SUPPLEMENTAL EXHIBIT – 20

S. Exh. 20

BEFORE THE ENVIRONMENTAL APPEALS BOARD
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C.

In re:	)
Town of Newmarket	)
NPDES APPEAL No. 12-05	)
NPDES Permit No. NH0100196	)
	)

AFFIDAVIT OF DEAN PESCHEL

Dean Peschel, being duly sworn deposes and says as follows:

1. I am the principal of Peschel Consulting, LLC. I regularly provide environmental consulting services for the City of Dover, New Hampshire, including, but not limited to, consulting services relating to the City of Dover's National Pollutant Discharge Elimination System (NPDES) permit. I have on a number of occasions served as the spokesperson for the Great Bay Municipal Coalition. I am personally familiar with the facts and circumstances set forth herein.

2. On November 19, 2012, I attended a meeting with representatives of Region 1 USEPA to discuss the City of Dover's draft NPDES Permit.

3. During that meeting, David Pincumbe of USEPA stated that USEPA was not relying on the New Hampshire Numeric Nutrient Criteria document for justification of the 3mg/l TN permit proposed for Dover. He stated that USEPA had done its own analysis and determined that the 3mg/1 limit was necessary.

4. I responded by asking Mr. Pincumbe for a copy of the analysis as I had never seen any independent EPA analysis. Mr. Pincombe stated that it is the body of documents available prepared by the Piscataqua Region Estuary Partnership and NHDES, all of which are available online. Mr. Pincumbe's response confirmed there is no "independent" EPA assessment available for public review.

Events Leading to DES Lawsuit over Unadopted Water Quality Standards

5. Following adoption of revised § 303(d) listings for the Great Bay Estuary in 2009, the major cities surrounding Great Bay formed a coalition (the Great Bay Municipal Coalition) to review the regulatory and scientific bases of these actions (not knowing, at this time, that the use

of the draft criteria in impairment listing was directed by EPA). Outside experts were hired to independently assess the 2009 Numeric Criteria (HydroQual and Hall & Associates)

6. EPA initiated a peer review in the spring of 2010. The communities sought involvement in a peer review planned by EPA to consider the draft 2009 Numeric Nutrient Criteria for the Great Bay Estuary, but EPA refused to allow consideration of any of their issues or the new analyses developed by the Coalition's consultants showing that transparency could not have caused the recent eelgrass declines.

7. The Coalition contacted DES repeatedly requesting that an open, state-run peer review occur because EPA had cut them out of the federal peer review. In December 2010, DES transmitted a letter agreeing to participate in such a review.

8. The Coalition's analyses of the data from Great Bay were transmitted to DES in January, 2011 indicating the following:

A. Algal levels never increased in response to TIN increases in the estuary. (If no increase occurred TN could not have caused poorer transparency anywhere in the system and TN control could not be expected to reduce algal levels and improve transparency).

B. Available data indicated that secchi depth (a measure of transparency) had not changed in either Great Bay/Little Bay and the Piscataqua River. (Therefore the claim that transparency caused the eelgrass declines was completely unsupported).

C. DO was naturally low in the tidal rivers and that low DO did not coincide with elevated algal levels. For the Lamprey River, in particular, detailed studies showed that a hydrodynamic anomaly was the primary cause of the periodic low DO in that system. (Therefore, reducing algal levels would not be expected to have a beneficial effect on DO levels in the tidal rivers).

D. The analyses DES used to support the 2009 Criteria were fundamentally flawed since they plotted data from radically different environmental settings and presumed (contrary to the available data) that TN was the key parameter that explained the variation in DO and transparency. (These analyses confirm that the effect of other critical system parameters controlling transparency and the effect of nitrogen inputs were completely ignored contrary to accepted scientific methodologies and EPA guidance manuals).

E. The analyses were only rough correlations that failed to consider over a dozen important physical, chemical, and biological factors influencing whether or not TN will have any significant effect on the endpoints. (Such analyses are not considered scientifically defensible methods per EPA's SAB).

9. The primary author of the 2009 Numeric Criteria document (Mr. Trowbridge) prepared a rebuttal in late January 2011. These differences in scientific opinion lead to a series

of meetings wherein the Coalition experts presented exhaustive analysis of the available data to DES. These analyses plainly showed that increasing TN levels could not possibly have been the cause of system wide eelgrass declines occurring in 2006. DES also indicated that it had conducted many of the same data evaluations performed by the Coalition's experts prior to issuing the 2009 Numeric Nutrient criteria document. This was a major surprise to the Coalition members in attendance at the meetings. In April 2011, DES eventually agreed with the Coalition's experts that there were substantial uncertainties with the scientific approach used to develop the 2009 Numeric Criteria and a Memorandum of Agreement (MOA) would describe how to move forward and resolve these issues. Because the parties agreed about the flawed scientific underpinnings of the 2009 Criteria, the need for an independent peer review was obviated.

10. Through the discussions DES agreed that application 0.3 mg/l TN numeric criteria for eelgrass was not appropriate for the tidal rivers and that low DO was the concern in those waters. The parties agreed that a more detailed assessment of the factors influencing low DO in the Squamscott River (and, as appropriate, completion of a water quality model) would provide information to resolve whether or not nitrogen control would significantly improve low DO conditions through reduced algal growth. The draft MOA circulated for review and approval of the parties reflected these conclusions also. The Coalition members subsequently committed approximately $100,000 to address the Squamscott River monitoring and assessment.

11. In June 2011, the MOA between DES and the Coalition cities was ratified. The MOA directed the parties to conduct follow-up meetings to resolve the scientific uncertainties with regard to the transparency-based 0.3 mg/l TN criteria and related issues (Provision V) under the auspices of the Southern Watershed Alliance or the Piscataqua Region Estuary Partnership (PREP).

12. Following the issuance of the MOA, the technical meetings called for by Provision V of that document were held with the Coalition's experts, DES, EPA (who only attended one meeting and was quite upset at the entire process), and UNH professors knowledgeable about the available studies for the estuary. The technical discussions from those meetings were memorialized in meeting minutes reviewed by all in attendance for accuracy.

13. The discussions in the July 2011 meeting confirmed that the approach used to develop the 2009 Numeric Criteria was fundamentally flawed and that there was no scientific basis for applying those criteria in the tidal rivers, as transparency is insufficient to support eelgrass growth in those areas, unrelated to TN levels or algal growth.

14. While the MOA group meetings were ongoing, DES was secretly in the process of changing its position with respect to the need to meet the 0.3 mg/l TN criteria in the tidal rivers. In response to a request from EPA, DES authored a letter indicating that the

transparency-based criteria for eelgrass protection should be applied in the Lamprey and Squamscott Rivers.

15. This DES letter was not released to the Coalition until months later, after the DO sampling program for the Squamscott River had occurred. In November 2011, the Coalition asked DES to modify its eelgrass impairment listings that had relied on the plainly unsupported draft 2009 Numeric Criteria document given the results of the updated technical discussions called for in the MOA and the new information presented. DES simply refused to modify any finding that would undercut the application of the 2009 Numeric Criteria.

16. At this point it became apparent to the Coalition that both EPA and DES were attempting to ignore the actual data for the system in seeking to impose nutrient reduction mandates regardless of actual need or technical justification. A FOIA response from EPA Region I also revealed that EPA was relying on representations made by Dr. Fred Short that were not supported by his research, claiming that changing nitrogen levels caused the decline in eelgrass in the estuary. These positions were contrary to those expressed in the MOA meetings.

17. The Coalition members met in mid-December to discuss the need to sue DES over the illegal use of an unadopted water quality standard and through that vehicle, obtain DES's testimony under oath on critical issues since DES apparently had abandoned the MOA process and had no intention of accurately reporting the scientific and factual information related to eelgrass declines and TN impacts on the estuary.

18. It took until mid-February, 2012 to obtain all of the Town and City council approvals to file a declaratory judgment petition. On or about March 23, 2012 the case was filed in Merrimack County Superior Court, Docket No. 217-2012-cv-00212.

19. Shortly thereafter, the parties moved to depose Dr. Fred Short, Philip Trowbridge and Paul Currier. Those depositions, which I attended, occurred in May, June and July 2012, in accordance with the availability of the deponents. DES was also requested to produce documents associated with the development and review of the 2009 Numeric Nutrient Criteria document.

20. After the completion of the depositions and the receipt of final transcripts, the Coalition filed supplemental comments with EPA Region I detailing that numerous technical errors and misrepresentations that were made with regard to the preparation and peer review of the 2009 Numeric Nutrient Criteria document. Such information was not available to the Coalition prior to the depositions and release of records confirmed that EPA was behind the classification of Great Bay as nutrient impaired in September 2009. In particular, DES produced an internal email that documented EPA had asked DES to declare Great Bay nutrient impaired to appease the Conservation Law Foundation (CLF) who supposedly had "threatened suit." EPA also asked DES to make this determination based on application of the unadopted 2009 Numeric Nutrient Criteria.

21. It was only through the state litigation discovery process, after the close of the permit comment period, that the various DES analyses were uncovered and EPA's knowledge that there was no objective basis for claiming TN caused significant transparency decreases or eelgrass impairment in this system was confirmed. Both DES and EPA knew of the information and analyses confirming the 2009 Numeric Nutrient Criteria approach was unsupported but repeatedly informed the public (and the peer reviews) of the opposite position.

22. Prior to December 2011, there was no reasonable basis for the Coalition or its members to file an action and allow depositions to be taken of Messrs. Trowbridge, Currier and Short. The Coalition thought it had worked out the scientific disputes through the MOA and MOA technical review process. That MOA expressly stated that DES did not support the application of the 2009 Numeric Criteria to develop effluent limits for the Coalition communities pending the completion of additional studies and publication of site-specific criteria. (Provisions III – Mutual Agreements; DES Agreement III) Therefore, there was no need to take any form of legal action. The events occurring in mid- November and December of 2011 provided the impetus for the filing of an action in state court once it was apparent that DES had reneged on the MOA and EPA was applying the 2009 Numeric Nutrient Criteria with the support of DES. The action was filed expeditiously thereafter.

