TOWN OF EXETER

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August 11, 2011

VIA OVERNIGHT DELIVERY & E-MAIL

Stephen S. Perkins, Director
Office of Ecosystem Protection
U.S. Environmental Protection Agency
Region 1
5 Post Office Square, Suite 100
Boston, MA 02109-3912

Re: Request for Public Comment on Draft NPDES Permit No. NH0100871
Town of Exeter, NH

Dear Mr. Perkins:

Enclosed please find the comments submitted by the Town of Exeter on draft NPDES Permit No. NH0100871 (Town of Exeter, NH). This is an extremely important issue for the Town of Exeter and the Region, as you are fully aware and as our comments reflect. We thank you for your careful consideration of these comments and for your thoughtful approach on this permit and on the overall issue of water quality in the Great Bay watershed.

Very truly yours,

Russell Dean
Town Manager

Enclosures
cc (via e-mail):
- Great Bay Municipal Coalition Members
- Tom Burack, Commissioner, DES
- Harry Stewart, DES
- Ted Diers, DES
- Phil Trowbridge, DES
- John Hall, Esq.
- Tupper Kinder, Esq.
- Drew Serell, Esq.
- Jennifer Perry
- Peter Atherton, Wright Pierce
- Dana Bisbee, Esq.

U.S. Environmental Protection Agency
NPDES Permit No. NH0100871 (Draft)
Town of Exeter, NH
August 11, 2011

COMMENTS SUBMITTED BY THE TOWN OF EXETER

A. Introduction

The Town of Exeter ("Exeter" or the "Town") submits the comments herein on the proposed modification of the Town of Exeter NPDES Permit No. NH0100871, that was published for comment as a draft permit by EPA on March 25, 2011. The deadline for filing comments was extended to August 12, 2011. The draft permit ("Permit") that was released for public comment on March 25, 2011 was partially revised from an earlier draft permit that was released for public comment on October 25, 2007. Based only on comments received from the Conservation Law Foundation ("CLF"), EPA reopened the 2007 draft permit to include new discharge limits for total nitrogen from the Exeter Wastewater Treatment Plant ("WWTP").

This new nitrogen limit for the Exeter permit is reflective of the U.S. Environmental Protection Agency's ("EPA") and the New Hampshire Department of Environmental Services ("DES") concern about nutrient loadings from all sources into Great Bay. The Town shares the concern of the federal and state governments about the health of the Great Bay Estuary. The Town fully appreciates that it discharges nitrogen from its wastewater treatment plant ("WWTP") and that upgrades to that plant are necessary to reduce nutrient loadings into the Squamscott River and ultimately into Great Bay. In addition to the recognized need for an upgraded wastewater treatment facility, the Town of Exeter also appreciates that, as the Fact Sheet indicates, the other sources of nutrient loadings into Great Bay must be identified and reduced. These other sources include sources such as agricultural sources, atmospheric deposition, fertilizer use, landfills, stormwater runoff (both regulated and non-regulated) and the hundreds of septic systems serving businesses and residences in the Squamscott River watershed (those septic systems that are failing, as well as fully functioning ones).

The Town has already entered into a written commitment through a Memorandum of Agreement with DES and other municipalities in the Great Bay watershed to reduce substantially the nitrogen discharge from its WWTP. The Town has committed to begin promptly planning for an upgraded treatment plant in Exeter that will achieve a nitrogen discharge limit of 8 mg/l. Thus, the comments filed today by the Town do not represent a disagreement on the need to reduce nitrogen loadings into Great Bay. They do, nevertheless, raise a substantial question about the degree to which the Town of Exeter (and subsequently other municipal wastewater treatment plants discharging into Great Bay) must reduce its nitrogen discharges. The ultimate question facing EPA, DES and the Town is (1) whether the nitrogen limit included now in the modified draft permit of a monthly average concentration of 3 mg/l is supported by the data and analyses that have taken place in Great Bay, and (2) whether the additional expenditure of millions of dollars to achieve that lower limit is a reasonable and lawful requirement for EPA to impose in its NPDES permit for Exeter.

For the reasons set forth herein, the Town requests that EPA reconsider its decision to re-open the draft Permit to impose a new limit for total nitrogen and that EPA modify the provisions addressing the nitrogen limit as recommended below.

B. Incorporation by Reference of the Comments, Filed by the Great Bay Municipal Coalition on August 9, 2011

The Town of Exeter is a member of the Great Bay Municipal Coalition ("Coalition"), an entity dedicated to the establishment of appropriate and cost-effective restoration measures to protect Great Bay. The Coalition filed comments on the Exeter draft permit on August 9, 2011. Those comments were filed on behalf of the Coalition and each of its member communities, and the Town of Exeter specifically incorporates those comments by reference herein. For ease of reference, we also include a copy of the Coalition's August 9, 2011 comments (but not the exhibits thereto). (Attachment A)

C. EPA's Proposed Discharge Limits are Inappropriately Low and Should Be Revised

1. EPA's Proposed Discharge Limits are Based on an Inappropriate Interpretation of the DES Narrative Criteria

There remains significant uncertainty with respect to what the numeric nutrient criteria should be to establish discharge limits for treatment facilities in the Great Bay system. DES has not adopted numeric nutrient criteria. Existing State Surface Water Criteria (Env-Ws 1700) have narrative criteria, but as DES states in their June 2009 report on *Numeric Criteria for the Great Bay Estuary* ("2009 Criteria Report"), "Narrative standards are difficult to apply for impairment and permitting decisions." Some states have done extensive scientific studies to establish specific numeric criteria. Due to limited available resources, DES chose to take a "weight of the evidence" approach. DES analyzed the growing but still limited available data, and largely relied on precedent from other states to develop recommended numeric nutrient criteria for the Great Bay system that are being used as interpretations of the narrative criteria. These criteria have not been finalized or adopted as rules under RSA 541-A, and remain in draft form.

By including a new nitrogen limit in the draft Permit, EPA has relied heavily on the DES draft, un-adopted numeric criteria and on experience from other locations in interpreting the narrative criteria. The problem with this approach is that much of the cited precedent from other states is not relevant to the Great Bay system, and should not be directly applied to Great Bay. For example, EPA cites various eelgrass (or submerged aquatic vegetation - SAV) criteria from other locations as supporting documentation for the total nitrogen discharge permit limit. However, the cited criteria from other locations are intended to address water transparency problems caused by excessive algae growth fueled by nitrogen levels. There are significant data to show that in the Great Bay system nitrogen levels are not the controlling factor for light transparency and therefore eelgrass habitat.

Relying on precedent from dissimilar estuaries brings a high level of uncertainty with respect to what the numeric criteria need to be to protect the Bay and river. Based on DES's analysis, the likely range of Great Bay nitrogen criteria would appear to be somewhere between 0.3 and 0.45 mg/l total nitrogen ("TN") depending on which water quality objective (e.g., eelgrass in the Bay, eelgrass in the river, dissolved oxygen ("DO") in the river, DO in the Bay, macro algae, etc.) is believed to be impacted by nitrogen. The low end of this range is premised on the common eelgrass/nitrogen/Chlorophyll a/light transparency relationship observed in other estuaries, but which does not exist in the Great Bay system. There is no basis to impose transparency-based nitrogen criteria from other estuaries when the transparency in Great Bay and the river is most significantly controlled by other factors, including naturally-occurring organics and turbidity.

The upper end of the appropriate nitrogen criterion may even be higher than 0.45 mg/l. In watersheds with much organic nitrogen (from all sources), as is the case in portions of the Great Bay system, nutrient criteria are occasionally established on the basis of inorganic nitrogen with resulting higher than typically allowable total nitrogen concentrations. In EPA's fact sheet (p. 20), there is reference to the Massachusetts Department of Environmental Protection's ("MADEP") total nitrogen criteria of between 0.3 and 0.39 mg/l. In estuaries with much organic nitrogen, MADEP has set an inorganic nitrogen criterion that has resulted in allowable total nitrogen concentration of greater than 0.5 mg/l (e.g., Pleasant Bay).

Even if there were an eelgrass/nitrogen/Chlorophyll a/light transparency relationship in Great Bay, there would be no basis to apply an eelgrass criterion to the Squamscott River. The actual cause of eelgrass loss in the Squamscott River is unknown and occurred more than 40 years ago (long before most documented eelgrass declines in Great Bay and before increasing Total Nitrogen ("TN") and decreasing transparency trends. Neither DES nor any other researchers have been able to link Squamscott River eelgrass losses with nitrogen conditions in the river. Further, the Great Bay Estuary Restoration Compendium, Figures 6 and 7, identify the Squamscott River as not suitable habitat for eelgrass restoration. (Attachments B)

There is also insufficient data to show a linkage between river DO and nitrogen, and thus, there is an insufficient basis for EPA to impose a permit limit premised on an uncertain relationship between river DO and nitrogen. The work that is currently underway by the Great Bay Municipal Coalition under its Memorandum of Agreement with DES will provide substantial new information and insights on the DO regime in the Squamscott River. EPA's final action on this proposed draft Permit should incorporate the monitoring and modeling efforts that are being undertaken by the Coalition now.

An underlying failing of EPA's justification for a total nitrogen limit of 3 mg/l is that the supporting basis for that limit as explained in the Fact Sheet focuses on the impact of the Exeter WWTP discharge on the Squamscott River, and not Great Bay. On pages 21-23 of the Fact Sheet, EPA points to the high nitrogen values measured in the Squamscott River and the total nitrogen concentration in the river, and then calculates a total median nitrogen concentration in the Squamscott by adding the concentration from the Exeter River (upstream of the Squamscott) together with the increase in nitrogen due to the effluent discharge at the treatment plant at the point of discharge. As explained above, there is substantial question as to whether impairment for eelgrass is an appropriate basis at all for a nitrogen limit for the Exeter WWTP, and the nitrogen-river DO relationship is also uncertain, pending the analysis underway by the Municipal Coalition. Therefore, the basis for EPA's position of a nitrogen limit of 3 mg/l is without sufficient foundation. No final decision on the nitrogen limit should be imposed until a sufficient basis has been established, either by substantiating the DO-nitrogen relationship in the Squamscott, or providing a more complete cause and effect relationship between nitrogen discharges from the Exeter treatment plant and any impairments in Great Bay.

EPA also inappropriately applies the near field low flow dilution factor of 25.2 to estimate the impact of Exeter's discharge on the nitrogen level in the river. This "Low Flow Conditions" dilution factor as defined in Env-Ws 1705.02 is intended to be used for calculating protective limits for toxic parameters such as ammonia or metals. Nutrient criteria are intended to be applied to average or median river and tidal flushing conditions. This misapplication of the dilution factor results in an overstatement of the TN concentration impacts of Exeter's plant on the river (stating that the Exeter WWTP adds 0.57 mg/l to the river when the actual amount is 0.15 mg/l at Chapman's Landing per DES's model). This misinformation should be corrected.

2. There Are Other Sources of Nitrogen That Need Control

Just as the Town of Exeter acknowledges that it has a need for, and has committed to, reductions in the nitrogen discharges from its treatment plant, EPA has also acknowledged that there is a need for other reductions in the entire watershed in order to address the health of Great Bay. Not only must there be reductions in nitrogen loads from other municipal treatment plants, but the largest contribution of nutrients to the Great Bay Estuary is from non-point sources. DES is in the process of identifying and quantifying the various sources of loads for the entire watershed and this effort should inform future non-point source reduction measures. In addition to these efforts, DES will need to undertake a non-point source TMDL.

There are also sources of nitrogen from outside the watershed that are contributing to the Great Bay nutrient challenge and these sources need to be targeted for reduction as well. The future direction of these other sources may have a huge impact on Great Bay. Currently 20% of the DES calculated allowable load to the Bay is consumed by background nitrogen from the ocean. The background ocean nitrogen concentration of 0.2mg/l is already at 2/3rds of DES's target maximum concentration for the Bay. If EPA imposed New England wide nitrogen controls and the background nitrogen level were reduced to say 0.1 mg/l, the watershed reduction goals would be reduced by approximately 25%, with watershed savings likely in excess of $100M. Conversely, if the background nitrogen levels increase to say 0.3 mg/l, the ocean will provide no dilution benefit to Great Bay and it would be practically impossible to attain DES's water quality objectives for the Bay. Based on this analysis, it would appear that the future of Great Bay water quality could be greatly impacted by what happens to the background nitrogen levels in the ocean. If these levels are allowed to continue to increase, any efforts within the watershed could be futile. In view of this, we need EPA's forecast of future of background nitrogen levels in the ocean and commitment to effect improvement in this regard. Another major source of nitrogen reaching the Bay from outside the watershed is atmospheric deposition. A preliminary estimate for the Lamprey River Sub-basin shows on the order of 50% of the watershed nitrogen input is from atmospheric deposition. This is obviously very significant and another area that we need EPA's forecast and commitment for future improvement.

3. It Is Not Appropriate to Hold Exeter Accountable for Non-point Source Reductions by Others

On page 24 of the Fact Sheet, EPA asserts that the permit will be reopened to incorporate more stringent nitrogen discharge standards in the event adequate progress is not made relative to non-point source nitrogen reductions. Much of the non-point source control efforts are beyond the Town's control and the Town should not be held accountable for the actions (or inactions) of state or federal agencies, other towns and regional authorities. Exeter is already shouldering a disproportionate share of the watershed nitrogen removal costs because we have a treatment plant that EPA can regulate. The failure to take a watershed-based permit approach to the complex Great Bay nutrient issues makes equitable cost allocation more challenging. Threatening to push Exeter further if the other stakeholders do not do their part with respect to non-point sources adds an onerous and unfair burden on the Town.

These provisions in the Fact Sheet also heighten our concerns about EPA proceeding with inappropriate interpretations of DES narrative criteria. As we identified above, much of the cited precedent for other watersheds (which is based on nitrogen-light transparency issues) is not relevant to Great Bay and results in erroneously low suggested target nitrogen criteria. This in turn may result in significant overestimation as to the level of non-point source nitrogen removal required. The Town of Exeter does not want to be held accountable for removing non-point source nitrogen to unjustifiable levels from sources outside the Town's control. EPA should review the sensitivity analysis (See Table 1 below) on the nitrogen removal requirements at assumed numeric nitrogen levels to understand the impacts of the scientific uncertainty. The provisions threatening further reduction of nitrogen from the Exeter WWTP – even below the limit of technology – should be removed from the Permit.

4. The Scientific Uncertainty Has Huge Financial Implications That Beg for an Adaptive Management Strategy

While the above-referenced range of potential nitrogen criteria (i.e., 0.3 to 0.45mg/l depending on the water quality objective) may not seem that large, it is important to understand the watershed-wide nitrogen control differences between the high and low end of this range is very significant and represents potentially hundreds of millions of dollars for the watershed. Table 1 illustrates the impact small changes in the nutrient criteria have on the Great Bay nitrogen removal requirements.

TABLE 1

GREAT BAY LOAD REDUCTION REQUIREMENTS FOR VARIOUS ASSUMED GREAT BAY TOTAL NITROGEN CRITERIA

TN Criteria (mg/l)	Great Bay Total Nitrogen Load				Point Source Reduction (ton/yr)	WWTP TN Limit (mg/l)	Non Point Source Reduction	
	Existing(1) (ton/yr)	Allowable(1) (ton/yr)	Reduction (ton/yr)	Reduction (%)			(ton/yr)	(%)
0.30	1408	988.9	419.1	29.8	280.8	3.0	138.3	13.4
0.32	1408	1071.3	336.7	23.9	280.8	3.0	55.9	5.4
0.34	1408	1153.7	254.3	18.1	264.4	3.5	0.0	0
0.35	1408	1194.9	213.1	15.1	215.3	5.0	0.0	0
0.36	1408	1236.1	171.9	12.2	182.5	6.0	0.0	0
0.37	1408	1277.3	130.7	9.3	133.4	7.5	0.0	0
0.38	1408	1318.5	89.5	6.4	100.6	8.5	0.0	0
0.39	1408	1359.7	48.3	3.4	48.3	>10	0.0	0
0.45	1408	1607.0	0	0	0	NL	0.0	0

Note

1. DES, *Great Bay Nitrogen Loading Analysis*, November 2010, page 11; Allowable loadings for various criteria determined by pro-rating the allowable loading of 1408 ton/yr based on a criteria of 0.3 mg/l per methodology shown in DES' report, *Preliminary Watershed Nitrogen Loading Thresholds*, October 2009, page 10.

The nitrogen removal requirements at a nitrogen criterion of 0.3mg/l are nearly five times what they are with a nitrogen criterion of 0.38 mg/l. EPA's proposed limit of technology (LOT) nitrogen discharge standard is premised on the false assumption that a TN criterion of 0.3mg/l has to be attained in the Bay and river to improve light transparency and thus eelgrass habitat. If the actual nitrogen criteria necessary to protect the Great Bay system were in the middle of the above referenced range, an 8 mg/l TN limit for WWTF point sources would be adequate to meet the criteria. It is important to note that there seems to be a consensus forming among the stakeholders that the ultimate controlling issue will be macro algae and not eelgrass light transparency issues or epiphyte issues, and that DES's macro algae criterion is in the middle of the above-referenced range.

Other factors that could reduce the magnitude of the nitrogen reduction required to achieve water quality goals are potential aquaculture (e.g., oyster beds) and bio-remediation efforts in Great Bay that have been discussed and may well be part of an adaptive management strategy.

Given the technical uncertainties with respect to appropriate nutrient criteria and given the very significant cost implications associated with these uncertainties, it would seem that the two reasonable and sustainable paths forward are to either (1) refine the technical basis for the nitrogen criterion and complete a TMDL before finalizing the permit limit, or (2) proceed with an adaptive management approach with an intermediate target nitrogen criterion (0.38 mg/l TN suggested as in the middle of the range), with future adjustments to this criterion based on monitoring results.

DES has appropriately captured the idea of such a phased approach. In its December 2010 draft *Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Estuary Watershed*, DES has set forth the estimated loadings from point source and non-point sources into Great Bay, and has also provided an estimate on the reductions that would be achieved at various treatment levels for nitrogen. In the concluding section of this draft report, DES states that "[a]ll of this information is needed to establish permit limits for nitrogen limits for WWTPs; however, this report does not actually set these permit conditions. The information in this report should be used to develop detailed Watershed Implementation Plans with steps that can be taken in a phased manner to reduce nitrogen loads from both point and non-point source". Further, DES recommends that such Watershed Implementation Plans "should be developed concurrently with additional research to refine our scientific understanding of the system." See Draft Loadings Report at p. 24. The Town of Exeter endorses this approach and encourages EPA to adopt it.

D. Even If EPA Declines to Withdraw the Draft Permit, Modifications to the Permit are Necessary

1. EPA's Proposed Nitrogen Limits are Actually Below Limits of Technology (LOT), Are Unattainable, and Should be Changed

As stated above, Exeter does not believe EPA has a sound scientific basis to impose a limit of technology (LOT) nitrogen limit. Even if EPA had reason to establish a LOT-type limit, however, EPA has insufficient basis to establish that limit at 3 mg/l – for several reasons. The first is that limits of technology need to be discussed in the context of a time period. What is achievable on an annual or seasonal average basis is different than what is achievable on a monthly average basis. EPA has inappropriately taken LOT expectations for southern climates and applied them to Exeter. Further, EPA has inappropriately taken annual average LOT expectations and applied them as monthly limits.

EPA's Municipal Nutrient Removal Technologies Reference Document (2008, p. 2-80) ("EPA Reference Document") references the several factors that affect nitrogen removal efficiency. One factor that can influence how low the TN can be reduced is the dissolved organic nitrogen (DON) concentration. At this point, the DON concentration in Exeter's wastewater is not known. This will be explored in more depth as part of the Facility Planning process which is tentatively scheduled for 2012. EPA's reference document states that "The DON concentration is a critical variable for determining TN standards because the chemicals have limited availability for biological removal." Absent this data, EPA cannot establish an appropriate LOT with certainty.

In the absence of DON data, EPA should consider a total inorganic nitrogen (TIN) limit. At a recent Southeast Watershed Alliance meeting, EPA representatives handed out an EPA Publication entitled *An Urgent Call to Action Report in the State-EPA Nutrient Innovations Task Group* (August 2009). In this publication, the stringent 3 mg/l technology-based nitrogen limits are discussed in the context of nitrate plus nitrite-nitrogen and not in the context of total nitrogen -- or even in the context of TIN which includes ammonia as well as nitrate plus nitrite-nitrogen (see Attachment C, p. 14). If EPA chooses to apply a LOT to this Permit, a TIN limit of 3 mg/l on a seasonal average basis would be more appropriate for Exeter than a TN limit of 3 mg/l. There is precedent for this elsewhere (e.g., Kalkaska, MI). The EPA Reference Document reports the LOT to be 3 mg/l on an annual average basis (not monthly average) based on a survey of, primarily, southern plants. The EPA Reference Document also references wastewater temperature as another factor that influences nitrogen treatment efficiency. Given the much colder temperatures in New Hampshire, the LOT for Exeter is expected to be higher than for these southern plants. Based on EPA's Reference Document, the proposed total nitrogen limit, even if applied on a seasonal average basis, is beyond the reasonable LOT in this instance because of the cold temperatures in NH.

Over the past few years, Connecticut communities have had to upgrade treatment facilities with state of the art technology to reduce nitrogen levels to the limits of technology in order to meet the requirements of the Long Island Sound total maximum daily load ("TMDL"). Table 2 below is a compilation of the 2010 data from ten of the recently upgraded plants in Connecticut.

TABLE 2
CONNECTICUT WWTFs 2010 DATA
MONTHLY AVERAGE TOTAL NITROGEN CONCENTRATION (mg/l)

Treatment Plant	12 Month Average	Apr-Oct Average	12 Month Max Month	Apr-Oct Max Month
Branford (4-stage Bardenpho)	3.4	3.1	6.6	4.7
Cheshire (Act Sludge, Denite Filter)	1.8	2.0	2.9	2.9
Jewett City (Phased Isolation Ox Ditch)	2.3	2.1	4.2	3.0
Southington (TF, Act Sludge, Denite Filter)	5.4	5.2	7.7	7.7
Suffield (MLE Ox Ditch)	2.1	1.9	4.6	2.9
Waterbury (4-stage Bardenpho)	4.1	3.7	6.0	5.4
Westport (4-stage Bardenpho)	2.6	2.1	4.7	2.6
Stamford (4-stage process)	3.5	2.8	5.4	3.2
New Canaan (MLE Ox Ditch)	3.1	2.4	4.8	3.1
Milford Housatonic (4-stage Bardenpho)	4.7	4.4	6.4	5.1
Average	3.3	3.0	5.3	4.0
Maximum	5.4	5.2	7.7	7.7
Minimum	1.8	1.9	2.9	2.6

*Reference Attachment D for complete 2010 data.

While many of these plants are producing very impressive results, it is important to note that 60% of these plants exceeded an annual average TN concentration of 3 mg/l. Importantly, nine out of ten plants exceeded 3 mg/l on a monthly average basis at least once during the year. The Connecticut data shows that six out of the ten enhanced nitrogen removal plants had annual average TN concentrations above 3 mg/l and four plants were below 3 mg/l. Further these 10 plants had maximum month concentrations that ranged from 2.9 to 7.7mg/l. These plants have an average maximum month concentration of 1.6 times the annual average. Based on this data, a maximum month concentration of 6 to 8 mg/l or more would appear more appropriate, if a monthly concentration limit is needed at all. Several of these plants are operating considerably below the design loadings and performance may not be as good once these facilities are operating at their design conditions. It is also important to note that Connecticut plants would be expected to outperform similar plants in NH due to temperature differences. For example, the design low water temperature for a facility in Westport, CT was 11 degrees Celsius, which is considerably higher than the 8 degrees Celsius design low temperature used for a recently constructed advanced treatment facility in Jaffrey, NH. As noted previously, actual water temperatures for advanced treatment facilities in northern New England (Jaffrey, North Conway, NH and Sanford, ME) can be as low as 5 degrees Celsius. Based on the CT data and based on the fact that NH is much colder than CT, EPA has no basis to establish a 3 mg/l limit on a seasonal basis, let alone on a monthly basis.

Massachusetts is another state with coastal nitrogen pollution concerns. The lowest TN permit limit EPA has imposed in Massachusetts that we could identify is 4 mg/l on a monthly basis in Scituate. Yet EPA proposes a limit of technology type limit in NH that is more restrictive than in Massachusetts. Even if EPA did have a sound basis to establish a LOT-type limit and even if that limit were 3 mg/l on a seasonal average basis, this limit would not translate to 3mg/l TN on a maximum monthly average basis.

Exeter will likely have to employ an enhanced nitrogen removal process such as the Bardenpho process to achieve the proposed limit. This process has two anoxic zones and supplemental carbon as necessary to reduce nitrate levels as low as practical, as compared with more basic biological nutrient removal processes such as the Modified Ludzack Ettinger (MLE) process which has only one anoxic zone. EPA's *Municipal Nutrient Removal Technologies Reference Document* (2008) ("EPA Reference Document") references the Bardenpho process as one of the primary alternatives to achieve low nitrogen levels as well as some other combined processes, such as a MLE process followed by a denitrification (denite) filter (pp. 2-57 to 2-60, per 2-77). In the Reference Document, EPA found that the combined processes operating in northern climates achieved maximum monthly TN values of between 4.2 and 4.9 mg/l. EPA referenced no Bardenpho plant employing supplemental carbon in northern climates.

In EPA's Reference Document, seven plants (mostly southern plants) that achieved an annual average TN concentration of less than 3 mg/l were profiled (p. 2-61). The maximum monthly concentrations averaged 1.5 times the annual average values. Based upon this data, a maximum monthly concentration limit of 4.5 mg/l or more would be consistent with an annual average of 3 mg/l for these southern plants.

A 2011 WEF/WERF report (Attachment E) showed the performance of ten Bardenpho plants in Florida achieved a 95 percentile monthly TN value of 3.5 mg/l. It should be noted that Florida plants are expected to perform better than northern plants because of the impact of temperature on biological kinetics. This same study cautioned against using 95 percentile data to confirm that maximum month permit levels can be achieved, since by definition they would be expected to be exceeded 5% of the time or for 3 months in a 5 year permit cycle.

The WEF/WERF study showed that Scituate, MA facility achieved a 95 percentile monthly TN value of 4.22mg/l. This study also concluded that there is a substantial degree of variability that needs to be recognized in establishing permit limits.

Based on the above referenced data, it is inappropriate for EPA to establish a monthly permit limit of 3 mg/l TN. If LOT were applied on a seasonal average basis, we believe a limit of 4 mg/l or greater (depending on the DON concentration) is more consistent with demonstrated LOT performance in northern climates and this would translate to a maximum month concentration of 6 to 8 mg/l.

2. The Proposed Monthly Average TN Limit Should be Changed to a Seasonal Average Limit

As documented in EPA's Reference Document, there is significant temporal variability in the performance of treatment facilities removing nitrogen to low levels. In Exeter's draft permit, EPA rationalizes a monthly concentration limit as incentive to optimize plant operations. There is more than sufficient incentive to optimize monthly operations, however, as that will be the only way the seasonal average is attained. The State of Connecticut, which has led the way with respect to low level nitrogen requirements in New England, imposes annual (12 month rolling average) nitrogen mass limits with no monthly limits and with no concentration limits. Further, the annual mass TN limit translates to a seasonal average TN concentration of greater than 3 mg/l at all the plants in Connecticut. A seasonal (May thru October/6-month rolling average) average total nitrogen mass limit is the more appropriate permit basis that would allow compliance and meet water quality goals.

3. The Proposed Nitrogen Removal Season Should be Changed

EPA's Reference Document addresses the impacts of wastewater temperature on nitrogen removal. Most of the nitrogen removal data cited by EPA came from southern climate plants with wastewater temperatures in the range of 20 degrees Celsius. Temperature has a very significant impact on nitrogen removal efficiency and Exeter's winter/spring time temperatures through April are very cold due to the climate and the magnitude of infiltration/inflow problems. The temperature issue will be explored in more detail in the Facility Planning process. Some neighboring communities have seen winter temperatures below 10 degrees Celsius and as low as 5 degrees Celsius. At temperatures as low as this, achieving a 3 or 4 mg/l TN limit is not practical. For this reason, the TN limit should begin in May and not April. This is consistent with the precedent set in Cranston and Woonsocket, RI based on Narragansett Bay water quality protection. With warmer temperatures there, one would assume that Narragansett Bay has an earlier start to the growing season than Great Bay.

4. The Proposed Mass Limit Restricts the Town's Ability to Expand Sewer Service and Address Non-point Source (NPS) Nitrogen Pollution – the Permit Should Include Provisions to Allow This Flexibility

The proposed mass limit for nitrogen effectively limits future plant flows to the current license flow limit of 3 million gallons per day (mgd). The proposed monthly average basis and inclusion of April of the permit limit severely limits future expansion of the sewer service area to help address non-point source loading reductions because existing maximum month flows to this facility are very near to the permit flow (example April 2010 flow = 2.8 MGD). As EPA knows, non-point sources of nitrogen represent the majority of the watershed nitrogen pollution to the Bay. Part of the solution to the NPS nitrogen might include sewer extensions to some unsewered areas to eliminate the nitrogen load from septic systems. For example, the Town has already had preliminary discussions with the neighboring community of Stratham about the possibility of extending sewers to their commercial strip (which is in close proximity to the Squamscott River). Stratham may desire as much as 0.75 mgd of capacity in Exeter's new treatment plant. While the Bay would most certainly be enhanced by the nitrogen reduction that would occur as a result of extending sewers to parts of Stratham, other neighboring communities and to unsewered parts of Exeter, the EPA's proposed mass limits would effectively prevent this from occurring without going through the onerous anti-degradation review process. As part of the Facility Planning process, the Town envisions exploring expanding the sewer service area. But it can only do so if it does not result in unachievable limits or trigger anti-degradation issues with EPA. We encourage EPA to provide a load offset mechanism for Exeter to receive adjustments in the mass limit as necessary to achieve NPS reductions.

5. The Vague References to Removing Phosphorus in the Draft Permit Should be Deleted

Section I.A.4 of the draft Permit provides as follows: "Existing discharges containing either phosphorus or nitrogen which encourage cultural eutrophication shall be treated to remove phosphorus or nitrogen to ensure attainment and maintenance of water quality." There is no documented scientific basis to impose a phosphorus limit on Exeter's treatment plant. This vague provision in the draft permit does nothing but create confusion regarding EPA's intent. This paragraph should be deleted or clarified.

E. Exeter Will Need An Affordability-based Compliance Schedule

EPA's proposed permit will require that the Town upgrade its treatment facility so that it will be capable of removing nitrogen to very low levels. As part of the facility planning process, the Town's financial capability to undertake such a project will be assessed in detail. Based on preliminary cost estimates developed by DES, the rate impacts of upgrading the plant to 8, 5, and 3mg/l limits are presented in Attachment F. To achieve limits of technology, sewer use rates are predicted to go up by a factor of 3.57 and exceed typical EPA affordability thresholds. This excludes any costs for inflow and infiltration reduction, combined sewer overflow ("CSO") abatement or asset renewal. This also excludes extensive expenditure anticipated for other Town infrastructure systems.

Even if the DES estimates are conservatively high, the Town faces very substantial expenditures in the near term to address environmental infrastructure needs. The Town will need an affordability-based implementation schedule to make the WWTF upgrade project financially viable. To complete a financial capability analysis, the Town will need to discuss and reach an understanding with EPA as to what other regulatory drivers the Town should expect over the next 20 years in areas such as stormwater, water treatment and additional wastewater requirements. The Town will most certainly need EPA input regarding prioritization and extended implementation schedules on all these regulatory-driven infrastructure projects (e.g., CSO abatement and stormwater mandates). The Town also understands that it will be necessary to enter into a compliance order after this Permit is finalized. In that we will not have completed a facility plan at the time we enter such an agreement, the Town requests that the compliance schedule have flexibility to reflect the outcome of the facility planning process.

LIST OF ATTACHMENTS

A. *Proposed Exeter Permit Comments of the Great Bay Municipal Coalition*, submitted on August 9, 2011

B. Selected pages from the *Great Bay Estuary Restoration Compendium* (September 2006), including figures 6 and 7 from that document

C. *An Urgent Call to Action Report of the State-EPA Nutrient Innovations Task Group* (August 2009) (p. 6)

D. Additional 2010 Discharge Data for CT WWTFs

E. *WEF/WERF Cooperative Study of Nutrient Removal Plants: Achievable Technology Performance Statistics for Low Effluent Limits,* Brown and Caldwell (2011)

F. Table entitled *Exeter, NH WWTF Upgrade Sewer User Rate Impacts* and map showing approximate sewered area and comparing Exeter mean household income town-wide and within the CDP area

INCORPORATION BY REFERENCE STATEMENT

Pursuant to 40 C.F.R. §124.13, the Town incorporates by reference the following documents that were provided at the June 9, 2011 public hearing on the Permit, are already presumed to be part of the administrative record, or are otherwise generally available reference material:

1. Draft Permit and Fact Sheet published for comment by EPA on March 25, 2011

2. *Exeter's Public Comments on EPA's Draft Discharge Permit* – PowerPoint presentation presented at the June 9, 2011 public hearing on the Permit

3. *Draft Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Estuary Watershed*, DES December, 2010

4. *Nitrogen Assessment for the Lamprey River Watershed*, New Hampshire Water Resources Research Center, September 7, 2010

5. *Amendment to the New Hampshire 2008 Section 303(d) List Related to Nitrogen and Eelgrass in the Great Bay Estuary*, DES August, 13, 2009

6. *Draft Numeric Nutrient Criteria for the Great Bay Estuary*, DES, June, 2009

7. *Municipal Nutrient Removal Technologies Reference Document* (EPA 2008)

8. *Great Bay Estuary Restoration Compendium* (UNH September 2006)

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August 9, 2011

VIA U.S. FIRST CLASS MAIL & E-MAIL

Stephen S. Perkins
Director, Office of Ecosystem Protection
U.S. Environmental Protection Agency
Region 1
5 Post Office Square
Suite 100
Boston, MA 02109-3912

RE: Request for Public Comment on Proposed Town of Exeter, NH, NPDES Permit No. NH0100871

Dear Mr. Perkins:

The Great Bay Municipal Coalition (the Coalition) is an organization dedicated to the establishment of appropriate and cost-effective restoration measures to protect Great Bay and its resources. The Coalition represents the six major communities whose wastewater flows into various parts of the Great Bay system – Dover, Durham, Exeter, Newmarket, Portsmouth, and Rochester. These communities are directly impacted by the proposed nutrient reduction water quality objectives and requirements for the Town of Exeter. Attached please find comments and objections to the proposed modification of the Town of Exeter, NH, NPDES Permit No. NH0100871. These comments are provided on behalf of the Coalition and on behalf of the Coalition's individual members. Thank you for your consideration of these comments. We look forward to the Region's response.

