EXHIBIT 42 (AR K.13)

Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Estuary Watershed

Appendix C:

<u>Watershed Nitrogen Loads for Different Permitting Scenarios for Wastewater Treatment Facilities</u>

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

DRAFT

Table of Contents

1 Introduction

In 2009, the New Hampshire Department of Environmental Services (DES) published a proposal for numeric nutrient criteria for the Great Bay Estuary (DES, 2009). These criteria were developed over a four-year period through an open process that involved local experts from universities, state agencies, federal agencies, municipalities, and non-governmental organizations. The report found that total nitrogen concentrations in most of the estuary needed to be less than 0.3 mg/L to prevent loss of eelgrass habitat and less than 0.45 mg/L to prevent occurrences of low dissolved oxygen. Eelgrass habitat and dissolved oxygen are both critical for supporting aquatic life in the Great Bay Estuary.

Based on these criteria and an analysis of a robust compilation of data from multiple sources, DES concluded that 11 of the 18 assessment zones in the Great Bay Estuary did not meet surface water quality standards and specifically did not comply with Env-Wq 1703.14, the narrative standard for nutrients (DES, 2009b). These impairments were added to New Hampshire's 2008 303(d) list on August 14, 2009, approved by EPA on September 30, 2009, and have subsequently been retained on the 2010 303(d) list. Nine of the 11 impaired assessment zones were the subestuaries of Great Bay, Little Bay, Upper Piscataqua River, and the tidal rivers that flow into these areas. The other two impaired assessment zones were Portsmouth Harbor and Little Harbor/Back Channel at the mouth of the estuary.

Under the Clean Water Act, if a water body is placed on the 303(d) list, a study must be completed to determine the existing loads of the pollutant and the load reductions that would be needed to meet the water quality standard. Nitrogen loads to the Great Bay Estuary have been estimated previously, but only for the whole estuary, not all of the smaller subestuaries that were added to the 303(d) list. Also, the contribution from individual point sources of nitrogen and the variability in nitrogen loads over time had not been adequately quantified.

For this analysis, the nitrogen loads for the subestuaries of Great Bay, Little Bay, Upper Piscataqua River, and the tidal rivers that flow into these areas were determined for different scenarios of NPDES permits for wastewater treatment facilities (WWTFs) and reductions in non-point sources of nitrogen. The three different permitting options considered for WWTFs were limits on the total nitrogen concentration in effluent of 8 mg N/L, 5 mg N/L, and 3 mg N/L with effluent flow equal to design flow. Non-point source reductions were estimated for deciles between 0% and 100%. The predicted nitrogen load for each scenario can be compared to the loading thresholds from Appendix B to determine whether the scenario would attain water quality standards. Scenarios were tested for each subestuary three two-year periods: 2003-2004, 2005-2006, and 2007-2008.

2 Methods

In Appendix A, the measured watershed nitrogen loads to each subestuary were determined. Appendix B described the nitrogen loading thresholds and percent reduction in existing nitrogen loads for each subestuary that would result in attainment of water quality standards. For each subestuary, three different loading thresholds were determined: One to prevent low dissolved oxygen locally, one to protect eelgrass locally, and one to protect eelgrass in downstream areas. This appendix builds on this information to show how much nitrogen loads would be reduced under different permitting scenarios for WWTFs and, for each WWTF permitting option, how much non-point sources of nitrogen would still need to be reduced to attain water quality standards.

The nitrogen loads for of 33 different scenarios were calculated. The matrix of scenarios consisted of three permitting options for WWTFs and 11 percent reduction values for non-point sources. The three different permitting scenarios for WWTFs were limits on the total nitrogen concentrations in effluent of 8 mg N/L, 5 mg N/L, and 3 mg N/L with effluent flow equal to design flow. Non-point source reductions were estimated for deciles of the existing non-point source load between 0% and 100%. The predicted nitrogen loads for each scenario were compared to the loading thresholds to determine whether the scenario would attain water quality standards. A different matrix was calculated for each subestuary for each of the three two-year periods (2003-2004, 2005-2006, and 2007-2008).

As an example, the matrix of predicted nitrogen loads (in units of tons per year) for the 33 scenarios for the Exeter River subestuary in 2003-2004 is shown below.

		WWTFs @ design flow and		
		8 mg/L	5 mg/L	3 mg/L
NPS Percent Reduction	0%	144.7	130.5	121.0
	10%	134.0	119.8	110.3
	20%	123.3	109.1	99.6
	30%	112.7	98.4	89.0
	40%	102.0	87.8	78.3
	50%	91.3	77.1	67.6
	60%	80.6	66.4	56.9
	70%	69.9	55.7	46.3
	80%	59.3	45.0	35.6
	90%	48.6	34.4	24.9
	100%	37.9	23.7	14.2

The total nitrogen loads in each cell of this table were calculated by summing the predicted loads from WWTFs and non-point sources in 2003-2004. The delivered load from contributing WWTFs was calculated by assuming a total nitrogen concentration in the effluent of 8, 5, or 3 mg N/L and the design flow for the WWTF. For distal WWTFs, attenuation of nitrogen before it reached the estuary was calculated using the delivery factors for WWTFs from Appendix A. The non-point source load was calculated as a percent of the existing non-point source load in 2003-2004 (106.8 tons/year).

The cells in this matrix have been color coded to denote compliance of the predicted loads with the different nitrogen loading thresholds determined in Appendix B. For this subestuary in 2003-2004, the threshold to prevent low dissolved oxygen locally was 99.8 tons per year. Cells that are less than value are colored yellow. The threshold to protect eelgrass locally was 62.1 tons per year. Cells that are les than this value are shaded green. (The green shading also denotes compliance with the threshold for preventing low dissolved oxygen because the threshold for protecting eelgrass is necessarily lower than the threshold for preventing low dissolved oxygen.) Finally, the Exeter River's portion of the nitrogen loading threshold to protect eelgrass in downstream areas (e.g., the Great Bay) was 117.8 tons per year. Cells that are less than this value have a red outline.

