New Hampshire Department of Environmental Services

RESPONSE TO PUBLIC COMMENT
AND
SUMMARY OF SUBSTANTIVE DIFFERENCES BETWEEN THE DRAFT AND FINAL 2010 SECTION 303 (D) SURFACE WATER QUALITY REPORT

4/1/2010

On February 19, 2010, the New Hampshire Department of Environmental Services (DES) released the draft Section 303(d) List of impaired waters for public comment. Downloadable copies of the draft list were made available on the DES website for review (http://des.nh.gov/organization/divisions/water/wmb/swqa/draft_303d_list.htm). In addition, the following organizations/agencies were notified by email:

Appalachian Mountain Club
Audubon Society
Connecticut River Joint Commissions
Conservation Law Foundation
County Conservation Districts
Lake and River Local Management Advisory Committees
Maine Department of Environmental Protection
Manchester Conservation Commission
Massachusetts Department of Environmental Protection
Merrimack River Watershed Council
National Park Service
New England Interstate Water Pollution Control Commission
NH Department of Health and Human Services
NH Coastal Program
NH Rivers Council
North Country Council
Regional Planning Commissions
Society for the Protection of National Forests
Natural Resources Conservation Service
The Nature Conservancy
Upper Merrimack River Local Advisory Committee
US Environmental Protection Agency
US Geological Survey
US Fish and Wildlife Service
US Forest Service
University of New Hampshire
Vermont Department of Environmental Conservation
Volunteer Lakes Assessment Program
Volunteer Rivers Assessment Program
Water Quality Standards Advisory Committee

The public comment period ended on March 22, 2010. The following represents DES's response to public comments received during this period and a summary of substantive differences between the draft and final Section 303(d) List.

A. RESPONSE TO PUBLIC COMMENT

Philip H. Bilodeau, P.E., Deputy Director, General Services Department, City of Concord

COMMENT # 1:

This letter is a follow up to our telephone and e-mail conversations requesting to remove the Penacook Lake from the draft 2010, 303(d) list of impaired water bodies in the state.

As per your request for additional information, the following information is being submitted:

1. All pH water data represents the untreated Penacook lake water at the intake to the water treatment plant. We only take water samples for water entering the WTP.

2. I have enclosed and previously emailed you the daily pH data. The data represents the period from January 1, 2009 through December 31, 2009.

Please call if you have any questions, comments or require additional information. The Penacook Lake is the primary water supply to the City of Concord and we want to ensure that it is not listed as an impaired water body. The lake and watershed is very well protected. It is representative of New Hampshire lakes in their natural state in the 21st century.

DES RESPONSE #1:

CHANGES MADE: DES appreciates the additional data with supporting metadata that was submitted March 12th 2010. The submitted data was found to be of sufficient quality for inclusion in the assessment process. Review of the data indicates 363 independent samples of which 22 (6.1 percent) have a pH of less than 6.5 and none were less than the pH magnitude of exceedence criteria of 5.5. Based on assessment of this data in accordance with the 2010 Consolidated Assessment and Listing Methodology (http://des.nh.gov/organization/divisions/water/wmb/swqa/documents/2010calm.pdf), the Assessment Unit for Penacook Lake is considered fully supporting for pH (i.e., category 2-M which means it marginally meets the pH criteria). Consequently, the Penacook Lake Assessment Unit is no longer shown as being impaired for pH on the 303(d) List

With regards to the statement "It is representative of New Hampshire lakes in their natural state in the 21st century" DES agrees that the pH levels in Penacook Lake appear to be typical of many other New Hampshire lakes. However, the 21st century condition does not qualify as "natural". The current condition represents the continued impact of acid deposition on New

Hampshire's landscape. The passage of the Clean Air Act Amendments in 1990 resulted in a decrease in sulfur dioxide emissions from in-state and out-of-state sources. This has resulted in a similar decline in sulfate deposition to the state and, to a lesser extent, a decline in sulfate concentrations in surface waters. Unfortunately, this has resulted in little, if any, improvement in the acidity or acid neutralizing capacity status of NH lakes. Computer model results for the Hubbard Brook Experimental Forest show that the 1990 Clean Air Act Amendments will have a positive effect on sulfate deposition but will not facilitate full recovery for acid-sensitive ecosystems in the Northeast. Deeper cuts in sulfur emissions (at least 80 percent beyond the 1990 Clean Air Act) will be needed for greater and faster recovery from acid deposition in the Northeast (Driscoll, C.T. et al. 2001. Acid Rain Revisited : Advances in scientific understanding since the passage of the 1970 and 1990 Clean Air Act Amendments. Hubbard Brook Research Foundation. Science Links:1(1)). So while Penacook Lake is considered fully supporting for pH, conditions are not truly natural and could be improved.

Robert Beaurivage, P.E., Assistant Director, Manchester Water Works

COMMENT #2:

> Relative to Lake Massabesic in Auburn, New Hampshire identified as Assessment Unit ID NHLAK700060702-03, Manchester Water Works is concerned with the designated use label of "primary contact recreation". Page 5 of the 303(d) of the 2010 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology document states that this definition applies to "waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water." Please find attached pages 51 and 52 of NHDES' Water Supply Watershed Rules that indicate that bathing, wading, swimming, water skiing or any similar water contact activity is prohibited on Lake Massabesic.
>
> In order to be consistent with NHDES Water Supply Watershed Rules and reflective of actual use, MWW would recommend the designated use for Lake Massabesic be revised to "drinking water supply after adequate treatment".

DES RESPONSE #2:

NO CHANGES MADE: As discussed in the 2010 Consolidated Assessment and Listing Methodology (http://des.nh.gov/organization/divisions/water/wmb/swqa/documents/2010calm.pdf) "designated uses" for all fresh surface waters (including Lake Massabesic) include

Aquatic Life,
Fish Consumption,
Drinking Water Supply After Adequate Treatment,

Primary Contact Recreation (i.e. swimming),
Secondary Contact Recreation, and
Wildlife .

These uses are based on State statute (RSA 485-A:8) and New Hampshire's surface water quality regulations (Env-Wq 1700).. Therefore, there are six designated uses for Lake Massabesic, one of which includes Drinking Water Supply After Adequate Treatment. The 303(d) List does not list all designated uses for each surface water; rather it only shows the designated uses that are impaired. Since the use of Drinking Water Supply After Adequate Treatment for Lake Massabesic is considered fully supporting (i.e., not impaired), it was not included on the 303(d) list of impaired waters.

With regards to removing designated uses, the process for doing so is described in Env-Wq 1709 of the surface water quality regulations. In general, one must first show that the use to be removed is not an existing use and then conduct a Use Attainability Analysis (UAA) in accord with 40 CFR Part 131. Since a UAA has not been completed and approved, the designated use of Primary Contact Recreation (i.e. swimming) must remain as a designated use for Lake Massabesic.

Adair Mulligan, Conservation Director, Connecticut River Joint Commissions

COMMENT #3:

1. NHLAK801040402-03…identified as "Wilder Lake, Lyme" is the Connecticut River where it is impounded behind Wilder Dam. This part of the Connecticut River was sampled in 2008 and 2009 in the course of the Connecticut River Tri-State Targeted Watershed Initiative, http://www.cesd.umass.edu/twi/index.html. Results indicated only one sampling event when *E.coli* could be considered an impairment to primary contact recreation. We would appreciate knowing the basis for the listing of this part of the Connecticut River.
2. We note that the reach of the Connecticut River from Lebanon to Cornish, which was previously considered impaired due to CSOs, does not appear on the draft 2010 list. We concur with this, as water quality monitoring through the above=mentioned program, designed to test impairment of this reach for recreation, turned up no concerns. However, the reach does not appear on the list of waters removed from the 2008 list.

DES RESPONSE #3:

NO CHANGES NECESSARY: The 2008 and 2009 data collected as part of the Connecticut River Tri-State Targeted Watershed Initiative was submitted and was included with additional data sources to make the 2010 assessment. The impairment determination was based upon the Escherichia coli geometric mean of 165.1 cts/100mL during the summer critical period in 2008. In Class B waters the numeric geometric mean criteria for Escherichia coli to protect primary *contact recreation (i.e. swimming) is 126 cts/100mL. In the table below, the underlined and BOLD values are those used to calculate the above mentioned geometric mean. BOLD values with an asterik are those that exceed either the Escherichia coli geometric mean criteria of 126 cts/100mL or the single sample criteria of 406 cts/100mL.*

DESCRIPTION OF COMPARISON	PROJECT*	STATION ID*	DATE~	E. coli (cts/100mL)
E.COLI-GEOMETRIC MEAN-CRITICAL PERIOD	na	na	8/18/2000	13.6
			9/13/2004	17.3
			8/21/2008	**165.1***
			8/20/2009	55.1
			9/3/2009	30.9
			9/10/2009	22.6
E.COLI, GEOMETRIC MEAN, NON-CRITICAL PERIOD	na	na	9/16/2008	117.4
E.COLI, GRAB SAMPLES, CRITICAL PERIOD	NHDES, AMBIENT RIVERS MONITORING PROJECT	30-CNT	6/21/2000	10
			7/31/2000	50
			8/18/2000	5
	NHDES COMPLAINT RESPONSE	01-CMP	6/23/2005	40
		30-CNT	6/23/2005	40
		33-CNT	6/23/2005	70
	CONNECTICUT RIVER INITIATIVE BACTERIA SAMPLING PROJECT	NHA7	7/25/2008	**188**
			8/7/2008	**520***
			8/21/2008	**46**
			6/22/2009	230
			7/9/2009	36
			7/16/2009	96
			7/23/2009	24
			7/30/2009	146
			8/8/2009	46
			8/20/2009	12
			9/3/2009	4
			9/10/2009	4
	VOLUNTEER RIVERS ASSESSMENT PROJECT (coordinated by NHDES)	30-CNT	6/1/2004	30
			7/28/2004	20
			8/3/2004	5
			8/18/2004	10
			9/13/2004	90
E.COLI, GRAB SAMPLES, NON-CRITICAL PERIOD	CONNECTICUT RIVER INITIATIVE BACTERIA SAMPLING PROJECT	NHA7	9/18/2008	30

** Geometric means are calculated from all data within an AU within a 60 day window. As such, no single station ID or project is valid.*

~ The date assigned to geometric means is the average date from the grab samples used to calculate the geometric mean.

With regards to the second comment, the assessment status for the reach of the Connecticut River from Lebanon to Cornish did not change from 2008 to 2010. Assessment Unit (AU) NHRIV801060302-05 defines the Connecticut River from the confluence with the Mascoma River downstream to the confluence with Blow-me-down Brook. This AU was assessed as impaired in 2008 and 2010 for primary contact recreation due to Escherichia coli from CSOs. However, this AU did not appear on the 2008 or 2010 303(d) list (which is a subset of all impaired waters) because it qualified for another list of impaired waters called Category 4B. The Category 4B list of impaired waters includes waters impaired or threatened for one or more designated uses but do not require the development of a TMDL because other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future. In this case the "other pollution control requirement" is an enforceable Consent Decree with EPA and DES that requires the City of Lebanon to eliminate their CSOs by separating their combined sewer system.

New Hampshire Department of Environmental Services, Internal Staff

COMMENT # 4:

Sediment toxicity data from of the "Final Draft Feasibility Study 13408B – Interstate 95 Bridge over the Taylor River (NHDOT No. 120/102 and Taylor River Pond Dam (NHDES No. 106.08/.09) Hampton Falls, Hampton NH [July 24, 2009]" was not used to assess the Taylor River Refuge Pond.

Based upon the Sediment toxicity data the Impoundment should be impaired.

DES RESPONSE #4:

CHANGES MADE: Data from the "Final Draft Feasibility Study 13408B" was not in the DES Environmental database (EMD) and DES assessors were not notified of the final draft study when the request for data was made on September 11, 2009. Consequently, this data was not accounted for in the 2010 Draft 303(d) List. DES has since assessed the sediment chemistry and toxicity data in the subject report in accordance with the 2010 Consolidated Assessment and Listing Methodology (http://des.nh.gov/organization/divisions/water/wmb/swqa/documents/2010calm.pdf) Based on this assessment, the Taylor River Impoundment ((NHLAK600031003-02) and the Rice Impoundment (NHIMP600031003-19) along the Taylor River, have been added to the 2010 303(d) list for the following impairments.

Taylor River Impoundment (NHLAK600031003-02) Impairments:

- *Sediment Toxicity Bioassays (station TR-S6)*
- *Sediment Chemistry*
  - *Metals*
    - *Arsenic (stations TR-S6, TR-S5)*
    - *Barium (station TR-S6)*
    - *Lead (station TR-S6)*
    - *Mercury (station TR-S6)*
    - *Nickel (station TR-S6)*
    - *Zinc (station TR-S6)*
  - *Pesticides*
    - *4-4'-DDD (station TR-S6)*
    - *4-4'-DDE (stations TR-S6, TR-S5)*
  - *Semi-Volatile Organic Compounds (SVOCs)*
    - *Anthracene (station TR-S6)*
    - *Pyrene (station TR-S6)*
    - *Benzo[b]fluoranthene (station TR-S6)*
    - *Benzo[k]fluoranthene (station TR-S6)*
    - *Benzo[a]pyrene (station TR-S6)*
    - *Indeno[1,2,3-cd]pyrene (station TR-S6)*

Rice Impoundment (NHIMP600031003-19) Impairments:

- *Sediment Toxicity Bioassays (stations TR-S11)*
- *Sediment Chemistry*
  - *Metals*
    - *Arsenic (station TR-S11)*
    - *Barium (station TR-S11)*
    - *Nickel (station TR-S11)*
    - *Zinc (station TR-S11)*
  - *Pesticides*
    - *4-4'-DDE (stations TR-S11)*
  - *Semi-Volatile Organic Compounds (SVOCs)*
    - *Benzo[b]fluoranthene (station TR-S11)*
    - *Benzo[k]fluoranthene (station TR-S11)*
    - *Benzo[a]pyrene (station TR-S11)*
    - *Indeno[1,2,3-cd]pyrene (station TR-S11)*

Miyoko Sakashita, Oceans Director, Staff Attorney, Center for Biological Diversity

COMMENT # 5:

Based on the scientific evidence provided by the Center for Biological Diversity (CBD), New Hampshire should list all ocean assessment units as impaired or threatened due to ocean acidification (i.e., the decrease in ocean pH caused by the uptake of atmospheric carbon dioxide) and create a TMDL under section 303(d) of the Clean Water Act.

New Hampshire's antidegradation policy Env-Wq 1708.01 dictates that, "Absent a finding by the Department that allowing lower water quality is necessary to accommodate important economic or social development following public notice and comment, such degradation of water quality shall not be permitted.

New Hampshire's marine pH standards included in Env-Wq 1703.18 are inadequate to protect aquatic life.

EPA has acknowledged the reach of the Clean Water Act to address ocean acidification (EPA 2009). Moreover, the EPA is taking steps that affirm states' duties and authorities to address ocean acidification under the Clean Water Act (See e.g. http://www.nytimes.com/gwire/2010/03/12/12greenwire-some-see-clean-water-act-settlementopening-new-4393.html).

(A CD with 31 reference documents was attached with the request.. The full text attached at the end of this document contains a list of the documents on the CD.)

DES RESPONSE #5:

NO CHANGES MADE: While the New Hampshire Department of Environmental Services (DES) agrees that ocean acidification is a global, long-term issue that warrants continued vigilance, DES does not believe it is appropriate at this time to list ocean water assessment units within New Hampshire's jurisdiction as either impaired or threatened due to ocean acidification per Section 303(d) of the Clean Water Act for the following reasons:

Surface water assessments are based on New Hampshire's water quality standards which are included in State statute (RSA 485-A:8) and regulation (Env-Wq 1700). New Hampshire's water quality standards have been approved by the US EPA (EPA). In New Hampshire, surface waters are classified as A or B with all marine waters being Class B. According to Env-Wq 1703.18 (b), "the pH for class B waters shall be 6.5 to 8.0, unless due to natural causes". Consequently, Class B surface waters are currently considered "acidic" if the pH falls below 6.5 unless naturally occurring. There are currently no ocean assessment units within the State's jurisdiction that are listed as impaired for low pH.

With regards to the adequacy of pH standards for marine waters, EPA is currently reviewing its aquatic life criterion for marine pH to determine if revisions are warranted. Their review is based on scientific information and data related to ocean acidification received in response to the Notice of Data Availability (NODA) included in the Federal Register notice of April 15, 2009 (Vol. 74, No. 71, page 17484). The public comment period for the NODA ended on June 15, 2009. It is DES' understanding that EPA will make a final decision by June 15, 2010. DES will *review EPA's final decision and, if deemed appropriate, will then recommend changes to its marine pH water quality standards in the future.*

After review of the information submitted by the CBD, DES is not aware of any evidence demonstrating local impairment of aquatic life due to ocean acidification in ocean waters under the jurisdiction of New Hampshire. With regards to listing these waters as threatened, the Consolidated Assessment and Listing Methodology (CALM) defines threatened waters as:

- *Waters which are expected to exceed water quality standards by the next listing cycle (every two years) and/or,*
- *Waters that do not have any measured in-stream violations but other data indicate the potential for water quality violations (such as calibrated predictive models or violations of NPDES permit effluent limits).*

Based on a DES' review of available information, including that submitted by the CBD, DES is not aware of any data or calibrated predictive models which indicates that New Hampshire's jurisdictional ocean water assessment units will violate New Hampshire's marine pH standards by the next listing cycle (every two years). Consequently, DES does not believe it is appropriate to list the New Hampshire's jurisdictional ocean water assessment units as threatened due to ocean acidification at this time.