Sincerely,

John Hall /ANT

John C. Hall

Enclosures
cc: Coalition Members
Ted Diers, DES

Proposed Exeter Permit
Comments of the Great Bay Municipal Coalition

The Great Bay Municipal Coalition (the Coalition) is an organization dedicated to the establishment of appropriate and cost-effective restoration measures to protect Great Bay and its resources. The Coalition members include the towns of Dover, Durham, Exeter, Newmarket, Portsmouth, and Rochester. These communities are directly impacted by the proposed nutrient reduction requirements for the Town of Exeter.

The following provides the comments and objections to the proposed modification of the Exeter, NH, NPDES Permit No. NH0100871. Pursuant to this proposed permit action, EPA is seeking to modify the existing permit to include a 3 mg/l total nitrogen monthly average limitation, asserting that such limitation is necessary to ensure compliance with New Hampshire's narrative water quality standards and abate existing impairments in the Squamscott River. In particular, the Region asserts that attainment of a 0.3 mg/l TN instream objective, in the Squamscott River, is necessary to restore lost eelgrass beds in that waterway. EPA has also stated in various forums that the same criteria and load reduction requirements will be applied to other wastewater discharges throughout the Great Bay watershed. For the reasons stated below, and based on information to be developed in accordance with the Coalition's Memorandum of Agreement (MOA) with New Hampshire's Department of Environmental Services ("DES") (Ex. 1), we object to this permit action as technically and legally flawed and request that the proposed permit modification action be withdrawn.

Preliminary Issues Regarding the Ability to Identify Available Arguments and All Supporting Materials

1. EPA's Failure to Provide Timely Access to Relevant Supporting Documents

The Coalition, through its representatives, has requested that EPA produce, under the Freedom of Information Act ("FOIA"), those agency records that support various claims that EPA has made in the permit Fact Sheet and in its public presentations. (Ex. 2.) This information is critical to the preparation of comprehensive comments on the proposed permit modification. EPA only recently provided that information on July 29, 2011. The completeness and applicability of EPA's response is yet to be determined. Therefore, the Coalition is unable to provide "all available arguments and supporting information" relevant to the proposed permit modification. Upon review of the requested information, the Coalition intends to supplement these preliminary comments if necessary.

2. Ongoing Water Quality Studies and Peer Review of Eelgrass Draft Numeric Criteria

Pursuant to the MOA, ongoing water quality modeling and peer review activities are underway regarding the draft numeric criteria that EPA relied upon in deciding to reopen the permit and in establishing the proposed effluent limits. These studies relate directly to the scientific defensibility of EPA's assertion that a transparency-based 0.3 mg/L TN criteria must be achieved in the Squamscott River, at the point of Exeter's discharge, to allow recovery of eelgrass in this tidal river. In prior correspondence, EPA has acknowledged that such information will be considered after the close of the public comment period. Therefore, when such information is available, the Coalition will submit it to EPA as supplemental comments and information that must be considered in issuing this modified permit as proposed.

3. Assumptions Regarding Causes of Use Impairment are Premature and Unsupported

The MOA between the Coalition and DES recognizes that use impairments exist in the Bay, but the causes of such impairments are still under investigation. EPA, however, presumed that all of the existing impairment designations were properly determined and conclusively related to excess nitrogen levels. It is generally understood that all Section 303(d) impairment designations are based on limited data and relatively little analysis as to cause. That is why during the permitting or TMDL process it is necessary to document and confirm that (1) the impairment designation is fully supported and (2) the cause is independently verified. EPA, however, presumed that such preliminary impairment designations and causes were fully documented by DES, contrary to the MOA which confirms that they are under active review. Moreover, the impairment designations for the Squamscott River (and other tidal rivers) are plainly in error with respect to eelgrass losses and DO impairments. In the Squamscott River and several other tidal rivers, it is acknowledged that the habitat/water quality is not suitable for eelgrass. (*See, e.g.*, Ex. 3, Great Bay Restoration Compendium, September 2006, Figure 6.) DES has verbally informed EPA that it intends to amend the eelgrass/transparency impairment designation for the Squamscott River to reflect those conditions that prevent eelgrass growth in these waters (e.g., elevated turbidity and color). Therefore, EPA's assertions that excessive nitrogen concentration is the reason for eelgrass loss and the key to their restoration in the Squamscott River or where this river enters the Bay are misplaced.

In addition, various reports, discussed herein, confirmed that periodic low DO conditions in the Squamscott and Lamprey Rivers were <u>not</u> associated with excessive algal growth. Therefore, regulating TN would not eliminate low DO in these waters as originally thought by DES. EPA's reliance on the impairment listings and preliminary causes previously identified by DES is without legal or technical basis. Under federal and state laws, EPA needs to justify this permit action, if it can, based on a site-specific demonstration that nutrients are causing the claimed impairments in the water body of concern and not on generalized information or preliminary impairment designations that have subsequently been shown to be misplaced following more detailed assessments. Such site-specific analysis must be presented to the public for review <u>before</u> any further action on this permit may occur.

Procedural Issues and Objections

1. The proposed permit action is premised on the conclusion that the underlying technical basis of DES's proposed draft numeric criteria used to justify the TN limits has been fully peer reviewed and is scientifically defensible. (*See* June 29, 2010, letter from EPA (Perkins) to DES (Stewart).) This is a requirement of 40 C.F.R. § 131.11.[1] These

[1] 40 C.F.R. § 131.11(a) states that "[s]uch criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use." 40 C.F.R. § 131.11(b) provides that "[i]n establishing criteria, States should: (1) Establish numerical values based on: (i) 304(a) Guidance; or (ii) 304(a) Guidance modified to reflect site-specific conditions; or (iii) Other scientifically defensible methods."

conclusions are in error from several perspectives. First, the Coalition and the impacted communities were excluded from the Regional Office peer review of the draft state numeric nutrient criteria. This violated the Act's public participation mandate (*see, e.g.*, CWA Sections 101(e) and 304(a); *see also* OMB Peer Review Bulletin, 70 Fed. Reg. 2664, 2668 (January 14, 2005) ("[m]ore rigorous peer review is necessary for information that is based on ***novel methods*** or presents complex challenges for interpretation. Furthermore, the need for rigorous peer review is greater when the information contains ***precedent-setting*** methods or models, presents conclusions that are likely to ***change prevailing practices***, or is likely to affect ***policy decisions*** that have a significant impact.") (emphasis added)).[2] The Coalition submitted relevant comments on the technical deficiencies in the DES numeric nutrient objectives to EPA and the deficiencies in the peer review charge questions which were not designed to elicit a probing review on the more obvious technical problems with the draft numeric criteria. In particular, these comments noted that the draft numeric criteria lacked documentation of basic cause and effect relationships and, therefore, cannot be "scientifically sound" as required by 40 C.F.R. § 131.11. (*See* Ex. 4, correspondence on the peer review.) However, these comments and the supporting assessments were never provided to the Region's chosen peer reviewers and, consequently, were never addressed by the two peer reviewers. (*See* EPA Peer Review Handbook, 3rd Ed., EPA/100/B-06/002, May 2006 ("If you obtain stakeholder input, include interested parties to the extent feasible based upon statutory, regulatory, budgetary and/or time constraints. Do not limit input to one stakeholder or one side of a controversial issue (e.g., a responsible party or environmental group).").) Therefore, the proposed permit's reliance on that peer review effort is inappropriate, as due process rights were violated and major technical issues were ignored by the peer reviewers. Excluding public participation on this critical review, EPA also violated mandatory duties under the Act. (*See CWA §§* 101(e) and 304 (a).)

Second, the peer review concluded that there was no certainty that the proposed nitrogen criteria would actually result in restoration of the use impairments as claimed in the draft numeric criteria document. (*See* May 29, 2010, comments of Walter Boynton.) This is also consistent with the findings and conclusions of the MOA. Therefore, the peer review (and MOA) confirms that the proposed nutrient criteria are not sufficient to meet Clean Water Act objectives. (*See American Iron & Steel Inst. v. EPA*, 115 F.3d 979, 990 (D.C. Cir. 1997) ("We have already mentioned that permits must incorporate discharge limitations necessary to ensure that the water quality standards are met. This requirement applies to *narrative criteria as well as to criteria specifying maximum amounts of particular pollutants.*") (emphasis added).) Thus, the Region's reliance on the peer review results is arbitrary and capricious and otherwise not in accordance with the Act. (*See* 40 C.F.R. § 122.44(d)(1)(vi) (A) (requiring a narrative standard based effluent limitation to "fully protect the designated use").) By EPA's own expert's admission, the

[2] Given the Region's stated intentions of employing these instream criteria throughout New Hampshire and the Great Bay watershed, EPA's permit modification is akin to criteria development, a process that must include the opportunity for public comment. CWA § 304(a)(3) ("Such criteria and information *and revisions thereof, shall be issued to the states and shall be published in the Federal Register and otherwise made available to the public.*") (emphasis added).

instream TN standard chosen for the Squamscott River will not protect the designated use.

We request that the issues raised in the correspondence to the peer reviewers be addressed in this permit action. Moreover, in accordance with applicable water quality criteria public participation provisions, we request that the public be given an opportunity to present information to this peer review panel before such draft criteria are considered acceptable for use in NPDES actions.

2. EPA's proposed actions are inconsistent with the current position of DES regarding the reliability and use of the draft numeric criteria/narrative criteria interpretation, as documented by the MOA. (Ex. 1.) The MOA concurs that the impact of nitrogen on eelgrass losses, via transparency, is uncertain and requires further peer review assessment. (*See* MOA Coalition Provision V and Whereas provisions.) Due to these uncertainties, DES, the document author, has stated that the draft criteria should not be used for NPDES derivation purposes until the subsequent peer review confirms that the criteria are necessary and appropriate. (MOA Provision Mutual Agreement II and III.) EPA's proposed permit is using the draft criteria in a manner inconsistent with the directives and intent of the state. This is prohibited under 40 C.F.R. § 122.44(d) when translating a state's narrative criteria. (*See Clarifications Regarding Certain Aspects of EPA's Surface Water Toxics Control Regulations*, USEPA, August 14, 1992, Response @ 4 (stating that permit writers are required to use formally-adopted state policies in interpreting narrative standards); *Kentucky Waterways Alliance v. Johnson*, 540 F.3d 493, 469 n.1 (6th Cir. 2008) ("In interpreting a state's water quality standard, ambiguities must be resolved by 'consulting with the state and relying on authorized state interpretations."); *Marathon Oil Co. v. Environmental Protection Agency*, 830 F.2d 1346, 1351-1352 (5th Cir. 1987) (EPA is merely an "interested observer" as to how a state interprets its WQS provisions); *American Paper Inst. v. EPA*, 996 F.2d 346, 351 (D.C. Cir. 1993) ("Of course, that does not mean that the language of a narrative criterion does not cabin the *permit writer's* authority at all; rather, *it is an acknowledgement that the writer will have to engage in some kind of interpretation to determine what chemical-specific numeric criteria--and thus what effluent limitations--are most consistent with the state's intent as evinced in its generic standard.*") (emphasis added).) Moreover, the applicable federal regulations do not allow EPA to take a draft, yet to be published for adoption, criteria and apply that draft value as if it were the adopted standard. DES has explicitly acknowledged that it needs to propose the draft criteria for adoption and has not yet done so in light of the admitted technical uncertainties (DES Agreement II-Ex.1; *see also* 40 C.F.R. § 131.20). EPA's actions run roughshod over the state's proposed approach and use the draft criteria in a manner expressly inconsistent with state guidance/policy on the use/interpretation of this narrative criteria interpretation. EPA's action plainly violates 40 C.F.R. § 122.44(d)(1)(vi)(A) as well as the public comment and notice provisions included in 40 C.F.R. § 131 (*see* Comment No. 3, below) applicable to the adoption of narrative criteria interpretations of general/regional applicability.

3. EPA is applying an unadopted and unproposed numeric nutrient value to derive the permit limitations and conclude that limits of technology requirements should be applied

to all point sources in this basin. There is nothing site-specific or waterbody specific with regard to the methods EPA employed to conclude that a 0.3 mg/l TN numeric criteria must be achieved. EPA has verbally indicated that this same standard will be used as the basis for revising permits for all of the major municipal facilities tributary to Great Bay. Thus, it is apparent that EPA is *de facto* adopting the draft criteria as the applicable numeric standard for the Great Bay region, without undertaking the formal adoption process required by state and federal law. Specifically, the CWA and implementing statutes mandate that state water quality standards (WQS), including new narrative criteria interpretation approaches, undergo a public review and adoption process BEFORE being used in the regulatory process pursuant to EPA's "Alaska rule."[3] This also applies to new narrative translator procedures. (*See* Ex. 6, United States Environmental Protection Agency Determination on Referral Regarding Florida Administrative Code Chapter 62-303, Identification of Impaired Surface Waters, July 6, 2005, EPA Florida Determination at 9 ("Provisions that affect attainment decisions made by the State and that define, change, or establish the level of protection to be applied in those attainment decisions, affect existing standards implemented under section 303(c) of the Act. These provisions constitute new or revised water quality standards.").[4] Failure of the state and EPA to undertake this process has violated federal law, state law, and the due process rights of the communities and individuals affected by the proposed numeric nutrient criteria. The communities must be afforded the opportunity to submit comments within the designated standard adoption process and appeal, if appropriate, this rule adoption action.

4. State authority over water quality standard decision-making must be respected by EPA pursuant to applicable federal rules. (33 U.S.C. §1313, *et seq.*[5]) EPA is supposed to

[3] Criteria, regardless, of whether they are narrative or numeric, must be vetted through a thorough public notice and comment process. 40 C.F.R. § 131.13; 40 C.F.R. § 131.20(a), (b), and (c).

[4] *See also* EPA's "Alaska Rule" governing adoption and modification of state water quality standards – 40 C.F.R. § 131.21, 65 Fed. Reg. 24641, 24647 (April 27, 2000) ("During the adoption of the detailed procedures, all stakeholders and EPA have an opportunity to make sure that important technical issues or concerns are adequately addressed in the procedures. *** This approach is particularly useful for criteria which are heavily influenced by site-specific factors such as nutrient criteria or sediment guidelines. Such procedures must include a public participation step to provide all stake-holders and the public an opportunity to review the data and calculations supporting the site-specific application of the implementation procedures."); U.S. Environmental Protection Agency, Water Quality Standards Handbook, Second Edition, EPA 823-9-94-005a (August 1994), available at http://water.epa.gov/scitech/swguidance/standards/handbook/index.cf, at 3-22 ("Where a State elects to supplement its narrative criterion with an accompanying implementing procedure, it *must formally* adopt such a procedure as a part of its water quality standards. The procedure *must* be used by the State to calculate derived numeric criteria that will be used as the basis for all standards' purposes, including the following: *developing TMDLs*, WLAs, and limits in NPDES permits . . . .") (emphasis added); *id.* at 3-22 ("To be consistent with the requirements of the Act, the State's procedures to be applied to the narrative criterion *must* be submitted to EPA for review and approval, and will become a part of the State's water quality standards. (*See* 40 C.F.R. § 131.21 for further discussion.)") (emphasis added); *id.* at 3-24 ("Where a State plans to adopt a procedure to be applied to the narrative criterion, it *must* provide full opportunity for public participation in the development and adoption of the procedure as part of the State's water quality standards.") (emphasis added).

[5] EPA's ability to promulgate new or revised standards is extremely limited. 33 U.S.C. §§ 303(a)(2), (b)(1), and (c)(4); 40 C.F.R. §§ 131.21 and 131.22.

implement the state's interpretation of its narrative criteria application (*see* Comment No. 2, above). EPA proposed permit action presumes that the draft numeric standards for Great Bay constitute the state's adopted narrative criteria interpretation of necessary water quality objectives to protect designated uses. However, under the MOA, issued after the publication of the draft criteria, the state has indicated that these values should not be used in a permitting context, until additional scientific evaluation occurs. (*See* MOA Mutual Provisions II and III.) Moreover, DES has determined that the DO based nutrient objectives are the concern in the tidal rivers, not the transparency based objectives. (*See generally* MOA.) Thus, assuming the underlying technical basis for transparency-based TN criteria was adequate, EPA has failed to properly apply relevant draft numeric value consistent with the state's intended use of those criteria. Application of the draft DO-based objective, if justified, would produce a significantly different effluent limit requirement. Because EPA's narrative criteria interpretation authority is subject to these state decisions, the permit has been improperly modified and must be withdrawn.

5. EPA's reliance on nutrient objectives adopted for other estuaries in the country as the basis for determining the numeric criteria for Great Bay is not allowable under either 40 C.F.R. §§ 131 or 122.44(d). Nowhere in the Act, or in its implementing regulations, is EPA authorized to conclude that the actions of other states may be used to govern or justify a narrative criteria interpretation in a different state, excepting where the actions of one state adversely affect standards compliance in another state (*see* 40 C.F.R. § 122.4(d)). The specific physiological characteristics of a state and of the water body types in that state must be fully considered to establish the specific nutrient values necessary to protect those waters from the adverse impacts of cultural eutrophication. SAB's *Review of Empirical Approaches for Nutrient Criteria Derivation*, April 27, 2010, at 38 ("Numeric nutrient criteria developed and implemented without consideration of system specific conditions (e.g., from a classification based on site types) can lead to management actions that may have negative social and economic and unintended environmental consequences without additional environmental protection.").[6] EPA's approach for the Squamscott River ignored the pertinent site-specific characteristics, contrary to published EPA guidance on nutrient criteria derivation and the recommendations of EPA's Science Advisory Board. Such actions are "per se" arbitrary and capricious. (*See Texas Oil & Gas Ass'n v. United States EPA*, 161 F.3d 923, 935 (5th Cir. 1998) ("When an agency adopts a regulation based on a study [that is] not designed for the purpose and is limited or criticized by its authors on points essential to the use sought to be made of it the administrative action is arbitrary and capricious and a clear error in judgment.") (*quoting Humana of Aurora, Inc. v. Heckler*, 753 F.2d 1579, 1583 (10th Cir. 1985), *cert. denied*, 474 U.S. 863 (1985)); *see, e.g., Pac. Coast Fed'n of Fishermen's Ass'ns, Inc. v. Nat'l Marine Fisheries Serv.*, 265 F.3d 1028, 1037-38 (9th Cir.

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[6]Available at http://yosemite.epa.gov/sab/sabproduct.nsf/0/E09317EC14CB3F2B85257713004BED5F/$File/EPA-SAB-10-006-unsigned.pdf; *see also Nutrient Criteria Technical Guidance Manual – Rivers and Streams*, USEPA, July 2000, at 13 ("Initial criteria should be verified and calibrated by comparing criteria in the system of study to nutrients, chl *a* and turbidity values in water bodies of known condition to ensure that the system of interest operates as expected.").

2001) (agency acted arbitrarily and capriciously by ignoring its own expert advice where no contrary recommendations existed in the record).) The failure to consider the relevant physical, chemical, and biological differences between the Squamscott River and the other state criteria renders EPA's analysis fatally flawed and nothing more than speculation.

6. EPA's failure to consider site-specific factors before concluding that the Exeter facility contributes to transparency-based eelgrass restoration criteria violations "at the point of discharge" (Fact Sheet @ 3) is another serious deficiency in the Region's justification for imposition of stringent TN limitations. Nothing in the record shows that TN is controlling transparency levels at the point of discharge, or that the relative importance of factors influencing transparency in the Bay are the same in the Squamscott River at the point of Exeter's discharge. As noted earlier, there are several expert technical reports that show eelgrass restoration is not possible in the Squamscott and Lamprey Rivers due to habitat and other factors. Moreover, information presented by the Coalition at the public hearing confirmed TN levels were not controlling transparency in the Squamscott River. Thus, EPA's assumption that a 0.3 mg/l TN objective in Squamscott River is required to meet state narrative criteria objectives is not scientifically defensible.

7. EPA's proposed permit modification regarding the need for stringent TN limitations at the Exeter facility is not based on the latest available scientific information. Moreover, as explained below, EPA's Fact Sheet analysis is based on a gross oversimplification and misapplication of the available information. In short, the proposed effluent limitations are not scientifically defensible and have not been demonstrated necessary to achieve applicable standards to protect the designated uses, contrary to Section 301(b)(1)(C) of the Act. Specifically, the fundamental "cause and effect" connections are missing from EPA's analyses, in particular with respect to addressing eelgrass losses and low DO in the estuary arms.[7] Nowhere in the record, or in EPA's Fact Sheet discussion, is the public presented with a scintilla of evidence that (1) eelgrass were present in the Squamscott River in the vicinity of Exeter's discharge, (2) changes in transparency or nutrient levels likely caused the eelgrass losses in this tidal river, or (3) that controlling nutrients will significantly improve transparency in this tidal river. Other DES documents (e.g., Great Bay Nitrogen Loading Analysis @ 10) confirm tidal river eelgrass losses have occurred even where waters are not considered nitrogen impaired (e.g. Winnicut River). EPA's Science Advisory Board has admonished the Agency for presuming rather than demonstrating that cause and effect exists when it is developing nutrient criteria. SAB's *Review of Empirical Approaches for Nutrient Criteria Derivation*, April 27, 2010, at 6 ("Without a mechanistic understanding and a clear causative link between nutrient levels and impairment, there is no assurance that managing for particular nutrient levels will lead to the desired outcome."); *id.* at 38 ("Large uncertainties in the stressor-response

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[7] It is a general principle of the Clean Water Act, or any environmental statute for that matter, that pollutants be regulated if and only if they are causing harm or impairment. In generating numeric water quality criteria, EPA must abide by the same principle. CWA §§ 303(c)(2)(A) and 304(a); 40 C.F.R. § 131.3(b); *Leather Indus. of Am. v. EPA*, 40 F.3d 392, 401 (D.C. Cir. 1994) ("EPA's mandate to establish standards 'adequate to protect public health and the environment from any reasonably anticipated adverse effects of each pollutant,' does not give the EPA blanket one-way ratchet authority to tighten standards.").

relationship and the fact that causation is neither directly addressed nor documented indicate that the stressor-response approach using empirical data cannot be used in isolation to develop technically defensible water quality criteria that will protect against environmental degradation by nutrients."). As discussed in Comment No. 5, narrative criteria implementation requires site-specific data showing that the pollutant of concern is the cause of the use impairment. There are no such data for the Squamscott River and, to the degree the issues have been analyzed by local experts, those analyses have confirmed that nitrogen is *not* the cause of the impairments EPA is intending to address. (*See, e.g.*, Jones et al., *Impacts of Wastewater Treatment Facilities on Receiving Water Quality* (April 2007) (New Hampshire Estuary Project Report).) Thus, EPA has failed to properly interpret the state's narrative standard and failed to demonstrate, with credible site-specific information, that nutrients are the cause of alleged eelgrass losses in the Squamscott River.

8. EPA's decision to reopen the permit based on a previously submitted comment by the Conservation Law Foundations ("CLF"), claiming without site-specific data that the Exeter facility is causing impairments related to DO and chlorophyll *a*, was inappropriate and unjustified. This is especially true, given the state's previous conclusions that (1) water quality modeling was required to properly assess the factors influencing the DO concerns in the estuary arms, (2) the effect, if any, of TN to the impairments was uncertain, and (3) that a further evaluation of the effect of nitrogen on eelgrass losses was needed in light of information presented by the Coalition. CLF's comments did not raise "substantial new questions" as claimed by the Region. The new "impacts" claimed to exist are the same impacts that were observed in 2007, when the various reports prepared by Piscataqua River Estuary Project (PREP) were available as part of the permit record at that time. Consequently, the legal standard for reopening the permit has not been met, and EPA acted arbitrarily and without substantial evidence in reopening this permit.

9. EPA's interpretation of CWA § 301(b)(1)(C), which lead to the decision to reopen the permit, is in error. This provision of the Act does not mandate that a facility receive effluent limitations that ensure it does not "cause or contribute to" a WQS exceedance, it only requires that limitations be imposed as "necessary to [a]chieve water quality standards established under Section 303 of the CWA." (40 C.F.R. § 122.44(d)(1).) Federal rules only prohibit "causing or contributing" where new facilities are being permitted, not existing facilities. Compare 40 C.F.R. § 122.4(i) with § 122.44(d).[8] Since this rationale was presented as the legal basis for reopening the permit (Fact Sheet @ 2), the permit should be withdrawn. Moreover, nowhere in the Fact Sheet does EPA demonstrate that a 3 mg/l monthly maximum limitation, as opposed to a less stringent limitation, is "necessary to achieve water quality standard" compliance in the Squamscott River, as required by the Act and implementing regulations (e.g., 40 C.F.R. §

[8] New sources of dischargers are prohibited from causing or contributing to a violation of water quality standards. 40 C.F.R. § 122.4(i) ("No permit may be issued: ... (i) to a new source or a new discharger, if the discharge from its construction or operation will cause or contribute to the violation of water quality standards."). Whereas, the trigger for existing sources is when a permitting authority determines that a specific discharger's effluent is at a level which is causing or contributing to pollutants. 40 C.F.R. § 122.44(d)(1)(i) (A WQBEL analysis occurs when a discharger's effluent "[is] or may be discharged at a level which will cause, or have the reasonable potential to cause, or contribute to an excursion above any State water quality standard.").

122.44(d)(1)). EPA seeks to rely on a draft document prepared by DES which analyzed several possible permitting scenarios, depending upon which yet unadopted, numeric nutrient criteria is used as the basis for analysis. The draft DES report is nothing more than a straw man and does not provide a technical basis for concluding a specific set of limitations must be incorporated into Exeter's permit. The very language of the report discloses that no decision regarding the proper instream criteria or plant effluent limits was being established: "If the WWTPs receive permits that limit effluent nitrogen concentrations to protect eelgrass in downstream locations, non-point sources would have to be reduced by --- percent." (Great Bay Nitrogen Loading Analysis - Draft Report @ 12, discussing the Exeter Subestuary.) Moreover, the analysis specifically assessed annual and multi-year average load reductions, not monthly maximum conditions as interpreted by the Region. Thus, to the degree EPA relied on this report as the basis for imposing limitations, EPA misapplied the results.

10. EPA is reinterpreting its rules to mandate "limits of technology" ("LOT") requirements for any facility that contributes a pollutant of concern to impaired waters, which is an illegal modification of applicable federal rules and is inconsistent with the framework of the Act. Nowhere does the Act provide authority for mandating a technology-based limitation simply because waters are found to be impaired and an existing discharge contributes some amount of a pollutant to those waters.[9] The Supreme Court in *Arkansas v. Oklahoma* indicated that the water quality management planning provisions of the Act (i.e., Section 303(d) TDML process) is the vehicle for resolving the establishment of limitations necessary to achieve applicable water quality standards.[10] There are thousands of nutrient impaired waters throughout the country, and EPA has never issued a rule or statutory interpretation that required imposition of LOT where a water body is impaired in advance of TMDL development. The Region, via the NPDES process, is not authorized to establish, adopt, or amend rules of general applicability or to set technology-based limits for POTWs. If this were a federal requirement, the entire drainage basin for the Mississippi River would be subject to this mandate due to nutrient impacts on the Gulf of Mexico. Thus, EPA's regulation of Exeter is in conflict with EPA's historical application of the Act and implementing regulations, as well as prior permitting decisions in this Region (e.g., Attleboro decision). This is unfair and inequitable treatment of similarly situated facilities which violates due process, equal protection, and is fundamentally unfair.

[9] The only technology-based limitation applicable to POTWs is the secondary treatment rule, which does not apply to nutrients. *See generally Maier v. EPA*, 114 F.3d 1032 (10th Cir. 1997); *Natural Resources Defense Council, Inc. v. EPA*, 790 F.2d 289 (3d Cir. 1986); 40 Fed. Reg. 34522, 34522 (Aug. 15, 1975) ("[s]econdary treatment processes were developed to biologically remove degradable organic materials from wastewater. The term 'secondary treatment' eventually became synonymous with the biological treatment of wastewater *for the removal of carbonaceous organic material.*")

[10] *Arkansas v. Oklahoma*, 503 U.S. 91, 108 (U.S. 1992) ("The [CWA] does, however, contain provisions designed to remedy existing water quality violations and to allocate the burden of reducing undesirable discharges between existing sources and new sources. *See, e.g.*, § 1313(d).").

Scientific Issues and Objections

11. The Agency's permitting analysis relies heavily on prior DES decisions regarding impairments occurring in the system, the causes of such impairments, and as of yet unadopted criteria derived to address the causes of impairment. (Fact Sheet @ 10-19.) The Great Bay communities have met with DES to review the prior technical conclusions related to the impairments and have presented information showing that those decisions were seriously flawed (discussed in greater detail below). As discussed in the Coalition's public hearing comments (incorporated by reference herein), the Bay is not suffering from insufficient transparency due to excessive plant growth, and the periodic low DO levels in the tidal rivers do not appear to be a function of the algal growth in those areas. There is no analysis anywhere in the record showing (1) transparency has decreased during the period of eelgrass decline, (2) existing transparency in Great Bay is insufficient given the tidal variation in the system, or (3) nitrogen has triggered excessive plant growth lowering ambient transparency levels. Absent such information, there can be no conclusion that transparency is a cause of eelgrass decline, as presumed in EPA's assessment. Analyses prepared by the Coalition's consultants (Ex. 5) confirm that (1) transparency in the Bay was not materially impacted by increased algal growth during the period of significant eelgrass decline and that (2) controlling nitrogen cannot ensure attainment of the transparency objectives underlying the 0.3 mg/l TN water quality objective used as the basis for this permit modification. These are fundamental deficiencies in the scientific basis for this proposed permit action. EPA recently attended a meeting with DES and the Coalition where Prof. Fred Short, the primary eelgrass expert relied upon by EPA, confirmed that transparency and epiphyte growth are not major factors limiting eelgrass growth in these waters as originally presumed. Thus, continued reliance on prior studies by this author to reach an opposite conclusion would be inappropriate.

12. The Fact Sheet assertion that "large diurnal swings are another indicator of eutrophication for the Squamscott River" is misplaced. The analysis of the diurnal data shows that it is caused by tidal variation and only a very minor component is attributable to the algal growth present in the tidal river. (Ex. 7, Diurnal DO Variation Analysis for Squamscott River developed by DES.) On average, the total algal induced variation is less than 1 mg/l (i.e., less than 10% variation in DO saturation). The total impact on minimum DO from algal growth is estimated at less than 0.4 mg/l – a negligible amount that cannot be significantly reduced. More detailed studies of the Squamscott River confirmed that low DO conditions were not apparently related to algal growth (Jones et al., *Impacts of Wastewater Treatment Facilities on Receiving Water Quality* (April 2007) (NH Estuary Project Report) @ 3: "The nutrient and chlorophyll a levels at the different sampling sites in the Squamscott River did not appear to have an discernable relationship to DO levels."). Likewise, analysis of data for the Lamprey River showed that low DO's occurred where low algal growth existed due to the system hydrodynamics and stratification. (*See* Pennock (2005), cited in *Numeric Nutrient Criteria for Great Bay – draft* (NHDES 2009) at 51 (hereafter 2009 DES Report)). None of the river specific data indicated a significant relationship between minimum DO and algal growth, confirming that (1) preliminary impairment causes of low DO were not well supported, and (2) the

system wide analysis used by DES to generate the DO-based TN numeric criteria provided misleading results.

DES's consideration of this information is what led the parties to conclude that a water quality model was required to properly assess the components affecting the DO regime and the remedial measure appropriate for improving the DO condition (assuming it is not otherwise natural). Therefore, EPA's reliance on the DES assumption that algal growth is the key factor influencing this DO condition is premature at best, if not demonstrably incorrect.