For each subestuary, the matrix of predicted nitrogen loads was calculated for three two-year periods: 2003-2004, 2005-2006, and 2007-2008. The matrices were reviewed together to determine consistent results across the three periods. The matrices for the downstream areas (Great Bay, Little Bay, and the Upper Piscataqua River) do not have downstream protective values because these *are* the downstream areas.

3 Results

The matrices of predicted nitrogen loads for different scenarios are summarized by subestuary on Tables 1 through 11.

Looking across all of the subestuaries, there are two important observations:

- In most tidal river subestuaries, the loading thresholds for preventing low dissolved oxygen locally and protecting eelgrass in downstream are similar. Therefore, the load reduction scenarios that would protect eelgrass in downstream areas will also prevent violations of the dissolved oxygen standard in the tidal rivers. This consistency is evident from the overlap of cells with yellow shading and red outlines in most matrices.
- In 2005-2006, the total precipitation jumped to 68 inches, compared to 44 and 51 inches in 2003-2004 and 2007-2008, respectively. During the "wet years" of 2005-2006, both the measured nitrogen loads and the loading thresholds both increased. The measured loads increased due to higher stormwater runoff (PREP, 2009). The loading thresholds increased due to faster rates of hydraulic flushing. However, despite these effects of increased precipitation, the matrix for 2005-2006 had similar patterns to the matrices from 2003-2004 and 2007-2008. Specifically, for a given WWTF permitting scenario (e.g., 8, 5, or 3 mg N/L), the percent reduction of non-point sources needed to attain standards was similar across all three years.

3.1 Winnicut River Watershed

There are no WWTFs to this watershed. Therefore, the permitting options for WWTFs are not relevant. Across the three periods, the matrices show that non-point sources would need to be reduced by 10-30% to prevent low dissolved oxygen in the subestuary. Protecting eelgrass downstream areas would require a 30% reduction in non-point sources. And, finally, in order to protect eelgrass in the subestuary, non-point sources would have to be reduced by 50-60%. The results for this subestuary are summarized in Table 1.

3.2 Exeter River Watershed

There are two WWTFs that discharge in the Exeter River watershed: Exeter and Newfields. The nitrogen load from the Exeter WWTF accounts for 96% of the delivered point source nitrogen load to this subestuary.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 40-50% to prevent low dissolved oxygen, 30% to protect eelgrass in downstream areas, and 70-80% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 30-40% to prevent low dissolved oxygen, 20-30% to protect eelgrass in downstream areas, and 60-70% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 20-40% to prevent low dissolved oxygen, 10-20% to protect eelgrass in downstream areas, and 60-70% to protect eelgrass locally.

The results for this subestuary are summarized in Table 2.

3.3 Lamprey River Watershed

There are two WWTFs that discharge in the Lamprey River watershed: Newmarket and Epping. The nitrogen load from the Newmarket WWTF accounts for 88% of the delivered point source nitrogen load to this subestuary.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 0-10% to prevent low dissolved oxygen, 20-30% to protect eelgrass in downstream areas, and 40-50% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 0-10% to prevent low dissolved oxygen, 10-30% to protect eelgrass in downstream areas, and 30-40% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen, 10-20% to protect eelgrass in downstream areas, and 30-40% to protect eelgrass locally.

The results for this subestuary are summarized in Table 3.

3.4 Oyster River Watershed

There is one WWTF that discharges in the Oyster River watershed: Durham. This WWTF currently accounts for 20% of the total nitrogen load to the subestuary. However, this facility already has total nitrogen effluent concentrations less than 8 mg N/L and is only using a fraction (1 MGD) of its design flow (2.5 MGD). The predicted loads for each scenario assume that the WWTF will be discharging at its design flow with total nitrogen effluent concentrations equal to 8, 5, or 3 mg N/L. Therefore, the scenarios predicted for this subestuary represent worst case conditions which may or may not occur.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 30-80% to prevent low dissolved oxygen, 70% to protect eelgrass in downstream areas, and 100% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 0-50% to prevent low dissolved oxygen, 40-50% to protect eelgrass in downstream areas, and 70-100% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 0-30% to prevent low dissolved oxygen, 20-40% to protect eelgrass in downstream areas, and 50-80% to protect eelgrass locally.

The results for this subestuary are summarized in Table 4.

3.5 Bellamy River Watershed

There are no WWTFs to this watershed. Therefore, the permitting options for WWTFs are not relevant. Across the three periods, the matrices show that non-point sources would need to be reduced by 0-10% to prevent low dissolved oxygen in the subestuary. Protecting eelgrass downstream areas would require a 20-30% reduction in non-point sources. And, finally, in order to protect eelgrass in the subestuary, non-point sources would have to be reduced by 30-50%. The results for this subestuary are summarized in Table 5.

3.6 Cocheco River Watershed

There are two WWTFs that discharge in the Cocheco River watershed: Rochester and Farmington. The nitrogen load from the Rochester WWTF accounts for 98% of the delivered point source nitrogen load to this subestuary.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 0-40% to prevent low dissolved oxygen, 0-40% to protect eelgrass in downstream areas, and 30-70% to protect eelgrass locally.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 0-20% to prevent low dissolved oxygen, 0-30% to protect eelgrass in downstream areas, and 20-60% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 0-10% to prevent low dissolved oxygen, 0-20% to protect eelgrass in downstream areas, and 0-50% to protect eelgrass locally.

The results for this subestuary are summarized in Table 6.

It should be noted that eelgrass has not been historically mapped in the Cocheco River. Therefore, the goal to restore eelgrass locally in this subestuary may not be relevant.

3.7 Salmon Falls River Watershed

There are six WWTFs that discharge in the Salmon Falls River watershed. The two largest WWTFs are Somersworth and Berwick. These two WWTFs account for 33% and 30% of the delivered point source nitrogen load to this subestuary, respectively.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 0-20% to prevent low dissolved oxygen, 40-70% to protect eelgrass in downstream areas, and 40-60% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 0-20% to prevent low dissolved oxygen, 30-60% to protect eelgrass in downstream areas, and 40-60% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 0-10% to prevent low dissolved oxygen, 30-50% to protect eelgrass in downstream areas, and 30-50% to protect eelgrass locally.

The results for this subestuary are summarized in Table 7.