I swear that the forgoing statements are true to the best of my knowledge.

Dean Peschel

STATE OF New Hampshire
COUNTY OF Strafford

Signed and sworn to before me on this 6 day of ~~February~~ March, 2013 by Dean Peschel.

Notary Public
My Commission Expires: COLLEEN E. A. BESSETTE, Notary Public My Commission Expires October 22, 2013

(Notary Seal)

SUPPLEMENTAL EXHIBIT – 21

S. Exh. 21

BEFORE THE ENVIRONMENTAL APPEALS BOARD
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C.

In re:	)
Town of Newmarket	)
NPDES APPEAL No. 12-05	)
NPDES Permit No. NH0100196	)
	)

AFFIDAVIT OF THOMAS GALLAGHER

Thomas Gallagher, being duly sworn deposes and says as follows:

1. I am a consulting environmental engineer with HDR/HydroQual, Inc. of Mahwah, NJ. I have provided environmental consulting services for the Cities of Dover and Rochester, New Hampshire, including, but not limited to, consulting services relating to the proposed City of Newmarket's National Pollutant Discharge Elimination System (NPDES) permit. I have over 40 years experience in performing detailed water quality impact analyses and modeling for local, private state and federal entities. I have on a number of occasions prepared detailed technical analyses of scientific validity of the 2009 Numeric Nutrient Criteria for Great Bay Estuary. I have met with Department of Environmental Services (DES) personnel on several occasions to discuss the serious scientific and methodological flaws associated with that document.

2. On April 5, 2011, I met with Mr. Paul Currier, Mr. Philip Trowbridge and Mr. Ted Diers, along with numerous members of the Great Bay Municipal Coalition, to discuss the Coalition's concerns with the 2009 Criteria document. The purpose of this meeting was to review whether or not the state's assumed statistical relationships met basic tests for scientific defensibility (i.e., did the relationships represent "cause and effect" conditions; did the field data demonstrate that nutrients caused a change in algal growth and transparency; were the DO and transparency changes claimed to be due to algal levels/nitrogen increases within the range of physically possible conditions, were essential components and factors that influence dissolved oxygen (DO) and transparency left out of the state's assessment).

3. Prior to this meeting I prepared a detailed assessment of the basic technical errors in that document (see, e.g., January 11, 2011 assessment of DES 2009 Numeric Nutrient Criteria). In particular, we noted that the relationships predicted in the 2009 Criteria document

were directly at odds with the available data collected for the estuary and the various detailed studies that analyzed nutrient and algal impacts on both light transmission and dissolved oxygen levels in the tidal rivers. It was also noted that several of the predicted relationships failed to account for numerous factors significantly affecting those endpoints and the predicted relationships were not physically possible (i.e., it was impossible for the degree of algal growth represented in the graphs to have caused the projected change in both transparency and DO). Therefore, it was apparent that the simplified regression analyses used to claim nitrogen caused changes in algal growth causing the existence of low DO and poor transparency were not defensible and clearly in error. Mr. Trowbridge prepared a response to that document dated March 10, 2011, providing additional simplified graphs and other written analyses to support his position that the criteria were scientifically defensible.

4. During the April 5, 2011 meeting, DES (Paul Currier) indicated that he understood that the analyses used to support the 2009 Numeric Criteria failed to account for the numerous factors affecting both DO and transparency in the system. DES agreed that if algal levels and transparency in Great Bay had not changed materially over time (1990-2006) nutrients could not have been the cause of eelgrass declines related to water transparency. We then presented the algal growth and transparency history for Great Bay which confirmed no material change in algal growth or transparency has occurred in over 30 years in Great Bay. DES did not disagree with the information.

5. I presented an analysis showing that it was physically impossible for the minimal level of algal growth present in the Great Bay system (averaging 2-4 ug/l chlorophyll 'a' in Great Bay through the Lower Piscataqua River) to cause the degree of transparency change attributed to nutrient impacts in the 2009 Numeric Nutrient Criteria document. The analysis, consistent with that used by EPA in other estuaries (e.g., Chesapeake Bay) and values of algal influence on water column transparency from literature confirmed that transparency might improve by 5% at most from limiting nitrogen as recommended in the 2009 Criteria Document. This was the same conclusion that a detailed study by Morrison reached with regard to Great Bay estuary. DES did not present any information that conflicted with this observation.

6. I also presented analyses showing the degree of DO change that could be attributed to the level of algal growth depicted in the DES charts purporting to relate algal growth to minimum and maximum DO levels. The analysis demonstrated that (1) the existing algal growth cannot possibly be responsible for the 6-10 mg/l difference (maximum to minimum) in DO depicted in the charts. Moreover, the degree of algal growth reduction claimed to eliminate the low DO conditions (about 3 ug/l chlorophyll 'a' at the 90 percentile level) could not possibly produce the improvement in DO predicted from the regressions. DES had no information that conflicted with these positions.

7. After the detailed discussions were over, Mr. Trowbridge indicated that he also had completed many of the same analyses showing that nutrients were not the cause of either low

DO or poor transparency in the system. This statement was shocking in light of the representations made in the 2009 Numeric Nutrient Criteria document which claimed the opposite was occurring in the system. The 2009 Criteria document nowhere indicates that any of these prior analyses had been completed and nowhere informed the public that DES was aware that the statistical relationships presented to derive the numeric criteria were inconsistent with its own more detailed assessments for the system.

8. HydroQual was subsequently hired to conduct data collection and analysis of factors affecting DO conditions in the Squamscott River. This was one of the items addressed in the Memorandum of Agreement between DES and the Coalition. HydroQual completed its report in January, 2012. That report, similar to prior assessments for the Squamscott River performed by Dr. Steven Jones of the UNH Jackson Laboratory, found the following:

a. Low DO, in general, was not associated with elevated algal growth, higher DO levels were generally associated with increased algal growth;
b. The DO regime of the river was complex with numerous factors influencing the occurrence of low DO;
c. The Exeter facility was contributing high algal levels into the system from its treatment lagoons and this probably contributes to sediment oxygen demand (SOD) in the system;
d. The Exeter impact was unique and heavily influenced the amount of algal growth found in the system; eliminating this algal discharge should result in some DO improvement by lessening SOD; and,
e. Modeling of the DO regime to determine the influence of algal growth should be deferred until Exeter updated its facility to eliminate the algal discharge at which point the effect of nitrogen on algal growth in this system and the residual SOD could be accurately assessed.

9. The detailed assessment of the Squamscott River confirmed that reducing nitrogen as proposed by the 2009 Numeric Nutrient Criteria could not possibly ensure that low DO conditions would be remedied in this river. The 2009 Numeric Nutrient Criteria are plainly misplaced and without reasonable scientific foundation.

I swear that the forgoing statements are true to the best of my knowledge.

Thomas W. Gallagher
Thomas Gallagher

STATE OF NEW JERSEY
COUNTY OF BERGEN

Signed and sworn to before me on this 27th day of February, 2013 by Thomas Gallagher.

SUPPLEMENTAL EXHIBIT – 22

S. Exh. 22

Original Message-----
From: Steve Jones [mailto:shj@unh.edu]
Sent: Tuesday, August 28, 2012 12:15 PM
To: Tom Gallagher; Cristhian Mancilla; John Hall; dean_peschel@yahoo.com Peschel
Subject: Fwd: Looking for a copy of the following report

Hi Tom, Cristhian and all,

I've never asked if you all had all three of these reports. I realized there were 3 related Squamscott study reports when asked by EPA- Narragansett today for a copy of the 2005 report. I sent them the three i've attached here. Maybe you have them already.

Cheers,

Steve

>
> Here are the three reports. The 2005 report as requested, the other
> two are: a (2007) similar study to what was conducted in the 2005
> published study, and the second report (2008) is a more in-depth
> analysis of the DO data.
>
> Cheers,
>
> Steve
>

S. Exh. 22

Incidence and Timing of Low Dissolved Oxygen Events in the Squamscott River: 2005-07

A Final Report to
The New Hampshire Estuarine Project

Addendum to:
"Impacts of Wastewater Treatment Facilities on Receiving Water Quality"

Submitted by

Steve Jones
Jackson Estuarine Laboratory
University of New Hampshire
Durham, NH 03824

July 2008

This project was funded in part by a grant from the New Hampshire Estuaries Project as authorized by the U.S. Environmental Protection Agency's National Estuary Program.

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EXECUTIVE SUMMARY

The Squamscott River has had extended episodes of low dissolved oxygen (DO) that have been recorded at a site near its mouth during the past few years. These episodes were recorded as a result of temporally intensive monitoring by a datasonde deployed through most of each year. Whereas low DO events can occur during April-November, events during the colder months are typically less frequent and are often caused by unusual natural or severe weather conditions. Low DO events occur most frequently during July-September when elevated levels of nutrients are most likely to contribute to their cause, and are thus of most concern.

The study found the warm season time period of July-September to be the time of year when low DO events were most frequent and pervasive. In comparisons between each year from 2005 to 2007, 2005 had less frequent and pervasive low DO events compared to 2006 and 2007. Relative to tidal cycle conditions, low DO conditions were most likely to occur during neap tide conditions, as indicated by the least shallow depth readings for the data sonde. Beyond the seasonal and tidal time periods, the time of day where conditions are most likely to cause low DO events is also critical for focusing field efforts. The most frequently observed time of day when either a low DO event was initiated or the lowest DO reading was recorded was in the morning, especially before 8:00 AM. Much less frequent occurrence of these events was observed during the second half of days.

