Testimony of:

Peter H. Rice, P.E.
City Engineer Water & Sewer
City of Portsmouth

On Behalf of the City of Portsmouth

"EPA Overreach and the Impact on New Hampshire Communities"

United States House of Representatives
Committee on Oversight and Government Reform

June 4, 2012

Mister Chairman, and Members of the Committee, on behalf of the City of Portsmouth and the Great Bay Municipal Coalition Communities, I would like thank you for this opportunity to testify today.

My name is Peter Hamilton Rice. I was born in New Hampshire and I am a twice graduate of the University of New Hampshire with an undergraduate degree in economics and a Masters Degree in Civil Engineering. I am currently the City Engineer for the City of Portsmouth and have been employed in this position for the last ten years. Prior to working for the City I worked as a consulting engineer. I am a registered professional engineer and have served on a variety of State water and wastewater commissions and organizations. I have provided a copy of my curriculum vitae with my testimony. I have been extensively involved in the Great Bay nutrient issues since 2002 representing the City's interests.

The City of Portsmouth is a small city with a population of 21,000. Despite its small size, Portsmouth has "big city" infrastructure challenges. The City owns and operates two wastewater treatment facilities, has over 120 miles of sewer pipe and manages twenty pumping stations.

Communities such as Portsmouth want predictable, scientifically-supported, environmental regulations that deliver demonstrable environmental benefits. Within such a regulatory framework, limited municipal resources can be secured, budgeted and invested wisely to deliver necessary services with the maximum environmental benefit.

The City of Portsmouth has a proven track record of good environmental stewardship. In 2007 the City Council voted to adopt an "Eco-Municipality" designation which committed the City to sustainable development practices. To that end the City has updated its land use ordinances to reflect low impact design requirements, has incorporated Leadership in Energy and Environmental Design (LEED) principals into its municipal buildings and incorporated green infrastructure into its municipal projects. These efforts have been recognized through a number of awards including Gulf of Maine Council on the Marine Environment – Visionary Award 2010; New England Water Works Association Water System of the Year 2011; and an American Society of Civil Engineers (ASCE) Outstanding Civil Engineering Achievement Award in 2010.

In 2002, I assumed my predecessor's position on the State Water Quality Standards Advisory Committee. As the NH Municipal Association's representative on this Committee I became involved in the Nutrient Technical Advisory Committee (TAC) for the New Hampshire Estuary Project which is currently the Piscataqua Regional Estuary Partnership (PREP). The purpose of the TAC was to provide technical peer review on the science used to develop water quality standards for the estuaries of New Hampshire. .A specific focus of this Committee was whether and how nitrogen could be affecting Bay ecology, in particular eelgrass populations that have varied widely over time.

In 2005, EPA directed the State to develop nutrient standards for the Estuary – this was part of a national effort on EPA's part. Up until late 2008 nitrogen, although a concern, was not identified as the source of impacts on the Great Bay. In particular, it was concluded, based on federally funded studies, that increased nitrogen levels had not caused increased algal growth and had not adversely impacted transparency in the Bay. I have attached with my comments presentations given by DES staff relative to these conclusions. Then in 2008 there was an abrupt turn around. At a Water Quality Standards Advisory Committee meeting a simplified data analysis was presented, ignoring the previous detailed studies and reaching an opposite conclusion. This incorrect analysis was supported by EPA and subsequently became the basis for setting standards and declaring virtually all waters in the estuary nutrient impaired. All of this occurred without any formal adoption in accordance with law or formal approval of the criteria by EPA as new water quality standards. Thus, the impacted communities had no opportunity to challenge these changes.

This about face caused Portsmouth to reach out to other communities with wastewater treatment facilities to discuss the State's water quality criteria. The change in the State's conclusion with regard to role of nutrients spelled trouble for municipalities discharging into the Great Bay Estuary. The proposed criteria for nitrogen is not achievable and has be used by EPA to claim that nitrogen must be treated to the "limit of technology" at wastewater treatment facilities and that stringent stormwater treatment must also be implemented to improve water transparency.

On March 15, 2010, I attended a Water Environment Federation EPA Staff briefing in Washington DC. Mike Hanlon, the Director of Wastewater Management, advised attendees that EPA didn't have the time or the money for science; and that EPA was going to apply the Chesapeake nutrient criteria program nationally. The following day at the Congressional Briefing breakfast I was told by Regional Administrator Spalding that until Portsmouth and the other communities developed their own science, EPA would not consider communities concerns that millions of dollars would be misspent, delivering little to no environmental benefit.

Complicating EPA's apparent limited "time and money," are the interests of Non-Governmental Organizations (NGOs) which appear to be having a disproportionate impact in the water quality process and the setting of permit limits. I was told that the regulators were worried about the possible lawsuits by NGOs and they were not afraid of the municipalities. This deference to the NGOs is an indication that EPA is more concerned about the policy issues than getting the science right and implementing cost effective solutions to protect and improve the environment.

This involvement by NGOs may explain why the repeated requests for involvement of the Coalition Communities' technical experts were rejected or trivialized.

For example, Portsmouth was given assurances by representatives of NHDES that it would be allowed to participate in a formal peer review of the NHDES draft nutrient criteria to be organized by EPA. Instead, Portsmouth and the other communities were excluded from the draft criteria peer review process at the EPA level in 2010. This EPA peer review was a carefully orchestrated exercise designed to provide an appearance of scientific credibility to a fundamentally flawed nutrient criteria that met EPA's policy objectives. I have attached for the record correspondence relative to that process.

By rejecting the public's request for an inclusive, objective and open process, the regulators have delayed action which may have yielded environmental benefits in the near term. By ignoring good science, the EPA's regulatory process has set unachievable goals which will misapply scarce public funds while not achieving the intended goal. Communities are forced to spend money on lawyers instead of science and solutions.

These regulatory mandates will have a major impact on the local economy for decades to come. The City's sewer users have seen their sewer rates double in the last ten years. If limits of technology are mandated for Portsmouth permits, the sewer rate could be as high as $22 per 100 cubic feet. That means that for the average home owner their annual sewer bill would be $2,640. To put this in perspective, my sewer bill will be about 40% of my annual property tax bill. These high rates will have the unintended consequence of driving businesses to non-sewered communities. The magnitude of these costs demand that the standards must be based on a proper scientific foundation and not policy directives. Given the 180 degree reversal on the science we need an objective and fair peer review. We cannot afford to have local resources mis-allocated on ineffective and unnecessary measures that will have little beneficial impact on the Estuary.

In summary, the Great Bay Municipal Coalition is committed to protecting and restoring the Great Bay but we believe the existing science does not support the regulatory decisions being made and should not be the basis for NPDES permits.

h\smw\public works\sewer and water\wastewater – nutrients\gov oversight hearing\phr testimony 52912

PETER H. RICE, P.E.

Portsmouth, New Hampshire

Current Position:

City Engineer, City of Portsmouth, New Hampshire.

Education

B.A., Economics, University of New Hampshire, Durham, 1985
M.S., Civil Engineering, University of New Hampshire, Durham, 1991

General Background

Experience includes: NPDES permit negotiations, project management, preparation of State Revolving Fund (SRF) and State Aid Grant (SAG) applications and contract documentation, analysis and design of wastewater collection, treatment facilities and pumping stations; preparation of plans and specifications; coordination with regulatory and funding agencies; construction administration; and site inspection.

Registration

Registered Professional Engineer: Maine

Relevant Experience:

Portsmouth, New Hampshire (2002-Present) - City Engineer Water & Sewer

- Manage development and implementation of schedules, budgets, and manage on-site City capital projects.
- Maintain compliance of EPA requirements and regulatory guidelines, performed research for requirements and prepared procedure manuals.
- Provide training and mentoring for Junior Engineers
- Manage compliance to all plans, specifications within required budget
- Conduct project engineering work, such as studies, conceptual and preliminary design, and post-design services.
- Conduct data analysis, report writing, presentations, and tours to regulatory agencies and residents regarding City WWTP and City upgrades to water and sewer system.

Portsmouth, New Hampshire- Project Engineer

- Responsible for Preparation of the CSO Long Term Control Plan
- Project staff management alternatives evaluation, subcontractor coordination, and oversight of project budget.
- Responsible for design and management of the Wastewater Facilities Improvement projects; the project involved upgrades at the Peirce Island WWTP to allow for Chemically Enhanced Primary Clarification and improved disinfection.
- Implemented upgrades at the Pease WWTP for construction of a new septage receiving facility.

Kennebunk Sewer District, Kennebunk Maine – Project Engineer

- Managed preparation of Technically Based Local Limits for the District's pretreatment Program.

Kennebunk Sewer District, Kennebunk Maine – Project Engineer

- Responsible for preparation of revised Sewer Use Ordinance.

Berwick Sewer District-Preparation of Preliminary Design phosphorus removal system

- Responsible for cost effective and alternative evaluation

Shoals Marine Lab, Appledore Island, ME – Project Engineer

- Responsible for the design and construction, administration of an innovative septic treatment system upgrade; including an automated batch chlorination/dechlorination disinfection system.

Portsmouth, New Hampshire- Pierce Island Force Main Replacement - Project Manager & Engineer

- Responsible for preliminary, final design, construction and administration of Mechanic Street Pumping station Upgrade.
- Responsible for disinfection system and evaluation study
- Responsible for updating the City's 201 Facilities Plan; including projection of future flows and load.
- Evaluation of the City's 4.8mgd primary treatment plant and hydraulic modeling of the City's collection system.
- Responsible for the preparation of the project specifications.

Highland Village District, Northfield, New Hampshire- Project Engineer

- Responsible for design and preparation of contract plans and specifications for a package trickling filter with subsurface discharge.

Hampton, New Hampshire- Project Engineer

- Responsible for the construction administration of an aeration system upgrade for a 4.7 MGD activated sludge wastewater treatment plant.
- Responsible for nitrification pilot study

Hampton, New Hampshire- Administrative Order

- Evaluate and recommend improvements necessary to meet new copper and ammonia limits in the NPDES permit.

Portsmouth, New Hampshire- CSO Nine Minimum Controls Update to EPA- Project Engineer

- Responsible for preparation of mandatory CSO update to the EPA

Hampton, New Hampshire- Order Control Study

- Prepared inventory of odor sources, review sampling results for odor sources and provided a review of technologies to address odors. Prepared odor control recommendations report.

Newmarket, New Hampshire- User Rate Study

- Review user rates for the Town of Newmarket and determine impact of projects need to address Administrative Order on the user base.

Commission Participation

- Member of SB – 70 NH Senate Commission to Study Great Bay Regional Treated Effluent Discharge System
- Past Chair and Member of the State of NH Water Quality Standards Advisory Committee
- Past Member of Nutrient Technical Advisory Committee (TAC) for the New Hampshire Estuary Project
- Assistant Chair of the NH Senate Commission on Sustainable Funding for Water Infrastructure
- Southeast Watershed Alliance – Board Member

Awards

- NEWEA - Alfred E Peloquin award for significant contributions to the wastewater field

Professional Affiliations:

Water Environment Federation
New England Water Environment Association
NH Water Pollution Control Association

Preliminary results from light attenuation sensors on the Great Bay buoy and hyper-spectral imagery of Great Bay

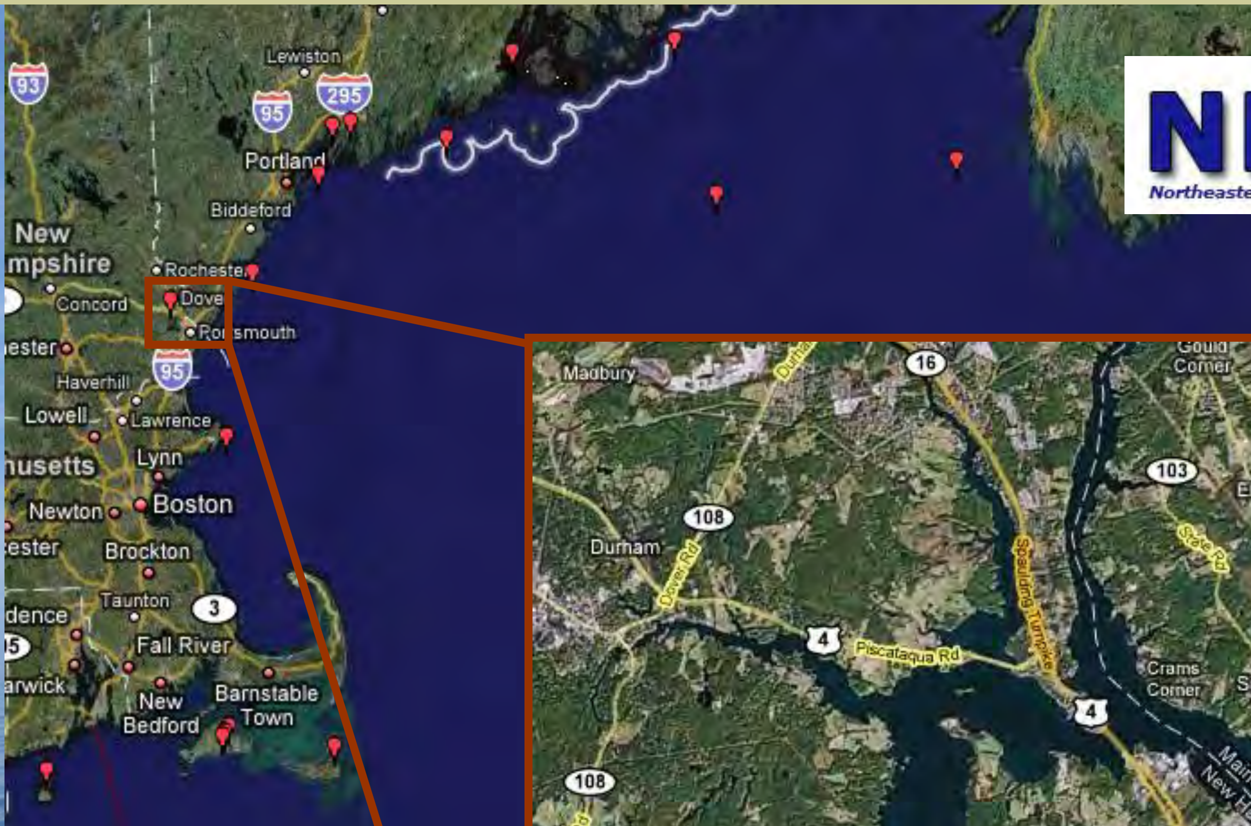
Ru Morrison, UNH
Phil Trowbridge, NH DES
Tom Gregory, UNH
Mike Novak, UNH

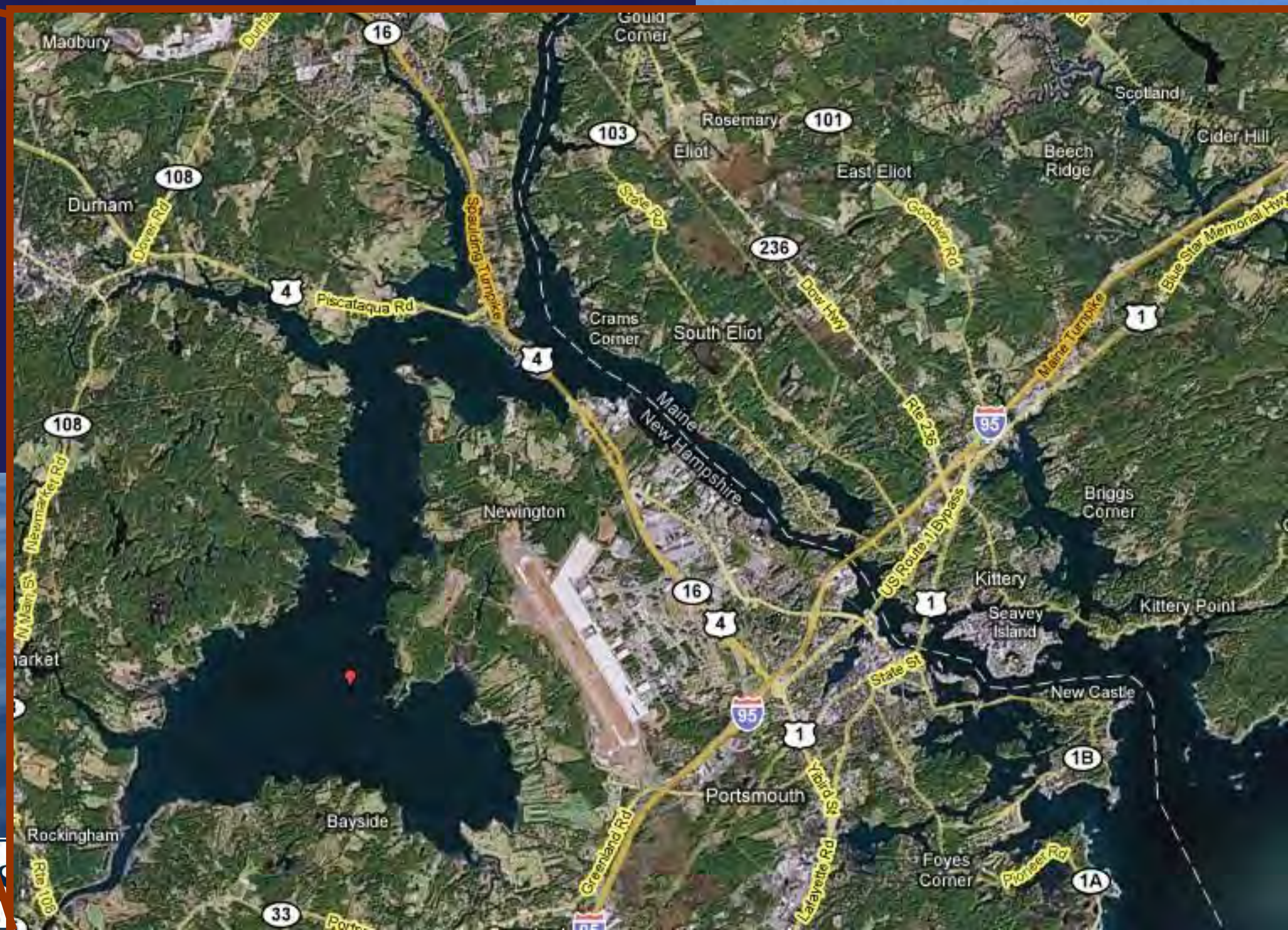
IOOS Observation Registry

Sensor Platforms Map

NERACOOS

Northeastern Regional Association of Coastal Ocean Observing Systems

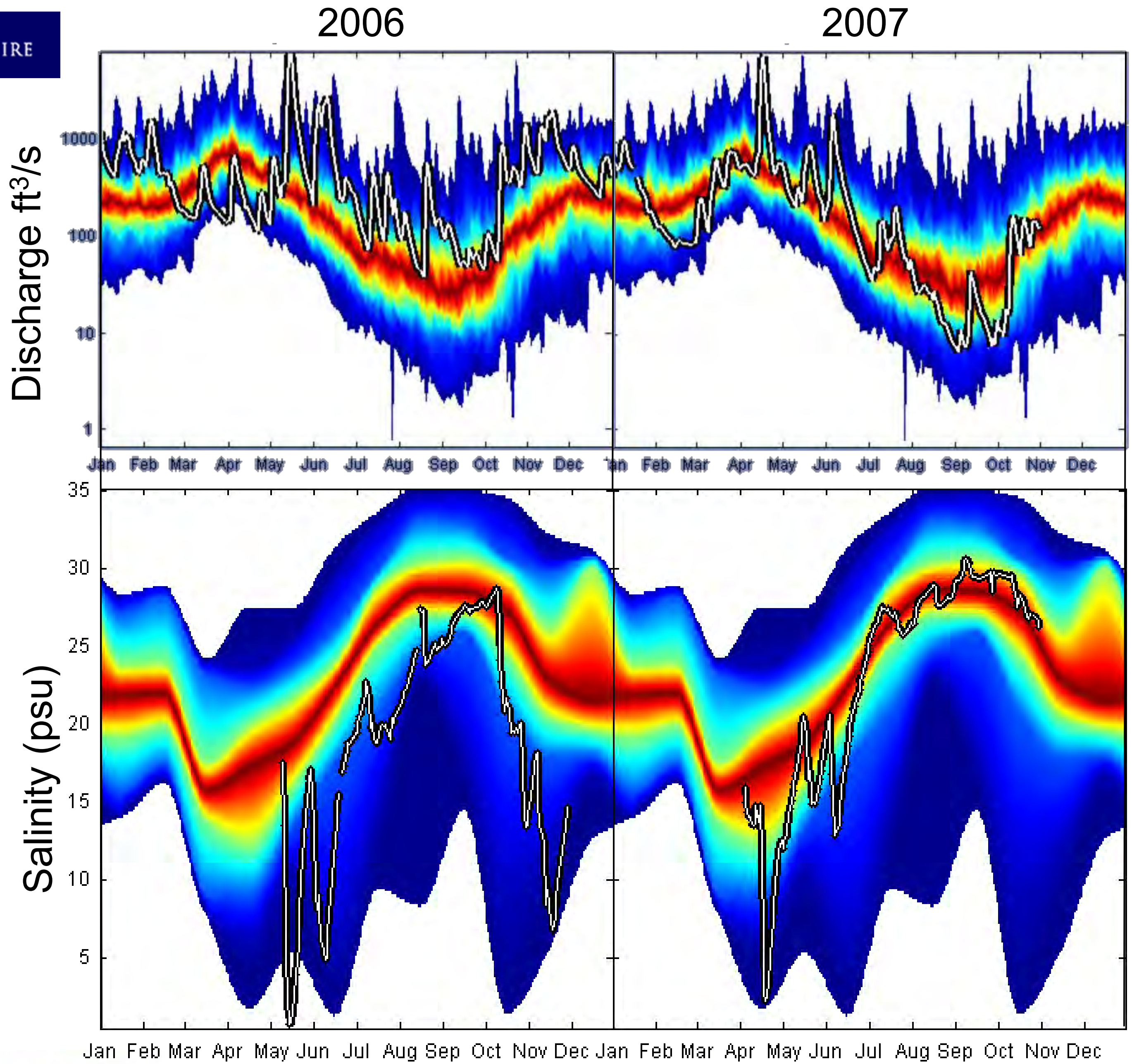


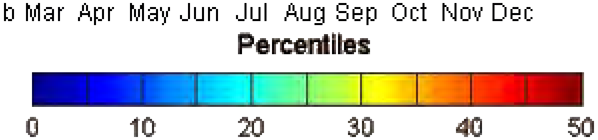


UNIVERSITY of NEW HAMPSHIRE

CENTER OF EXCELLENCE IN COASTAL OCEAN OBSERVATION & ANALYSIS
COASTAL OCEAN Observing Center

Great Bay Coastal Buoy Climatology Visualization



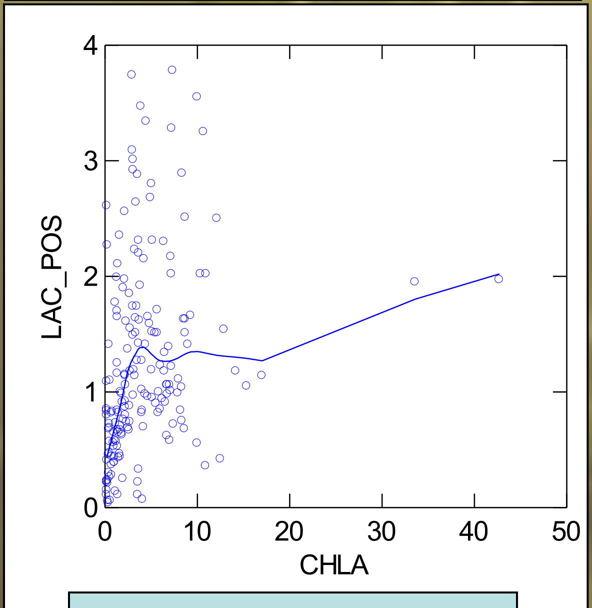


NERACOOS
Northeastern Regional Association of Coastal Ocean Observing Systems

Plots available real time at http://www.cooa.unh.edu/data/buoys/great_bay/

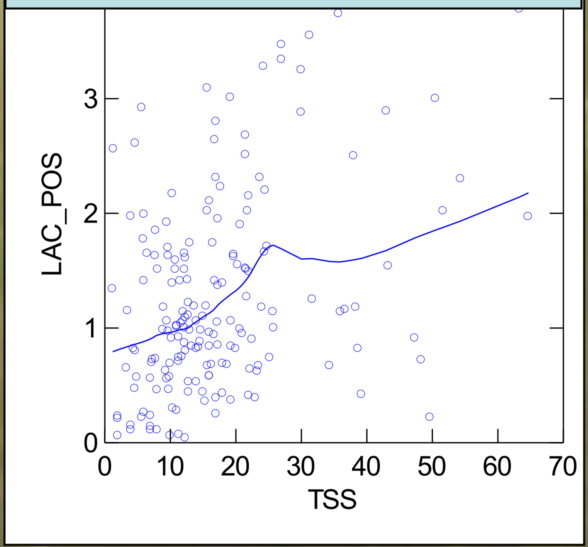
Univariate Regression of Kd vs. Water Quality Parameters