It should be noted that eelgrass has not been historically mapped in the Salmon Falls River. Therefore, the goal to restore eelgrass locally in this subestuary may not be relevant.

The Salmon Falls River subestuary is the only tidal river for which the nitrogen loading threshold to protect eelgrass in downstream areas is lower than the threshold to protect eelgrass locally. The downstream area that is affected by the Salmon Falls River watershed is the Upper Piscataqua River subestuary. This Upper Piscataqua River subestuary is also the downstream area for the Cocheco River watershed. The sum of the loads from the Cocheco and the Salmon Falls watersheds must remain below the sum of their downstream protective thresholds. However, the downstream protective thresholds could be traded between the watersheds to give a larger allocation to the Salmon Falls River watershed. This approach seems appropriate given that the current allocations require much smaller percent reductions for non-point sources in the Cocheco River watershed than the Salmon Falls River watershed.

3.8 Great Bay Watershed

There are eight WWTFs that discharge in the Great Bay watershed or otherwise contribute nitrogen to the Great Bay. The two largest WWTFs are Exeter and Newmarket. These two WWTFs account for 52% and 37% of the delivered point source nitrogen load to this subestuary, respectively.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 20-30% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 20-30% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 10-20% to protect eelgrass locally.

The results for this subestuary are summarized in Table 8.

There are no thresholds for protecting eelgrass in downstream areas because this subestuary is a downstream area.

3.9 Great Bay-Little Bay Watershed

There are nine WWTFs that discharge in the Great Bay-Little Bay watershed or otherwise contribute nitrogen to the Great Bay and Little Bay. The four largest WWTFs are Exeter, Newmarket, Portsmouth, and Durham. These four WWTFs account for 38%, 27%, 11% and 11% of the delivered point source nitrogen load to this subestuary, respectively.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 20-30% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 10-30% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 10-20% to protect eelgrass locally.

The results for this subestuary are summarized in Table 9.

There are no thresholds for protecting eelgrass in downstream areas because this subestuary is a downstream area.

3.10 Upper Piscataqua River Watershed

There are thirteen WWTFs that discharge in the Upper Piscataqua River watershed or otherwise contribute nitrogen to the Upper Piscataqua. The two largest WWTFs are

Dover and Rochester. These two WWTFs account for 39% and 48% of the delivered point source nitrogen load to this subestuary, respectively.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 30-60% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 10-40% to protect eelgrass locally.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 0% to prevent low dissolved oxygen and 0-30% to protect eelgrass locally.

The results for this subestuary are summarized in Table 10.

There are no thresholds for protecting eelgrass in downstream areas because this subestuary is a downstream area.

3.11 All Areas Combined

In the previous sections, each of the subestuaries were evaluated separately. However, all of the individual nitrogen loading thresholds can combined to determine the total load threshold for Great Bay, Little Bay, and Upper Piscataqua River needed to achieve different conditions of compliance with the numeric nutrient criteria. The first condition was protecting eelgrass in the Great Bay, Little Bay, and Upper Piscataqua River only. The second condition was protecting eelgrass in the Great Bay, Little Bay, and Upper Piscataqua River while also preventing low dissolved oxygen in the other tidal river subestuaries. The third condition was protecting eelgrass in all areas. This calculation was needed to provide overall loading reduction numbers for the watershed.

There are 18 WWTFs that discharge in the watershed or otherwise contribute nitrogen to the Great Bay, Little Bay, and the Upper Piscataqua River. The four largest WWTFs are Rochester, Dover, Exeter, and Newmarket. These four WWTFs account for 34%, 27%, 11% and 8% of the delivered point source nitrogen load to these downstream subestuaries, respectively.

In Appendix B, it was determined that the nitrogen loading thresholds to meet the first and second conditions were approximately equal. Therefore, protecting eelgrass in the downstream areas and preventing low dissolved oxygen in the tidal rivers would require the same nitrogen load reductions. Protecting eelgrass in the tidal river subestuaries would require greater reductions in nitrogen loads. Therefore:

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 8 mg N/L at design flow, non-point sources would have to be reduced by 30-40% to prevent low dissolved oxygen in the tidal river subestuaries and to protect eelgrass in the Great Bay, Little Bay, and Upper Piscataqua. In order to protect eelgrass in the tidal rivers also, non-point sources would have to be reduced by 50-60%.

- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 5 mg N/L at design flow, non-point sources would have to be reduced by 20-30% to prevent low dissolved oxygen in the tidal river subestuaries and to protect eelgrass in the Great Bay, Little Bay, and Upper Piscataqua. In order to protect eelgrass in the tidal rivers also, non-point sources would have to be reduced by 40-50%.
- If the WWTFs receive permits that limit the total nitrogen concentration in effluent to 3 mg N/L at design flow, non-point sources would have to be reduced by 10-20% to prevent low dissolved oxygen in the tidal river subestuaries and to protect eelgrass in the Great Bay, Little Bay, and Upper Piscataqua. In order to protect eelgrass in the tidal rivers also, non-point sources would have to be reduced by 30-40%.

The results for all subestuaries combined are summarized in Table 11.

4 References

DES. 2009. Nutrient Criteria for the Great Bay Estuary. New Hampshire Department of Environmental Services, Concord, NH. Published online: http://www.prep.unh.edu/resources/nutrient/20090601_nutrient_criteria.pdf (Accessed September 23, 2009)

DES. 2009b. Amendment to the New Hampshire 2008 Section 303(d) List Related to Nitrogen and Eelgrass in the Great Bay Estuary. R-WD-09-14. New Hampshire Department of Environmental Services, Water Division, Concord, NH.

