presentation:

- Atmospheric deposition of nitrogen is not changing in the region. Therefore, human influence in the watershed is somehow increasing the delivery of nitrogen from the watershed. Increasing impervious surfaces speed up delivery of stormwater to river systems.
- The total nitrogen flux out of the watershed in 2006 was 3.25 kg/ha/year. This value is similar to the total nitrogen flux from the Great Bay watershed in 2002-2004 (3.9 kg/ha/yr).
- Mass balance is based on dissolved inorganic nitrogen. It would be interesting to compile a total nitrogen mass balance.

4. Antidegradation policies which could be used to limit nitrogen loading
Paul Currier gave a presentation on the antidegradation provisions of the Clean Water Act. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

5. (1) Nitrogen loading rates for Great Bay compared to other estuaries; (2) Estuarine nutrient criteria in other states, and (3) Deadline for establishing nutrient criteria for NH's estuaries
Phil Trowbridge gave a presentation on various topics. The nitrogen loading rates for the Great Bay Estuary are higher than would be expected for the amount of eelgrass still present. Four reference estuaries in the Gulf of Maine were identified based on EPA classifications and the Level III Ecoregions. Nitrogen yields from the watersheds draining to these estuaries decreased from south to north. The presentation and supporting documents are posted on the NHEP website (http://www.nhep.unh.edu/programs/nutrient.htm, under the 12/7/07 meeting).

The group made the following comments during the presentation:

- Comparisons of nitrogen yield from estuarine drainage areas are not appropriate because they do not normalize for the hydrology of the estuary.
- Reference estuaries in the Gulf of Maine are too different from Great Bay to be useful.
- Estuaries with colder temperatures are less susceptible to eutrophication, so comparisons to estuaries north of Great Bay would not be protective.

6. Develop group consensus on how to proceed in order to meet the deadline
The group discussed the best way to develop nutrient criteria by December 2008. Five options were considered. The pros and cons for each option were summarized in a handout (attached).

- Option 1: Develop a long-term trend of nitrogen and sediment loads to the estuary and compare to historic eelgrass distribution
- Option 2: Develop different nutrient criteria for different segments of the estuary
- Option 3: Designate the Great Bay Estuary as a Tier I waterbody for nitrogen and sediment
- Option 4: Reference concentration approach within Great Bay
- Option 5: Reference approach for other estuaries in the ecoregion

The group discussed the various options. There was not consensus on the way forward or even on using eelgrass as the indicator for nutrient criteria. In general, the group did not feel that options 3 and 5 would be effective. Research should continue on Options 1, 2, and 4. Major points from the discussion are summarized below.

- Are nitrogen loads now much higher than in the 1950s when raw sewage was dumped into the bay? Need to do Option 1 to figure this out. Get historical modeling methods from the Long Island Sound Study.
- Focus on subtidal eelgrass beds to determine the effect of water clarity/water quality changes on eelgrass. If subtidal eelgrass is being lost due to decreased clarity, determine whether nitrogen is the cause of the decline. Use deep edge research at subtidal beds.
- Investigate relationships between DOC delivery from watersheds and CDOM in the estuary.
- Do not spend time researching other estuaries for Option 5. The reference estuaries are too different from Great Bay to be useful. Use the available time and resources to study the Great Bay Estuary.
- Is there a way to combine the cumulative effects of multiple stressors on eelgrass: hydrology, nutrients, CDOM, sediments, sea level rise?
- The imagery for the 1981 eelgrass maps should be reviewed to determine the quality of the 1981 eelgrass distribution maps.
- Comparison of nitrogen yield between watersheds ignores differences in estuarine flushing. This approach will not be productive.
- The Great Bay-Little Bay part of the estuary is very different from the Piscataqua River-Portsmouth Harbor part of the estuary. The former is dominated by intertidal areas. The latter mostly has subtidal habitats. These two parts of the estuary should be studied separately. Different nutrient criteria (especially for water clarity) may be needed for each section.
- Research the direct effects of nitrogen on eelgrass. Journal articles are available from Burkholder (1992, 1994), van Katwijk et al. (1997, Mar. Ecol. Prog. Ser., Vol.157: 159-173), and Touchette (2002, Botanica Marina, Vol. 45: 23-34).

Phil Trowbridge requested that people send additional ideas for analysis or process to him after the meeting.

7. Proposal for updating the environmental indicator reports in 2008-2009 with limited staff time
This agenda item was not discussed due to time constraints. The NHEP will distribute a proposal to the TAC via email to get feedback on this topic.

8. Adjourn
The meeting was adjourned at 12:30 pm.