Kd vs Chlorophyll-a



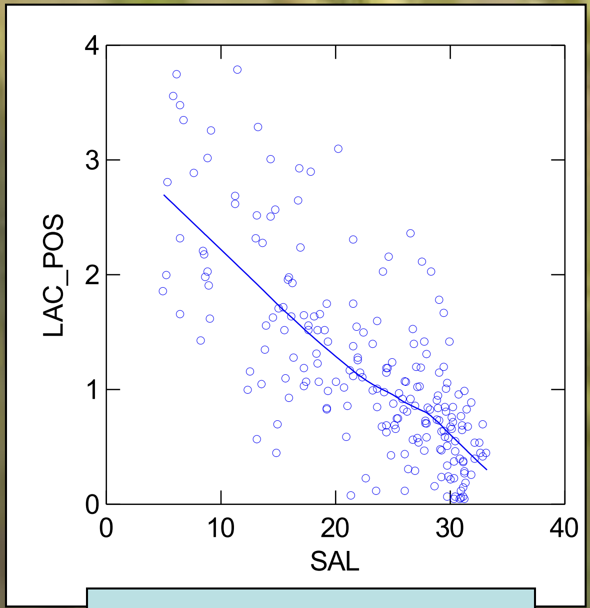
N = 184
R^2 = 0.07

Kd vs TSS



N = 176
R^2 = 0.13

Kd vs Salinity (CDOM)

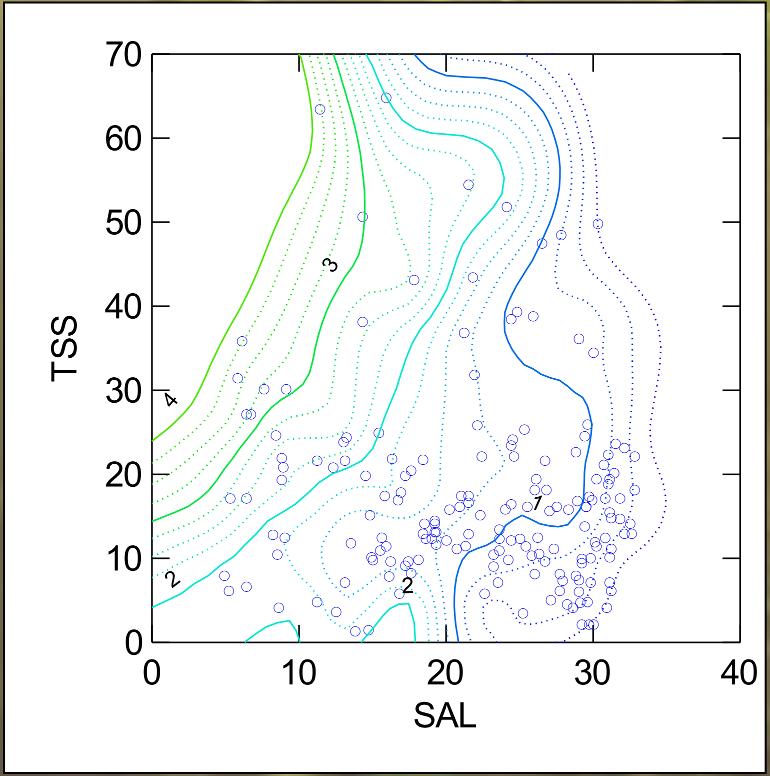


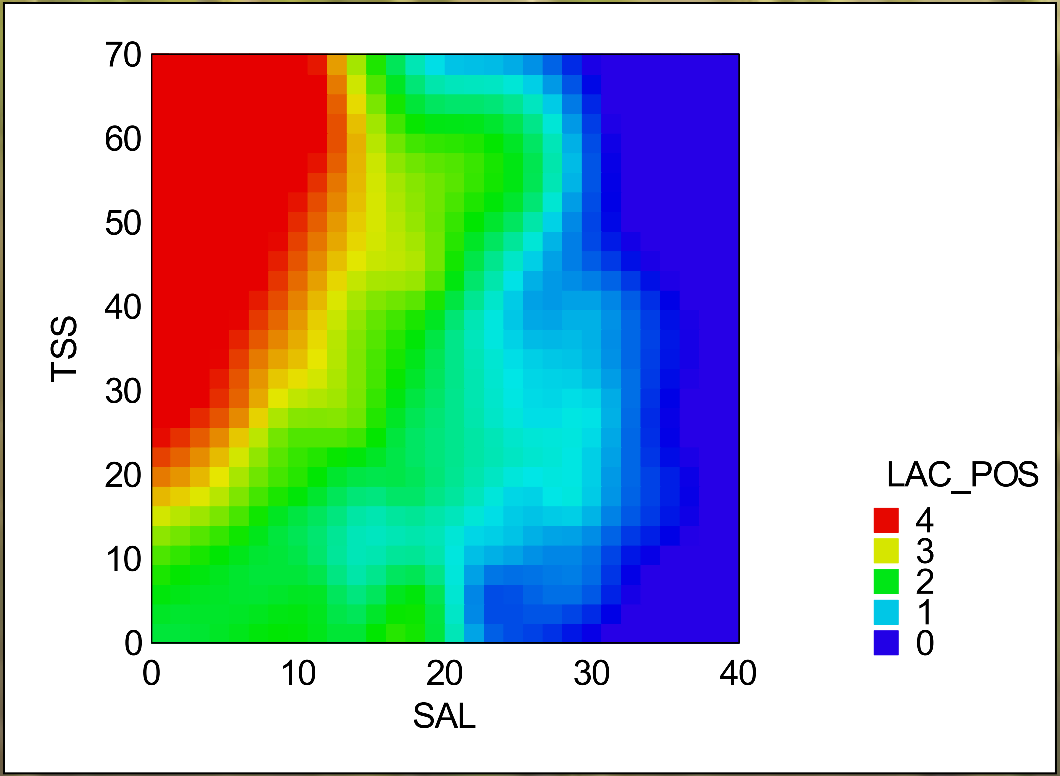
N = 209
R^2 = 0.54

Phil Trowbridge, NHDES

Multivariate Regression of Kd vs. Water Quality Parameters

Multivariate Regression of Kd vs. TSS, Chla, and Salinity (CDOM)
TSS and Salinity are significant, R^2 = 0.61, n=176

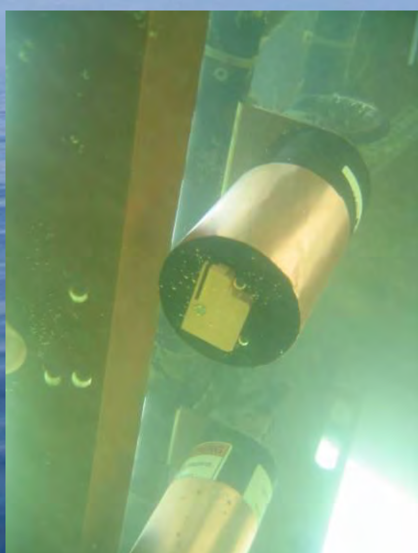


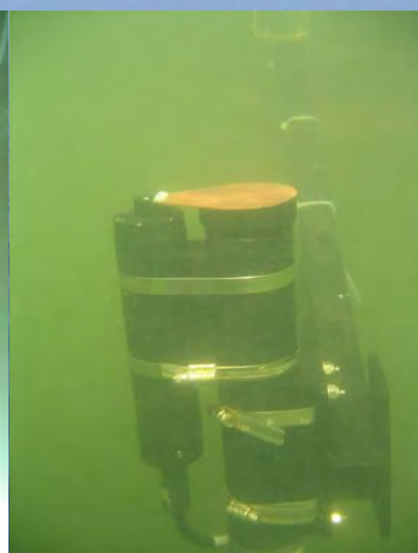


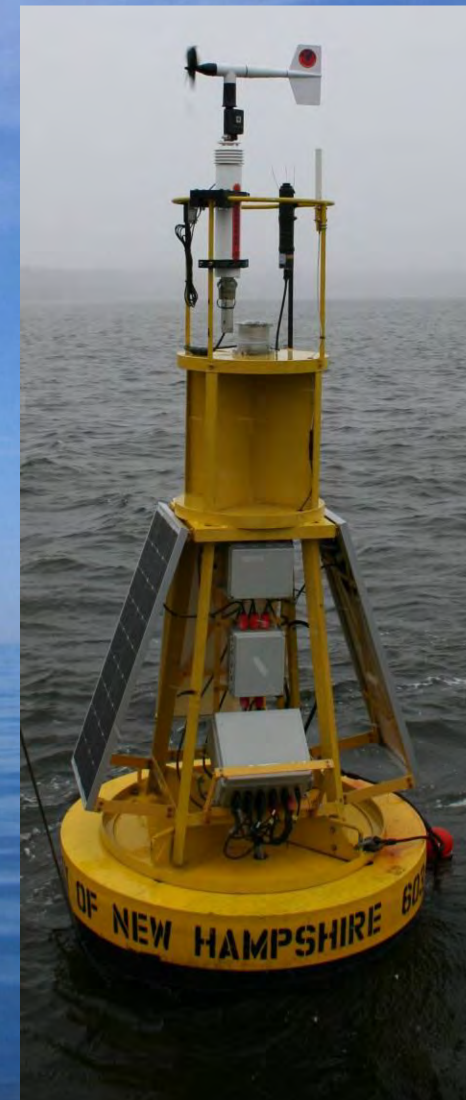
Phil Trowbridge, NHDES

Buoy Light Attenuation Measurements

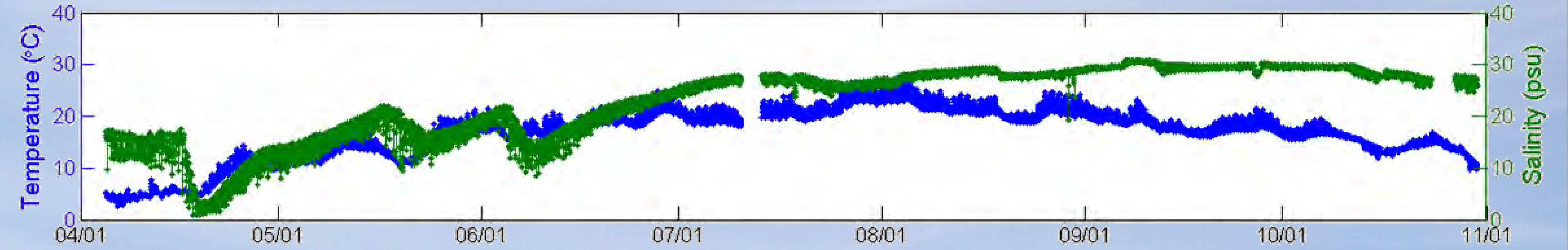
- Surface Irradiance (Hyperspectral 350 nm – 800 nm)
- Subsurface Irradiance (1.1 m)
- FLNTUS – Chlorophyll and Turbidity
- FLCDS – CDOM

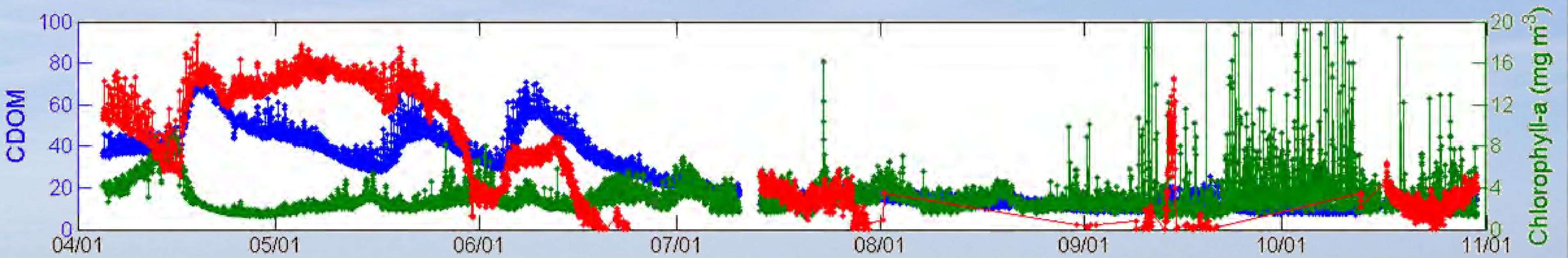




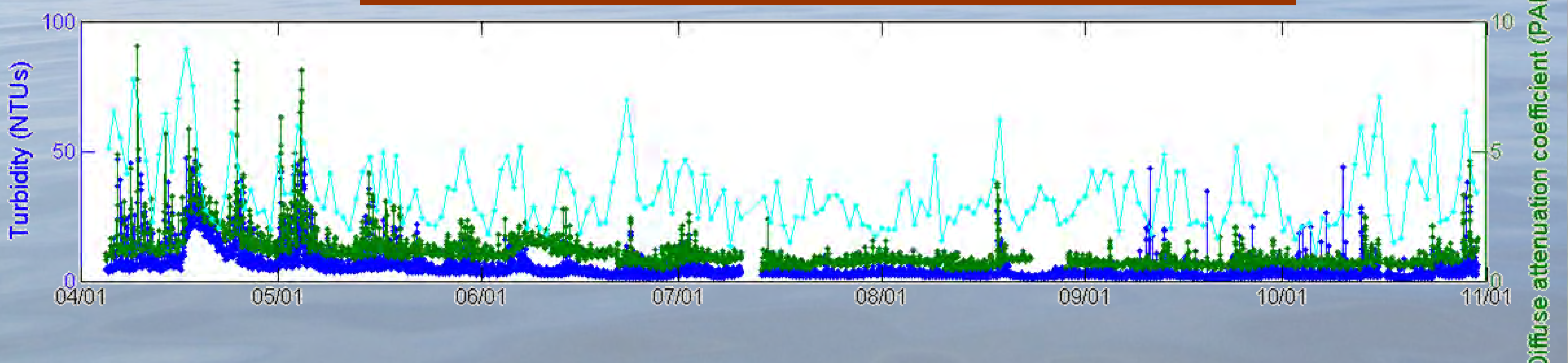


And much more……

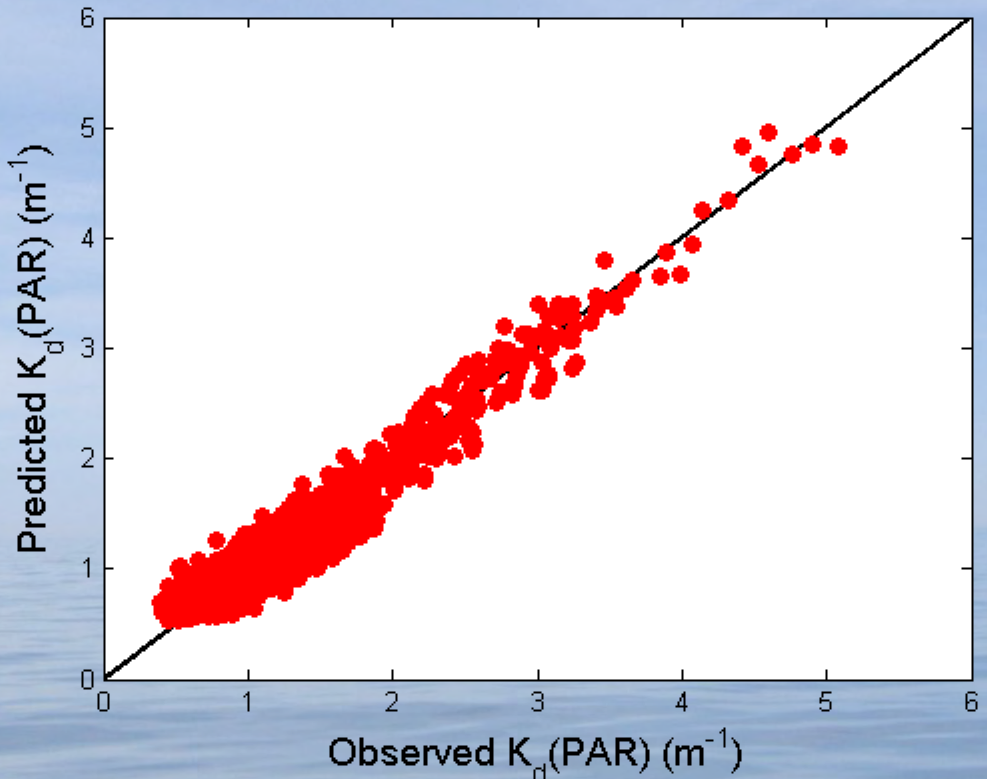




Over 9000 data points so to this year



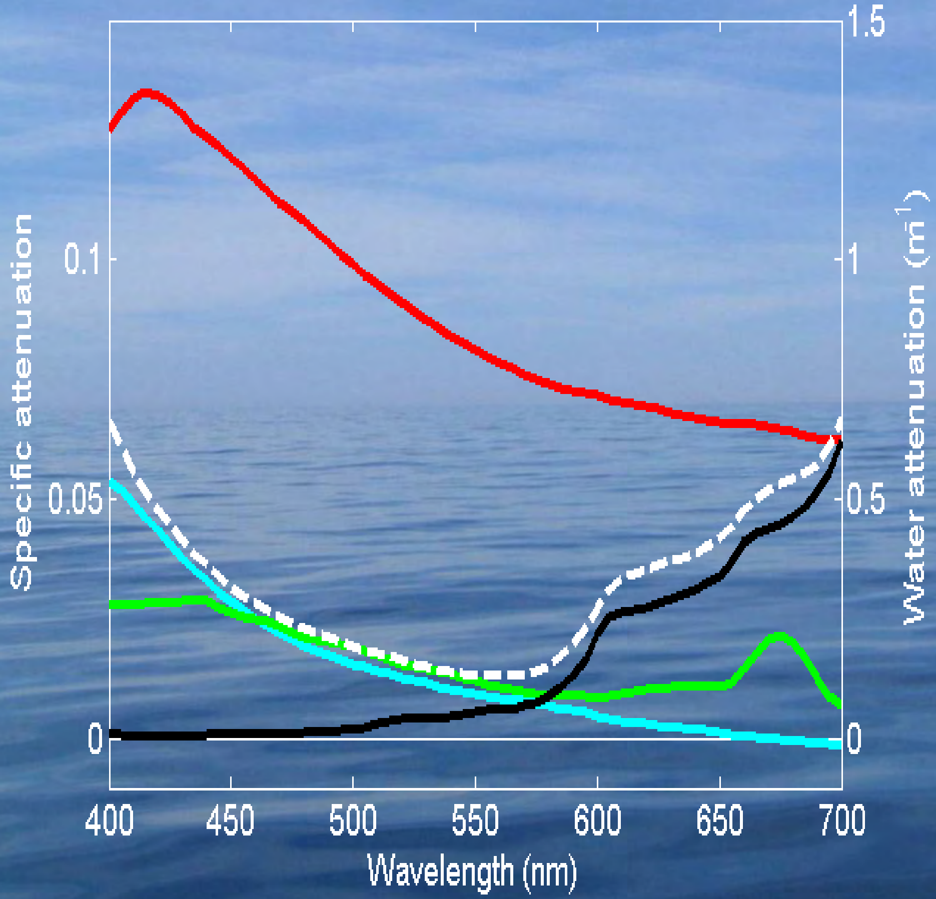
Provisional Buoy relationship –PAR



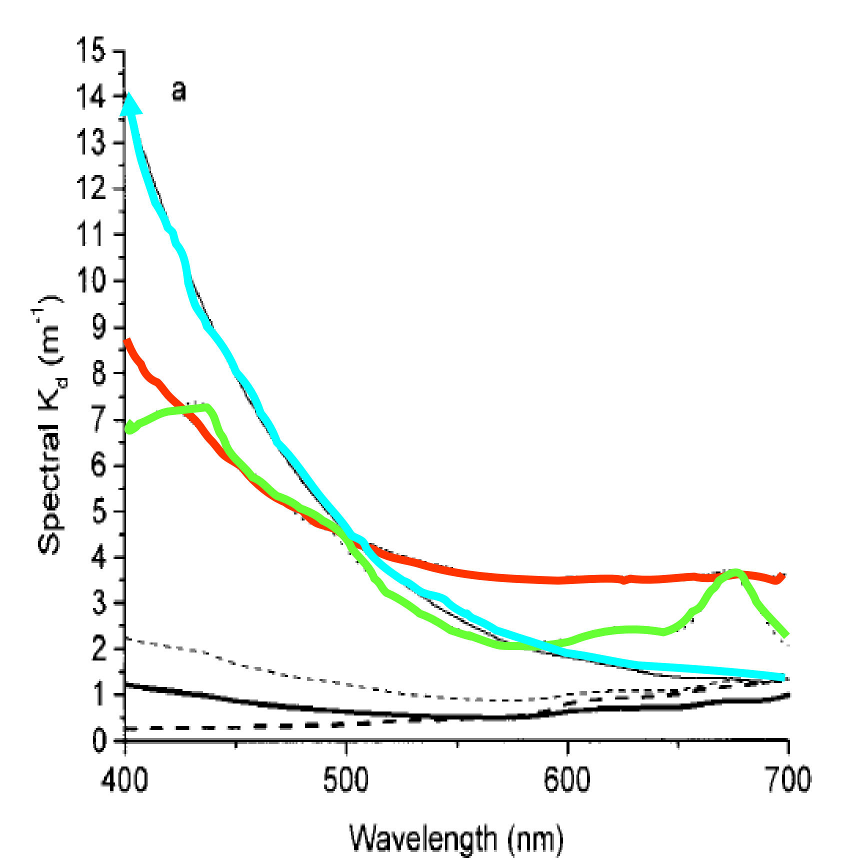
$$Kd(PAR) = 0.3561 + 0.0083.CDOM + 0.0152.Chl + 0.0737.NTUS$$