13. The Bay does have a macroalgae problem due to invasive species as confirmed by several UNH researchers. However, the degree of nitrogen control necessary to address that issue is not known. The 2009 DES Report indicated that possible Great Bay TN objectives to address this area of concern might range from 0.34 - 0.38 mg/l TN. DES estimates that somewhere between a 10-20% TN reduction may be needed to reduce the growth of such species. (2009 DES Report.) This level of reduction would reflect TN levels in the mid-to-late 1990s when macroalgae growth was minimal. It is reasonable that a mid-range reduction of 15% TN would be used as a starting point, given the uncertainties with this endpoint and the lack of understanding regarding the ability to control the invasive species. This level of reduction would not require point sources to achieve TN limits less than 8 mg/l which will ensure municipal loads are well below pre-1990 levels when macroalgae growth was minor. Thus, there is no basis for EPA to conclude that a 3 mg/l TN level is necessary to protect the Bay or the tidal rivers from cultural eutrophication.

Moreover, EPA is recommending regulation of the wrong form of nitrogen. The invasive species and macroalgae are stimulated by excess inorganic nitrogen; therefore, the form of nitrogen to control would not be total nitrogen, which contains a substantial organic N component not available for plant growth. Given the system dynamics and relatively short detention time (18 days – Fact Sheet @ 4), there is no reason to believe that organic nitrogen cycling plays any role in stimulating plant growth in this system, and no analysis shows that it is a significant factor influencing plant growth in this system. If nitrogen control is necessary to address excessive plant growth (via macroalgae), then only inorganic nitrogen forms need to be regulated. Likewise, there is no information showing that TN versus TIN would be the appropriate parameter to regulate in the tidal rivers (assuming it is the pollutant controlling algal growth – another undocumented assumption). Those waters have even shorter detention time (2-3 days possibly) than the Bay, and only the readily available nutrient forms could pose an issue in these areas.

14. EPA's beliefs that transparency is controlling eelgrass growth in Great Bay and that increased nitrogen is the cause of reduced transparency are misplaced (as also recently clarified by Professor Short). For nitrogen to affect transparency, it must cause increased and excessive chlorophyll *a* levels. (EPA Fact Sheet @ 7.) The historical data evaluations presented for Great Bay confirm that average algal growth increases have been slight and therefore could not have been the underlying cause of eelgrass decline occurring throughout the system. The PREP Environmental Indicators Report - 2009

shows that from 1993-2000 chlorophyll *a* levels did not increase and averaged about 2.5 ug/l. (See 2009 PREP Report, Figure NUT3-5.) This was also confirmed by time series analysis of the data (Ex. 8). Therefore, algal growth induced transparency decreased and could not have played any role in eelgrass declines during this period, as EPA has assumed. This same PREP Report figure shows that algal levels increased by about 1 ug/l from 2001-2008. These are very low levels of primary productivity and minor changes in average system productivity that produced trivial changes in light penetration. Such algal growth in the Bay was demonstrated by Morrison to be a minor component affecting transparency. (*See* 2009 DES Report @ 61; Ex. 9.) EPA's peer review also noted that the Great Bay did not exhibit substantial algal growth and that, therefore, limited transparency benefits could be obtained by attempting to reduce algal growth in the Bay.

The various references to the 2003 and 2006 PREP reports cited by EPA confirm that even though nitrogen levels have "increased by 59% in the past 25 years. Negative effects of excessive nitrogen, such as algal blooms and low dissolved oxygen levels, are not evident." (Fact Sheet @ 12.) Thus, the ability of nitrogen to affect transparency through algal growth in this system, at this time, is not very significant. It is not apparent how EPA could conclude that a limit of technology approach for nitrogen is necessary to restore eelgrass populations by improving transparency, given these regulatory findings and the relevant sampling data. HydroQual's analysis of transparency impact (Ex. 10), dated January 2011, confirms that attaining the proposed TN standard will only change ambient transparency by about 5% and cannot possibly ensure that the intended level of transparency will be achieved in the Bay. Thus, the proposed TN criteria for ensuring transparency goals will be met is neither necessary nor appropriate.

Regarding DO in the tidal rivers, it should be noted that the more recent assessments indicate that low DO conditions are occurring less frequently from 2005-2008 than occurred earlier in the decade. (*See* 2009 PREP Estuaries Report NUT 5-1 to 5-5.) Thus, the DO data demonstrate that there is not a direct connection between low DO and TN levels as the *higher* TN levels and loadings have produced the *better* DO conditions. Clearly, EPA's misplaced generalizations regarding trend data and the influence of TN on transparency and DO conditions in the estuary do not provide a scientifically defensible basis for reopening the Exeter permit to impose stringent TN limitations as the "cure" for the alleged transparency and DO impairments.

15. Conclusions regarding the increase of systemwide TN loadings in the past 5 years (2002 versus 2008) are misleading and inappropriate. (Fact Sheet @ 12.) First, the change in TN level is due to an evaluation comparing loads between drought years and extreme wet weather years. This change in rainfall fully accounts for the difference in loading and does not indicate a system subject to runaway growth inducing higher TN levels. Data on WWTP flows indicate that municipal loadings have been relatively constant for the past 15 years. (Ex. 11, Trend Analysis of Municipal Flows During Dry Weather Years.) Thus, the change in conditions is not due to significant increases in point source contributions but rather changes in precipitation and land use practices. This indicates that only a moderate reduction in point source contribution is necessary to ensure reduced

nitrogen levels to the Bay to reflect mid-to-late 1990s conditions when eelgrass health was excellent. Likewise, EPA's conclusion that point sources account for over 30% of the TN loadings to the Bay is misplaced. (EPA Public Hearing Observation.) DES recalculated the point source load inputs, accounting for system hydrodynamics. The point source contribution is currently about 16%. (*See* Ex. 1, MOA attachment Table II.) Given this small percentage of TN loading, forcing communities to "limits of technology" would not result in any meaningful changes in comparison to less restrictive limitations (e.g., 8 mg/l TN). As EPA's load reduction analysis was premised on a belief that point source loads were a far greater percentage of TN loads, the analysis must be reconsidered. An 8 mg/l TN limit would produce approximately a 70% reduction in current point source TIN levels and result in water quality reflecting acceptable mid-to-late 1990s conditions for this parameter when the system was considered "healthy."

16. EPA's assertion that the greatest loss in eelgrass has occurred in the upper portion of the estuary where TN levels are highest is incorrect. (Fact Sheet @ 13.) This statement was intended to confirm that reducing TN levels would lead to improved eelgrass populations. Data from the Piscataqua River developed by Prof. Fred Short (an eelgrass expert for Great Bay), show that eelgrass losses are equally high where lower TN levels occur and water quality is otherwise excellent. (*See* Figure HAB12-1, PREP 2009 Report; Ex. 5, HydroQual, Figure 12). Figure 6 presented in the Fact Sheet also documents that EPA's position is in error, showing 100% eelgrass loss in the upper and lower Piscataqua River where the transparency is excellent and TN concentrations meet the 0.3 mg/l TN objective assumed applicable in this action. The cause of this dramatic eelgrass decline is unknown. The undisputable fact that eelgrass declined in areas with both elevated and low TN concentrations means that it cannot be presumed that lowering TN levels will result in eelgrass restoration in the tidal rivers or the Bay. (Compare EPA Fact Sheet Figures 6/7 with Figure 5.) Likewise, as discussed earlier, lower DO occurs in the tidal rivers, but the occurrence of such conditions is not a function of chlorophyll *a* or TN levels, even though the highest TN levels occur in these areas. It should be noted that virtually EVERY water quality pollutant indicator is higher in the tributaries than in the Bay or Piscataqua River where greater dilution exists. This coincidence does not prove that a particular pollutant caused the impairment of concern and is little more than generalized speculation. The Lamprey River, with the lowest chlorophyll *a* levels, has the *poorest* DO compliance due to system hydrodynamics. (*See* Ex. 12; Pennock (2005).) Thus, EPA's broad brush analysis asserting TN and chlorophyll *a* are the causes of all system impairments is simply not scientifically defensible and is demonstrably incorrect.

17. Data on chlorophyll *a* levels and secchi depth, not originally considered by DES when issuing the 2009 draft numeric criteria document, confirms that transparency did not materially change in Great Bay during the period of eelgrass reduction and that chlorophyll *a* increases are not associated with eelgrass decline. (*See* Ex. 8.) This data confirms that transparency was not a causative agent in the eelgrass decline of the 1990s and that, in fact, transparency appears better today than during the mid-1990s. Moreover, the data further support the conclusion that transparency (as measured by secchi depth) is not materially impacted by the chlorophyll *a* level in this system, as Morrison had also determined. Comparing EPA's Figure 5-Gradient of Light Attenuation with Figure 4-

Gradient of Chlorophyll *a* confirms that median transparency has little to do with algal growth; therefore, controlling TN levels to control algal growth will have no material impact on water column transparency. The data cited by the Region in support of the permit action show that TN control will not achieve its intended purpose. The Upper Piscataqua has a lower transparency level than Great Bay, but also lower chlorophyll *a* levels, verifying that other factors are controlling transparency in this system. In fact, the difference in median chlorophyll *a* in all of these areas is negligible (1-3 ug/l). This difference in chlorophyll *a* could not physically account for the wide range of light attenuation occurring in the various areas (0.5-2.3 Kd m-1). Thus, the Region's assumption that reducing TN will produce significant improvement in water column transparency is not supported by the information presented in the Fact Sheet.

Finally, the DES analyses relied upon by EPA provide no demonstration that eelgrass losses in the Bay are, in fact, correlated to reduced transparency. If they were, eelgrass losses from the deeper Bay waters would be the most prevalent – they are not. (*See* Ex. 13, Figure 5, presentation of Fred Short, entitled Impediments to Eelgrass Restoration.) Recently, Professor Fred Short has acknowledged that the large tidal fluctuation in Great Bay allows the eelgrass to receive sufficient light and therefore transparency is not likely a controlling factor in this area. (Personal discussion T. Gallagher and F. Short at Southeast Watershed Alliance Symposium and statements at Coalition/DES meeting of July 29, 2011.) In contrast to the transparency theory of eelgrass loss, higher losses appear to have occurred in shallower environments where the most light is available and eelgrass are healthiest in the deeper waters. (*See* Figure HAB2-2, 2009 PREP Report.) This <u>could</u> evidence that macroalgae or shoreline development are adversely impacting eelgrass populations. Therefore, mandating TN reduction because of an assumed connection between eelgrass loss and transparency was in error.

In conclusion, throughout the late 1990s as eelgrass declined, chlorophyll *a* levels remained constant, even though data confirm that TIN levels increased by 40%. These data confirm that chlorophyll *a* growth in the system is not significantly responding to increase inorganic nitrogen levels (the component of nitrogen that supports plant growth). Likewise, data from the tidal rivers do not show any significant relationship between algal levels and minimum DO occurrence. The assumption that nitrogen levels and excessive phytoplankton growth in the system is causing widespread impairment is simply not justified based on the available data.

18. The underlying technical basis for the nutrient criteria applied in the permit modification is a "stressor response" analysis completed by DES in 2009. That analysis plotted total nitrogen concentrations from various places in the estuary system versus light extinction and concluded that a specific ambient nitrogen concentration was necessary to attain a Kd of 0.75/m in the Great Bay and its tributaries. (Ex. 14.) The method used to derive the DO-based TN objectives was derived similarly. The proposed criteria derivation method employed by DES and relied upon by EPA to set ambient total nitrogen water quality standards is not scientifically defensible and was not based on accepted scientific methodologies. DES plotted areas with radically different physical and chemical conditions and presumed that the level of TN occurring in the different areas was the only

parameter controlling changes in DO, transparency, or algal growth. (Ex. 15.) It is not scientifically defensible to plot data from such different areas on a single graph and conclude that the dependent pollutant caused the system response when other major physical and chemical factors are known to affect the result and have not been considered in the analysis.

19. The USEPA Science Advisory Board has indicated that such "cause and effect" relationships cannot be presumed from such simplified analyses and that other factors that co-vary and may otherwise explain the change in the measured response variable must be assessed. (*See* "Review of Empirical Approaches to Nutrient Criteria Derivation," April 28, 2010.) The SAB has also cautioned that only data taken from similar habitats should be used for stressor response analyses. EPA's Fact Sheet likewise noted that "estuarine nutrient dynamics are complex, and are influenced by flushing time, freshwater inflow and stratification among other factors." None of these factors or changing conditions were considered by DES in the evaluation of the system response to nutrient inputs. Dilution alone can explain the majority of the relationship between TN and all of the parameters plotted that were claimed to be caused by changes in TN. (Ex. 16.) Moreover, HydroQual confirmed that for transparency turbidity co-varied with nitrogen levels and also explained the change in transparency throughout the Great Bay system. (Ex. 17.) Nitrogen does not relate directly to "turbidity" that is caused by a number of physical processes unrelated to the ambient nutrient concentration. Other parameters such as TSS, salinity, dissolved organic matter, color, SOD, phosphorus, and a host of other parameters also co-vary with TN and DO levels. (See, e.g., Exs. 18 and 19.) Unless these factors are considered and it is confirmed that TN caused excessive plant growth, which in turn controlled the endpoint of concern (low DO or decreased transparency), there is no basis to conclude that TN was the cause of the changes occurring in DO or transparency throughout the system. This is a seriously flawed analysis, as the basic physical and chemical parameters influencing the pollutant levels and resultant water quality were not addressed in the DES assessment. This fundamentally flawed assessment methodology cannot be relied upon to demonstrate that TN reduction is necessary to protect the Bay or that the particular ambient TN level selected by DES will be sufficient to restore use impairments of concern.

20. The TN/transparency relationship developed for the Bay does not apply to the tidal rivers as EPA has assumed. The factors controlling transparency in the Bay, Piscataqua River, and mouth of the estuary are dramatically different than those controlling transparency in the tidal rivers or near their mouths in the Bay. The Squamscott River and other tidal rivers are heavily influenced by the color of the waters entering the system. (Ex. 19.) These areas have naturally low transparency due to color leaching out of wetland and other areas into the system. Turbulence due to tidal exchange also causes high turbidity in these systems, as demonstrated by the DES turbidity data contained in Ex. 17. Consequently, transparency is naturally low in the Squamscott River and cannot be increased simply by regulating TN to control chlorophyll '*a*' growth. (Ex. 20.) Because the conditions producing poor water quality are natural, these conditions do not constitute a violation of the state's narrative water quality standards, and a TN-based transparency standard to protect eelgrass growth is not germane to this area. In summary, the typically

low transparency of the Squamscott River has virtually nothing to do with nutrient levels or algal growth. This is a natural condition that cannot be changed. Therefore, EPA's presumption that TN control will produce improved transparency levels in the Squamscott River sufficient to allow eelgrass growth is unfounded. This permit action should be withdrawn since the central scientific and legal premises of the action are in error.

21. EPA's reliance on studies from other states or EPA manuals (Fact Sheet @ 20-21) to assert that specific nitrogen-related impairments are present in Great Bay is misplaced. The available data from the underlying studies indicate that the system was not suffering adverse impacts from excessive algal growth or reduced transparency due to excessive algal growth. Moreover, there is no indication that application of such results from Massachusetts or Delaware was intended to apply to the highly dynamic tidal river and bay systems present here. Absent some demonstration that the physical settings and water quality conditions are the same (i.e., critical factors influencing plant growth in any system), there is no technical basis to conclude that these other state standards have any relevance to Great Bay. It should be noted further that 40 C.F.R. § 122.44(d) does not allow the presumptive application of "out of state" standards as a basis for interpreting a narrative criteria. Thus, the applicable federal regulation is being misapplied.

Finally, the focus on eelgrass loss in the tidal rivers is completely arbitrary, given that it is admitted no one knows why the eelgrass loss occurred over 40 years ago and that the State of New Hampshire has determined that the primary ecologic concern in the tidal rivers is DO. (Fact Sheet @ 11.) Neither DES nor PREP has ever attempted to claim that reduced nitrogen levels would restore eelgrass in these areas. The analysis was focused on an alleged relationship between transparency and TN in the Bay, not miles up the tidal rivers. Therefore, EPA's assertion that "[s]ince eelgrass was present in the Squamscott River, the applicable total nitrogen criteria to ensure its recovery is 0.3 mg/l" is simply unsupported speculation. Other DES-funded studies (e.g., 2006 Great Bay Estuary Restoration Compendium) confirm that it is not reasonable to presume that reducing TN levels will result in eelgrass restoration in the Squamscott River, and Ex. 20 explains that natural transparency is insufficient to support eelgrass growth. DES recently indicated that it plans to clarify the impairment zone listing information to reflect those areas of the tidal river systems where eelgrass growth and restoration is improbable due to factors unrelated to nitrogen impairments. Given that major eelgrass losses are also occurring even in high quality waters, EPA's decision to stringently control TN inputs is not supported by the relevant data for the estuary.

Pursuant to 122.44(d), EPA is to follow the state's narrative criteria approach where such information is available. That approach does not support applying the Bay eelgrass protection targets in the tidal rivers, assuming the criteria were not fundamentally flawed, as explained earlier. Consequently, EPA's proposed permitting approach for Exeter should be withdrawn because there is no credible scientific data showing that decades-old eelgrass losses in the Squamscott River have anything to do with changes in TN levels. To the opposite, EPA's own fact sheet recognized that the cause (and therefore the remedy) of such losses is currently "unknown." Therefore, any regulatory requirement at this point is pure speculation, and, consequently, the proposed related effluent limits are arbitrary and capricious.[11]

22. The proposed permit applies the proposed criteria for eelgrass protection in the tidal rivers, at a 7/Q/10 low flow. (Fact Sheet @ 22-23). The chosen water quality criteria are not based on short-term or near field impact considerations. Consequently, this is a misapplication of the draft DES TN criteria from several perspectives. First, the impact of concern "transparency" is a long-term effect. The data used by DES to derive the 0.3 mg/l TN criteria was based on multi-year average ambient conditions. It is therefore inappropriate to assert that compliance with that objective must be maintained under a rare 7/Q/10 flow condition. Second, the impact on transparency, if it did exist, has nothing to do with the dilution available in the current Exeter mixing zone. There is not sufficient time for the Town's effluent quality to alter algal growth at this point of discharge. Assuming the 0.3 mg/l TN objective was properly derived and necessary to ensure use protection, this objective would be applied under some type of growing season average tidal dilution flow condition, relevant to the time period when algal growth could significantly influence water column transparency.

23. The proposed permit requires that the facility optimize TN reduction during the non-growing season (November – March), despite recognizing that "these months are not the most critical period for phytoplankton and macroalgae growth." (Fact Sheet @ 3.) There is no technical or regulatory justification for this requirement; therefore, it should not be included in the permit. As noted earlier, EPA must demonstrate that a water quality-based effluent limitation is necessary to achieve water quality standard compliance. The permit record provides no such demonstration and concedes that it is not demonstrated to be necessary. Therefore, this provision is not legally or technically supported.

24. The permit should not contain a monthly maximum effluent limit since it has not been demonstrated that this restrictive permit averaging period is necessary to ensure WQS compliance. Assuming it is proper to rely on the state's draft, unadopted criteria in setting permit limits, those criteria are based on long-term (multi-year) median conditions. Therefore, at a minimum, limitations necessary to comply with such limits should be established as long-term averages, as EPA has done in similar situations. For instance, nutrient limits were applied to derive annual average requirements with EPA's approval in Chesapeake Bay and Long Island Sound. If EPA now insists that monthly averages must be set, EPA must account for the difference between the standard and permit averaging periods when setting the limits. Finally, the use of concentration-based limits, which assume the facility is discharging at design flow, produces unnecessarily restrictive permit limits. Under lower flow conditions and existing effluent discharge rates, the allowable effluent quality may range up to 6 mg/l and still meet loading targets equal to 3 mg/l at the design flow of 3 MGD. To ensure that only necessary permit limitations are established, flow tiered concentration limits should be established to properly implement whatever load limits are set to achieve narrative criteria compliance.

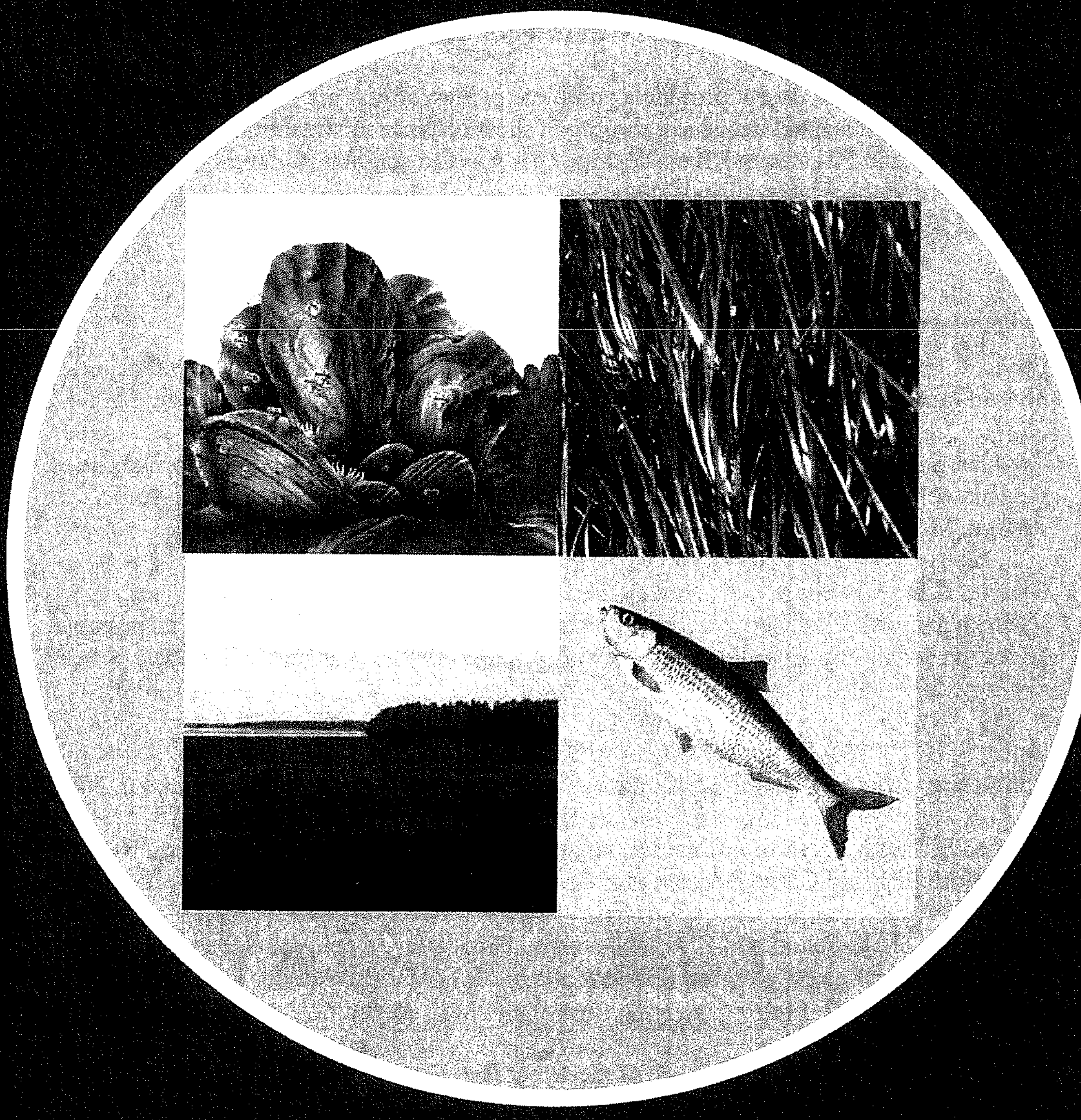
[11] It should be noted that, out of concern for the health of the Bay, the Coalition has agreed that several facilities should be designed to achieve an 8 mg/l TN limit. This agreement, however, is not premised on a conclusion that TN has been adequately confirmed to be the cause of eelgrass loss.

EXETER EXHIBIT LIST

EX. 1	Memorandum of Agreement (MOA)
EX. 2	Freedom of Information Act (FOIA)
EX. 3	Figure 6 – Great Bay 2006 Great Bay Restoration Compendium
EX. 4	Assessment of Appropriate Peer Review Charge Questions
EX. 5	Evaluation of Proposed Numeric Nutrient Water Quality Criteria – June 30, 2010
EX. 6	EPA Region IV – Statement on WQS Changes Requiring EPA Approval
EX. 7	Diurnal DO Variation in Squamscott
EX. 8	Measured Chl *a* and Secchi Disk at Adams Point (1988-2009)
EX. 9	Contributions to Kd (PAR) Measured at the Great Bay Buoy
EX. 10	HydroQual Report – January 10, 2011
EX. 11	Trend Analysis – WWTP Loads/Flows
EX. 12	In-situ Measurements Refine Thresholds for DO Violations (DES 2011)
EX. 13	Impediments to Eelgrass (Zostera Marina) Restoration – Figure 5
EX. 14	Relationship Between Height Attenuation Coefficient and TN at Trend Stations (DES 2009)
EX. 15	Major Physical Differences in Sample Location
EX. 16	Salinity/Dilution TN Covary in GB System
EX. 17	Covariation between Turbidity and TN at Datasonde Stations
EX. 18	Salinity/Dilution: Transparency Covary in GB System
EX. 19	Color-Salinity/Dilution Covary in GB System – Tidal River Source
EX. 20	Transparency Versus Chlorophyll *a* – Squamscott River

Attachment B

Great Bay Estuary Restoration Compendium



The Nature Conservancy

New Hampshire Estuaries Project

New Hampshire Coastal Program

NHCP

University of New Hampshire

September, 2006

Dr. Short has developed a site suitability model (Figure 6) that utilizes information on historical eelgrass distribution, salinity, depth, substrate, and pollution levels. The model produces spatially explicit output that ranks areas of the estuary for their ability to support eelgrass growth at five levels – best, good, fair, poor, or unsuitable. The new shapefile showing areas of eelgrass loss was clipped with a copy of the model output that excluded areas coded as poor or unsuitable. This produced a final shapefile that showing priority restoration sites – the sites where eelgrass historically occurred but has been lost *and* can still be expected to support eelgrass following restoration efforts (See Figure 7).

Historic data sets do not provide a complete picture of historic eelgrass coverage. In particular, the Krochmal data ends abruptly a short distance upstream from the mouths of the Bellamy and Piscataqua Rivers because that was the geographic extent of his survey. Consequently, there are additional eelgrass restoration opportunities not revealed using our data and methods.

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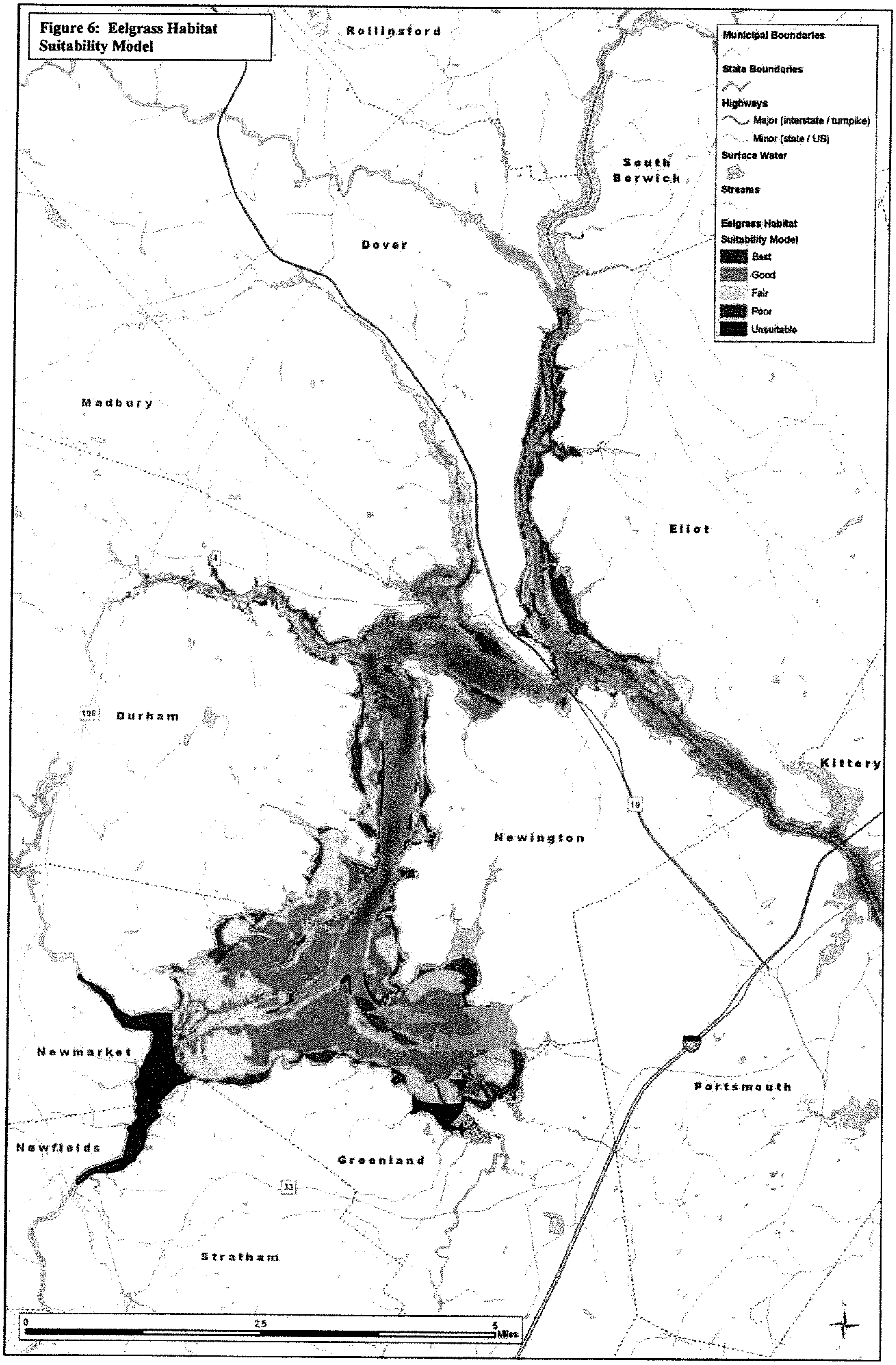
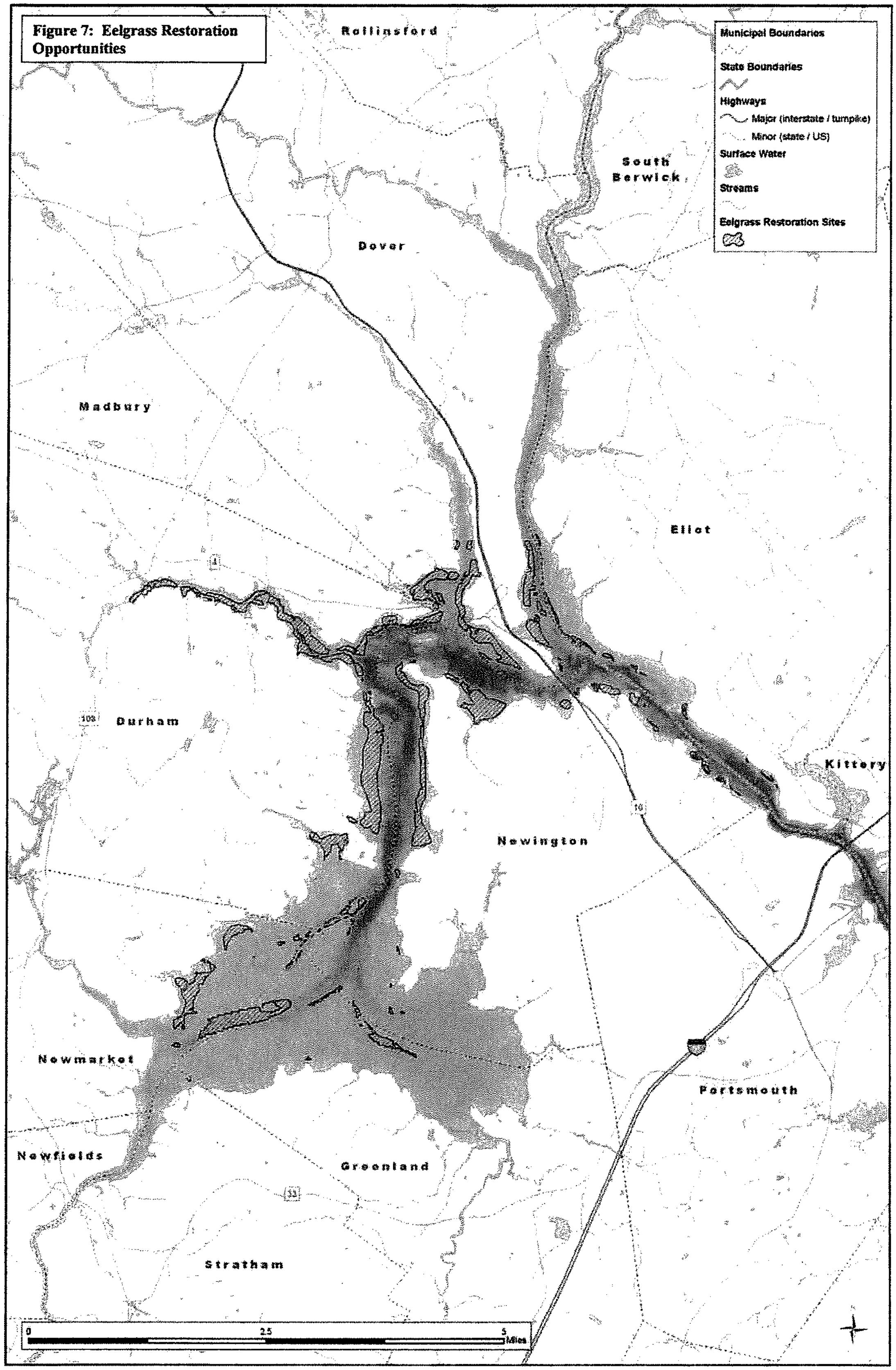


Figure 6: Eelgrass Habitat Suitability Model
Rollinsford
Municipal Boundaries
State Boundaries
Highways
Major (interstate / turnpike)
Minor (state / US)
Surface Water
Streams
Eelgrass Habitat Suitability Model
Best
Good
Fair
Poor
Unsuitable
South Berwick
Dover
Madbury
Eliot
4
108
Durham
Kittery
16
Newington
Newmarket
Portsmouth
Newfields
Greenland
33
Stratham
0
2.5
5
Miles

Figure 7: Eelgrass Restoration Opportunities



Attachment C

STATE-EPA NUTRIENT INNOVATIONS TASK GROUP
AUGUST 2009

AN URGENT CALL TO ACTION
REPORT OF THE STATE-EPA NUTRIENT INNOVATIONS TASK GROUP

recreational areas, and undeveloped tracts of land. Impervious lands include roofs, parking lots and streets. Stormwater collects fertilizers and other applied nutrients, as well as other pollutants on impervious surfaces, before it is discharged to receiving waters. As noted in the EPA SAB report *Urban Stormwater Management in the United States* (NRC 2008b):

> *Urban stormwater may actually have slightly lower pollutant concentrations than other nonpoint sources of pollution, especially for sediments and nutrients. The key difference is that urban watersheds produce a much larger annual volume of runoff waters, such that the mass of pollutants discharged is often greater following urbanization.*

Urban stormwater discharges via municipal separate storm sewer systems (MS4s) and combined storm sewer systems (CSSs) are regulated under the National Pollutant Discharge Elimination System (NPDES) permit program of the CWA. There are several thresholds for MS4 stormwater regulations. However, a significant number of communities and a substantial amount of urban growth occur outside of MS4s and are only subject to construction stormwater general permits.