Finally, in the March 22, 2010 Federal Register, EPA issued a call for public comment on Ocean Acidification as it relates to 303(d) listings including whether EPA should issue guidance regarding the listing of impaired waters as threatened or impaired for ocean acidification, and what that potential guidance might entail. EPA expects to make a decision by November 15, 2010. DES will review EPA's decision prior to making a decision on how to address ocean acidification in future 303(d) listings.

E. Tupper Kinder, Esquire, On behalf of the City of Portsmouth

COMMENT # 6:

"The City objects to the designation of certain assessment units as impaired for nitrogen and light attenuation. The basis of the objection has been previously discusses with NHDES. To preserve the City's rights the City reiterates it is concerned that NHDES has declared these designations without complying with administrative procedures and without reasonable scientific support."

DES RESPONSE #6:

NO CHANGES MADE: New Hampshire's surface water quality standards (WQSs) are specified in RSA 485-A and Env-Wq 1700, and include both numeric and narrative criteria, in accordance with the federal Clean Water Act. Prior to each assessment cycle, DES publishes *detailed guidance regarding how to apply the WQSs to specific assessment units for the purpose of making assessments. This guidance is called the Consolidated Assessment and Listing Methodology or CALM. In addition, DES publishes detailed guidance from time to time on the quantitative application of narrative WQSs. This was done for estuarine nutrient criteria in a document entitled "Numeric Nutrient Criteria for the Great Bay Estuary". This long-standing DES practice is completely consistent with the Clean Water Act, and with other states. Further, it is DES' obligation to interpret its own rules so that they can be applied in a consistent manner to specific situations; this is the purpose of the guidance documents.*

The assessments were made in strict accordance with the 2010 CALM which was issued for public comment on September 3rd, 2009. At that time only one comment was received on the "Numeric Nutrient Criteria for Great Bay" and that comment was affirming the sound science behind the methodology. (http://des.nh.gov/organization/divisions/water/wmb/swqa/documents/resp_comnts_draft_2010_calm.pdf)

Finally, the issues raised by the City and their agents (Applied Science Associates, Inc. (ASA) and Brown and Caldwell) have been discussed at length. The June 2009 Report "Numeric Nutrient Criteria for the Great Bay Estuary" includes the response to all science based comments including those provided by Applied Science Associates, Inc. (ASA) and Brown and Caldwell in May 2009 on the behalf of the City of Portsmouth. http://des.nh.gov/organization/divisions/water/wmb/wqs/documents/20090610_estuary_criteria.pdf (pgs 74-84).

B. SUMMARY OF SUBSTANTIVE DIFFERENCES BETWEEN THE DRAFT AND FINAL 2008 SECTION 303(D) LIST OF IMPAIRED SURFACE WATERS

TABLE 1: PARAMETER LEVEL SUBSTANTIVE CHANGES MADE TO ASSESSMENT UNITS (AUs)						
Assessment Unit ID	**Assessment Unit Name**	**Use Description**	**Impairment Name**	**Draft 303(d) DES Category**	**Final 303(d) DES Category**	**Parameter Comments**
NHLAK700060302-09	Penacook Lake	Aquatic Life Use	pH	5-M	2-M	Additional data provided in comments on the draft 303(d).
NHLAK600031003-02	Taylor River Impoundment	Aquatic Life Use	Arsenic	3-ND	5-M	Additional data provided in comments on the draft 303(d).
			Barium	3-ND	5-M	
			Lead	3-ND	5-M	
			Mercury	3-ND	5-M	
			Nickel	3-ND	5-M	
			Zinc	3-ND	5-M	
			4-4'-DDD	3-ND	5-M	
			4-4'-DDE	3-ND	5-M	
			Anthracene	3-ND	5-M	
			Pyrene	3-ND	5-M	
			Benzo[b]fluoranthene	3-ND	5-M	
			Benzo[k]fluoranthene	3-ND	5-M	
			Benzo[a]pyrene	3-ND	5-M	
			Indeno[1,2,3-cd]pyrene	3-ND	5-M	
NHIMP600031003-19	Rice Impoundment	Aquatic Life Use	Arsenic	3-ND	5-M	Additional data provided in comments on the draft 303(d).
			Barium	3-ND	5-M	
			Nickel	3-ND	5-M	
			Zinc	3-ND	5-M	
			4-4'-DDE	3-ND	5-M	
			Benzo[b]fluoranthene	3-ND	5-M	
			Benzo[k]fluoranthene	3-ND	5-M	
			Benzo[a]pyrene	3-ND	5-M	
			Indeno[1,2,3-cd]pyrene	3-ND	5-M	

TABLE 2: PARAMETER LEVEL SUBSTANTIVE CHANGES MADE DUE TO ASSESSMENT UNIT (AU) CHANGES						
Assessment Unit ID in Draft 303(d) (This is the AU that was deleted)	**Assessment Unit Name**	**Assessment Unit ID in Final 303(d) (This is the replacement AU)**	**Use Description**	**Impairment Name**	**Final 303(d) DES Category**	**Comments**
NHRIV700020110-03	Lake Waukewan Outlet	NHRIV700020109-06	Aquatic Life Use	pH	5-M	The old AUID was tagged with the wrong HUC12 at the core of its AUID. This is just a technical correction.
NHRIV700060906-24	Souhegan River	NHRIV700060906-18	Aquatic Life Use	pH	5-M	The old AUID was merged into the new AUID when impoundment NHIMP700060906-14 was physically removed from the Souhegan River. Data and impairments from the old AUID were applied to the new AUID.
				Aluminum	5-M	
NHRIV700060906-25	Souhegan River	NHRIV700060906-18	Primary Contact Recreation	*E. coli*	5-M	The old AUID was merged into the new AUID when impoundment NHIMP700060906-14 was physically removed from the Souhegan River. Data and impairments from the old AUID were applied to the new AUID.

TABLE 3: PARAMETER LEVEL CHANGES TO TMDL DATES						
Assessment Unit ID	**Assessment Unit Name**	**Designated Use**	**Impairment Name**	**TMDL Date in 2008 303(d)**	**Cycle First Listed**	**New TMDL Date for 2010 303(d)**
NHIMP600030603-01	Cocheco River – City Dam 1	Aquatic Life	Dissolved oxygen saturation	2008	2004	2017
			Oxygen, Dissolved	2008	2004	2017
NHRIV600030603-01	Cocheco River	Aquatic Life	Dissolved oxygen saturation	2008	2004	2017
			Oxygen, Dissolved	2008	2004	2017
NHIMP700030104-04	Contoocook River - Noone Mill Pond	Primary Contact	Chlorophyll-a	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
NHIMP700030104-08	Contoocook River - Transcript Printing Co Dam	Primary Contact	Chlorophyll-a	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
NHIMP700030104-12	Contoocook River – North Village Dam	Primary Contact	Chlorophyll-a	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2006	2019
NHLAK700030107-03	Powder Mill Pond, Hancock/Greenfield	Aquatic Life	Dissolved oxygen saturation	2007	2006	2019
			Oxygen, Dissolved	2007	2006	2019
		Primary Contact	Chlorophyll-a	2006	2006	2011
NHRIV700030101-16	Contoocook River	Primary	Chlorophyll-a	2006	2006	2019

TABLE 3: PARAMETER LEVEL CHANGES TO TMDL DATES

Assessment Unit ID	Assessment Unit Name	Designated Use	Impairment Name	TMDL Date in 2008 303(d)	Cycle First Listed	New TMDL Date for 2010 303(d)
		Contact				
			Phosphorus (Total)	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2006	2019
NHRIV700030101-17	Contoocook River	Primary Contact	Chlorophyll-a	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2006	2019
NHRIV700030104-03	Contoocook River	Primary Contact	Chlorophyll-a	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2004	2017
NHRIV700030104-12	Contoocook River	Primary Contact	Chlorophyll-a	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2006	2019
NHRIV700030104-16	Contoocook River	Primary Contact	Chlorophyll-a	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
		Aquatic Life	Dissolved oxygen saturation	2006	2006	2019
			Oxygen, Dissolved	2006	2006	2019
NHRIV700030104-17	Contoocook River	Primary Contact	Chlorophyll-a	2006	2006	2019
			Phosphorus (Total)	2006	2006	2019
NHRIV700030104-23	Contoocook River	Aquatic Life	Oxygen, Dissolved	2007	2006	2019
NHRIV700030108-15	Contoocook River	Aquatic Life	Dissolved oxygen saturation	2007	2004	2017
			Oxygen, Dissolved	2007	2004	2017
NHRIV700030108-23	Contoocook River	Aquatic Life	Oxygen, Dissolved	2007	2004	2017
NHIMP801060405-11	Sugar River	Aquatic Life	Oxygen, Dissolved	2007	2004	2017
NHIMP801060406-08	Sugar River	Aquatic Life	Oxygen, Dissolved	2007	2004	2017
NHRIV801060405-10	Sugar River	Aquatic Life	Oxygen, Dissolved	2007	2004	2017
NHRIV801060405-29	Sugar River	Aquatic Life	Oxygen, Dissolved	2007	2004	2017

TABLE 4: SUBSTANTIVE CHANGES MADE TO THE CONSOLIDATED ASSESSMENT AND LISTING METHODOLGY (CALM)
NO CHANGES WERE MADE.

City of Concord, New Hampshire
GENERAL SERVICES DEPARTMENT
311 N STATE STREET
CONCORD, NH 03301

PHILIP H. BILODEAU, P..E.
Deputy Director of General Services
(603) 228-2737

RECEIVED

MAR 15 2010

DEPARTMENT OF
ENVIRONMENTAL SERVICES

March 12, 2010

Ken Edwardson
NH DES, Water Quality Assessment Program Coordinator
PO Box 95, 29 Hazen Drive
Concord, NH 03302-0095

RE: Concord Public Water System
NH Draft 2010, 303(d) List of Impaired Surface Waters

Dear Mr. Edwardson:

This letter is a follow up to our telephone and e-mail conversations requesting to remove the Penacook Lake from the draft 2010, 303(d) list of impaired water bodies in the state.

As per your request for additional information, the following information is being submitted:

1. All pH water data represents the untreated Penacook lake water at the intake to the water treatment plant. We only take water samples for water entering the WTP.

2. I have enclosed and previously emailed you the daily pH data. The data represents the period from January 1, 2009 through December 31, 2009.

Please call if you have any questions, comments or require additional information. The Penacook Lake is the primary water supply to the City of Concord and we want to ensure that it is not listed as an impaired water body. The lake and watershed is very well protected. It is representative of New Hampshire lakes in their natural state in the 21st century.

Sincerely yours,

Philip H. Bilodeau

Philip H. Bilodeau, P.E.
Deputy Director
Concord general Services Department

Cc: Earle Chesley, P. E.

DATE	TIME	FILT	pH's									
			STD	BASIN 1	BASIN 2	BASIN 3	BASIN 4	FILT'D	RAW	CWI	DOM	Hi pH
1/1/2009	15:00	1	9.05	6.6	6.6	6.6	6.6	6.6	6.6	7.3	9.4	10.9
1/2/2009	13:00	2	5.98	6.5	6.5	6.5	6.4	6.5	6.4	7.3	9.3	10.8
1/3/2009	13:00	3	9.03	6.6	6.5	6.4	6.7	6.6	6.6	6.9	9.1	10.5
1/4/2009	13:30	4	5.97	6.5	6.5	6.5	6.5	6.6	6.5	6.8	9.3	10.9
1/5/2009	15:00	1	9.03/5.95	6.6	6.5	6.4	6.6	6.5	6.4	6.8	9.2	10.8
1/6/2009	8:00	2	6.00	6.5	6.6	6.7	6.5	6.6	6.5	7.3	9.3	10.8
1/7/2009	10;10	3	6.01	6.7	6.8	6.6	6.6	6.8	6.7	7.6	9.2	10.9
1/8/2009	14:00	4	5.97	6.7	6.6	6.7	6.8	6.7	6.6	7.6	9.2	10.8
1/9/2009	8:37	1	6.01	6.8	6.8	6.8	6.7	6.8	6.7	7.5	9.3	10.9
1/10/2009	11:00	2	9.02	6.9	6.9	6.9	6.8	6.9	6.8	7.6	8.9	10.8
1/11/2009	15:00	3	6.00	6.8	6.8	6.8	6.8	6.8	6.7	7.6	9.0	10.8
1/12/2009	12:45	4	9.00	6.7	6.6	6.6	6.7	6.5	6.4	7.8	9.1	10.8
1/13/2009	11:00	1	5.94	6.5	6.5	6.7	6.4	6.5	6.3	7.6	9.1	10.8
1/14/2009	13;00	2	9.00/5.93	6.6	6.6	6.5	6.6	6.7	6.6	7.5	9.0	10.7
1/15/2009	9:15	3	8.99/5.93	6.6	6.7	6.7	6.6	6.7	6.6	7.4	9.1	10.7
1/16/2009	9:30	4	5.94	6.6	6.6	6.5	6.6	6.6	6.5	7.5	8.8	10.7
1/17/2009	11:00	1	8.95	6.6	6.6	6.6	6.6	6.7	6.5	7.4	8.9	10.7
1/18/2009	16:00	2	5.96	6.6	6.7	6.6	6.6	6.7	6.6	7.4	9.0	10.7
1/19/2009	12:30	3	5.93	6.6	6.7	6.7	6.5	6.8	6.7	7.3	8.8	10.7
1/20/2009	12:00	4	5.96/9.03	6.4	5.4	6.3	6.4	6.5	6.5	7.1	9.3	10.8
1/21/2009	9:15	1	5.96/9.00	6.5	6.5	6.5	6.5	6.6	6.7	7.2	9.3	10.5
1/22/2009	09;00	2	9.00/5.98	6.5	6.5	6.5	6.5	6.5	6.4	7.3	9.5	10.7
1/23/2009	09;00	3	8.97/5.95	6.5	6.5	6.5	6.5	6.5	6.4	7.2	9.4	10.7
1/24/2009	13:00	4	5.96	6.7	6.7	6.7	6.6	6.7	6.4	7.5	9.4	10.7
1/25/2009	12:30	1	9.01	6.7	6.7	6.7	6.7	6.8	6.5	7.5	9.4	10.7
1/26/2009	11;44	2	9.01/5.97	6.8	6.7	6.7	6.7	6.6	6.5	7.2	9.5	10.7
1/27/2009	08;30	3	8.97	6.7	6.8	6.6	6.7	6.7	6.5	7.3	9.5	10.7
1/28/2009	16:00	4	5.97	6.8	6.8	6.8	6.8	6.7	6.6	7.4	9.5	10.7
1/29/2009	13;15	1	8.95/5.96	6.7	6.9	6.7	6.7	6.8	6.6	7.3	9.4	10.7
1/30/2009	09;30	3	8.95/5.96	6.7	6.7	6.7	6.8	6.7	6.5	7.3	9.5	
1/31/2009	11:00	4	5.96	6.6	6.6	6.7	6.7	6.7	6.6	7.3	9.5	10.6
2/1/2009	14:30	1	8.97	6.7	6.7	6.7	6.7	6.7	6.6	7.3	9.4	10.6
2/2/2009	14;30	2	9.03/5.99	6.7	6.7	6.7	6.7	6.7	6.6	7.6	9.5	10.7
2/3/2009	10:00	3	5.99	6.8	6.8	6.8	6.8	6.7	6.7	7.5	9.5	10.8
2/4/2009	12;06	4	9.07/6.01	6.8	6.8	6.8	6.8	6.8	6.6	7.5	9.5	10.8
2/5/2009	9:50	1	9.08/6.03	6.8	6.8	6.8	6.8	6.8	6.6	7.5	9.6	10.8
2/7/2009	13;49	2	9.08/6.00	6.6	6.6	6.6	6.6	6.6	6.6	7.3	9.5	10.7
2/8/2009	13:30	3	9.05	6.8	6.8	6.8	6.8	6.8	6.6	7.5	9.5	10.9
2/9/2009	14;30	4	9.03/5.98	6.6	6.7	6.7	6.7	6.7	6.5	7.2	9.5	10.8
2/10/2009	11;00	1	6.00	6.6	6.6	6.6	6.7	6.6	6.5	7.2	9.5	10.8
2/11/2009	10;50	2	9.07/6.01	6.8	6.8	6.8	6.8	6.7	6.5	7.4	*10.2	10.9
2/12/2009	11:30	3	6/9.05	6.7	6.7	6.7	6.7	6.8	6.6	7.4	9.5	10.8
2/13/2009	12;00	4	9.05/6.00	6.7	6.7	6.7	6.7	6.6	6.4	7.4	9.5	10.8
2/14/2009	12:30	1	5.99	6.8	6.7	6.7	6.7	6.6	6.6	7.4	9.6	10.9
2/15/2009	14:00	2	9.05	6.7	6.7	6.7	6.7	6.6	6.6	7.4	9.7	10.8
2/16/2009	14:30	3	6.01	6.7	6.7	6.7	6.7	6.8	6.6	7.3	9.5	10.8
2/17/2009	13;00	4	6.01/8.99	6.6	6.6	6.7	6.6	6.7	6.6	7.1	9.5	10.8
2/18/2009	12;18	1	9.03/6.02	6.7	6.7	6.7	6.7	6.7	6.6	7.3	9.5	10.8
2/19/2009	14:45	2	6.00	6.7	6.7	6.6	6.6	6.5	6.5	7.3	9.6	10.8
2/20/2009	13:00	3	9.03	6.7	6.6	6.7	6.7	6.7	6.5	7.3	9.6	10.5