It appears that the predicted conditions for conducting water measurements and sampling during 2005 were relatively accurate. The study should have been more successful except that 2005 was a year in which low DO episodes were less frequent and pervasive. Future studies in the Squamscott River area near the data sonde can benefit from use of the results reported herein. The same kind of analysis could also be used to help inform studies in other areas of the estuary where data sondes are nearby and have available databases for water quality conditions.

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INTRODUCTION

Contaminants of concern discharged to tidal waters in effluent from wastewater treatment facilities (WWTFs) are controlled through the permitting process for every facility in New Hampshire. Several types of effluent characteristics are universally controlled, including solids, coliform bacteria, ammonia and biological oxygen demand (BOD). However, no Seacoast NH facility is yet permitted for nutrients like nitrogen and phosphorus. The impact of effluent on the oxygen in the receiving water is mitigated by removal of BOD, but high loading of nutrients can have a detrimental impact through the process of eutrophication. High loading rates of nutrients, especially nitrogen in estuarine waters because it is typically limiting, can stimulate the growth of phytoplankton and nuisance algae. Over production of plants eventually causes die off and the decomposition of algal biomass by heterotrophic bacteria is an oxygen-demanding process. Too much demand on dissolved oxygen (DO) in the water, especially in warmer months can cause episodic or chronic periods of hypoxia, and even anoxia. Other processes also can be oxygen demanding. Ammonium in effluent can also cause oxygen demand because it is oxidized to nitrate by nitrifying bacteria in receiving waters, and even low concentrations of BOD can have impacts under the right conditions.

The Squamscott River (NHEST600030806-01) was listed as "Not Supporting" for Aquatic Life Use Support because of low dissolved oxygen in the 2004 §305(b) report. It was de-listed for % saturation in the 2006 NH 305(b) report (http://www.des.state.nh.us/wmb/swqa/303dList.html), but remains listed for DO concentration (ppm). The Great Bay Estuarine Research Reserve has deployed oxygen sensors at the Squamscott River railroad bridge and at 4 other sites in the Great Bay Estuary in recent years. Data every 15-30 minutes has been radioed back to Jackson Estuarine Laboratory from these sites, providing an intensive real-time picture of conditions. Episodes of depressed (<5.0 mg/l & < 75% saturation) DO occurred at the one site in the Squamscott River during 2003 and 2004. The New Hampshire National Coastal Assessment (NCA) also documented depressed oxygen at several Squamscott River sites at both ends of the river in 2000- 2004. The NCA program also conducted two synoptic assessments at 15 sites in the river in 2004 to provide a better sense of the geographical range of these episodes (Jones 2005).

The low DO episodes in the Squamscott River were recorded as a result of temporally intensive monitoring by a datasonde deployed from April to December. Whereas low DO events can occur throughout this time period, events during the colder months are often caused by unusual natural or severe weather conditions. In contrast, low DO episodes occur most frequently during July-September when elevated levels of nutrients are most likely to contribute to their cause, and are thus of most concern. As part of a larger study to discern the wider spatial extent and causes of low DO events in the Squamscott River (Jones 2007), there was a need to predict when these events were most likely to occur to enable planning and field deployment of resources. Sampling and measurements were taken on five dates in 2005 and one in 2006. Only one date, August 19, 2005, showed

spatially extensive low DO levels. Results on the other sample dates showed either acceptable levels, or low DO levels were confined only to small areas on two other dates. The areas where low DO levels occurred on the three dates were all distinctly different areas of the river, possibly reflecting different causes. tidal transport of low DO waters, or as some factor of sample timing relative to conducive conditions. Overall, conditions recorded by the datasonde for 2005 showed greatly diminished episodes of depressed DO levels compared to previous years.

STUDY GOALS

The goal of this study was to provide information that would help predict when conditions for low DO are most likely to occur. Data from the Squamscott River datasonde were analyzed to determine when low DO episodes occurred during 2005-07. The main questions being addressed were whether criteria chosen for the timing of field efforts conducted by Jones (2007) were accurate, and whether 2005 was an unusual year compared to previous and ensuing years relative to overall conditions conducive to the onset and incidence of low DO episodes.

METHODS

The method used to evaluate the timing of low DO events was to review existing data recorded at the Squamscott River data sonde from 2005 to 2007. Data from 2003-04 had been previously analyzed to help in predicting when to conduct field assessments of the spatial extent of low DO episodes on the river as part of a larger project that included this study (Jones 2007).

Data from all sondes deployed through the Great Bay National Estuarine Research Reserve System Wide Monitoring Program can be downloaded from the website for the National Estuarine Research Reserve System Centralized Data Management Office at http://cdmo.baruch.sc.edu/. The data used included date, time, DO % saturation, DO concentration and height of the data sonde as an indication of tidal amplitude and the effect of tidal cycles. Each time at which low DO was first recorded was considered the time of initiation of a low DO event. These events could occur as single recorded incidences or they could continue for longer time periods, so there could be more than one event in a day. Event duration was considered to be instantaneous for events with a single recorded incidence of low DO, as noted in the summary data tables in the following sections. The data were analyzed for seasonal, monthly and daily trends and characteristic conditions.

Data from the 2003 and 2004 sonde databases were also analyzed. Some of the key analyses have been summarized in Trowbridge (2006) and not included in this report.

RESULTS AND DISCUSSION

The DO % saturation and concentration data from 2003 to 2007 were analyzed to determine mean monthly values and to identify minimum and maximum values for each month (Table 1). DO measurements were made starting in April and continuing through December each month. The frequency of DO measurement by the sonde was every 30 minutes for 2003-06, and changed to every 15 minutes for 2007, thus doubling the number of data records for each month.

S. Exh. 22

	Record	#	% DO saturation				DO concentration (mg/L)				First & last
2007	inverval	Records	mean	stdev	min	max	mean	stdev	min	max	days
Apr	0:15	2352	100.3	5.94	71.4	124.6	11.63	1.3	5.9	14.1	4/6/07
May	0:15	2976	95.9	4.69	80.5	107.5	9.17	0.77	7.3	10.9	
June	0:15	2880	91.1	10.47	71.3	134.5	7.7	0.68	5.9	11.2	
July	0:15	2976	98.2	13.69	49.7	146.4	7.41	0.9	4.1	11.2	
Aug	0:15	2976	103.7	13.05	52	134	7.6	0.94	4.1	9.9	
Sept	0:15	2880	99.6	13.84	58.3	135.3	7.75	1.04	4.8	10.5	
Oct	0:15	2976	93.9	12.56	65.4	134.3	8.08	0.89	5.6	10.6	
Nov	0:15	2880	90.9	3.62	82	105.8	9.98	0.76	8.3	11.8	
Dec	0:15	426	89.9	2.03	85.9	97.2	11.32	0.44	10	14.8	12/5/07
2006											
Apr	0:30	1070	103.0	10.22	81.9	132	10.53	1.26	7.9	13.6	4/6/06
May	0:30	1276	91.9	5.08	76.4	123.3	9.25	1.16	6.7	12.7	
June	0:30	1440	90.2	3.34	69.2	111.5	7.99	0.88	5.9	10.9	
July	0:30	1488	90.8	12.66	59.4	132.2	7.02	0.96	4.6	10.2	
Aug	0:30	1461	83.9	10.46	51.4	112.2	6.49	0.74	4	9	
Sept	0:30	1440	94.7	12.29	52.3	126.4	7.68	0.91	4.6	9.9	
Oct	0:30	1488	101.7	8.06	81.2	128.4	9.82	1.03	7.2	13	
Nov	0:30	1440	109.7	4.28	98.8	118.9	12.62	1.12	11	15.3	
Dec	0:30	215	114.6	1.78	110.5	119	13.38	0.58	12	14.8	12/5/06
2005											
Apr	0:30	1228	100.1	7.28	88.7	126	10.76	0.68	9.4	12.9	4/5/05
May	0:30	1487	106.3	5.55	92.7	122.5	10.84	0.74	9.6	13.2	
June	0:30	1440	89.9	17.93	61.7	153.4	7.7	1.58	5.5	13.9	
July	0:30	1488	113.6	19.49	77.2	168	8.73	1.31	5.7	12.3	
Aug	0:30	1488	107.8	14.59	55.3	141.2	7.98	1.08	4.5	10.7	
Sept	0:30	1440	107.2	22.26	59.7	150.5	8.14	1.52	4.8	11.4	
Oct	0:30	1488	87.2	15.27	48.5	119.1	8.72	1.81	5.4	12.5	
Nov	0:30	1438	97.3	10.61	48	113.9	11.41	1.93	5.3	15.4	
Dec	0:30	401	107.1	1.87	102.1	111.5	13.7	0.82	12	15.7	12/9/05
2004											
Apr	0:30	282	107.1	9.8	85	137.2	10.89	1.01	8.8	13.6	4/20/04
May	0:30	956	67.2	9.29	46.9	97.2	6.3	1.11	4	9.4	
June	0:30	1109	82.0	17.58	46.2	123.8	6.97	1.17	3.9	9.6	
July	0:30	1460	86.8	17.73	45.6	137.2	6.58	1.25	3.6	10.2	
Aug	0:30	1488	90.1	16.18	53.8	138.6	6.94	1.1	4.3	10	
Sept	0:30	1440	105.7	12.66	68.9	139.6	8.98	0.93	5.7	11.2	
Oct	0:30	1468	110.8	15.56	80.3	150.2	10.33	1.21	7.4	13	
Nov	0:30	1158	101.5	5.73	92.1	119.1	11.36	0.55	10	13.1	
Dec	0:30	649	101.6	2.93	93.7	109.3	13.08	1.18	11	15.7	12/14/04
2003											
Apr	0:30	352	105	4.76	96.2	115.1	11.05	0.4	9.8	12	4/23/03
May	0:30	1452	94.85	6.79	75.3	117	9.08	0.69	7.3	11.2	
June	0:30	1440	101.8	8.15	58	126.1	8.66	0.98	4.6	11	
July	0:30	1168	92.21	15.26	52.5	131.4	6.6	1.05	3.7	9.5	
Aug	0:30	1064	85.46	18.3	40	125.7	6.3	1.27	3	9.3	
Sept	0:30	0									
Oct	0:30	1075	84.22	6.46	57.1	96.9	8.17	0.81	5.5	9.9	
Nov	0:30	233	88.25	2.46	83	97	10.09	0.58	8.5	11.2	11/6/03

Table 1. Summary of % DO saturation and DO concentration data from the Squamscott River data sonde during 2005-2007.