Municipal Wastewater Treatment

Municipal wastewater treatment plants, also known as publicly owned treatment works (POTWs), usually discharge both phosphorus and nitrogen. Depending on the local ecological conditions and their relative contribution, POTW discharges can be a significant source of nutrients in some watersheds. People produce about 18 million tons of solid waste (feces) annually (based on Freitas Jr. 1999; MERCK 2007). U.S. municipal wastewater treatment facilities currently treat about 34 billion gallons of wastewater per day (USEPA 2008c).

For most of the country, municipal wastewater treatment generates two waste streams—biosolids and discharges of treated wastewater to surface water—which are regulated under the provisions of sections 301, 402, and 405 of the CWA, respectively. Municipal or sewage waste biosolids that are to be land applied must meet specific CWA and state regulatory standards to protect surface water and groundwater from contamination. Treatment for surface water discharges is regulated through NPDES permits, which must reflect both the technology-based requirements of secondary treatment (biological oxygen demand (BOD), total suspended solids (TSS), and pH) and applicable water quality standards. However, only a subset of POTW permits currently contain nitrogen and phosphorus limits. Of more than 16,500 municipal POTWs nationwide (USEPA 2008c), approximately 4 percent have numeric limits for nitrogen[2] and 9.9 percent for phosphorus (USEPA 2009e). Estimated costs for municipal nutrient removal can vary widely depending on level of treatment and process used, wastewater characteristics, plant capacity, existing treatment facilities, and other site-specific factors.

The estimated cost to upgrade all the POTWs in the United States to achieve the more stringent technology-based limits—3 mg/L for nitrate and nitrite and 0.1 mg/L for phosphate—would be about $44 billion to remove nitrogen, about $44.5 billion to remove phosphorus, and approximately $54 billion to include capabilities to simultaneously remove both nitrogen and phosphorus (based on USEPA 2008c). In addition, our growing population will result in

[2] Although 43.5 percent of POTW permits have limits for ammonia, limiting ammonia generally does not reduce overall nitrogen loadings because nitrates and nitrites continue to be discharged.

Attachment D

Additional 2010 Discharge Data for CT WWTF

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
BRANFORD WPCF	01/06/2010	CT0100048	3.8	6.82	0.9	7.7	244	
BRANFORD WPCF	01/13/2010	CT0100048	3.4	3.01	1.17	4.2	119	
BRANFORD WPCF	01/20/2010	CT0100048	3.6	8.25	0.14	8.4	252	
BRANFORD WPCF	01/27/2010	CT0100048	4	4.28	1.83	6.1	204	6.6
BRANFORD WPCF	02/03/2010	CT0100048	3.5	2.61	1.49	4.1	120	
BRANFORD WPCF	02/10/2010	CT0100048	3.3	3.2	1.54	4.7	129	
BRANFORD WPCF	02/17/2010	CT0100048	3.3	3.23	2.04	5.3	146	
BRANFORD WPCF	02/24/2010	CT0100048	8.5	4.58	1.55	6.1	432	5.1
BRANFORD WPCF	03/03/2010	CT0100048	5	2.34	0.9	3.2	133	
BRANFORD WPCF	03/10/2010	CT0100048	4	0.8	0.79	1.6	53	
BRANFORD WPCF	03/17/2010	CT0100048	5.9	0.95	0.97	1.9	94	
BRANFORD WPCF	03/24/2010	CT0100048	7	1.59	1.08	2.7	158	
BRANFORD WPCF	03/31/2010	CT0100048	11.2	8.4	1.9	10.3	962	4.1
BRANFORD WPCF	04/07/2010	CT0100048	5	0.51	0.74	1.3	54	
BRANFORD WPCF	04/14/2010	CT0100048	4	2.2	1.15	3.4	113	
BRANFORD WPCF	04/21/2010	CT0100048	3.7	2.7	1.09	3.8	117	4.7
BRANFORD WPCF	05/07/2010	CT0100048	3.6	6.4	1.34	7.7	231	
BRANFORD WPCF	05/12/2010	CT0100048	3.4	1.08	1.77	2.9	82	
BRANFORD WPCF	05/19/2010	CT0100048	4.1	1.08	0.97	2.1	72	
BRANFORD WPCF	05/26/2010	CT0100048	3.4	3.87	0.31	4.2	119	4.2
BRANFORD WPCF	06/02/2010	CT0100048	3.3	2.76	1.31	4.1	113	
BRANFORD WPCF	06/09/2010	CT0100048	3.3	1.54	1.97	3.5	96	
BRANFORD WPCF	06/16/2010	CT0100048	3.2	2.6	0.74	3.3	88	
BRANFORD WPCF	06/23/2010	CT0100048	3.3	2.6	0.87	3.5	96	
BRANFORD WPCF	06/30/2010	CT0100048	3.1	2	0.64	2.6	67	3.4
BRANFORD WPCF	07/07/2010	CT0100048	3.1	1.81	2.08	3.9	101	
BRANFORD WPCF	07/14/2010	CT0100048	3.7	2.2	1.07	3.3	102	
BRANFORD WPCF	07/21/2010	CT0100048	3.2	2.3	0.67	3	80	
BRANFORD WPCF	07/28/2010	CT0100048	3.2	1.52	0.76	2.3	61	3.1
BRANFORD WPCF	08/04/2010	CT0100048	3	2.1	0.65	2.8	70	
BRANFORD WPCF	08/11/2010	CT0100048	3.1	0.54	0.79	1.3	34	
BRANFORD WPCF	08/18/2010	CT0100048	3	0.92	0.83	1.8	45	
BRANFORD WPCF	08/25/2010	CT0100048	3.2	1.08	0.39	1.5	40	1.9
BRANFORD WPCF	09/01/2010	CT0100048	3	0.92	0.96	1.9	48	
BRANFORD WPCF	09/08/2010	CT0100048	2.9	1.08	0.86	1.9	46	
BRANFORD WPCF	09/15/2010	CT0100048	2.8	1.17	1.44	2.6	61	
BRANFORD WPCF	09/22/2010	CT0100048	2.8	0.84	1.74	2.6	61	
BRANFORD WPCF	09/29/2010	CT0100048	2.8	0.99	1.65	2.6	61	2.3
BRANFORD WPCF	10/06/2010	CT0100048	3	0.93	1.87	2.8	70	
BRANFORD WPCF	10/13/2010	CT0100048	2.8	0.57	0.75	1.3	30	
BRANFORD WPCF	10/20/2010	CT0100048	2.8	0.5	0.92	1.4	33	
BRANFORD WPCF	10/27/2010	CT0100048	2.9	0.92	0.92	1.8	44	1.8
BRANFORD WPCF	11/03/2010	CT0100048	2.7	0.27	0.63	0.9	20	
BRANFORD WPCF	11/10/2010	CT0100048	3	0.49	0.61	1.1	28	
BRANFORD WPCF	11/17/2010	CT0100048	3.5	0.92	1.28	2.2	64	
BRANFORD WPCF	11/23/2010	CT0100048	2.8	1.38	1.04	2.4	56	1.7
BRANFORD WPCF	12/01/2010	CT0100048	3.3	0.57	0.57	1.1	30	
BRANFORD WPCF	12/08/2010	CT0100048	2.8	0.46	0.98	1.4	33	
BRANFORD WPCF	12/15/2010	CT0100048	3.2	0.25	0.72	1	27	
BRANFORD WPCF	12/21/2010	CT0100048	3.1	0.76	0.9	1.7	44	
BRANFORD WPCF	12/28/2010	CT0100048	3	1.34	1.21	2.6	65	1.6
					Average	3.1745	110.745098	**3.4**
					April - October	2.8	77.06896552	**3.1**
					Max	10.3	962	**6.6**
					Min	0.9	20	**1.6**
					Max (Apr-Oct)	7.7	231	**4.7**
					Min (Apr-Oct)	1.3	30	**1.8**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
CHESHIRE WPCF	01/14/2010	CT0100081	2.8	1.2	1.3	2.5	58	
CHESHIRE WPCF	01/21/2010	CT0100081	2.7	0.9	0.4	1.3	29	
CHESHIRE WPCF	01/28/2010	CT0100081	4.5	0.7	0.2	0.9	34	1.6
CHESHIRE WPCF	02/04/2010	CT0100081	3.2	1.3	0.57	1.9	51	
CHESHIRE WPCF	02/11/2010	CT0100081	2.8	1.2	0.29	1.5	35	
CHESHIRE WPCF	02/18/2010	CT0100081	2.5	1.4	0.35	1.8	38	
CHESHIRE WPCF	02/25/2010	CT0100081	3.6	1	0.51	1.5	45	1.7
CHESHIRE WPCF	03/04/2010	CT0100081	4.6	0.71	0.29	1	38	
CHESHIRE WPCF	03/11/2010	CT0100081	3.3	0.49	0.26	0.8	22	
CHESHIRE WPCF	03/18/2010	CT0100081	5.1	1.3	0.2	1.5	64	
CHESHIRE WPCF	03/25/2010	CT0100081	6.2	1.1	1.4	2.5	129	1.5
CHESHIRE WPCF	04/01/2010	CT0100081	6.1	1	1.8	2.8	142	
CHESHIRE WPCF	04/08/2010	CT0100081	4.3	0.6	0.27	0.9	32	
CHESHIRE WPCF	04/15/2010	CT0100081	2.8	0.6	0.4	1	23	
CHESHIRE WPCF	04/22/2010	CT0100081	2.2	1.3	1.1	2.4	44	
CHESHIRE WPCF	04/29/2010	CT0100081	2	1.4	0.51	1.9	32	1.8
CHESHIRE WPCF	05/06/2010	CT0100081	1.8	0.82	0.11	0.9	14	
CHESHIRE WPCF	05/13/2010	CT0100081	1.8	1	0.1	1.1	17	
CHESHIRE WPCF	05/20/2010	CT0100081	1.8	1.6	2.7	4.3	65	
CHESHIRE WPCF	05/27/2010	CT0100081	1.6	1	0.3	1.3	17	1.9
CHESHIRE WPCF	06/03/2010	CT0100081	1.5	1.3	0.18	1.5	19	
CHESHIRE WPCF	06/10/2010	CT0100081	2	1.2	0.28	1.5	25	
CHESHIRE WPCF	06/17/2010	CT0100081	2	0.8	0.18	1	17	
CHESHIRE WPCF	06/24/2010	CT0100081	1.9	1.7	0.18	1.9	30	1.5
CHESHIRE WPCF	07/01/2010	ct0100081	1.9	3.1	0.9	4	63	
CHESHIRE WPCF	07/08/2010	ct0100081	1.8	1.3	0.9	2.2	33	
CHESHIRE WPCF	07/15/2010	ct0100081	1.9	2.4	0.15	2.6	41	
CHESHIRE WPCF	07/22/2010	ct0100081	1.9	2.6	0.53	3.1	49	
CHESHIRE WPCF	07/29/2010	ct0100081	1.8	2.4	0.08	2.5	38	2.9
CHESHIRE WPCF	08/05/2010	CT0100081	1.7	1.2	0.13	1.3	18	
CHESHIRE WPCF	08/12/2010	CT0100081	1.8	1.5	0.15	1.7	26	
CHESHIRE WPCF	08/19/2010	CT0100081	1.8	1.4	0.52	1.9	29	
CHESHIRE WPCF	08/26/2010	CT0100081	2	0.9	0.19	1.1	18	1.5
CHESHIRE WPCF	09/02/2010	CT0100081	1.9	0.6	0.52	1.1	17	
CHESHIRE WPCF	09/09/2010	CT0100081	1.8	1.1	0.7	1.8	27	
CHESHIRE WPCF	09/16/2010	CT0100081	1.9	1.3	0.65	2	32	
CHESHIRE WPCF	09/23/2010	CT0100081	1.7	1.3	0.22	1.5	21	
CHESHIRE WPCF	09/30/2010	CT0100081	1.9	2.1	0.4	2.5	40	1.8
CHESHIRE WPCF	10/07/2010	CT0100081	2	2	2.3	4.3	72	
CHESHIRE WPCF	10/14/2010	CT0100081	2	1.4	1.3	2.7	45	
CHESHIRE WPCF	10/21/2010	CT0100081	2.1	1.2	0.53	1.7	30	
CHESHIRE WPCF	10/28/2010	CT0100081	2	0.77	0.28	1.1	18	2.5
CHESHIRE WPCF	11/04/2010	ct0100081	2	1.3	1.73	3	50	
CHESHIRE WPCF	11/12/2010	ct0100081	2.1	1.4	0.49	1.9	33	
CHESHIRE WPCF	11/18/2010	ct0100081	2.7	1.9	0.34	2.2	50	
CHESHIRE WPCF	11/24/2010	ct0100081	2.4	1.2	0.4	1.6	32	2.2
CHESHIRE WPCF	12/02/2010	CT0100081	2.7	1	0.46	1.5	34	
CHESHIRE WPCF	12/09/2010	CT0100081	2.5	0.9	0.61	1.5	31	
CHESHIRE WPCF	12/16/2010	CT0100081	4.4	0.7	0.39	1.1	40	
CHESHIRE WPCF	12/23/2010	CT0100081	3.1	0.9	0.73	1.6	41	
CHESHIRE WPCF	12/30/2010	CT0100081	2.7	1	0.52	1.5	34	1.4
					Average	1.8569	38.8627451	**1.8**
					April - October	1.9871	35.29032258	**2.0**
					Max	4.3	142	**2.9**
					Min	0.8	14	**1.4**
					Max (Apr-Oct)	4.3	142	**2.9**
					Min (Apr-Oct)	0.9	14	**1.5**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
JEWETT CITY WPCF	01/18/2010	CT0100269	0.32	1.3	1.31	2.6	7	
JEWETT CITY WPCF	01/22/2010	CT0100269	0.32	0.81	0.49	1.3	3	
JEWETT CITY WPCF	01/29/2010	CT0100269	0.36	0.91	0.43	1.3	4	1.7
JEWETT CITY WPCF	02/05/2010	CT0100269	0.29	0.5	1.11	1.6	4	
JEWETT CITY WPCF	02/12/2010	CT0100269	0.3	1.8	0.68	2.5	6	
JEWETT CITY WPCF	02/19/2010	CT0100269	0.29	2.4	0.56	3	7	
JEWETT CITY WPCF	02/26/2010	CT0100269	0.62	2	0.23	2.2	11	2.3
JEWETT CITY WPCF	03/05/2010	CT0100269	0.39	2	0.42	2.4	8	
JEWETT CITY WPCF	03/12/2010	CT0100269	0.34	1.8	0.28	2.1	6	
JEWETT CITY WPCF	03/19/2010	CT0100269	0.47	1.3	0.18	1.5	6	
JEWETT CITY WPCF	03/26/2010	CT0100269	0.58	1.5	0.28	1.8	9	2.0
JEWETT CITY WPCF	04/09/2010	CT0100269	0.62	1.1	0.27	1.4	7	
JEWETT CITY WPCF	04/16/2010	CT0100269	0.47	0.85	0.36	1.2	5	
JEWETT CITY WPCF	04/23/2010	CT0100269	0.37	0.98	0.64	1.6	5	
JEWETT CITY WPCF	04/30/2010	CT0100269	0.32	0.67	2.31	3	8	1.8
JEWETT CITY WPCF	05/07/2010	CT0100269	0.31	0.7	0.86	1.6	4	
JEWETT CITY WPCF	05/14/2010	CT0100269	0.31	1.1	2.21	3.3	9	
JEWETT CITY WPCF	05/21/2010	CT0100269	0.3	1.7	0.74	2.4	6	
JEWETT CITY WPCF	05/28/2010	CT0100269	0.28	1.4	0.48	1.9	4	2.3
JEWETT CITY WPCF	06/04/2010	CT0100269	0.26	1.3	1.03	2.3	5	
JEWETT CITY WPCF	06/11/2010	CT0100269	0.28	1.4	2.43	3.8	9	
JEWETT CITY WPCF	06/18/2010	CT0100269	0.27	2.1	0.77	2.9	7	
JEWETT CITY WPCF	06/25/2010	CT0100269	0.27	2.4	0.57	3	7	3.0
JEWETT CITY WPCF	07/02/2010	CT0100269	0.28	3.4	0.63	4	9	
JEWETT CITY WPCF	07/09/2010	CT0100269	0.28	1.9	0.52	2.4	6	
JEWETT CITY WPCF	07/16/2010	CT0100269	0.29	0.65	0.49	1.1	3	
JEWETT CITY WPCF	07/23/2010	CT0100269	0.25	0.5	1.23	1.7	4	
JEWETT CITY WPCF	07/30/2010	CT0100269	0.26	1.2	0.54	1.7	4	2.2
JEWETT CITY WPCF	08/06/2010	CT0100269	0.23	1.2	0.61	1.8	3	
JEWETT CITY WPCF	08/13/2010	CT0100269	0.25	0.9	0.59	1.5	3	
JEWETT CITY WPCF	08/20/2010	CT0100269	0.23	1.1	0.58	1.7	3	
JEWETT CITY WPCF	08/27/2010	CT0100269	0.23	1	0.48	1.5	3	1.6
JEWETT CITY WPCF	09/03/2010	CT0100269	0.31	1	0.73	1.7	4	
JEWETT CITY WPCF	09/10/2010	CT0100269	0.25	0.85	0.57	1.4	3	
JEWETT CITY WPCF	09/17/2010	CT0100269	0.25	0.82	0.71	1.5	3	
JEWETT CITY WPCF	09/24/2010	CT0100269	0.25	0.8	1.1	1.9	4	1.6
JEWETT CITY WPCF	10/01/2010	CT0100269	0.31	0.96	0.81	1.8	5	
JEWETT CITY WPCF	10/08/2010	CT0100269	0.23	0.78	1.21	2	4	
JEWETT CITY WPCF	10/15/2010	CT0100269	0.24	0.68	1.01	1.7	3	
JEWETT CITY WPCF	10/22/2010	CT0100269	0.27	0.85	1.41	2.3	5	
JEWETT CITY WPCF	10/29/2010	CT0100269	0.27	0.83	0.66	1.5	3	1.9
JEWETT CITY WPCF	11/05/2010	CT0100269	0.25	1.2	1.71	2.9	6	
JEWETT CITY WPCF	11/12/2010	CT0100269	0.25	1.2	1.31	2.5	5	
JEWETT CITY WPCF	11/19/2010	CT0100269	0.23	1.5	0.67	2.2	4	
JEWETT CITY WPCF	11/23/2010	CT0100269	0.25	1.4	1.01	2.4	5	2.5
JEWETT CITY WPCF	12/03/2010	CT0100269	0.24	1.8	1.31	3.1	6	
JEWETT CITY WPCF	12/10/2010	CT0100269	0.22	1.7	2.61	4.3	8	
JEWETT CITY WPCF	12/17/2010	CT0100269	0.24	1.8	1.91	3.7	7	
JEWETT CITY WPCF	12/21/2010	CT0100269	0.28	1.9	3.41	5.3	12	
JEWETT CITY WPCF	12/28/2010	CT0100269	0.25	2.4	2.15	4.6	10	4.2
					Average	2.298	5.64	**2.3**
					April - October	2.0533	4.933333333	**2.1**
					Max	5.3	12	**4.2**
					Min	1.1	3	**1.6**
					Max (Apr-Oct)	4	9	**3.0**
					Min (Apr-Oct)	1.1	3	**1.6**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
SOUTHINGTON WPCF	01/13/2010	CT0100536	4.7	6.4	0.8	7.2	282	
SOUTHINGTON WPCF	01/20/2010	CT0100536	4.6	4	3.7	7.7	295	
SOUTHINGTON WPCF	01/27/2010	CT0100536	6	3.1	0.5	3.6	180	6.2
SOUTHINGTON WPCF	02/03/2010	CT0100536	5	3.9	1.6	5.5	229	
SOUTHINGTON WPCF	02/10/2010	CT0100536	4.8	5.6	3	8.6	344	
SOUTHINGTON WPCF	02/17/2010	CT0100536	4.6	3.1	1	4.1	157	
SOUTHINGTON WPCF	02/24/2010	CT0100536	5.8	3	3.7	6.7	324	6.2
SOUTHINGTON WPCF	03/03/2010	CT0100536	6.2	1.5	4.6	6.1	315	
SOUTHINGTON WPCF	03/10/2010	CT0100536	5.5	3.2	2.6	5.8	266	
SOUTHINGTON WPCF	03/17/2010	CT0100536	7.6	2.1	2.3	4.4	279	
SOUTHINGTON WPCF	03/24/2010	CT0100536	8.1	2.3	5.4	7.7	520	
SOUTHINGTON WPCF	03/30/2010	CT0100536	11.1	1.8	3.1	4.9	454	5.8
SOUTHINGTON WPCF	04/07/2010	CT0100536	7.5	4.2	1.7	5.9	369	
SOUTHINGTON WPCF	04/14/2010	CT0100536	5.8	1.1	3.1	4.2	203	
SOUTHINGTON WPCF	04/21/2010	CT0100536	5.2	1.7	3	4.7	204	
SOUTHINGTON WPCF	04/28/2010	CT0100536	4.7	1.5	8.8	10.3	404	6.3
SOUTHINGTON WPCF	05/05/2010	CT0100536	4.5	1.6	2.1	3.7	139	
SOUTHINGTON WPCF	05/12/2010	CT0100536	4.4	1.5	3.8	5.3	194	
SOUTHINGTON WPCF	05/19/2010	CT0100536	4.6	2.5	2.7	5.2	200	
SOUTHINGTON WPCF	05/26/2010	CT0100536	4.8	2	3.8	5.8	232	5.0
SOUTHINGTON WPCF	06/02/2010	CT0100536	4.2	2.2	1.8	4	140	
SOUTHINGTON WPCF	06/09/2010	CT0100536	3.6	2	3.2	5.2	156	
SOUTHINGTON WPCF	06/16/2010	CT0100536	3.8	2.5	8.2	10.7	339	
SOUTHINGTON WPCF	06/23/2010	CT0100536	3.8	1.7	6.2	7.9	250	
SOUTHINGTON WPCF	06/29/2010	CT0100536	3.4	2	8.5	10.5	298	7.7
SOUTHINGTON WPCF	07/07/2010	CT0100536	3.1	2.6	2.7	5.3	137	
SOUTHINGTON WPCF	07/14/2010	CT0100536	3.4	2	1.9	3.9	111	
SOUTHINGTON WPCF	07/21/2010	CT0100536	3	1.8	0.2	2	50	
SOUTHINGTON WPCF	07/29/2010	CT0100536	2.8	1.5	1.1	2.6	61	3.5
SOUTHINGTON WPCF	08/04/2010	CT0100536	2.6	2	1.2	3.2	69	
SOUTHINGTON WPCF	08/11/2010	CT0100536	3.1	2	3.7	5.7	147	
SOUTHINGTON WPCF	08/18/2010	CT0100536	2.7	1.9	14.9	16.8	378	
SOUTHINGTON WPCF	08/25/2010	CT0100536	3	1.8	1.4	3.2	80	7.2
SOUTHINGTON WPCF	09/08/2010	CT0100536	3	1.3	1.1	2.4	60	
SOUTHINGTON WPCF	09/15/2010	CT0100536	2.9	2.7	2.1	4.8	116	
SOUTHINGTON WPCF	09/22/2010	CT0100536	2.7	2.1	1.1	3.2	72	
SOUTHINGTON WPCF	09/29/2010	CT0100536	2.8	2	1.2	3.2	75	3.4
SOUTHINGTON WPCF	10/06/2010	CT0100536	3.3	2.1	1.5	3.6	99	
SOUTHINGTON WPCF	10/13/2010	CT0100536	2.8	4.7	0.9	5.6	131	
SOUTHINGTON WPCF	10/20/2010	CT0100536	2.1	1.1	1.7	2.8	49	
SOUTHINGTON WPCF	10/27/2010	CT0100536	2.5	0.8	1.2	2	42	3.5
SOUTHINGTON WPCF	11/03/2010	CT0100536	3.2	4.9	1.8	6.7	179	
SOUTHINGTON WPCF	11/10/2010	CT0100536	3.1	2.1	2.6	4.7	122	
SOUTHINGTON WPCF	11/17/2010	CT0100536	4.1	2.5	1.8	4.3	147	
SOUTHINGTON WPCF	11/24/2010	CT0100536	3.4	1.6	1.2	2.8	79	
SOUTHINGTON WPCF	11/29/2010	CT0100536	2.9	5.5	1.5	7	169	5.1
SOUTHINGTON WPCF	12/08/2010	CT0100536	3.3	4.3	4	8.3	228	
SOUTHINGTON WPCF	12/15/2010	CT0100536	5	2.5	3.1	5.6	234	
SOUTHINGTON WPCF	12/22/2010	CT0100536	4.6	1.5	1.6	3.1	119	
SOUTHINGTON WPCF	12/27/2010	CT0100536	4.3	1.8	0.8	2.6	93	4.9
					Average	5.422	196.4	**5.4**
					April - October	5.3	165.6896552	**5.2**
					Max	16.8	520	**7.7**
					Min	2	42	**3.4**
					Max (Apr-Oct)	16.8	404	**7.7**
					Min (Apr-Oct)	2	42	**3.4**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
SUFFIELD WPCF	01/13/2010	CT0100552	1.3	1.5	0.15	1.7	18	
SUFFIELD WPCF	01/20/2010	CT0100552	1.5	1.2	0.06	1.3	16	
SUFFIELD WPCF	01/27/2010	CT0100552	1.8	1.5	0	1.5	23	1.5
SUFFIELD WPCF	02/03/2010	CT0100552	1.4	1.4	0	1.4	16	
SUFFIELD WPCF	02/10/2010	CT0100552	1.3	2.7	1.1	3.8	41	
SUFFIELD WPCF	02/17/2010	CT0100552	1.2	2.3	4.11	6.4	64	
SUFFIELD WPCF	02/24/2010	CT0100552	2.1	5.6	1.06	6.7	117	4.6
SUFFIELD WPCF	03/03/2010	CT0100552	1.9	5.3	1.03	6.3	100	
SUFFIELD WPCF	03/10/2010	CT0100552	1.5	1.9	2.74	4.6	58	
SUFFIELD WPCF	03/17/2010	CT0100552	1.7	0.3	0	0.3	4	
SUFFIELD WPCF	03/24/2010	CT0100552	2.2	1.7	0.18	1.9	35	
SUFFIELD WPCF	03/31/2010	CT0100552	4.1	2.1	0	2.1	72	3.0
SUFFIELD WPCF	04/07/2010	CT0100552	1.8	0.9	0	0.9	14	
SUFFIELD WPCF	04/14/2010	CT0100552	1.5	3.2	0.2	3.4	43	
SUFFIELD WPCF	04/21/2010	CT0100552	1.4	3.7	0.13	3.8	44	
SUFFIELD WPCF	04/28/2010	CT0100552	1.3	3.4	0	3.4	37	2.9
SUFFIELD WPCF	05/05/2010	CT0100552	1.2	1.5	0	1.5	15	
SUFFIELD WPCF	05/12/2010	CT0100552	1.2	0.8	0.22	1	10	
SUFFIELD WPCF	05/19/2010	CT0100552	1.3	0.7	0	0.7	8	
SUFFIELD WPCF	05/26/2010	CT0100552	1.1	0.1	0	0.1	1	0.8
SUFFIELD WPCF	06/02/2010	CT0100552	1.1	1.2	0	1.2	11	
SUFFIELD WPCF	06/09/2010	CT0100552	1.2	0.6	0.14	0.7	7	
SUFFIELD WPCF	06/16/2010	CT0100552	1.2	0.7	0.07	0.8	8	
SUFFIELD WPCF	06/23/2010	CT0100552	1.1	0.98	0.05	1	9	
SUFFIELD WPCF	06/30/2010	CT0100552	1	0.8	0.07	0.9	8	0.9
SUFFIELD WPCF	07/07/2010	CT0100552	1	1.8	0.05	1.9	16	
SUFFIELD WPCF	07/14/2010	CT0100552	1.1	0.9	0	0.9	8	
SUFFIELD WPCF	07/21/2010	CT0100552	1	0.9	0.06	1	8	
SUFFIELD WPCF	07/28/2010	CT0100552	0.9	1.3	0.1	1.4	11	1.3
SUFFIELD WPCF	08/04/2010	CT0100552	1	0.6	0.32	0.9	8	
SUFFIELD WPCF	08/11/2010	CT0100552	0.9	0.7	0.41	1.1	8	
SUFFIELD WPCF	08/18/2010	CT0100552	0.9	0.8	0.95	1.8	14	
SUFFIELD WPCF	08/25/2010	CT0100552	1	1.2	0.49	1.7	14	1.4
SUFFIELD WPCF	09/01/2010	CT0100552	1	0.8	0.45	1.3	11	
SUFFIELD WPCF	09/08/2010	CT0100552	1	0.7	3.62	4.3	36	
SUFFIELD WPCF	09/15/2010	CT0100552	0.9	1	0.44	1.4	11	
SUFFIELD WPCF	09/22/2010	CT0100552	0.9	1	3.7	4.7	35	
SUFFIELD WPCF	09/29/2010	CT0100552	1	0.6	2.23	2.8	23	2.9
SUFFIELD WPCF	10/06/2010	CT0100552	1.4	0.6	2.5	3.1	36	
SUFFIELD WPCF	10/13/2010	CT0100552	1.1	0.5	4.72	5.2	48	
SUFFIELD WPCF	10/20/2010	CT0100552	1.1	0.8	2.33	3.1	28	
SUFFIELD WPCF	10/27/2010	CT0100552	1.1	0.2	0	0.2	2	2.9
SUFFIELD WPCF	11/03/2010	CT0100552	1	0	0.79	0.8	7	
SUFFIELD WPCF	11/10/2010	CT0100552	1.3	0	0.93	0.9	10	
SUFFIELD WPCF	11/17/2010	CT0100552	2	0.3	0.35	0.7	12	
SUFFIELD WPCF	11/24/2010	CT0100552	1.3	0.5	0.32	0.8	9	0.8
SUFFIELD WPCF	12/01/2010	CT0100552	1.6	0.5	1.44	1.9	25	
SUFFIELD WPCF	12/08/2010	CT0100552	1.2	0	1.78	1.8	18	
SUFFIELD WPCF	12/15/2010	CT0100552	1.8	0	0.64	0.6	9	
SUFFIELD WPCF	12/22/2010	CT0100552	1.3	0.5	2.14	2.6	28	
SUFFIELD WPCF	12/29/2010	CT0100552	1.2	0.9	3.29	4.2	42	2.2
					Average	2.1275	24.62745098	2.1
					April - October	1.8733	17.73333333	1.9
					Max	6.7	117	4.6
					Min	0.1	1	0.8
					Max (Apr-Oct)	5.2	48	2.9
					Min (Apr-Oct)	0.1	1	0.8