$r^2 = 0.94$, N=3371

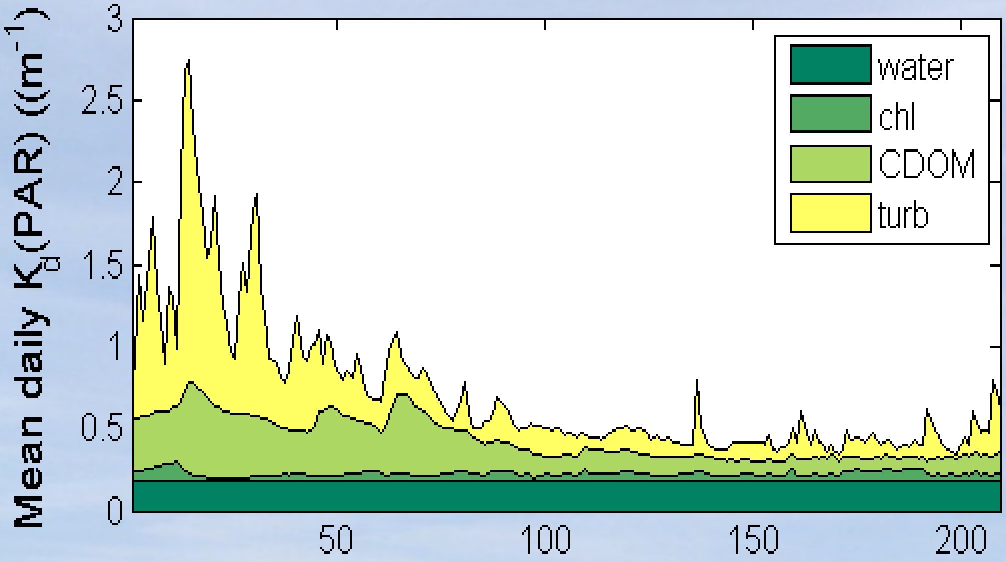
Buoy – Spectral Attenuation

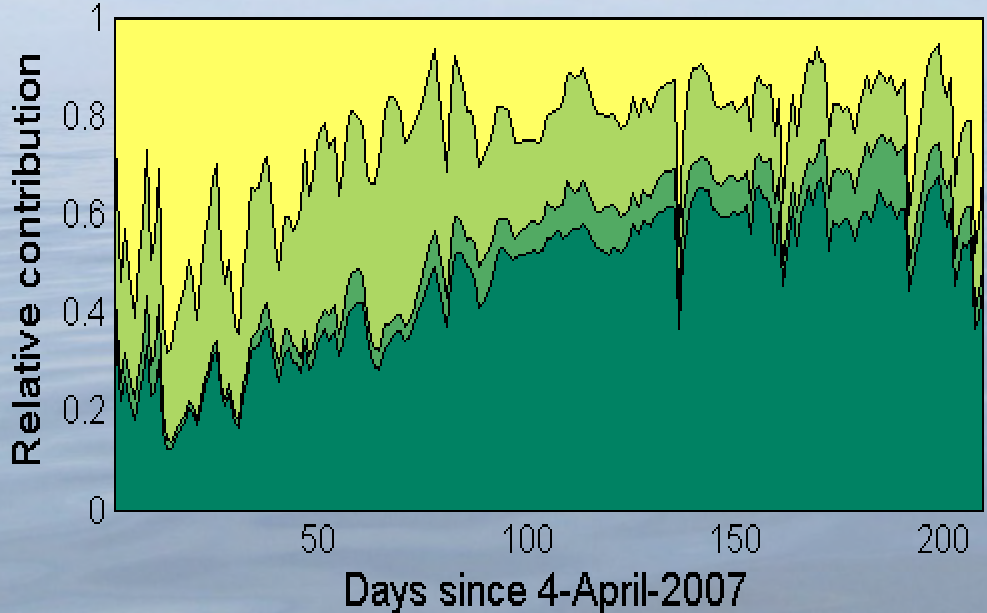


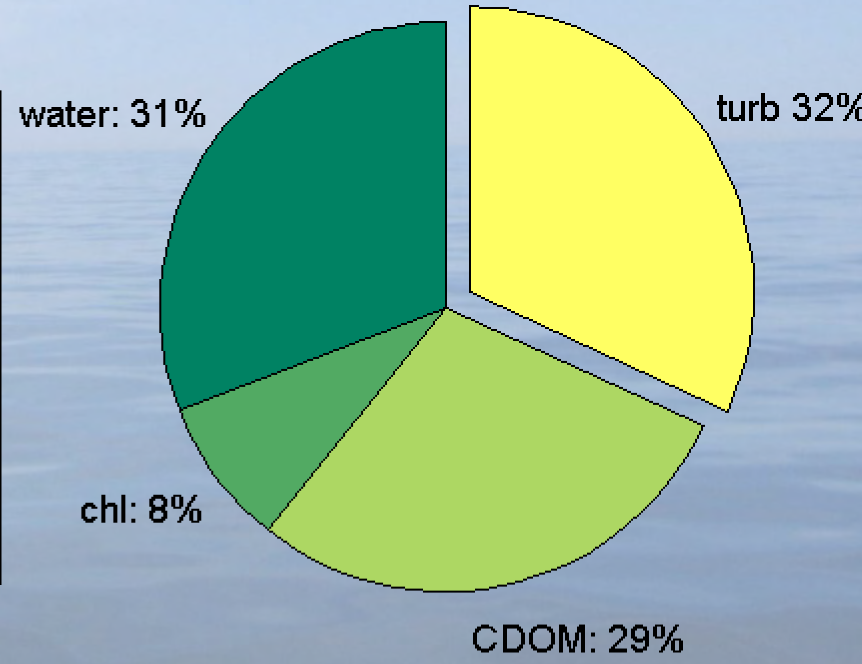
Gallegos, 2001



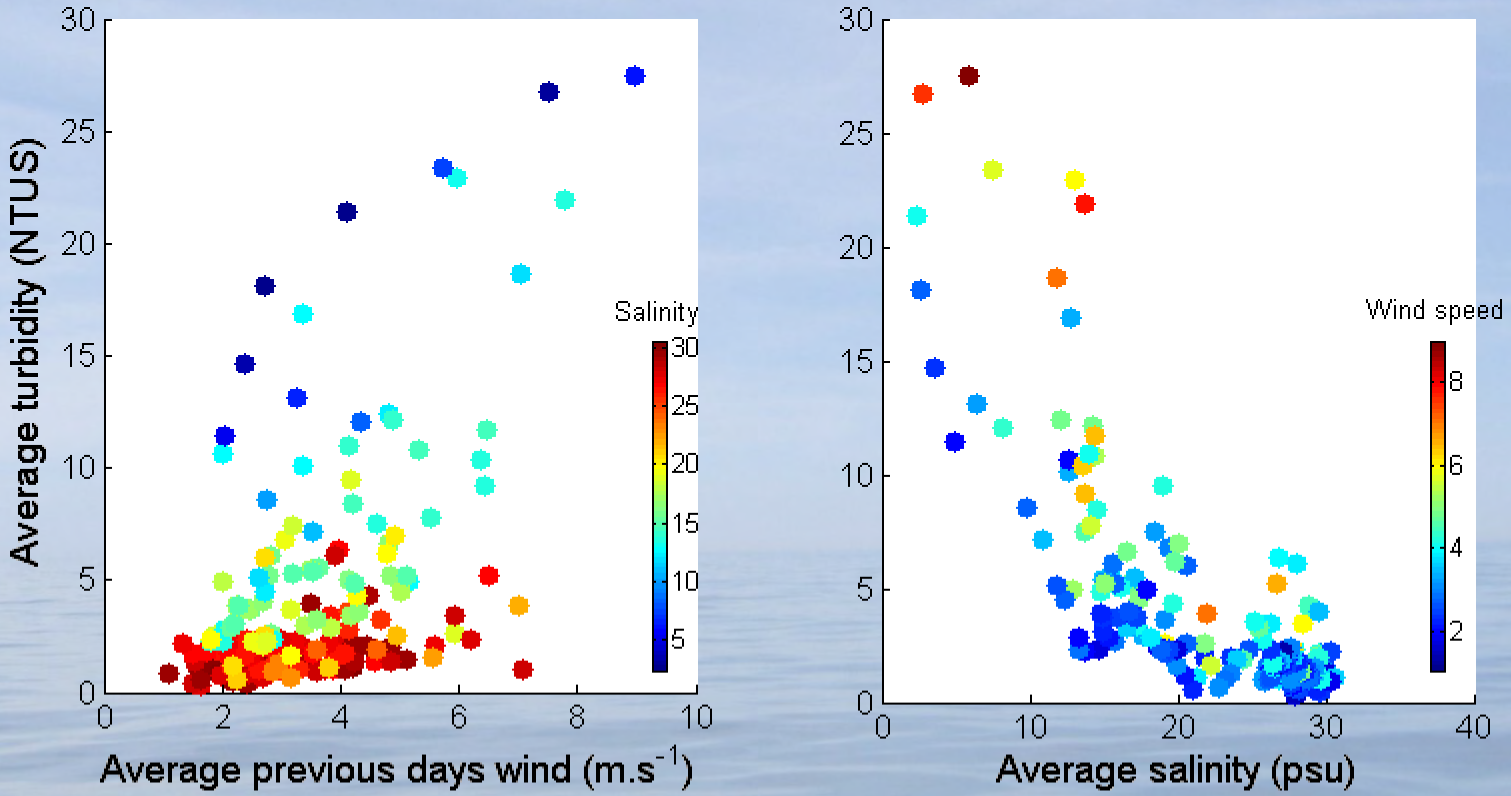
Contributions to K_d(PAR)







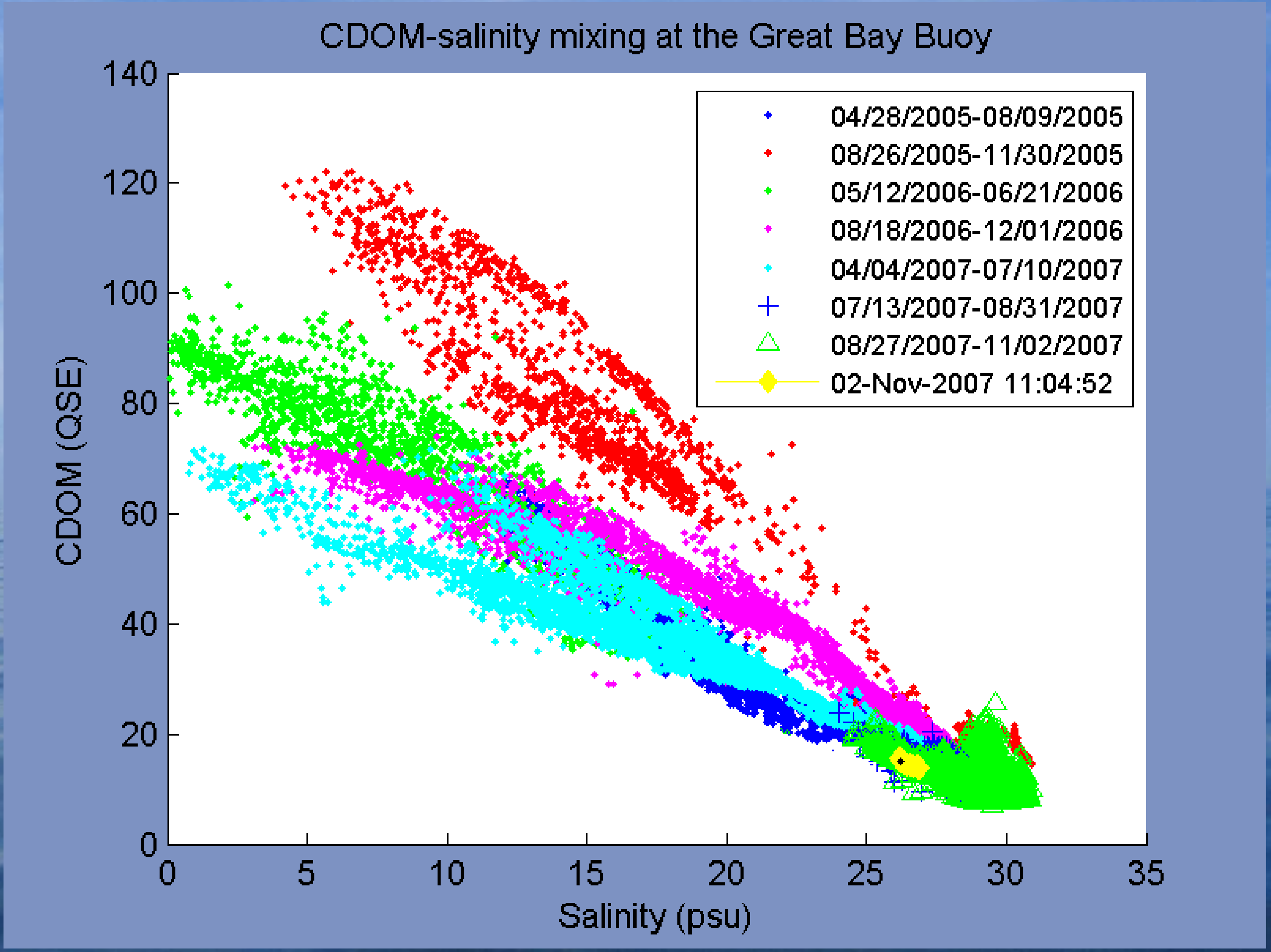
Sources of Variability - turbidity



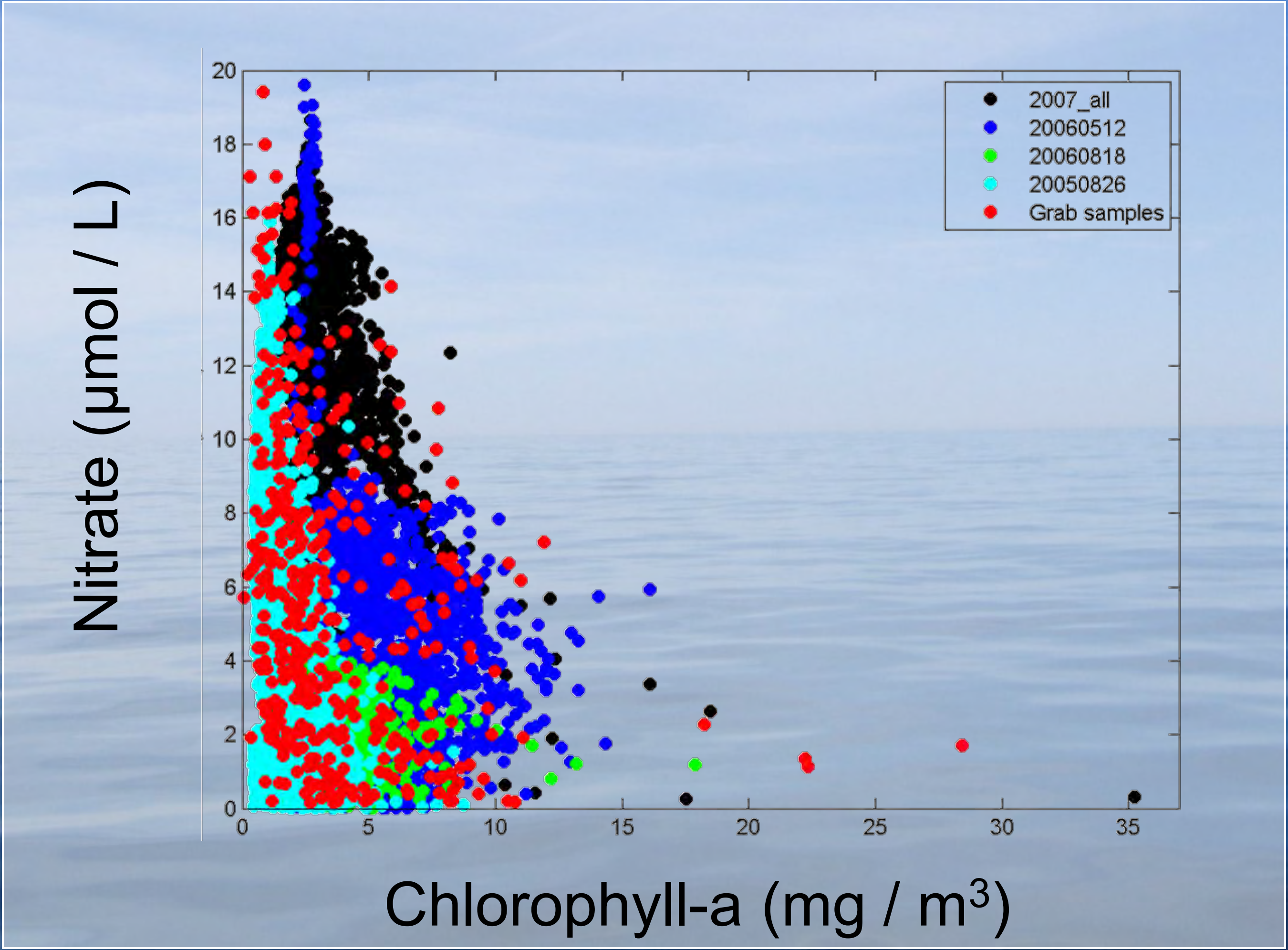
$$\text{Turbidity} = 10^{(1.03 + 0.087.\text{Wind} - 0.041.\text{Salinity})}$$

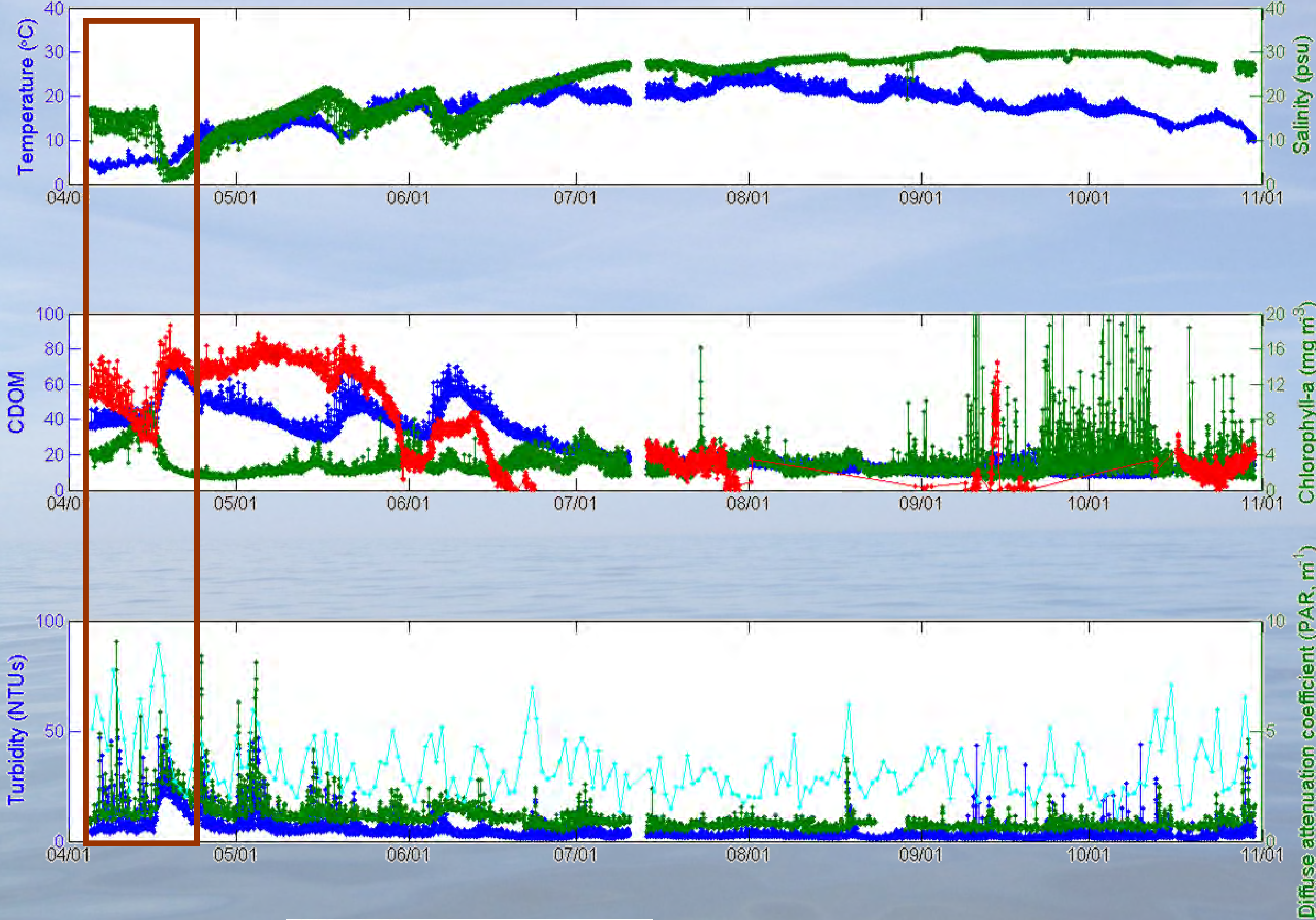
$r^2 = 0.75$, N=207

Sources of Variability - CDOM



Sources of variability - chlorophyll





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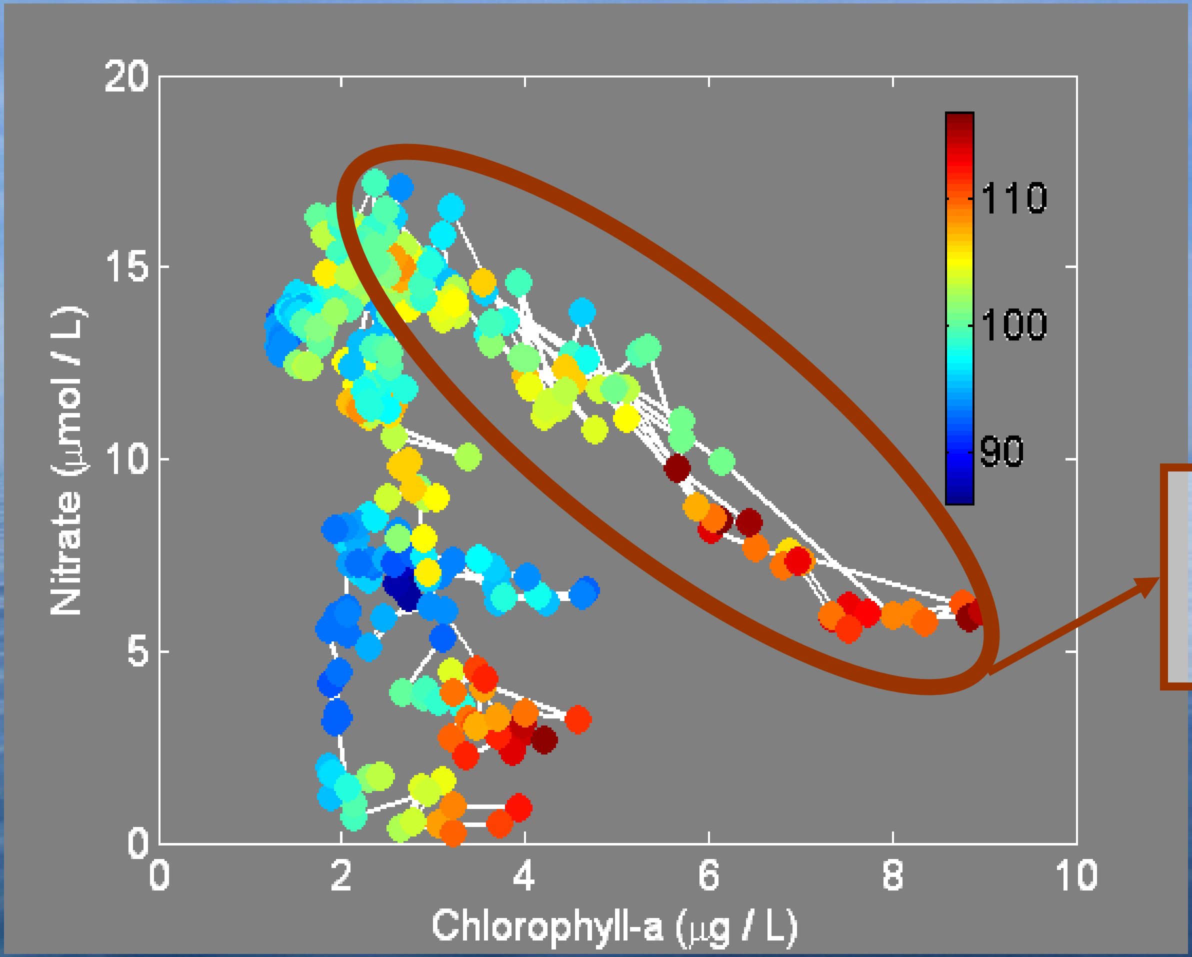
UNH Coastal Observing Center

Sources of variability - chlorophyll



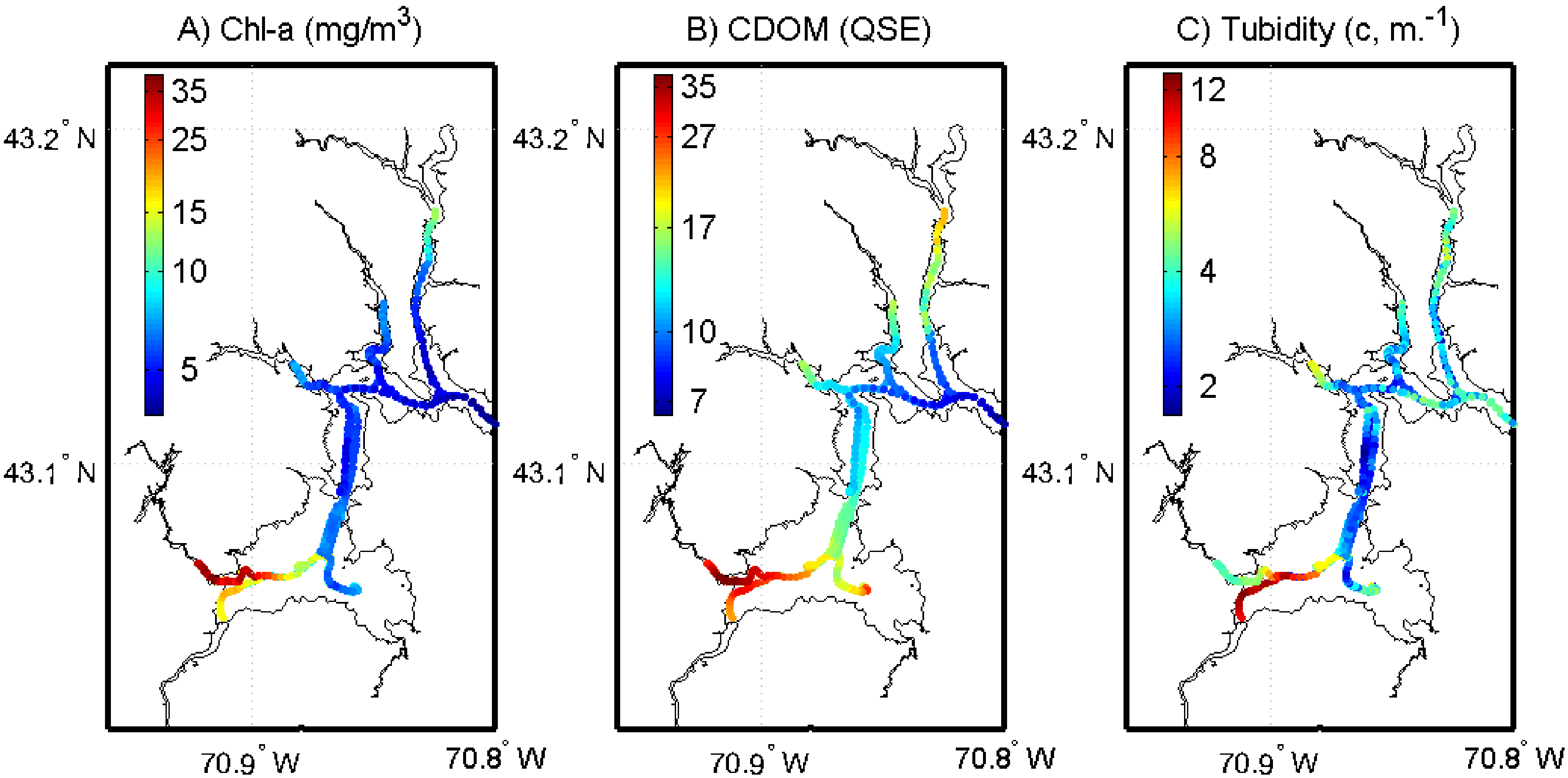
NO_3 = 19.0 - 1.59.Chl-a

r^2 = 0.90, N = 69

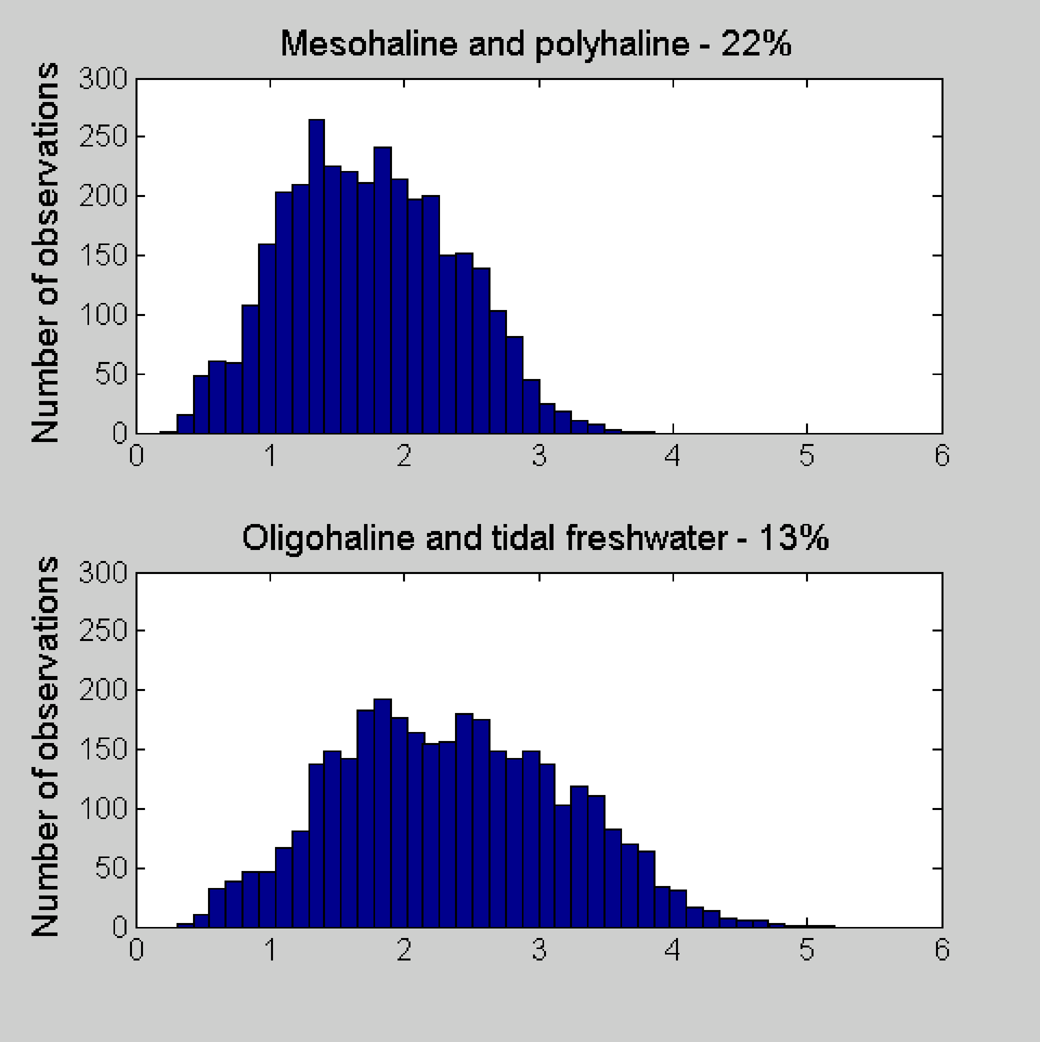
Spatial variability

- EPA grant with NHEP
- Expand results from Great Bay Buoy with hyperspectral imagery
- SpecTIR collected imagery (2 flights between end of July and end of October)
- Grab samples and spatial survey underneath with multiple partners

Flow thru data



How much light does eelgrass need?