The average % DO saturation values during 2005-07 were variable for most months (Figure 1). During the critical July-September period, the average monthly DO saturation was strikingly higher during 2005 compared to the other two years, especially 2006. The average DO concentrations during 2005-07 were relatively similar for most months, with the greatest variation during July and August, when the values for 2005 were again higher than for the other two years (Figure 2). As for % DO saturation, the lowest monthly average DO concentration occurred in August 2006. This suggests that 2005 was a year in which conditions conducive to low DO in the Squamscott River were not prevalent. Indeed, the frequency of days in which % DO saturation of DO concentration dipped below the state standards was lowest during 2005 compared to 2006 and 2007 (Table 2). The numbers of events and days in which DO concentration was lower than the state standard were fewer than for those for % DO saturation.

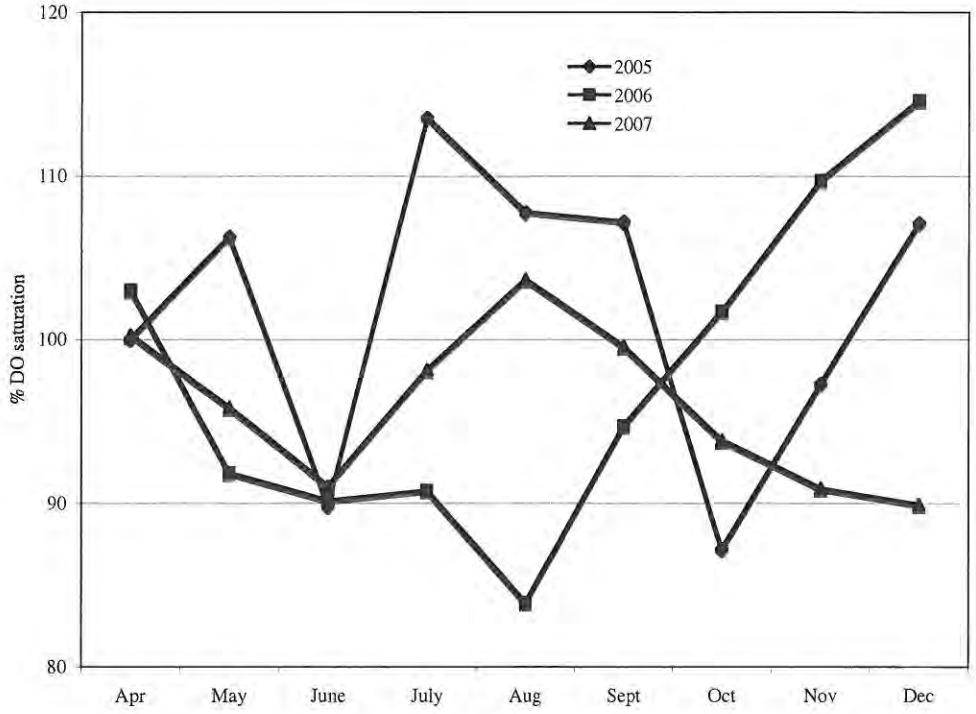


Figure 1. Monthly average % DO saturation values recorded by the Squamscott River data sonde: 2005-2007.

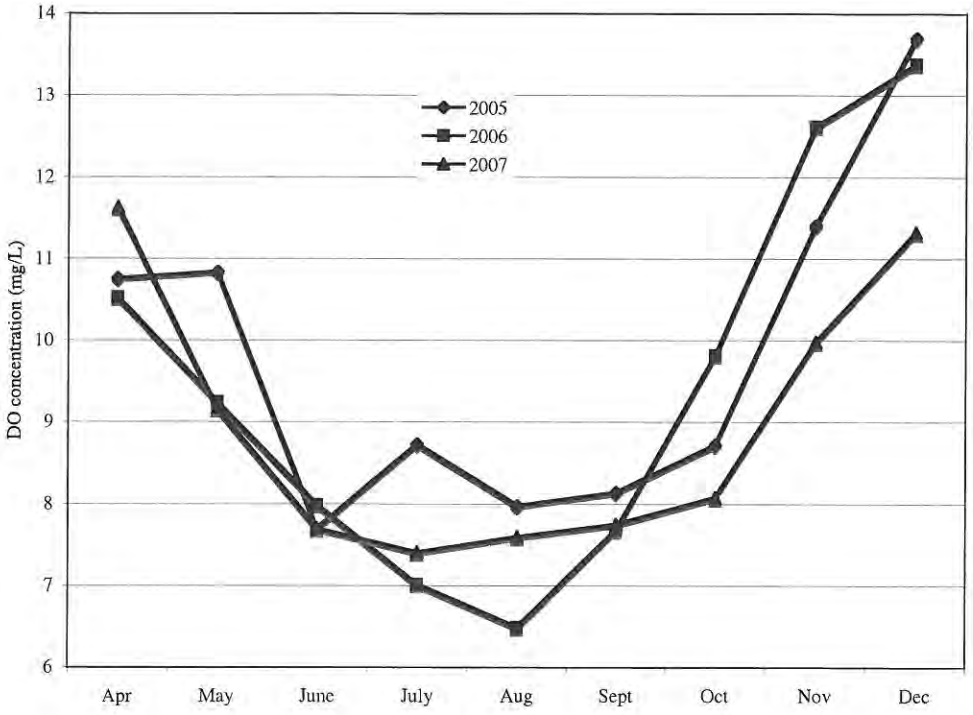


Figure 2. Monthly average DO concentration values recorded by the Squamscott River data sonde: 2005-2007.

YEAR	Complete days	# of days [DO] <5 mg/L	# of days DO sat <75%	# of events [DO] <5 mg/L	# of events DO sat <75%
2005	92	4	14	4	19
2006	89	10	39	11	96
2007	92	8	27	8	44

Table 2. The number of days and events in which measured DO values fell below state standards.

The minimum DO % saturation values recorded for each month during 2003-07 were consistently below the standard 75% saturation value during July-September (Table 1, Figure 3), with only the July 2005 value being >75%. The minimum % DO saturation value for August 2005 was also the highest for all five years, while the September 2005 value was the second highest to the September 2004 value. This also suggests that low DO events were less pervasive during 2005 compared to the other 4 years. Similar results can be observed for monthly minimum DO concentrations values (Figure 4).

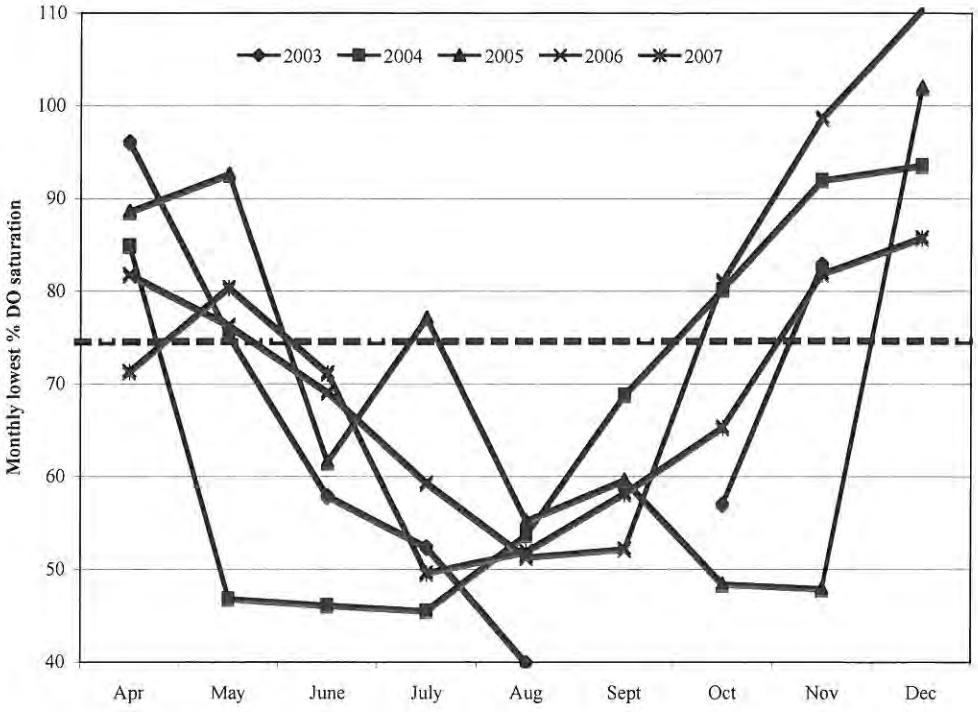


Figure 3. The lowest recorded % DO saturation values: 2005-07.