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
WATERBURY WPCF	01/04/2010	CT0100625	25.7	4.6	0.6	5.2	1115	
WATERBURY WPCF	01/05/2010	CT0100625	25.4	5.2	1.5	6.7	1419	
WATERBURY WPCF	01/10/2010	CT0100625	23	3.4	1.7	5.1	978	
WATERBURY WPCF	01/11/2010	CT0100625	22.2	2.9	0.7	3.6	667	
WATERBURY WPCF	01/12/2010	CT0100625	21.9	4.4	0.7	5.1	932	
WATERBURY WPCF	01/18/2010	CT0100625	23.6	3.5	1	4.5	886	
WATERBURY WPCF	01/19/2010	CT0100625	21.5	2.6	0.8	3.4	610	
WATERBURY WPCF	01/20/2010	CT0100625	21.2	2.9	1	3.9	690	
WATERBURY WPCF	01/24/2010	CT0100625	21.3	1.7	1.5	3.2	568	
WATERBURY WPCF	01/25/2010	CT0100625	35.1	20.1	2	22.1	6469	
WATERBURY WPCF	01/26/2010	CT0100625	33.6	2	4.1	6.1	1709	
WATERBURY WPCF	01/31/2010	CT0100625	27.1	2	1.5	3.5	791	6.0
WATERBURY WPCF	02/01/2010	CT0100625	26	1.7	1.2	2.9	629	
WATERBURY WPCF	02/02/2010	CT0100625	25.4	2.4	1.9	4.3	911	
WATERBURY WPCF	02/07/2010	CT0100625	23.4	1.9	1.7	3.6	703	
WATERBURY WPCF	02/08/2010	CT0100625	22.3	1.4	1.6	3	558	
WATERBURY WPCF	02/09/2010	CT0100625	22.8	4.1	3.3	7.4	1407	
WATERBURY WPCF	02/15/2010	CT0100625	21.1	1.3	1.5	2.8	493	
WATERBURY WPCF	02/16/2010	CT0100625	20.7	1.2	1.8	3	518	
WATERBURY WPCF	02/17/2010	CT0100625	21.1	1.9	2.1	4	704	
WATERBURY WPCF	02/21/2010	CT0100625	21.5	1.6	1.6	3.2	574	
WATERBURY WPCF	02/22/2010	CT0100625	20.6	1.8	1.3	3.1	533	
WATERBURY WPCF	02/23/2010	CT0100625	22	2.6	1.7	4.3	789	
WATERBURY WPCF	02/28/2010	CT0100625	37.4	2.8	2	4.8	1497	3.9
WATERBURY WPCF	03/01/2010	CT0100625	35.3	1.8	1.2	3	883	
WATERBURY WPCF	03/02/2010	CT0100625	33.4	3.4	1.8	5.2	1449	
WATERBURY WPCF	03/07/2010	CT0100625	29.2	3.1	0.8	3.9	950	
WATERBURY WPCF	03/08/2010	CT0100625	28.3	3.4	0.8	4.2	991	
WATERBURY WPCF	03/09/2010	CT0100625	28.4	4.1	1.1	5.2	1232	
WATERBURY WPCF	03/14/2010	CT0100625	44.3	3.2	2.8	6	2217	
WATERBURY WPCF	03/15/2010	CT0100625	48	3.5	3.2	6.7	2682	
WATERBURY WPCF	03/16/2010	CT0100625	43.4	3.5	2.7	6.2	2244	
WATERBURY WPCF	03/21/2010	CT0100625	30.8	1.7	1.1	2.8	719	
WATERBURY WPCF	03/22/2010	CT0100625	31.6	1.6	1.6	3.2	843	
WATERBURY WPCF	03/23/2010	CT0100625	43.9	4.9	2.3	7.2	2636	
WATERBURY WPCF	03/28/2010	CT0100625	31.1	1.3	1.9	3.2	830	
WATERBURY WPCF	03/29/2010	CT0100625	44.5	3.5	2	5.5	2041	
WATERBURY WPCF	03/30/2010	CT0100625	51	4.7	3.6	8.3	3530	5.0
WATERBURY WPCF	04/04/2010	CT0100625	41	1.4	2.4	3.8	1299	
WATERBURY WPCF	04/05/2010	CT0100625	40.6	1.5	1.7	3.2	1084	
WATERBURY WPCF	04/06/2010	CT0100625	35	0.9	2.5	3.4	992	
WATERBURY WPCF	04/11/2010	CT0100625	29.5	1.4	2	3.4	837	
WATERBURY WPCF	04/12/2010	CT0100625	29.6	0.8	1.8	2.6	642	
WATERBURY WPCF	04/13/2010	CT0100625	29.5	1	2.7	3.7	910	
WATERBURY WPCF	04/18/2010	CT0100625	26.4	1.2	2.6	3.8	837	
WATERBURY WPCF	04/19/2010	CT0100625	23.5	1	2.9	3.9	764	
WATERBURY WPCF	04/20/2010	CT0100625	23.7	1.1	3.2	4.3	850	
WATERBURY WPCF	04/25/2010	CT0100625	23.7	1.5	3.6	5.1	1008	
WATERBURY WPCF	04/26/2010	CT0100625	23.7	1.6	2.8	4.4	870	
WATERBURY WPCF	04/27/2010	CT0100625	22.5	1.3	3.3	4.6	863	3.9
WATERBURY WPCF	05/02/2010	CT0100625	20.6	7.6	3.3	10.9	1873	
WATERBURY WPCF	05/03/2010	CT0100625	22.4	1.4	2.5	3.9	729	
WATERBURY WPCF	05/04/2010	CT0100625	20.8	1.5	3.5	5	867	
WATERBURY WPCF	05/09/2010	CT0100625	19	1	1.9	2.9	460	
WATERBURY WPCF	05/10/2010	CT0100625	20.1	1.3	1.7	3	503	
WATERBURY WPCF	05/11/2010	CT0100625	20	1.5	1.9	3.4	567	
WATERBURY WPCF	05/16/2010	CT0100625	19.7	1	1.7	2.7	444	
WATERBURY WPCF	05/17/2010	CT0100625	20.1	0.9	1.6	2.5	419	
WATERBURY WPCF	05/18/2010	CT0100625	21.9	0.8	1.6	2.4	438	
WATERBURY WPCF	05/23/2010	CT0100625	19.4	0.5	2	2.5	405	
WATERBURY WPCF	05/24/2010	CT0100625	20.1	0.5	2.1	2.6	436	
WATERBURY WPCF	05/25/2010	CT0100625	20.1	0.5	2.8	3.3	553	
WATERBURY WPCF	05/31/2010	CT0100625	19.2	1.5	2.4	3.9	625	3.8
WATERBURY WPCF	06/01/2010	CT0100625	19.9	1.2	2.6	3.8	631	
WATERBURY WPCF	06/02/2010	CT0100625	19.9	1.2	3.2	4.4	730	
WATERBURY WPCF	06/06/2010	CT0100625	19.2	2.1	2.5	4.6	737	
WATERBURY WPCF	06/07/2010	CT0100625	19.7	1.7	2	3.7	608	
WATERBURY WPCF	06/08/2010	CT0100625	19.7	1.6	1.9	3.5	575	
WATERBURY WPCF	06/13/2010	CT0100625	20.5	1.7	1.9	3.6	616	
WATERBURY WPCF	06/14/2010	CT0100625	19.9	1.1	2.1	3.2	531	
WATERBURY WPCF	06/15/2010	CT0100625	20.1	1.4	2.3	3.7	620	
WATERBURY WPCF	06/20/2010	CT0100625	17.7	1.2	3	4.2	620	
WATERBURY WPCF	06/21/2010	CT0100625	18.5	1.3	2.1	3.4	525	
WATERBURY WPCF	06/22/2010	CT0100625	17.6	1.5	2.6	4.1	602	
WATERBURY WPCF	06/27/2010	CT0100625	18	1.2	3.2	4.4	661	
WATERBURY WPCF	06/28/2010	CT0100625	18.6	1.4	2.6	4	621	
WATERBURY WPCF	06/29/2010	CT0100625	19.1	1.6	3.3	4.9	781	4.0
WATERBURY WPCF	07/05/2010	CT0100625	17.1	5.9	1.5	7.4	1055	
WATERBURY WPCF	07/06/2010	CT0100625	18.4	2	2.5	4.5	691	
WATERBURY WPCF	07/07/2010	CT0100625	18.1	1.6	2.9	4.5	679	
WATERBURY WPCF	07/11/2010	CT0100625	17	1.4	3.1	4.5	638	

WATERBURY WPCF	07/12/2010	CT0100625	18.1	0.6	3.9	4.5	679	
WATERBURY WPCF	07/13/2010	CT0100625	20.8	1.4	4.7	6.1	1058	
WATERBURY WPCF	07/19/2010	CT0100625	18.1	1.2	4.8	6	906	
WATERBURY WPCF	07/20/2010	CT0100625	17.8	1.3	6.4	7.7	1143	
WATERBURY WPCF	07/21/2010	CT0100625	17.9	1.3	7.1	8.4	1254	
WATERBURY WPCF	07/25/2010	CT0100625	17.6	1.3	2.4	3.7	543	
WATERBURY WPCF	07/26/2010	CT0100625	17.7	1.1	2.7	3.8	561	
WATERBURY WPCF	07/27/2010	CT0100625	17.7	1.4	2	3.4	502	5.4
WATERBURY WPCF	08/01/2010	CT0100625	16.5	1.3	1.3	2.6	358	
WATERBURY WPCF	08/02/2010	CT0100625	17.4	1.4	1.4	2.8	406	
WATERBURY WPCF	08/03/2010	CT0100625	16.5	1.6	1.7	3.3	454	
WATERBURY WPCF	08/08/2010	CT0100625	16.2	1.1	1.6	2.7	365	
WATERBURY WPCF	08/09/2010	CT0100625	18	1.2	2.4	3.6	540	
WATERBURY WPCF	08/10/2010	CT0100625	17.3	1.1	2.5	3.6	519	
WATERBURY WPCF	08/15/2010	CT0100625	16.3	1.3	1.2	2.5	340	
WATERBURY WPCF	08/16/2010	CT0100625	20.1	1.2	1.6	2.8	469	
WATERBURY WPCF	08/17/2010	CT0100625	18.9	0.8	2	2.8	441	
WATERBURY WPCF	08/22/2010	CT0100625	21	1.6	1.5	3.1	543	
WATERBURY WPCF	08/23/2010	CT0100625	22.5	1.1	1.2	2.3	432	
WATERBURY WPCF	08/24/2010	CT0100625	19.3	1.9	1.2	3.1	499	
WATERBURY WPCF	08/30/2010	CT0100625	19	1.4	1.8	3.2	507	
WATERBURY WPCF	08/31/2010	CT0100625	19	1.3	2.4	3.7	586	3.0
WATERBURY WPCF	09/06/2010	CT0100625	17.6	1.4	0.1	1.5	220	
WATERBURY WPCF	09/07/2010	CT0100625	18.7	0.7	1.1	1.8	281	
WATERBURY WPCF	09/08/2010	CT0100625	18.2	1.5	2.3	3.8	577	
WATERBURY WPCF	09/12/2010	CT0100625	17.5	1.5	1.3	2.8	409	
WATERBURY WPCF	09/13/2010	CT0100625	18.1	1.9	1	2.9	438	
WATERBURY WPCF	09/14/2010	CT0100625	17.2	2.5	1.2	3.7	531	
WATERBURY WPCF	09/19/2010	CT0100625	17.2	2.6	1.3	3.9	559	
WATERBURY WPCF	09/20/2010	CT0100625	16.5	1.5	1.4	2.9	399	
WATERBURY WPCF	09/21/2010	CT0100625	14.4	1.7	1.7	3.4	408	
WATERBURY WPCF	09/26/2010	CT0100625	17.7	1.2	2.5	3.7	546	
WATERBURY WPCF	09/27/2010	CT0100625	18.3	1.3	2.4	3.7	565	
WATERBURY WPCF	09/28/2010	CT0100625	22	1.3	2.8	4.1	752	3.2
WATERBURY WPCF	10/03/2010	CT0100625	19.2	1.3	1.8	3.1	496	
WATERBURY WPCF	10/04/2010	CT0100625	19.7	1.3	1.6	2.9	476	
WATERBURY WPCF	10/05/2010	CT0100625	19.8	1.7	1.7	3.4	561	
WATERBURY WPCF	10/11/2010	CT0100625	18.4	0.6	1.6	2.2	338	
WATERBURY WPCF	10/12/2010	CT0100625	19.2	0.5	1.5	2	320	
WATERBURY WPCF	10/13/2010	CT0100625	19.1	0.6	1.9	2.5	398	
WATERBURY WPCF	10/17/2010	CT0100625	18.4	1.3	1.8	3.1	476	
WATERBURY WPCF	10/18/2010	CT0100625	19.2	1.1	1.4	2.5	400	
WATERBURY WPCF	10/19/2010	CT0100625	19	1.3	1.8	3.1	491	
WATERBURY WPCF	10/24/2010	CT0100625	17.7	1.3	1.7	3	443	
WATERBURY WPCF	10/25/2010	CT0100625	18.9	1.3	1.7	3	473	
WATERBURY WPCF	10/26/2010	CT0100625	19.1	1.2	2.6	3.8	605	2.9
WATERBURY WPCF	11/01/2010	CT0100625	18.5	1.7	1.6	3.3	509	
WATERBURY WPCF	11/02/2010	CT0100625	18.2	1.4	1.9	3.3	501	
WATERBURY WPCF	11/07/2010	CT0100625	19	1.6	1.4	3	475	
WATERBURY WPCF	11/08/2010	CT0100625	19.2	1.6	0.2	1.8	288	
WATERBURY WPCF	11/09/2010	CT0100625	19.5	1.7	1.7	3.4	553	
WATERBURY WPCF	11/14/2010	CT0100625	18.1	1.9	1.4	3.3	498	
WATERBURY WPCF	11/15/2010	CT0100625	18.9	2.1	1.3	3.4	536	
WATERBURY WPCF	11/16/2010	CT0100625	19.2	2.5	1.2	3.7	592	
WATERBURY WPCF	11/21/2010	CT0100625	19	2.1	1.3	3.4	539	
WATERBURY WPCF	11/22/2010	CT0100625	19.6	2.9	1.3	4.2	687	
WATERBURY WPCF	11/23/2010	CT0100625	19.7	1.8	1.8	3.6	591	
WATERBURY WPCF	11/28/2010	CT0100625	18.3	1.8	1.8	3.6	549	
WATERBURY WPCF	11/29/2010	CT0100625	19	1.9	1.9	3.8	602	
WATERBURY WPCF	11/30/2010	CT0100625	19.4	1.2	2.1	3.3	534	3.4
WATERBURY WPCF	12/05/2010	CT0100625	22.6	1.2	1.7	2.9	547	
WATERBURY WPCF	12/06/2010	CT0100625	21.4	1.2	1.6	2.8	500	
WATERBURY WPCF	12/08/2010	CT0100625	20.6	2.8	2.6	5.4	928	
WATERBURY WPCF	12/12/2010	CT0100625	30.1	3.3	1.8	5.1	1280	
WATERBURY WPCF	12/13/2010	CT0100625	34.4	2.5	2.2	4.7	1348	
WATERBURY WPCF	12/14/2010	CT0100625	30.4	2.4	3	5.4	1369	
WATERBURY WPCF	12/19/2010	CT0100625	24.2	2.5	1.8	4.3	868	
WATERBURY WPCF	12/20/2010	CT0100625	23.7	2.2	1.3	3.5	692	
WATERBURY WPCF	12/21/2010	CT0100625	22.3	2.7	2.2	4.9	911	
WATERBURY WPCF	12/26/2010	CT0100625	19.7	2.1	1.7	3.8	624	
WATERBURY WPCF	12/27/2010	CT0100625	20	2.2	2.1	4.3	717	
WATERBURY WPCF	12/28/2010	CT0100625	19.9	2.6	1.9	4.5	747	4.3
					Average	4.0405	802.9084967	**4.1**
					April - October	3.709	623.1797753	**3.7**
					Max	22.1	6469	**6.0**
					Min	1.5	220	**2.9**
					Max (Apr-Oct)	10.9	1873	**5.4**
					Min (Apr-Oct)	1.5	220	**2.9**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
WESTPORT WPCF	01/12/2010	CT0100684	1.73	1.4	0.8	2.2	32	
WESTPORT WPCF	01/19/2010	CT0100684	1.67	1.9	1.2	3.1	43	
WESTPORT WPCF	01/26/2010	CT0100684	2.19	3.4	0.5	3.9	71	3.1
WESTPORT WPCF	02/02/2010	CT0100684	1.67	3.6	1.1	4.7	65	
WESTPORT WPCF	02/09/2010	CT0100684	1.54	4.1	1.1	5.2	67	
WESTPORT WPCF	02/16/2010	CT0100684	1.28	3.4	1.4	4.8	51	
WESTPORT WPCF	02/23/2010	CT0100684	1.46	2.8	1.2	4	49	4.7
WESTPORT WPCF	03/02/2010	CT0100684	3.23	1.7	1.3	3	81	
WESTPORT WPCF	03/09/2010	CT0100684	2.29	1.2	2.4	3.6	69	
WESTPORT WPCF	03/16/2010	CT0100684	4.44	1.2	5.7	6.9	256	
WESTPORT WPCF	03/23/2010	CT0100684	3.6	1	2.8	3.8	114	
WESTPORT WPCF	03/30/2010	CT0100684	5.39	1.2	2.9	4.1	184	4.3
WESTPORT WPCF	04/06/2010	CT0100684	3.08	1	2.2	3.2	82	
WESTPORT WPCF	04/13/2010	CT0100684	2.2	1.1	1.3	2.4	44	
WESTPORT WPCF	04/20/2010	CT0100684	1.83	1	0.9	1.9	29	
WESTPORT WPCF	04/27/2010	CT0100684	2.2	1	1	2	37	2.4
WESTPORT WPCF	05/04/2010	CT0100684	1.99	1.3	0.8	2.1	35	
WESTPORT WPCF	05/11/2010	CT0100684	1.47	1.2	1.4	2.6	32	
WESTPORT WPCF	05/25/2010	CT0100684	1.45	1.1	1.7	2.8	34	
WESTPORT WPCF	05/28/2010	CT0100684	1.57	1.4	1.5	2.9	38	2.6
WESTPORT WPCF	06/01/2010	CT0100684	1.41	1	0.9	1.9	22	
WESTPORT WPCF	06/08/2010	CT0100684	1.49	1.2	0.7	1.9	24	
WESTPORT WPCF	06/15/2010	CT0100684	1.33	1.9	0.4	2.3	26	
WESTPORT WPCF	06/20/2010	CT0100684	1.34	1.4	0.8	2.2	25	2.1
WESTPORT WPCF	07/06/2010	CT0100684	1.06	1.1	0.8	1.9	17	
WESTPORT WPCF	07/13/2010	CT0100684	1.19	1.8	0.7	2.5	25	
WESTPORT WPCF	07/20/2010	CT0100684	1.5	1.3	0.6	1.9	24	
WESTPORT WPCF	07/28/2010	CT0100684	1.23	1.1	0.7	1.8	18	2.0
WESTPORT WPCF	08/03/2010	CT0100684	1.21	1	0.9	1.9	19	
WESTPORT WPCF	08/10/2010	CT0100684	1.2	1.1	0.6	1.7	17	
WESTPORT WPCF	08/17/2010	CT0100684	1.25	1.3	0.3	1.6	17	
WESTPORT WPCF	08/24/2010	CT0100684	1.46	1.2	0.6	1.8	22	
WESTPORT WPCF	08/31/2010	CT0100684	1.24	1.1	0.5	1.6	17	1.7
WESTPORT WPCF	09/06/2010	CT0100684	1.03	1.1	0.7	1.8	15	
WESTPORT WPCF	09/14/2010	CT0100684	1.23	1.9	0.6	2.5	26	
WESTPORT WPCF	09/21/2010	CT0100684	1.14	1.5	0.7	2.2	21	
WESTPORT WPCF	09/28/2010	CT0100684	1.3	1.3	0.5	1.8	20	2.1
WESTPORT WPCF	10/05/2010	CT0100684	1.51	1.5	0.5	2	25	
WESTPORT WPCF	10/12/2010	CT0100684	1.25	1.1	0.4	1.5	16	
WESTPORT WPCF	10/19/2010	CT0100684	1.31	1.3	0.8	2.1	23	
WESTPORT WPCF	10/26/2010	CT0100684	1.31	1.5	1.1	2.6	28	2.1
WESTPORT WPCF	11/02/2010	CT0100684	1.173	1.8	0.5	2.3	23	
WESTPORT WPCF	11/09/2010	CT0100684	1.37	1.1	1	2.1	24	
WESTPORT WPCF	11/16/2010	CT0100684	1.32	1.5	0.5	2	22	
WESTPORT WPCF	11/23/2010	CT0100684	1.4	1.4	0.4	1.8	21	
WESTPORT WPCF	11/30/2010	CT0100684	1.35	1.3	0.7	2	23	2.0
WESTPORT WPCF	12/07/2010	CT0100684	1.46	1.4	0.8	2.2	27	
WESTPORT WPCF	12/14/2010	CT0100684	1.93	1.3	2.2	3.5	56	
WESTPORT WPCF	12/21/2010	CT0100684	1.56	1.3	1.1	2.4	31	
WESTPORT WPCF	12/28/2010	CT0100684	1.27	1.3	0.9	2.2	23	2.6
					Average	2.624	42.2	**2.6**
					April - October	2.1172	26.82758621	**2.1**
					Max	6.9	256	**4.7**
					Min	1.5	15	**1.7**
					Max (Apr-Oct)	3.2	82	**2.6**
					Min (Apr-Oct)	1.5	15	**1.7**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
STAMFORD WPCF	01/04/2010	CT0101087	17.9	2.3	1.1	3.4	508	
STAMFORD WPCF	01/05/2010	CT0101087	17.4	2.9	1.6	4.5	653	
STAMFORD WPCF	01/06/2010	CT0101087	17	2.6	1.9	4.5	638	
STAMFORD WPCF	01/07/2010	CT0101087	16.7	2.6	1.7	4.3	599	
STAMFORD WPCF	01/11/2010	CT0101087	16	2.7	1.8	4.5	600	
STAMFORD WPCF	01/12/2010	CT0101087	15.8	3	1.6	4.6	606	
STAMFORD WPCF	01/13/2010	CT0101087	15.7	2.3	1.9	4.2	550	
STAMFORD WPCF	01/14/2010	CT0101087	15.5	2.6	1.6	4.2	543	
STAMFORD WPCF	01/18/2010	CT0101087	15.9	2.3	1	3.3	438	
STAMFORD WPCF	01/19/2010	CT0101087	15.3	2.8	0.8	3.6	459	
STAMFORD WPCF	01/20/2010	CT0101087	15.3	2	1.1	3.1	396	
STAMFORD WPCF	01/21/2010	CT0101087	15.1	2	1.5	3.5	441	
STAMFORD WPCF	01/24/2010	CT0101087	14.7	2.9	1.2	4.1	503	
STAMFORD WPCF	01/25/2010	CT0101087	17.5	9.5	1.4	10.9	1591	
STAMFORD WPCF	01/26/2010	CT0101087	17.5	3.2	0.9	4.1	598	
STAMFORD WPCF	01/27/2010	CT0101087	17	3.2	1.7	4.9	695	
STAMFORD WPCF	01/28/2010	CT0101087	16.8	2.9	1.7	4.6	645	
STAMFORD WPCF	01/31/2010	CT0101087	16.2	6.2	1.4	7.6	1027	4.7
STAMFORD WPCF	02/01/2010	CT0101087	16	8.9	0.9	9.8	1308	
STAMFORD WPCF	02/02/2010	CT0101087	15.7	4.5	0.8	5.3	694	
STAMFORD WPCF	02/03/2010	CT0101087	15.5	2.7	1.1	3.8	491	
STAMFORD WPCF	02/04/2010	CT0101087	15.4	2.7	1.3	4	514	
STAMFORD WPCF	02/07/2010	CT0101087	15.1	2.8	1.8	4.6	579	
STAMFORD WPCF	02/08/2010	CT0101087	15	2.9	1.6	4.5	563	
STAMFORD WPCF	02/09/2010	CT0101087	14.5	3.2	1.4	4.6	556	
STAMFORD WPCF	02/10/2010	CT0101087	14.5	3.1	1.3	4.4	532	
STAMFORD WPCF	02/15/2010	CT0101087	14.3	2.7	0.6	3.3	394	
STAMFORD WPCF	02/16/2010	CT0101087	14.4	2.9	0.7	3.6	432	
STAMFORD WPCF	02/17/2010	CT0101087	14.3	2.4	1.2	3.6	429	
STAMFORD WPCF	02/21/2010	CT0101087	14.8	2.2	0.9	3.1	383	
STAMFORD WPCF	02/22/2010	CT0101087	14.8	6.2	1.2	7.4	913	
STAMFORD WPCF	02/23/2010	CT0101087	15.9	6.6	1.6	8.2	1087	
STAMFORD WPCF	02/28/2010	CT0101087	27.8	2.4	1.5	3.9	904	4.9
STAMFORD WPCF	03/01/2010	CT0101087	26.5	2.5	1.2	3.7	818	
STAMFORD WPCF	03/02/2010	CT0101087	25.4	2	1.8	3.8	805	
STAMFORD WPCF	03/03/2010	CT0101087	24.6	1.9	1.8	3.7	759	
STAMFORD WPCF	03/04/2010	CT0101087	23.4	1.9	1.7	3.6	703	
STAMFORD WPCF	03/07/2010	CT0101087	20.8	2.2	0.7	2.9	503	
STAMFORD WPCF	03/08/2010	CT0101087	20.2	2	0.7	2.7	455	
STAMFORD WPCF	03/09/2010	CT0101087	19.6	2.2	1.2	3.4	556	
STAMFORD WPCF	03/10/2010	CT0101087	19	2.2	0.9	3.1	491	
STAMFORD WPCF	03/11/2010	CT0101087	18.5	2.4	1	3.4	525	
STAMFORD WPCF	03/15/2010	CT0101087	34.3	13.1	0.2	13.3	3805	
STAMFORD WPCF	03/16/2010	CT0101087	30.3	11.9	0.3	12.2	3083	
STAMFORD WPCF	03/17/2010	CT0101087	26.8	5.1	0.4	5.5	1229	
STAMFORD WPCF	03/18/2010	CT0101087	25.7	1.8	0.5	2.3	493	
STAMFORD WPCF	03/21/2010	CT0101087	21.7	1.9	0.5	2.4	434	
STAMFORD WPCF	03/24/2010	CT0101087	30.4	5.9	0.6	6.5	1648	
STAMFORD WPCF	03/25/2010	CT0101087	27.3	3.3	1.2	4.5	1025	
STAMFORD WPCF	03/28/2010	CT0101087	22.8	1.9	0.5	2.4	456	
STAMFORD WPCF	03/29/2010	CT0101087	33.7	14	0.3	14.3	4019	
STAMFORD WPCF	03/31/2010	CT0101087	46.6	7.8	1.5	9.3	3614	5.4
STAMFORD WPCF	04/04/2010	CT0101087	26.6	2.4	0.3	2.7	599	
STAMFORD WPCF	04/05/2010	CT0101087	25.3	2.2	0.3	2.5	528	
STAMFORD WPCF	04/06/2010	CT0101087	24.1	2	0.4	2.4	482	
STAMFORD WPCF	04/07/2010	CT0101087	22.9	2.2	0.4	2.6	497	
STAMFORD WPCF	04/08/2010	CT0101087	22	2.4	0.4	2.8	514	
STAMFORD WPCF	04/11/2010	CT0101087	19.6	2.2	0.6	2.8	458	
STAMFORD WPCF	04/12/2010	CT0101087	19.3	2.3	0.6	2.9	467	
STAMFORD WPCF	04/13/2010	CT0101087	18.6	2.6	0.9	3.5	543	
STAMFORD WPCF	04/14/2010	CT0101087	18.3	2.2	1.1	3.3	504	
STAMFORD WPCF	04/15/2010	CT0101087	17.9	2.3	1.3	3.6	537	
STAMFORD WPCF	04/18/2010	CT0101087	17.6	2.1	1.3	3.4	499	
STAMFORD WPCF	04/19/2010	CT0101087	17.3	2.1	0.8	2.9	418	
STAMFORD WPCF	04/20/2010	CT0101087	16.9	2.6	0.9	3.5	493	
STAMFORD WPCF	04/21/2010	CT0101087	16.7	2.4	0.8	3.2	446	
STAMFORD WPCF	04/22/2010	CT0101087	16.6	2.4	0.7	3.1	429	
STAMFORD WPCF	04/25/2010	CT0101087	17.2	2.3	1	3.3	473	
STAMFORD WPCF	04/26/2010	CT0101087	18.7	2.8	0.6	3.4	530	
STAMFORD WPCF	04/27/2010	CT0101087	18.8	3.4	0.8	4.2	659	
STAMFORD WPCF	04/28/2010	CT0101087	16.6	1.8	1.8	3.6	498	
STAMFORD WPCF	04/29/2010	CT0101087	16.8	1.9	0.9	2.8	392	3.1
STAMFORD WPCF	05/02/2010	CT0101087	16.5	1.8	0.7	2.5	344	
STAMFORD WPCF	05/03/2010	CT0101087	18.4	1.9	0.6	2.5	384	
STAMFORD WPCF	05/04/2010	CT0101087	17.2	1.9	0.7	2.6	373	
STAMFORD WPCF	05/05/2010	CT0101087	16.8	1.9	0.7	2.6	364	
STAMFORD WPCF	05/06/2010	CT0101087	16.4	1.9	0.8	2.7	369	
STAMFORD WPCF	05/09/2010	CT0101087	15.8	2	0.6	2.6	343	
STAMFORD WPCF	05/10/2010	CT0101087	15.9	2.3	0.5	2.8	371	
STAMFORD WPCF	05/11/2010	CT0101087	15.6	2.4	0.6	3	390	
STAMFORD WPCF	05/12/2010	CT0101087	16.1	2.4	0.7	3.1	416	