Median survival depth = 1.72 m

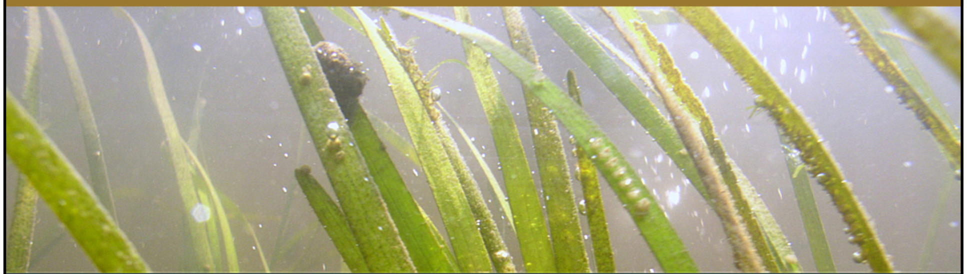
Median $K_d(PAR)$ = 0.88 m^{-1}

Median survival depth = 2.31 m

Acknowledgements

Thanks to:

- All those who collected the historical data
- Dave Shay and the faculty and staff of Jackson Estuarine Laboratory
- Chris Hunt and Shawn Shelito for help with the flow through measurements
- The captain and crew of the R/V Gulf Challenger
- Rich Lagan and Jon Pennock, University of New Hampshire
- Darrell Adams, Cyril Dempsey, and all at Satlantic Inc.
- Andrew Barnard, Ian Walsh, Alex Derr, Ron Zaneveld and all at WET Labs, Inc.
- NOAA for the funding
- NHEP and NHDES



Summary of Light Availability and Light Attenuation Factors for the Great Bay Estuary

Phil Trowbridge, P.E.
NHEP Coastal Scientist
February 14, 2007

New Hampshire Estuaries Project

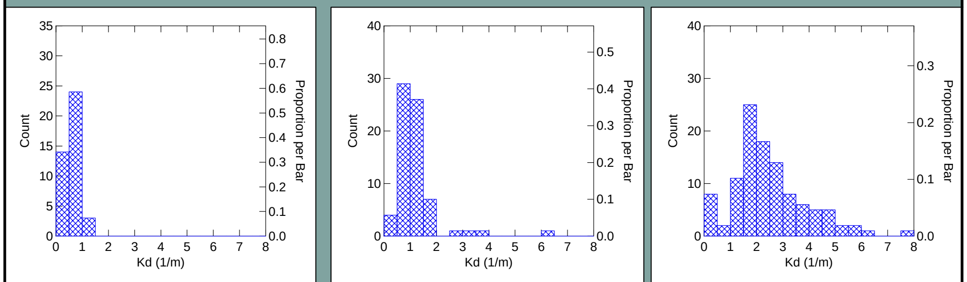
Water Quality Target

- Eelgrass viability is the target for numeric nutrient criteria development
- Factors affecting eelgrass
  - Light through water (water quality)
  - Light to leaf (epiphytes, macroalgae)
  - Disease

Focus on light through water as a first step

Measured Bulk Light Attenuation Through Water in Great Bay

Piscataqua River/ Portsmouth Harbor | **Great Bay/ Adams Point** | **Tidal Tributaries**



Piscataqua River/ Portsmouth Harbor	Great Bay/ Adams Point	Tidal Tributaries
n = 41	**n = 70**	**n = 108**
Median Kd = 0.58 m^{-1}	**Median Kd = 1.01 m^{-1}**	**Median Kd = 2.17 m^{-1}**
Mean Kd = 0.56 m^{-1}	**Mean Kd = 1.19 m^{-1}**	**Mean Kd = 2.45 m^{-1}**

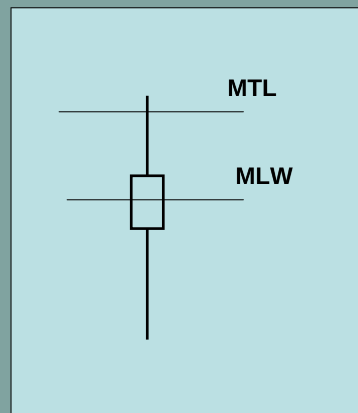
Predicted Depth Range for Eelgrass based on Measured Kd

- Piscataqua River/Portsmouth Harbor
  - Z= -1.2 to -2.6 m, Delta = 1.4 m
- Great Bay/Adams Point
  - Z= -0.9 to -1.5 m, Delta = 0.6 m
- Tributaries
  - None (Zmin>Zmax)

Assumes light requirement of 22% of surface light field for eelgrass survival and no effect of leaf epiphytes. Depth datum is MTL.

Measured Depth Range for Eelgrass in Great Bay

- Merged 2004 eelgrass coverage with bathymetry
- Percentiles of eelgrass depth (MTL)
  - 95th: 0.21 m
  - 75th: -0.64 m
  - 50th: -0.90 m
  - 25th: -1.19 m
  - 5th: -2.33 m



Factors Influencing Light Attenuation

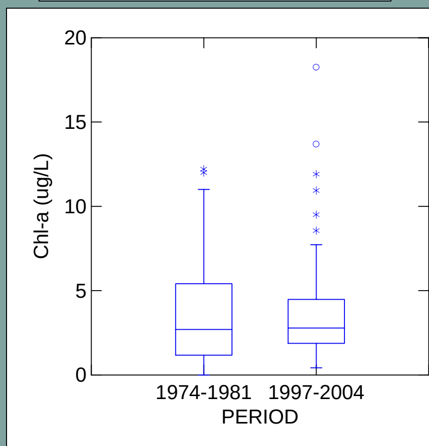
- Phytoplankton (chlorophyll-a)
- Suspended sediments/turbidity
- Colored dissolved organic matter (CDOM)
- Water itself (assumed to be constant)

Assumption: If eelgrass viability is changing, one of these factors must also be changing.

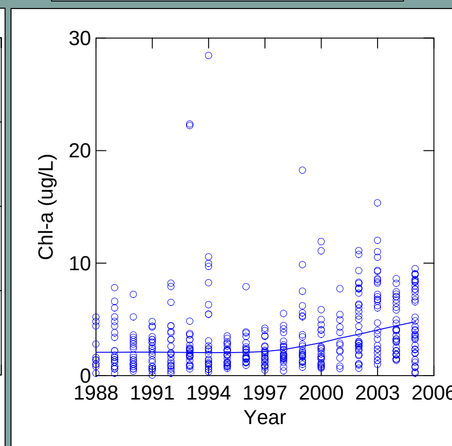
New Hampshire Estuaries Project

Chlorophyll-a Trends at Adams Pt

25 Year Comparison
No apparent change



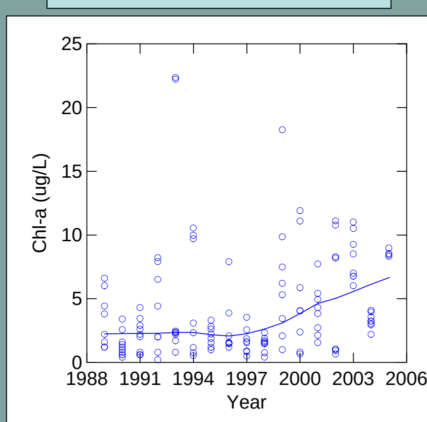
18 Year Record
Slight Increase



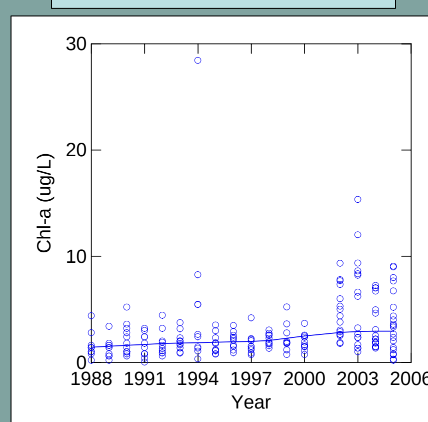
New Hampshire Estuaries Project

Chlorophyll-a Trends at Adams Pt

Spring Bloom (Feb-May)

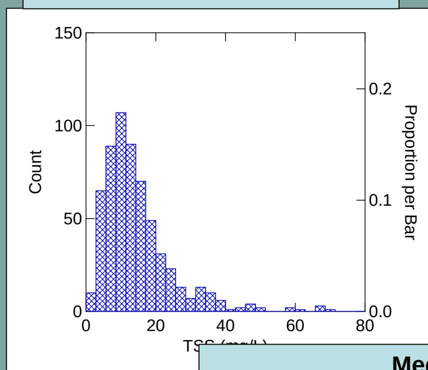


Fall Bloom (Aug-Dec)

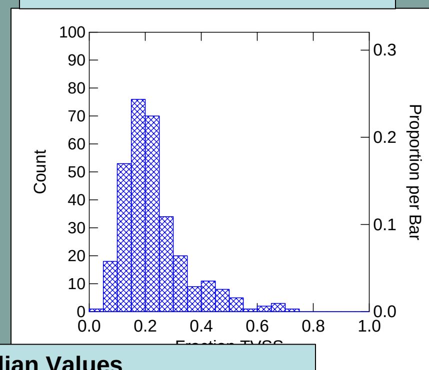


Composition of Suspended Solids

Total Suspended Solids (mg/L)



Fraction of solids that is organic matter

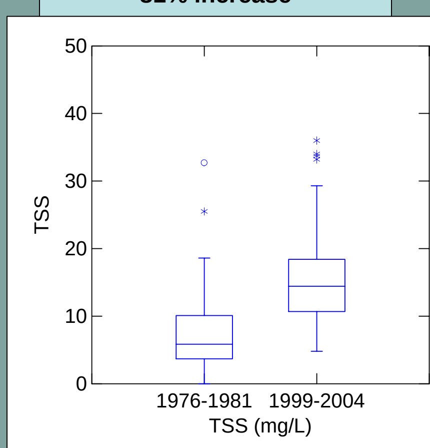


Median Values

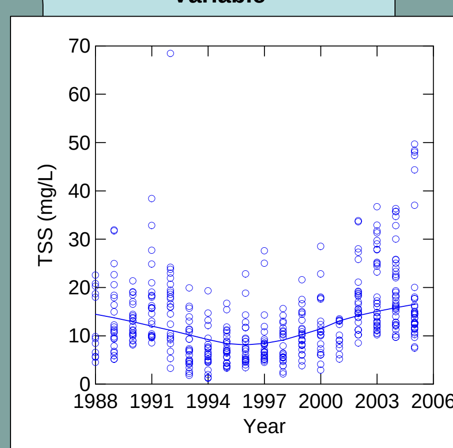
TSS (mg/L)	12.3 mg/L
Part. Organic Matter (mg/L)	1.9 mg/L
Part. Organic Carbon (mg/L)	0.8 mg/L

TSS Trends at Adams Point

25 Year Comparison
81% increase



18 Year Record
Variable



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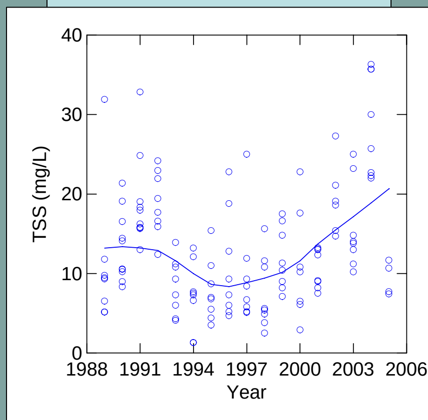
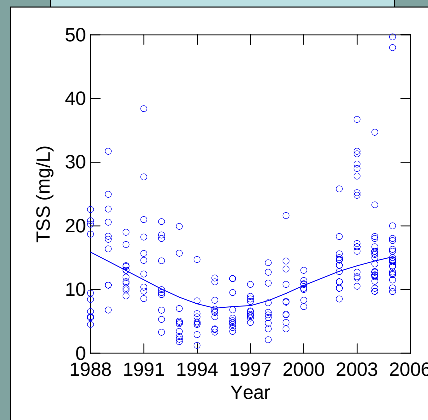
TSS Trends at Adams Point

Spring Bloom (Feb-May)



Fall Bloom (Aug-Dec)



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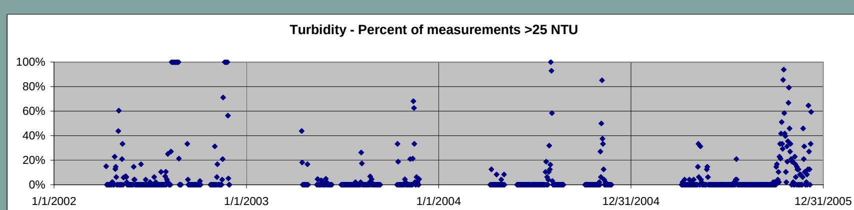
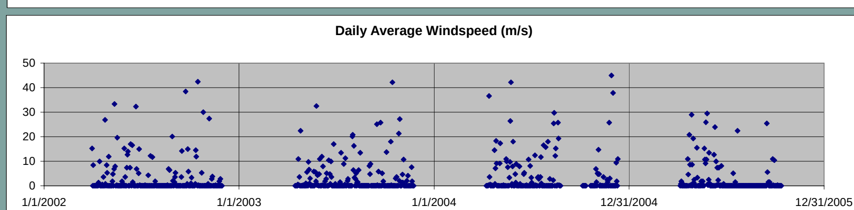
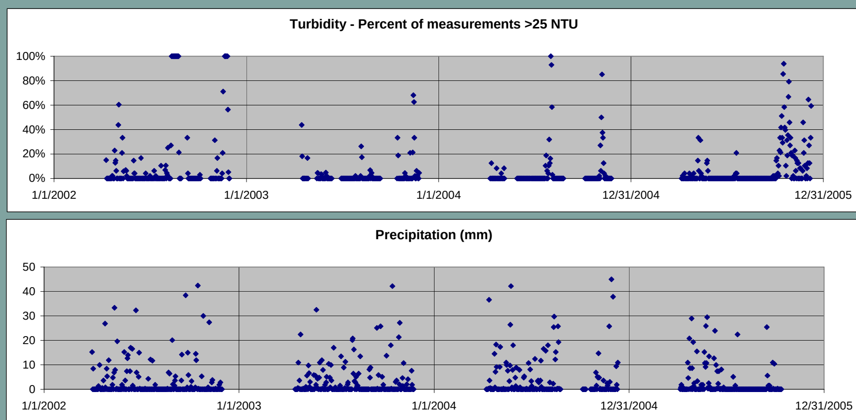
Turbidity Trends in Great Bay





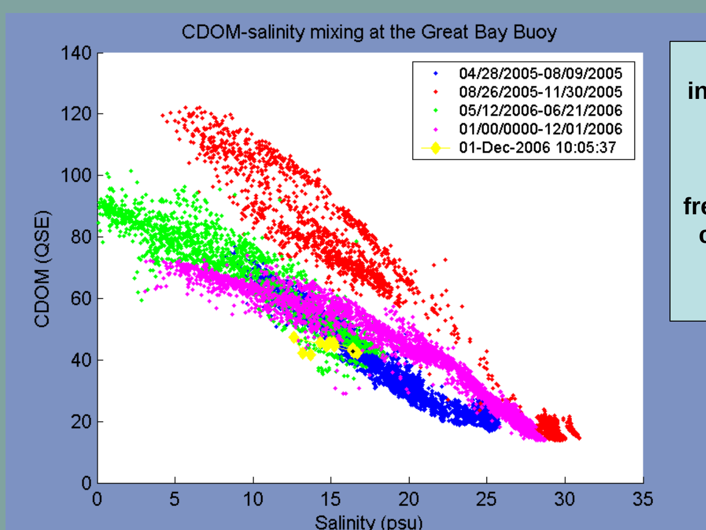
Turbidity vs. Daily Average Wind Speed

Turbidity Trends



Turbidity vs. Daily Precipitation

Colored Dissolved Organic Matter



CDOM is inversely related to salinity because it is loaded with freshwater and is conservatively diluted by seawater.

Data from UNH Coastal Ocean Observing Center

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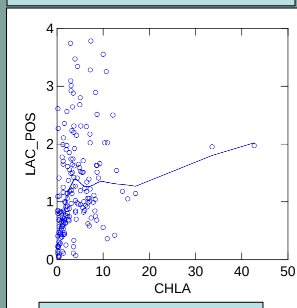
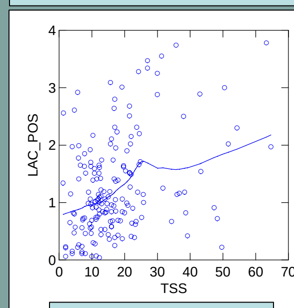
Univariate Regression of Kd vs. Water Quality Parameters

Kd vs Chlorophyll-a



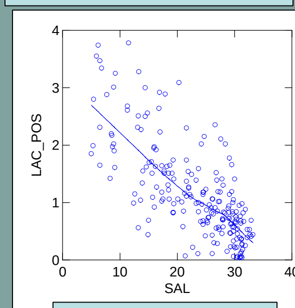
N = 184
R^2 = 0.07

Kd vs TSS



N = 176
R^2 = 0.13

Kd vs Salinity (CDOM)



N = 209
R^2 = 0.54

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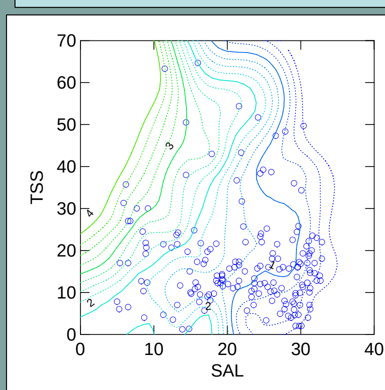
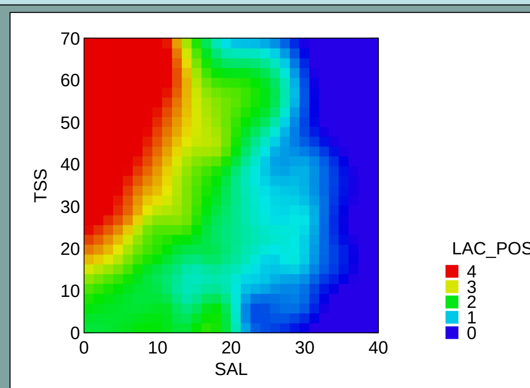
Multivariate Regression of Kd vs. Water Quality Parameters

Multivariate Regression of Kd vs. TSS, Chla, and Salinity (CDOM)
TSS and Salinity are significant, R^2 = 0.61, n=176





CDOM Observations

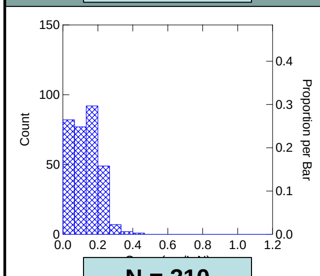
- CDOM accounts for ~50% of the light attenuation in Great Bay.
- Light attenuation by CDOM is a more complicated process than the "nitrogen > phytoplankton > shading model" (Roulet and Moore, 2006, Nature).
- Need changes to buoy instrumentation to build better regression equations.

