12-31-2008

Total Nitrogen Concentrations in Wastewater Treatment Plant Effluent in the Great Bay Estuary Watershed in 2008

Philip Trowbridge
New Hampshire Estuaries Project

2008

New Hampshire Estuaries Project

Total Nitrogen Concentrations in Wastewater Treatment Plant Effluent in the Great Bay Estuary Watershed in 2008

Prepared by:

Philip Trowbridge, P.E.
New Hampshire Estuaries Project

December 31, 2008

Introduction

Nitrogen enrichment is a growing concern for the Great Bay Estuary. For the 2006 State of the Estuaries report (NHEP, 2006), the NHEP calculated the nitrogen load from wastewater treatment facilities (WWTF) using data on total dissolved nitrogen in WWTF effluent in 2002 from Bolster et al. (2003). The NHEP needs to update this indicator for the 2009 State of the Estuaries report. Not only is more recent data needed but also measurements of total nitrogen are needed to avoid assumptions about the ratio of dissolved to total nitrogen. Therefore, the NHEP allocated staff time to collect effluent samples from the major WWTFs in the Great Bay watershed and funded laboratory analysis of the samples for total nitrogen (TN) and total dissolved nitrogen (TDN).

Methods

Sampling and Analytical Methods

The field sampling and laboratory analysis methods have been documented in the approved Quality Assurance Project Plan (RFA #08082; NHEP, 2008). Ten municipal WWTFs were included in the study: Kittery ME, Berwick ME, South Berwick ME, Portsmouth NH, Newmarket NH, Somersworth NH, Durham NH, Rochester NH, Exeter NH, and Dover NH (Figure 1). Ten grab samples were collected from each WWTF over a year at approximately monthly intervals. The Water Quality Analysis Laboratory at the University of New Hampshire used USGS Method I-4650-03 (Alkaline persulfate digestion) and high temperature catalytic oxidation (Merriam et al., 1996) to determine the TN and TDN concentrations in samples, respectively. The instantaneous loads of nitrogen from each WWTF on the sampling dates were calculated from the measured TN concentrations and the daily average flows recorded on monthly operating reports.

Quality Assurance Audit

Several quality control tests were planned in the QAPP (NHEP, 2008). The results of quality control samples have been summarized in Tables 1 and 2. All of the data quality objectives for the study were substantially met. The only deviations from the QAPP were that the WWTFs for Portsmouth NH and South Berwick ME were dropped from the study after it was learned that these WWTFs already test their effluent for TN.

During the quality assurance review of the data, the results for one sample were rejected. The effluent sample from the Durham WWTF on 7/9/08 had TN and TDN concentrations of 27 and 20.5 mg N/L, respectively. These concentrations were nearly 3 standard deviations from the mean values for this WWTF. All of the other samples from the Durham WWTF had concentrations less than 9.4 mg N/L for TN and 8.4 mg N/L for TDN. Given the large discrepancy between the 7/9/08 results and the other results from the Durham WWTF, the 7/9/08 results were considered outliers and were rejected. The discrepancy was probably caused by an unrepresentative sample of wastewater because it was only a grab sample.

Results and Discussion

The quality assured results for daily average flow, TN concentrations, TDN concentrations, and nitrogen loads for each WWTF are shown in Table 3. Figures 2-9 contain plots for each WWTF showing the TN and TDN concentrations over time, the TN and TDN concentrations versus flow, and the nitrogen load over time.

The purpose of this report is to publish the results from the NHEP sampling program for nitrogen in WWTF effluent. A detailed accounting of total nitrogen loads to the estuary from all sources (e.g., WWTFs, non-point sources, and atmospheric deposition) will be included in the 2009 State of the Estuaries Report. The State of the Estuaries Report will be prepared by the NHEP by October 2009. In the meantime, the following are some general observations which can be made based on the WWTF data:

- The average concentrations of TDN and TN in all the effluent samples were 13.1 and 17.8 mg N/L, respectively.
- The average TN concentration for different WWTFs ranged from 5 to 30 mg N/L. The WWTF with the lowest average TN concentration was Somersworth NH. The Rochester NH WWTF had the highest average TN concentration.
- For many of the WWTFs there was an inverse relationship between TN concentrations and flow. This relationship is probably due to dilution of sanitary wastewater by stormwater and infiltration.

