GREAT BAY MUNICIPAL COALITION

October 7, 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

Dear Regional Administrator Deziel and Assistant Administrator Ross:

This letter follows our September 30, 2019 letter to you requesting 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.

Enclosed is a letter received from Dr. Brian Howes, an expert on the restoration of estuarine nutrient related habitat and a Professor at the UMass/Dartmouth School of Marine Science and Technology (SMAST). SMAST, under Dr. Howes' leadership, partnered with the Massachusetts Department of Environmental Protection (DEP) in the Massachusetts Estuary Project (the Project). The Project, through SMAST, is providing the scientific and technical support to the DEP for the development and implementation of policies on nitrogen sensitive embayments. The program is performing the data collection and modeling required for the management and restoration of the 89 embayment systems comprising the coastline of southeastern Massachusetts.

Based on his extensive experience, we asked Dr. Howes for his opinion as to the appropriate nitrogen concentrations for the protection of eelgrass resources in the Great Bay Estuary. As you will see from the attached letter, Dr. Howes indicated that a growing season (typically May to September) average nitrogen concentration of between 0.32 – 0.35 mg/l "should be protective of that resource based on [his] experience with the nearby Massachusetts estuarine waters." The growing season average nitrogen concentration found protective of eelgrass in the Massachusetts Estuaries Project ranged from 0.32 – 0.45 mg/l.

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GREAT BAY MUNICIPAL COALITION

We submit this letter in further support of our request for an independent peer review of the 100 kg/ha-yr nitrogen target proposed by EPA Region I for the Great Bay Estuary. Such a loading level would translate into a considerably lower concentration than the 0.32 – 0.35 mg/l growing season average nitrogen endpoint that Dr. Howes has indicated should be protective of eelgrass.

We look forward to hearing from you soon in response to our September 30, 2019 request for an independent peer review.

Sincerely,

CITY OF DOVER, NH

Michael Joyal, City Manager

CITY OF ROCHESTER, NH

Blaine Cox, City Manager

Enclosure

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

SMAST
University of Massachusetts Dartmouth
The School for Marine Science and Technology

Dear Mr Peschel:

As requested, I have reviewed the documentation provided regarding various total nitrogen targets/thresholds for the restoration/protection of eelgrass and benthic resources in various estuaries in New England that have EPA-approved Total Maximum Daily Loads (TMDL) under the Clean Water Act. SMAST was involved in the majority of those projects and is cited heavily in their TN threshold analyses. As a result, I am quite familiar with the level of water quality modeling and water quality monitoring that were used to develop these protective nutrient targets for the eelgrass endpoint. The characteristics of those studies and data collection efforts supporting the development of the TN endpoints and TMDL reductions are stated below.

Background on SMAST Endpoint and TMDL Development

Virtually all of the studies were conducted to address the impacts on TN on saltwater "ponds" and embayments. The nitrogen sources to these systems were generally "non-point" (i.e., groundwater, septic, and surface runoff) with point sources limited to a only a few estuaries. These systems were not associated with major river systems, significant upland watersheds or substantial WWTPs. For these systems, the groundwater, groundwater fed streams and sediment components would have been primarily contributing dissolved inorganic nitrogen forms (i.e., nitrate from septic tanks or ammonium from sediment organic matter decay). TN loading to the estuaries was determined from individual parcel data coupled to nitrogen source strengths from local studies (watershed module) and directly measured stream nitrogen discharges and directly measured sediment nitrogen release.

The system data used to identify the protective TN targets and calibrate the embayment specific water quality models were collected during the growing season (typically May – September), as the critical period for management. The growing season was selected as the focus as it supports the poorest water and habitat quality of the year. Embayment specific hydrodynamic models were used to ensure that the impact of the external loading sources were properly considered, with respect to system transport, dilution (dispersion), flushing and boundary exchanges and freshwater volumetric inputs as they affect the distribution of TN concentrations throughout the system of interest. The forms of nitrogen present were typically composed of bioavailable or readily degradable plus more refractory forms (refractory is defined as not biologically available within its residence time in a basin). As the external loading sources to the watershed (e.g., septic tanks) did not vary seasonally for the most part, the TMDLs have only recommended annual average load reductions. If the sources had a major seasonal component (like riverine or WWTP inputs), this temporal variation was integrated into the water quality models to assess growing season impacts. This was relatively straightforward as most embayments had water exchanges on the order of weeks to a month.