STAMFORD WPCF	05/13/2010	CT0101087	15.7	2.2	1.2	3.4	445	
STAMFORD WPCF	05/16/2010	CT0101087	15.2	2.1	0.8	2.9	368	
STAMFORD WPCF	05/17/2010	CT0101087	15.3	2.2	0.7	2.9	370	
STAMFORD WPCF	05/18/2010	CT0101087	16.3	2.4	1	3.4	462	
STAMFORD WPCF	05/19/2010	CT0101087	16.2	1.5	1.3	2.8	378	
STAMFORD WPCF	05/20/2010	CT0101087	15.8	1.4	1.1	2.5	329	
STAMFORD WPCF	05/23/2010	CT0101087	15.2	1.5	0.9	2.4	304	
STAMFORD WPCF	05/24/2010	CT0101087	15.6	1.7	0.7	2.4	312	
STAMFORD WPCF	05/25/2010	CT0101087	15.4	1.8	0.6	2.4	308	
STAMFORD WPCF	05/26/2010	CT0101087	15.5	1.6	0.7	2.3	297	
STAMFORD WPCF	05/27/2010	CT0101087	15.1	1.6	0.8	2.4	302	
STAMFORD WPCF	05/31/2010	CT0101087	14.7	1.4	0.9	2.3	282	2.7
STAMFORD WPCF	06/01/2010	CT0101087	15.1	1.6	0.8	2.4	302	
STAMFORD WPCF	06/02/2010	CT0101087	14.8	1.7	0.8	2.5	309	
STAMFORD WPCF	06/03/2010	CT0101087	14.7	1.4	1	2.4	294	
STAMFORD WPCF	06/06/2010	CT0101087	14.6	1.5	0.9	2.4	292	
STAMFORD WPCF	06/07/2010	CT0101087	14.3	1.5	0.7	2.2	262	
STAMFORD WPCF	06/08/2010	CT0101087	14.2	2.1	0.9	3	355	
STAMFORD WPCF	06/09/2010	CT0101087	14.8	1.9	1.3	3.2	395	
STAMFORD WPCF	06/13/2010	CT0101087	14.2	1.7	0.6	2.3	272	
STAMFORD WPCF	06/14/2010	CT0101087	14.5	1.7	0.7	2.4	290	
STAMFORD WPCF	06/15/2010	CT0101087	14.4	2.1	0.6	2.7	324	
STAMFORD WPCF	06/16/2010	CT0101087	14.4	1.6	0.8	2.4	288	
STAMFORD WPCF	06/17/2010	CT0101087	14.6	1.8	1	2.8	341	
STAMFORD WPCF	06/20/2010	CT0101087	14.2	2	1.5	3.5	415	
STAMFORD WPCF	06/21/2010	CT0101087	14.3	1.9	1.2	3.1	370	
STAMFORD WPCF	06/22/2010	CT0101087	14.5	2.1	1.1	3.2	387	
STAMFORD WPCF	06/23/2010	CT0101087	14.8	1.6	1.1	2.7	333	
STAMFORD WPCF	06/24/2010	CT0101087	14.2	1.6	1.2	2.8	332	
STAMFORD WPCF	06/27/2010	CT0101087	13.8	1.7	0.9	2.6	299	
STAMFORD WPCF	06/28/2010	CT0101087	14.5	1.6	0.9	2.5	302	
STAMFORD WPCF	06/29/2010	CT0101087	14.2	1.8	0.8	2.6	308	
STAMFORD WPCF	06/30/2010	CT0101087	13.7	1.7	1.3	3	343	2.7
STAMFORD WPCF	07/05/2010	CT0101087	13	1.6	1.7	3.3	358	
STAMFORD WPCF	07/06/2010	CT0101087	13.4	1.6	1.4	3	335	
STAMFORD WPCF	07/07/2010	CT0101087	13.6	1.7	1.8	3.5	397	
STAMFORD WPCF	07/08/2010	CT0101087	13.8	1.4	1.7	3.1	357	
STAMFORD WPCF	07/11/2010	CT0101087	13.3	1.5	1.5	3	333	
STAMFORD WPCF	07/12/2010	CT0101087	13.6	1.5	1.1	2.6	295	
STAMFORD WPCF	07/13/2010	CT0101087	15.4	1.8	1	2.8	360	
STAMFORD WPCF	07/14/2010	CT0101087	15.2	1.6	0.8	2.4	304	
STAMFORD WPCF	07/15/2010	CT0101087	15	1.5	0.7	2.2	275	
STAMFORD WPCF	07/18/2010	CT0101087	13.6	1.5	0.8	2.3	261	
STAMFORD WPCF	07/19/2010	CT0101087	15.2	1.6	0.7	2.3	292	
STAMFORD WPCF	07/20/2010	CT0101087	14.4	2.5	0.7	3.2	384	
STAMFORD WPCF	07/21/2010	CT0101087	14.9	2.1	1.1	3.2	398	
STAMFORD WPCF	07/22/2010	CT0101087	15	2.3	1.5	3.8	475	
STAMFORD WPCF	07/25/2010	CT0101087	14.7	2.8	1.3	4.1	503	
STAMFORD WPCF	07/26/2010	CT0101087	14.5	2.4	1.5	3.9	472	
STAMFORD WPCF	07/27/2010	CT0101087	14.3	2.4	1.7	4.1	489	
STAMFORD WPCF	07/28/2010	CT0101087	14.3	1.9	1.9	3.8	453	
STAMFORD WPCF	07/29/2010	CT0101087	14.3	1.9	2	3.9	465	3.2
STAMFORD WPCF	08/01/2010	CT0101087	13.4	2	0.7	2.7	302	
STAMFORD WPCF	08/02/2010	CT0101087	13.8	2.1	0.8	2.9	334	
STAMFORD WPCF	08/03/2010	CT0101087	13.6	2.7	0.7	3.4	386	
STAMFORD WPCF	08/04/2010	CT0101087	13.8	1.9	0.9	2.8	322	
STAMFORD WPCF	08/05/2010	CT0101087	13.7	1.9	0.9	2.8	320	
STAMFORD WPCF	08/08/2010	CT0101087	13.2	1.8	1	2.8	308	
STAMFORD WPCF	08/09/2010	CT0101087	13.7	1.8	1.1	2.9	331	
STAMFORD WPCF	08/10/2010	CT0101087	13.6	1.9	1	2.9	329	
STAMFORD WPCF	08/11/2010	CT0101087	13.6	1.6	0.9	2.5	284	
STAMFORD WPCF	08/12/2010	CT0101087	13.7	1.6	0.9	2.5	286	
STAMFORD WPCF	08/15/2010	CT0101087	13	1.7	1	2.7	293	
STAMFORD WPCF	08/16/2010	CT0101087	14	1.6	1.1	2.7	315	
STAMFORD WPCF	08/17/2010	CT0101087	13.5	1.8	0.8	2.6	293	
STAMFORD WPCF	08/18/2010	CT0101087	13.1	1.7	1.1	2.8	306	
STAMFORD WPCF	08/19/2010	CT0101087	13	1.8	1.1	2.9	314	
STAMFORD WPCF	08/22/2010	CT0101087	14.6	1.8	0.8	2.6	317	
STAMFORD WPCF	08/23/2010	CT0101087	15.3	1.7	0.6	2.3	293	
STAMFORD WPCF	08/24/2010	CT0101087	14.1	1.8	0.7	2.5	294	
STAMFORD WPCF	08/25/2010	CT0101087	14.1	1.5	0.7	2.2	259	
STAMFORD WPCF	08/26/2010	CT0101087	13.9	1.7	0.7	2.4	278	
STAMFORD WPCF	08/29/2010	CT0101087	13.4	1.8	0.9	2.7	302	
STAMFORD WPCF	08/30/2010	CT0101087	13.8	1.7	0.8	2.5	288	
STAMFORD WPCF	08/31/2010	CT0101087	13.8	1.7	0.8	2.5	288	2.7
STAMFORD WPCF	09/01/2010	CT0101087	13.8	1.5	0.8	2.3	265	
STAMFORD WPCF	09/02/2010	CT0101087	13.7	1.5	0.9	2.4	274	
STAMFORD WPCF	09/06/2010	CT0101087	13.1	1.7	0.9	2.6	284	
STAMFORD WPCF	09/07/2010	CT0101087	13.5	1.7	0.6	2.3	259	
STAMFORD WPCF	09/08/2010	CT0101087	13.4	1.9	0.7	2.6	291	
STAMFORD WPCF	09/09/2010	CT0101087	13.4	1.9	0.8	2.7	302	
STAMFORD WPCF	09/12/2010	CT0101087	13.2	2.4	1.1	3.5	385	

STAMFORD WPCF	09/13/2010 CT0101087	13.5	2.1	1	3.1	349	
STAMFORD WPCF	09/14/2010 CT0101087	13.1	2.3	0.9	3.2	350	
STAMFORD WPCF	09/15/2010 CT0101087	13	2.1	1.2	3.3	358	
STAMFORD WPCF	09/16/2010 CT0101087	13.8	1.9	0.9	2.8	322	
STAMFORD WPCF	09/19/2010 CT0101087	13	2.1	0.9	3	325	
STAMFORD WPCF	09/20/2010 CT0101087	13	2	0.7	2.7	293	
STAMFORD WPCF	09/21/2010 CT0101087	12.9	2.2	0.7	2.9	312	
STAMFORD WPCF	09/22/2010 CT0101087	13.3	1.6	0.9	2.5	277	
STAMFORD WPCF	09/23/2010 CT0101087	13.2	1.6	0.8	2.4	264	
STAMFORD WPCF	09/26/2010 CT0101087	12.8	1.7	0.7	2.4	256	
STAMFORD WPCF	09/27/2010 CT0101087	13.9	1.9	0.6	2.5	290	
STAMFORD WPCF	09/28/2010 CT0101087	13.8	3.2	0.6	3.8	437	
STAMFORD WPCF	09/29/2010 CT0101087	13.5	2.6	0.7	3.3	372	2.8
STAMFORD WPCF	10/03/2010 CT0101087	15.5	1.7	0.8	2.5	323	
STAMFORD WPCF	10/04/2010 CT0101087	15.5	1.8	0.7	2.5	323	
STAMFORD WPCF	10/05/2010 CT0101087	15.3	2.1	0.7	2.8	357	
STAMFORD WPCF	10/06/2010 CT0101087	15.3	2	0.6	2.6	332	
STAMFORD WPCF	10/07/2010 CT0101087	15	2.3	0.7	3	375	
STAMFORD WPCF	10/11/2010 CT0101087	14.7	1.8	0.6	2.4	294	
STAMFORD WPCF	10/12/2010 CT0101087	14.7	1.8	0.6	2.4	294	
STAMFORD WPCF	10/13/2010 CT0101087	14.2	2.2	0.7	2.9	343	
STAMFORD WPCF	10/14/2010 CT0101087	15	1.7	0.7	2.4	300	
STAMFORD WPCF	10/17/2010 CT0101087	15	1.6	0.5	2.1	263	
STAMFORD WPCF	10/18/2010 CT0101087	14.9	2	0.5	2.5	311	
STAMFORD WPCF	10/19/2010 CT0101087	14.8	1.7	0.7	2.4	296	
STAMFORD WPCF	10/20/2010 CT0101087	14.6	1.9	0.8	2.7	329	
STAMFORD WPCF	10/21/2010 CT0101087	14.8	1.8	0.8	2.6	321	
STAMFORD WPCF	10/24/2010 CT0101087	14.4	1.6	0.7	2.3	276	
STAMFORD WPCF	10/25/2010 CT0101087	14.4	1.7	0.7	2.4	288	
STAMFORD WPCF	10/26/2010 CT0101087	14.4	1.9	0.9	2.8	336	
STAMFORD WPCF	10/27/2010 CT0101087	14.8	1.6	0.9	2.5	309	
STAMFORD WPCF	10/28/2010 CT0101087	14.4	1.7	1	2.7	324	
STAMFORD WPCF	10/31/2010 CT0101087	13.8	1.9	0.8	2.7	311	2.6
STAMFORD WPCF	11/01/2010 CT0101087	13.8	2.1	0.8	2.9	334	
STAMFORD WPCF	11/02/2010 CT0101087	13.9	2.1	0.8	2.9	336	
STAMFORD WPCF	11/03/2010 CT0101087	13.8	1.7	0.7	2.4	276	
STAMFORD WPCF	11/04/2010 CT0101087	15.3	1.8	0.5	2.3	293	
STAMFORD WPCF	11/07/2010 CT0101087	14.4	2	0.7	2.7	324	
STAMFORD WPCF	11/08/2010 CT0101087	15.2	2.1	0.9	3	380	
STAMFORD WPCF	11/09/2010 CT0101087	15.5	2.3	0.6	2.9	375	
STAMFORD WPCF	11/11/2010 CT0101087	14.1	2.4	1.3	3.7	435	
STAMFORD WPCF	11/14/2010 CT0101087	13.9	2.2	0.7	2.9	336	
STAMFORD WPCF	11/15/2010 CT0101087	13.9	2.3	0.7	3	348	
STAMFORD WPCF	11/16/2010 CT0101087	14	3.5	0.8	4.3	502	
STAMFORD WPCF	11/17/2010 CT0101087	15.4	2.4	0.8	3.2	411	
STAMFORD WPCF	11/18/2010 CT0101087	14.4	2.1	0.9	3	360	
STAMFORD WPCF	11/21/2010 CT0101087	14.1	2.3	0.6	2.9	341	
STAMFORD WPCF	11/22/2010 CT0101087	14	2.3	0.7	3	350	
STAMFORD WPCF	11/23/2010 CT0101087	14.1	2.1	0.9	3	353	
STAMFORD WPCF	11/28/2010 CT0101087	13.9	2.1	1.1	3.2	371	
STAMFORD WPCF	11/29/2010 CT0101087	13.7	2.1	0.9	3	343	
STAMFORD WPCF	11/30/2010 CT0101087	13.5	3.5	1	4.5	507	3.1
STAMFORD WPCF	12/05/2010 CT0101087	14.7	2.2	1	3.2	392	
STAMFORD WPCF	12/06/2010 CT0101087	14.6	2.1	0.9	3	365	
STAMFORD WPCF	12/07/2010 CT0101087	14.1	2.3	1.3	3.6	423	
STAMFORD WPCF	12/08/2010 CT0101087	14.1	2.3	1.6	3.9	459	
STAMFORD WPCF	12/09/2010 CT0101087	14	2.2	1.9	4.1	479	
STAMFORD WPCF	12/13/2010 CT0101087	17.1	2.5	0.7	3.2	456	
STAMFORD WPCF	12/14/2010 CT0101087	16	3.3	1	4.3	574	
STAMFORD WPCF	12/15/2010 CT0101087	15.7	2.5	1.2	3.7	484	
STAMFORD WPCF	12/16/2010 CT0101087	15.4	2.6	1.3	3.9	501	
STAMFORD WPCF	12/19/2010 CT0101087	15	2.4	1.4	3.8	475	
STAMFORD WPCF	12/20/2010 CT0101087	14.9	2.6	1.4	4	497	
STAMFORD WPCF	12/21/2010 CT0101087	14.8	2.2	2.1	4.3	531	
STAMFORD WPCF	12/22/2010 CT0101087	14.7	2.4	2	4.4	539	
STAMFORD WPCF	12/26/2010 CT0101087	13.8	2.3	1.5	3.8	437	
STAMFORD WPCF	12/27/2010 CT0101087	14	2.7	2.2	4.9	572	
STAMFORD WPCF	12/28/2010 CT0101087	14	2.4	2.1	4.5	525	
STAMFORD WPCF	12/29/2010 CT0101087	13.9	2.9	1.6	4.5	522	3.9
				Average	3.4147	487.0862069	**3.5**
				April - October	2.8146	354.9166667	**2.8**
				Max	14.3	4019	**5.4**
				Min	2.1	256	**2.6**
				Max (Apr-Oct)	4.2	659	**3.2**
				Min (Apr-Oct)	2.1	256	**2.6**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
NEW CANAAN WPCF	01/12/2010	CT0101273	1	2	3.4	5.4	45	
NEW CANAAN WPCF	01/19/2010	CT0101273	0.9	2.4	1.9	4.3	32	
NEW CANAAN WPCF	01/26/2010	CT0101273	1.4	2	2.7	4.7	55	4.8
NEW CANAAN WPCF	02/02/2010	CT0101273	1	1.2	2.2	3.4	28	
NEW CANAAN WPCF	02/09/2010	CT0101273	0.9	1.4	3.2	4.6	35	
NEW CANAAN WPCF	02/16/2010	CT0101273	0.7	1.9	1.3	3.2	19	
NEW CANAAN WPCF	02/23/2010	CT0101273	0.8	2	1.9	3.9	26	3.8
NEW CANAAN WPCF	03/02/2010	CT0101273	2.1	1.5	3.4	4.9	86	
NEW CANAAN WPCF	03/09/2010	CT0101273	1.4	1.8	2.1	3.9	46	
NEW CANAAN WPCF	03/16/2010	CT0101273	2.7	1.5	2.6	4.1	92	
NEW CANAAN WPCF	03/23/2010	CT0101273	1.3	1.3	2.3	3.6	39	
NEW CANAAN WPCF	03/30/2010	CT0101273	4	1.4	3.4	4.8	160	4.3
NEW CANAAN WPCF	04/06/2010	CT0101273	1.6	1	2.3	3.3	44	
NEW CANAAN WPCF	04/13/2010	CT0101273	1.2	1.3	2.9	4.2	42	
NEW CANAAN WPCF	04/20/2010	CT0101273	1	1.9	0.9	2.8	23	
NEW CANAAN WPCF	04/27/2010	CT0101273	1	1.5	0.4	1.9	16	3.1
NEW CANAAN WPCF	05/04/2010	CT0101273	1.1	1.2	0.5	1.7	16	
NEW CANAAN WPCF	05/11/2010	CT0101273	0.9	1.9	0	1.9	14	
NEW CANAAN WPCF	05/18/2010	CT0101273	0.9	1.7	0.4	2.1	16	
NEW CANAAN WPCF	05/25/2010	CT0101273	0.9	1.8	0.7	2.5	19	2.1
NEW CANAAN WPCF	06/01/2010	CT0101273	0.7	1.2	0.5	1.7	10	
NEW CANAAN WPCF	06/08/2010	CT0101273	0.8	2	0.5	2.5	17	
NEW CANAAN WPCF	06/15/2010	CT0101273	0.8	2.2	0.9	3.1	21	
NEW CANAAN WPCF	06/22/2010	CT0101273	0.8	2.2	0.7	2.9	19	
NEW CANAAN WPCF	06/29/2010	CT0101273	0.7	1.8	0.6	2.4	14	2.5
NEW CANAAN WPCF	07/06/2010	CT0101273	0.6	1.4	0.8	2.2	11	
NEW CANAAN WPCF	07/13/2010	CT0101273	0.7	1.2	0.7	1.9	11	
NEW CANAAN WPCF	07/20/2010	CT0101273	0.8	1.5	0.5	2	13	
NEW CANAAN WPCF	07/27/2010	CT0101273	0.8	1.4	0.8	2.2	15	2.1
NEW CANAAN WPCF	08/03/2010	ct0101273	0.7	1.4	0.6	2	12	
NEW CANAAN WPCF	08/10/2010	ct0101273	0.7	1.4	0.4	1.8	11	
NEW CANAAN WPCF	08/17/2010	ct0101273	0.7	1.1	0.3	1.4	8	
NEW CANAAN WPCF	08/24/2010	ct0101273	0.8	1.5	1	2.5	17	
NEW CANAAN WPCF	08/31/2010	ct0101273	0.7	1.4	1.4	2.8	16	2.1
NEW CANAAN WPCF	09/07/2010	CT0101273	0.6	1.7	1.2	2.9	15	
NEW CANAAN WPCF	09/14/2010	CT0101273	0.6	1.9	1.2	3.1	16	
NEW CANAAN WPCF	09/21/2010	CT0101273	0.7	2.2	0.9	3.1	18	
NEW CANAAN WPCF	09/28/2010	CT0101273	0.8	1.8	0.5	2.3	15	2.9
NEW CANAAN WPCF	10/05/2010	CT0101273	1	1.5	1.7	3.2	27	
NEW CANAAN WPCF	10/12/2010	CT0101273	0.8	1.2	0.6	1.8	12	
NEW CANAAN WPCF	10/19/2010	CT0101273	0.9	1.4	1	2.4	18	
NEW CANAAN WPCF	10/26/2010	CT0101273	0.8	2.1	0.5	2.6	17	2.5
NEW CANAAN WPCF	11/02/2010	CT0101273	0.74	1.8	1.2	3	19	
NEW CANAAN WPCF	11/09/2010	CT0101273	0.9	1.5	1.6	3.1	23	
NEW CANAAN WPCF	11/16/2010	CT0101273	0.8	1.9	1.1	3	20	
NEW CANAAN WPCF	11/23/2010	CT0101273	0.9	2.2	1.1	3.3	25	
NEW CANAAN WPCF	11/30/2010	CT0101273	0.8	1.7	1.3	3	20	3.1
NEW CANAAN WPCF	12/07/2010	CT0101273	0.9	2.2	1.9	4.1	31	
NEW CANAAN WPCF	12/14/2010	CT0101273	1.5	2.5	2.6	5.1	64	
NEW CANAAN WPCF	12/21/2010	CT0101273	1	2.2	1.6	3.8	32	
NEW CANAAN WPCF	12/28/2010	CT0101273	0.9	2.9	2	4.9	37	4.5
					Average	3.0843	28.56862745	**3.1**
					April - October	2.44	17.43333333	**2.4**
					Max	5.4	160	**4.8**
					Min	1.4	8	**2.1**
					Max (Apr-Oct)	4.2	44	**3.1**
					Min (Apr-Oct)	1.4	8	**2.1**

Plant	Date	Permit	FlowMGD	FTKN	NO2NO3	TN	TNMASS	TN Monthly Average
MILFORD HOUSATONIC WPCF	01/12/2010	CT0101656	6.4	3.2	3.4	6.6	352	
MILFORD HOUSATONIC WPCF	01/19/2010	CT0101656	6.4	1.8	2.3	4.1	219	
MILFORD HOUSATONIC WPCF	01/26/2010	CT0101656	5.1	1.5	1.8	3.3	140	4.7
MILFORD HOUSATONIC WPCF	02/02/2010	CT0101656	6	1.4	2.2	3.6	180	
MILFORD HOUSATONIC WPCF	02/09/2010	CT0101656	5.5	2.1	2.8	4.9	225	
MILFORD HOUSATONIC WPCF	02/16/2010	CT0101656	5.3	2.5	2	4.5	199	
MILFORD HOUSATONIC WPCF	02/23/2010	CT0101656	5.5	1.5	1.7	3.2	147	4.1
MILFORD HOUSATONIC WPCF	03/02/2010	CT0101656	11	5.1	2.4	7.5	688	
MILFORD HOUSATONIC WPCF	03/09/2010	CT0101656	7.9	4.9	1.5	6.4	422	
MILFORD HOUSATONIC WPCF	03/16/2010	CT0101656	16.1	3.3	3.6	6.9	927	
MILFORD HOUSATONIC WPCF	03/23/2010	CT0101656	7.5	3.9	1	4.9	307	
MILFORD HOUSATONIC WPCF	03/30/2010	CT0101656	15.3	2	2.2	4.2	536	6.0
MILFORD HOUSATONIC WPCF	04/06/2010	CT0101656	10.61	2.6	2.3	4.9	434	
MILFORD HOUSATONIC WPCF	04/13/2010	CT0101656	7.74	1.7	2	3.7	239	
MILFORD HOUSATONIC WPCF	04/20/2010	CT0101656	6.61	1.5	2.4	3.9	215	
MILFORD HOUSATONIC WPCF	04/27/2010	CT0101656	7.6	1.4	2.2	3.6	228	4.0
MILFORD HOUSATONIC WPCF	05/04/2010	CT0101656	6.7	1.6	3	4.6	257	
MILFORD HOUSATONIC WPCF	05/11/2010	CT0101656	5.7	1.4	3.7	5.1	242	
MILFORD HOUSATONIC WPCF	05/18/2010	CT0101656	4.5	1.4	4.1	5.5	206	
MILFORD HOUSATONIC WPCF	05/25/2010	CT0101656	6.1	1.5	3.6	5.1	259	5.1
MILFORD HOUSATONIC WPCF	06/01/2010	CT0101656	5.6	1.4	3.6	5	234	
MILFORD HOUSATONIC WPCF	06/08/2010	CT0101656	5	1.7	3	4.7	196	
MILFORD HOUSATONIC WPCF	06/15/2010	CT0101656	5.5	2.4	3.5	5.9	271	
MILFORD HOUSATONIC WPCF	06/22/2010	CT0101656	4.9	2	1.6	3.6	147	
MILFORD HOUSATONIC WPCF	06/29/2010	CT0101656	5.1	2.9	1.4	4.3	183	4.7
MILFORD HOUSATONIC WPCF	07/06/2010	CT0101656	5.1	1.6	3.2	4.8	204	
MILFORD HOUSATONIC WPCF	07/13/2010	CT0101656	4.6	1.9	3.3	5.2	200	
MILFORD HOUSATONIC WPCF	07/20/2010	CT0101656	5.2	1.6	3.2	4.8	208	
MILFORD HOUSATONIC WPCF	07/27/2010	CT0101656	4.9	1.5	3.1	4.6	188	4.9
MILFORD HOUSATONIC WPCF	08/03/2010	CT0101656	5.1	1.3	2.8	4.1	174	
MILFORD HOUSATONIC WPCF	08/10/2010	CT0101656	4.6	1.7	3.2	4.9	188	
MILFORD HOUSATONIC WPCF	08/17/2010	CT0101656	4.6	1.9	1.9	3.8	146	
MILFORD HOUSATONIC WPCF	08/24/2010	CT0101656	5.2	1.5	2.4	3.9	169	
MILFORD HOUSATONIC WPCF	08/30/2010	CT0101656	4.6	1.4	2.5	3.9	150	4.1
MILFORD HOUSATONIC WPCF	09/07/2010	CT0101656	4.5	2.1	2.3	4.4	165	
MILFORD HOUSATONIC WPCF	09/14/2010	CT0101656	4.2	2.3	1.4	3.7	130	
MILFORD HOUSATONIC WPCF	09/21/2010	CT0101656	4.2	2.5	1.6	4.1	144	
MILFORD HOUSATONIC WPCF	09/28/2010	CT0101656	4.5	2.1	2.2	4.3	161	4.1
MILFORD HOUSATONIC WPCF	10/05/2010	ct0101656	4.9	2.2	0.5	2.7	110	
MILFORD HOUSATONIC WPCF	10/12/2010	ct0101656	3.6	1.3	1.8	3.1	93	
MILFORD HOUSATONIC WPCF	10/19/2010	ct0101656	4.5	2.3	1.9	4.2	158	
MILFORD HOUSATONIC WPCF	10/26/2010	ct0101656	4.6	1.8	3.6	5.4	207	3.9
MILFORD HOUSATONIC WPCF	11/02/2010	CT0101656	4.5	4.9	2.7	7.6	285	
MILFORD HOUSATONIC WPCF	11/09/2010	CT0101656	4.9	5.3	1.4	6.7	274	
MILFORD HOUSATONIC WPCF	11/16/2010	CT0101656	4.7	7.3	1.2	8.5	333	
MILFORD HOUSATONIC WPCF	11/23/2010	CT0101656	4.9	2.6	1.5	4.1	168	
MILFORD HOUSATONIC WPCF	11/30/2010	CT0101656	4.6	2	3.2	5.2	200	6.4
MILFORD HOUSATONIC WPCF	12/07/2010	CT0101656	5.1	2.3	1.8	4.1	174	
MILFORD HOUSATONIC WPCF	12/14/2010	CT0101656	7	2.2	1.8	4	234	
MILFORD HOUSATONIC WPCF	12/21/2010	CT0101656	5.6	2.2	1.8	4	187	
MILFORD HOUSATONIC WPCF	12/28/2010	CT0101656	6	5.2	1.4	6.6	330	4.7
					Average	4.7588	243.7843137	**4.7**
					April - October	4.3933	196.8666667	**4.4**
					Max	8.5	927	**6.4**
					Min	2.7	93	**3.9**
					Max (Apr-Oct)	5.9	434	**5.1**
					Min (Apr-Oct)	2.7	93	**3.9**

WEF/WERF Cooperative Study of Nutrient Removal Plants: Achievable Technology Performance Statistics for Low Effluent Limits

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ABSTRACT

WEF and WERF cooperated in a comprehensive study of nutrient removal plants designed and operated to meet very low effluent TN and TP concentrations, several as low as 3.0 mg/L TN and 0.1 mg/L TP. The investigation also focused on the ability of nitrification technologies to meet low maximum day limits for ammonia. This effort focused on maximizing what can be learned from existing technologies in order to provide a database that will inform key decision makers about proper choices for both technologies and rational bases for statistical permit writing. Managers of 22 plants provided 3 years of operational data that were analyzed using a consistent statistical approach that considered both process reliability and the permit limits applied. A proposed set of quantitative descriptors were developed to describe the performance of BNR plants meeting stringent nutrient requirements in terms of effluent quality percentile statistics. Technology Performance Statistics (TPS) were defined as three separate values representing the ideal, median, and reliably achievable performance. Also, monthly average 95th percentiles of effluent data were used to compare the plants in terms of their ability to achieve the 3.0 mg/L TN or 0.1 mg/L TP criteria. Maximum day statistics were used to stratify the ability of plants to meet low maximum day permit levels.

KEYWORDS

Nutrient removal, nitrification, statistical reliability, permitting, nitrogen removal, phosphorus removal, limit of technology, technology performance statistics

INTRODUCTION

The Water Environment Research Foundation (WERF) Nutrient Challenge Research Program and the Water Environment Federation (WEF) cooperated in a comprehensive study of nutrient removal plants designed and operated to meet very low levels of effluent nitrogen and phosphorus. Both existing and new technologies are being adapted to meet requirements that are as low as 3 mg/L TN and 0.1 mg/L TP or lower, and there is a need to define their capabilities and reliabilities in the real world situation of wastewater treatment plants. In addition, it was noted that very low maximum day permit levels for Ammonia-Nitrogen were being seen in new permits, and a concern arose whether these levels could be obtained with current technologies. Therefore, an evaluation was completed of exemplary plants across North America.

METHODOLOGY

Organization

To accomplish the goals of the study with limited funding for data collection, analysis and management, it was necessary to leverage the volunteer efforts of many individuals. To this end, managers of 22 plants, ten achieving low effluent TP, nine achieving low effluent TN, and three achieving low effluent ammonia, provided three years of operational data that were analyzed using a consistent statistical approach. No plant simultaneously achieved both low TN and TP. Technical papers were compiled by a manager representing each plant, which included a summary of influent loading, process design and operating conditions, unusual events, upsets and anecdotes related to process operation, and the statistical summary of final effluent data that considered both process reliability and the permit limits applied. The papers submitted by the plant managers are those listed here: Bailey and Murthy, 2008; Belschner and Wimmer, 2009; Clark and Neethling, 2009; Dodson, 2008; Drury and Shepherd, 2008; Emrick, 2009; Farmer, 2009; Gray *et al.*, 2008; Gosselin, 2009; Holloway *et al.*, 2008; Madhanagopal, 2008; Maher, 2008; Meyer *et al.*, 2008; O'Shaughnessy, 2009; Phillips, 2008; Porter, 2008; Rowland, 2009; Selock *et al.*, 2008; Sezgin, 2009; Shirodkar, 2009; Spani, 2008; and Tennyson, 2009.

The managers for all but one of the plants also presented their findings for discussion at two WEFTEC workshops. The Municipal Wastewater Treatment Design Committee of WEF helped organize the volunteers who assisted the plant managers who participated in this investigation. WEF's participation in this investigation greatly expanded its scope, depth, and value. The volunteers were selected on the basis that they were not involved in the design of the treatment facilities investigated, so that all strengths and weaknesses of the plants could be clearly portrayed without bias or "diplomatic" issues. The volunteers and plant managers (and their organizations) are acknowledged at the end of this paper.

A project steering committee consisting of WEF members, WERF staff and contractors, and an EPA staff member helped provide guidance throughout this investigation. This steering committee included Charles Bott (chair, second year; member, first year), HRSD; Denny Parker (chair, first year; member, second year), Brown and Caldwell; Amit Pramanik, WERF; JB Neethling, HDR; Sudhir Murthy, DC Water; and Phil Zahreddine, EPA (member, second year only).

Approach

Exemplary wastewater treatment plants were identified from past surveys and project team knowledge. Plant managers were approached as to their willingness to have their plants represented in this investigation as well as to volunteer their staff time to make the work a success. Only a very few of the plants approached declined participation, usually because of staff time limitations. Only plants that had accumulated 36 months of operating data were included; this necessarily caused certain emerging technologies to be excluded. Nothing was excluded from the data sets that were analyzed herein. The three linear or consecutive years of data encapsulates 12 full seasons, without emphasizing any particular season or year.

The project team was reliant in this investigation upon the data available from each plant; no special sampling was conducted. As in the past for other WERF projects, plant operating data and analytical information was requested and accepted without independent confirmation of the analytical work. This approach is taken because of the stringent liabilities under existing federal regulations for misreporting data. Moreover, the exemplary plants in this study are under elevated regulatory scrutiny, and also have stringent and verifiable QA/QC procedures, given the environments to which they discharge.

No attempt was made to get into detail about the factors impacting the various unit processes within a plant; rather the attempt was to try to identify the treatment capabilities of different overall flow sheets in meeting stringent treatment objectives. In this regard, the study looked at individual treatment processes as building blocks towards contributing to effluent reliability. The disadvantages of this approach are recognized by the steering committee; for instance, the current flow and loading relative to the design capacity obviously reflects the degree of "stress" placed on the plant. And stress testing coupled with plant modeling is obviously a key element in determining the capacity of an individual plant. WERF, in fact, has developed programs that include a stable of valuable protocols for stress testing and modeling components of plants (Parker *et al.*, 1999, Melcer *et al.*, 2003; Wahlberg, 2004; Wahlberg, 2006). None of these rating and modeling approaches supported a full evaluation of the treatment plant's reliability to achieve very low nutrient limits. Therefore, a supplementary approach was deemed necessary. The approach for this study was to identify those exemplary plants that had features which produce exceptional effluent quality and to use a common method to portray their reliability on a statistical basis. In using this approach, we acknowledge that the contributions of the specific dimensioning or specific features of a process (e.g. the different types of effluent filters) would remain opaque to the analyses that could be done during this project.

Another disadvantage of the project's approach is that for the most part, plants were operated below their design flows and loadings, and therefore were not challenged by the stressors of their design conditions. There is no doubt that the difficulties for managing operations to attain low effluent conditions are greater as any plant approaches its design conditions. The best that can be said in this circumstance is that, to emulate the performance of the studied exemplary plants, excellent operation and conservative design must be employed. Nonetheless, the plants studied are real plants subject to variability in wastewater characteristics, unavoidable imperfections that are present in every design or operation and under market conditions, which at times cause disruption of key resources, such as reliability in chemical supply. In addition, the plants in some cases were subject to impacts of toxic events or construction scheduling impacts, which are not unusual in municipal wastewater treatment. Nothing was excluded from the data analyzed.
Due to the above factors, the performance reported by the well-operated plants should be viewed as pertaining to what can be achieved by the processes given their site-specific conditions which impact performance, as opposed to being an absolute measure of how reliable they are in meeting a particular discharge permit limit.

Statistical Analysis

Data were analyzed two ways, both on a probability basis and on a reliability basis. The methods used for statistical evaluation have been presented previously by Bott *et al.*, 2009 and in the project report (Bott *et al.*, in press). Log normal distributions were fit to the data and equations modified from the original work of Niku *et al.*, 1979, as modified by Oliveira and Sperling, 2008. The fitted log transformed distributions allowed calculation of the reliability of meeting permit limits or target objectives. However, the probability of occurrence was used for the technology stratification, which is the subject of this paper. The data series were used to calculate probability of occurrence, untransformed by the log normal assumption themselves to calculate effluent values. These percentile statistics are referred to as Technology Performance Statistics or TPSs are used to develop common percentage probabilities for comparison of technologies. The long normal fit curves could not be used as they tended to depart from the data in the regions of most interest (low and high concentrations).
Three TPSs were used: the ideal, the median, and the reliable.

Ideal Technology Performance Statistic. The ideal Technology Performance Statistic provides an unbiased value of the ideal performance of the technology – when it is minimally influenced by all the factors that cause statistical variability in real plants. These conditions are ones that likely replicate those ideal conditions that might be obtained under controlled laboratory conditions with defined, treatable influents. For full scale performance, the ideal TPS represent the lowest concentrations (idealistic performance) observed. The ideal TPS is defined as the performance under the conditions of operation that can be sustained for a short period of time. The project steering committee proposed that the ideal TPS achievable concentration is the performance that remains sustainable for a two week period in one year. Note that the 14-day TPS, or TPS-14d, is exceeded 50 out of 52 weeks per year and is definitely not an appropriate permit limit. Beyond influent variability, other realistic factors determine plant performance which are not captured by this statistic, including variable climatic conditions during a year, process control corrections which may lag periods of lower performance, ability to automate the process, specific attributes of the service area such as seasonal loadings, discontinuous impacts of commercial industrial contributions, mechanical or sensor failures, impacts of solids processing returns, and human error. The 14-day TPS is proposed instead for other reasons. BNR processes operate over a large range of sludge age conditions, but typically at a sludge age between 8 and 20 days. A two week period would therefore capture one sludge age of operation for a number of the plants.