2/21/2009	12:30	4	6.01	6.7	6.7	6.7	6.7	6.8	6.6	7.3	9.6	10.8
2/22/2009	16:30	1	9.04	*	*	6.7	*	6.8	6.6	7.2	9.4	10.8
2/23/2009	15:00	2	6.00	6.6	6.7	6.7	6.7	6.6	6.5	7.2	9.6	10.8
2/24/2009	09;03	3	9.05/6.01	6.7	6.7	6.7	6.7	6.7	6.5	7.2	9.6	10.8
2/25/2009	10:08	4	9.01/5.98	6.7	6.7	6.7	6.7	6.7	6.6	7.3	9.3	10.8
2/26/2009	11:28	1	8.99/5.97	6.7	6.7	6.7	6.7	6.5	6.5	7.4	9.4	10.8
2/27/2009	12:30	2	5.95/9.01	6.6	6.6	6.6	6.5	6.4	6.4	7.2	9.3	10.8
2/28/2009	11:00	3	5.95	6.6	6.8	6.5	6.7	6.5	6.4	7.2	9.3	10.7
3/1/2009	11:00	4	9.03	6.7	6.7	6.7	6.7	6.6	6.6	7.3	9.4	10.8
3/2/2009	10:15	1	8.96/5.98	6.5	6.6	6.6	6.6	6.6	6.4	7.2	9.2	10.7
3/3/2009	11:40	2	9.03/5.96	6.7	6.6	6.6	6.6	6.6	6.5	7.4	9.2	10.7
3/4/2009	11:30	3	9.06/5.99	6.6	6.6	6.6	6.6	6.5	6.5	7.4	9.3	10.8
3/5/2009	9:45	4	9.05/6.00	6.7	6.8	6.7	6.6	6.7	6.6	7.4	9.3	10.8
3/6/2009	13:00	1	6.00	6.5	6.7	6.6	6.7	6.6	6.5	7.4	9.1	10.8
3/7/2009	13:30	2	9.06	6.6	6.8	6.7	6.7	6.7	6.6	7.4	9.3	10.8
3/8/2009	16:00	3	5.99	6.7	6.7	6.7	6.7	6.8	6.6	7.6	9.3	10.8
3/9/2009	12:15	4	9.02/6.00	6.8	6.7	6.7	6.7	6.7	6.6	7.3	9.3	10.8
3/10/2009	11:45	1	9.04/5.99	6.6	6.7	6.7	6.5	6.6	6.4	7.1	9.3	10.8
3/11/2009	12:30	2	9.03/6.02	6.7	6.7	6.7	6.7	6.7	6.5	7.2	9.3	10.8
3/12/2009	15:00	3	9.04/6.01	6.8	6.8	6.8	6.8	6.80	6.6	7.10	9.3	10.70
3/13/2009	15:00	4	9.02/5.99	6.5	6.6	6.7	6.6	6.5	6.4	7.0	9.3	10.7
3/14/2009	10:30	1	5.98/9.02	6.7	6.8	6.6	6.8	6.6	6.4	7.2	9.2	10.8
3/15/2009	16:30	2	5.99/9.03	6.7	6.8	6.8	6.8	6.6	6.6	7.3	9.2	10.8
3/16/2009	13:30	3	5.97/9.00	6.5	6.6	6.5	6.6	6.5	6.5	7.3	9.2	10.7
3/17/2009	11:54	4	5.99	6.7	6.6	6.7	na	6.7	6.5	7.3	9.4	10.8
3/18/2009	13:30	1	5.95/9.01	6.7	6.7	6.6	6.6	6.5	6.5	7.3	9.2	10.8
3/19/2009	10:30	2	9.03	6.7	6.7	6.7	6.7	6.6	6.6	7.4	9.2	10.8
3/20/2009	0:00	3	5.96	6.7	6.8	6.6	6.7	6.8	6.5	7.4	9.3	10.8
3/21/2009	14:30	3	9.02	6.7	6.8	6.8	6.8	6.7	6.6	7.4	9.3	10.8
3/22/2009	13:45	4	5.97	6.6	6.6	6.7	6.6	6.5	6.5	7.2	9.5	10.8
3/23/2009	12:00	2	5.97/9.00	6.6	6.6	6.7	6.6	6.4	6.4	7.2	9.4	10.7
3/24/2009	11:30	3	6.02/9.06	6.8	6.9	6.8	6.7	6.6	6.6	7.7	9.3	10.8
3/25/2009	9:15	4	5.99/9.01	6.8	6.7	6.9	6.9	6.8	6.6	7.5	9.4	10.8
3/26/2009	12:15	1	5.95/9.02	6.6	6.7	6.8	6.8	6.5	6.5	7.3	9.3	10.8
3/27/2009	9:45	2	5.96/9.03	6.7	6.8	6.7	6.7	6.5	6.3	7.4	9.4	10.8
3/28/2009	15:00	3	5.98/9.03	6.8	6.8	6.7	6.8	6.6	6.5	7.3	9.4	10.8
3/29/2009	12:00	4	6.01/9.02	6.6	6.6	6.6	6.6	6.6	6.5	7.5	9.4	10.8
3/30/2009	13:00	1	5.98/9.02	6.6	6.7	6.6	6.5	6.6	6.5	7.7	9.4	10.7
3/31/2009	12:15	2	6.00/9.03	6.6	6.6	6.6	6.7	6.6	6.5	7.8	9.5	10.8
4/1/2009	9:00	3	5.98/9.02	6.6	6.7	6.7	6.6	6.6	6.4	7.5	9.1	10.7
4/2/2009	13:00	4	5.99/9.02	6.7	6.8	6.6	6.7	6.7	6.3	7.3	9.1	10.7
4/3/2009	12:15	1	5.97/9.02	6.6	6.6	6.7	6.7	6.5	6.3	7.3	9.2	10.7
4/4/2009	13:00	2	6/9.04	6.6	6.6	6.6	6.7	6.5	6.5	7.4	9.3	10.8
4/5/2009	15:00	3	5.99/9.03	6.6	6.7	6.7	6.7	6.6	6.5	7.5	9.3	10.8
4/6/2009	11:45	4	5.92/9.06	6.7	6.7	6.7	6.8	6.6	6.4	7.7	9.5	10.8
4/7/2009	8:30	1	5.99/9.06	6.8	6.8	6.8	6.7	6.7	6.5	7.6	9.3	10.9
4/8/2009	11:45	2	6.03/9.10	6.8	6.9	6.7	6.7	6.7	6.5	7.8	9.4	10.9
4/9/2009	15:00	3	6.03/9.04	6.8	6.9	7.0	7.0	7.0	6.7	7.8	9.2	10.9
4/10/2009	10:00	4	6.02/9.08	6.9	7.0	7.0	6.7	6.8	6.4	7.8	9.3	10.9
4/11/2009	13:30	1	6.01/9.07	7.3	7.2	6.7	6.8	7.5	6.6	8.0	9.3	10.9
4/12/2009	15:00	2	6.02/9.02	6.8	6.8	6.8	6.7	6.9	6.6	8.0*	9.3	10.9
4/13/2009	11:00	3	6.04/9.04	6.8	6.9	7.0	7.0	6.9	6.6	7.8	9.2	10.8
4/14/2009	15:30	4	6.05/9.05	6.7	6.7	6.9	6.9	6.6	6.7	7.6	9.2	10.9
4/15/2009	10:30	1	6.03/9.07	7.0	7.1	7.1	7.0	7.0	6.7	7.7	9.4	10.9
4/16/2009	16:30		9.05						6.6	7.5	9.2	
4/17/2009	11:55	2	5.95/9.01	6.8	6.8	6.8	6.9	6.9	6.7	7.5	9.1	10.8

4/18/2009	14:30	3	5.97/9.03	6.8	6.8	6.8	6.8	6.9	6.7	7.6	9.2	10.8
4/19/2009	14:00	4	5.99/9.03	6.7	6.7	6.8	6.8	6.9	6.7	7.5	9.3	10.8
4/20/2009	14:00	1	5.97/9.04	7.0	7.0	6.9	7.1	6.8	6.9	7.6	9.3	10.8
4/21/2009	9:30	2	5.98/9.05	6.8	6.8	6.7	6.5	6.5	6.6	7.5	9.3	10.8
4/22/2009	9:30	3	5.97/9.02	6.9	6.9	6.8	7.0	6.6	6.7	7.5	9.3	10.8
4/23/2009	12:00	4	5.98/9.03	6.8	6.8	6.8	6.8	6.8	6.8	7.6	9.3	10.8
4/24/2009	11:00	1	5.99/9.04	7.1	6.9	7.1	7.1	6.7	6.7	7.8	9.4	10.8
4/25/2009	10:00	2	5.95/9.06	6.9	6.9	6.9	6.8	6.6	6.7	7.6	9.3	10.8
4/26/2009	11:30	3	5.96/8.99	6.7	6.8	6.8	6.8	6.7	6.7	7.5	9.4	10.8
4/27/2009	14:30	4	5.97/9.02	6.8	6.8	6.8	6.8	6.8	6.7	7.5	9.3	10.8
4/28/2009	12:30	1	5.99/9.02	6.8	6.7	6.7	6.7	6.7	6.7	7.5	9.3	10.8
4/29/2009	14:45	2	5.99/9.03	6.8	6.8	6.9	6.8	6.6	6.7	7.7	9.5	10.8
4/30/2009	12:00	3	5.97/9.06	6.8	6.7	6.9	6.9	6.6	6.8	7.5	9.4	10.7
5/1/2009	15:00	4	6.00/9.05	6.8	6.9	6.7	6.8	6.6	6.8	7.4	9.2	10.7
5/2/2009	13:45	1	5.98/9.03	6.8	6.8	6.8	6.8	6.6	6.8	7.6	9.2	10.7
5/3/2009	14:30	2	5.98/9.02	6.8	6.8	6.7	6.8	6.6	6.8	7.6	9.2	10.7
5/4/2009	10:30	3	5.98/9.00	6.9	6.9	6.9	6.9	6.7	6.9	7.4	9.2	10.7
5/5/2009	10:40	4	6.02/9.06	6.8	6.8	6.9	6.9	6.6	6.7	7.5	9.5	10.7
5/6/2009	12:44	1	6.01/9.05	6.7	6.7	6.8	6.8	6.7	6.7	7.6	9.5	10.7
5/7/2009	12:15	2	5.98/9.05	6.7	6.6	6.5	6.5	6.4	6.6	7.4	9.4	10.7
5/8/2009	14:15	3	5.95/9.01	6.8	6.7	6.7	6.7	6.5	6.8	7.6	9.5	10.7
5/9/2009	14:30	4	5.94/8.99	6.6	6.6	6.6	6.6	6.4	6.6	7.3	9.4	10.6
5/10/2009	13:30	1	5.99/9.01	6.7	6.7	6.6	6.6	6.6	6.7	7.4	9.4	10.6
5/12/2009	12:00	2	5.95/8.96	6.7	6.7	6.7	6.7	6.6	6.7	7.3	9.4	10.6
5/13/2009	11:20	3	6.07/9.06	6.7	6.7	6.7	6.7	6.7	6.8	7.5	9.7	10.8
5/14/2009	9:15	4	6.08/9.14	6.7	6.8	6.8	6.7	6.7	6.8	7.5	9.1	10.8
5/15/2009	10:00	1	5.94/9.00	6.6	6.6	6.6	6.6	6.3	6.6	7.3	9.5	10.6
5/16/2009	15:00	2	5.96	6.7	7.0	6.4	6.5	6.7	6.9	7.2	9.5	10.5
5/17/2009	12:30	3	5.98/9.01	6.6	6.7	6.7	6.6	6.5	6.7	7.3	9.5	10.6
5/18/2009	16:00	4	6.00/9.03	6.7	6.9	6.7	6.7	6.6	6.7	7.3	9.7	10.6
5/19/2009	12:00	1	6.02/9.04	6.7	6.7	6.7	6.7	6.6	6.7	7.3	9.6	10.7
5/20/2009	14:00	2	5.98/9.01	6.8	6.7	6.6	6.7	6.4	6.7	7.3	9.6	10.6
5/21/2009	10:00	3	5.97/9.04	6.8	6.6	6.8	6.8	6.5	6.7	7.3	9.6	10.6
5/22/2009	12:00	4	5.99/9.05	6.5	6.6	6.7	6.7	6.5	6.6	7.3	9.5	10.7
5/23/2009	13:00	1	5.95/9.04	6.7	6.7	6.6	6.7	6.5	6.7	6.7	9.4	10.6
5/24/2009	13:00	2	5.96/8.97	6.7	6.8	6.8	6.8	6.5	6.6	7.3	9.6	10.6
5/25/2009	12:30	3	5.94/9.00	6.7	6.6	6.7	6.7	6.5	6.7	7.2	9.5	10.6
5/26/2009	13:30	4	5.96/9.00	6.5	6.5	6.5	6.5	6.6	6.7	7.4*	9.5	10.6
5/27/2009	10:50	1	5.97/9.00	6.7	6.7	6.7	6.6	6.5	6.6	7.5	9.5	10.6
5/28/2009	9:10	2	9.01/5.97	6.6	6.6	6.7	6.6	6.5	6.6	7.3	9.4	10.6
5/29/2009	12:30	3	5.95/8.97	6.5	6.5	6.6	6.6	6.5	6.6	7.3	9.4	10.6
5/30/2009	12:00	4	5.98/9.01	6.6	6.6	6.6	6.6	6.5	6.7	7.3	9.5	10.6
5/31/2009	11:30	1	6.00/9.01	6.6	6.6	6.6	6.6	6.7	6.8	7.3	9.6	10.6
6/1/2009	11:30	2	6.02/9.09	6.7	6.7	6.7	6.6	6.4	6.7	7.5	9.7	10.7
6/2/2009	11:15	3	6.01/9.07	6.8	6.7	6.7	6.7	6.4	6.7	7.5	9.6	10.7
6/3/2009	9:41	4	6.00/9.03	6.7	6.7	6.8	6.8	6.7	6.7	7.5	9.5	10.7
6/4/2009	12:30	1	5.99/9.01	6.7	6.8	6.6	6.6	6.5	6.7	7.5	9.5	10.6
6/5/2009	10:30	2	5.96/8.99	6.7	6.7	6.7	6.8	6.6	6.7	7.4	9.5	10.6
6/6/2009	13:30	3	5.99/9.00	6.7	6.6	6.7	6.7	6.6	6.8	7.5	9.5	10.6
6/7/2009	13:00	4	5.97/8.98	6.6	6.6	6.6	6.6	6.6	6.8	7.5	9.6	10.6
6/8/2009	9:30	1	5.97/9.00	6.8	6.8	6.7	6.7	6.6	6.7	7.4	9.5	10.7
6/9/2009	8:30	2	6.00/9.00	6.8	6.7	6.7	6.6	6.5	6.6	7.4	9.5	10.6
6/10/2009	9:00	3	5.98/9.01	6.6	6.6	6.6	6.5	6.5	6.4	7.3	9.5	10.6
6/11/2009	9:30	4	5.95/8.99	6.6	6.6	6.5	6.5	6.4	6.5	7.3	9.5	10.6
6/12/2009	10:00	1	5.92	6.5	6.6	6.6	6.4	6.3	6.5	7.3	9..5	10.5
6/13/2009	13:00	2	6.06/9.08	6.7	6.7	6.8	6.8	6.5	6.5	7.5	9.6	10.6