Factors Influencing Water Quality

- Nutrient concentrations / limiting nutrients
- Nutrient loads
- Suspended sediment loads

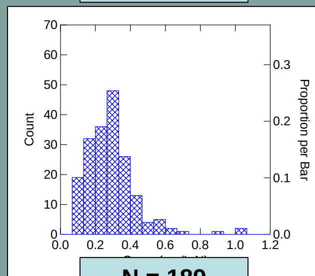
Nitrogen Concentrations in Great Bay (2000-2005)

Dissolved Inorganic Nitrogen



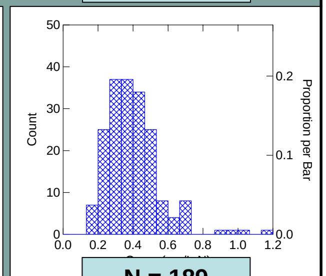
N = 310
Median = 0.131 mg/L

Total Dissolved Nitrogen



N = 189
Median = 0.280 mg/L

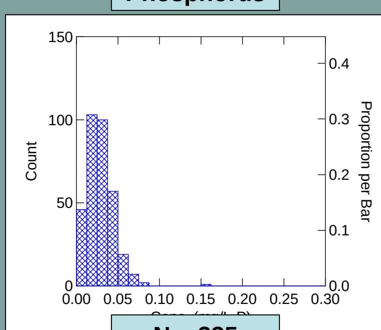
Total Nitrogen



N = 189
Median = 0.370 mg/L

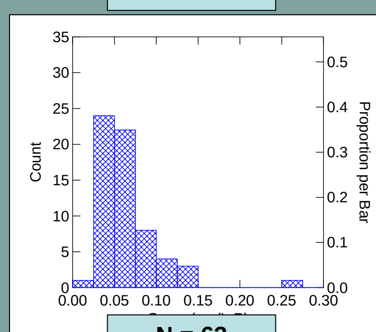
Phosphorus Concentrations in Great Bay (2000-2005)

Dissolved Inorganic Phosphorus



N = 335
Median = 0.027 mg/L

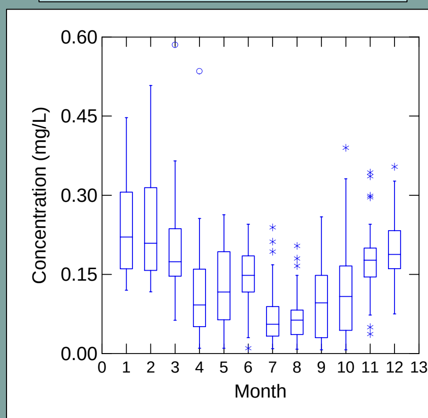
Total Phosphorus



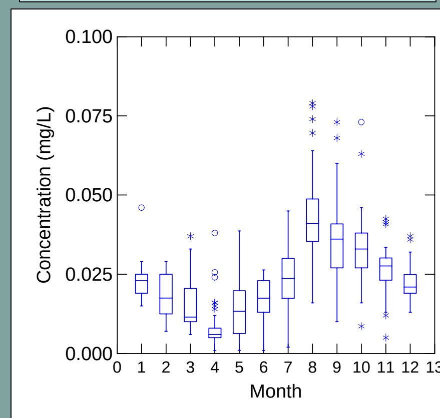
N = 63
Median = 0.059 mg/L

Dissolved Nitrogen and Phosphorus Seasonal Trends

Dissolved Inorganic Nitrogen

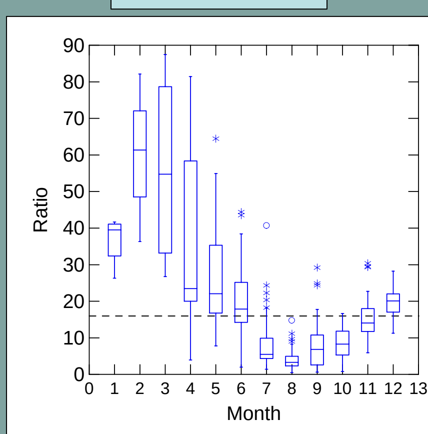


Dissolved Inorganic Phosphorus

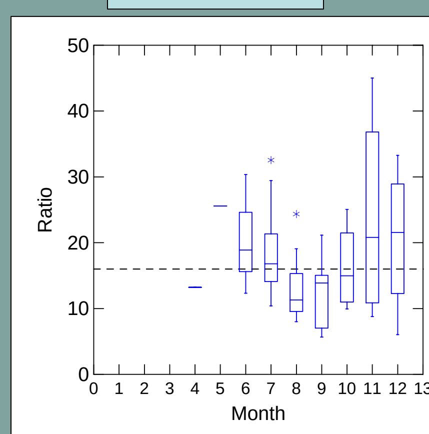


Nitrogen to Phosphorus Molar Ratios in Great Bay 2000-2005

DIN:DIP



TN:TP



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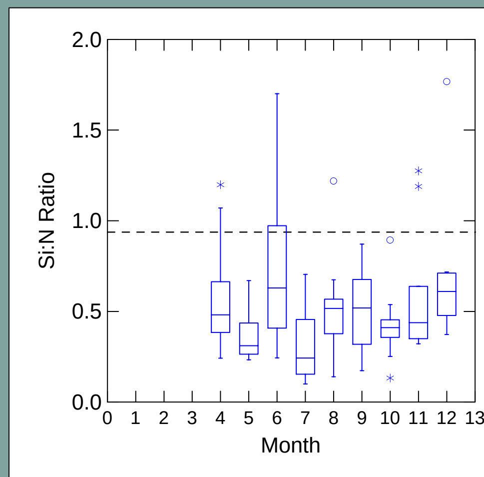
Silica to Nitrogen Molar Ratio in Great Bay 2004-2005



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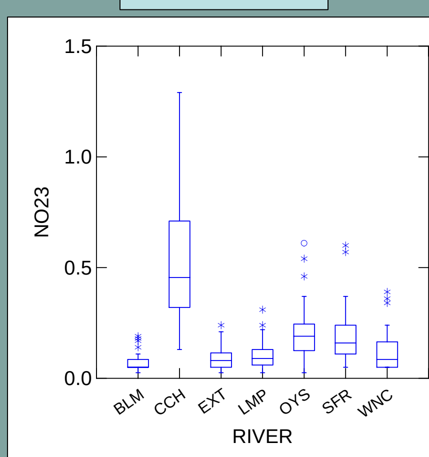
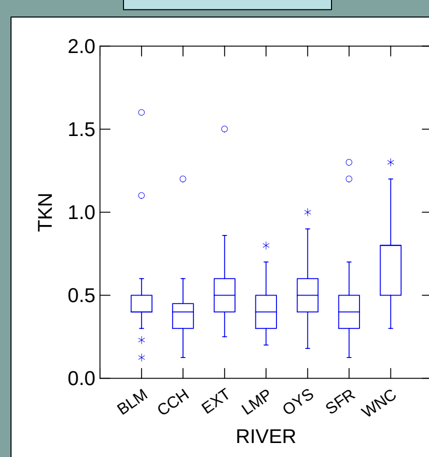
Nitrogen Species Concentrations in Great Bay Tributaries

Nitrate (mg/L)



TKN (mg/L)



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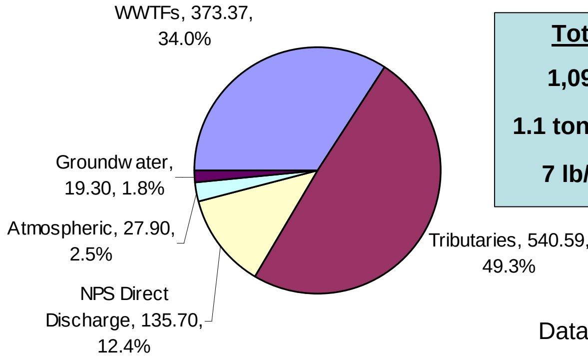
Nitrogen Loads to the Great Bay Estuary

Great Bay and Upper Piscataqua River Estuary
Total Nitrogen Loads in tons N per year



Total N load

1,097 tons/yr

1.1 tons/yr/sq. mile

7 lb/person/yr

Data Source: NHEP

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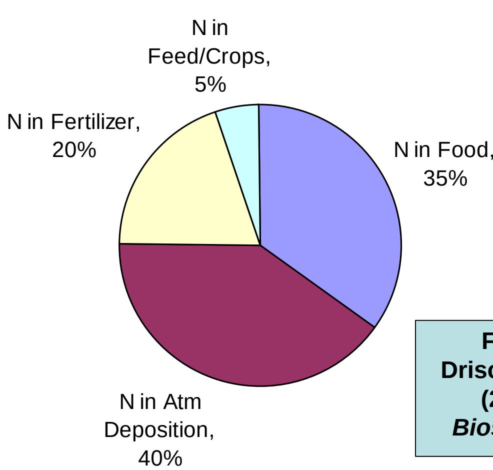
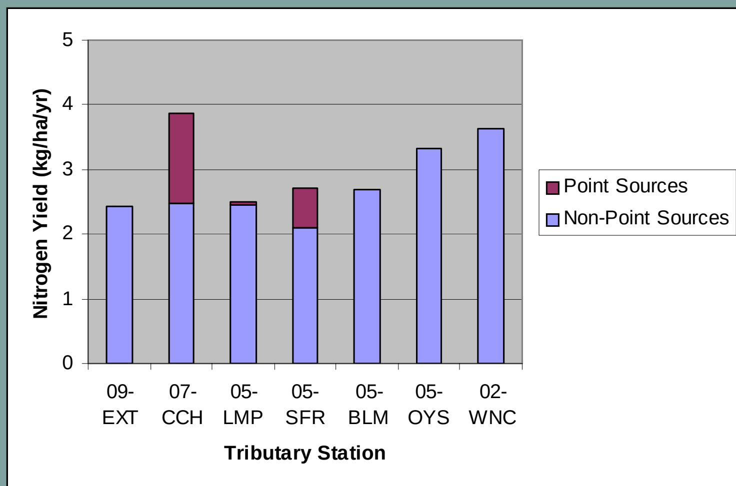
Nitrogen Sources in the Great Bay Watershed



From: Driscoll et al. (2003) *Bioscience*

Nitrogen Yield from Watersheds



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Nitrogen Yield from Watersheds

- Overall nitrogen yield for Great Bay watershed was 3.9 kg/ha/yr.
- Albemarle-Pamlico Study (1992)
  - TN yield for forest was 2.3 kg/ha/yr
  - TN yield for developed land was 7.5 kg/ha/yr

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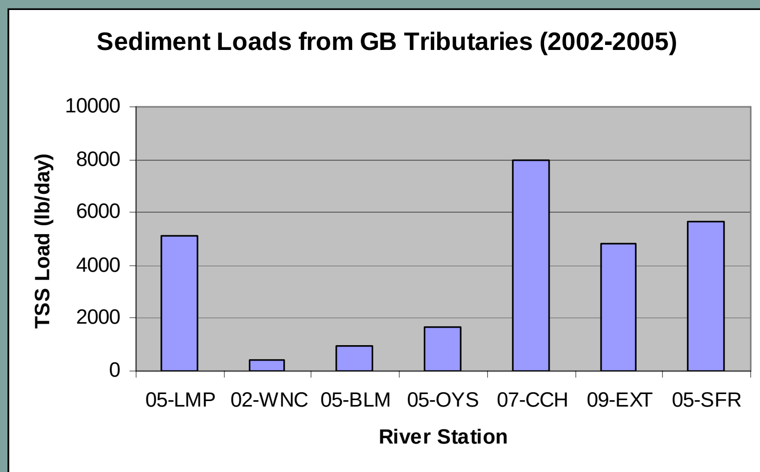
Sediment Loads



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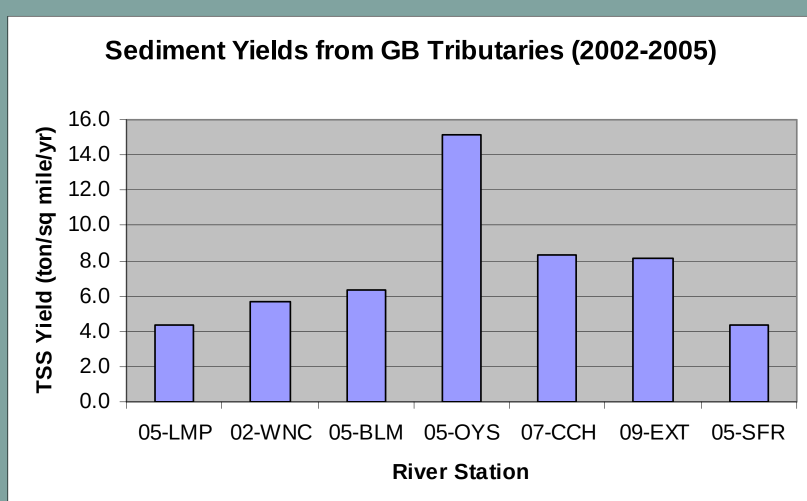
Sediment Yield from Watersheds



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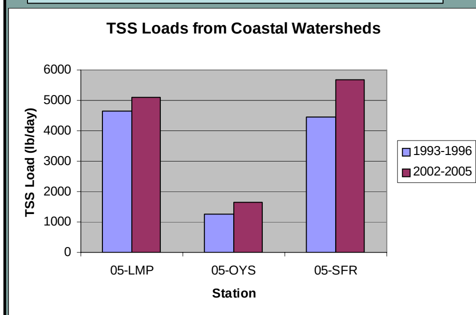
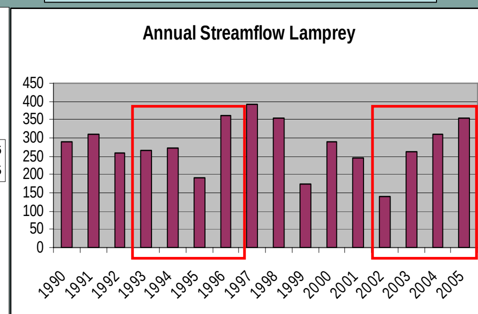
Sediment Load Trends

Trends in Mean TSS Loads



Trends in Annual Streamflow



Relative Change 1993-96 vs 2002-05

Lamprey River	**9%**
Oyster River	**32%**
Salmon Falls River	**27%**

*Differences not statistically significant

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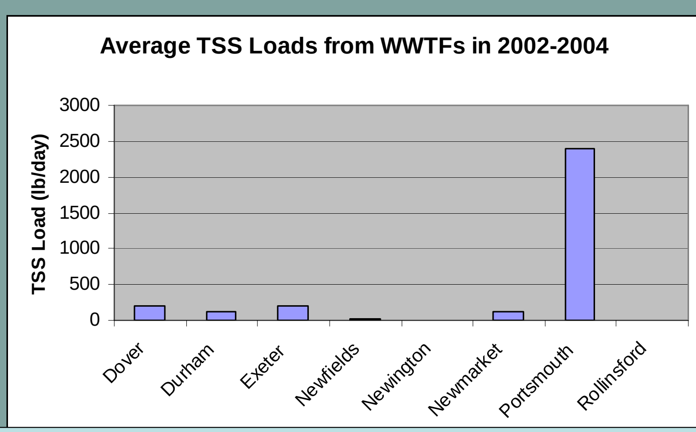
Sediment Loads from WWTFs



Note: The measured load for the Cocheco River was 8,000 lb/day.
The WWTF loads are all much smaller than the river loads.

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Observations

- Measured Kd values accurately predict eelgrass presence/absence.
- The best predictor of Kd was CDOM (salinity).
- Obvious water quality trends were not apparent.
- Phosphorus is the limiting nutrient during winter-spring. Nitrogen is the limiting nutrient in summer-fall.
- Sediment yields were highest for the Oyster River watershed.

New Hampshire Estuaries Project

Questions

- If CDOM is the major factor in attenuation, how is it related to nutrients and human processes in the watersheds?
- Is epiphytic growth on eelgrass a significant factor?
- How do you deal with the probable effects of macroalgae?
- Are sediment loads relevant?
- Where do we go from here?

Suzanne M. Woodland

From: E Tupper Kinder [ekinder@nkms.com]
Sent: Friday, April 09, 2010 3:22 PM
To: dierker.carl@epa.gov
Cc: Suzanne M. Woodland; Peter H. Rice
Subject: FW: Letter to Burack/Spaulding attached.
Attachments: Burack.Spaulding.ETK.4.9.10.PDF

Carl, I left you a voice mail about this letter earlier today. The letter went out today but I wanted you to have a copy. I would like to speak to you next week about this when you have a chance.

NKMS

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April 9, 2010

Thomas Burack, Commissioner
NHDES
29 Hazen Drive, PO Box 95
Concord, NH 03301

Curt Spalding, Regional Administrator
US EPA, Region 1
5 Post Office Square - Suite 100
Boston, MA 02109-3912

Re: Nutrient Criteria: Request for Rulemaking and Open Peer Review Process for NHDES Approach to Developing Nutrient Water Quality Standards for the Great Bay Estuary

Dear Commissioner Burack and Regional Administrator Spalding:

The City of Portsmouth on behalf of the New Hampshire communities of Dover, Durham, Exeter, Newmarket and Rochester request that NHDES initiate a formal rule making proceeding including an open and independent peer review of the scientific approach which NHDES utilized to develop the nutrient water quality standards for the Great Bay Estuary. The new standards will result in hundreds of millions of dollars of additional treatment costs for the New Hampshire communities and the Great Bay Estuary. Yet, there is little to suggest that the criteria and the corresponding expenditure of funds will deliver a measurable environmental benefit. With the severe demands on municipal and town budgets, it is imperative that there be a sound scientific basis for the nutrient criteria. Each community has an interest in protecting and promoting water quality, but there must be a demonstrated cause and effect. This demands that the technical validity for NHDES's new approach to setting water quality criteria be independently assessed.

There are two basic reasons for our concerns. First, the NHDES approach to setting nutrient water quality criteria is procedurally flawed. Although the nutrient criteria fall clearly within the definition of "rules" as set forth in RSA 541A, NHDES has failed to initiate a rulemaking proceeding or to apply any of the due process safe guards required under RSA 541A. Moreover, NHDES has sought EPA Region 1's approval of these nutrient criteria and requested EPA to use its Office of Science and

Technology to perform a closed peer review that further violates the due process rights of the New Hampshire communities. The EPA internal peer review process does not purport to comply with due process requirements, but rather engages in a closed process involving internally hand-picked reviewers to address a limited list of NHDES-developed questions. This process is not a fair or open process required by rulemaking procedures established by law and does not provide any of the effected New Hampshire communities or independent scientists with an opportunity to have input into the review process.

From a substantive approach, the establishment of the nutrient water quality criteria for the Great Bay Estuary is also flawed. This unprecedented approach assumes that nitrogen directly impairs eelgrass populations without confirming that nutrients are the cause of eelgrass impairment or establishing that nutrient control will remedy the current concerns about the loss of eelgrass habitat. It short, this approach is a radical departure from published criteria development methods that have always been premised on a clear scientific demonstration of causation and need.

As you are aware, EPA has historically conducted an independent peer review of new scientific approaches before utilizing such approaches in the water quality criteria development process (see, e.g., Science Advisory Board Review of EPA's Approach to Emerging Contaminants and EPA's 2006 Peer Review Handbook). The purpose of an independent peer review is to ensure EPA is basing its regulatory program requirements on scientifically defensible and well-documented evidence linking the environmental concern to a workable regulatory solution. You are likely also aware that EPA's Office of Water recently requested the Science Advisory Board (SAB) to review the agency's draft guidance document entitled *Empirical Approaches for Nutrient Criteria Derivation*. In response to the agency's request, the Science Advisory Board Ecological Processes and Effects Committee, augmented with additional experts, has been meeting to conduct a review of the guidance. This approach recognizes that independent peer review is the preferred and required process evaluating a new approach to the setting of nutrient criteria which will undoubtedly have such wide-reaching ramifications.

Given the importance of having scientifically defensible procedures for generating nutrient standards, we respectfully request that you direct the NHDES and the EPA Office of Water to submit the NHDES nutrient criteria for the Great Bay Estuary for independent peer review at the Science Advisory Board. We believe it is highly probable that the nutrient criteria established by NHDES and approved by EPA Region I will not result in any meaningful ecological improvements and that this open and fair review process is critical to developing criteria that will be both cost effective and beneficial to the Great Bay Estuary.

Very truly yours,

City of Portsmouth

By its attorneys,

Nelson, Kinder, Mosseau & Saturley, P.C.

E. Tupper Kinder, Esquire

ETK/sma/ljl

cc: The Honorable Governor John H. Lynch
The Honorable Judd A.Gregg, United States Senate
The Honorable Jeanne Shaheen, United States Senate
Congresswoman Carol Shea-Porter
Congressman Paul W. Hodes
John Bohenko, Portsmouth City Manager
J. Michael Joyal, Jr., Dover City Manager
John Scruton, Rochester City Manager
Becky I. Benvenuti, Durham Town Clerk
Todd Selig, Durham Town Administrator
Russell J. Dean, Exeter Town Manager
Harry Stewart, NHDES

Paul Currier, NHDES
Orville B. Fitch, II, Esquire Deputy Attorney General
Carl Dierker, Esquire U.S. EPA Region 1 General Counsel
Ephraim King, Director, U.S. EPA Office of Science and Technology
Lauren J. Noether, Esquire Senior Assistant Attorney General

Suzanne M. Woodland

From:	E Tupper Kinder [ekinder@nkms.com]
Sent:	Wednesday, June 02, 2010 2:49 PM
To:	Stewart, Harry; silva.stephen@epa.gov
Cc:	Suzanne M. Woodland; Peter H. Rice; John Hall; Craig Swanson
Subject:	FW: City of Portsmouth
Attachments:	Burack.ETK.5.12.10.pdf; Trowbridge.Public Works.3.20.09.PDF

Steve and Harry, this communication follows Harry's e –mail of May 28, 2010 in which he indicated that NHDES supports having interested parties have the opportunity to submit information to be considered by Dr. Howarth and Dr. Boynton in their review of the DES Nutrient Criteria document. I did not realize that this opportunity was available. Accordingly, I have attached to this e-mail two documents : one prepared by Applied Science Associates dated March 19 , 2010 and one by Hall and Associates dated May 12, 2010, which I think you will recognize as having been previously submitted to NHDES regarding this Nutrient Criteria matter. Please forward these documents to the reviewers for their consideration. I do anticipate having some limited additional input shortly and so I would appreciate knowing what the schedule is for submitting comments. Thank you for your assistance in this matter

NKMS

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May 12, 2010

Thomas Burack, Commissioner
NHDES
29 Hazen Drive, PO Box 95
Concord, NH 03301

Re: Nutrient Criteria: Request for Rulemaking and Open Peer Review Process for NHDES Approach to Developing Nutrient Water Quality Standards for the Great Bay Estuary

Dear Commissioner Burack:

As you know, on April 9, 2010, a letter was submitted by the New Hampshire communities of Dover, Durham, Exeter, Newmarket, Portsmouth and Rochester, requesting that NHDES initiate a formal rulemaking proceeding including an open and independent peer review of the scientific approach which NHDES utilized to develop Nutrient Water Quality Standards for the Great Bay Estuary. Our communities are intensely interested in the health of the Great Bay Estuary and rely upon it for the quality of life enjoyed by its citizenry. However, we are extremely concerned that NHDES's nutrient impacts and criteria evaluation has failed to fully and properly evaluate the effect of nutrients on eelgrass populations and measures necessary to ensure protection of the Great Bay Estuary resources. We believe that the current nutrient criteria analysis is misplaced because of inadequate data and lack of assessment tools needed to properly evaluate this complex system. This lack of critical information caused NHDES to make assumptions about the causal relationship between nutrient levels and the environmental health of the Bay, which are simply not warranted and not supported by reliable scientific data. If these misplaced assumptions are not corrected, the Great Bay's valued resources will not be restored or protected and an enormous waste of scarce municipal resources will occur. Such an occurrence is not in anyone's interests.

The concern expressed by these communities in the April 9, 2010 letter has been heightened by the development of additional information over the last month. On April 27, 2010, the Science Advisory Board ("SAB") finalized its review of EPA's guidance document, Empirical Approaches for Nutrient Criteria Derivation. At the time of the April 9, 2010 letter, the SAB's analysis was only in draft form. The final report demonstrates quite clearly that the type of approach taken by NHDES to develop its June 2009 Numeric Nutrient Criteria for the Great Bay Estuary, has been discredited as having significant flaws. This report underscores why it is essential that reliable data be used to confirm rather than presume the existence of cause and effect relationships when assessing environmental impairments and considering the need for nutrient criteria.

The municipalities have engaged the assistance of Hall & Associates of Washington, D.C. to evaluate the NHDES Numeric Nutrient Criteria document in light of the SAB findings. Hall & Associates was instrumental in obtaining SAB review of the EPA guidance document entitled "Empirical Approaches for Nutrient Criteria Derivation". Attached hereto as Exhibit A are the preliminary comments of Hall & Associates with respect to the extent to which the SAB findings impact the NHDES' nutrient criteria document. This additional information demonstrates that the NHDES Numeric Criteria are based on a scientifically flawed methodology and the NHDES needs to reevaluate. An open and independent peer review of the NHDES nutrient criteria document is critical not only to provide a document based upon accepted scientific principles but also to accomplish acceptance of these criteria within the general public. In the event that NHDES elects to continue to move forward with the EPA review by the Office of Science and Technology, over the communities' objection, the comments of Hall and Associates also include "charge questions."

The health of the Great Bay Estuary can best be preserved by a scientifically based regulatory program which can focus regulatory actions where they can achieve benefits most efficiently and effectively. We therefore request that NHDES withdraw its request to EPA that the nutrient criteria document be reviewed by the EPA Office of Science and Technology through a closed peer review and defer further action on this proposal until additional information on the need for nutrient criteria related to eel grass is developed. All parties are interested in protecting the Great Bay Estuary, and there is no need to develop a program based on assumption when the ability to obtain the necessary information that could guide decision making is possible.

If DES agrees to such deferral, we believe that there are several steps for which there is substantial consensus with the communities which can be helpful to assure that the review process results in a regulatory approach that provides environmental benefits and avoids misspending tax dollars on ineffective supposed solutions. The communities are willing to discuss a commitment of funding and support for the following approach.

1. Establish an independent peer review panel to review the NHDES Numeric Nutrient Criteria document through an open process which allows for public comment and scientific input. The communities believe that this process can begin providing valuable information to NHDES and the communities within six months of reaching an agreement on this or a similar approach.

2. Undertake a thorough hydrodynamic model to be performed for the Great Bay Estuary to provide insight on nutrient/sediment transport and other mechanisms that have substantial influence on eelgrass health.

3. Establish a supplemental environmental project, such as an eelgrass and/or shellfish restoration project, aimed at providing data relevant to water quality improvement.

In conclusion, the New Hampshire communities of Dover, Durham, Exeter, Newmarket, Portsmouth and Rochester recognize that NHDES, as the regulatory agency charged with compliance with state and federal law, is the ultimate decision-maker on what numeric levels of nutrients are appropriate for the Great Bay Estuary. These communities share NHDES' concern and recognize they also share the responsibility for achieving compliance with scientifically based regulatory criteria. We look forward to discussing the best way that we can work together to achieve our mutual goals.

Very truly yours,

City of Portsmouth on behalf of
Dover,
Durham,
Exeter,
Newmarket,
Portsmouth, and
Rochester,

By Counsel for the City of Portsmouth,

Nelson, Kinder, Mosseau & Saturley, P.C.

E. Tupper Kinder, Esquire

ETK/sma
Encls.
cc: The Honorable Governor John H. Lynch
The Honorable Judd A.Gregg, United States Senate
The Honorable Jeanne Shaheen, United States Senate
Congresswoman Carol Shea-Porter
Congressman Paul W. Hodes
John Bohenko, Portsmouth City Manager
J. Michael Joyal, Jr., Dover City Manager
John Scruton, Rochester City Manager
Edward J. Wojnowski, Newmarket Town Administrator
Todd Selig, Durham Town Administrator
Russell J. Dean, Exeter Town Manager
Harry Stewart, NHDES
Paul Currier, NHDES
Orville B. Fitch, II, Esquire Deputy Attorney General
Carl Dierker, Esquire U.S. EPA Region 1 General Counsel
Ephraim King, Director, U.S. EPA Office of Science and Technology
Lauren J. Noether, Esquire Senior Assistant Attorney General
Peter H. Rice, City Engineer
Suzanne Woodward, Assistant City Attorney

EXHIBIT A

Assessment of Appropriate Peer Review Charge Questions For Evaluation of the Numeric Nutrient Criteria for the Great Bay Estuary, New Hampshire

Prepared by
Hall & Associates
Washington, D.C.