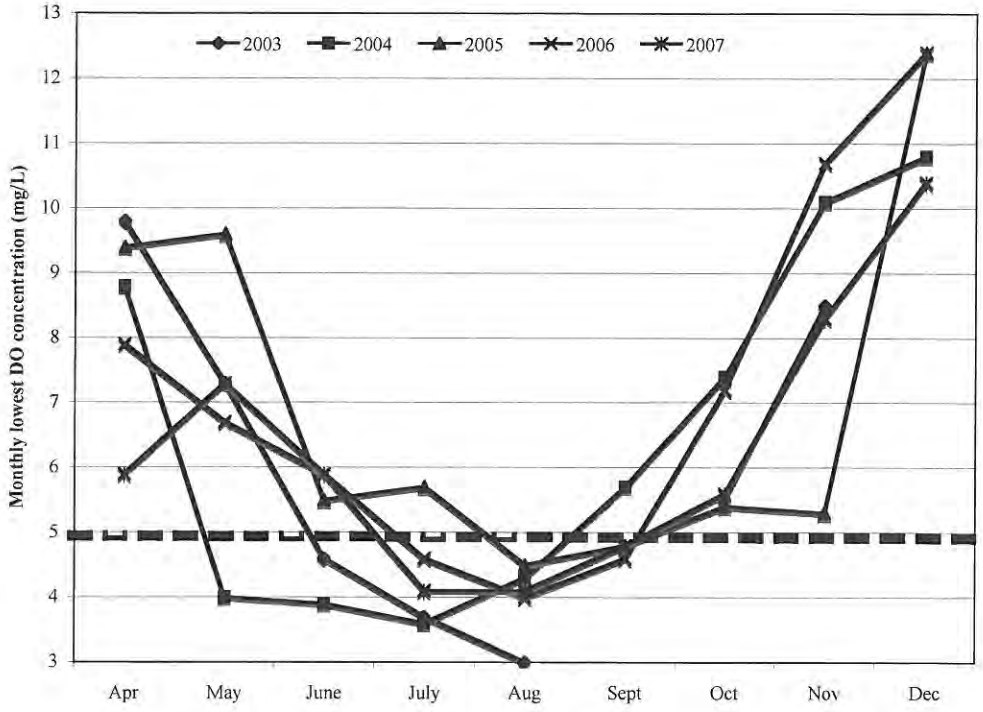
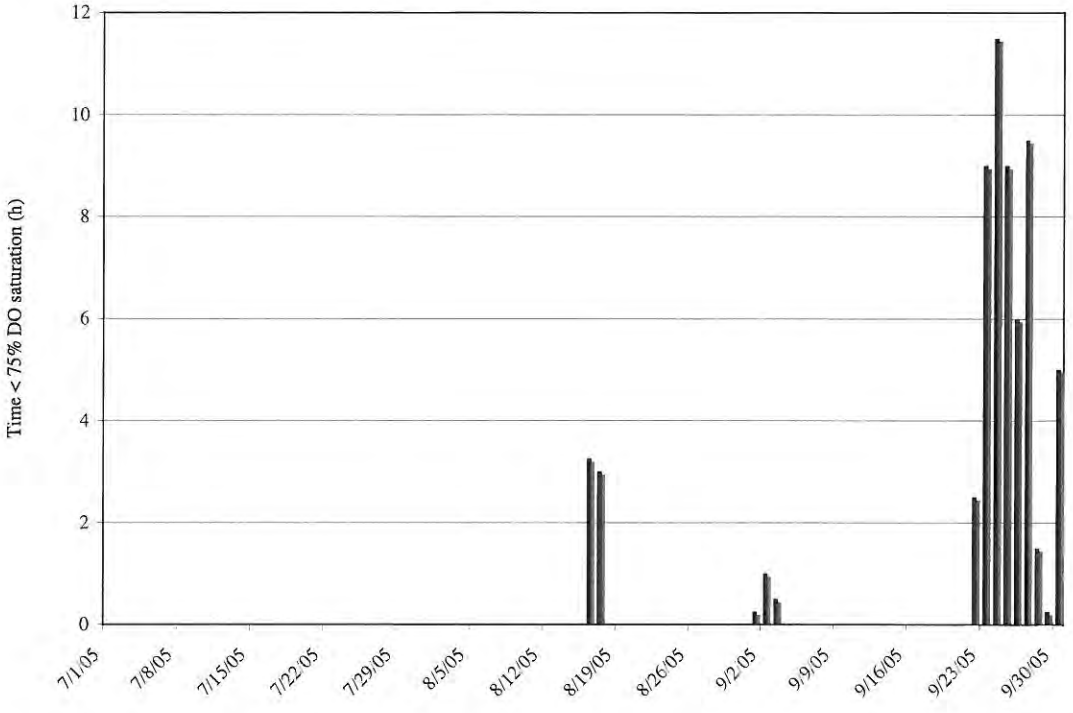


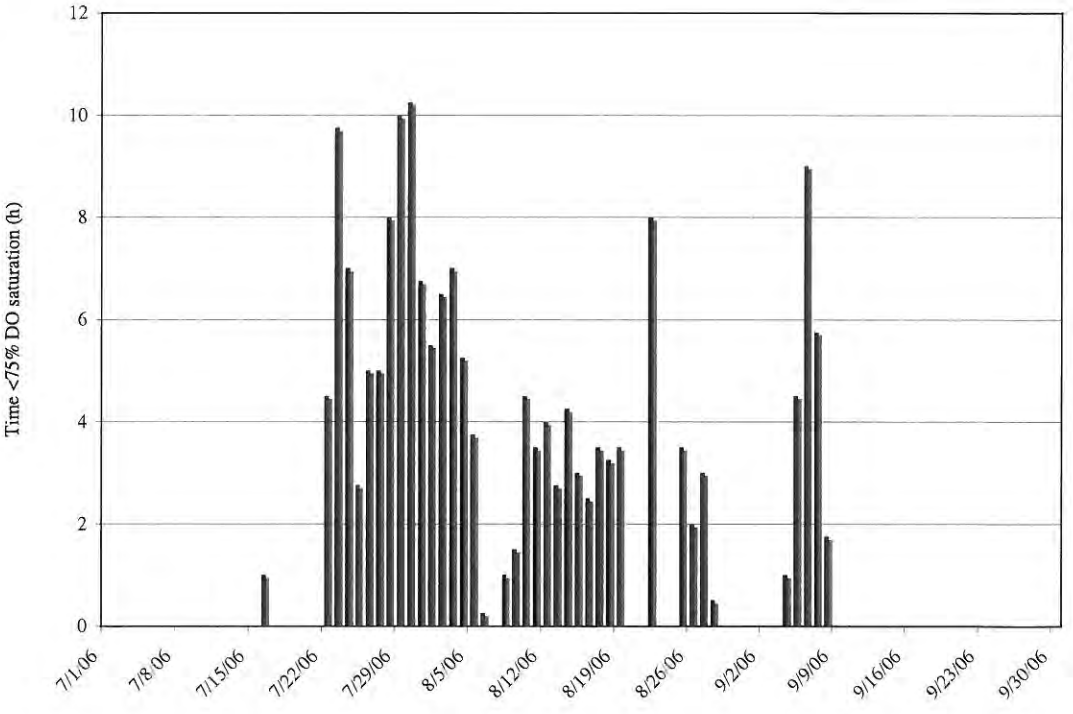
Figure 4. The lowest recorded DO concentrations values: 2005-07.

The dates on which low % DO saturation events occurred, and the cumulative daily duration of % DO saturation below standards revealed certain periods within each month in which conditions appeared to be conducive to low DO episodes (Figures 5 A-C). A comparison of these dates with the height of the data sonde suggested that low DO episodes were often associated with neap tide conditions (Figures 6 A-C), i.e., the lowest height of the sonde was relatively high on most days in which DO was low. This observation was slightly different than what was observed for sonde readings during 2003 and 2004 (Jones 2007), where a general periodicity of beginning a few days after either the spring or the neap tide was observed. For 2005-07, there were several episodes that overlapped spring tide conditions, especially during 2006 when, during a 38 day period from July 22 to August 28, only three days did not have low DO readings (Figure 6 B); note that data were incomplete and thus not used during August 20-21, yet low DO conditions were recorded on these days (data not shown). Overall, there appears to be a more discernable periodicity of low DO conditions during neap tides (less shallow sonde height) for 2005 and 2007, when low DO conditions were less pervasive and frequent. This observation can help to inform future DO studies where field measurements would be taken to determine the frequency, duration and spatial extent of low DO conditions.

S. Exh. 22

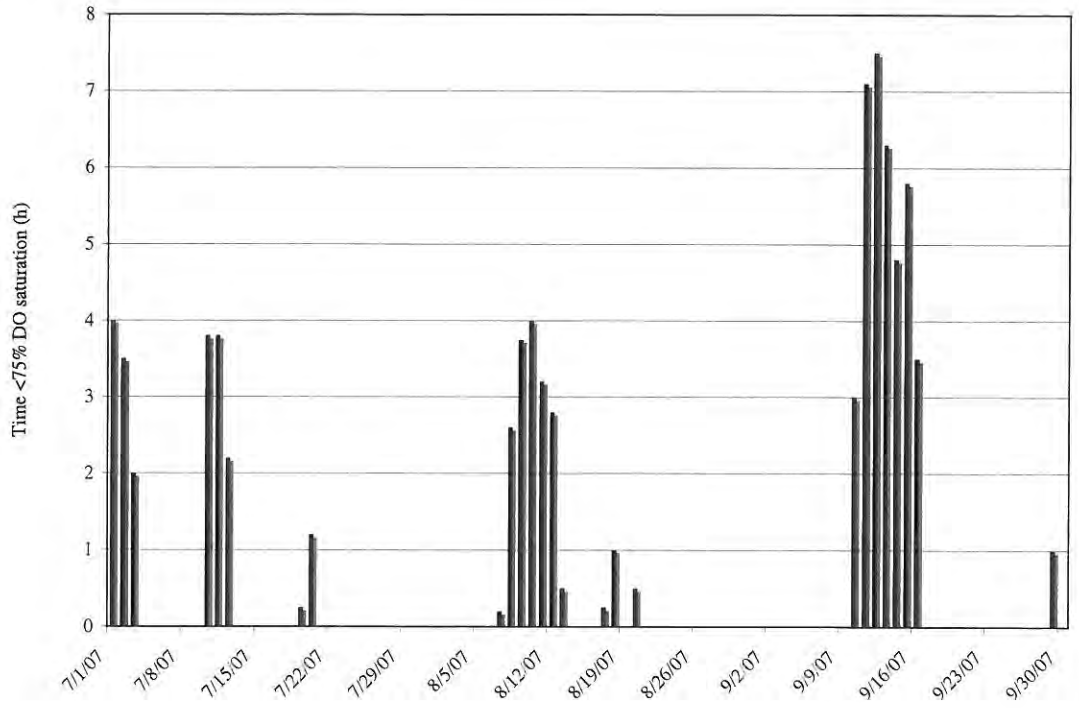

Time < 75% DO saturation (h)
12
10
8
6
4
2
0
7/1/05
7/8/05
7/15/05
7/22/05
7/29/05
8/5/05
8/12/05
8/19/05
8/26/05
9/2/05
9/9/05
9/16/05
9/23/05
9/30/05

A.