PREP. 2009. Environmental Indicators Report. Piscataqua Region Estuaries Partnership, Durham, NH. Published online: http://www.prep.unh.edu/resources/pdf/environmental_indicators_report-prep-09.pdf (Accessed September 23, 2009)

5 Tables

List of Tables

EXHIBIT 42 (AR K.13)

1. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Winnicut River Watershed

Year[1]	**2003-2004**		**2005-2006**		**2007-2008**	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
None						
Subtotal	0.00	0%	0.00	0%	0.00	0%
Nitrogen Non-Point Source Loads	25.08	100%	40.19	100%	27.54	100%
Total	25.08	100%	40.19	100%	27.54	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	17.9	29%	29.9	26%	25.1	9%
Protect eelgrass locally	10.6	58%	18.3	55%	14.9	46%
Protect eelgrass downstream[3]	20.0	20%	28.8	28%	21.8	21%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading =
Prevents low DO locally

Green (dark) Shading =
Protects eelgrass locally

Red (dark) Outline=
Protects downstream uses

	2003-2004 WWTFs @ design flow and			2005-2006 WWTFs @ design flow and			2007-2008 WWTFs @ design flow and		
NPS Percent Reduction	8 mg/L	5 mg/L	3 mg/L	8 mg/L	5 mg/L	3 mg/L	8 mg/L	5 mg/L	3 mg/L
0%	25.1	25.1	25.1	40.2	40.2	40.2	27.5	27.5	27.5
10%	22.6	22.6	22.6	36.2	36.2	36.2	24.8	24.8	24.8
20%	20.1	20.1	20.1	32.1	32.1	32.1	22.0	22.0	22.0
30%	17.6	17.6	17.6	28.1	28.1	28.1	19.3	19.3	19.3
40%	15.1	15.1	15.1	24.1	24.1	24.1	16.5	16.5	16.5
50%	12.5	12.5	12.5	20.1	20.1	20.1	13.8	13.8	13.8
60%	10.0	10.0	10.0	16.1	16.1	16.1	11.0	11.0	11.0
70%	7.5	7.5	7.5	12.1	12.1	12.1	8.3	8.3	8.3
80%	5.0	5.0	5.0	8.0	8.0	8.0	5.5	5.5	5.5
90%	2.5	2.5	2.5	4.0	4.0	4.0	2.8	2.8	2.8
100%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Observations
There are no WWTFs in this watershed.
Non-point source reductions of 50-60% are needed to protect all local and downstream uses.

Footnotes
Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.

EXHIBIT 42 (AR K.13)

2. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Exeter River Watershed

Year[1]	2003-2004		2005-2006		2007-2008	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
Exeter	39.30		49.36		39.40	
Newfields	1.31		1.78		1.65	
Subtotal	40.62	28%	51.14	20%	41.04	17%
Nitrogen Non-Point Source Loads	106.80	72%	201.16	80%	193.80	83%
Total	147.41	100%	252.30	100%	234.84	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	99.8	32%	176.4	30%	144.7	38%
Protect eelgrass locally	62.1	58%	111.0	56%	90.3	62%
Protect eelgrass downstream[3]	117.8	20%	181.1	28%	186.1	21%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading = Prevents low DO locally

Green (dark) Shading = Protects eelgrass locally

Red (dark) Outline= Protects downstream uses

2003-2004 (WWTFs @ design flow and)

NPS Percent Reduction	8 mg/L	5 mg/L	3 mg/L
0%	144.7	130.5	121.0
10%	134.0	119.8	110.3
20%	123.3	109.1	99.6
30%	112.7	98.4	89.0
40%	102.0	87.8	78.3
50%	91.3	77.1	67.6
60%	80.6	66.4	56.9
70%	69.9	55.7	46.3
80%	59.3	45.0	35.6
90%	48.6	34.4	24.9
100%	37.9	23.7	14.2

2005-2006 (WWTFs @ design flow and)

NPS Percent Reduction	8 mg/L	5 mg/L	3 mg/L
0%	239.1	224.8	215.4
10%	218.9	204.7	195.3
20%	198.8	184.6	175.1
30%	178.7	164.5	155.0
40%	158.6	144.4	134.9
50%	138.5	124.3	114.8
60%	118.4	104.2	94.7
70%	98.2	84.0	74.6
80%	78.1	63.9	54.4
90%	58.0	43.8	34.3
100%	37.9	23.7	14.2

2007-2008 (WWTFs @ design flow and)

NPS Percent Reduction	8 mg/L	5 mg/L	3 mg/L
0%	231.7	217.5	208.0
10%	212.3	198.1	188.6
20%	192.9	178.7	169.2
30%	173.6	159.3	149.9
40%	154.2	140.0	130.5
50%	134.8	120.6	111.1
60%	115.4	101.2	91.7
70%	96.0	81.8	72.4
80%	76.7	62.4	53.0
90%	57.3	43.1	33.6
100%	37.9	23.7	14.2

Observations

If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 70-80% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 60-70% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 60-70% to protect all local and downstream uses.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.

EXHIBIT 42 (AR K.13)

3. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Lamprey River Watershed

Year[1]	2003-2004		2005-2006		2007-2008	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
Newmarket	30.66		31.90		28.70	
Epping	3.69		4.94		4.31	
Subtotal	34.35	17%	36.84	12%	33.01	15%
Nitrogen Non-Point Source Loads	170.08	83%	258.63	88%	183.70	85%
Total	204.43	100%	295.47	100%	216.71	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	185.5	9%	263.9	11%	228.8	-6%
Protect eelgrass locally	111.1	46%	167.9	43%	141.5	35%
Protect eelgrass downstream[3]	163.4	20%	212.1	28%	171.8	21%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading = Prevents low DO locally

Green (dark) Shading = Protects eelgrass locally

Red (dark) Outline= Protects downstream uses

2003-2004

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	184.0	178.8	175.3
10%	166.9	161.7	158.3
20%	149.9	144.7	141.3
30%	132.9	127.7	124.3
40%	115.9	110.7	107.3
50%	98.9	93.7	90.2
60%	81.9	76.7	73.2
70%	64.9	59.7	56.2
80%	47.9	42.7	39.2
90%	30.9	25.7	22.2
100%	13.9	8.7	5.2

2005-2006

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	272.5	267.3	263.8
10%	246.6	241.4	238.0
20%	220.8	215.6	212.1
30%	194.9	189.7	186.2
40%	169.1	163.8	160.4
50%	143.2	138.0	134.5
60%	117.3	112.1	108.7
70%	91.5	86.3	82.8
80%	65.6	60.4	56.9
90%	39.7	34.5	31.1
100%	13.9	8.7	5.2

2007-2008

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	197.6	192.4	188.9
10%	179.2	174.0	170.5
20%	160.8	155.6	152.2
30%	142.5	137.3	133.8
40%	124.1	118.9	115.4
50%	105.7	100.5	97.1
60%	87.4	82.2	78.7
70%	69.0	63.8	60.3
80%	50.6	45.4	41.9
90%	32.2	27.0	23.6
100%	13.9	8.7	5.2

Observations

If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 40-50% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 30-50% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 30-40% to protect all local and downstream uses.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.