The New Hampshire Department of Environmental Services (DES) recently proposed draft numeric criteria for total nitrogen to protect eelgrass habitat in the Great Bay Estuary. [1] The Report indicates that multiple lines of evidence were used in a "weight-of-evidence" analysis to derive the proposed numeric nutrient criteria. The Report states that data sources were chosen based on relevance to a conceptual model of eutrophication in estuaries. This would imply that total nitrogen (TN) was the cause of excessive plant growth in the Great Bay Estuary, which in turn caused the reduced light penetration that adversely affected eelgrass growth. The evaluation concluded that low dissolved oxygen and loss of eelgrass habitat were the most important impacts to aquatic life from nutrient enrichment and recommended ambient thresholds for TN concentration to address these impacts. Correlations between TN concentrations and chlorophyll-a, dissolved oxygen, and water clarity were assessed using linear regressions to establish the proposed numeric criteria.

Unrelated to this development, the EPA Science Advisory Board, Ecological Processes and Effects Committee, recently considered draft guidance on Empirical Approaches for Nutrient Criteria Derivation developed by EPA.[2] This guidance document described regression techniques for evaluating data for nutrient criteria derivation, such as the linear regressions used by DES for the Great Bay Estuary. The SAB cited significant deficiencies in this approach. Prior to the issuance of the SAB report, the City of Portsmouth requested that the draft nutrient criteria undergo a similar peer review. The assessment below summarizes the SAB findings relevant to the empirical nutrient criteria development approach used for the Great Bay Estuary, critiques the charge questions suggested by DES and EPA, and presents more relevant charge questions for consideration by the peer review panel, given the SAB findings.

EPA Science Advisory Board Findings on Utility of Empirical Approaches for Nutrient Criteria Development

In general, the SAB found that empirical approaches cannot be used as a stand-alone demonstration that criteria are justified. In reviewing EPA's draft guidance manual, the SAB reached the following findings that are relevant to review of the draft total nitrogen criteria developed for Great Bay Estuary.

- A clear framework for statistical model selection is needed. This framework should include: 1) an assessment of whether analyses indicate that the stressor-response approach is appropriate; 2) selection criteria to evaluate the capability of models to consider cause/effect and direct/indirect relationships

[1] New Hampshire Department of Environmental Services. June 2009. Numeric Criteria for the Great Bay Estuary.

[2] US EPA Science Advisory Board, Ecological Processes and Effects Committee. April 27, 2010. SAB Review of Empirical Approaches for Nutrient Criteria Derivation.

between stressors and responses; 3) consideration of model relevance to known mechanisms and existing conditions; 4) establishment of biological relevance; and 5) ability to predict probability of meeting designated use categories. (at xix, first bullet response on Charge Question 6)

- Without a mechanistic understanding and a clear causative link between nutrient levels and impairment, there is no assurance that managing for particular nutrient levels will lead to the desired outcome. (at 6, first paragraph)
- [T]he empirical stressor-response approach does not result in cause-effect relationships; it only indicates correlations that need to be explored further. (at 41, bullet #1)
- In order to be scientifically defensible, empirical methods must take into consideration the influence of other variables. (at 24, 2nd bullet from bottom) The statistical methods in the Guidance require careful consideration of confounding variables before being used as predictive tools. ... Without such information, nutrient criteria developed using bivariate methods may be highly inaccurate. (at 24, first complete bullet)

EPA has also provided additional background documentation regarding what should constitute an acceptable "weight of evidence" approach used in criteria development. (*"Using Field Data and Weight of Evidence to Develop Water Quality Criteria", Cormier et al, 2008 SETAC*). That document, prepared by EPA's Office of Research and Development, specifies the following, with respect to criteria derivation:

> *Development of numeric WQC is based on 3 basic assumptions: First, causal relationships exist between agents and environmental effects. Second, these causal relationships can be quantitatively modeled. Finally, if exposures to the causal agent remain within a range predicted by the quantitative model, unacceptable affects will not occur and designated uses will be safeguarded. Therefore, for criteria to be valid there must be evidence that the criteria are based on reasonably consistent and scientifically defensible causal relationships.*

Issues of Concern with Numeric Nutrient Criteria Development

The findings in the SAB report are directly applicable to the evaluations presented in the Report to support the proposed numeric nitrogen criteria, particularly with regard to the assumed relationship between eelgrass habitat and annual median total nitrogen concentration in the Great Bay Estuary. The Report (at 55, et seq.) attempts to establish a linkage between eelgrass habitat and total nitrogen via its effect on water clarity (light attenuation). The Report presents a multivariate linear regression linking light attenuation to phytoplankton (chlorophyll-a), colored dissolved organic matter (CDOM), non-algal turbidity, and water. The Report cites a study by Morrison et al. (2008) that determined the relative contribution of each of these factors to the light attenuation coefficient, indicating the following contributions: water (32%), phytoplankton (12%), CDOM (27%) and non-algal turbidity (29%). These factors are reported to explain 95 percent of the variance in the observed light attenuation measurements. The Report then presents linear regression analyses relating *total nitrogen* to median turbidity and to median light attenuation coefficient as the basis to support the proposed total nitrogen criteria.

The Report presents no mechanistic model linking total nitrogen to non-algal turbidity and the total nitrogen – water clarity regression jumps over underlying factors influencing light attenuation. The SAB report repeatedly warns that such regressions do not demonstrate cause-and-effect, and such a demonstration is needed to provide assurance that compliance with the criteria will protect the designated use. For example, that fact that TN is associated with non-algal particulates (turbidity) does not mean that controlling TN from all sources will control turbidity. Rather, if non-algal particulates are somehow controlled, turbidity would be reduced and the nitrogen associated with these particulates will also be controlled. However, waste load allocations limiting TN from POTWs, which is primarily present in the dissolved form, will have no effect on non-algal particulates and would be inappropriate if the real goal was to reduce turbidity.

The Report must provide a mechanistic model linking the stressor (nitrogen) to the responses (water clarity, eelgrass habitat) before the proposed relationships can be accepted. Of the four factors acknowledged to influence light attenuation, only phytoplankton growth is mechanistically associated with nitrogen, but the Report does not present a regression analysis for phytoplankton and light attenuation. For biologically available nitrogen to affect light attenuation, changes in concentration or loading must result in phytoplankton (chlorophyll-a) changes that are significant with respect to light attenuation. However, the data presented in the Report indicate that algal levels are quite low given the available nutrients. The fact that median phytoplankton levels are low suggests that nutrient concentrations are not the primary factor controlling phytoplankton growth and, therefore, nitrogen control may not significantly affect phytoplankton levels. Moreover, given the assessment indicating that only 12% of the light attenuation coefficient is attributed to phytoplankton, there is no reasonable expectation that light attenuation is significantly related to median total nitrogen due to the effect of nitrogen on phytoplankton growth. *Consequently, it appears that the entire premise of the draft criteria is misplaced.*

To be scientifically defensible, these concerns regarding the relationship between nitrogen, phytoplankton, and light attenuation must be addressed. The Report needs to provide the following evaluations:

- An analysis demonstrating that median total nitrogen controls phytoplankton growth in the Great Bay Estuary;
- A mechanistic analysis demonstrating that a reduction in median phytoplankton concentration will occur, and the impact of this reduction on light penetration, if the proposed criteria are achieved;
- A mechanistic analysis demonstrating that a TN reduction is required to address non-algal turbidity;
- A mechanistic analysis demonstrating the light attenuation goals will be achieved by reducing dissolved forms of nitrogen;
- An assessment of factors influencing light penetration that co-vary with TN and may otherwise explain or control the available light for submerged aquatic vegetation; and

- An analysis showing that (1) eelgrass losses are tied to TN increases and (2) eelgrass will be restored if the proposed criteria are achieved.

Charge Questions

The DES and EPA suggested that the peer review panel evaluate the proposed nutrient criteria with respect to the following charge questions.

- **Transparency**

  Is the process for the development of the criteria well described and documented?

- **Defensibility**

  Were accepted sampling and analysis methods used?

  Was a QA/QC process used and documented?

  Are the designated uses of the Great Bay clearly articulated?

  Is there a clear discussion of the logic of how the criteria protect those designated uses?

- **Reproducibility**

  Does analysis of the available data reproduce the results included in the report?

These proposed charge questions do not address the concerns identified by the SAB on the use of empirical approaches to develop numeric nutrient criteria. The SAB noted that the relationship between nutrients and designated use impairments is often very complex, with many confounding factors. For this reason, the SAB recommended that nutrient criteria be developed using a weight-of-evidence approach that significantly reduces uncertainty and that a clear causative link be established between nutrient levels and use impairment. These concerns are not addressed with the proposed charge questions. The basic problem with the proposed peer review is that it fails to seek confirmation on whether the Great Bay nutrient criteria report has (1) established the existence of a direct causal relationship between light penetration, eelgrass losses and TN concentration, (2) fully evaluated the factors that influence light penetration and (3) demonstrated the impact of the suggested TN reductions on algal growth/light penetration improvement. These key issues, among others, should be the focus of the peer review.

In order to address the concerns raised by the SAB and to ensure that the final numeric criteria are scientifically defensible, we recommend that the following charge questions be posed to the peer review committee.

Proposed Charge Questions

1. To be scientifically defensible, the Numeric Nutrient Criteria for the Great Bay Estuary must be based on the correct underlying causal model that considers all of the

significant factors affecting the causal variable (light penetration) and designated uses of concern (eelgrass).

a. Has the report adequately documented that lower light penetration was the cause of eelgrass losses? Was the level of light penetration used to set nutrient targets demonstrated to be necessary to support healthy eelgrass growth?

b. Has the Report adequately confirmed that ambient TN concentration increases since 1997 were the cause of eelgrass losses in the Bay and that other factors were not responsible for this condition?

c. Do the linear regressions presented in the report demonstrate cause-and-effect relationships between total nitrogen and the designated use metric (light penetration)?

d. Is the linear regression relating TN to turbidity scientifically defensible and will TN control result in significant changes in turbidity with respect to light attenuation in the estuary?

e. Has the evaluation confirmed that TN is the factor controlling phytoplankton chlorophyll 'a' concentration and that reducing TN will significantly reduce the level of plant growth with respect to light attenuation?

f. Has the Report documented that dissolved forms of nitrogen discharged by wastewater facilities or present in runoff must be controlled to achieve light penetration goals?

2. Has the uncertainty in the regression analysis been addressed sufficiently to support a target of 0.25 – 0.30 mg N/L (annual median)?

3. The Report establishes a median annual instream concentration of total nitrogen and a 90^{th} percentile chlorophyll-a concentration as the basis for maintaining compliance with the instantaneous dissolved oxygen water quality standard.

   a. Is it scientifically defensible to establish an annual median total nitrogen concentration to protect an instantaneous minimum dissolved oxygen concentration?

   b. Is it scientifically defensible to establish a 90th percentile chlorophyll-a concentration to protect an instantaneous minimum dissolved oxygen concentration?

Please contact John C. Hall at 202-463-1166 or jhall@hall-associates.com if you have any questions regarding the information contained in this document

PUBLIC WORKS DEPARTMENT

CITY OF PORTSMOUTH
680 Peverly Hill Road
Portsmouth N.H. 03801
(603) 427-1530 FAX (603) 427-1539

March 20, 2009

Philip Trowbridge, P.E.
NH Department of Environmental Services
Watershed Management Bureau
P.O. Box 95
Concord, NH 03302-0095

Re: Nutrient Criteria for the Great Bay Estuary
Great Bay Water Quality Coalition

Dear Mr. Trowbridge:

The City of Portsmouth along with a number of communities within the Great Bay watershed have joined together to review and comment on the draft nutrient criteria for the Great Bay Estuary. Attached please find memoranda prepared by Brown and Caldwell, and Applied Science Associates, Inc. with specific comments regarding the draft nutrient criteria for the Great Bay.

The communities recognize how important the health of the Great Bay Estuary is to the seacoast environment. However, there is concern that the regulated communities, those with wastewater and stormwater permitted discharges, could be disproportionately and un-necessarily burdened beyond their actual contribution to the nutrient related water quality issues in the Great Bay Estuary and Piscataqua River. Overburdening these communities will not address nutrient related water quality issues caused by other sources.

Representatives of the City of Portsmouth and communities within the Great Bay watershed have preliminarily discussed the possibility of forming a watershed based regional coalition to address both point and non-point pollution sources to the Great Bay. This approach is consistent with the recently published State's Water Resource Primer which recommends a shift towards watershed/regional planning and regulation to better address the complex challenges of ensuring water quality.

Competing financial needs of New Hampshire's Great Bay communities require that future nutrient limits be based on documented, verifiable data, using established methodologies. The setting of nutrient criteria that are arbitrary and unsupported by science is not in the long term interest of the regulating agencies, the communities affected or ultimately the environment. Financial resources are not infinite and must be spent wisely. There must also be a sensitivity to the totality of environmental impacts in addressing water quality concerns.

We request that the DES conduct the additional studies outlined in the Applied Science Associates, Inc. technical review report prior to finalizing the proposed nutrient criteria. We are prepared to support further efforts by the DES to establish a nutrient criteria which is statistically valid and consistent with other accepted methodologies. We understand that this is a complex and difficult issue, however, we believe that together, working with other regulated communities we will be able to achieve water quality in the Great Bay.

If you have questions or require additional information, please contact Peter Rice at 766-1416.

Sincerely,
Coalition Communities

Peter Rice, P.E.
City of Portsmouth
City Engineer, Water and Sewer Divisions

Jennifer Royce, P.E.
Town of Exeter
Director of Public Works

David Cedarholm, P.E.
Town of Durham
Town Engineer

Sean Greig
Town of Newmarket
Chief Plant Operator

David Green
City of Rochester
Chief Plant Operator

Dean Peschel
City of Dover
Environmental Projects Manager

c.c. John P. Bohenko, City Manager
David Allen, Deputy Director of Public Works
Suzanne Woodland, Assistant City Attorney

BROWN AND CALDWELL

Memorandum

155 Fleet Street
Portsmouth, NH 03801
(603) 570 4869

Date: March 17, 2009

To: Peter Rice, P.E., City of Portsmouth, NH

From: Mark Allenwood, P.E.

Subject: Technical Review of Draft NHDES Nutrient Criteria for Great Bay

The purpose of this memorandum is to present our comments regarding the NHDES Nutrient Criteria for Great Bay. We have worked with Applied Science Associates, Inc. of South Kingston, RI, with their comments attached.

We also offer the following additional comments in regard to the NHDES Nutrient Criteria for Great Bay.

1. The hyperspectral imagery was performed on August 29, 2008. The summer of 2008 was very rainy. This may have impacted the findings of this task. In addition, while the weather was on that particular day was clear, other factors may have affected the data (i.e. haze, temperature, etc).

2. The equipment utilized on August 29, 2008 to collect data during the area over flights was reported to have been faulty and could not be calibrated to half the light spectrum required. This nullified the ability to utilize the algorithms previously developed. A new algorithm had to be created for this project. We assume that the data collected in the field during the over flights was utilized to calibrate the algorithm. Given that only one data set was used to calibrate the algorithm, we believe that the data presented in Figure 25 is statically insignificant, since the algorithm was created to fit a single data set.

3. The report builds to Figure 29 based on the relationship between nitrogen and organic carbon (R^2 = 0.56) shown in Figure 27, organic carbon and turbidity (R^2 = 0.47), shown in Figure 28, and finally nitrogen and turbidity (R^2 = 0.99) shown in Figure 29. The correlations in Figures 27 and 28 are not significant.

4. The report surmises that an increase in nitrogen will cause an increase in turbidity. This is illustrated in Figure 29, with an R^2 of 0.99, or a nearly perfect correlation. While this is not surprising, it cannot be asserted nitrogen is the cause of an increase in turbidity. It can just as easily be stated that turbidity is causal of increased nitrogen. Even though the particulate fraction of nitrogen was low, dissolved nitrogen can certainly be associated with runoff, as will particulate matter which leads to turbidity.

Applied Science Associates, Inc

Seattle, WA USA

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

FROM: Richard Sweetman
Jennifer A. Cragan
Craig Swanson

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 for each sampling day, and
- Monthly median concentrations of nitrogen and phosphorus concentrations.

The statistical approach used on the data 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 cites 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 continues 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 provides 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.

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Suzanne M. Woodland

From:	Peter H. Rice
Sent:	Wednesday, July 08, 2009 8:07 AM
To:	'HARRY.STEWART@DES.NH.GOV'
Cc:	'PAUL.CURRIER@DES.NH.GOV'; 'PAUL.HEIRTZLER@DES.NH.GOV'
Subject:	Meeting Request with the Commissioner
Attachments:	tb meeting request letter.pdf

Harry:

Attached, please find a copy of a letter that has been sent to Commissioner Burack from the Town and City Managers of Dover, Durham, Exeter, Newmarket, Portsmouth and Rochester. The managers would like to meet with the Commissioner to discuss on-going efforts to improve water quality in the Great Bay Estuary and its tributaries. As we previously discussed we believe this is a good opportunity to start the regional dialog that will help coordinate efforts being made by all parties to ensure wise use of scarce financial resources.

Please call if you have any questions.

Peter Rice
City Engineer, Water and Sewer Divisions
680 Peverly Hill Road
Portsmouth, New Hampshire 03801

603-766-1416
Fax 603-427-1539

Dover, Durham, Exeter, Newmarket, Portsmouth, Rochester

July 6, 2009

Thomas S. Burack
Commissioner
NH Department of Environmental Services
P.O. Box 95
Concord, NH 03302-0095

Re: Nutrient Criteria and Waste Load Allocation for the Great Bay Estuary

Dear Commissioner Burack:

The town and city managers of the communities of Dover, Durham, Exeter, Newmarket, Portsmouth, and Rochester respectfully request a meeting to discuss on-going efforts to improve water quality in the Great Bay Estuary and its tributaries.

The communities recognize how important the health of the Great Bay Estuary is to the seacoast environment. However, there is concern that the regulated communities, those with wastewater and stormwater permitted discharges, could be disproportionately and un-necessarily burdened beyond their actual contribution to the nutrient related water quality issues in the Great Bay Estuary and Piscataqua River. Overburdening these communities will not address nutrient related water quality issues caused by other sources.

Competing financial needs of New Hampshire's Great Bay communities require that future nutrient limits be based on documented, verifiable data, using established methodologies. Financial resources are not infinite and must be spent wisely. There must also be a sensitivity to the totality of environmental impacts in addressing water quality concerns.

We request that the DES work with our communities as we do additional science and studies, at our own cost, to augment existing work to better refine the nutrient criteria and waste load allocation. We understand that this is a complex and difficult issue, however, we believe that together, working with other regulated communities we will be able to achieve water quality in the Great Bay.

We respectfully request an opportunity to meet with you to discuss these vital issues.

If you have questions or require additional information, please contact Peter Rice at 766-1416 who will be assisting in organizing the meeting.

Sincerely,

The Communities of:

J. Michael Joyal, Jr.
City Manager
City of Dover

Todd Selig
Town Administrator
Town of Durham

Russell Dean,
Town Manager
Town of Exeter

Edward Wojnowski
Town Administrator
Town of Newmarket

John P. Bohenko
City Manager
City of Portsmouth

John Scruton
City Manager
City of Rochester

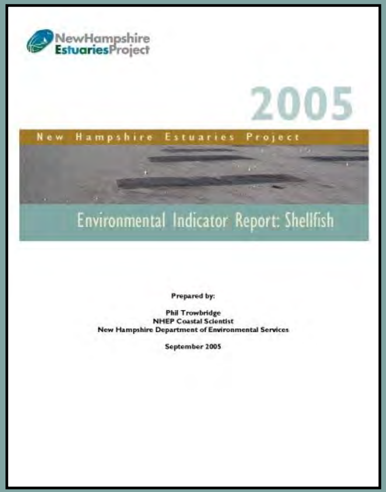
NH Estuaries Project Environmental Indicators

Phil Trowbridge, P.E.

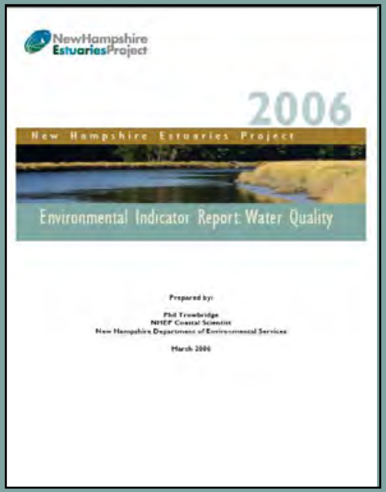
NHEP/DES Coastal Scientist

June 15, 2006

Environmental Indicator Reports


NewHampshire EstuariesProject
2005
New Hampshire Estuaries Project
Environmental Indicator Report: Shellfish
Prepared by:
Phil Trowbridge
NHEP Coastal Scientist
New Hampshire Department of Environmental Services
September 2005


NewHampshire EstuariesProject
2006
New Hampshire Estuaries Project
Environmental Indicator Report: Critical Habitats and Species
Prepared by:
Phil Trowbridge
NHEP Coastal Scientist
New Hampshire Department of Environmental Services
March 2006


NewHampshire EstuariesProject
2006
New Hampshire Estuaries Project
Environmental Indicator Report: Water Quality
Prepared by:
Phil Trowbridge
NHEP Coastal Scientist
New Hampshire Department of Environmental Services
March 2006

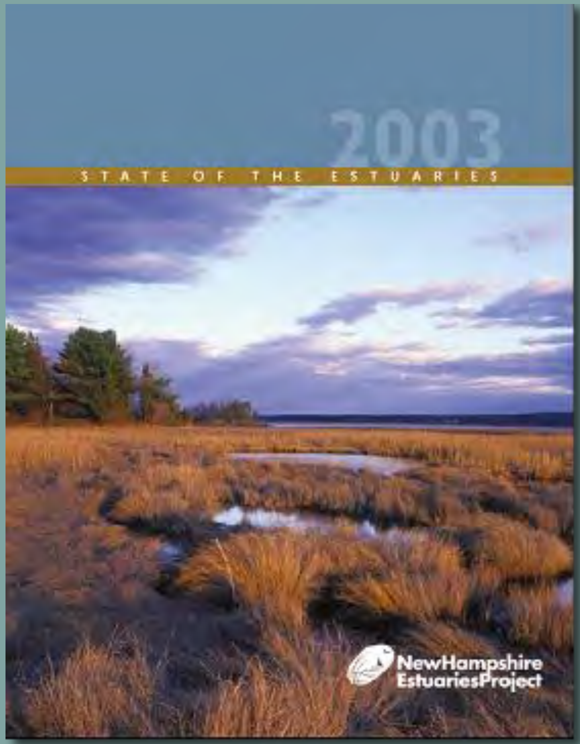

NewHampshire EstuariesProject
2006
New Hampshire Estuaries Project
Environmental Indicator Report: Land Use and Development
Prepared by:
Phil Trowbridge
NHEP Coastal Scientist
New Hampshire Department of Environmental Services
May 2006

- **Reviewed by NHEP staff and Technical Advisory Committee**

- **Represents current scientific consensus**

State of the Estuaries Report

- Summary of 12 key indicators
- Additional indicators included as “side bars”
- Latest report in 2003
- Next version will be released in October 2006
- October 27, 2006 Conference