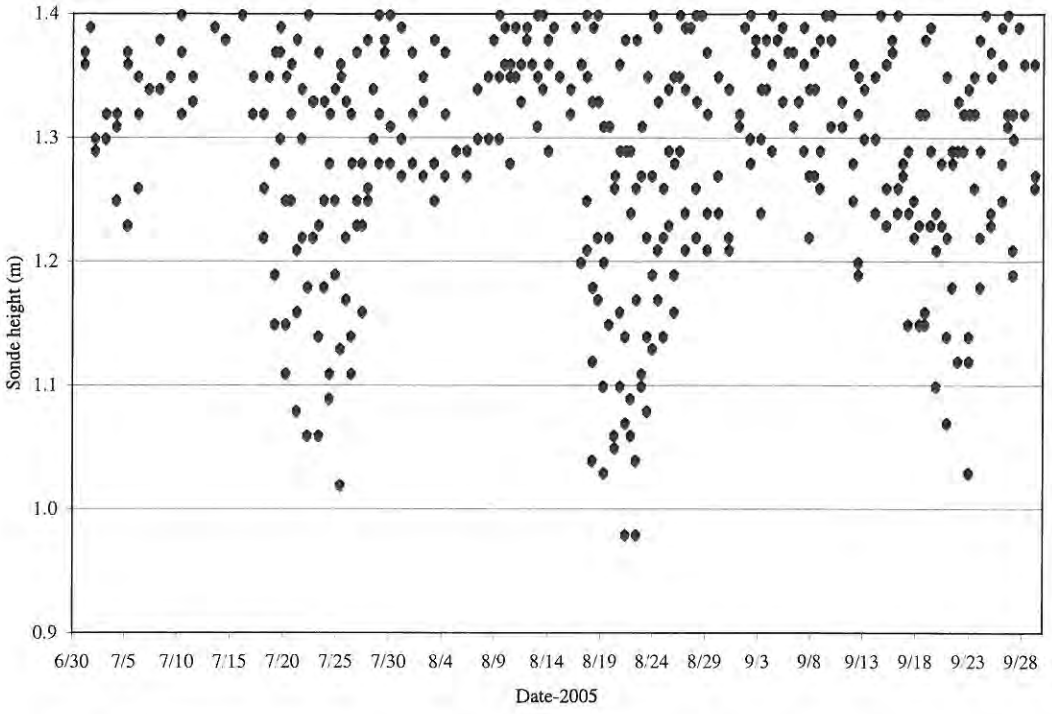

Time <75% DO saturation (h)
12
10
8
6
4
2
0
7/1/06
7/8/06
7/15/06
7/22/06
7/29/06
8/5/06
8/12/06
8/19/06
8/26/06
9/2/06
9/9/06
9/16/06
9/23/06
9/30/06

B.

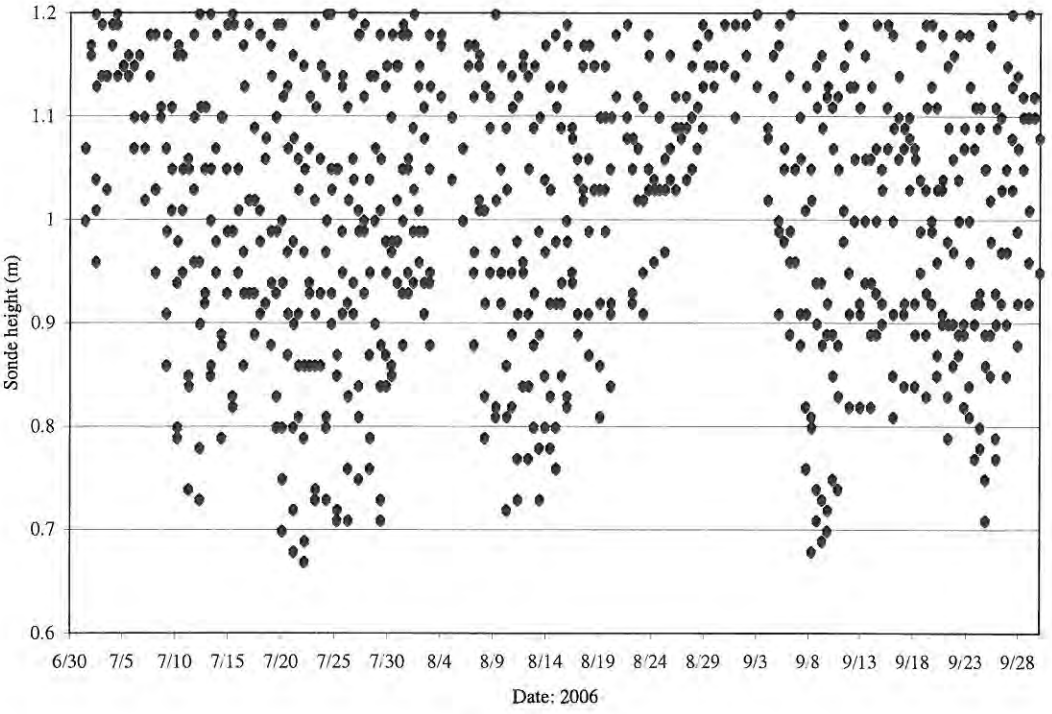
C.



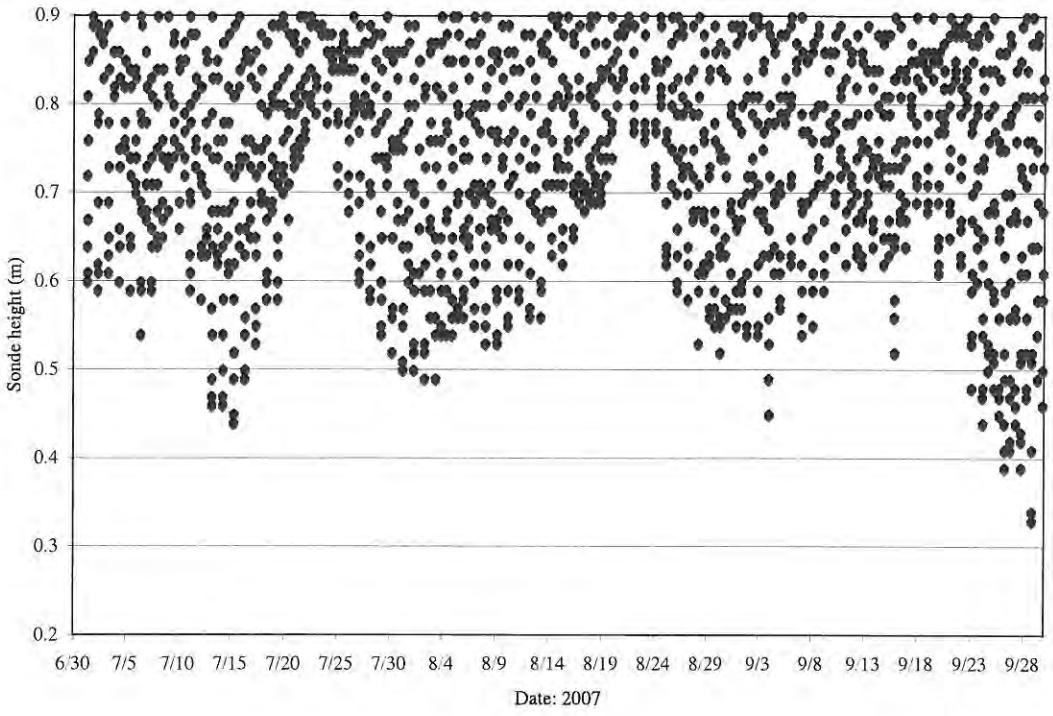
Figures 5 A-C. Dates and duration of low DO (% saturation) events for a. 2005, b. 2006, c. 2007.


1.4
1.3
1.2
1.1
1.0
0.9
Sonde height (m)
6/30 7/5 7/10 7/15 7/20 7/25 7/30 8/4 8/9 8/14 8/19 8/24 8/29 9/3 9/8 9/13 9/18 9/23 9/28
Date-2005

A.


1.2
1.1
1
0.9
0.8
0.7
0.6
Sonde height (m)
6/30 7/5 7/10 7/15 7/20 7/25 7/30 8/4 8/9 8/14 8/19 8/24 8/29 9/3 9/8 9/13 9/18 9/23 9/28
Date: 2006

B.



C.

Figures 6 A-C. Data sonde height range at the Squamscott River railroad bridge during low tides from July 1 to September 30: 2005-07.