6/14/2009	11:30	3	6.11/9.10	6.7	6.8	6.7	6.7	6.6	6.7	7.5	9.7	10.6
6/15/2009	10:15	4	6.08/9.08	6.6	6.6	6.7	6.6	6.4	6.8	7.5	9.8	10.6
6/16/2009	8:30	1	6.05/9.08	6.6	6.6	6.7	6.6	6.4	6.7	7.5	9.7	10.6
6/17/2009	14:30	2	6.07/9.07	6.9	6.9	6.8	6.8	6.5	6.9	7.5	9.8	10.6
6/18/2009	9:00	3	6.04/9.06	6.7	6.7	6.7	6.8	6.5	6.8	7.5	9.8	10.6
6/19/2009	12:15	4	6.02/9.01	6.7	6.6	6.6	6.6	6.5	6.9	7.4	9.8	10.6
6/20/2009	12:30	1	5.95/8.96	6.7	6.8	6.8	6.8	6.6	6.8	7.3	9.5	10.5
6/21/2009	11:00	2	5.97/8.99	6.8	6.8	6.8	6.8	6.5	6.9	7.4	9.7	10.5
6/22/2009	9:00	3	5.95/9.00	na	na	na	na	6.5	6.8	7.6	9.7	10.5
6/22/2009	19:00	4		6.9	6.8	6.8	6.8	6.5	6.8	7.4	9.7	10.6
6/23/2009	8:00	1	5.92/8.97	6.6	6.6	6.6	6.5	6.4	6.6	7.3	9.8	10.5
6/24/2009	9:15	2	5.95/8.94	6.6	6.6	6.6	6.7	6.6	6.7	7.6	9.7	10.5
6/25/2009	9:30	3	5.98/8.98	6.7	6.6	6.7	6.7	6.6	6.8	7.6	9.7	10.5
6/26/2009	10:45	4	5.96/8.97	6.8	6.8	6.8	6.6	6.7	6.8	7.6	9.7	10.5
6/27/2009	12:30	1	5.95/8.96	6.9	6.7	6.7	6.7	6.6	6.8	7.6	9.6	10.5
6/28/2009	13:30	2	5.95/8.96	6.7	6.8	6.7	6.8	6.7	6.8	7.7	9.7	10.5
6/29/2009	11:00	3	5.91/8.96	6.7	6.7	6.8	6.7	6.7	6.7	7.6	9.6	10.5
6/30/2009	8:30	4	5.93/8.96	6.8	6.8	6.8	6.8	6.8	6.8	7.5	9.5	10.5
7/1/2009	10:00	1	5.91/8.98	6.8	6.8	6.8	6.8	6.7	6.8	7.4	9.6	10.5
7/2/2009	9:00	2	5.96/8.97	6.6	6.6	6.8	6.6	6.6	6.6	7.2	9.4	10.4
7/3/2009	12:30	3	5.94/8.93	6.7	6.7	6.7	6.7	6.7	6.8	7.1	9.2	10.5
7/4/2009	13:00	4	5.91/8.96	6.6	6.6	6.6	6.7	6.6	6.6	7.1	9.2	10.4
7/5/2009	9:00	1	5.93/8.95	6.6	6.6	6.6	6.6	6.6	6.8	7.1	9.2	10.4
7/6/2009	9:15	2	6.02/8.95	6.8	6.8	6.7	6.8	6.7	6.7	7.4	9.2	10.5
7/7/2009	13:43	3	5.98/8.97	6.6	6.7	6.7	6.7	6.6	6.7	7.3	9.2	10.4
7/8/2009	9:00	4	5.97/8.96	6.7	6.6	6.7	6.6	6.6	6.6	7.3	9.1	10.4
7/9/2009	9:06	1	5.96/8.95	6.6	6.6	6.7	6.6	6.5	6.6	7.2	9.0	10.4
7/10/2009	12:30	2	5.92/8.96	6.6	6.6	6.6	6.6	6.5	6.5	7.2	9.1	10.4
7/11/2009	15:00	3	5.94/8.96	6.7	6.7	6.7	6.7	6.6	6.7	7.2	9.0	10.5
7/12/2009	9:15	4	5.95/8/95	6.7	6.7	6.6	6.7	6.6	6.8	7.2	9.1	10.4
7/13/2009	12:00	1	5.97/8.96	6.8	6.8	6.8	6.8	6.7	6.8	7.1	9.1	10.4
7/14/2009	10:00	2	5.91/8.93	maint	6.7/6.6	6.6	6.6	6.6	6.7	7.1	9.1	10.4
7/15/2009	10:00	3	6.01/9.01	6.7	6.7	6.7	6.8	6.7	6.6	7.1	9.1	10.4
7/16/2009	9:30	4	6.00/9.03	6.7	6.7	6.7	6.6	6.6	6.8	7.1	9.2	10.4
7/17/2009	15:30	1	5.99/9.01	6.8	6.7	6.8	6.9	6.6	6.8	7.2	9.1	10.4
7/18/2009	13:30	2	6.01/9	6.9	6.7	7.0	7.0	6.7	6.8	7.2	9.2	10.4
7/19/2009	14:00	3	5.96/8.98	6.7	6.6	6.7	6.7	6.7	6.8	7.2	9.1	10.4
7/20/2009	9:30	4	5.96/8.97	6.7	6.7	6.7	6.8	6.6	6.7	7.2	9.1	10.4
7/21/2009	12:00	1	5.99/8.98	6.9	6.8	6.8	6.8	6.7	6.8	7.3	9.3	10.5
7/22/2009	8:00	2	5.99/9.02	6.8	6.7	6.8	6.7	6.7	6.7	7.2	9.2	10.4
7/23/2009	9:30	3	6.01/9.02	6.7	6.7	6.8	6.7	6.7	6.7	7.1	9.2	10.4
7/24/2009	0800-11	4	5.98/9.00	6.6	6.6	6.6	6.6	6.6	6.6	7.2	9.3	10.5
7/25/2009	15:00	1	5.98/9.00	6.7	6.7	6.7	6.7	6.5	6.6	7.2	9.2	10.4
7/26/2009	16:00	2	5.97/8.97	6.7	6.7	6.7	6.7	6.5	6.6	7.2	9.2	10.4
7/27/2009	0800-1030	3	5.97/8.98	6.6	6.6	6.6	6.7	6.5	6.7	7.3	9.2	10.5
7/28/2009	8:50	4	6.01/9.06	6.8	6.8	6.8	6.8	6.6	6.8	7.2	9.3	10.5
7/29/2009	9:00	1	6.00/9.01	6.8	6.7	6.7	6.8	6.7	6.8	7.2	9.3	10.4
7/30/2009	8:00	2	6.00/9.03	6.7	6.7	6.8	6.8	6.7	6.8	7.1	9.0	10.4
7/31/2009	0845-1130	3	5.98/9.02	6.7	6.7	6.7	6.7	6.6	6.7	7.2	9.1	10.4
8/1/2009	8:50	4	5.99/9.01	6.6	6.7	6.7	6.7	6.6	6.7	7.1	9.1	10.4
8/2/2009	13:00	1	6.02/8.99	6.7	6.7	6.7	6.7	6.6	6.7	7.1	9.0	10.4
8/3/2009	7:50	2	5.95/8.98	6.7	6.7	6.7	6.7	6.6	6.7	7.2	9.0	10.4
8/4/2009	8:30	3	5.99/9.04	6.7	6.7	6.7	6.7	6.6	6.7	7.3	9.0	10.4
8/5/2009	8:30	4	6.00/9.02	6.7	6.8	6.8	6.8	6.6	6.8	7.2	9.0	10.4
8/6/2009	8:45	2	5.97/8.98	6.7	6.7	6.7	6.7	6.6	6.7	7.2	9.1	10.4
8/7/2009	9:30	3	5.97/9.01	6.6	6.7	6.7	6.7	6.5	6.6	7.2	9.1	10.4
8/8/2009	11:00	4	6/9.01	6.7	6.7	6.7	6.7	6.6	6.7	7.2	9.1	10.4

8/9/2009	13:00	1	5.99/8.95	6.7	6.7	6.7	6.7	6.6	6.7	7.2	9.1	10.4
8/10/2009	10:20	2	5.97/8.96	6.6	6.6	6.6	6.6	6.5	6.6	7.2	9.0	10.3
8/11/2009	12:45	3	5.97/8.95	6.8	6.8	6.8	6.8	6.7	6.8	7.2	9.0	10.4
8/12/2009	13:45	4	5.97/8.95	6.6	6.6	6.7	6.7	6.6	6.6	7.3	9.0	10.3
8/13/2009	10:00	1	5.99/8.99	6.7	6.7	6.7	6.7	6.6	6.6	7.3	9.0	10.3
8/14/2009	8:00	2	5.99/8.96	6.7	6.7	6.7	6.7	6.5	6.7	7.2	9.0	10.4
8/15/2009	12:30	3	5.95/9	6.6	6.7	6.7	6.7	6.7	6.7	7.3	9.0	10.4
8/16/2009	12:45	4	5.96/8.95	6.7	6.7	6.7	6.7	6.7	6.8	7.2	9.0	10.4
8/17/2009	9:15	1	5.96/8.99	6.7	6.7	6.8	6.8	6.7	6.7	7.1	8.9	10.3
8/18/2009	12:00	2	5.98/9.04	6.8	6.8	6.8	6.8	6.6	6.7	7.4	9.1	10.4
8/19/2009	10:00	3	5.99/8.98	6.8	6.8	6.8	6.7	6.7	6.8	7.2	8.9	10.4
8/20/2009	10:20	4	5.98/8.96	6.8	6.8	6.8	6.8	6.7	6.8	7.2	9.1	10.4
8/21/2009	11:15	1	5.95/8.99	6.7	6.7	6.7	6.7	6.6	6.7	7.4	9.4	10.4
8/22/2009	12:30	2	5.96/9.02	6.7	6.6	6.7	6.7	6.6	6.7	7.3	9.3	10.3
8/23/2009	9:00	3	5.95/8.97	6.7	6.7	6.7	6.7	6.6	6.7	7.1	9.5	10.4
8/24/2009	9:00	4	5.99/9.03	6.6	6.6	6.6	6.6	6.6	6.6	7.5	9.5	10.4
8/25/2009	8:00	1	5.98/9.04	6.6	6.7	6.7	6.7	6.6	6.7	7.4	9.4	10.3
8/26/2009	9:00	2	5.97/9.04	6.6	6.7	6.7	6.7	na	6.7	7.1	9.5	10.3
8/27/2009	10:30	3	5.99/8.99	6.7	6.7	6.7	6.7	na	6.7	7.3	9.6	10.4
8/28/2009	11:30	4	5.95/9.03	6.5	6.6	6.6	6.6	6.6	6.6	7.3	9.6	10.4
8/29/2009	13:00	1	5.98/9.03	6.7	6.6	6.6	6.6	6.6	6.8	7.2	9.5	10.1
8/30/2009	13:00	2	5.97/8.97	6.6	6.6	6.6	6.6	6.6	6.7	7.3	9.6	10.4
8/31/2009	11:00	3	5.98/9.06	6.7	6.8	6.8	6.7	6.6	6.8	7.2	9.6	10.3
9/1/2009	12:45	4	5.97/9.03	6.6	6.5	6.5	6.6	6.6	6.7	7.1	9.4	10.4
9/2/2009	13:16	1	5.98/9.02	6.6	6.6	6.6	6.6	6.6	6.6	7.1	9.4	10.4
9/3/2009	8:30	2	5.99/9.00	6.7	6.7	6.8	6.8	6.6	6.6	7.2	9.4	10.4
9/4/2009	12:00	3	5.97/8.99	6.6	6.7	6.7	6.7	6.6	6.7	7.5	9.5	10.4
9/5/2009	8:30	4	5.99/9.01	6.8	6.8	6.8	6.8	6.7	6.8	7.2	9.5	10.3
9/6/2009	12:00	1	5.98/9.00	6.7	6.7	6.7	6.7	6.6	6.8	7.2	9.4	10.4
9/7/2009	12:40	2	6.00/9.01	6.7	6.7	6.7	6.7	6.6	6.6	7.2	9.4	10.4
9/8/2009	11:00	3	5.97/9.01	6.6	6.7	6.7	6.6	6.6	6.6	7.2	9.4	10.4
9/9/2009	9:00	4	6.01/9.02	6.6	6.7	6.8	6.8	6.8	6.8	7.2	9.3	10.4
9/10/2009	10:30	1	5.98/8.98	6.8	6.8	6.8	6.8	6.8	6.8	7.2	9.4	10.4
9/11/2009	9:30	3	5.98/9.01	6.6	6.6	6.6	6.6	6.7	6.6	7.3	9.3	10.4
9/12/2009	12:00	4	5.96/9.0	6.6	6.6	6.6	6.6	6.6	6.6	7.1	9.3	10.4
9/13/2009	8:00	1	5.98/9.00	6.6	6.6	6.6	6.6	6.6	6.7	7.1	9.3	10.4
9/14/2009	10:30	3	5.99/9.03	6.6	6.6	6.6	6.6	6.6	6.7	7.3	9.3	10.5
9/15/2009	11:15	4	5.99/9.02	6.5	6.5	6.5	6.5	6.6	6.5	7.4	9.3	10.5
9/16/2009	10:10	1	5.97/9.02	6.6	6.6	6.6	6.6	6.6	6.6	7.2	9.3	10.5
9/17/2009	8:00	3	5.96/9.04	6.7	6.8	6.8	6.8	6.6	6.5	7.3	9.2	10.4
9/18/2009	1100/1330	4	5.96/9.00	6.7	6.7	6.6	6.6	6.4	6.6	7.3	9.3	10.5
9/19/2009	9:00	1	5.97/9.01	6.7	6.7	6.7	6.7	6.5	6.6	7.2	9.2	10.5
9/20/2009	11:00	3	5.97/9.00	6.8	6.8	6.7	6.7	6.6	6.8	7.2	9.3	10.5
9/21/2009	15:00	4	5,97/9.01	6.7	6.7	6.7	6.7	6.6	6.6	7.3	9.2	10.5
9/22/2009	8:30	1	6.02/9.03	6.6	6.7	6.7	6.8	6.7	6.8	7.4	9.3	10.5
9/23/2009	8:30	2	5.95/9.01	6.8	6.8	6.8	6.8	6.7	6.8	7.6	9.3	10.3
9/24/2009	8:00	3	5.96/9.05	6.8	6.8	6.9	6.8	6.8	6.8	7.3	9.3	10.5
9/25/2009	0900/1300	4	5.99/9.05	6.8	6.7	6.7	6.7	6.8	6.8	7.3	9.4	10.5
9/26/2009	9:30	1	5.96/9.04	6.8	6.8	6.8	6.9	6.7	6.8	7.2	9.4	10.2
9/27/2009	16:30	2	6.01/8.98	6.8	6.8	6.8	6.8	6.7	6.8	7.2	9.4	10.5
9/28/2009	10:00	3	6.00/9.03	6.7	6.8	6.8	6.7	6.7	6.7	7.1	9.3	10.5
9/29/2009	10:45	4	6.01/9.03	6.8	6.8	6.8	6.8	6.7	6.7	7.1	9.3	10.5
9/30/2009	9:00	1	6.03/9.06	6.8	6.8	6.9	6.9	6.7	6.7	7.3	9.3	10.5
10/1/2009	10:45	2	6.02/9.06	6.7	6.7	6.8	6.8	6.7	6.7	7.2	9.3	10.5
10/2/2009	)8:00/11:0(	3	5.99/9.08	6.7	6.7	6.7	6.7	6.7	6.7	7.4	9.4	10.6
10/3/2009	9:30	4	5.96/9.09	6.8	6.8	6.8	6.8	6.7	6.7	7.4	9.3	10.6
10/4/2009	13:30	1	6.02/8.99	6.8	6.8	6.8	6.8	6.8	6.7	7.1	9.1	10.5