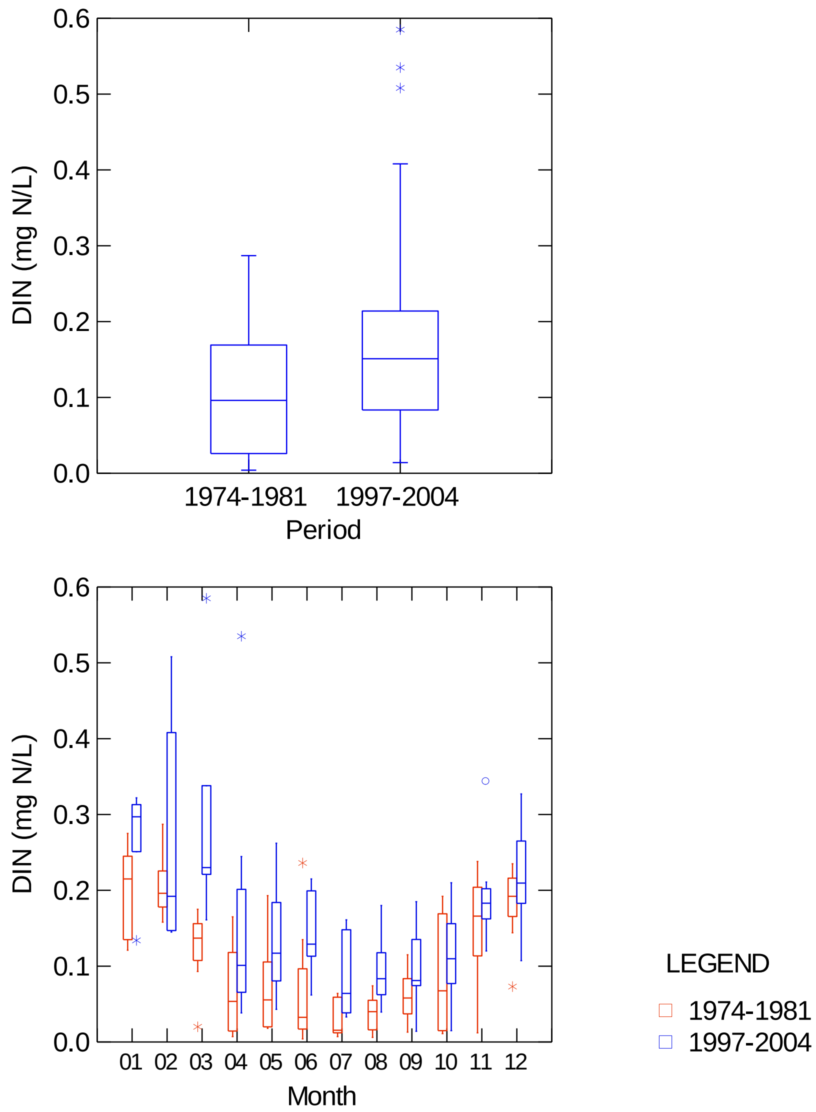


Nitrogen Trends

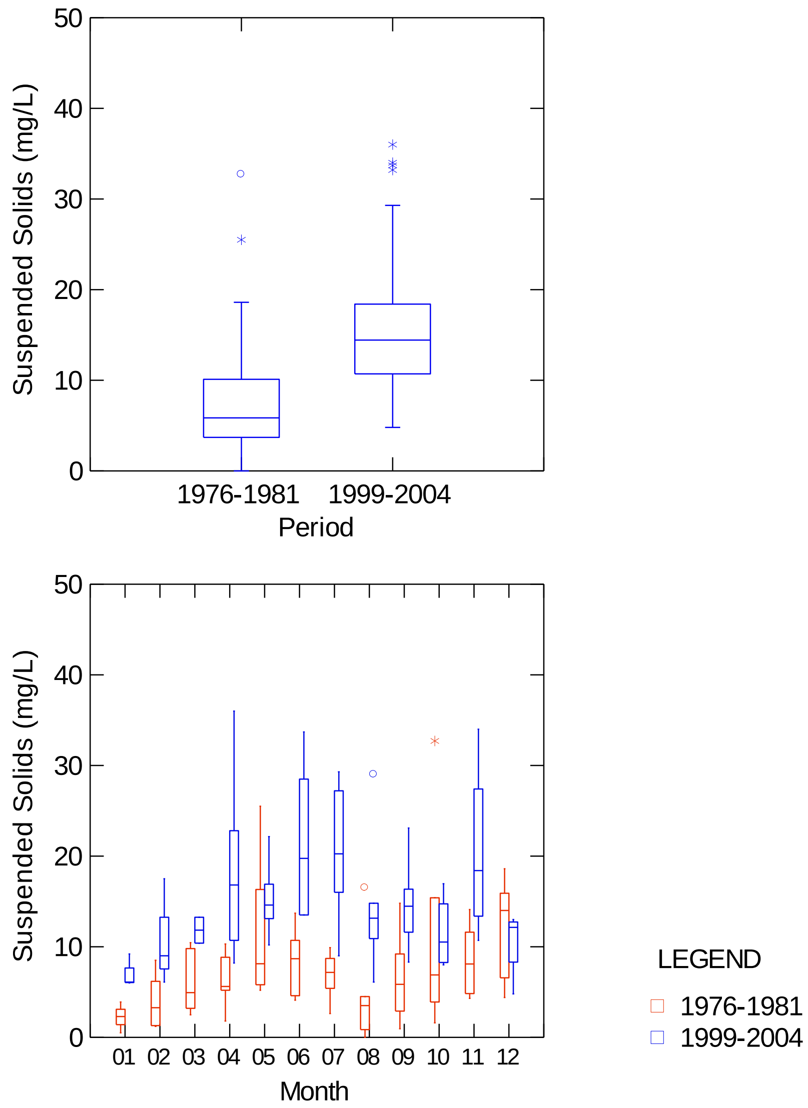
- Q: Have nitrogen concentrations in Great Bay changed significantly over time?

- A: Yes. Comparisons to historical data show that dissolved inorganic nitrogen concentrations have increased in Great Bay by 59% in the past 25 years. During the same period, suspended solids concentrations increased by 81%, although there are some questions about the appropriateness of the comparison. Trends over the past 15 years since the current monitoring program began are equivocal, with increasing trends evident at only a few stations for a few parameters.

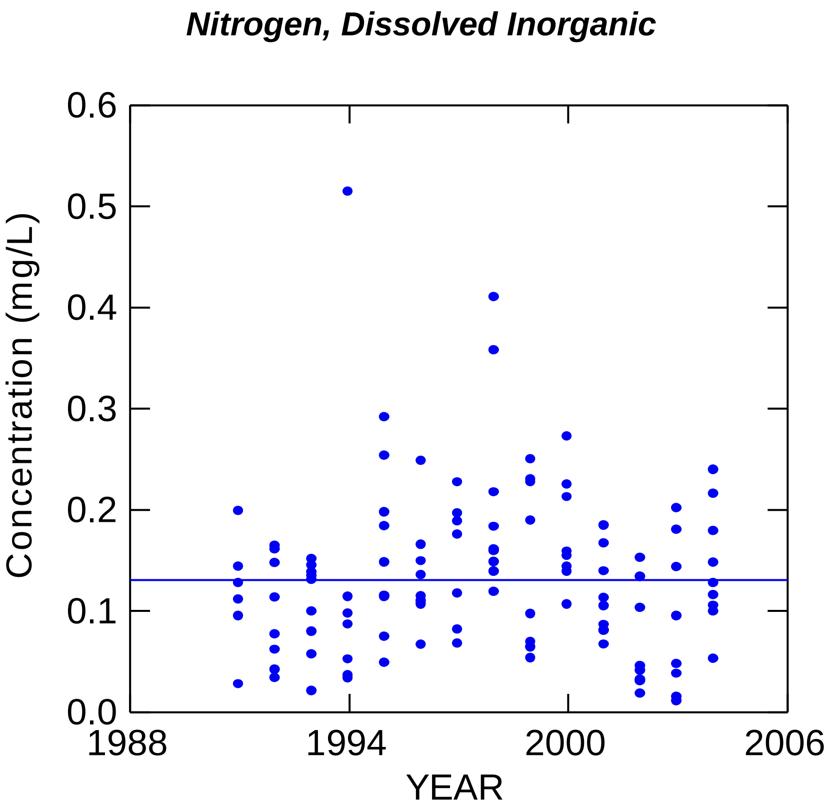
Dissolved Inorganic Nitrogen at Adams Point at Low Tide

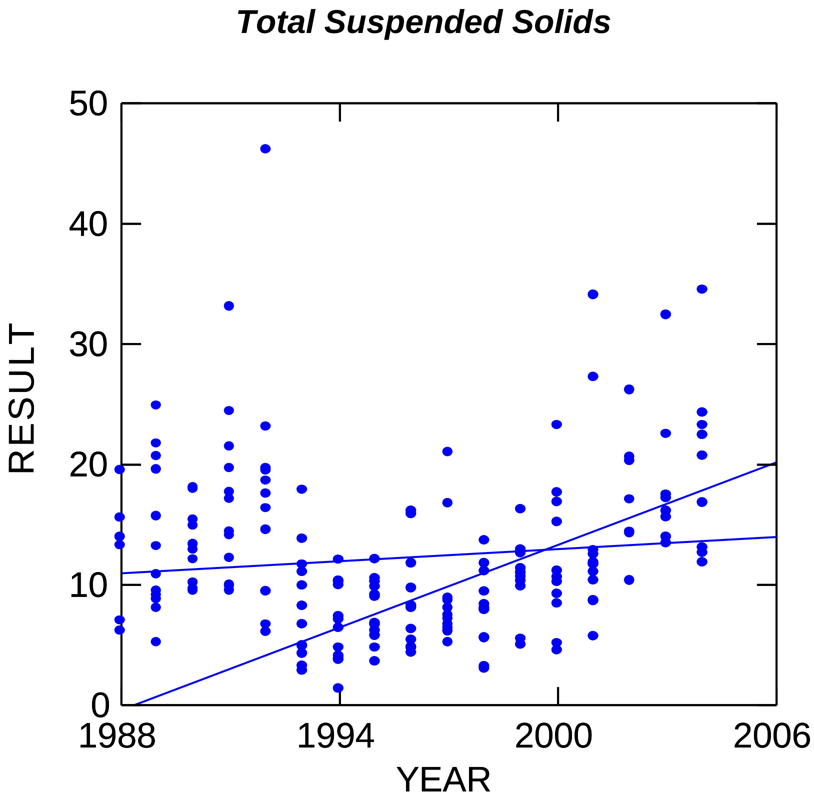


Suspended Solids at Adams Point at Low Tide



NewHampshire EstuariesProject

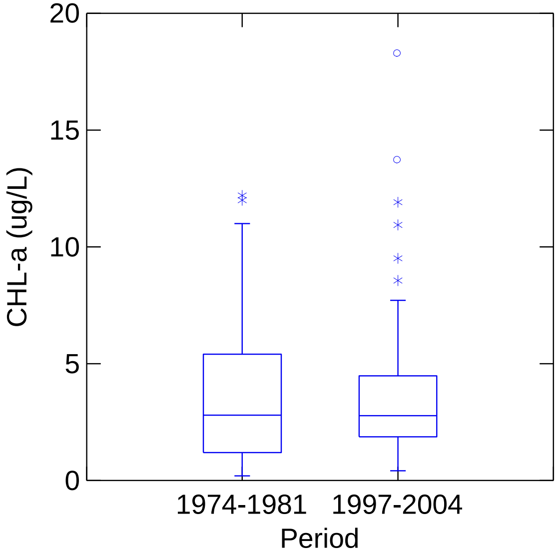


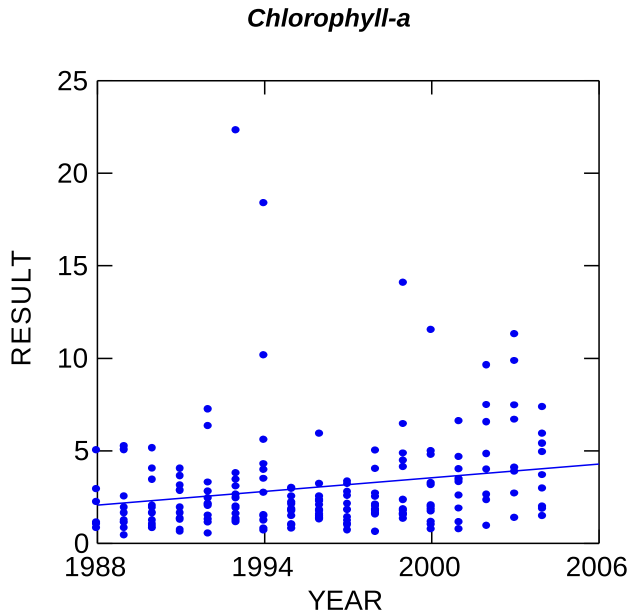


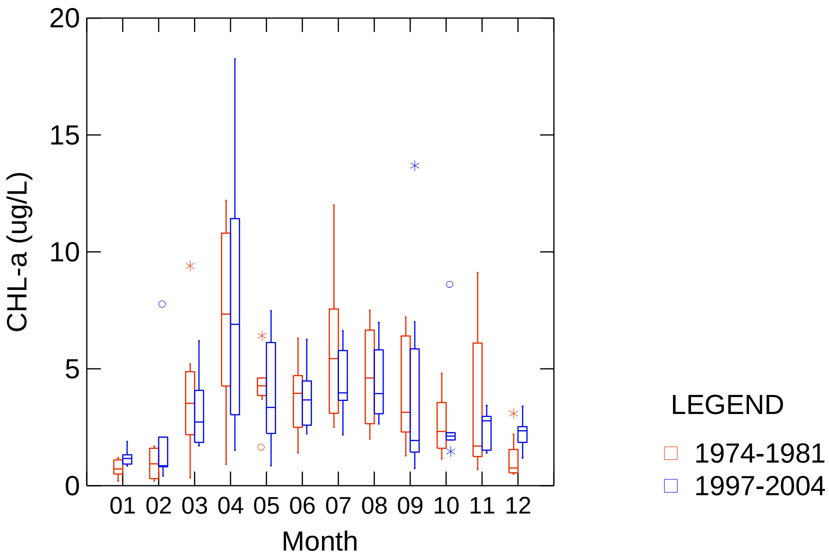
- Any increase in nitrogen concentrations has apparently not resulted in increased phytoplankton blooms. The only increasing trend for chlorophyll-a was observed at a station with very low concentrations already. Moreover, a probabilistic survey of the estuary in 2002-2003 found only 1.6% of the estuary to have chlorophyll-a concentrations greater than 20 ug/L.

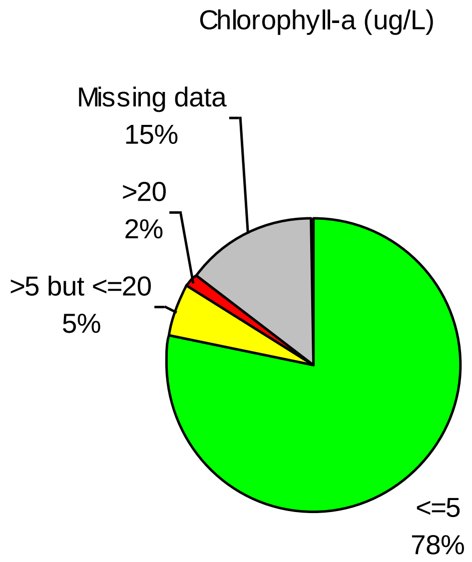
NewHampshire EstuariesProject

Chlorophyll-a at Adams Point at Low Tide

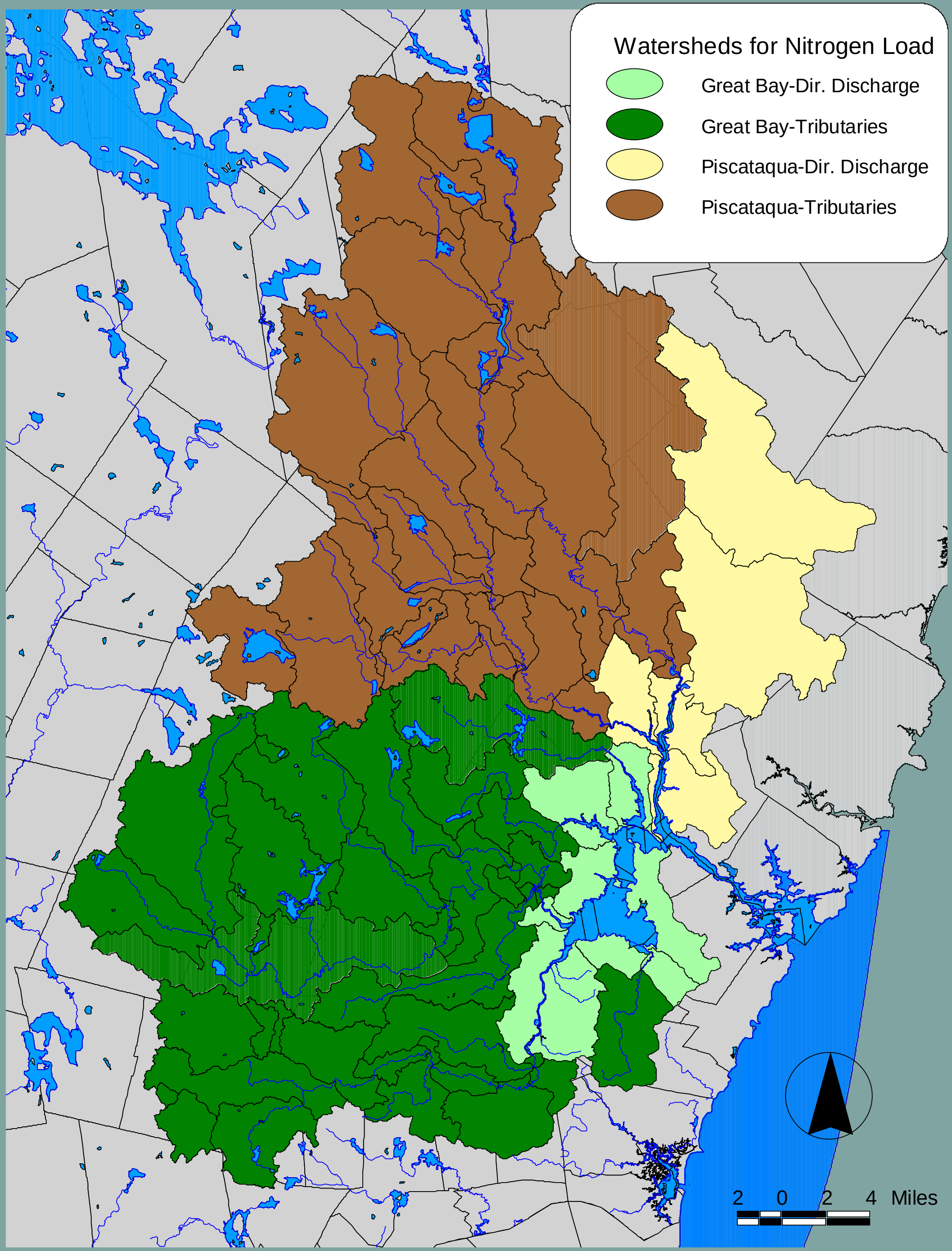






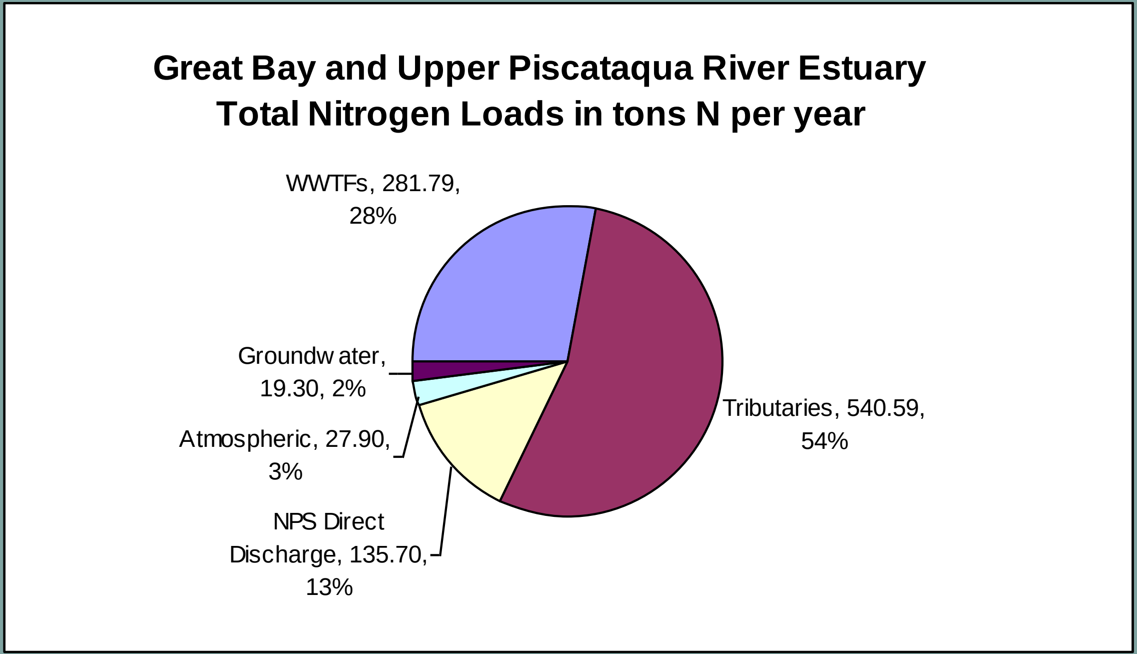


- The total nitrogen load to the estuary in 2002-2004 was determined to be between 1,005 and 1,097 tons/year. This estimate is 30% lower than modeled values from the USGS SPARROW model.


Watersheds for Nitrogen Load
Great Bay-Dir. Discharge
Great Bay-Tributaries
Piscataqua-Dir. Discharge
Piscataqua-Tributaries
2 0 2 4 Miles

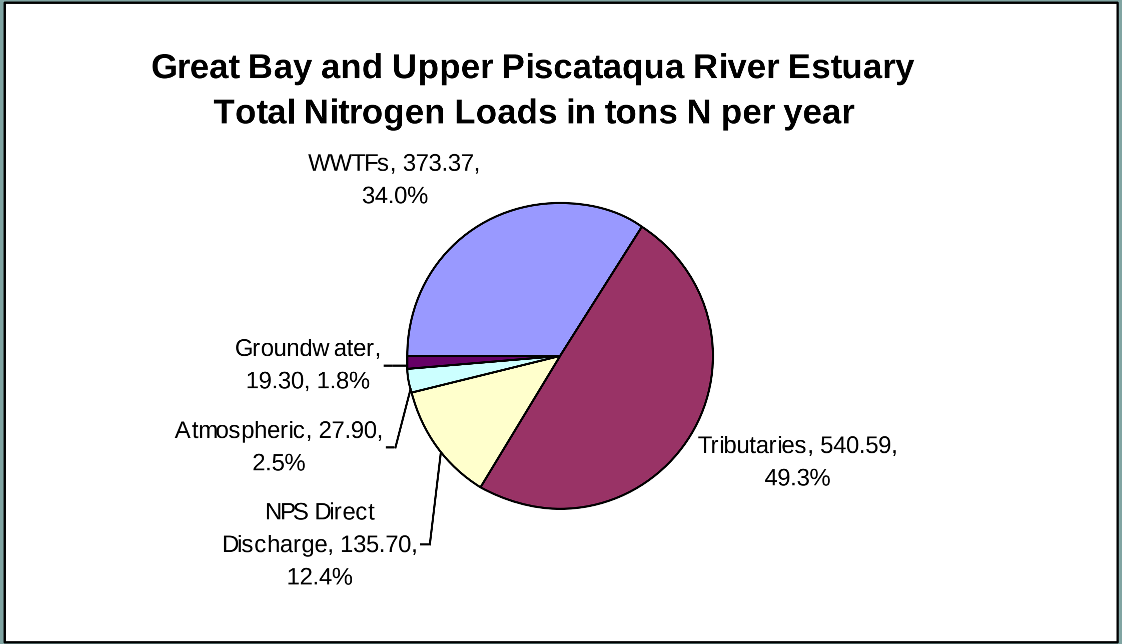
Without WWTFs in Piscataqua River

1,005 tons/yr



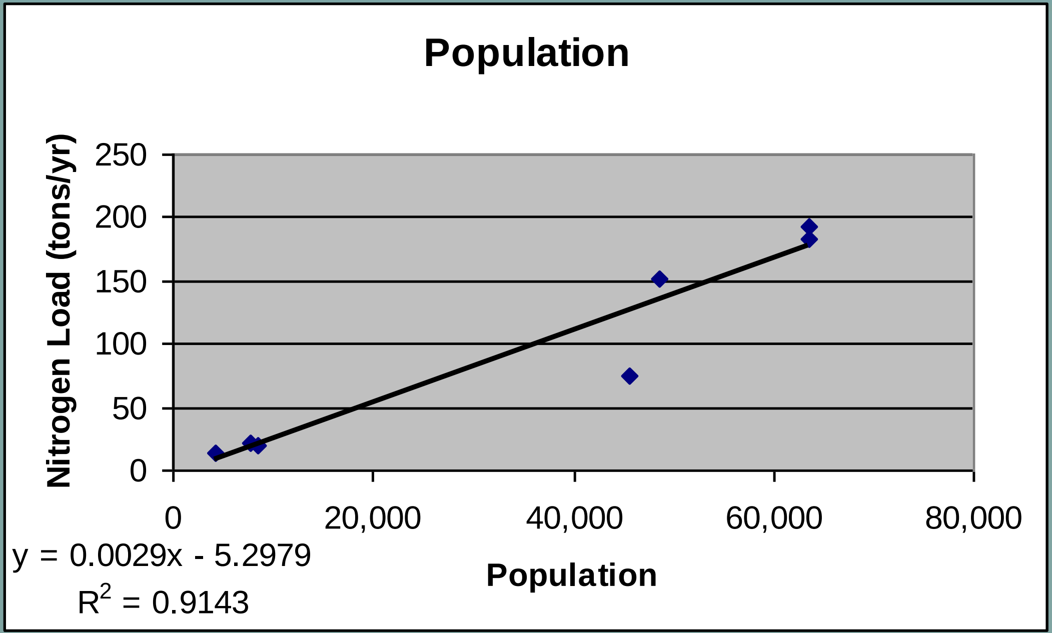
With 50% of WWTFs in Piscataqua River

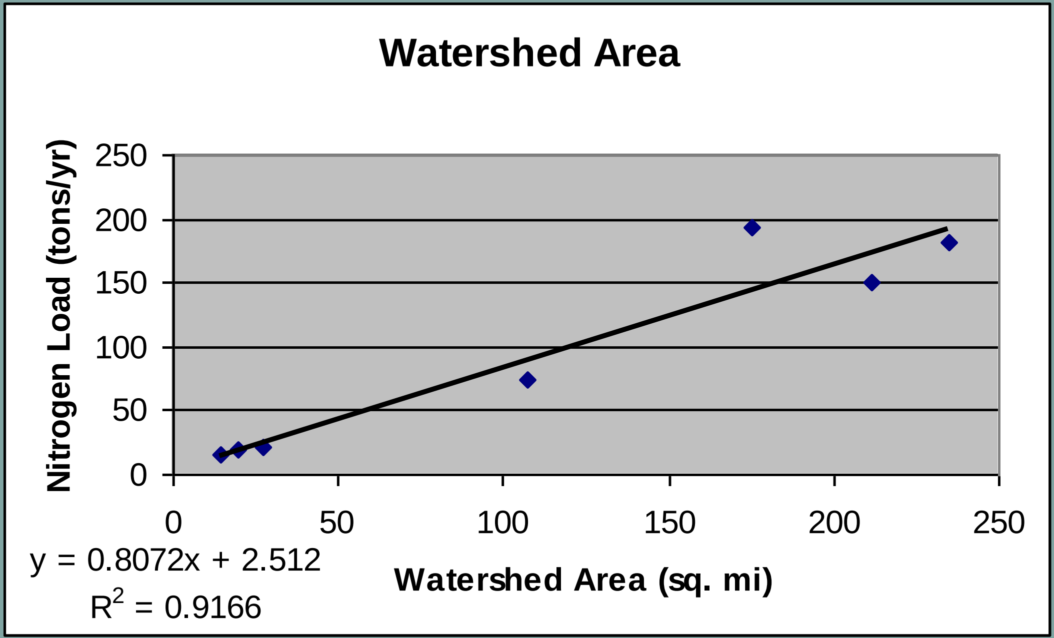
1,097 tons/yr



Correlations between N Load and Land Use in Watersheds

	Total N Load	NPS N Load
Population	0.943	0.922
Watershed Area	0.947	1.000
Developed	0.951	0.975
Agriculture	0.854	0.922
Forest	0.941	0.998
Wetlands	0.897	0.954
Open Water	0.934	0.987