The actual timing of the initiation and continuation of low DO conditions on a daily basis is also a key observation that can inform future studies on the incidence and causes of low DO conditions. The $ DO saturation and concentration data for 2005-07 were analyzed to identify the time of day when low DO events were initiated. These times were summarized for each year and organized into 4 h time intervals to determine if certain timer periods during the day were more conducive to low DO occurrence (Figure 7). The frequency (%) of low DO events that were initiated during 12:00-4:00 AM ranged from 20-50% for both % DO saturation and DO concentration for all three years, and the frequency ranged from 25-38% for the 4:00-8:00 AM time interval. The frequency for the occurrence of initiation of low DO events was much lower for other time intervals later in the day. A similar analysis was given to the time of day when the lowest DO value recorded for each day with DO less than state standards occurred (Figure 8). By far, most of the lowest daily DO values occurred from 12:00 AM to 12:00 PM, with strikingly fewer occurrences during the second half of days.

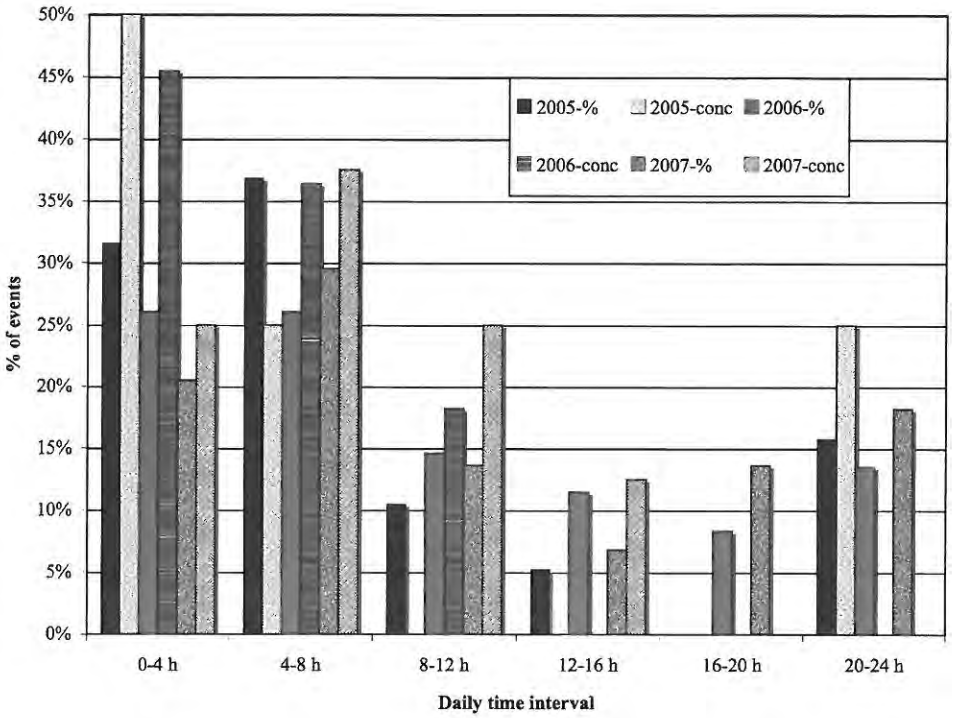


Figure 7. The frequency (%) of daily time interval when low DO events were initiated.

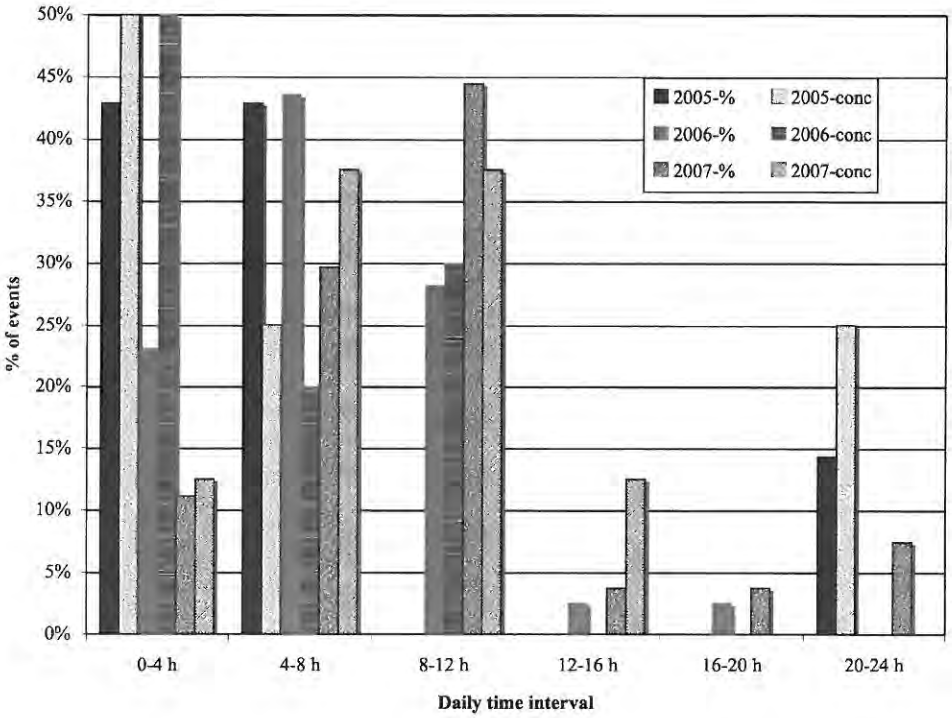


Figure 8. The frequency (%) of daily time intervals when the lowest DO values were recorded for each day.

CONCLUSIONS

This report presents the results of some detailed analysis of existing data for DO values in the Squamscott River to determine if there is a way to predict when low DO episodes occur. The results confirm that low DO episodes are most frequent and pervasive during the warmest months, from July-September each year. One question being addressed through this analysis was whether 2005 was different from other years, particularly whether low DO conditions were less frequent and pervasive. It appears that this is the case, and that the study conducted during 2005 (Jones 2007) to evaluate the spatial extent of low DO conditions was unfortunately timed during a year where low DO conditions were so infrequent that for most of the sampling dates chosen in the study, measured DO values did not fall below the state standards. In contrast, 2006 appeared to be a year in which low DO conditions were the most frequent and pervasive of the three years.

Another key to predicting when to conduct field studies is the tidal cycle conditions associated with low DO conditions. The results of this study suggest that low DO conditions may be most likely to occur during neap tide conditions, as indicated by the least shallow depth readings for the data sonde.

Beyond the seasonal and tidal time periods, it is also critical to focusing field efforts to be able to conduct studies at the most critical time of day. The widely accepted time period of near sunrise appears to be borne out by the results of this study. The most frequently observed time of day when either a low DO event was initiated or the lowest DOI reading was recorded was in the morning, especially before 8:00 AM. Much less frequent occurrence of these events was observed during the second half of days.

It appears that the predicted conditions for conducting water measurements and sampling during 2005 were relatively accurate. The study could have been more successful except that 2005 was a year in which low DO episodes were less frequent and pervasive. Future studies in the Squamscott River area near the data sonde can benefit from use of the results reported herein. The same kind of analysis could also be used to help inform studies in other areas of the estuary where data sondes are nearby and there are available databases for water quality conditions.

RECOMMENDATIONS

1. Conduct DO studies during July-September, especially during August.

2. The timing of field studies on the Squamscott River should be during neap tides and during early to mid-morning hours.

REFERENCES

Jones, S.H. 2007. Impacts of Wastewater Treatment Facilities on Receiving Water Quality. Final Report. The New Hampshire Estuarine Project, Durham, NH.

Jones, S.H. 2005. Survey of dissolved oxygen in the Lamprey and Squamscott rivers.Summary report. Office of Research and Development, Atlantic Ecology Division, U.S. Environmental Protection Agency, Narragansett, RI.

Trowbridge, (2006) NHEP Environmental Indicator Report: Water Quality 2006. The New Hampshire Estuarine Project, Durham, NH.