10/5/2009	10:00	2	6.00/9.01	6.7	6.7	6.8	6.8	6.7	6.8	7.2	9.2	10.5
10/6/2009	13:30	3	6.03/9.01	6.8	6.8	6.9	6.9	6.8	6.7	7.4	9.3	10.5
10/7/2009	12:30	4	6.00/9.03	6.7	6.7	6.7	6.7	6.7	6.7	7.2	9.2	10.5
10/8/2009	10:30	1	6.04/9.03	6.8	6.8	6.8	6.8	6.8	6.8	7.1	9.2	10.5
10/9/2009	0930/1300	2	5.96/9.02	6.7	6.7	6.8	6.8	6.8	6.8	7.2	9.3	10.5
10/10/2009	9:30	3	6.02/9.03	6.8	6.8	6.8	6.8	6.8	6.7	7.1	9.1	10.5
10/11/2009	9:00	4	6.04/9.04	6.8	6.8	6.8	6.8	6.8	6.7	7.0	9.2	10.5
10/12/2009	12:00	1	5.95/9.04	6.7	6.8	6.8	6.8	6.7	6.8	7.1	9.2	10.5
10/13/2009	9:00	2	5.95/9.05	6.7	6.8	6.8	6.8	6.7	6.8	7.1	9.2	10.5
10/14/2009	10:15	3	6.06/9.05	6.8	6.8	6.8	6.8	6.8	6.8	7.0	9.1	10.5
10/15/2009	13:00	4	6.02	6.8	6.8	6.8	6.8	6.8	6.7	7.1	9.0	10.6
10/16/2009	0930/1130	1	6.05/9.04	6.7	6.7	6.7	6.6	6.6	6.7	7.1	9.0	10.6
10/17/2009	9:15	2	6.02/9.06	6.8	6.8	6.8	6.8	6.7	6.8	7.1	9.1	10.6
10/18/2009	11:45	3	6.00/8.96	6.8	6.7	6.7	6.7	6.7	6.7	7.1	9.0	10.6
10/19/2009	10:30	4	6.05/9.00	6.8	6.8	6.8	6.8	6.7	6.7	7.0	9.0	10.6
10/20/2009	10:30	1	6.02/9.03	6.8	6.9	6.8	6.8	6.8	6.8	7.4	9.1	10.6
10/21/2009	11:30	2	5.99/9.09	6.8	6.8	6.8	6.8	6.8	6.8	7.1	9.2	10.6
10/22/2009	10:45	3	5.98/8.98	6.8	6.8	6.8	6.8	6.8	6.8	7.0	9.0	10.6
10/23/2009	0:00	4	5.99/9.02	6.7	6.7	6.7	6.7	6.7	6.7	7.0	9.2	10.6
10/24/2009	11:00	1	5.96/9.05	6.7	6.7	6.8	6.7	6.7	6.7	7.0	9.1	10.6
10/25/2009	12:00	2	6.03/8.99	6.7	6.7	6.7	6.7	6.7	6.7	7.1	9.2	10.6
10/26/2009	10:50	3	6.05/na	6.7	6.7	6.7	6.7	6.6	6.7	7.0	9.1	10.6
10/27/2009	10:30	4	5.98	6.7	6.7	6.7	6.7	6.6	6.8	7.2	9.0	10.6
10/28/2009	8:30	1	5.96	6.7	6.7	6.7	6.8	6.6	6.7	7.1	9.1	10.6
10/29/2009	8:30	2	6.04	6.7	6.7	6.7	6.7	6.7	6.8	7.0	9.1	10.6
10/30/2009	0:00/12:3(	3	6.06	6.8	6.7	6.7	6.6	6.6	6.7	7.1	9.2	10.6
10/31/2009	12:30	4	5.95	6.7	6.6	6.6	6.7	6.6	6.7	7.0	9.1	10.6
11/1/2009	9:00	1	5.96	6.7	6.7	6.7	6.7	6.6	6.7	7.1	9.2	10.6*
11/2/2009	12:30	2	6.02	6.6	6.6	6.6	6.7	6.5	6.6	7.1	9.1	10.6
11/3/2009	9:00	3	5.95	6.6	6.6	6.6	6.6	6.5	6.7	7.0	9.2	10.6
11/4/2009	11:45	4	6.01	6.7	6.7	6.7	6.7	6.6	6.7	7.0	9.2	10.6
11/5/2009	9:50	1	6.04/9.03	6.6	6.7	6.7	6.7	6.6	6.7	7.0	9.1	10.6
11/6/2009	15:30	2	5.99/9.00	6.6	6.6	6.6	6.6	6.7	6.6	7.0	9.0	10.6
11/7/2009	9:30	3	5.95/9.04	6.7	6.7	6.6	6.7	6.6	6.7	7.0	9.2	10.5
11/8/2009	8:30	4	6.00/8.99	6.7	6.7	6.7	6.7	6.6	6.7	7.0	9.1	10.6
11/9/2009	11:00	1	5.96/9.02	6.7	6.8	6.8	6.8	6.7	6.8	7.0	9.1	10.6
11/10/2009	8:30	2	5.98/9.05	6.6	6.7	6.7	6.7	6.6	6.7	6.9	9.1	10.6
11/11/2009	8:00	3	5.98/9.03	6.7	-	-	-	6.7	6.8	7.0	9.2	10.7
11/12/2009	8:30	4	5.95/9.05	-	-	-	6.8	6.6	6.6	6.9	9.1	10.6
11/13/2009	9:15	1	5.98/9.04	_	6.5	6.6	_	6.6	6.7	7.0	9.2	10.7
11/14/2009	9:30	2	5.95/9.03		6.6			6.6	6.7	7.0	9.1	10.7
11/15/2009	9:00	3	5.98/9.04		6.6			6.7	6.7	7.1	9.1	10.7
11/16/2009	13:00	4	6.03/9.03		6.7			6.7	6.7	7.0	9.1	10.7
11/17/2009	8:30	1	5.95/9.05				6.7	6.7	6.7	7.0	9.2	10.7
11/18/2009	13:15	2	5.95/9.06	6.6				6.6	6.6	7.1	9.1	10.7
11/19/2009	10:00	3	5.96/9.01		6.7			6.6	6.7	7.0	8.7*	10.6
11/20/2009	9:45	4	5.97/8.99			6.6		6.5	6.6	7.0	8.9	10.7
11/21/2009	12:30	1	5.94/9.03	6.6				6.6	6.6	7.0	8.9	10.7
11/22/2009	9:00	2	5.97/9.00		6.7			6.7	6.7	7.0	8.9	10.7
11/23/2009	11:00	3	5.98/9.03		6.7			6.6	6.7	7.0	8.9	10.7
11/24/2009	12:15	4	6.02/9.03					6.7	6.7	7.2	9.0	10.7
11/25/2009	11:00	1	5.92/9.03					6.6	6.5	7.1	9.3	10.6
11/26/2009	8:45	2	6.01/9.06					6.5	6.6	7.7	9.2	10.7
11/27/2009	8:30	3	5.98/9.07					6.5	6.6	7.1	9.2	10.7
11/28/2009	9:00	4	6.03/9.08					6.6	6.7	7.4*	9.2	10.8
11/29/2009	10:00	1	6.06/9.03					6.7	6.7	7.1	9.3	10.8
11/30/2009	9:45	2	6.05/9.07					6.5	6.7	7.1	9.2	10.7

12/1/2009	8:30	3	5.96/9.01					6.5	6.6	7.2	9.1	10.8
12/2/2009	8:30	4	6.01/9.06					6.7	6.7	7.4	9.3	10.8
12/3/2009	8:30	1	5.95/9.04					6.7	6.7	7.4	9.2	10.8
12/4/2009	9:30	2	5.98/9.05					6.7	6.7	7.4	9.3	10.8
12/5/2009	13:00	3	5.99/9.07					6.7	6.8	7.2	9.2	10.7
12/6/2009	9:00	4	6.03/9.05					6.7	6.8	7.2	9.3	10.8
12/7/2009	10:15	1	6.01/9.03					6.7	6.7	7.1	9.2	10.7
12/8/2009	13:00	2	6.04/8.99					6.7	6.7	7.2	9.2	10.8
12/9/2009	16:30	3	5.95/9.04					6.7	6.7	7.2	9.2	10.8
12/10/2009	10:15	4	6.02/9.04					6.7	6.7	7.2	9.2	10.8
12/11/2009	11:00	1	5.95/9.02					6.6	6.7	7.3	9.5	10.8
12/12/2009	9:45	2	5.95/9.03					6.7	6.6	7.3	9.2	10.8
12/13/2009	10:00	3	6.04/8.97					6.7	6.7	7.2	9.2	10.8
12/14/2009	13:00	4	6.02/8.98					6.5	6.6	7.2	9.0	10.8
12/15/2009	8:30	1	5.95/9.05					6.5	6.6	7.1	9.0	10.8
12/16/2009	9:45	2	6.04/9.05					6.6	6.7	7.3	9.2	10.8
12/17/2009	8:30	3	5.95/9.05					6.6	6.6	7.2	9.1	10.7
12/18/2009	11:00	4	5.95/9.02					6.5	6.6	7.2	9.2	10.8
12/19/2009	9:30	1	5.94/9.04					6.5	6.6	7.1	9.0	10.7
12/20/2009	8:30	2	6.01/8.99					6.5	6.6	7.1	9.1	10.8
12/21/2009	10:00	3	5.96/9.03					6.6	6.6	7.2	9.2	10.8
12/22/2009	12:45	4	5.99/9.02					6.6	6.6	7.1	10.0*	10.7*
12/23/2009	8:30	1	5.96/9.04					6.6	6.7	7.2	9.1	10.7
12/24/2009	9:00	2	5.96/9.04					6.7	6.6	7.2	8.9	10.7
12/25/2009	12:00	3	5.99/9.06					6.7	6.7	7.1	9.2	10.8
12/26/2009	9:30	4	6.05/9.03					6.8	6.8	7.1	9.2	10.8
12/27/2009	9:15	1	6.03/8.97					6.7	6.7	7.2	9.2	10.8
12/28/2009	10:00	2	6.01/9.04					6.7	6.7	7.1	9.2	10.8
12/29/2009	8:30	3	5.95/9.05					6.8	6.7	7.1	9.2	10.8
12/30/2009	9:45	4	6.00/9.03					6.6	6.7	7.1	9.0	10.8
12/31/2009	12:30	1	6.00/9.01					6.5	6.6	7.1	9.0	10.8

CITY OF MANCHESTER INCORPORATED JUNE 1846

MANCHESTER WATER WORKS

281 LINCOLN ST., MANCHESTER, NEW HAMPSHIRE 03103-5093 Tel. (603) 624-6494

February 25, 2010

2010, 303(d) Comments
Attention: Mr. Ken Edwardson
NH Dept. of Environmental Services
Watershed Management Bureau
PO Box 95
Concord, NH 03302-0095

RE: COMMENTS ON DRAFT 2010, 303(D) LIST OF IMPAIRED SURFACE WATERS

Dear Mr. Edwardson:

Relative to Lake Massabesic in Auburn, New Hampshire identified as Assessment Unit ID NHLAK700060702-03, Manchester Water Works is concerned with the designated use label of "primary contact recreation". Page 5 of the 303(d) of the 2010 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology document states that this definition applies to "waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water." Please find attached pages 51 and 52 of NHDES' Water Supply Watershed Rules that indicate that bathing, wading, swimming, water skiing or any similar water contact activity is prohibited on Lake Massabesic.

In order to be consistent with NHDES Water Supply Watershed Rules and reflective of actual use, MWW would recommend the designated use for Lake Massabesic be revised to "drinking water supply after adequate treatment".

Thank you for the opportunity to comment on this list of impaired surface waters, and please contact me should you have any questions.

Sincerely,

Robert Beaurivage

Robert Beaurivage, P.E.
Assistant Director

RB:ds

cc: Thomas Bowen
David Paris
Harry Stewart, NHDES

(g) Where any provision of this section is in conflict with local ordinances, the more stringent provision shall apply.

(h) Waivers and exemptions to this section shall apply as follows:

(1) Any person may request from the department a waiver from the provisions of this section in accordance with Env-Ws 386.04; and

(2) Employees of the board of water commissioners engaged in the performance of necessary duties for the protection and control of Lake Massabesic, its tributaries, and its watershed shall be exempt from the provisions of this section.

(i) The Manchester Water Works shall post a summary of the information contained in (d), above and the prohibitions and restrictions contained in (l), (m), (o) through (q), (s), and (t), below in locations where persons might reasonably be expected to access Manchester Water Works' property, or Lake Massabesic or its tributaries. The posted summary may also contain any other prohibitions contained in this section and any prohibitions or restrictions enacted by local ordinance.

(j) Within 200 feet of Lake Massabesic or any pond, reservoir, or stream tributary thereto, a person shall not build any privy, pigpen, stable, or other buildings or structure in which horses, cattle, swine or other animals or fowl are kept.

(k) Within 200 feet of Lake Massabesic or Tower Hill Pond, the following provisions shall apply:

(1) A person shall not build any privy, toilet, sink drain, or subsurface septic disposal system or allow any discharges therefrom, except as provided by (k)(2) below;

(2) Existing properly functioning septic systems may remain in place; and

(3) If failure of an existing septic system occurs, the owner shall repair or replace said system in accordance with Env-Ws 1003.10.

(l) With the exception of operating an outboard motor, on or within 200 feet of the waters or ice of Lake Massabesic or any pond, reservoir, or stream tributary thereto, a person shall not:

(1) Deposit any dead animal or parts thereof, food or any article perishable or decayable, kitchen waste, swill, garbage, or human waste;

(2) Deposit any hazardous waste, as defined in Env-Wm 110.01(b)(56), such as solid, semi-solid, liquid or contained gaseous waste, or any combination of wastes which possess a threat to human health or the environment;

(3) Deposit solid waste such as refuse, appliances, auto parts, tires, tree stumps, or similar waste; or

(4) Deposit manure, fertilizer, or chemical waste such as gasoline, paint, or similar waste.

(m) On or within the water or ice of Lake Massabesic or any pond, reservoir, or stream tributary thereto the following prohibitions and restrictions shall apply:

(1) A person shall not bathe, wade, swim, water ski or perform any similar water contact activity;

(2) A person shall not use a sunfish, sailfish, sail board, ski craft as defined in RSA 270:73, V, or other craft which in the judgment of the board of water commissioners or its representatives makes extensive bodily contact with the water unavoidable;

(3) A person shall not discharge from or off a vessel, cruiser, boat, houseboat, wharf or from a structure of any kind or any tank or receptacle thereon or therein contained, any excrement, urine, or waste;

(4) All boats or structures of any kind that are equipped with toilet, lavatory, or other sewage or waste producing fixtures shall be provided with water-tight tanks or receptacles for the reception and temporary storage of such wastes;

(5) The aforementioned tanks or receptacles shall be maintained as required in RSA 487:2 and the contents thereof shall be disposed of in a municipal sewage system or to any adequate sewage disposal system on shore;

(6) A person shall not tie, beach, or ground an occupied vessel, cruiser, boat, houseboat, or structure of any kind to the water or ice, or tie to the shore for an overnight period or any part of an overnight period, except as permitted by Manchester Water Works pursuant to (t)(4) or (t)(5), below;

(7) An unoccupied vessel, cruiser, boat, houseboat, or structure of any kind may be anchored or grounded to said waters or ice only by permission of the board of water commissioners pursuant to (t)(4) or (t)(5), below or land owner, lessee, or person otherwise in control of such location;

(8) A person shall not cut or take ice therefrom except by permission and under the direction of the board of water commissioners as provided for in RSA 485:54; and

(9) A person shall not use any aircraft.

(n) In the Lake Massabesic watershed, the following prohibitions or restrictions shall apply:

(1) A person shall conduct all pesticide applications, as defined in RSA 430, in strict accordance with the rules of the New Hampshire pesticide control board;

(2) A person shall conduct all forestry or timber harvesting activities in strict accordance with state of New Hampshire laws including RSA 227-J and in consultation with the Manchester Water Works forester, and

(3) A person shall handle any agricultural compost, chemical fertilizer, or manure, as defined in RSA 431:33, in accordance with best management practices published by the New Hampshire department of agriculture, markets, and food in accordance with RSA 431:34.

(o) In or on Manchester Water Works' property or the waters or ice of Lake Massabesic or any pond, reservoir, or stream tributary thereto, the following prohibitions or restrictions shall apply:

Edwardson, Ken

From: Adair Mulligan [adair.mulligan@crjc.org]
Sent: Wednesday, March 10, 2010 12:42 PM
To: 303d Comment
Cc: 'Sharon F. Francis'
Subject: draft 303d list

Ken:

We have two comments:

1. NHLAK801040402-03…identified as "Wilder Lake, Lyme" is the Connecticut River where it is impounded behind Wilder Dam. This part of the Connecticut River was sampled in 2008 and 2009 in the course of the Connecticut River Tri-State Targeted Watershed Initiative, http://www.cesd.umass.edu/twi/index.html. Results indicated only one sampling event when E.coli could be considered an impairment to primary contact recreation. We would appreciate knowing the basis for the listing of this part of the Connecticut River.
2. We note that the reach of the Connecticut River from Lebanon to Cornish, which was previously considered impaired due to CSOs, does not appear on the draft 2010 list. We concur with this, as water quality monitoring through the above=mentioned program, designed to test impairment of this reach for recreation, turned up no concerns. However, the reach does not appear on the list of waters removed from the 2008 list.

Adair D. Mulligan
Conservation Director
Connecticut River Joint Commissions
PO Box 117, Lyme Center NH 03769
voice: 603-795-2104
fax: 603-795-9955
www.crjc.org
~Giving Voice to New England's River~

CENTER *for* BIOLOGICAL DIVERSITY

Because life is good.

Sent via certified and electronic mail

March 18, 2010

Ken Edwardson
New Hampshire Department of Environmental Services
Watershed Management Bureau
29 Hazen Drive, P.O. Box 95
Concord, NH 302-0095
By e-mail: 303dcomment@des.state.nh.us

Re: Comments on New Hampshire's Draft 2010 Section 303(d) List of Impaired Waters

On behalf of the Center for Biological Diversity, these comments are submitted in response to New Hampshire's draft list of impaired water bodies pursuant to the Clean Water Act section 303(d). New Hampshire's draft 303(d) list failed to include any ocean waters that are threatened or impaired by ocean acidification. This comment letter supports the inclusion of Atlantic Ocean waters on the list.

The ocean absorbs carbon dioxide causing seawater to become more acidic. Among various adverse impacts to marine life, this process—termed ocean acidification—impairs the ability of calcifying organisms to build their protective structures. Already ocean pH has changed significantly due to human sources of carbon dioxide. On the current trajectory, ocean ecosystems are likely to become severely degraded due to ocean acidification.

On October 26, 2009, the Center for Biological Diversity submitted scientific information supporting the inclusion of ocean waters on New Hampshire's 303(d) list. Since then, it has only become more apparent that ocean acidification poses a serious threat to seawater quality with adverse effects on marine life. Nonetheless, New Hampshire's draft 303(d) list failed to include any ocean segments threatened or impaired by ocean acidification. The overwhelming scientific evidence supports the inclusion of ocean waters on the 303(d) list because ocean acidification is causing degradation of seawater quality in violation of New Hampshire's water quality standards and threatens to become worse. This letter and its source documents should be taken under consideration in support of listing ocean waters, and the Center's previous letter and documents are incorporated by reference.

New Hampshire is urged to take ocean acidification seriously and to take prompt steps to halt this threat to our ocean ecosystems. New Hampshire should place ocean water segments subject to it's jurisdiction on the 303(d) list and develop a total maximum daily load for carbon dioxide pollution that is impairing our seawater quality.