EXHIBIT 42 (AR K.13)

4. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Oyster River Watershed

Year[1]	2003-2004		2005-2006		2007-2008	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
Durham	11.04		12.85		11.39	
Subtotal	11.04	22%	12.85	17%	11.39	21%
Nitrogen Non-Point Source Loads	39.37	78%	63.83	83%	42.63	79%
Total	50.41	100%	76.68	100%	54.02	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	39.7	21%	56.7	26%	64.2	-19%
Protect eelgrass locally	21.3	58%	31.8	58%	34.4	36%
Protect eelgrass downstream[3]	43.0	15%	55.8	27%	44.2	18%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading =
Prevents low DO locally

Green (dark) Shading =
Protects eelgrass locally

Red (dark) Outline=
Protects downstream uses

2003-2004

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	69.8	58.4	50.8
10%	65.8	54.4	46.8
20%	61.9	50.5	42.9
30%	58.0	46.6	39.0
40%	54.0	42.6	35.0
50%	50.1	38.7	31.1
60%	46.1	34.7	27.1
70%	42.2	30.8	23.2
80%	38.3	26.9	19.3
90%	34.3	22.9	15.3
100%	30.4	19.0	11.4

2005-2006

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	94.2	82.8	75.2
10%	87.8	76.4	68.8
20%	81.5	70.1	62.5
30%	75.1	63.7	56.1
40%	68.7	57.3	49.7
50%	62.3	50.9	43.3
60%	55.9	44.5	36.9
70%	49.5	38.1	30.5
80%	43.2	31.8	24.2
90%	36.8	25.4	17.8
100%	30.4	19.0	11.4

2007-2008

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	73.0	61.6	54.0
10%	68.8	57.4	49.8
20%	64.5	53.1	45.5
30%	60.2	48.8	41.2
40%	56.0	44.6	37.0
50%	51.7	40.3	32.7
60%	47.5	36.1	28.5
70%	43.2	31.8	24.2
80%	38.9	27.5	19.9
90%	34.7	23.3	15.7
100%	30.4	19.0	11.4

Observations

The Durham WWTF already has nitrogen concentrations less than 8 mg/L and is only using a fraction (1 MGD) of its design flow (2.5 MGD). This explains the steep reductions required for NPS.
If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 90-100% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 70-100% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 50-80% to protect all local and downstream uses.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.

EXHIBIT 42 (AR K.13)

5. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Bellamy River Watershed

Year[1]	2003-2004		2005-2006		2007-2008	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
None						
Subtotal	0.00	0%	0.00	0%	0.00	0%
Nitrogen Non-Point Source Loads	37.34	100%	59.73	100%	46.70	100%
Total	37.34	100%	59.73	100%	46.70	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	47.4	-27%	59.5	0%	63.5	-36%
Protect eelgrass locally	24.5	34%	33.4	44%	34.0	27%
Protect eelgrass downstream[3]	31.8	15%	43.4	27%	38.2	18%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading =
Prevents low DO locally

Green (dark) Shading =
Protects eelgrass locally

Red (dark) Outline=
Protects downstream uses

NPS Percent Reduction	2003-2004: WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L	2005-2006: WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L	2007-2008: WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	37.3	37.3	37.3	59.7	59.7	59.7	46.7	46.7	46.7
10%	33.6	33.6	33.6	53.8	53.8	53.8	42.0	42.0	42.0
20%	29.9	29.9	29.9	47.8	47.8	47.8	37.4	37.4	37.4
30%	26.1	26.1	26.1	41.8	41.8	41.8	32.7	32.7	32.7
40%	22.4	22.4	22.4	35.8	35.8	35.8	28.0	28.0	28.0
50%	18.7	18.7	18.7	29.9	29.9	29.9	23.3	23.3	23.3
60%	14.9	14.9	14.9	23.9	23.9	23.9	18.7	18.7	18.7
70%	11.2	11.2	11.2	17.9	17.9	17.9	14.0	14.0	14.0
80%	7.5	7.5	7.5	11.9	11.9	11.9	9.3	9.3	9.3
90%	3.7	3.7	3.7	6.0	6.0	6.0	4.7	4.7	4.7
100%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Observations
There are no WWTFs in this watershed.
Non-point source reductions of 30-50% are needed to protect all local and downstream uses.

Footnotes
Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.

EXHIBIT 42 (AR K.13)

6. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Cocheco River Watershed

Year[1]	2003-2004		2005-2006		2007-2008	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
Farmington	1.80		3.16		3.02	
Rochester	119.70		135.46		127.25	
Subtotal	121.50	46%	138.62	41%	130.27	54%
Nitrogen Non-Point Source Loads	143.64	54%	198.75	59%	111.07	46%
Total	265.14	100%	337.37	100%	241.34	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	148.8	44%	225.1	33%	209.8	13%
Protect eelgrass locally	92.0	65%	144.4	57%	129.8	46%
Protect eelgrass downstream[3]	141.8	47%	209.4	38%	180.4	25%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading = Prevents low DO locally