The eelgrass TN thresholds developed by SMAST were fundamentally based on intra and intersystem comparisons of eelgrass and measured water quality (including TN, water clarity, salinity, depth) with tidally averaged TN from the validated numerical water quality modeling. However, the modeling of TN was a refinement and is not always critical to developing a threshold.

It is the comparison of TN levels across a variety of eelgrass sites (areas with healthy eelgrass and stable beds, areas with thinning beds, areas where eelgrass beds have been declining or have recently disappeared) that underpins threshold analysis for the eelgrass endpoint. This comparative approach is used for to develop a variety of threshold in aquatic systems and is generally accepted as the best available approach because it is based upon actual measurements of the constituent of interest (nitrogen) and the"health" of the selected endpoint (in this case eelgrass, but also benthic animals). The approach is both robust and verifiable and can be augmented by the use of indexes or models,

Regarding to the questions that you posed, please see my answers below:

Appropriate nitrogen concentrations for the protection of eelgrass resources;

For eelgrass, the protective growing season TN concentration identified by SMAST typically ranged 0.32-0.45 mg/l, as you have properly identified in the summary attachment. (Enclosure). For the Great Bay system, selecting a growing season average in the range of 0.32-0.35 mg/l should be protective of that resource based on our experiences with the nearby Massachusetts estuarine waters. But analysis of the Great Bay available data on water quality and eelgrass is needed to be sure. Also, the range in TN across the SMAST threshold analyses stems from differences between estuaries, particularly in terms of depth, tidal range, amount of inorganic material versus organic material in watercolumn and data on site specific temporal trends in eelgrass coverage. For example, eelgrass in shallow water can tolerate higher TN and turbidity levels than in adjacent sites in deeper water, etc.

Timing and Forms of Nitrogen to Regulate

I understand that the Great Bay system is relatively well flushed (relatively short residence time) and that the form of nitrogen likely includes components that are not biologically active during their short time in the estuary, for example bulk DOC/DON can be 100's of years old and typically makes up the majority of TN entering through the offshore boundary on incoming tides. Given that the point and non-point system loads to Great Bay Estuary can vary significantly seasonally the peak seasonal loads need to be used in the modeling and the model verified with growing season measured TN levels throughout the basins. The growing season loading needs to account for regeneration of nitrogen from the sediments, as this can be a significant input during summer. I suggest that the modeling also include bioactive nitrogen (DIN+PON) as it has been found to be more accurate in large basins, as it does not include bulk DON which is generally refractory. Having both the TN and bioactive N models should allow better targeting of N load reductions and over-management.

This system would have a higher particulate N loading than the systems evaluated by SMAST, given the large watershed that feeds into Great Bay and the Piscataqua River. Some particles would be expected to settle within the system. Therefore, it is recommended that the impact of sediment release of bioavailable forms of nitrogen be assessed. In some systems, this is significant, others less so. This would provide insight on the need to address the control of particulate forms of nitrogen from the watershed in runoff that could settle and create adverse impacts during the growing season. The model calibration for TN and bioactive N should also yield insight into the importance of summer sediment N release to the overall N load to the watercolumn.

Overall, it appears that a comparative analysis of key water quality metrics and eelgrass health/stability will support a site-specific TN threshold for Great Bay. Also, nitrogen modeling needs to provide distribution of TN and bioactive N throughout the system and allow validation using actual data to ensure proper N load reductions are developed.

Presently, I am not aware of any other papers or studies addressing the level of nitrogen that would be protective of eelgrass resources in the New England area. I hope you find this information helpful in completing your analyses of the Great Bay System.

Sincerely,

Brian L. Howes, Ph.D.

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Evaluation of TN Endpoint for the Protection of Eelgrass

Prepared by
Great Bay Municipal Coalition

In November 2018, EPA Region I identified a paper published by Dr. James Latimer (Latimer and Rego, 2010)[1] as appropriate for setting nitrogen load restriction in Great Bay estuary for the protection of eelgrass. In subsequent meetings, NHDES requested that the Great Bay Municipal Coalition identify an alternative approach, based on literature and other relevant scientific information, that could be considered protective of eelgrass resources and used to set nutrient limitations while site-specific studies are being conducted in the Estuary. This memorandum provides a Summary Table of various TN endpoints identified as being protective of eelgrass resources in nearby New England estuarine systems. The table primarily reflects a subset of TN endpoints from approved TMDLs developed to protect eelgrass habitat, prepared by MassDEP as part of the Massachusetts Estuaries Project (MEP). The MEP program relied on verified exposure data and resulting system response (i.e., the values are based on conditions documented to be protective, not theoretical model loading analyses). The subset was limited to about 20 approved endpoints (instead of pulling all of the TMDL endpoints) because the TN targets all clustered within a small range and our purpose was to select an interim value supported by a preponderance of accepted values.