The Clean Water Act Requires New Hampshire to Include Ocean Waters Threatened or Impaired by Ocean Acidification on Its 303(d) List

Under the Clean Water Act, "[e]ach state shall identify those waters within its boundaries for which the effluent limitations … are not stringent enough to implement any water quality standard applicable to such waters." 33 U.S.C. § 1313(d)(1)(a). A water body failing to meet any numeric criteria, narrative criteria, waterbody uses, or antidegradation requirements shall be included as a water-quality limited segment on the 303(d) list, as well as water bodies that are threatened with such impairment. 40 C.F.R. § 130.7(b)(3).

EPA has acknowledged the reach of the Clean Water Act to address ocean acidification (EPA 2009). Moreover, the EPA is taking steps that affirm states' duties and authorities to address ocean acidification under the Clean Water Act (See e.g. http://www.nytimes.com/gwire/2010/03/12/12greenwire-some-see-clean-water-act-settlement-opening-new-4393.html). Additionally, the Clean Water Act's section 303(d) is an effective mechanism to address atmospheric deposition of carbon dioxide (CO_2) and has been used to address parallel pollution problems such as mercury and acid rain. EPA's *Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions* acknowledges that atmospheric deposition must be a factor considered by states during their water quality assessments (available at http://www.epa.gov/owow/tmdl/2008_ir_memorandum.html).

New Hampshire must list ocean waters as impaired for ocean acidification because designated uses for shellfish, aquatic life, and wildlife are not being attained. To support aquatic life uses, the waters must "provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms." N.H. Water Quality Report at 44-45. Waters designated for wildlife uses must "provide suitable physical and chemical conditions in the water and the riparian corridor to support wildlife as well as aquatic life." Id. These uses are not being attained and are threatened due to ocean acidification as described in this letter and supporting documents.

Moreover, it is New Hampshire's antidegradation policy that "where the quality of the surface waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water, that quality shall be maintained and protected." ENV-WQ 1708.01. Absent a finding by the Department that allowing lower water quality is necessary to accommodate important economic or social development following public notice and comment, such degradation of water quality shall not be permitted.

New Hampshire's numeric water quality standard for pH requires that waters between pH of 6.5 to 8.0, unless due to natural causes. ENV-WQ 1703.18 PH. This standard, however, is inadequate to protect marine fauna and flora. Zeebe et al. (2008). In light of this insufficiency and EPA's current review and possible revision of its marine pH criterion, New Hampshire should gauge the need to list waters due to ocean acidification on the 303(d) list by the impacts on water quality and marine life.

For these reasons, which are supported by the Center for Biological Diversity's previous submission and information contained herein, New Hampshire must list its ocean waters on its 303d list.

Additional Information Illustrating Impairment of Ocean Waters by Ocean Acidification and Corresponding Adverse Impacts to Marine Life

Ocean acidification is already affecting a variety of marine organisms. New scientific information continues to affirm that ocean acidification is degrading water quality and impairing aquatic life beneficial uses of the ocean. Some of this new information is described here, and additional information is referenced in the bibliography and enclosed on a CD.

Ocean acidification's effects will become increasingly severe due to continuing emissions and the relatively long atmospheric residence time of carbon dioxide.

> Increasing ocean acidification follows directly (albeit with a time lag) the accelerating trend in world CO_2 emissions, and the magnitude of ocean acidification can be predicted with a high level of certainty.

(Secretariat of the Convention on Biological Diversity 2009: 21). This trend of accelerating acidification is of particular concern because current rates of increase in atmospheric CO_2 content are 100 times faster than any recorded in the last million years, and ocean pH is now predicted to reach lows not seen in hundreds of millions of years (Talmage & Gobler 2009). Many calcifying species have never experienced a change in pH of this magnitude so rapidly, and may be unable to adapt (Talmage & Gobler 2009). Recently, a survey in the Pacific revealed that ocean acidification from anthropogenic sources is already significantly affecting surface waters (Bryne et al. 2009). The Byrne study calculated that surface ocean waters in the North Pacific Ocean have experienced an annual decline of 0.0017 pH units between 1991 and 2006, and that this rate of change is accelerating (Byrne et al. 2009). The study suggests that basin-wide pH change is also occurring in the North Atlantic.

The predicted drop in ocean pH will affect a wide array of calcifying marine organisms, including corals. For example, in order to form the coral's protective aragonite structures, coral polyps require ocean water that is sufficiently saturated with carbonate ions. As the pH of ocean water drops, so does the amount of carbonate ions. Carbonate coral reefs do not form in water with carbonate ion concentrations below 200 µmol kg-1 (Secretariat of the Convention on Biological Diversity 2009). A recent study concluded that "even at future atmospheric CO_2 concentrations of 450–500 ppm (a conservative estimate), carbonate-ion concentrations will drop below 200 µmol per kg-1, beyond which CaCO3-building reefs are no longer viable, and reef erosion will exceed calcification" (Secretariat of the Convention on Biological Diversity 2009: 29). Current carbonate ion concentrations are about 210 µmol kg-1 (Secretariat of the Convention on Biological Diversity 2009). Similar impacts may be experienced by the Atlantic's cold water corals.

Cold water corals found in the North Atlantic Ocean along the east coast of the United States are among the varieties which will be affected by ocean acidification. Cold water corals provide shelter and feeding grounds for a variety of organisms, including commercially valuable fish species (Secretariat of the Convention on Biological Diversity 2009: 39). "An estimated 40% of current fishing grounds are located in waters hosting cold-water coral communities", which have been theorized to serve as nurseries for juveniles (*Id.*). Cold water corals generally inhabit waters with naturally elevated pH levels, being "restricted to high latitudes and deeper depths, which exhibit lower saturation state of calcium carbonate" (Maier et al. 2009). While their natural tolerance to heightened pH levels might at first appear to give cold water corals an advantage in increasingly acidified oceans, their specialized habitat actually renders cold water corals particularly vulnerable. "[M]ore than 95% of cold-water coral communities occur in waters that are supersaturated with respect to aragonite, confining their global distribution to ocean basins where the aragonite saturation horizon remains relatively deep" (Secretariat of the Convention on Biological Diversity 2009: 39). See Figure 1.

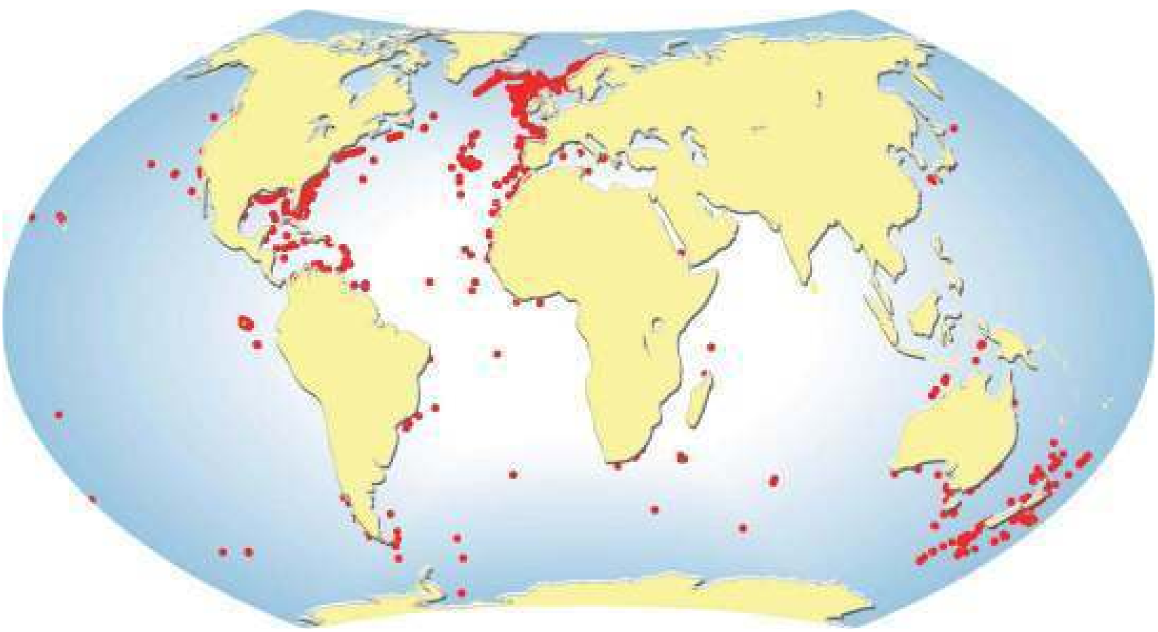

Figure 1 Global distribution of cold-water coral communities. *Source: Hugo Ahlenius, UNEP – WCMC 2005*236

Cold water corals reside in areas where the water is both sufficiently cold and unusually saturated with aragonite. The aragonite saturation horizon, or the depth below which ocean water becomes under saturated with aragonite, is predicted to become dramatically shallower as oceanic CO_2 concentrations increase (Maier et al. 2009, Secretariat of the Convention on Biological Diversity 2009). Studies indicate that over 70% of cold water coral communities will be exposed to waters undersaturated with aragonite by the end of this century, making many areas uninhabitable for cold water corals even sooner than corals living in warmer, shallower areas (Maier et al. 2009, Secretariat of the Convention on Biological Diversity 2009). Cold water corals are relatively difficult to study because of the depths at which they grow (Secretariat of the Convention on Biological Diversity 2009). The loss of these corals would be especially tragic because the full extent of their ecological significance has yet to be determined.

Corals are by no means the only calcifying organisms directly and detrimentally affected by changes in ocean pH. Most marine animals studied thus far have demonstrated adverse effects to ocean acidification, and new studies continue to confirm this unfortunate news. For example, exposure of brittlestar (*Ophiothrix fragilis*) to low levels of pH cause reduced larval size, abnormal development, and skeletogenesis (Secretariat of the Convention on Biological Diversity 2009). Even more poignantly, a 0.2 unit drop in pH resulted in 100% larval mortality within eight days, whereas the control group showed only a 30% mortality rate within the same period (Secretariat of the Convention on Biological Diversity 2009).

Most importantly, for New Hampshire's consideration, shellfish are vulnerable to adverse consequences due to ocean acidification. Another study of clams, scallops, and oysters showed that levels of CO_2 expected to be absorbed this century by oceans worldwide "are capable of significantly decreasing the size, rates of metamorphosis, and survivorship of larvae from three species of commercially and ecologically valuable shellfish (*M. mercenaria, A. irradians, and C. virginica*)" (Talmage & Gobler 2009: 2076). Under CO_2 conditions expected later this century, the shellfish experienced dramatic declines in survivorship and impaired growth (*Id.*). Already, ocean acidification may have contributed to global declines in shellfish (*Id.*). The impacts of ocean acidification from loss of calcifying organisms or alterations in marine food webs are estimated at about $160 billion annually (Cooley et al. 2009). Annual harvests of the three species in the Talmage study in states on the east coast of United States alone are estimated to be worth hundreds of millions of dollars (Talmage & Gobler 2009). Ecosystem services provided by these species have been valued even more highly than their harvest (*Id.*). Consequently, New Hampshire's coastal resources are at risk due to acidification.

Additionally, a decline of 0.3 pH united causes a 40 percent decrease in the sound absorption of surface seawater and sound may travel 70 percent farther, thus noise from vessels, military, and other human sources may adversely affect sensitive marine mammals (Brewer et al. 2009).

The scientific information about ocean acidification is compelling, and it shows that ocean acidification is among the top water quality problems facing our marine waters. The overwhelming scientific information about ocean acidification confirms that it is from anthropogenic pollution, that it is already affecting ocean waters, that the majority of marine organisms are adversely affected by it, and that it is poised to continue to become more severe in the years to come.

New Hampshire Is Required to Consider Scientific Evidence of Ocean Acidification Submitted by the Center for Biological Diversity.

In preparing its 2010 303(d) list, New Hampshire has a duty to consider the information submitted by the Center for Biological Diversity. The regulations governing implementation of the Clean Water Act's section 303(d) *require* that a state "evaluate all existing and readily available water quality-related data and information to develop the list." 40 C.F.R. § 130.7(b)(5); *see also Sierra Club v. Leavitt*, 488 F.3d 904 (11th Cir. 2007). The data and information provided by the Center for Biological Diversity on ocean acidification is from highly credible scientific journals and reports. Not only is the scientific understanding of ocean acidification well established, but also the magnitude of the problem and likely effects are predictable with a high degree of certainty (Secretariat of the Convention on Biological Diversity 2009).

Conclusion

The materials submitted with the previous letter and here support a finding that New Hampshire's oceans are threatened or impaired. The purpose of water quality standards is to protect the biological diversity of New Hampshire's waters as well as recreational and commercial uses. Ocean acidification will have significant negative impacts on the survival of calcareous organisms as well as fish and other marine species. Commercial and recreational uses will be harmed as a result, which will particularly affect the tourism and fishing industries that are so important to New Hampshire's residents.

We urge New Hampshire to add ocean water segments to its list of threatened and impaired waters under section 303(d) of the Clean Water Act. New Hampshire has the authority and the duty to address this serious water quality problem—ocean acidification.

Respectfully submitted,

Miyoko Sakashita
Oceans Director
Staff Attorney
miyoko@biologicaldiversity.org
enclosure

References

The following articles are enclosed on a compact disc to support listing waters as threatened or impaired under section 303(d) of the Clean Water Act.

Balch, W.M. and P.E. Utgoff. 2009. Potential Interactions Among Ocean Acidification, Coccolithophores, and the Optical Properties of Seawater. Oceanography 22:146-159.

Brewer, P.G. 2009. A Changing Ocean Seen with Clarity. Proceedings of the National Academy of Sciences 106: 12213.

Brewer, P.G. and K. Hester. 2009. Ocean Acidification and the Increasing Transparency of the Ocean to Low-Frequency Sound. Oceanography 22:86-93.

Burns, W.C.G. 2008. Anthropogenic Carbon Dioxide Emissions and Ocean Acidification: The Potential Impacts on Ocean Biodiversity. In R.A. Askins et al. (eds.), Saving Biological Diversity 187-202.

Byrne, R.H. Sabine Mecking, Richard A. Feely, and Xuewu Liu. 2009. Direct observations of basin-wide acidification of the North Pacific Ocean. Geophysical Research Letters 37: L02601.

Cohen, A.L. and M. Holcomb. 2009. Why Corals Care About Ocean Acidification: Uncovering the Mechanism. Oceanography 22:118-127.

Cohen, A. L., D. C. McCorkle, S. de Putron, G. A. Gaetani, and K. A. Rose. 2009. Morphological and compositional changes in the skeletons of new coral recruits reared in acidified seawater: Insights into the biomineralization response to ocean acidification, Geochem. Geophys. Geosyst., 10, Q07005.

Convention on Biological Diversity. 2009. Scientific Synthesis of the Impacts of Ocean Acidification on Marine Biodiversity. CBD Technical Series 46.

Cooley, S.R., H.L. Kite-Powell, and S.C. Doney. 2009. Ocean Acidification's Potential to Alter Global Marine Ecosystem Services. Oceanography 22: 172-181.

Doney, S.C., W.M. Balch, V.J. Fabry, and R.A. Feely. 2009. Ocean Acidification: A Critical Emerging Problem for the Ocean Sciences. Oceanography 22: 16-25.

Doney S. C., Fabry V. J., Feely R. A., & Kleypas J. A. 2009. Ocean Acidification: The Other CO_2 Problem. Annual Review of Marine Science 1:169–92.

Dore, John. E., Roger Lukasb, Daniel W. Sadlerb, Matthew J. Churchb, and David M. Karlb. 2009. Physical and biogeochemical modulation of ocean acidification in the central North Pacific. Proceedings of the National Academy of Sciences, 106: 12235–12240.

Environmental Protection Agency. 2009. Ocean Acidification and Marine pH Water Quality Criteria. Federal Register 74: 17484.

Fabry, V.J., J.B. McClintock, J.T. Mathis, and J.M. Grebmeier. 2009. Ocean Acidification at High Latitudes: The Bellweather. Oceanography 22: 160-171.

Feely, R.A., S.C. Doney, and S.R. Cooley. 2009. Ocean Acidification: Present Conditions and Future Changes in a High- CO_2 World. Oceanography 22:

Fore, L. 2009. Heeding a call to action for US coral reefs: The untapped potential of the Clean Water Act (editorial). Marine Pollution Bulletin 58 (2009) 1421–1423.

Gattuso, J.-P., L. Hansson, and the EPOCA Consortium. 2009. European Project on Ocean Acidification (EPOCA): Objectives, Products, and Scientific Highlights. Oceanography 22:190-201.

Gledhill, D.K., R. Wanninkhof, and C.M. Eakin. 2009. Observing Ocean Acidification from Space. Oceanography 22:48-59.

Hauri, C., N. Gruber, G.-K. Plattner, S. Alin, R.A. Feely, B. Hales, and P.A. Wheeler. 2009. Ocean Acidification in the California Current System. Oceanography 22:60-71.

Hutchins, D.A., M.R. Mulholland, and F. Fu. 2009. Nutrient Cycles and Marine Microbes in a CO_2-Enriched Ocean. Oceanography 22:128-145.