Green (dark) Shading = Protects eelgrass locally

Red (dark) Outline= Protects downstream uses

NPS Percent Reduction	2003-2004 WWTFs @ design flow and 8 mg/L	2003-2004 5 mg/L	2003-2004 3 mg/L	2005-2006 WWTFs @ design flow and 8 mg/L	2005-2006 5 mg/L	2005-2006 3 mg/L	2007-2008 WWTFs @ design flow and 8 mg/L	2007-2008 5 mg/L	2007-2008 3 mg/L
0%	192.4	174.1	161.9	247.5	229.2	217.0	159.8	141.5	129.4
10%	178.0	159.8	147.6	227.6	209.4	197.2	148.7	130.4	118.2
20%	163.7	145.4	133.2	207.8	189.5	177.3	137.6	119.3	107.1
30%	149.3	131.0	118.8	187.9	169.6	157.4	126.5	108.2	96.0
40%	134.9	116.7	104.5	168.0	149.7	137.5	115.4	97.1	84.9
50%	120.6	102.3	90.1	148.1	129.9	117.7	104.3	86.0	73.8
60%	106.2	87.9	75.7	128.3	110.0	97.8	93.2	74.9	62.7
70%	91.9	73.6	61.4	108.4	90.1	77.9	82.1	63.8	51.6
80%	77.5	59.2	47.0	88.5	70.2	58.0	71.0	52.7	40.5
90%	63.1	44.8	32.6	68.6	50.3	38.2	59.9	41.6	29.4
100%	48.8	30.5	18.3	48.8	30.5	18.3	48.8	30.5	18.3

Observations

WWTFs account for half of the nitrogen load in this watershed; therefore, non-point source reductions are lower in this watershed than others.
If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 30-70% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 20-60% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 0-50% to protect all local and downstream uses.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.

EXHIBIT 42 (AR K.13)

7. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Salmon Falls River Watershed

Year[1]	**2003-2004**		**2005-2006**		**2007-2008**	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
South Berwick	4.95		6.13		5.52	
Berwick	9.29		10.20		9.08	
Milton	1.22		2.05		1.50	
Rollinsford	2.64		3.07		2.80	
Somersworth	8.58		11.64		11.46	
North Berwick	2.00		2.08		1.75	
Subtotal	28.67	10%	35.17	9%	32.11	9%
Nitrogen Non-Point Source Loads	266.57	90%	338.65	91%	306.45	91%
Total	295.25	100%	373.82	100%	338.57	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	271.8	8%	437.2	-17%	371.2	-10%
Protect eelgrass locally	166.4	44%	271.7	27%	227.2	33%
Protect eelgrass downstream[3]	157.9	47%	232.0	38%	253.1	25%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading =
Prevents low DO locally

Green (dark) Shading =
Protects eelgrass locally

Red (dark) Outline=
Protects downstream uses

2003-2004

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	322.7	301.6	287.6
10%	296.0	275.0	261.0
20%	269.4	248.3	234.3
30%	242.7	221.7	207.6
40%	216.1	195.0	181.0
50%	189.4	168.4	154.3
60%	162.7	141.7	127.7
70%	136.1	115.0	101.0
80%	109.4	88.4	74.4
90%	82.8	61.7	47.7
100%	56.1	35.1	21.0

2005-2006

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	394.8	373.7	359.7
10%	360.9	339.9	325.8
20%	327.0	306.0	292.0
30%	293.2	272.1	258.1
40%	259.3	238.3	224.2
50%	225.4	204.4	190.4
60%	191.6	170.5	156.5
70%	157.7	136.7	122.6
80%	123.8	102.8	88.8
90%	90.0	68.9	54.9
100%	56.1	35.1	21.0

2007-2008

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	362.6	341.5	327.5
10%	331.9	310.9	296.9
20%	301.3	280.2	266.2
30%	270.6	249.6	235.6
40%	240.0	218.9	204.9
50%	209.3	188.3	174.3
60%	178.7	157.7	143.6
70%	148.1	127.0	113.0
80%	117.4	96.4	82.3
90%	86.8	65.7	51.7
100%	56.1	35.1	21.0

Observations

If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 40-70% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 30-60% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 30-50% to protect all local and downstream uses.
It may be appropriate to allocate a higher threshold for protecting eelgrass downstream by trading with the Cocheco River watershed in order to keep the NPS reductions compatible between the two watersheds.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.

EXHIBIT 42 (AR K.13)

8. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Great Bay Watershed

Year[1]	2003-2004		2005-2006		2007-2008	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
Exeter	39.30		49.36		39.40	
Newfields	1.31		1.78		1.65	
Newmarket	30.66		31.90		28.70	
Epping	3.69		4.94		4.31	
Kittery	0.66	Note 4	0.81	Note 4	0.75	Note 4
Newington	0.12	Note 4	0.14	Note 4	0.14	Note 4
Portsmouth	1.59	Note 4	1.93	Note 4	1.75	Note 4
Pease ITP	0.24	Note 4	0.36	Note 4	0.32	Note 4
Subtotal	77.58	19%	91.23	14%	77.00	15%
Nitrogen Non-Point Source Loads	337.38	81%	548.47	86%	444.53	85%
Total	414.96	100%	639.70	100%	521.54	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	661.1	-59%	856.4	-34%	799.2	-53%
Protect eelgrass locally	331.9	20%	459.2	28%	413.4	21%
Protect eelgrass downstream[3]	none		none		none	

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading =
Prevents low DO locally

Green (dark) Shading =
Protects eelgrass locally

Red (dark) Outline=
Protects downstream uses

2003-2004

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	391.5	371.2	357.7
10%	357.8	337.5	323.9
20%	324.0	303.7	290.2
30%	290.3	270.0	256.5
40%	256.6	236.3	222.7
50%	222.8	202.5	189.0
60%	189.1	168.8	155.3
70%	155.3	135.0	121.5
80%	121.6	101.3	87.8
90%	87.9	67.6	54.0
100%	54.1	33.8	20.3

2005-2006

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	602.6	582.3	568.8
10%	547.8	527.5	513.9
20%	492.9	472.6	459.1
30%	438.1	417.8	404.2
40%	383.2	362.9	349.4
50%	328.4	308.1	294.5
60%	273.5	253.2	239.7
70%	218.7	198.4	184.8
80%	163.8	143.5	130.0
90%	109.0	88.7	75.1
100%	54.1	33.8	20.3

2007-2008

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	498.7	478.4	464.8
10%	454.2	433.9	420.4
20%	409.8	389.5	375.9
30%	365.3	345.0	331.5
40%	320.9	300.6	287.0
50%	276.4	256.1	242.6
60%	231.9	211.6	198.1
70%	187.5	167.2	153.7
80%	143.0	122.7	109.2
90%	98.6	78.3	64.8
100%	54.1	33.8	20.3

Observations

If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 20-30% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 20-30% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 10-20% to protect all local and downstream uses.
The loading threshold for Great Bay is protective of downstream uses in Little Bay.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.
Note 4: Assuming that 13% of nitrogen from LPR dischargers that reaches Dover Point enters Great Bay.