Median Technology Performance Statistic. The Median Technology Performance Statistic (TPS-50%) represents a measure of the concentration that was achieved on a statistical annual average basis. The project team used the median (the 50^{th} percentile data number) in this study rather than the arithmetic average, because it is impacted less by extreme values resulting from upset events. In this study, the TPS-50% is used to develop ratios from the reliable TPS values, in order to indicate how much performance deviates from the average performance to the reliable levels as a function of effluent requirements and averaging periods. Technologies with consistently low variability can inform designers and managers about the extent of provisions provided for reliability to use in design.

Reliable Technology Performance Statistic. The reliable TPS does not represent a single percentile value for an averaging period (e.g. 95th or 99th percentile). Rather, it is a selected value depending on the technology, the averaging period used in the permit and the acceptable risk associated with frequency of violations. Using the TPS notation, the 90th, 95th, and 99th percentiles would be noted as the TPS-90%, TPS-95%, and TPS-99%, respectively.

Use of Ratios to Compare Variability in Performance. Deviations from the lowest achievable performance can be assessed using the relationship between the TPS values, by determining the ratio of the 3.84th, 50th, and 95th percentiles as a measure of variability. The ratio between these values represents the variability of performance, and it provides a measure of the differences in performance between the lowest, median, and maximum month limits. The ratio of the 50th to 3.84th percentile represents the difference between the average performance achievable compared to the TPS-14d, while the 95th to 50th percentile represents the ability of a technology to meet monthly limits compared to annual values.

Use of TPS in Evaluation of Technologies. The concentrations that were the focus of the technology evaluation corresponding to daily, rolling 30-day average, monthly, and annual averages were the 50th, 90th, 95th and 99th percentile values. (Only some of these statistics are reported herein; for the remainder, see Bott and Parker, 2010.) To give these values meaning in terms of violations per the five year National Pollutant Discharge Elimination System (NPDES) permit period, Table 1 reports the number of exceedances per permit period for each of these values. In picking only three years of data to evaluate, projecting concentrations for longer periods (e.g. ten years) is a significant extrapolation and may not represent all of the events that could impact the reliability of plants striving to attain low levels for nutrient removal. While the calculated percentile values could be supported by the plant database, the assumption would have to be that the experience of the 36 months evaluated would recur for the remaining 84 months of the ten year period. This assumption could not be validated during this investigation.

Table 1 -Number of Exceedances per Five Year NPDES Permit Period for Daily, Monthly, and Annual Average Permits for Given Percentile Values

Percentile Less Than Stated Concentration	Daily (with Daily Sampling)	Monthly	Annual Average
Total reporting events in 5 years	1826	60	5
50	912	30	2.5 or 3
90	183	6	0.5 (or 1 per 2 permit periods) [1]
95	91	3	0.25 (or 1 per 4 permit periods) [1]
99	18	0.6 (or 1 per 2 permit periods) [1]	0.05 (or 1 per 20 permit periods) [1]

[1] These percentile values can only be calculated assuming the longer periods are adequately represented by 36 months of data.

The project steering committee found that the monthly performance statistics were a logical basis for ranking technologies, partly because the majority of plants in the US are governed by monthly permits and also because monthly values could be compared to an earlier survey of Florida plants that would allow more conclusive judgments to be drawn about technology rankings. The 95th percentile values for monthly permits is used in the technology rankings, rather than the maximum value, which sometimes exhibited inconsistent relationships when evaluated on a ratio basis to the median value. The 95th percentile monthly value would not normally be used for permit setting, owing to the high violation frequency per permit period.

Summary of Plants Evaluated

Tables 2 to 5 provide a brief overview of the primary, secondary, and tertiary treatment processes at each plant. The summaries also include the location and type of any chemical addition that occurs at each plant using a coding system that is described in Table 2. The plants were classified according to minimum wastewater temperatures according to the following scheme: greater than 20 °C, warm; 15 to 20 °C, moderate; 12 to 15 °C cold; and less than 12 °C, very cold.

The nitrogen and phosphorus removal plants are also categorized according to how nutrients are removed. The nitrogen removal plants (Table 3) are considered either combined nitrogen removal, separate stage denitrification, or multiple stages for nitrification and denitrification. A combined nitrogen removal plant removes nitrogen in one single process, for example, a single sludge system such as a 4-stage Bardenpho that achieves both nitrification and denitrification. A separate stage plant has two separate processes, one for nitrification and one for denitrification. An example would be a plant that has an activated sludge process for nitrification and carbon removal followed by a deep-bed denitrification filter. A multistage plant utilizes several treatment processes to remove nitrogen. For example, a 4-stage Bardenpho for nitrification and denitrification followed by a denitrification filter for additional nitrogen removal.

A prior survey of Florida nutrient removal plants completed by Brown and Caldwell (Jimenez et al, 2007), allowed the definition of the performance capabilities of nitrogen removal plants in warm climatic conditions, so in this investigation only a few Florida plants were included and the emphasis was on nitrogen plants in moderate to colder climates. The Florida survey results were used to confirm and extend the technology rankings.

The phosphorus plants (Table 4) are categorized as either single stage, multistage, or little to no chemical addition. This system is based on how many chemical addition points a plant uses specifically for phosphorus removal. A multistage plant utilizes at least two different chemical addition points. The chemicals may or may not be the same at these plants. And they may be used to supplement biological phosphorus removal. A single stage plant utilizes only one chemical addition point and a little to no chemical addition plant tries to rely exclusively on biological phosphorus removal. However, these plants may have the capability to periodically add chemicals to enhance treatment, although they do not add chemicals regularly.

Table 2 - Process Summary Legend

Code	Definition	Code	Definition
1	Primary treatment	C_M	Methanol
1C	Chemical added to primaries	C_{Fe}	Iron (Fe^{3+} or Fe^{2+})
1_C	Ability to add chemical to primaries but not added regularly	C_{Al}	Alum
2	Secondary treatment	C_F	Fermentate
2B	Secondary treatment with biological phosphorus removal	C_{Ac}	Acetic acid
2C	Chemical added to secondary treatment process	C_L	Lime
2_C	Ability to add chemical to secondary process but not added regularly	F	Suspended solids removal filters
3	Tertiary treatment	TF	Trickling filters
3C	Chemical added to tertiary process	NTF	Nitrifying trickling filters
3_C	Ability to add chemical to tertiary process but not added regularly	DF	Deep bed denitrifying filters
3F	Tertiary Filtration	UF	Ultrafiltration

Table 3 – Process Summaries of Nitrogen Removal Plants

Plant	Code	Cold or Warm	Primary Treatment	Secondary Treatment	Tertiary Treatment	Category
River Oaks	$1C_{AI}$-$2C_{AI}$-$3C_{M}$-3F	Warm	Clarifiers, EQ	(3) Aeration Tanks in Series, Clarifiers	Denitrification Basins, Clarifiers, Dual Media Deep Bed Filters	Sep Stage
Eastern WRF	$2B_{CAI}$-3F	Warm	None	5-Stage Bardenpho Carrousel, Clarifiers	ABW Filters	Combined
Parkway	1-2_{CAI}	Cold	Clarifiers	4-Stage Bardenpho, Clarifiers	None	Combined
Fiesta Village	$2C_{AI}$-$3C_{M}$DF	Warm	None	Oxidation Ditches, Clarifiers	Denitrification Filters	Multistage
Western Branch	$2C_{M}C_{AI}$-3F	Cold	None	HRAS, Clarifiers, NAS, Clarifiers, DNAS, N_2 Stripping Channel, Clarifiers	Dual Media Gravity Filters	Sep Stage
Scituate	2-$3C_{M}$DF	Very Cold	None	Aeration Tanks, Clarifiers	Denitrification Filters	Sep Stage
Truckee Meadows	1-2-3NTF-$3C_{M}$-3F	Cold	Clarifiers	Aeration Basins, Clarifiers	Nitrifying Trickling Filters, Denitrifying FBRs, Dual Media Gravity Filters	Sep Stage
Piscataway	1-$2C_{AI}$-3F	Cold	Clarifiers	Step Feed Biological Nutrient Removal, Clarifiers	Dual Media Gravity Filters	Multistage
Tahoe-Truckee	1-$3C_{L}$-$3C_{M}$-3_{CAI}F	Very Cold	Clarifiers	HPOAS, Clarifiers	Floc Basins, Chemical Clarifiers, Recarb Basins, Clarifiers, Recarb Basins Ballast Ponds, BAF, Tertiary Filters, Disinfection, SAT	Sep Stage

Table 4 - Process Summaries of Phosphorus Removal Plants

Plant	Code	Cold or Warm	Primary Treatment	Secondary Treatment	Tertiary Treatment
Iowa Hill WRF	$2\text{-}3C_{Al}\text{-}3F$	Very Cold	None	Anaerobic Zones, Aeration Basins, Clarifiers, EQ	Fine Screening, BAFs, DensaDeg Chem P Removal, Continuous Backwash Upflow Sand Filters
F. Wayne Hill [1]	$1\text{-}2BC_{Al}\text{-}3C_{Fe}\text{-}3F$	Moderate	Clarifiers	Aeration Basins, Clarifiers, EQ	Chemical Clarifiers, Deep Bed Granular Media Filters
F. Wayne Hill [1]	$1\text{-}2BC_{Al}\text{-}3C_{Fe}\text{-}3UF$	Moderate			Chemical Clarifiers, Ultrafiltration Membranes
Cauley Creek	$2BC_{Fe}\text{-}3UF$	Moderate	None	Modified Johannesburg BNR	MBR
Clark County [1]	$1C_{Fe}\text{-}2B\text{-}3C_{Al}F$	Moderate	Clarifiers	Anaerobic/Oxic Basins, Clarifiers	Dual Media Filters
Clark County [1]	$1C_{Fe}\text{-}2B\text{-}3C_{Al}\text{-}3F$	Moderate			Chemical Clarifiers, Dual Media Filters
Rock Creek [1]	$1C_{Al}\text{-}2\text{-}3C_{Al}\text{-}3F$	Very Cold	Clarifiers	Step Feed MLE Aeration Basin, MLE Aeration Basins, Clarifiers	Upflow Floc Blanket Clarifiers, Monomedia Gravity Filters
Rock Creek [1]	$1C_{Al}\text{-}2\text{-}3C_{Al}\text{-}3F$	Very Cold		MLE Aeration Basins, Clarifiers	Chemical Clarifiers, Dualmedia Gravity Filters
Blue Plains	$1C_{Fe}\text{-}2C_{Fe}\text{-}3C_M\text{-}3F$	Cold	Clarifiers	Activated Sludge, Clarifiers	Nitrification and Denitrification Reactors, Clarifiers, Multimedia Filters
ASA	$1_{CFe}\text{-}2C_MC_{Fe}\text{-}3C_{Al}\text{-}3F$	Cold	Clarifiers	Step Feed Biological Reactor Basins, Clarifiers	Rapid Mix and Flocculation, Inclined Plate Settlers, Gravity Filters
Pinery	$2BC_F\text{-}3C_{Al}F$	Cold	None	5-Stage Bardenpho Process, Clarifiers, EQ	Trident Adsorption Clarifier-Filter Process
Kelowna	$1\text{-}2B_{CAl}C_F\text{-}3F$	Cold	Clarifiers, EQ	3-Stage Bardenpho Process, Clarifiers	Dual Granular Media Gravity Filters
Kalispell	$1\text{-}2B_{CAl}\text{-}3F$	Very Cold	Clarifiers, EQ	Modified UCT Process, Clarifiers	Gravity Sand Filters

[1] These plants have two separate types of treatment trains.

Table 5 – Process Summaries of Nitrification Reliability Plants

Plant	Code	Cold or Warm	Primary Treatment	Secondary Treatment	Tertiary Treatment
Utoy Creek	$1C_{Fe}$-$2BC_{Fe}C_{Ac}$-3F	Cold	Clarifiers	Biological Nutrient Removal Process, Clarifiers	Deep Bed Monomedia Filters
Kalkaska	$2BC_{Fe}$	Very Cold	None	4-stage Bardenpho Oxidation Ditches, Clarifiers	Rapid Infiltration Basins
Littleton/ Englewood	1-2TF-3NTF	Cold	Clarifiers	Trickling Filters, Solids Contact, Clarifiers	Nitrifying Trickling Filters

PERFORMANCE OF NITROGEN REMOVAL PLANTS

Table 6 shows the daily data TPS total nitrogen concentrations calculated from the nine plants studied that have nitrogen limits. The table also shows the process and permit limits for the facilities. The results show that the multistage (Fiesta Village) and separate stage (Western Branch and River Oaks) processes achieved the lowest daily data TPS-14d values. The control provided to plants with tertiary denitrification processes gives them the ability to reduce nitrate to low concentrations.

Table 6 –Total Nitrogen Daily Data TPS Concentrations (mg/L)

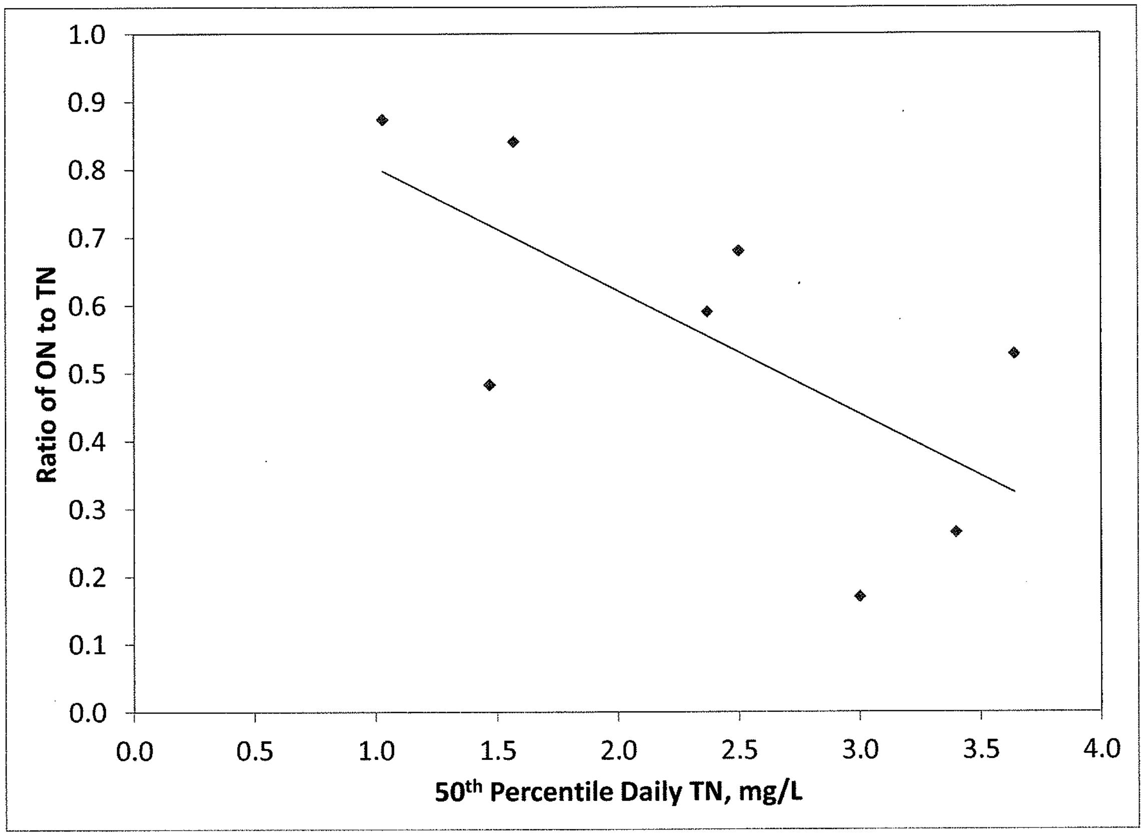
Plant	Process Code [1]	TN Permit (mg/L)/ Averaging Period [2]	3.84% (14d)	50%	95%	3.84%/ 50%	95%/ 50%
Fiesta Village, FL	$2C_{Al}$-$3C_M$DF	3/M	0.25	1.03	2.71	0.25	2.62
Kalkaska, MI	$2BC_{Fe}$	5 [3]/W	0.31	0.75	2.40	0.41	3.20
Western Branch, MD	$2C_MC_{Al}$-3F	3/M	0.66	1.47	3.20	0.45	2.18
River Oaks, FL	$1C_{Al}$-$2C_{Al}$-$3C_M$-3F	3/A	0.78	1.45	2.92	0.54	2.01
Truckee Meadows, NV	1-2-3NTF-$3C_M$-3F	2/M	1.16	1.57	2.85	0.74	1.82
Scituate, MA	2-$3C_M$DF	4/M	1.21	2.37	4.22	0.51	1.78
Piscataway, MD	1-$2C_{Al}$-3F	8/M	1.30	3.00	8.00	0.43	2.67
Tahoe-Truckee, CA	1-$3C_L$-$3C_M$-3_{CAl}F	3 [4]/M	1.67	2.50	3.37	0.67	1.35
Eastern WRF, FL	$2B_{CAl}$-3F	3/A	2.08	3.64	8.56	0.57	2.35
Parkway, MD	1-2_{CAl}	7/M	2.10	3.40	6.40	0.62	1.88

[1] See Tables 2 and 3 for explanation
[2] A = Annual, M = Monthly, W = Weekly
[3] Kalkaska has a TIN based permit.
[4] Tahoe-Truckee's permit is on SAT effluent, data is for BAF effluent

The daily data TPS-14d concentration for the nine plants analyzed is typically 50 to 60 percent of the median performance. The exception is Fiesta Village, where the lowest achievable concentration is 25 percent of the median performance. The 95th percentile performance is between 1.8 and 2.5 times the median performance. Comparing the 95th percentile to the TPS-14d, there is up to ten times difference in these values for the plants operating at very low effluent TN. This substantial degree of variability should be recognized in the permitting and design process and is an important finding of this project.

In addition to the Total Nitrogen (TN) TPS values calculated in Table 6, daily data on Organic Nitrogen (ON) TPS-50% values were determined and compared to the daily data TN TPS-50% values. A ratio of the two values was determined and plotted against the daily data TN TPS-50% values (Figure 1). As lower TN values are obtained, the effluent TN becomes more dominated by ON.

Figure 1 - Ratio of ON and TN Daily Data TPS-50% Values



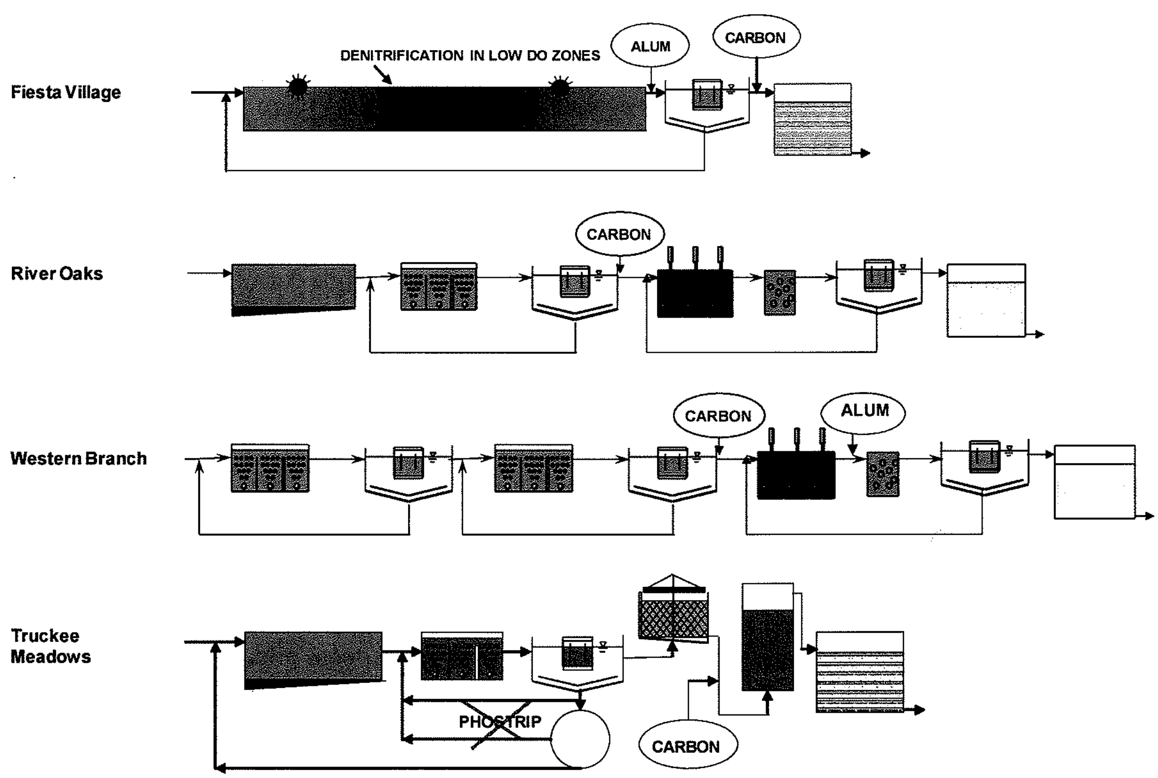
Based on the 95th percentile of monthly average data, the best performing plants in the study for nitrogen removal were the Fiesta Village and River Oaks plants, both located in Florida (Table 7). These warm climate plants were followed closely by plants in colder climates, the Truckee Meadows WRF and the Western Branch plant. The slightly superior performance of the two Florida plants may not only be due to the fact that they are in warmer climates, but also due in part due to the fact that both transport their solids offsite for subsequent processing. Both the Truckee Meadows and Western Branch plants process solids on site. Differences between these four plants are small considering their effluent TN varies on 95th percentile monthly basis only between 2.2 and 2.5 mg/L. Given their different designs, varying influent characteristics and climatic conditions, plus differing permit conditions, this small difference in effluent quality may not be significant and it would be best to view the four of them as a group as the best performing plants in the US. Figure 2 shows the flow sheets for the four plants. A characteristic of all of them is that they have either a separate denitrification stage or a polishing step with methanol, which allows more precise control of effluent quality than the processes with combined flow sheets offer.

Table 7 – 95th Percentile Monthly Average TN for Three Categories of Nitrogen Removal Plants

Separate Stage	TN, mg/L	Combined	TN, mg/L	Multiple Stage	TN, mg/L
River Oaks, FL	2.3	Kalkaska, MI	1.7 [1]	Fiesta Village, FL (Denite Filter)	2.2
Western Branch WSSC, MD	2.4	Parkway WSSC, MD	5.1	5 A^2/O Plants with Denite Filters, FL [2]	3.0
Truckee Meadows, NV	2.5	Eastern WRF, FL	6.7		
Tahoe-Truckee, CA	3.1	Piscataway WSSC, MD	7.2		
Scituate, MA	3.8	10 Bardenpho Plants, FL [2]	3.5		
Howard F Curran, FL [2]	3.0				

[1] Kalkaska has a TIN based permit; assuming ON value of 1.0 to 1.5 mg/L, TN Value could be 2.7 to 3.2 mg/L.
[2] Data for these plants are from Jimenez et al., 2007.

Figure 2 – Flow Sheets for Best Performing Nitrogen Removal Plants



Using the 95th percentile criterion to assess the technologies, separate stage denitrification processes were able to satisfy or closely approach the maximum month criteria of 3.0 mg/L. With respect to combined processes, it was found at Parkway that with carbon addition the plant could achieve the monthly TN of 3.0 mg/L in the winter but not on a firm basis, although this was due to nitrification problems and inconsistent carbon addition and improper carbon addition control. The Kalkaska CWP, a Bardenpho plant operating under very cold climatic conditions, was able to achieve a monthly TIN below 3.0 mg/L. If one assumes that Kalkaska has an ON effluent concentration between 1.0 and 1.5 mg/L, then Kalkaska would be achieving approximately 2.7 to 3.2 mg/L TN on a monthly 95th percentile basis. The Eastern Water Reclamation Facility was loaded more aggressively than other Florida Bardenpho plants and therefore not typical. The performance of Bardenpho plants with carbon addition from the earlier Florida survey achieved a 95th percentile monthly value of 3.5 mg/L, which while better than the two plants we studied, is still above the two other nitrogen removal categories. The EPA Municipal Nutrient Removal Technologies Reference Document (Kang *et al.*, 2008) found max month values of 4.2 to 4.9 mg/L for other combined processes in northern climatic conditions, but no other Bardenpho processes with routine carbon addition were found in northern climates, so firm conclusions about the Bardenpho process performance under colder climatic conditions cannot be drawn at this time.

Multiple stage N removal processes constitute ones where denitrification occurs both in an activated sludge step as well as in a polishing step such as in an effluent filter designed for denitrification. At least under the warm climatic conditions in Florida they worked as well as separate stage processes (Table 7). The Fiesta Village plant's exceptional performance may in part have been due to the fact that it lacked complete solids processing facilities that generate high strength return streams on site when compared to other plants in the study that had them. Finally, no multiple stage processes with three years of operating data were found to study under colder climatic conditions, so the generality of the conclusions about multiple stage plants is uncertain at this point in time.

While the 95th percentile monthly performance statistics are used in ranking nitrogen removal technologies, they should not be used to confirm that maximum month permit levels can be achieved for the plants studied, since by definition, they would be exceeded three months in a permit period, or five percent of the time. For example, while the 95th percentile monthly effluent TN concentration of the Truckee Meadows plant was 2.5 mg/L, the actual maximum month for the 36 month period analyzed was 3.2 mg/L. Similarly, the Martis Valley plant owned by T-TSA had a 95th percentile monthly effluent TN concentration of 3.0 mg/L, while the actual maximum month value for the 36 months of record was 3.4 mg/L.

PERFORMANCE OF PHOSPHORUS REMOVAL PLANTS

Table 8 shows the daily data TPS total phosphorus concentrations calculated from the ten plants studied that reported phosphorus data. The table also shows the process and permit limits for the facilities and the averaging periods. The results show that the two stage chemical addition, often in combination with EBPR, produced low effluent concentrations. This is also true for single stage chemical addition coupled with EBPR or for single stage tertiary chemical addition with high chemical dosages (Iowa Hill).

Table 8 - Total Phosphorus Daily Data TPS Concentrations (mg/L)

Plant	Process Code[1]	TN Permit (mg/L)/ Averaging Period [2]	3.84% (14d)	50%	95%	3.84% /50%	95%/ 50%
Iowa Hill WRF, CO	2-3C$_{Al}$-3F	0.05/A	0.004	0.012	0.045	0.33	3.8
Blue Plains, DC	1C$_{Fe}$-2C$_{Fe}$-3C$_{M}$-3F	0.18/A	0.005	0.070	0.180	0.07	2.6
Pinery, CO	2BC$_{F}$-3C$_{Al}$F	0.05/M	0.014	0.023	0.045	0.58	2.0
F. Wayne Hill, GA	1-2BC$_{Al}$-3C$_{Fe}$-3UF	0.13/M	0.020	0.040	0.110	0.50	2.8
Rock Creek, OR	1C$_{Al}$-2-3C$_{Al}$-3F	0.10/MM	0.025	0.065	0.210	0.38	3.2
ASA, VA	1$_{CFe}$-2C$_{M}$C$_{Fe}$-3C$_{Al}$-3F	0.18/M	0.025	0.050	0.120	0.50	2.4
Cauley Creek, GA	2BC$_{Fe}$-3UF	0.13/M	0.040	0.080	0.160	0.50	2.0
Clark County, NV	1C$_{Fe}$-2B-3C$_{Al}$-3F	0.14/M	0.045	0.081	0.201	0.55	2.5
Kalispell, MT	1-2B$_{CAl}$-3F	1.0/M	0.050	0.100	0.230	0.50	2.3
Kelowna, BC	1-2B$_{CAl}$C$_{F}$-3F	0.25/A	0.090	0.150	0.324	0.60	2.2

[1] Process codes explanation can be found in Tables 2 and 4.
[2] Permit limits are shows only as an indication of the requirement under which the plant operates. Permits requirements varies – for example Rock Creek operates under a monthly median permit. M= Monthly, A= Annual, MM = Seasonal Median Monthly

The daily data TPS-14d concentrations for the ten processes analyzed are typically 40 to 50 percent of the median performance. The exception is Blue Plains and Iowa Hill, where the lowest achievable limit is 10-33% of the median performance. The 95th percentile performance is typically between two and three times the median performance. Iowa Hill reports nearly four times the median. Iowa Hill had the lowest daily data TPS-50% value. The phosphorus performance variability TPS-95%/TPS-50% ratio seems to show a relationship to the median value, increasing as the median value decreases. Comparing the 95th percentile to the TPS-14d, there are up to ten times the difference in these values for the plants operating at very low effluent TP. This substantial degree of variability should be recognized in the permitting and design process and is an important finding of this project.

As a class, single stage chemical addition processes for TP removal outperformed multiple stage processes (Table 9), but at the expense of higher chemical dosages as shown in Table 10. The lowest TP values were found at the Iowa Hill plant with its tertiary ballasted sedimentation process. It is notable that the level of chemical addition at this plant was higher than at any other (alum 100 to 300 mg/L, sodium hydroxide, 80 to 100 mg/L), which is the major factor contributing to its very low effluent TP levels. It is not known if this reflects technological performance superiority over the MBR (Cauley Creek), as this may just reflect differing effluent requirements and chemical dosing practices rather than real technological superiority of the technology applied at Iowa Hill. It is notable that Cauley Creek and Pinery also employed biological phosphorus removal during the period evaluated, but Iowa Hill did not. Thus, the benefit of preceding biological phosphorus removal is discernable from the data, since all three plants had relatively high chemical dosages (Table 10).

The five multiple stage plants (Table 9) were similar in performance on a 95th percentile basis for maximum month conditions, but only the F. Wayne Hill and the ASA plants achieved 0.1 mg/L TP on a 95th percentile maximum month basis. The Rock Creek plant might have ranked somewhat higher as it transitions from no chemical addition to chemical addition seasonally, hence the impacts of transitional periods are included in its data.

The performance of the two plants reliant almost exclusively on biological phosphorus removal, Kelowna and Kalispell performed exceptionally well, but not at the same levels as those that either were reliant on chemical addition or a combination of biological phosphorus removal with chemical addition to a tertiary step.

While the 95th percentile monthly performance statistics are useful in ranking TP removal technologies, they should not be used for permit setting, since by definition they would be exceeded three months in a permit period, or 5 percent of the time. For example, while the 95 percentile monthly effluent TP concentration of the Iowa Hill plant was 0.03 mg/L, the actual maximum month for the 36 month period analyzed was 0.07 mg/L. Similarly, the ASA plant had a 95th percentile monthly effluent TP concentration of 0.10 mg/L, while the actual maximum month value for the 36 months of record was 0.12 mg/L. And the Kelowna plant had a 95 percentile value of 0.22 mg/L, while the actual maximum monthly value was 0.87 mg/L.