APPENDICES

Appendix 1: Summary Table for data related to low DO events

S. Exhibit 22

DATE	Duration	Time of initiation	DO%	Time of low DO%	Time of initiation	DO [DO]	Time of low [DO]
2005							
8/16/05	3, *						
8/17/05	3	2:30, 16:00	58.9	4:00	4:00	4.7	4:00
9/1/05	*				4:30	4.5	5:00
9/2/05	1	6:30	71.6	6:30			
9/3/05	0.5	6:30	70.4	7:00			
9/22/05	2.5	21:30	61.6	23:00			
9/23/05	1,7,2	5:30,22:00	62.9	23:30			
9/24/05	2.5,8.5,0.5	4:30,23:30	59.7	0:30			
9/25/05	2.5,2	11:30	63	1:00	23:00	4.9	23:00
9/26/05	3.5,*,*,2	0:00,8:00,9:00	64.5	2:00			
9/27/05	9.5	0:00	65.8	3:00	0:00	4.8	0:30
9/28/05	1.5	3:30	70.8	4:00			
9/29/05	*	5:00	73.6	5:00			
9/30/05	5	2:30	69.5	5:30			
2006							
7/16/06	1	8:30	74.1	9:00			
7/22/06	4.5	14:30, 18:00	72.3	15:00			
7/23/06	7, 2.5, *	2:00, 14:30, 19:30	60.5	6:30	4:30	4.8	5:00
7/24/06	7	2:30	62.3	5:30			
7/25/06	2.5, *	4:00, 9:30	68.4	6:00			
7/26/06	5	5:00	69.8	7:00			
7/27/06	5	5:30	66.7	7:30			
7/28/06	5, 3	6:00, 20:00	66.4	8:00			
7/29/06	6.5, 3.5	5:30, 20:30	59.7	9:00	7:30	4.6	9:00
7/30/06	*, 6.5, 3.5	6:00, 21:30	59.4	9:30	7:30	4.6	9:00
7/31/06	*, 5.5, 1	7:00, 23:00	65.1	10:00			
8/1/06	*, 5, *	8:00, 23:30	66.5	11:30			
8/2/06	1.5,4.5,.5	9:00, 23:30	63.7	1:00	1:00	4.9	1:00
8/3/06	2.5,*,4,*	8:00, 10:;30, 13:30	68.2	2:00			
8/4/06	.5,*, 4.5	1:00, 3:00, 10:30	66.1	11:30	11:30	4.9	11:30
8/5/06	*, 3.5	0:30, 1:30	69.9	4:00			
8/6/06	*	5:00	72.3	5:00			
8/8/06	.5,*,*	4:30, 6:30	73.6	6:30			
8/9/06	1,*,*	5:00, 7:00, 9:00	71.8	5:30			
8/10/06	4.5	5:30, 9:30	68.8	6:30			
8/11/06	3,*,*	6:00, 10:30, 22:30	67.1	6:30			
8/12/06	3.5,*,*	6:00, 20:30, 23:30	66.7	8:00			
8/13/06	*,2,*,*	7:00, 12:00, 23:00	68	8:30			
8/14/06	.5,1,2.5,*	0:30, 4:30, 7:00, 11:30	66.5	5:00			
8/15/06	.5,*,1.5,*,.5	0:00, 1:30, 9:00, 13:30, 23:00	69.5	1:30			
8/16/06	2,*,*	1:00, 11:00, 13:30	64.1	1:00			
8/17/06	*,2.5,***	0:00, 1:30, 8:00, 15:30, 20:30	62.4	2:00	2:00	4.9	2:00
8/18/06	*,2.5,.5	1:00, 2:30, 8:30, 15:30	54.7	3:30	3:00	4.3	3:30
8/19/06	.5,2.5,*,*	2:00, 3:30, 16:30, 22:00	59.7	4:00	4:00	4.6	4:00
8/20/06	data incomplete						
8/21/06	data incomplete						
8/22/06	0.5, 7.5	0:00, 3:00	57.7	0:30	0:00, 8:30	4.4	0:30
8/25/06	3, 0.5	6:30, 19:00	64.9	9:00			
8/26/06	2	6:30, 19:30	66.4	9:30			
8/27/06	3	7:00, 20:00	19:12	8:30			
8/28/06	*,*	7:30, 21:00	68	10:30			
9/4/06	0.5, 0.5	0:30, 14:30	57.1	4:30			
9/5/06	2.5, 2	2:30, 14:30	62.1	5:30			
9/6/06	*, 5.5,1.5,*,2.5	0:00, 2:00, 9:00, 12:30, 15:30	61.6	18:30			
9/7/06	*, 5.5	0:30, 3:00	52.3	7:00	7:00	4.6	7:00
9/8/06	1.5, *	5:30, 19:30	68.1	7:30			
2007			2007				
7/1/07	3.5, 0.5	6:30, 20:15	69.3	8:30			
7/2/07	3.2, *	7:15, 21:15	68	9:00			
7/3/07	2	8:45	71.5	9:30			
7/10/07	3.8	1:45	71.5	5:00			
7/11/07	3.8	2:45	70.3	6:00			
7/12/07	1.2,0.7,0.3	3:45,6:45,9:30	49.7	9:30	9:30	4.1	9:30
7/19/07	0.25	23:30	74.6	23:30			
7/20/07	*, 1	0:15,9:30	74.4	10:00			
8/7/07	*	2:15	73.6	2:15			
8/8/07	1.8, 0.8	2:30,14:45	64.4	3:15	3:15	4.8	3:15
8/9/07	3.25, 0.5	2:45,16:00	55.3	4:30	3:15	4.1	4:30
8/10/07	2.8, 1.2	4:00,16:45	61.3	5:15	4:45	4.6	5:15
8/11/07	3, *	4:45,18:30	62	6:15			
8/12/07	2.8	5:45	66.4	7:15			
8/13/07	0.5	8:00	73.6	8:00			
8/17/07	0.25	12:45	52	12:45	12:45	4.5	12:45
8/18/07	0.25,0.75	11:00,23:15	71.2	23:45			
8/19/08	1.8	10:30	66.9	11:30			
8/20/07	0.5	0:15	72	0:30			
9/10/07	1, 2	6:30,18:00	71.3	19:00			
9/11/07	3.8, 3.3	5:30,18:00	62.7	7:30	7:30	4.9	7:30
9/12/07	4.5, 3	5:15,18:45	58.3	8:15	8:00	4.8	8:15
9/13/07	3.5, 2.8	6:30,19:45	58.5	8:45	8:30	4.9	8:30
9/14/07	2.8, 2	7:30,20:45	63	9:15			
9/15/07	2.5, 3.3	8:15,20:45	66.7	10:00			
9/16/07	*, 3, *	8:00,23:15	70.5	10:15			
9/29/07	1	7:45	74.4	8:15			

*Denotes low DO events where a single sonde datum were recorded for a given event.

SUPPLEMENTAL EXHIBIT – 23

S. Exh. 23

From: John Hall
Sent: Friday, December 09, 2011 4:11 PM
To: Diers, Ted
Subject: Re: Application of eelgrass-based criteria in the tidal rivers

Thx for the update
Sent from my Verizon Wireless BlackBerry

From: "Diers, Ted" <Ted.Diers@des.nh.gov>
Date: Fri, 9 Dec 2011 16:03:58 -0500
To: John Hall<jhall@hall-associates.com>
Cc: dean_peschel@yahoo.com<dean_peschel@yahoo.com>; Peter H. Rice<phrice@cityofportsmouth.com>
Subject: RE: Application of eelgrass-based criteria in the tidal rivers

John,
No reaction yet.

Thanks,
Ted

Ted Diers
Watershed Management Bureau
NH Department of Environmental Services

-----Original Message-----
From: John Hall [mailto:jhall@hall-associates.com]
Sent: Friday, December 09, 2011 10:52 AM
To: Diers, Ted
Cc: dean_peschel@yahoo.com; 'Peter H. Rice'
Subject: RE: Application of eelgrass-based criteria in the tidal rivers

Ted
Any reaction yet from Harry on the clarification request regarding the August 8th letter?

John

John C. Hall
Hall & Associates – **Note new address:**
1620 I Street, NW, Suite 701
Washington, DC 20006
Phone: 202-463-1166
Fax: 202-463-4207
E-Mail: jhall@hall-associates.com

S. Exh. 23

From: John Hall
Sent: Tuesday, December 06, 2011 12:53 PM
To: 'THEODORE.DIERS@DES.NH.GOV'
Cc: dean_peschel@yahoo.com; 'Peter H. Rice'
Subject: Application of eelgrass-based criteria in the tidal rivers

Ted
Per our discussion yesterday, a short synopsis of relevant information. The 2009 DES "recommended" transparency target to support eelgrass restoration in GB was 0.75. *(Meeting that target has been admitted to be unnecessary to restore/protect eelgrass in Great Bay – see MOA group meeting minutes of July 29, 2011).* Lamprey transparency data (while limited) are the same as the Squamscott. The mouth of the Lamprey data show Kd ranging 2-3.5 with minimal algae present (1-5 ug/l). Plainly the transparency readings at this station have virtually nothing to do with TN/chl a and the claimed relationship between TN and transparency generated by DES in the 2009 WQS Report is completely in error. *(We have already discussed extensively how that regression analysis was fundamentally flawed which is why, in part, the MOA was developed).* Whatever is causing lower transparency at this station (and in the other tidal rivers) is probably natural (color/turbidity) and certainly not caused by the treatment plants. I would note further that given the tidal variation, it is not apparent that this level of transparency (Kd average 2.5) is insufficient to support eelgrass at least in some areas of the Lamprey, per Short's observation at the July 29th MOA review group meeting. So, this would indicate something other than transparency is likely precluding eelgrass restoration in the Lamprey River, but as discussed below, no one knows what it is.

Both PREP and DES have acknowledged that the cause of eelgrass losses over 40 years ago in the Lamprey and Squamscott Rivers is "unknown." There is no "weight of evidence" basis from the 2009 DES WQS document that would support any application of eelgrass related TN criteria as the solution to restoring eelgrass in either area. In fact, there is virtually no discussion of macroalgae or eelgrass related to the tidal rivers in the 2009 DES document to form a "weight of evidence" conclusion for these water bodies. Nonetheless, DES's August 8th letter to EPA specifically stated that the 0.3 mg/l TN eelgrass/transparency-based draft criteria should be applied in these waters. This DES recommendation to EPA was directly in conflict with the DES representations made during the MOA development (DO, not transparency is the issue for the tidal rivers) and with the MOA review group discussions the week before that DES participated in. The communities have never been presented with any scientific information or analysis that could possibly support such a recommendation and the recommendation is demonstrably at odds with the available information. Consequently, we need a clear and unequivocal response from DES to our Coalition and EPA that withdraws the August 8th letter and firmly states that (1) there is no basis to conclude that eelgrass restoration in the tidal rivers is controlled by transparency or macroalgae growth and (2) the application of any TN criteria to restore eelgrass in the tidal rivers is inappropriate at this time because there is no evidence that TN had previously played or continues to play any significant role in the loss of that resource that occurred over 40 years ago.

As discussed, we look forward to receiving that clarification.

S. Exh. 23

John

John C. Hall
Hall & Associates – **Note new address:**
1620 I Street, NW, Suite 701
Washington, DC 20006
Phone: 202-463-1166
Fax: 202-463-4207
E-Mail: jhall@hall-associates.com

s transmission.