Each of the MassDEP TMDL endpoints was developed for a relatively small embayment, using the "sentinel" station approach to develop the target endpoint. The target TN endpoint was selected from a station near the mouth of the embayment system with higher quality waters that supported eelgrass habitat. Each of the embayments was primarily under the influence of TN loading from groundwater sources associated with septic systems and land usage. As such, the TN load was primarily in the form of dissolved inorganic nitrogen (DIN). Each of the reported endpoints in the Summary Table is a growing season average concentration. Therefore, if an interim endpoint value is selected from the Summary Table for application to the Great Bay Estuary, it should also be applied as a growing season average. For added conservativism, the criteria would be applied as total nitrogen.

As part of this literature review the Coalition also examined the *Long Island Sound Comprehensive Conservation and Management Plan 2015* and the *Long Island Sound Nitrogen Reduction Strategy* (December 2015) which, among other things, establish goals for restoring eelgrass and limiting hypoxia in Long Island Sound. This Plan was developed and approved by multiple parties, including EPA Region 1, to protect eelgrass resources. An overview of the nitrogen reduction strategy was presented by EPA via public webinar on November 8, 2017. One conclusion of the strategy was to differentiate between coastal embayments with small watersheds influenced primarily by groundwater loadings and those which received loadings from larger riverine systems (such as that present in Great Bay). The USEPA Fact Sheet with the Nitrogen Reduction Strategy specifically noted that the empirical relationships between nitrogen

[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 (2010) 231 – 240.

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loads and eelgrass health, such as that developed by Latimer and Rego (2010), may not be valid for larger riverine systems and, consequently, was not employed as the basis for developing nutrient loading targets. (*Nitrogen Reduction Strategy, Fact Sheet #2* at 1). As noted in the LIS documents, the direct loading approach suggested by Latimer and Rego (2010) does not addresses (1) actual site-specific system responses, (2) relevant forms of nitrogen, (3) systems where the major loading are from riverine sources or (4) the unique hydrodynamics of an estuary impacting plant growth responses to nitrogen inputs. Consequently, as with the LIS Strategy, the use of this approach is not scientifically defensible for assessing TN impacts in the Great Bay Estuary system.

EPA (through Tetra Tech) also prepared a literature review memo summarizing its technical approach for establishing nitrogen thresholds in Long Island Sound[2]. The literature review memo is organized by watershed groupings including separate evaluations for smaller embayments and those affected by large riverine systems. For each of these groupings, EPA is developing nitrogen thresholds to translate the narrative water quality standard into a numeric target concentration (as done in the MEP TMDLs summarized in the table) and identifying where nitrogen watershed loading results in exceedances of the identified threshold. Based on the literature review of median growing season TN concentration necessary to protect eelgrass, page F-3 of the Report stated the following:

> *For embayments, Tetra Tech selected a median value of 0.40 mg/L TN to protect the seagrasses in embayments. This value is the rounded value of the median TN protective of seagrasses (0.39 mg/L; range: 0.30 to 0.49 mg/L). Values above the literature review maximum TN concentration of 0.49 mg/L were not considered protective of eelgrass (see Table F-1).*

Once a TN endpoint was identified, the load necessary to meet the endpoint was calculated considering the system hydrodynamics. (See, *Establishing Nitrogen Endpoints for Three Long Island Sound Watershed Groupings. Subtasks F and G. Summary of Empirical Modeling and Nitrogen Endpoints*. April 13, 2018) From the LIS studies and peer review (discussed below), it is clear EPA Region 1 is not using the Latimer and Rego (2010) loading approach to establish reduction requirements for eelgrass protection in Long Island Sound, even in the smaller embayments. Rather, first a TN concentration necessary to protect eelgrass resources is identified. Then, the load necessary to ensure that the TN endpoint is not exceeded is determined. This is the same approach used in the MEP TMDLs that are summarized in the Endpoint Summary Table and is consistent with the approach the Coalition has undertaken here.

Finally, an independent peer review of the proposed LIS approach was completed in January 29, 2019 by EPA Region 1. The independent peer review Technical Review Team, funded by EPA, included Dr. Victor J. Bierman. Dr. Bierman was also on the peer review team that evaluated the 2009 Draft Nutrient Criteria for Great Bay. In that analysis, Dr. Bierman stated the following:

[2] Literature Review Memo. March 27, 2018. Long Island Sound (LIS): Application of Technical Approach for Establishing Nitrogen Thresholds and Allowable Loads for Three LIS Watershed Groupings: Embayments, Large Riverine Systems and Western LIS Point Source Discharges to Open Waters.