Juranek, L. W. , R. A. Feely, W. T. Peterson, S. R. Alin, B. Hales, K. Lee, Sabine, C. L. and J. Peterson. 2009. A novel method for determination of aragonite saturation state on the continental shelf of central Oregon using multi-parameter relationships with hydrographic data. Geophysical Research Letters 36, L24601.

Kleypas, J.A. and K.K. Yates. 2009. Coral Reefs and Ocean Acidification. Oceanography 22:

Maier, C., J. Hegeman, M. G.Weinbauer, and J.-P. Gattuso. 2009. Calcification of the cold-water coral Lophelia pertusa under ambient and reduced pH. Biogeosciences, 6: 1671–1680.

Millero, F.J., R. Woosley, B. DiTrolio, and J. Waters. 2009. Effect of Ocean Acidification on the Speciation of Metals in Seawater. Oceanography 22:72-85.

Ocean Acidification Reference User Group. 2009. Ocean Acidification: The Facts. A special introductory guide for policy advisers and decision makers. Laffoley, D. d'A., and Baxter, J.M. (eds). European Project on Ocean Acidification (EPOCA).

Orr, J.C., K. Caldeira, V. Fabry, J.-P. Gattuso, P. Haugan, P. Lehodey, S. Pantoja, H.-O. Pörtner, U. Riebesell, T. Trull, E. Urban, M. Hood, and W. Broadgate. 2009. Research Priorities for Understanding Ocean Acidification: Summary From the Second Symposium on the Ocean in a High- CO_2 World. Oceanography 22:182-189.

Parks. N. 2009. Is regulation on ocean acidification on the horizon? Environmental Science and Technology 6118.

Talmage, Stephanie C. and Gobler, Christopher J. 2009. The Effects of Elevated Carbon Dioxide Concentrations on the Metamorphosis, Size, and Survival of Larval Hard Clams (Mercenaria Mercenaria), Bay Scallops (Argopecten Irradians), and Eastern Oysters (Crassostrea Virginica). Stony Brook University, School of Marine and Atmospheric Sciences.

Tans. P. 2009. An Accounting of the Observed Increase in Oceanic and Atmospheric CO_2 and an Outlook for the Future. Oceanography 22:26-35.

Veron, J.E.N. et al. 2009. The coral reef crisis: The critical importance of <350 ppm CO_2. Marine Pollution Bulletin 58: 1428–1436.

Nelson Kinder Mosseau & Saturley PC
ATTORNEYS AT LAW

E. Tupper Kinder, Esquire
Manchester Office
Direct Dial: 603-606-5002
Email: ekinder@nkms.com

March 23, 2010

2010, 303(d) Comments
New Hampshire Department of Environmental Services
Watershed Management Bureau
29 Hazen Drive
PO Box 95
Concord, NH 03302-0095

Attn: Ken Edwardson

RE: Comments by City of Portsmouth on Draft 2010 303(d) List of Impaired Waters

Dear Mr. Edwardson:

The City of Portsmouth submits these comments on the Draft 2010 List of Threatened or Impaired Waters. The City objects to the designation of certain assessment units as impaired for nitrogen and light attenuation. The basis of the objection has been previously discussed with NHDES. To preserve the City's rights the City reiterates it is concerned that NHDES has declared these designations without complying with administrative procedures and without reasonable scientific support.

The City believes that these determinations are "rules" within the meaning of RSA 541-A, the Administrative Procedure Act, and the required procedures must follow. However, NHDES has failed to comply with the procedures required for the adoption of rules. The designations are also without support from a substantive perspective. Specifically, the City objects to the designation of certain assessment units as impaired for light attenuation and nitrogen. The City bases its objection on the fact that the determination of these impairments has not been based upon a reasonably rigorous scientific program to develop and assess data to support a conclusion that these waters are impaired for light attenuation and nitrogen. Attached hereto are comments, previously provided to NHDES, which have been developed by consultants, Applied Science Associates, Inc. ("ASA") and Brown and Caldwell. Based upon these comments, Portsmouth believes that NHDES improperly concluded that assessment units within the Great Bay Estuary and Piscataqua River are impaired because of the scientific errors in the development and analysis of the existing data, the reliance on insufficient data and the improper of use data to draw conclusions.

For example, NHDES relies heavily on the condition of eelgrass within the estuary in concluding impairment due to nitrogen and light attenuation. However, NHDES does not have reasonable level of scientific data to support that nitrogen and light attenuation conditions are causally related to the absence of eelgrass in certain areas. Because there are many other factors which may be affecting the presence of eelgrass, NHDES' conclusion that the absence of eelgrass is due to impairment of waters for nitrogen and light attenuation is unreasonable and unsupported by scientific data. Additionally, NHDES has relied heavily on the assumption that nitrogen concentrations in the Great Bay Estuary generally are increasing. NHDES' assumption that this is true is not based on adequate scientific data. NHDES has failed to develop an appropriate methodology for comparing data acquired from different time periods while controlling for variables of different sampling and analysis procedures over time. The failure to adopt a reasonable methodology to allow for the comparison of these disparate data sets has caused NHDES to reach conclusions of questionable scientific validity with respect to the total loading of the Great Bay Estuary for nitrogen, the trend of estuarine nutrient concentrations, and the environmental impact of nutrient levels on the aquatic life including eelgrass.

The City of Portsmouth looks forward in discussing these comments in more detail with NHDES.

Respectfully submitted,

The City of Portsmouth

By its attorneys,

Nelson, Kinder, Mosseau & Saturley, PC

E. Tupper Kinder, Esquire

ETK/sma
Enclosures
cc: via email: 303comment@des.state.nh.us

155 Fleet Street, Suite 209
Portsmouth, NH 03801

Tel: (603) 570-4869
Fax: (603) 570-4865

May 22, 2009

BROWN AND CALDWELL

Mr. Peter H. Rice, P.E.
City of Portsmouth Public Works
680 Peverly Hill Road
Portsmouth, NH 03801

Subject: **Review of NH DES Draft Wasteload Allocation Methodology**

Dear Mr. Rice,

As requested, Brown and Caldwell and Applied Science Associates have completed a technical review of the Methodology for Wasteload Allocation for the Cocheco River Watershed (Methodology) developed by the New Hampshire Department of Environmental Science (NH DES). This letter summarizes the findings of our technical review and makes conclusions and recommendations for the finalization of the Methodology in consideration of the lasting impact the results of the wasteload allocation will have on wastewater treatment facilities in the City of Portsmouth and the entire NH Seacoast Community.

1.1 Introduction

The New Hampshire Department of Environmental Services (NHDES) issued the *Methodology to Determine Wasteload Allocation for Wastewater Treatment Facilities* (WWTFs) *in the Cocheco River Watershed* (Methodology) on March 27, 2009. The purpose of the Methodology is to allocate nutrient loadings from each WWTF discharging to the Great Bay Estuary. This first evaluation will be used as a blueprint for allocations in other watersheds, including the Upper and Lower Piscataqua. For the Cocheco River, the nutrients of concern are nitrogen and phosphorus. However, the Methodology only addresses nitrogen loadings and does not address phosphorus loadings.

The following sections discuss the approach, assumptions, data used, and conclusions made in the Methodology. The discussion is structured around major parts of the methodology including:

- Use of mass balance model
- Estimation of nitrogen loading targets
- Determination of target "dry" condition nitrogen loading target
- Attenuation coefficients – USGS sparrow model & Cocheco River size classification
- Calculated point and non-point source nitrogen load to the Cocheco River assessment zone wasteload allocations - scenarios for different TN limits

1.2 Use of Mass Balance Model

The Methodology references the model described in "Mixing in Coastal Inland and Coastal Waters" (Fischer et al., 1979). This is a simple mass balance model to determine nitrogen wasteload allocation and, as such, is only appropriate for simple watersheds. This model is not appropriate for a complex estuary system like the Great Bay Watershed.

The dataset used by the NHDES to validate accuracy of model predictions is inconsistent and unrepresentative of the dataset used for model inputs. The authors use simplifications to estimate central tendency nitrogen concentrations, but notes that salinity must represent "steady state" conditions to be applicable. The salinity and nitrogen data used in the mass balance model were from median concentrations in sub-estuaries from sampling in 2002-2004 and used to compare model predictions for offshore waters in the Gulf of Maine in 2008. This modeling assumes that salinity concentrations during the 2002 – 2004 and 2008 periods were at steady state conditions and that these data are congruent. Steady state salinity conditions are unlikely to occur in the Great Bay Estuary due to the significant currents, tidal flushing and volume of stormwater runoff tributary to the estuary. Therefore the use of the Fischer model is not justified, and an alternative method of modeling the Great Bay Estuary is necessary

In addition, comparing the 2002-2004 and 2008 incongruent data sets and drawing conclusions from them cannot be supported with the sparse volume of data collected.

Besides the implications to the model, it is important to establish valid salinity concentrations in the development of the mass balance model because of the impact of salinity on nitrogen concentrations and fate in an estuary environment. Typically, there is an inverse, linear relationship between salinity and dissolved inorganic nitrogen concentrations in estuaries. Salinity also affects the stratification of estuarine waters and high runoff periods can lead to low salinity and high stratification within the water column. Ionic strength is also directly related to salinity and can affect the activity and nitrogen fixation of microorganisms.

The Methodology should address how the apparent lack of steady state salinity in the data affects the ability to apply the use of a simple mass balance model similar to the model referenced in the Methodology.

1.3 Estimation of Nitrogen Loading Targets

The Methodology used "dry" conditions represented by nitrogen concentration data from 2001 instead of "typical" conditions represented by data from 2007 to establish the nitrogen loading target for the Cocheco River Assessment Zone. Dry-condition nitrogen loading was shown as 111 tons per year and is a lower target than the nitrogen loading under typical conditions of 136 tons per year. Using dry conditions as a basis establishes a lower allowable effluent nitrogen concentration from the WWTFs discharging to the Cocheco River. The reasoning behind the use of dry weather conditions versus typical conditions to represent the nitrogen loading target was not justified. Due to the large difference in nitrogen loading between dry and typical conditions (25 tons/year), the use of this approach must be justified with additional supporting information.

1.4 Determination of Target "Dry" Condition Nitrogen Loading Target

The Methodology indicates that data needed to calculate an accurate median value of salinity in the Cocheco River (assessment zone) was incomplete for this Assessment Zone ("not enough salinity measurements"). The method for back-calculating ocean flushing and salinity in the Cocheco River Assessment Zone for the 2001 "dry condition" used flushing rate (not tidal flow) and salt mass balance from 2007. The statement indicating justification due to a static water level in the estuary during dry conditions (compared to typical) is not supported by data. The justification that water level is static due to ocean water entering the estuary also indicates that during dry weather, the additional inflow from ocean water would carry higher salinity and different nitrogen background conditions in the estuary compared to "typical" conditions. The impact of ocean water inflow on the dry weather condition nitrogen loading target should be analyzed before using this as the basis for wasteload allocations. The flow and salinity data sets have been mixed, and therefore have no statistical relevance and cannot be used for comparative analysis.

1.5 Attenuation Coefficients –USGS Sparrow Model & Cocheco River Size Classification

The method for determining the size classification and, as a result, attenuation factor for the Cocheco River Estuary was not justified or supported clearly in the Methodology. Based on the USGS Sparrow model and associated attenuation coefficients referenced in the Methodology, the size classification of the stream being modeled has significant impacts on the value of the attenuation coefficient and the amount of attenuated or "lost" nitrogen in the stream or river.

The following were the flows defined in the Methodology for the Cocheco River in the Assessment Zone:

- Minimum flow (at the Farmington WWTP) of 72.1 cubic feet per second (cfs)
- Maximum flow (near Dover at the Tidal Dam) of 284.5 cfs.
- Mean stream flow (Sparrow model shapefiles) of 140.5 cfs

The following were the size classifications defined for small and medium-sized rivers using the USGS Sparrow model referenced in the Methodology:

- Medium stream flow (q) = 200 $<$q$<$ 1000 cfs; or q$<$1000 cfs.
- Small stream flow of q$<$ 200 cfs.

Note that the mean stream flow for the Cocheco River, based on Sparrow shapefiles, is 140.5 cfs and should be characterized as a small stream under the definitions presented in the Methodology.

The Methodology presents the attenuation coefficients calculated for certain stream sizes that were used in the Sparrow model referenced. Based on the size classification, the following were the attenuation factors (based on stream size):

- Medium streams:
    - Farmington: 35% to 42% loss of nitrogen per day
    - Rochester: 17% to 21% loss of nitrogen per day
- Small streams:
    - Farmington: 66-67% loss of nitrogen per day
    - Rochester: 38% loss of nitrogen per day

The Methodology characterizes the Cocheco River as strictly a medium stream using Sparrow model definitions and, what appears to be maximum flow. It is not clear or justified as to which flow for the Cocheco River was used to define overall stream size classification.

The model used in the Methodology averages the medium stream loss percentage through attenuation for Farmington. The following is the result of this averaging and the attenuation loss percentages used to determine the nitrogen load from the Rochester and Farmington WWTFs:

- Farmington: 39% loss to attenuation
- Rochester: 19% loss to attenuation

The Methodology refers to these attenuation loss percentages, but erroneously claims that "these selected attenuation factors predict that 39% and 19%, respectively, of the nitrogen discharged from the WWTFs will be delivered to the estuary." It is our understanding that an attenuation loss factor is used to calculate the amount of nitrogen "lost" through attenuation and not "delivered", as the Methodology states. Therefore, using the calculated attenuation factors for Farmington and Rochester of 39% and 19%, respectively, the calculated predictions for the percentage of nitrogen delivered to the estuary should be:

- Farmington: 61% delivered
- Rochester: 81% delivered

These delivered percentages of nitrogen loads are much higher than what is calculated in the Methodology and stress the need for justification for using a medium stream size classification and associated attenuation coefficient versus a small stream size classification. Note again that the mean stream flow for the Cocheco River, based on Sparrow shapefiles, is 140.5 cfs and would be characterized as a small stream under the definitions presented in the Methodology.

If the averages of small stream attenuation factors were used, the following would be the percentages of nitrogen loads from the Farmington and Rochester WWTFs lost to attenuation and delivered to the estuary:

- Farmington: 66.5% lost/attenuated, 33.5% delivered
- Rochester: 38% lost/attenuated, 62% delivered

As shown, the percent lost to attenuation based on a small stream size classification are significantly higher than the percent lost based on a medium stream size classification.

1.6 Calculated Point and Non-Point Source Nitrogen Load to the Cocheco River Assessment Zone

The Methodology states that WWTF loads were calculated using "at least monthly measurements of total nitrogen in effluent during 2008". It is unclear which data from WWTFs were used from the New Hampshire Estuaries Project (NHEP) measurements from 2006 to 2008, and why data from only 2008 appeared to be used to calculate WWTF nitrogen loads. It is also unclear and not justified in the Methodology how effluent data from WWTFs in 2008 can be evaluated against a dry weather condition nitrogen loading target during the dry year of 2001. The flows and associated WWTP effluent nitrogen loads during the dry weather year of 2001 would likely be lower than effluent nitrogen loads in 2008.

The assumptions made to estimate non-point source (NPS) nitrogen loading downstream of the tidal dam are not clear or justified in the Methodology. The Methodology notes that the NPS load downstream of the tidal dam was estimated "using average nitrogen yield from watersheds without upstream WWTFs (1.39 tons N/yr/sq.mi.)". The Methodology does not indicate where this nitrogen yield was acquired and does not give supporting reference information. It is imperative that this NPS nitrogen yield be representative of the watersheds and the land use it of the Cocheco River Assessment Zone that it is being applied to in this method. As understood, watershed characteristics (runoff, groundwater loads, etc) and land use in watersheds (i.e. agriculture, commercial/industrial use, transportation, etc.) have major influences on nitrogen yield from NPS. The Methodology should describe the watershed characteristics and land use for the nitrogen yield used to estimate NPS nitrogen load for the area downstream of the tidal dam.

1.7 Wasteload Allocations - Scenarios for Different TN Limits

Table 4, *Wasteload Allocations and Percent Reductions in NPS Needed to Reach Loading Target*, provides various scenarios for WWTF effluent TN limits versus non-point source (NPS) nitrogen reduction to meet the dry weather condition total nitrogen loading target of 111 tons of nitrogen per year. These scenarios are predicated on the assumptions that the TN limits of 3, 5 and 8 mg/L could be met at the WWTF discharge. The assumption that effluent limits of 3 or 5 mg/L TN are achievable with biological nutrient removal (BNR) processes is not accurate. In reality, limits below 5 mg/L will be difficult to achieve on an annual average basis utilizing BNR systems. Further, with specific BNR treatment processes already utilized in the watershed, limits below 8 mg/L may be difficult to achieve. This is supported by ongoing WERF-funded research on the Limit of Technology (LOT) for BNR systems using actual data from operating BNR WWTFs in the US as case studies. This is also supported by previous EPA research into the LOT.

The assumption that TN limits of 3, 5, and 8 mg/L are achievable in New England climates provides the false hope that a significant reduction in point source TN discharge will provide for potentially achievable reductions in non-point source (NPS) TN by 30% (or less). As shown by data in the current WERF and past EPA studies, costly WWTF BNR upgrades targeted to meet limits of 3 or 5 mg/L TN will not achieve these results. Therefore, additional NPS reduction will be required, beyond a 30% reduction. These reductions in NPS are unlikely to be achieved as well, given that EPA has stated that NPS reductions above 10% are unlikely based on experiences in Lake Champlain and other regions where NPS nitrogen load reduction has been attempted in the US.