Population
Nitrogen Load (tons/yr)
250
200
150
100
50
0
0
20,000
40,000
60,000
80,000
Population
y = 0.0029x - 5.2979
R2 = 0.9143

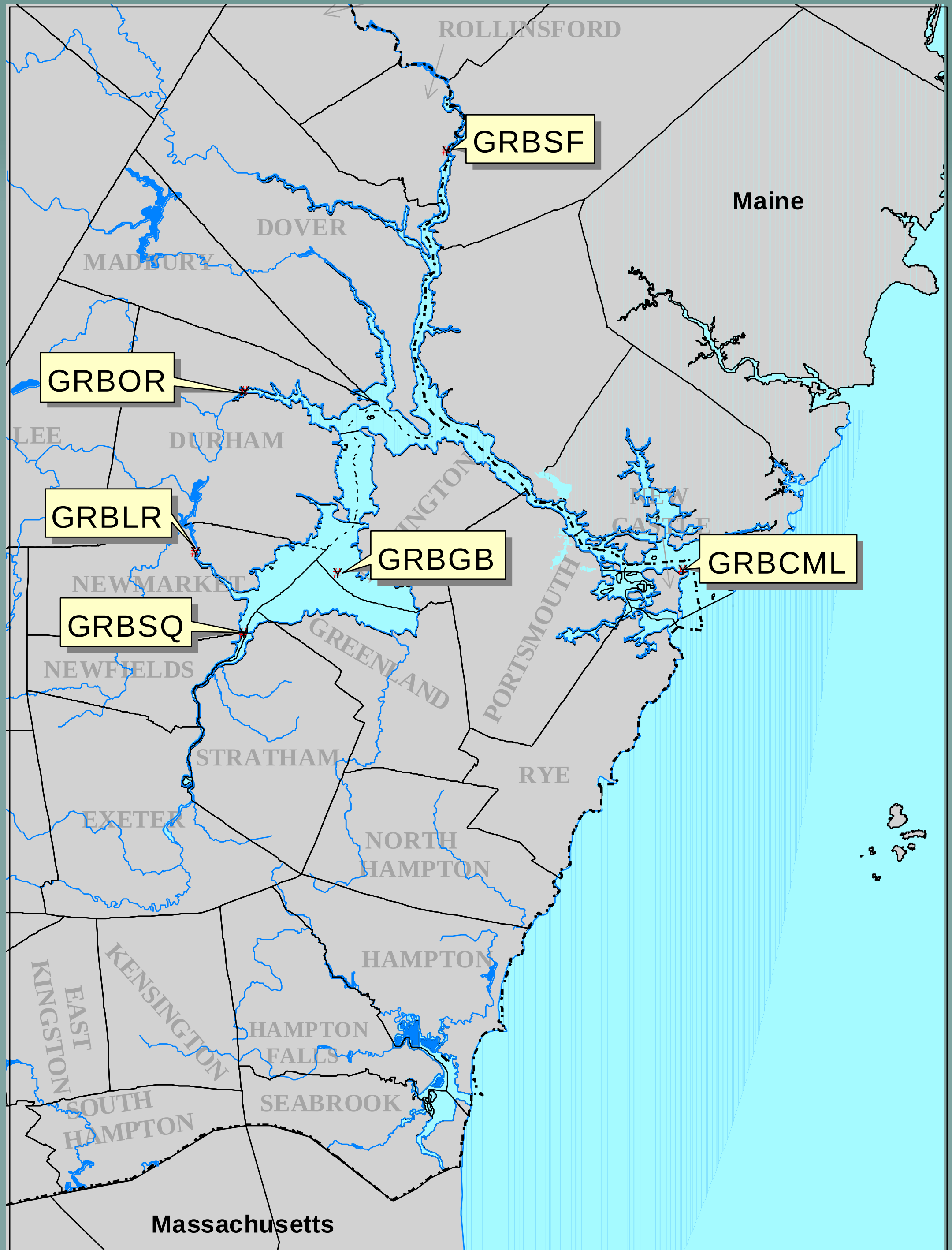

Watershed Area
Nitrogen Load (tons/yr)
250
200
150
100
50
0
0
50
100
150
200
250
Watershed Area (sq. mi)
y = 0.8072x + 2.512
R2 = 0.9166

Dissolved Oxygen

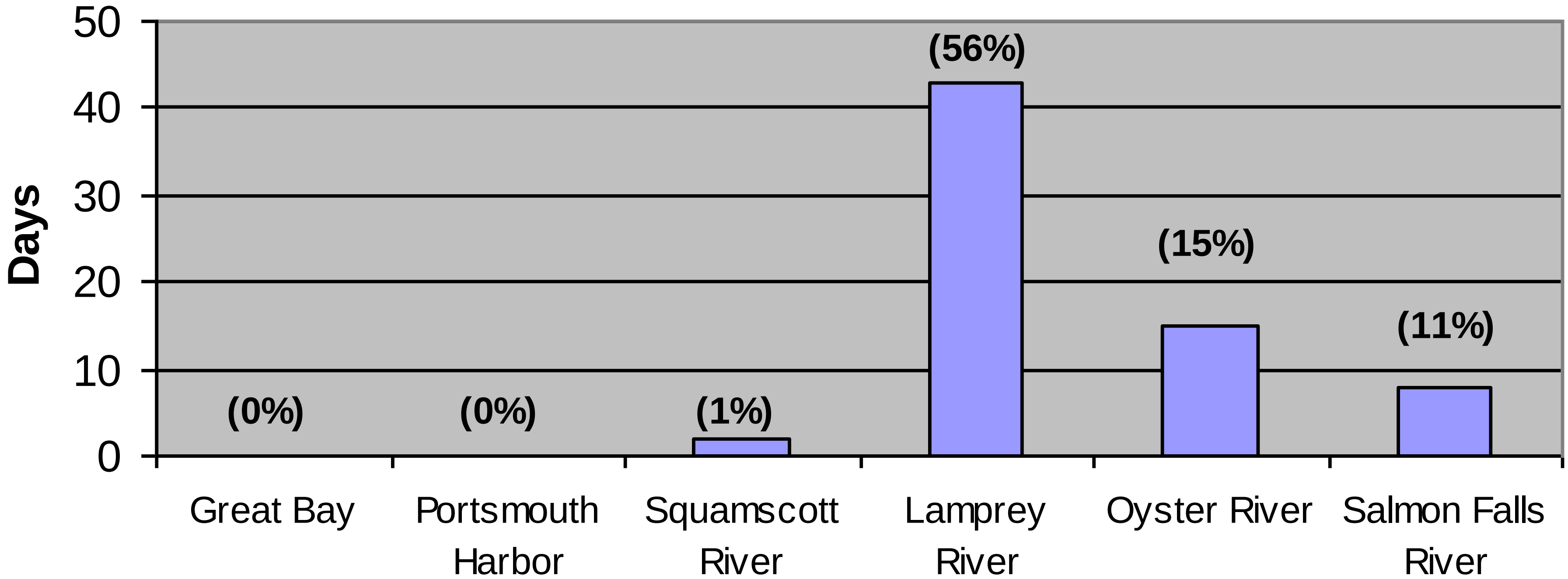
- Q: How often do dissolved oxygen levels in the estuary fall below State standards?

- A: Dissolved oxygen in the tidal tributaries often falls below 75%. This occurs most often in the Lamprey River. Dissolved oxygen in Great Bay and Portsmouth Harbor always meets standards.

NewHampshire EstuariesProject



Number of Summer Season Days in 2002-2004 with Daily Average Dissolved Oxygen <75%



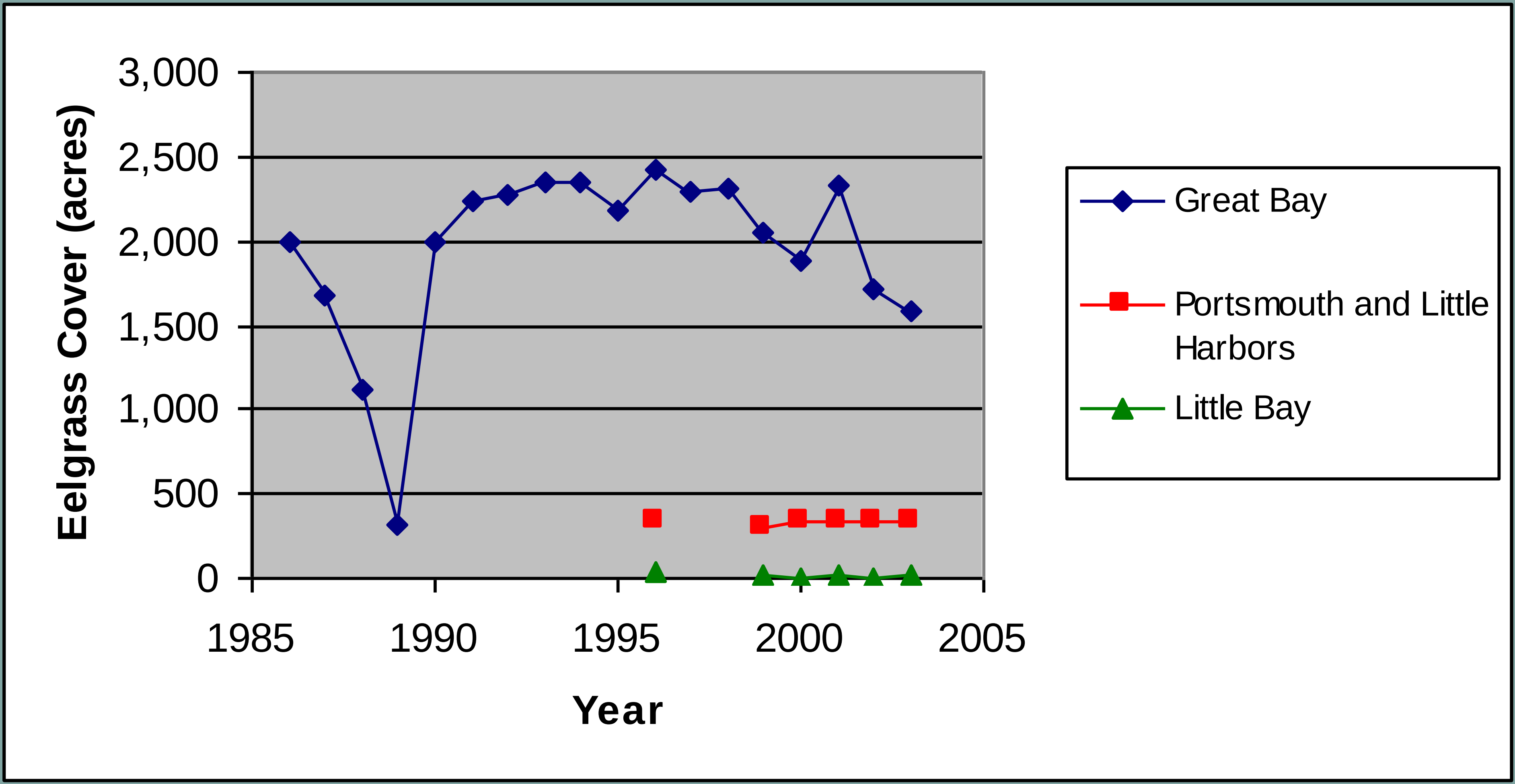
Numbers in parentheses are the percent of daily average DO measurements <75%

Eelgrass Distribution

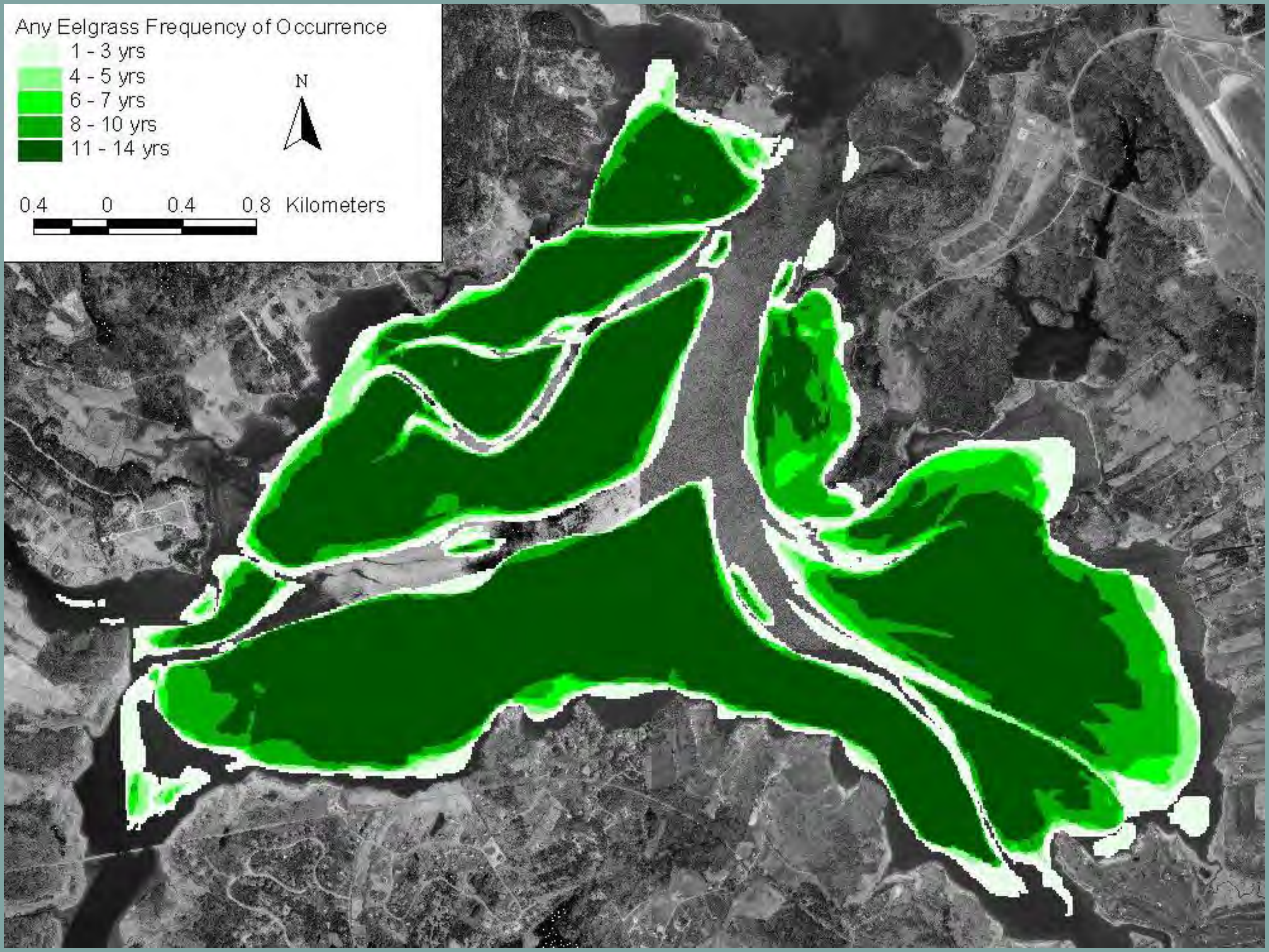
- Q. Has eelgrass habitat in Great Bay changed over time?

- A. Yes. Eelgrass coverage in the Great Bay has been declining since 1996 except for one good year in 2001. Between 1992 and 2003, the eelgrass biomass in Great Bay declined by 71%.

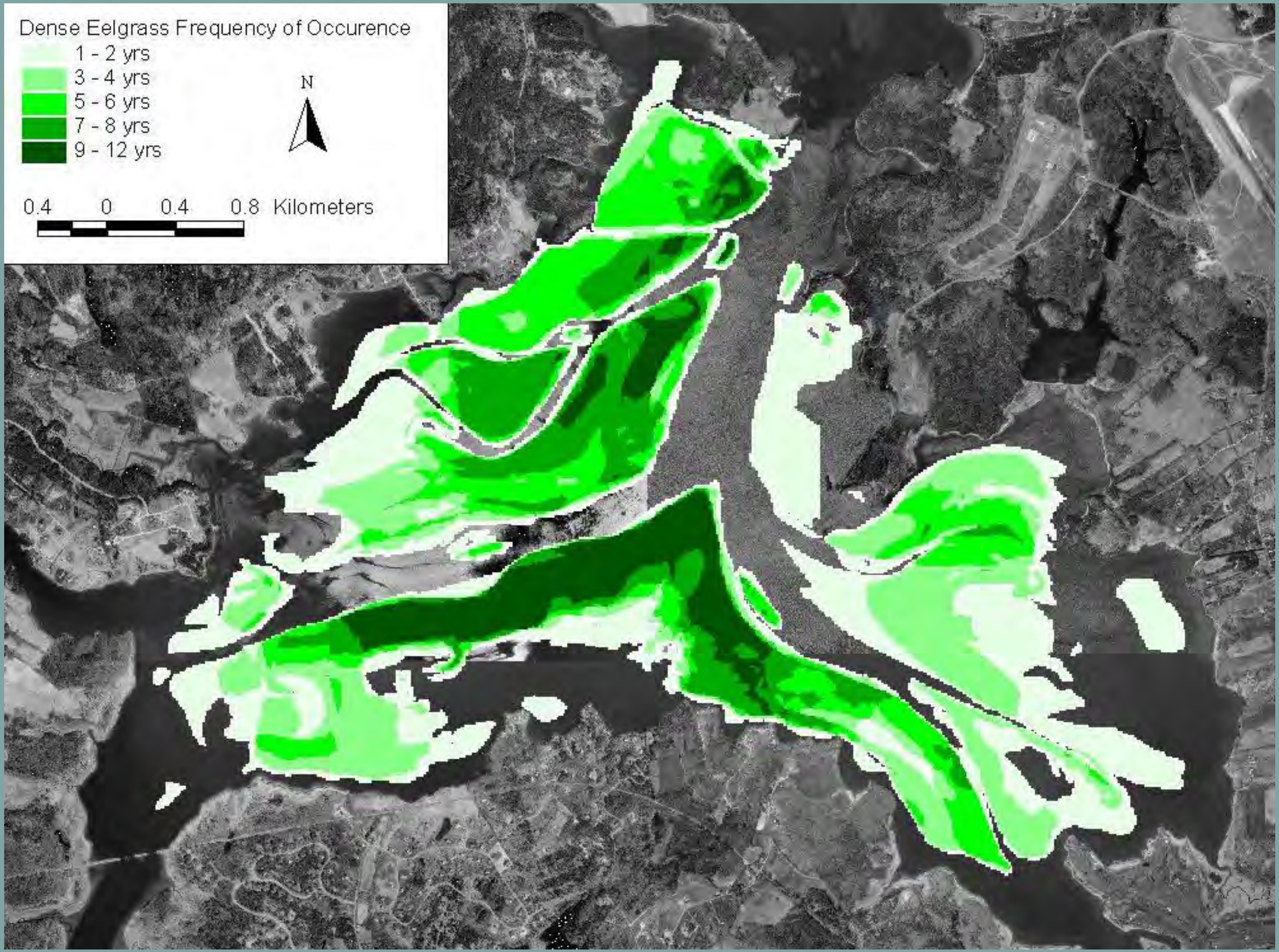
Eelgrass Coverage (1986-2003)



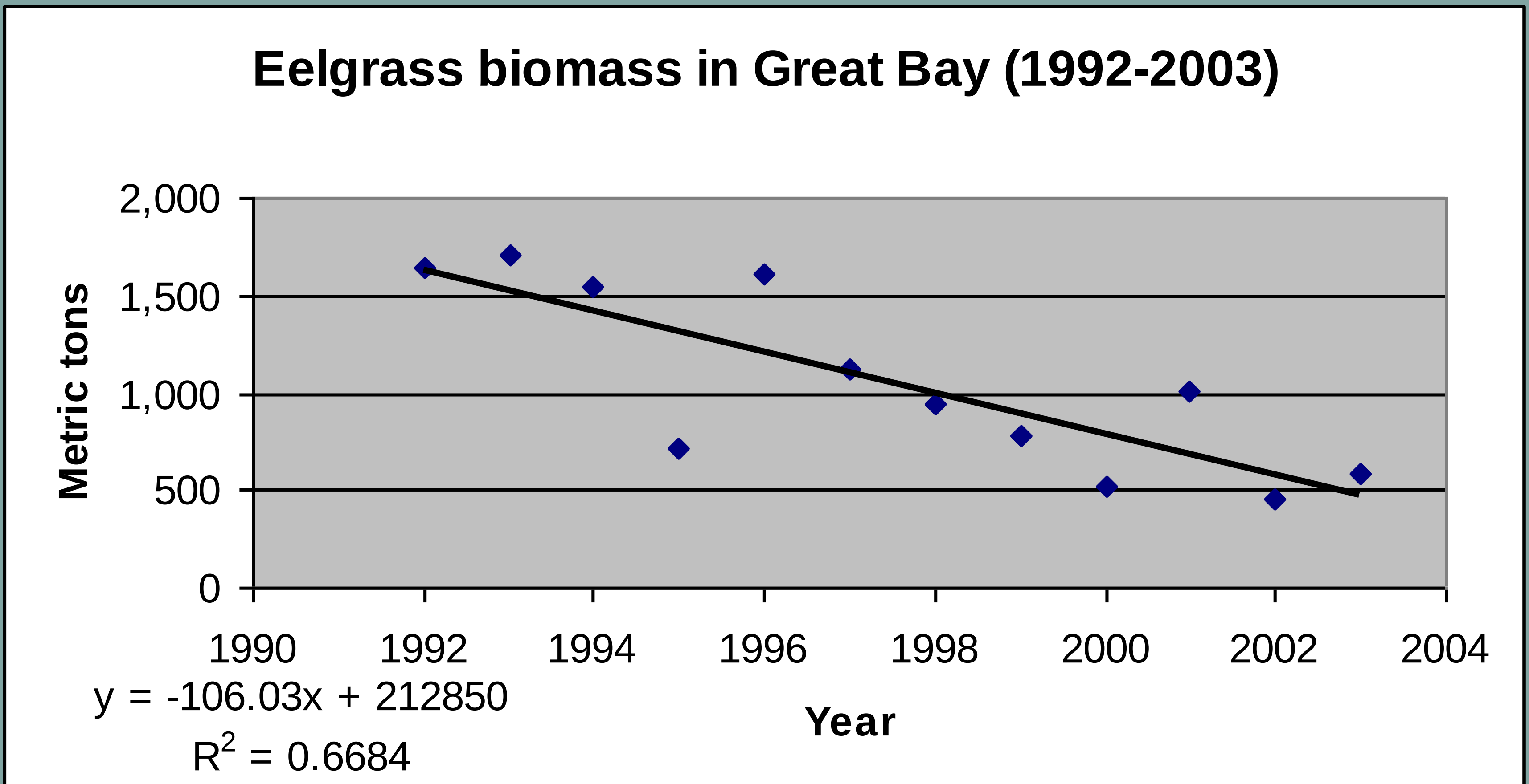
Eelgrass in Great Bay 1990-2003



Dense eelgrass in GB 1990-2003



Trends in Eelgrass Biomass



Summary

- Dissolved inorganic nitrogen has increased by 59% over the past 25 years.
- More recent trends in DIN are equivocal.
- No evidence for elevated chlorophyll-a.
- Low dissolved oxygen limited to tributaries
- Eelgrass has been declining for 10 years. Nitrogen load estimates are 30% lower than SPARROW, and are correlated with population and land area. WWTFs account for 28-34% of the load.