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> [E]elgrass and aquatic life are the assessment endpoints. If appropriate analyses are conducted with all of the relevant site-specific data, then TN concentration targets can be developed that will protect the assessment endpoints. In turn, an appropriate site-specific, load-response model can then be used to determine TN loads from the watershed that can meet the in-water TN concentration targets. This is the approach currently being used with the linked watershed-embayment model in the 89 MEP embayments (Howes et al., 2006).

This is the approach that the Great Bay Municipal Coalition is currently pursuing. Therefore, consistent with EPA's own findings and approaches in LIS, it is appropriate to employ the literature review approach presented in this memorandum, to identify a range of growing season average TN endpoints (0.35-0.45 mg/l) for use as an interim target, pending completion of the site-specific studied for the Great Bay system. The interim TN target can be used to evaluate interim TN load limitations using the hydrodynamic model as we are currently doing.

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TN Endpoint Summary Table

No.	Receiving Water/Source	Author	Protected Use	TN Source	Avg. Period	TN Endpoint	Page Citation
1	Wild Harbor Estuarine System TMDL for TN	MassDEP November 2017	Eelgrass Cover	Ground water (septic)	Summer Seasonal Avg.	0.35 mg/L	iii
2	Parkers River Embayment System TMDL for TN	MassDEP May 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.42 mg/L	iii
3	Fiddlers Cove and Rands Harbor Embayment Systems TMDL for TN	MassDEP November 2017	Benthic Community Structure	Ground water (septic)	Summer Seasonal Avg.	0.50 mg/L	iv
4	Quissett Harbor Embayment System TMDL for TN	MassDEP November 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.34 mg/L	iv
5	Bass River Estuarine System TMDL for TN	MassDEP May 2017	Eelgrass, Benthic Habitat	Ground water (septic)	Summer Seasonal Avg.	0.42 mg/L	V
6	Tampa Bay	Barriers and Bridges in abating Coastal Eutrophication March 2019	Eelgrass	Point Sources	Annual	~0.32 mg/L	See Figure 2 at 9
7	Lagoon Pond TMDL for TN	MassDEP July 2015	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.35 mg/L	V
8	Nantucket Harbor TMDL for TN	MassDEP January 28, 2009	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.35 – 0.36 mg/L (no macroalgae present)	Iii

TN Endpoint Summary Table (continued)

No.	Receiving Water/Source	Author	Protected Use	TN Source	Avg. Period	TN Endpoint	Page Citation
9	Green Pond TMDL for TN	MassDEP April, 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.42 mg/L	13
10	Great Pond TMDL for TN	MassDEP April, 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.40 mg/L	13
11	Bournes Pond TMDL for TN	MassDEP April, 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.45 mg/L (shallow)	13
12	Tisbury Great Pond Black Point Pond Estuarine System TMDL for TN	MassDEP December 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.46 mg/L (limited habitat; bathymetry)	Iv
13	Three Bays System TMDL for TN	MassDEP September 2007	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.38 – 0.50 mg/L	Iii
14	Swan Pond River Estuarine System TMDL for TN	MassDEP May 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.40 mg/L	V
15	West Falmouth Harbor Embayment System TMDL for TN	MassDEP November 2007	Eelgrass Habitat	Ground water (WWTP, septic)	Summer Seasonal Avg.	0.35 mg/L	Iii
16	Pleasant Bay System TMDL for TN	MassDEP May 2007	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.16 – 0.20 mg/L bioactive N conc. (DIN + DON) 0.52 mg/L TN	Iii
17	Waquoit Bay System TMDL for TN – Jehu Pond/Great River	MassDEP January 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.446 mg/L	12

TN Endpoint Summary Table (continued)

No.	Receiving Water/Source	Author	Protected Use	TN Source	Avg. Period	TN Endpoint	Page Citation
18	Waquoit Bay System TMDL for TN – Hamblin Pond/Little River	MassDEP January 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.38 mg/L	12
19	Waquoit Bay System TMDL for TN – Quashnet River	MassDEP January 2006	Benthic Habitat	Ground water (septic)	Summer Seasonal Avg.	0.50 mg/L	12
20	MEP Linked Watershed-Embayment Approach – Waquoit Bay	MassDEP May 2012	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.327 mg/L	197

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