Table 9 - 95th Percentile Monthly Average TP for Three Categories of Phosphorus Removal Plants

Single Stage Chemical Addition	TP, mg/L	Multiple Stage Chemical Addition	TP, mg/L	Little or No Chemical Addition	TP, mg/L
Iowa Hill WRF, CO	0.0306	F Wayne Hill, GA	0.0902	Kalispell, MT	0.17
Pinery, CO	0.0363	ASA, VA	0.101	Kelowna, BC	0.22
Cauley Creek, GA	0.116	Clark County, NV	0.153		
		Rock Creek, OR	0.151		
		Blue Plains, DC	0.161		

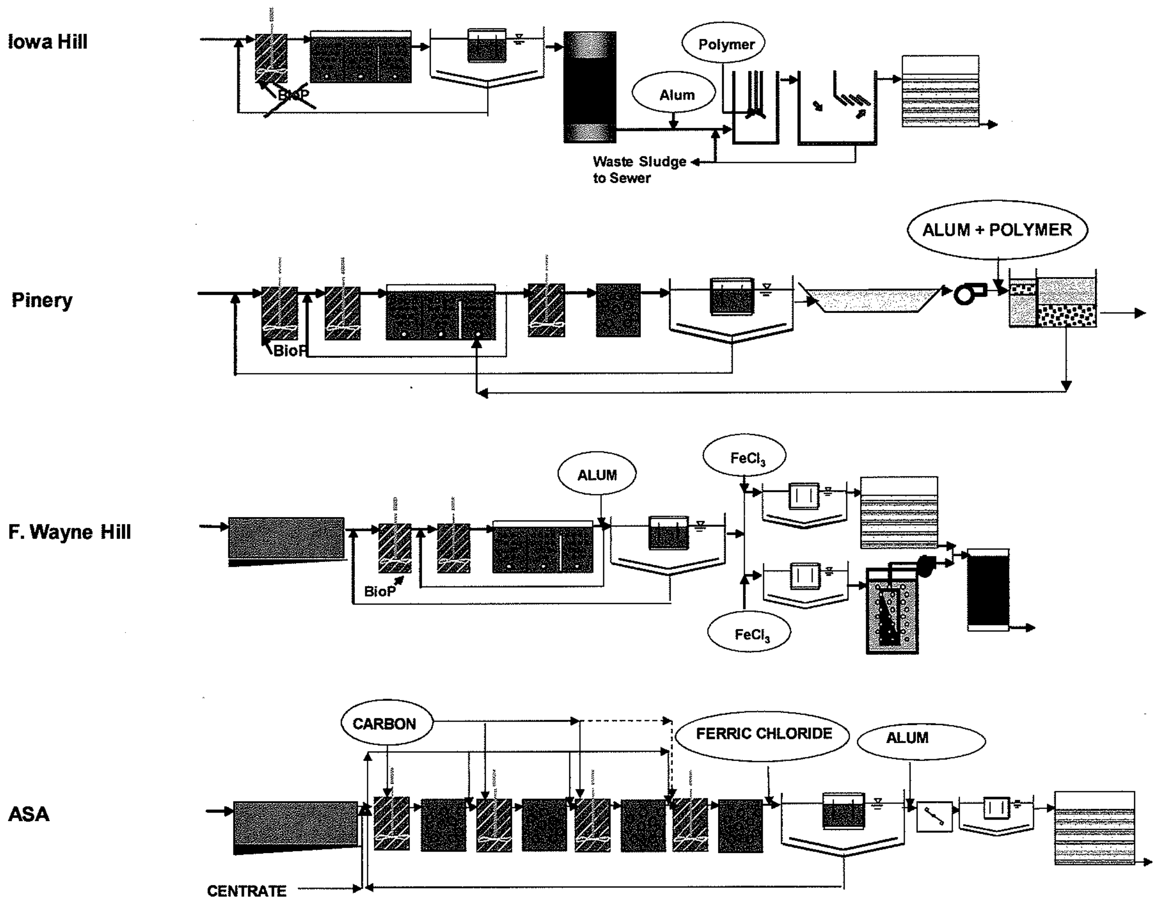
Table 10 - Average Chemical Dosages for the Phosphorus Removal Plants

Plant	Category	Chemical	Addition Point	Dosage (mol Al^{3+} or Fe^{3+} / mol Influent TP) [1]
Iowa Hill WRF	Single Stage	Alum	Tertiary Flash Mixer	2.92
Pinery	Single Stage	Alum	Filters	3.11
Cauley Creek	Single Stage	$FeCl_3$	MBR Influent	3.06
ASA	Multiple Stage	$FeCl_3$	Secondary Clarifiers	0.61
		Alum	Tertiary Clarifiers	0.44
F. Wayne Hill	Multiple Stage	Alum	Secondary Clarifiers	0.12
		$FeCl_3$	Tertiary Chemical Clarifiers	0.03
		$FeCl_3$	Tertiary Chemical Clarifiers	0.03
Clark County	Multiple Stage	$FeCl_3$	Primary Clarifiers	0.27
		Alum	Tertiary Clarifiers (AWT)	0.13
		Alum	Tertiary Filters (CP)	0.13
Rock Creek	Multiple Stage	Alum	Primary Clarifiers	N/A
		Alum	Tertiary Clarifiers	N/A
Blue Plains	Multiple Stage	$FeCl_3$	Primary Clarifiers	0.66
		$FeCl_3$	Secondary Biological Reactors	0.33

[1] Dosages calculated based on plant's raw influent.

The best four performing plants phosphorus removal plants rated on the 95th percentile maximum month basis were the Iowa Hill, Pinery, F. Wayne Hill and the ASA plant. The flow sheets for these plants are shown in Figure 3.

Figure 3 – Flow Sheets for Best Performing Phosphorus Removal Plants



PERFORMANCE OF NITRIFICATION RELIABILITY PLANTS

Table 11 shows the daily data TPS ammonia concentrations calculated from all of the plants that were analyzed for nitrification reliability. The table also shows the type of process that was used to achieve nitrification . The results indicate that most of the technologies examined can on average accomplish a high degree of nitrification at least on long-term averaging basis. The 95th percentile performance is highly variable, ranging between 1.6 and 49 times the median performance. This indicates that the nitrification performance variability is much greater than for nutrient removal performance.

Table 11 – Ammonia Nitrogen Daily Data TPS Concentrations (mg/L)

Plant	Nitrification Process [1]/ Code	3.84% (14d)	50%	95%	3.84%/ 50%	95%/ 50%
Fiesta Village, FL	AS/2C$_{Al}$-3C$_{M}$DF	0.0050	0.0050	0.24	1.0	48.8
Kelowna, BC	AS/1-2B$_{CAl}$C$_{F}$-3F	0.010	0.30	1.16	0.033	3.88
Blue Plains, DC	AS/1C$_{Fe}$-2C$_{Fe}$-3C$_{M}$-3F	0.010	0.38	3.07	0.026	8.07
Western Branch, MD	AS/2C$_{M}$C$_{Al}$-3F	0.017	0.036	0.52	0.47	14.4
Piscataway, MD	AS/1-2C$_{Al}$-3F	0.017	0.017	3.24	1.0	191
Eastern WRF, FL	AS/2B$_{CAl}$-3F	0.020	0.10	5.25	0.20	52.5
Parkway, MD	AS/1-2$_{CAl}$	0.025	0.10	1.80	0.25	18.0
Utoy Creek, GA	AS/1C$_{Fe}$-2BC$_{Fe}$C$_{Ac}$-3F	0.030	0.040	0.14	0.75	3.50
Kalkaska, MI	AS/2BC$_{Fe}$	0.050	0.050	0.34	1.0	6.84
Truckee Meadows, NV	BR/1-2-3NTF-3C$_{M}$-3F	0.050	0.050	0.69	1.0	13.8
Tahoe-Truckee, CA	BR/1-3C$_{L}$-3C$_{M}$-3$_{CAl}$F	0.050	0.28	0.60	0.18	2.11
Scituate, MA	AS/2-3C$_{M}$DF	0.10	0.30	0.90	0.33	3.0
Littleton/Englewood, CO[2]	BR/1-2TF-3NTF	1.35	2.38	3.88	0.57	1.63

[1] Process where nitrification takes place: AS = Activated Sludge, BR = Biofilm Reactor
[2] Littleton/Englewood has ammonia based permits for which the lowest monthly permit value was 4.5 mg/L. The plant was not managed to achieve low ammonia values and operated to blend nitrified effluent with secondary effluent so as to achieve a combined chlorine residual.

The main interest of the evaluation of nitrification capability was related to the ability of the various technologies to meet maximum day requirements, since as shown, most technologies can accomplish a high degree of nitrification on an average basis. Very low permit concentrations for maximum day performance may be set for plants discharging to effluent dominated streams because of acute toxicity criteria. Thus, Table 12 focuses on peak daily performance and compares technology where activated sludge is used for the nitrification stage to technologies using biofilm reactors. The activated sludge technologies are shown in the upper part of the table, while the biofilm reactor technologies are shown in the lower part. Peak day performance in the 36 months of record for each plant is also compared to 99 percentile performance, to determine if there is anything unusual in the record which would alter the process rank. Recall, 99^{th} percentile performance would be exceeded 18 times in a five year permit period if the effluent were to be analyzed every day. The process ranking is not altered much by the use of either statistic, with the Utoy Creek plant achieving the most dependable performance using either statistic.

Both the Truckee Meadows and Littleton Englewood plants are shown twice in Table 12, to show a comparison of the NTF effluent with the final effluent. The best performing activated sludge plants out-perform those with nitrifying trickling filters when comparing peak day performance statistics for ammonia.

Only four plants were identified that could meet a maximum day effluent ammonia criteria of 4 mg/L, meaning that reliability of plants with limits less than 4 mg/L will be expected to be poor. The flow sheets for these plants are shown in Figure 4. Other measures beyond what has been provided in the exemplary plants examined will have to be implemented to meet low maximum day ammonia limits.

On an annual basis, NTFs produce about 0.5 mg/L Ammonia Nitrogen more than the best performing activated sludge plants. However, when a nitrifying biofilm reactor is followed by a downstream denitrification reactor, ammonia uptake in the denitrification step mitigates the difference. For instance, compare the results in Table 12 for the Truckee Meadows plant NTF effluent to the final effluent for the plant. The Truckee-Meadows plant performance compares favorably to the best performing activated sludge plant effluents on an annual average basis. Similarly, compare the small difference between Tahoe-Truckee denitrifying BAF effluent to the Scituate and Fiesta Village plant effluents, both of which have denitrifying filters downstream of their nitrifying activated sludge step. And the nitrifying biofilm reactor plants that have a downstream denitrification step also have comparable statistics for maximum day statistics for the better performing activated sludge plants.

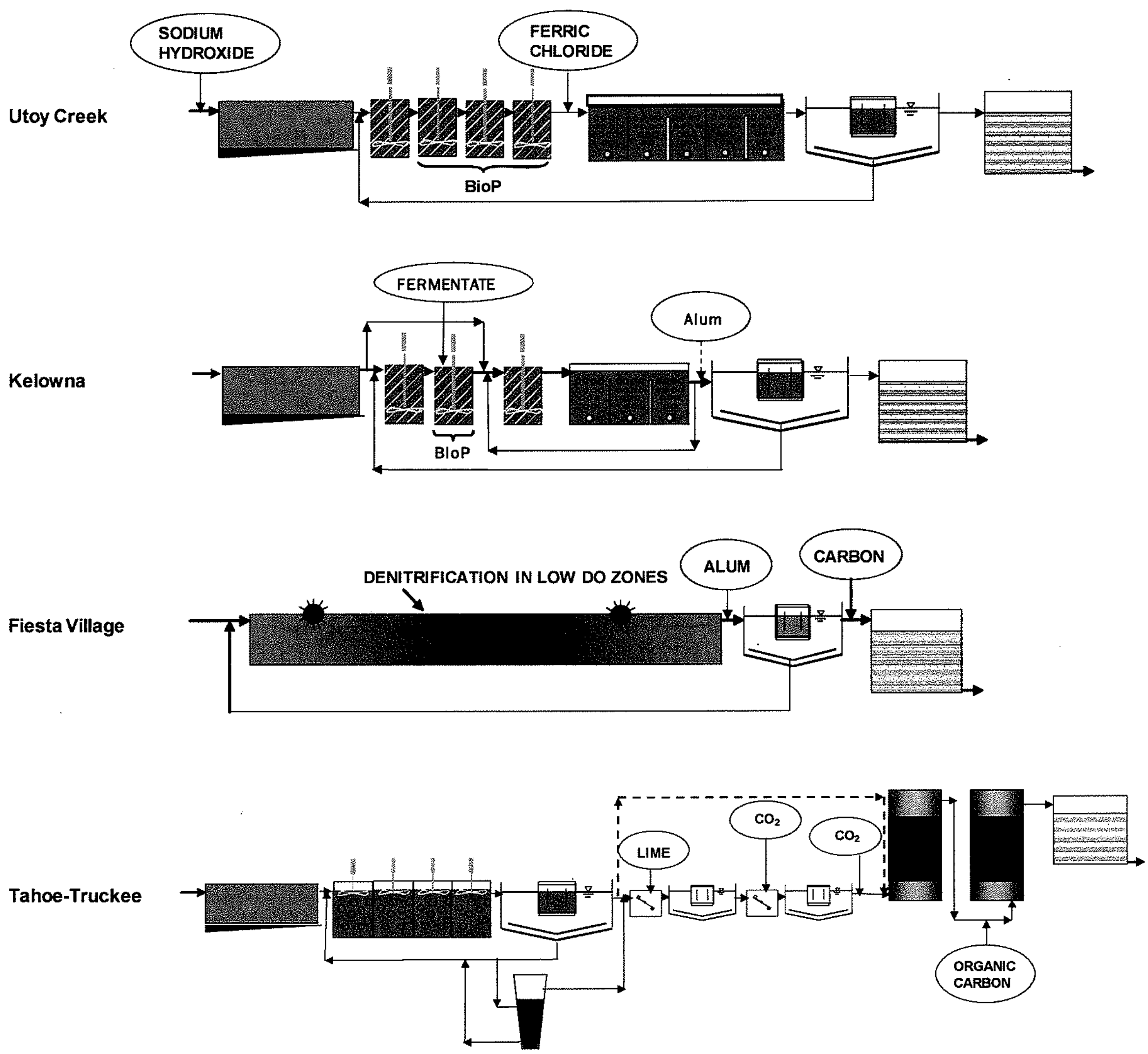
Table 12 - Relevant Statistics for Effluent Ammonia Nitrogen Concentrations

Plant	Nitrification Process [1]/Flow Sheet Code	Maximum Day, in Record, mg/L	Daily, 99 percentile, mg/L	Annual, 50 percentile, mg/L
Utoy Creek	AS/1C$_{Fe}$-2BC$_{Fe}$C$_{Ac}$-3F	2.20	0.50	0.057
Scituate	AS/2-3C$_{M}$DF	5.8	1.39	0.39
Fiesta Village	AS/2C$_{Al}$-3C$_{M}$DF	3.11	1.68	0.042
Kelowna	AS/1-2B$_{CAl}$C$_{F}$-3F	2.74	1.68	0.39
Kalkaska	AS/2BC$_{Fe}$	4.24	1.82	0.170
Parkway	AS/1-2$_{Cal}$	6.80	4.36	0.30
Blue Plains	AS/1C$_{Fe}$-2C$_{Fe}$-3C$_{M}$-3F	6.74	4.58	0.82
Western Branch	AS/2C$_{M}$C$_{Al}$-3F	9.49	4.65	0.12
Piscataway	AS/1-2C$_{Al}$-3F	10.27	6.15	0.12
Eastern	AS/2B$_{CAl}$-3F	19.8	12.5	1.15
Tahoe-Truckee, BAFs	BR/1-3C$_{L}$-3C$_{M}$-3$_{CAl}$F	2.53	0.83	0.28
Truckee Meadows, Final	BR/1-2-3NTF-3C$_{M}$-3F	5.26	1.67	0.16
Truckee Meadows, NTF	BR/1-2-3NTF	6.94	3.54	0.63
Littleton/Englewood, Final [2]	BR/1-2TF-3NTF	7.71	4.72	2.48
Littleton/Englewood, NTF	BR/1-2TF-3NTF	5.77	3.39	0.70

[1] Process where nitrification takes place: AS = Activated Sludge, BR = Biofilm Reactor

[2] Littleton/Englewood has ammonia based permits for which the lowest monthly permit value was 4.5 mg/L. The plant was not managed to achieve low ammonia values and operated to blend part of nitrified effluent with secondary effluent so as to achieve a combined chlorine residual.

Figure 4 – Plants with Lowest Maximum Day Ammonia Concentrations



LESSONS LEARNED

Many factors that influence reliability and variability were determined from the data and from the plant managers. These included external and operations or design influences as follows:

- Infrequent toxic event upsets. Biological processes are a main feature of all the plants surveyed and are subject to upsets.
- Unexpected interruptions in chemical supply. The majority of plants in the survey use chemicals for either nitrogen or phosphorus removal.
- Plant upgrading projects and the impacts of construction on effluent reliability.

- Peak flow events were the most difficult operating issues along with seasonal variations in flows and loads.
- Biological treatment capacity issues impacted performance during more stressed periods.
- Internal sludge supernatant recycle streams containing ammonia.
- Chemical feed control issues for phosphorus removal.
- Fermenter control issues were the most difficult aspect of operations in plants reliant solely on biological phosphorus removal.

CONCLUSIONS

As with the previous Florida survey (Jimenez *et al.*, 2007), the nutrient removal and nitrification plant flow sheets stratified themselves on a technology basis. Using the data reported by full scale facilities, the investigation showed that:

- Flow sheets have been identified that have achieved either a monthly max of 3.0 mg/L TN or 0.1 mg/L TP on a 95^{th} percentile basis. It is important to recognize that performance at this level for both TN and TP at the same plant has not been demonstrated.
- Separate stage N plants outperform combined N plants due to a higher degree of denitrification control possible with a separate stage process.
- Four or five-stage Bardenpho plants come close to meeting the TN of 3 mg/l, 95 percent of the time; a prior survey of 10 plants in a warm climate (Florida) show a capability of 3.5 mg/L. The exemplary performance of the cold climate Kalkaska plant, even though it only monitors TIN suggests, shows that it may reach close to 3.0 mg/L TN on 95 percentile monthly basis, when assuming a range of values for its (unmeasured) ON content.
- As a class, single stage chemical addition processes for TP removal outperformed multiple stage processes, but at the expense of higher chemical dosages.
- Tertiary chemical addition and effective filtration (gravity media or membrane) is required to achieve very low effluent TP. Plants with some form of tertiary chemical addition, clarification, and filtration outperform (slightly) those which have only effluent filters.
- Kelowna and Kalispell (single stage BioP plants) performed very well without tertiary chemicals achieving 0.10 and 0.15 mg/L on median daily basis. This represents a tremendous achievement in terms of weaning plants from chemicals.
- Full scale plant performance for total nitrogen showed that the TPS-14d value of a typical plant is 50- 60% of the median value. The TPS-95% is 180-250% of the median value.
- Full scale plant performance for total phosphorus showed that the TPS-14d value of a typical plant is 40-50% of the median value. The TPS-95% is 200-300% of the median value.

- For total nitrogen and total phosphorus, comparing the 95th percentile to the TPS-14d, there is up to ten times difference in these values for the plants operating at very low effluent concentrations. This substantial degree of variability in these exemplary plants should be recognized in the permitting and design process and is an important finding of this project.
- 95th percentile values for maximum month performance should not be the basis of regulation, since they represent 3 months of permit exceedance in a five year permit period. For several plants, the maximum month value was significantly higher than the 95th percentile value and no consistent relationship between the two statistics was found.
- Only four plants were identified that could meet a maximum day effluent ammonia criteria of 4 mg/L, meaning that reliability of plants with limits less than 4 mg/L will be expected to be poor. Other measures beyond what has been provided in the exemplary plants examined will have to be implemented to meet low maximum day ammonia limits.

Despite the various factors influencing performance from site to site, four plants have been identified as the best performing plants in the nation with respect to nitrogen removal when evaluated on a maximum month basis. These are the Fiesta Village, River Oaks, Truckee Meadows and the Western Branch plants. Their 95th percentile monthly performance varied only from 2.2 to 2.5 mg/L. Considering all the factors influencing their performance, they cannot be further distinguished in a technology stratification sense, one from the other. Their superior performance has one thing in common: they have either a separate denitrification stage or a polishing step with methanol, which allows more precise control of effluent quality than the processes with combined flow sheets (like Bardenpho) offer. This is not to say that any plant with one of the flow sheets these four plants represent can be placed anywhere, under any climatic and flow and loading condition and be expected to produce the same result. The four plants exhibit significant effluent TN variability in Technology Performance Statistics (concentrations and performance ratios), as documented in this report.

As another example, this investigation has shown that at low effluent TN levels, the composition of the TN becomes dominated by organic nitrogen (ON) that is resistant to further biological degradation. The ON residual is known to have significant plant to plant variability and is impacted by industrial contributions specific to each plant, ON in the drinking water supply as well as by extracellular production of ON by the biological organisms in the wastewater treatment process. Understanding the composition of ON and designing processes that can effectively remove it is a research need, if even lower effluent TN levels are sought beyond the capabilities of the technologies examined in this investigation.

Considerable judgment must be employed in using this information in designing for Greenfield plants or conversions of secondary processes to nutrient removal, as the database herein can only be used for guidance and cannot be directly translated. In design, highly parameterized plant process models are routinely used. When designing for effluents close to zero, these models do not accurately capture the statistical variability of nutrient removal processes. For such situations, there are many unknowns that are not resolvable early in project implementation and are only partially compensated by conservatism in design. In such cases, success will only be statistically defined in the first years of plant operation.

This investigation was limited by the availability of exemplary performing plants that had been operating for at least 36 months. In future years, the technologies that were emerging at the time of writing will have come online and should be subject to evaluation. In addition, there were a very limited number of nitrogen removal plants operating in cold climates in either the combined or multiple stage configurations at the time of study. However, there are a number of these currently under construction and data will start to become available within four or five years. Other technologies, such as BAFs and MBRs configured for either low nutrient concentration or high degrees of nitrification will be coming online and can be used to extend the database assembled in this investigation. When these plants accumulate sufficient operating history, they should be subjected to analysis so as to expand the conclusions about technology stratification presented herein.

Many technical publications can be found in the literature making claims about the capabilities of specific technologies in reaching low nutrient concentrations. Unless supported by complete descriptions about plant operation and design along with statistical analysis of data from longer term operating periods, these claims should be viewed with a high degree of skepticism. As can be demonstrated by examination of almost any of the cases analyzed herein, presentation of performance data without stating its statistical characteristics is virtually meaningless. Indeed, this investigation establishes a new protocol that should be used for data presentation in the future, so that data between studies can be comprehensively compared on common bases.

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The mention of trade names, specific vendors, or products does not represent an actual or presumed endorsement, preference, or acceptance by EPA or the federal government. Stated analyses, results and conclusions contained herein do not necessarily represent the views or policies of EPA.

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EXETER, NH

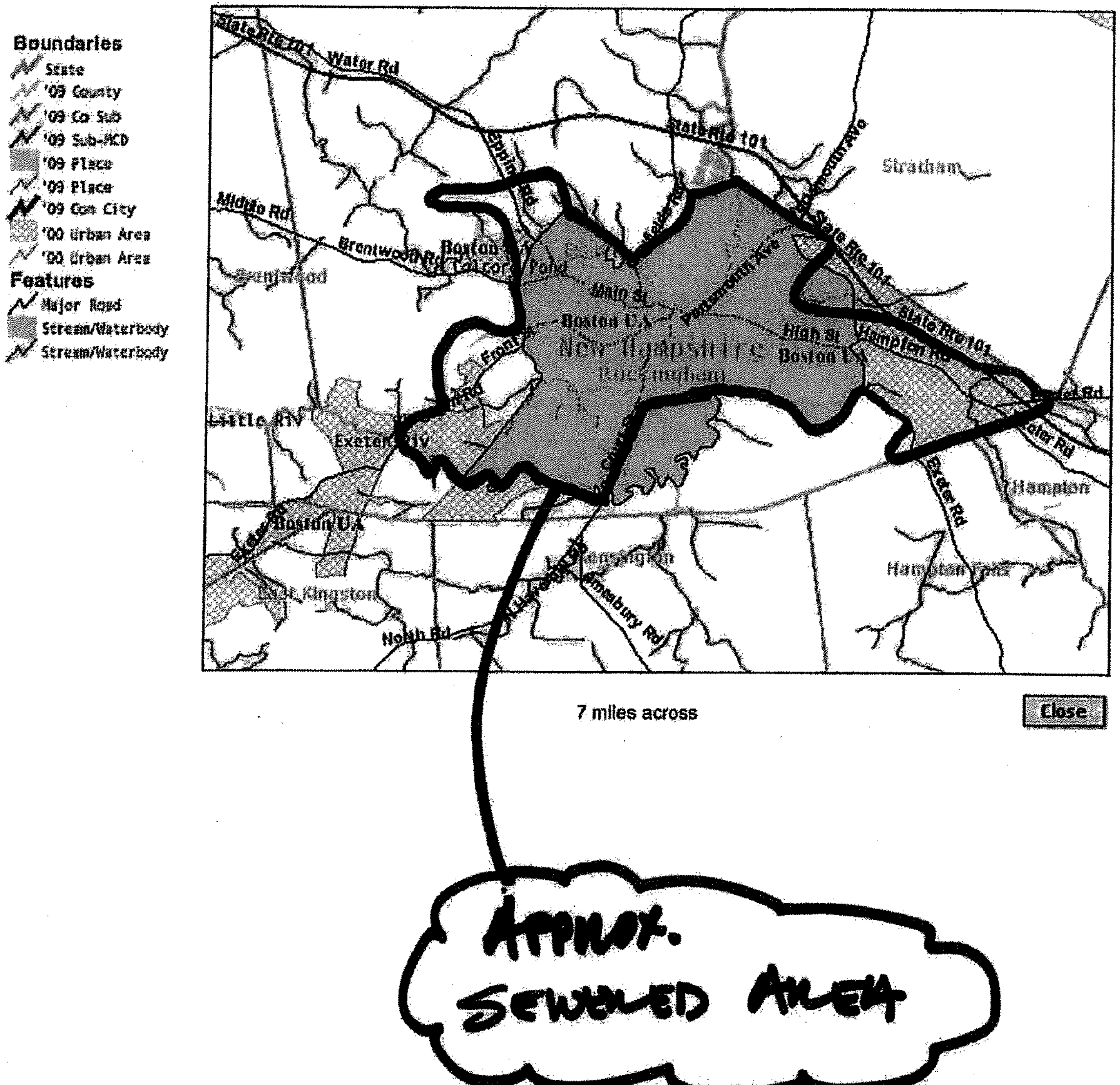
WWTF UPGRADE
SEWER USER RATE IMPACTS

ITEM	CURRENT	FUTURE NITROGEN LIMIT 8 mg/l	5 mg/l	3 mg/l
Current User Rate ($/1,000 gal)	$4.35	-	-	-
Service Charge ($/Year)	$112	-	-	-
Avg. Annual Usage (gal/yr) (1)	90,000	90,000	90.000	90,000
Current Avg. User Charge ($/yr)	$503.50	-	-	-
Current User Charge Revenues ($/yr)	$2,096,706	$2,096,706	$2,096,706	$2,096,706
WWTF Capital Cost ($) (2)	-	$35,910,000	$44,100,000	$51,660,000
- Bond Cost ($/yr) (3)	-	$2,640,000	$3,250,000	$3,800,000
Increased O&M Cost ($/yr) (4)	-	$520,000	$1,230,000	$1,640,000
Total Annual Costs ($/yr)	$2,096,706	$5,256,706	$6,576,706	$7,536,706
- % Increase over current	**0%**	**151%**	**214%**	**259%**
Future User Cost ($/yr)	$503.50	$1,264	$1,579	$1,808
Median Household Income ($/yr) (5)				
- Entire Town	$61,089	$61,089	$61,089	$61,089
- CDP (6)	$53,860	$53,860	$53,860	$53,860
User Cost/MHI Ratio (%) (7)				
- Entire Town	0.82%	2.07%	2.58%	2.96%
- CDP	0.93%	2.35%	2.93%	3.36%

Notes:

1. NHDES User Rate Survey assumed average usage value = 90,000 gal/yr
2. NHDES, Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Estuary Watershed, Appendix E - Capital and Operation/Maintenance Costs Associated with Nitrogen Removal at 18 Municipal Wstewater Treatment Facilities Discharging to the Great Bay Estuary, December 2010
3. Assume 4% interest rate, 20-year term, level payments
4. NHDES, Analysis of Nitrogen Loading Reductions for Wastewater Treatment Facilities and Non-Point Sources in the Great Bay Estuary Watershed, Appendix E - Capital and Operation/Maintenance Costs Associated with Nitrogen Removal at 18 Municipal Wstewater Treatment Facilities Discharging to the Great Bay Estuary, December 2010
5. 2009 Data (most recent available)
6. Exeter Census Designated Place (CDP) boundary correlates closely to the sewered area of the town (see attached figure)
7. Annual household sewer rates that exceed 2% of MHI are generally considered not affordable by USEPA

Exeter CDP, New Hampshire



7 miles across

Close

EXETER MHF
- CDP AREA (2009) $53,860
- TOWN WIDE (2009) $61,089

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August 12, 2011

VIA E-MAIL

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Director, Office of Ecosystem Protection
U.S. Environmental Protection Agency
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Suite 100
Boston, MA 02109-3912
E-mail: Perkins.Stephen@epamail.epa.gov

RE: Supplemental Comments in Response to Request for Public Comment on Proposed Town of Exeter, NH, NPDES Permit No. NH0100871

Dear Mr. Perkins:

The Great Bay Municipal Coalition (the Coalition) is an organization dedicated to the establishment of appropriate and cost-effective restoration measures to protect Great Bay and its resources. The Coalition represents the six major communities whose wastewater flows into various parts of the Great Bay system – Dover, Durham, Exeter, Newmarket, Portsmouth, and Rochester. These communities are directly impacted by the proposed nutrient reduction water quality objectives and requirements for the Town of Exeter. Attached please find supplemental comments and objections to the proposed modification of the Town of Exeter, NH, NPDES Permit No. NH0100871. These supplemental comments are provided on behalf of the Coalition and on behalf of the Coalition's individual members in addition to the comments and objections submitted to EPA by the Coalition on Aug. 9, 2011. Thank you for your consideration of these comments. We look forward to the Region's response.

Sincerely,

John Hall/AM

John C. Hall

Enclosures
cc: Coalition Members
Ted Diers, DES

Proposed Exeter Permit
Supplemental Comments of the Great Bay Municipal Coalition

The Great Bay Municipal Coalition (the Coalition) is an organization dedicated to the establishment of appropriate and cost-effective restoration measures to protect Great Bay and its resources. The Coalition members include the towns of Dover, Durham, Exeter, Newmarket, Portsmouth, and Rochester. These communities are directly impacted by the proposed nutrient reduction requirements for the Town of Exeter. These comments supplement the comments submitted by the Coalition on Aug. 9, 2011, regarding the proposed modification of the Exeter, NH, NPDES Permit No. NH0100871 and are based on EPA's July 29, 2011, response to the Coalition's FOIA request dated June 8, 2011. EPA's response – en toto – is incorporated by reference as the administrative record documents addressing the specific topics covered in the Coalition's FOIA request. Further comments may be submitted based on EPA's response to the Coalition's request that EPA clarify or supplement the response provided to the Coalition.

Based on these supplemental comments and the earlier comments submitted by the Coalition, we object to this permit action as technically and legally flawed and request that the proposed permit modification action be withdrawn.

Supplemental Issues Regarding the Ability to Identify Available Arguments and All Supporting Materials

1. The Administrative Record Lacks Adequate Information on the Squamscott River

The Coalition, through its representatives, requested that EPA produce, under the Freedom of Information Act ("FOIA"), those agency records that support various claims that EPA has made in the permit Fact Sheet and in its public presentations regarding the proposed permit modification. EPA recently provided that information on July 29, 2011, and Hall & Associates has reviewed those documents. The FOIA response rather uniformly lacked Agency records addressing nutrient impacts on the Squamscott River, as follows (numbering follows that of original FOIA request):

1. Data from and analyses of the Squamscott River showing:

    a. changes in transparency caused the eelgrass losses in this system;

    b. whether the 0.75 Kd (the transparency basis for the 0.3 mg/1 TN numeric criteria) is attainable in this system;

    c. how other confounding/contributing factors, unrelated to algal growth, impact transparency in this system (i.e., color, turbulent mixing, turbidity);

    d. the relative importance of turbidity and color versus algal level in controlling transparency in the Squamscott River;

e. whether it is proper to apply the 0.3 mg/1 TN median value developed by DES under low flow, limited dilution conditions to derive permit limits;

f. the frequency of occurrence for the conditions used by EPA to generate the TN permit limits;

g. that TN, rather than biologically available nitrogen (generally inorganic nitrogen (TIN), is the appropriate form of nitrogen to control in this system;

h. that there is sufficient detention time in this system to convert organic forms of nitrogen into inorganic nitrogen and significantly impact algal growth in the system;

i. the degree to which chlorophyll a in the Squamscott River affects transparency under average/median conditions; and

j. that nutrients are the limiting factor controlling algal growth in the Squamscott River and Great Bay.

2. Documentation showing where eelgrass originally was present in the Squamscott system and whether the habitat in those areas has changed in the past 40 years.

3. Documentation showing what the TIN, TN and algal levels were in the system when eelgrass was present in the Squamscott River.

4. Documentation showing what caused the loss of eelgrass in the Squamscott River prior to 1980.

5. Documentation showing that the causes of eelgrass decline in the Bay are the same factors that caused eelgrass losses in the Squamscott River decades earlier.

6. Documentation showing that DES has adopted and EPA has approved the proposed numeric criteria used to derive the Exeter permit limits.

7. Documentation of the public review process showing that the 0.3 mg/1 TN criteria applied by EPA has undergone formal notice and comment by DES as part of the CWA Section 303(c) adoption process, as required by applicable federal rules (40 CFR 131.21).

8. Documentation showing that the 0.3 mg/1 TN criteria was based on an analysis of how conditions in the tidal rivers influence algal growth and transparency.

9. Documentation showing that attainment of the 0.3 mg/1 TN criteria will assure attainment of the 22% incident light at 2 meters (0.75 Kd) in the Squamscott River.

10. Documentation that promoting eelgrass growth in the Squamscott River requires the same degree of light penetration as the Bay (22% incident light at 2 meters).

11. Documentation on the degree of transparency improvement and algal growth reduction that will occur in the Squamscott River if the Exeter discharge is limited to 3 mg/1 as recommended in the draft permit.

12. Documentation showing that reduced transparency has occurred in Great Bay from 1990-2008 and that the change in transparency was sufficient to cause the eelgrass reductions occurring in the Great Bay system.

13. All documentation showing that the existing transparency level in the Bay is insufficient to maintain current eelgrass populations, even when the tidal variation in the Bay is considered.

15. Any correspondence/communications between EPA and NHDES indicating whether or not that EPA should impose the transparency-based TN criteria in the tidal rivers such as the Squamscott River.

16. Documentation showing that the TN objectives used by Massachusetts and Delaware referenced in the permit Fact Sheet were intended to be applied in tidal rivers with hydrodynamics similar to the Squamscott River.

Consequently, this FOIA response confirmed that the Administrative record lacks adequate information upon which the Agency could appropriately base a decision that 1) attainment of a 0.3 mg/l TN instream objective in the Squamscott River is necessary to restore lost eelgrass beds in that waterway, and 2) that a 3 mg/l total nitrogen monthly average limitation is necessary to ensure compliance with New Hampshire’s narrative water quality standards and abate existing impairments in the Squamscott River.