EXHIBIT 42 (AR K.13)

9. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Great Bay-Little Bay Watershed

Year[1]	**2003-2004**			**2005-2006**			**2007-2008**		
Measured Watershed Nitrogen Loads									
Nitrogen Point Source Loads[2]	tons/yr	% of total		tons/yr	% of total		tons/yr	% of total	
Durham	11.04			12.85			11.39		
Exeter	39.30			49.36			39.40		
Newfields	1.31			1.78			1.65		
Newmarket	30.66			31.90			28.70		
Epping	3.69			4.94			4.31		
Kittery	4.69		Note 4	5.83		Note 4	5.36		Note 4
Newington	0.85		Note 4	1.02		Note 4	1.00		Note 4
Portsmouth	11.40		Note 4	13.77		Note 4	12.50		Note 4
Pease ITP	1.72		Note 4	2.59		Note 4	2.26		Note 4
Subtotal	104.68	20%		124.04	15%		106.56	16%	
Nitrogen Non-Point Source Loads	426.52	80%		687.90	85%		547.35	84%	
Total	531.20	100%		811.94	100%		653.90	100%	
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria									
	tons/yr	% reduct.		tons/yr	% reduct.		tons/yr	% reduct.	
Prevent low DO locally	934.3	-76%		1131.0	-39%		1054.4	-61%	
Protect eelgrass locally	454.0	15%		590.6	27%		534.9	18%	
Protect eelgrass downstream[3]	none			none			none		

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading =
Prevents low DO locally

Green (dark) Shading =
Protects eelgrass locally

Red (dark) Outline=
Protects downstream uses

2003-2004

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	525.6	488.4	463.7
10%	482.9	445.8	421.0
20%	440.3	403.1	378.4
30%	397.6	360.5	335.7
40%	355.0	317.8	293.1
50%	312.3	275.2	250.4
60%	269.7	232.5	207.8
70%	227.0	189.9	165.1
80%	184.4	147.2	122.5
90%	141.7	104.6	79.8
100%	99.1	61.9	37.1

2005-2006

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	787.0	749.8	725.0
10%	718.2	681.0	656.3
20%	649.4	612.2	587.5
30%	580.6	543.4	518.7
40%	511.8	474.6	449.9
50%	443.0	405.9	381.1
60%	374.2	337.1	312.3
70%	305.4	268.3	243.5
80%	236.6	199.5	174.7
90%	167.8	130.7	105.9
100%	99.1	61.9	37.1

2007-2008

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	646.4	609.3	584.5
10%	591.7	554.5	529.8
20%	536.9	499.8	475.0
30%	482.2	445.1	420.3
40%	427.5	390.3	365.6
50%	372.7	335.6	310.8
60%	318.0	280.9	256.1
70%	263.3	226.1	201.4
80%	208.5	171.4	146.6
90%	153.8	116.6	91.9
100%	99.1	61.9	37.1

Observations

If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 20-30% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 10-30% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 10-20% to protect all local and downstream uses.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.
Note 4: Assuming that 93% of nitrogen from LPR dischargers that reaches Dover Point enters Great Bay/Little Bay.

EXHIBIT 42 (AR K.13)

10. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the Upper Piscataqua River Watershed

Year[1]	2003-2004		2005-2006		2007-2008	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
Dover	96.30		113.49		101.29	
South Berwick	4.95		6.13		5.52	
Farmington	1.80		3.16		3.02	
Rochester	119.70		135.46		127.25	
Berwick	9.29		10.20		9.08	
Milton	1.22		2.05		1.50	
Rollinsford	2.64		3.07		2.80	
Somersworth	8.58		11.64		11.46	
North Berwick	2.00		2.08		1.75	
Kittery	0.35	Note 4	0.44	Note 4	0.40	Note 4
Newington	0.06	Note 4	0.08	Note 4	0.08	Note 4
Portsmouth	0.86	Note 4	1.04	Note 4	0.94	Note 4
Pease ITP	0.13	Note 4	0.19	Note 4	0.17	Note 4
Subtotal	247.88	37%	289.02	34%	265.26	38%
Nitrogen Non-Point Source Loads	426.42	63%	561.39	66%	436.25	62%
Total	674.30	100%	850.41	100%	701.51	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Prevent low DO locally	684.2	-1%	897.0	-5%	943.5	-34%
Protect eelgrass locally	366.9	46%	514.7	39%	505.9	28%
Protect eelgrass downstream[3]	none		none		none	

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading = Prevents low DO locally

Green (dark) Shading = Protects eelgrass locally

Red (dark) Outline= Protects downstream uses

2003-2004

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	589.7	528.5	487.7
10%	547.1	485.8	445.0
20%	504.4	443.2	402.4
30%	461.8	400.6	359.7
40%	419.1	357.9	317.1
50%	376.5	315.3	274.4
60%	333.9	272.6	231.8
70%	291.2	230.0	189.2
80%	248.6	187.3	146.5
90%	205.9	144.7	103.9
100%	163.3	102.1	61.2

2005-2006

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	724.7	663.4	622.6
10%	668.5	607.3	566.5
20%	612.4	551.2	510.3
30%	556.3	495.0	454.2
40%	500.1	438.9	398.1
50%	444.0	382.8	341.9
60%	387.8	326.6	285.8
70%	331.7	270.5	229.7
80%	275.6	214.3	173.5
90%	219.4	158.2	117.4
100%	163.3	102.1	61.2

2007-2008

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	599.5	538.3	497.5
10%	555.9	494.7	453.9
20%	512.3	451.1	410.2
30%	468.7	407.4	366.6
40%	425.0	363.8	323.0
50%	381.4	320.2	279.4
60%	337.8	276.6	235.7
70%	294.2	232.9	192.1
80%	250.5	189.3	148.5
90%	206.9	145.7	104.9
100%	163.3	102.1	61.2

Observations

If WWTFs are permitted at 8 mg/L and design flow, non-point sources must be reduced by 30-60% to protect all local and downstream uses.
If WWTFs are permitted at 5 mg/L and design flow, non-point sources must be reduced by 10-40% to protect all local and downstream uses.
If WWTFs are permitted at 3 mg/L and design flow, non-point sources must be reduced by 0-30% to protect all local and downstream uses.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.
Note 3: Downstream protective values are the allowable nitrogen loads from this watershed that would support eelgrass in Great Bay, Little Bay, and the Upper Piscataqua River. These values were calculated by assuming downstream WWTFs (Dover, Portsmouth, Kittery, Pease, and Newington) were permitted at 8 mg/L and design flow and assuming an equal percent reduction across all contributing watersheds.
Note 4: Assuming that 7% of nitrogen from LPR dischargers that reaches Dover Point enters the Upper Piscataqua River.