2. CONCLUSIONS

The overall approach used in the Methodology is not well defined or justified by supporting information shown in the Methodology. The assumptions used to determine the nitrogen loading target and attenuation coefficients from stream classification are not justified and appear to misrepresent conditions in the Cocheco River sub-estuary that underestimate background nitrogen concentrations and loads from non-point sources.

The wasteload allocation is based upon background nitrogen levels which were developed as part of the previous estuaries study. These levels were derived to either support eel grass habitat or provide sufficient dissolved oxygen levels within the estuary. Previous comments regarding the background level must be addressed before the wasteload allocation can be finalized.

3. RECOMMENDATIONS

It is recommended that the NH DES justify the major modeling assumptions and data used As it exists now, the Methodology does not use representative data in model assumptions and model results cannot be justifiably used to allocate nitrogen wasteloads in the Cocheco River sub-estuary and the Great Bay estuary.

The use of a simple mass balance model to determine wasteload allocation in a complex sub-estuary system needs to be justified with supporting information and recent examples of where this approach has been previously used.

It is recommended that the determination of target nitrogen loads in the Cocheco River sub-estuary and in future methods for other sub-estuaries be based on average or typical conditions rather than "dry weather" conditions to more accurately establish a representative baseline for wasteload allocation. This change would result in a 22% higher target nitrogen load.

The determination and use of attenuation coefficients must be better defined and justified in the final methodology. It is not clear how the use of "medium" stream attenuation coefficients can be applied to the Cocheco River when the flow data presented in the Methodology indicates the Cocheco River should be classified as a "small" stream using the associated small stream attenuation coefficients. This methodology leads to modeled nitrogen loads from the Rochester WWTF to the Great Bay that may be significantly higher than actual loads. Use of this methodology to model other sub-estuaries would overestimate nitrogen loads from other Seacoast Community WWTFs to the Great Bay estuary and lead to future NPDES permit effluent nitrogen limits that are misrepresentative. Utilizing a small stream attenuation coefficient would result in a higher allowable WWTF total nitrogen limit.

In cases where data is lacking, the use of assumptions to fill gaps in these data should not be the primary method over collection of more data. Alleviation of good science is not appropriate given the significant and lasting impact that the results of wasteload allocations will have on NH Seacoast Communities.

Overall, it appears that the Methodology has utilized overly conservative factors which have resulted in lower target total nitrogen limits for future WWTF NPDES permits The reductions of non-point source nitrogen that will need to be achieved to meet water quality standards do not appear to be realistic. Therefore, even with total nitrogen limits at the limit of technology for the WWTF discharges, which is unachievable in New England, water quality standards, as derived by the NHDES cannot be met based on the Methodology presented.

If you have questions regarding this evaluation, please contact me.

Very truly yours,
BROWN AND CALDWELL

Mark Allen

Mark K. Allenwood, P.E.
N.E. Wastewater Practice Leader

cc: Richard Sweetman, ASA

Craig Swanson

TO: Mark Allenwood P.E., Brown and Caldwell
Eian Lynch, Brown and Caldwell

FROM: Craig Swanson
Jennifer A. Cragan
Richard Sweetman

DATE: March 19, 2009

RE: Technical Review of the Draft NHDES Nutrient Criteria for the Great Bay Estuary Report

Table of Contents

1. Introduction

1.1. *Technical Review Objective and Framework*

This report is a technical review of the draft New Hampshire Estuaries Project (NHEP) Report. This report assesses the methods used to determine the proposed nutrients thresholds for the Great Bay Estuary and the overall data quality of nutrient and supporting analyses (both grab samples and continuous measurements). The report also critically reviews the relationship between nutrient concentrations, primary indicators and secondary indicators of eutrophication. Finally we examine the proposed numeric threshold nutrient criteria.

1.2. *Approach Summary*

The New Hampshire Department of Environmental Services (DES) did not use any single approach to determine numeric nutrient criteria for the Great Bay estuary. Instead, they stated they used the following resources and assessment criteria to arrive at the thresholds nutrient levels for the Great Bay Estuary:

- NH Water Quality Standards which have only narrative criteria,
- Precedents from other states as a guide (i.e. Massachusetts Estuarine Reports),
- Division of the Great Bay estuary into 14 different assessment zones, and
- National Oceanic and Atmospheric Administration (NOAA) Estuarine Eutrophication Model relating external nutrient input to primary and secondary indicators of the symptoms of eutrophication.

2. Discussion

2.1. *Data Sources Used for Determination of Nutrient Concentrations*

The Report uses valid data gathered from the DES Environmental Monitoring Database. The database was queried to return the results of samples collected between January 1, 2000 and December 31, 2007. The majority of these data were acquired from the following programs:

- Great Bay National Estuarine Research Reserve System Wide Monitoring Program (http://nerrs.noaa.gov/Monitoring/),
- University of New Hampshire (UNH) Tidal Water Quality Monitoring Program, and
- National Coastal Assessment (http://www.epa.gov/emap/nca/).

Statistical analysis techniques were utilized to relate nutrient data for nitrogen and phosphorus species to the primary (chlorophyll-a and macroalgae) and secondary indicators (benthic invertebrates and sediment quality, dissolved oxygen, and eelgrass).

2.2. Assessment of Estuary Study and Data Used

Sample Resolution

The number of samples used for each assessment zone does not provide sufficient resolution to determine health in the Great Bay. According to the methods section "For each parameter, the minimum, 10th percentile, median, 90th percentile, and maximum concentrations were calculated from all the measurements between 2000 and 2007 in each assessment area and for each trend station." Non-detected data was not incorporated into the final results. One method for dealing with non-detected data is to report the data value as the method detection limit, which is quantified as a result of instrument performance. Although the number of non-detect data points was reported to be less than 10% of the overall samples, not including this data for analysis biases the reported results slightly.

Field sampling was conducted between April and November at monthly intervals. These data were used to calculate:

- Percentages of nitrogen and phosphorus in different fraction types (e.g., dissolved, particulate),
- Molar ratios between nitrogen and phosphorus,
- Average nitrogen and phosphorus concentrations at each water quality station, and
- Monthly median concentrations of nitrogen and phosphorus concentrations.

The statistical approach used on the data set is questionable because of the sparse data set. The DES notes that the nitrogen cycle is represented incompletely. The aggregate statistics could not comprehensively illustrate the nutrient dynamics because nutrient measurements were not temporally coordinated. A method DES employed to work around the data gaps was to switch between using median and average for the determination of values. If a median value is used for total nitrogen, then the associated values for the median total nitrogen components should be used. It would be more statistically robust to have consistently used averages. Additionally, the data density is somewhat sparse for the time period, with mostly monthly measurements.

A further problem with the data quality in terms of application to estuary-wide analyses is the inability to take into account tidal signatures. This is largely the result of low sampling frequency (1/month/station). It is recommended that an appropriate study of the transport and ocean-estuary exchange be considered when determining numeric nutrient criteria here. Tidal influences are more thoroughly considered in other reports of this type (such as the Massachusetts Estuarine Project) beyond setting a boundary condition.

Chlorophyll-a Data

Inspection of Figure 12 (page 30) appears to indicate that chlorophyll-a values violate the DES chlorophyll-a primary contact water quality criterion only in the fresh-water sections of the estuary. Higher salinity regions clearly are associated with lower average chlorophyll-a concentrations. It appears that the average values for the majority of the estuary are below 6 ug/L. Other methodologies for determining the degree of eutrophication within estuaries and coastal ponds, including the Buzzard's Bay Coalition (Costa *et al*, 1999) would indicate that values within this range represent acceptable levels of chlorophyll-a. For saline environments, chlorophyll-a concentrations in excess of 10 ug/L are indicative of a significant degree of eutrophication. The saline waters within the estuary indicate healthy levels of chlorophyll-a based on other methodologies.

Nitrogen Cycle Assumptions

Nitrogen incorporation into phytoplankton is attributed as being less than 1 percent of the total, on page 14 of the report. This would indicate that the majority of the nitrogen present is not being incorporated into phytoplankton biomass. Typically, eutrophication induced phytoplankton blooms would considerably deplete dissolved nitrogen (in the case of saline waters). Considering the low percentage of nitrogen incorporated into the biomass, it would seem that nitrogen is not significantly contributing to phytoplankton blooms.

Figure 7 (on page 22) represents median N:P ratios for a range of salinities throughout the watershed. The reference to high incorporation of nitrogen into biomass appears to refer to low salinity regions. This statement is perhaps misleading because fresh water phytoplankton are generally phosphorus limited, which would contribute to a high N:P ratio, but not large incorporation into the biomass. An apparent trend for the data in Figure 7 would seem to more closely resemble nitrogen sources than a biological trend. The statement that the bio-available forms of nitrogen are generally depleted in more saline waters does not appear to be represented in the chlorophyll-a data.

Boundary Condition

The off shore nitrogen boundary condition was set to 0.244 mg N/L by the DES. This is the expected concentration of total nitrogen that the Gulf of Maine contributes to the Great Bay Estuary. The data used to determine the boundary concentration only contained measurements of dissolved inorganic nitrogen (DIN) and particulate organic nitrogen (PON) and did not include measurements of dissolved organic nitrogen (DON). The DES estimated dissolved organic nitrogen using the values from Portsmouth Harbor, station GRBCML. The boundary concentrations were 0.096 mg DIN/L and 0.031 mg PON/L. The dissolved contribution estimated using the GRBCML station mean value was

0.117 mg DON/L. It is attributed to station GRBCML, but in Table 4 the median concentration at this station is given as 0.104 mg DON/L, 0.092 mg DIN/L and 0.058 mg PON/L. The assumption that the GRBCML station organic nitrogen concentrations can be applied to offshore locations would be justified if it were possible to compare the total nitrogen values from offshore locations with the derived value. Comparison to Nantucket Sound may or may not be accurate. Based on the mixture of average and median values, the derived result of 0.244 mg/L for total dissolved nitrogen (TDN) does not, despite being similar in magnitude to Nantucket Sound values, accurately represent the TDN for offshore waters.

Benthic Invertebrates

The conceptual model section of the DES report (page 4.) states that the benthic index of biologic integrity was a consideration. However this approach is not appropriate for low salinity environments, as the DES concede. No numeric nutrient criteria were developed for this indicator.

Sediment Quality

There was large variability in the relationship between total organic carbon and chlorophyll-a, and between total organic carbon and nitrogen data. The uncertainty motivated the DES to not use the thresholds of numeric nutrient criteria calculated from total organic carbon.

Dissolved Oxygen

The oxygen data-set is comprised of grab samples and datasonde measurements. The DES point out that the datasonde measurements offer a richer perspective because of the number of measurements and the placement of datasondes. The DES use the datasondes as the source of oxygen data for comparison to nitrogen and chlorophyll-a, and rely on grab samples of oxygen and nitrogen, and oxygen and chlorophyll-a as brackets. The volume of the oxygen data does not account for the scarcity in the nitrogen and chlorophyll-a grab samples, despite a weight of evidence.

The DES could not obtain significant regressions between minimum dissolved oxygen and median nitrogen at each datasonde location. Instead, nitrogen concentrations at stations where the minimum dissolved oxygen concentrations fell below water quality standards was compared to nitrogen concentrations at stations without violations to parameterize the range of possible thresholds. This comparison will not account for habitat types or salinity dependencies because the low oxygen data will come from the tributaries and the healthy oxygen data will come from open, higher saline waters.

Eelgrass

The DES developed a numeric nutrient threshold based on the health of eelgrass in the Great Bay system. Eelgrass health is commonly regarded as being controlled by light availability. From this stand point; attention is paid to water quality because of its relationship to light and regression analysis to factors controlling water quality and nitrogen concentration.

Additionally, the DES cite Koch (2001) as the source of the model to predict eelgrass growth based on not only light attenuation but also depth requirements. In summary, Koch encourages that eelgrass habitat requirement not be focused solely on light attenuation. Also, no consideration is given to sediment sulfide content, tidal currents, eelgrass lifecycle or boat traffic in the NHDES report.

The Piscataqua River can experience flows up to 2.3 m/sec (Bilgili,1996). Flows of this magnitude should be assessed over the entire system as another parameter to constrain eelgrass habitat. The Lower Piscataqua is considered by the DES as an example of a zone needing higher water quality standards to get light to the substrate but the flow may be too high to support eelgrass.

The report does not reference previously studies and reports conducted in the Great Bay estuary system, such as the New Hampshire Port Authority transplant project, dredging or a comprehensive overview of eelgrass health studies to give context to the complex nature of eelgrass in the Great Bay Estuary.

Nitrogen Threshold Determination

The 0.32 mg N/L threshold is based on eelgrass health, an estimated boundary condition of 0.24 mg N/L, an upper limit of 0.40 mg N/L controlled by a very limited image dataset of Macroalgae coverage in the Great Bay (no Piscataqua River imagery), and comparisons to other estuaries. The DES attempt to bolster the threshold by using the EPA's reference concentration approach (EPA, 2001): using the Portsmouth Harbor /Little Harbor as the reference area. It is unlikely that the Portsmouth Harbor/Little Harbor area meets the criteria laid out by the EPA as an applicable reference area. The reference concentration approach mandates that the reference area be minimally impacted at worst and pristine at best. If the DES continue to insist that the EPA reference concentration approach is applicable to the Great Bay Estuary, and that the designation of Portsmouth Harbor and Little Harbor area is representative and impacted minimally, then the DES should present arguments supporting how the Great Bay Estuary, Portsmouth Harbor and Little Harbor meet the requirements defined for using this approach.

3. Conclusions

The approach and methods used in this report are not sufficient to establish N and P limits for point source discharges. Non-point sources of N and P have not been considered. Additional data collection and analysis is necessary to justify nutrient threshold limits for point source discharged.

Specific conclusions, based on the data presented in the report are:

- The number of samples for each assessment zone provide insufficient resolution to determine a nitrogen threshold for the Great Bay Estuary.
- With the exception of the freshwater tributaries, the Chlorophyll-a values are indicative of a healthy estuary.
- Nitrogen is not significantly contributing to phytoplankton blooms.
- The derived ocean boundary concentration of 0.244 mg/L for TDN does not, despite being similar in magnitude to Nantucket Sound values, accurately represent the TDN for offshore waters.
- The benthic indicator criteria originally set as a secondary indicator was not used because of its inapplicability to low saline environments.
- Sediment quality was too variable to derive a nitrogen threshold.
- Oxygen datasonde data was not correlated to nitrogen. Only oxygen levels in the freshwater tributaries violated water quality standards.
- Eelgrass habitat requirements other than light and depth were not considered.
- Nutrient thresholds were determined by:
    - A limited dataset with large uncertainties,
    - A questionable designation of the Portsmouth Harbor/Little Harbor as a basis for an EPA reference approach, and
    - Comparison to other estuaries in New England Which are not in the Gulf of Maine (Massachusetts).

4. Recommendations

Prior to finalizing the report, we recommend that the DES address the following:

- Identify the sources of nitrogen and phosphorus loads to the Great Bay Estuary.
- Explore other approaches that are documented and accepted. An example is the Eutrophication Index (EI) (Costa et al 1999) utilized in the Massachusetts Estuarine Program reports. The oxygen and chlorophyll-a data indicate that a different approach would yield higher nitrogen thresholds.

- Justify the approaches used in the study, specifically the aforementioned EPA reference concentration approach.
- Identification of sources of nitrogen in the fresh water areas and a general understanding of the magnitude of nitrogen loading within the estuary would potentially provide a better means of addressing major sources if a numeric criteria is to be prudently applied.
- Collection or identification of additional data to add more statistical validity to the conclusions of the DES Report.
- Utilize average values and do not mix data sets in data analysis.
- Utilize and present non-detect data in the data analysis. This data should not be ignored.
- Evaluate sediment sulfide contents, tidal currents, eelgrass lifecycle, and boat traffic in addition to nutrient levels, as they relate to eelgrass health in the Great Bay Estuary.
- Re-evaluate the background nitrogen concentrations utilized as the threshold basis.

References

Bilgili, A., M. Robinson Swift, B. Celikkol. 1996. Shoal formation in the Piscataqua River, New Hampshire. Estuaries and Coasts. 19(3). Pp.518-525

Beem, N.T. F.T.Short, 2009. Subtidal Eelgrass Declines in the Great Bay Estuary, New
Hampshire and Maine, USA. Estuaries and Coasts 32. 202–205

Costa, J.E, B.L. Howes, D. Janik, D. Aubrey, E. Gunn and A.E. Giblin, 1999. Managing anthropogenic nitrogen inputs to coastal embayments: technical basis and evaluation of a management strategy adopted for Buzzards Bay. Buzzards Bay Project Technical Report. Draft Final, 24 September 1999, 62 pgs.

Environmental Protection Agency. 2001. Nutrient Criteria Technical Guidance Manual:Estuarine and Coastal Marine Waters. U.S. Environmental Protection Agency, Office of Water, EPA-822-B-01-001. October 2001. Published Online http://www.epa.gov/waterscience/criteria/nutrient/guidance/marine/index.html. Accessed February 19th 2009