EXHIBIT 42 (AR K.13)

11. Watershed Nitrogen Loads Relative to Targets For Different Permitting Scenarios for the All Areas Combined

Year[1]	**2003-2004**		**2005-2006**		**2007-2008**	
Measured Watershed Nitrogen Loads						
Nitrogen Point Source Loads[2]	tons/yr	% of total	tons/yr	% of total	tons/yr	% of total
Durham	11.04	0.9%	12.85	0.8%	11.39	0.8%
Exeter	39.30	3.3%	49.36	3.0%	39.40	2.9%
Newfields	1.31	0.1%	1.78	0.1%	1.65	0.1%
Newmarket	30.66	2.5%	31.90	1.9%	28.70	2.1%
Dover	96.30	8.0%	113.49	6.8%	101.29	7.5%
South Berwick	4.95	0.4%	6.13	0.4%	5.52	0.4%
Kittery	5.05	0.4%	6.27	0.4%	5.76	0.4%
Newington	0.91	0.1%	1.10	0.1%	1.08	0.1%
Portsmouth	12.26	1.0%	14.81	0.9%	13.45	1.0%
Pease ITP	1.85	0.2%	2.78	0.2%	2.43	0.2%
Farmington	1.80	0.1%	3.16	0.2%	3.02	0.2%
Rochester	119.70	9.9%	135.46	8.1%	127.25	9.4%
Epping	3.69	0.3%	4.94	0.3%	4.31	0.3%
Berwick	9.29	0.8%	10.20	0.6%	9.08	0.7%
Milton	1.22	0.1%	2.05	0.1%	1.50	0.1%
Rollinsford	2.64	0.2%	3.07	0.2%	2.80	0.2%
Somersworth	8.58	0.7%	11.64	0.7%	11.46	0.8%
North Berwick	2.00	0.2%	2.08	0.1%	1.75	0.1%
Subtotal	352.55	29%	413.07	25%	371.82	27%
Nitrogen Non-Point Source Loads	852.95	71%	1,249.28	75%	983.60	73%
Total	1,205.50	100%	1,662.35	100%	1,355.41	100%
Watershed Nitrogen Loading Thresholds to Comply with Numeric Nutrient Criteria						
	tons/yr	% reduct.	tons/yr	% reduct.	tons/yr	% reduct.
Protect eelgrass in downstream areas only	820.8	32%	1105.3	34%	1040.8	23%
Protect eelgrass in downstream areas and prevent low DO in tidal rivers	797.4	34%	1100.5	34%	999.3	26%
Protect eelgrass in all areas	624.5	48%	881.4	47%	817	40%

Predicted Watershed Nitrogen Loads Under Different Permitting Scenarios for WWTFs in the Watershed and Different Percent Reductions in Non-Point Sources

Key to Cell Shading

Yellow (light) Shading =
Prevents low DO locally

Green (dark) Shading =
Protects eelgrass locally

Red (dark) Outline=
Protects downstream uses

2003-2004

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	1115.3	1016.9	951.3
10%	1030.0	931.6	866.0
20%	944.7	846.3	780.7
30%	859.4	761.0	695.4
40%	774.1	675.7	610.1
50%	688.8	590.4	524.9
60%	603.5	505.1	439.6
70%	518.2	419.9	354.3
80%	432.9	334.6	269.0
90%	347.6	249.3	183.7
100%	262.4	164.0	98.4

2005-2006

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	1511.6	1413.3	1347.7
10%	1386.7	1288.3	1222.7
20%	1261.8	1163.4	1097.8
30%	1136.8	1038.5	972.9
40%	1011.9	913.5	848.0
50%	887.0	788.6	723.0
60%	762.1	663.7	598.1
70%	637.1	538.8	473.2
80%	512.2	413.8	348.2
90%	387.3	288.9	223.3
100%	262.4	164.0	98.4

2007-2008

NPS Percent Reduction	WWTFs @ design flow and 8 mg/L	5 mg/L	3 mg/L
0%	1245.9	1147.6	1082.0
10%	1147.6	1049.2	983.6
20%	1049.2	950.8	885.3
30%	950.9	852.5	786.9
40%	852.5	754.1	688.5
50%	754.1	655.8	590.2
60%	655.8	557.4	491.8
70%	557.4	459.0	393.5
80%	459.1	360.7	295.1
90%	360.7	262.3	196.7
100%	262.4	164.0	98.4

Observations

If WWTFs are permitted at 8 mg/L and design flow, NPS must be reduced by 30-40% to protect eelgrass in downstream areas and DO in tidal rivers. NPS reductions of 50-60% would be needed to protect eelgrass in all areas.
If WWTFs are permitted at 5 mg/L and design flow, NPS must be reduced by 20-30% to protect eelgrass in downstream areas and DO in tidal rivers. NPS reductions of 40-50% would be needed to protect eelgrass in all areas.
If WWTFs are permitted at 3 mg/L and design flow, NPS must be reduced by 10-20% to protect eelgrass in downstream areas and DO in tidal rivers. NPS reductions of 30-40% would be needed to protect eelgrass in all areas.

Footnotes

Note 1: Total precipitation in 2003-2004, 2005-2006, and 2007-2008 was 43.7, 67.9, and 51.4 inches, respectively.
Note 2: Nitrogen loads from WWTFs are expressed as delivered loads to the estuary.