References

NHEP. 2006. State of the Estuaries. New Hampshire Estuaries Project, University of New Hampshire, Durham, NH. 30 p. Published Online http://www.nhep.unh.edu/resources/soe_report.htm, Accessed December 24, 2008.

NHEP. 2008. Total Nitrogen Concentrations in Wastewater Treatment Plant Effluent in the NHEP Study Area in 2008. New Hampshire Estuaries Project, University of New Hampshire, Durham, NH. Published Online http://www.nhep.unh.edu/resources/qapps/total_nitrogen_concentrations-nhep-08.pdf. Accessed December 24, 2008.

Bolster, C.H., Jones, S.H., and Bromley, J.M. 2003. Evaluation of Effects of Wastewater Treatment Discharge on Estuarine Water Quality. University of New Hampshire, Durham, NH. A final report to the NH Estuaries Project, Portsmouth, NH. Published Online http://www.nhep.unh.edu/resources/pdf/evaluationofeffects-unh-03.pdf. Accessed December 24, 2008.

Merriam, J.L, W.H. McDowell, and W.S. Currie. 1996. A high-temperature catalytic oxidation technique for determining total dissolved nitrogen. *Soil Science Society of America Journal* 60: 1050-1055.

Table 1: Summary of Quality Control Samples for Total Nitrogen

Data Quality Indicators	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Results
Precision-Overall	RPD < 30%	Field Duplicates (Two field samples collected at the same time)	N=10 Ave RPD = 8.5% Max RPD=46.3% 1 of 10 duplicate RPDs >30%[1]
Precision-Lab	RPD < 15%	Lab Duplicates (Two samples from same field sample run through all the lab processes separately)	N=26 Ave RPD = 6.5% Max RPD = 27.9% 4 of 26 duplicate RPDs >15%[2] A total of 29 lab duplicates were run but three duplicates were not used because the concentrations were very low (<0.13 mg N/L) which inflated the RPDs for small differences.
Accuracy/Bias	>85% and <115% recovery	Certified Reference Material Samples Laboratory Fortified Matrix Samples	N=34 Min % recovery = 85% Max % recover = 104%
Comparability	Measurements should follow standard methods that are repeatable	NA	Standard methods were followed for data collection and analysis
Sensitivity	Percent of censored data	NA	The minimum TN concentration in samples was 2.33 mg N/L. The method detection limit was 0.015 mg N/L. No results were censored.
Data Completeness	Valid data for 90% of planned samples (9 samples at each WWTF)	Data Completeness Check	At least 9 samples were collected from each WWTF.

1. Field duplicate that failed QC criteria was from the Somersworth WWTF on 5/5/08 with TN concentrations of 5.51 and 8.83 mg N/L.
2. Lab duplicates that failed QC criteria in mg N/L: 0.41/0.49 (17%), 0.36/0.46 (24%), 0.37/0.45 (19%), and 1.01/1.34 (28%).

Table 2: Summary of Quality Control Samples for Total Dissolved Nitrogen

Data Quality Indicators	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Results
Precision-Overall	RPD < 30%	Field Duplicates (Two field samples collected at the same time)	N=10 Ave RPD = 2.8% Max RPD=8.8%
Precision-Lab	RPD < 15%	Lab Duplicates (Two samples from same field sample run through all the lab processes separately)	N=9 Ave RPD = 4.4% Max RPD = 8.8%
Accuracy/Bias	>85% and <115% recovery	Certified Reference Material Samples Laboratory Fortified Matrix Samples	N=21 Min % recovery = 86% Max % recover = 106%
Comparability	Measurements should follow standard methods that are repeatable	NA	Standard methods were followed for data collection and analysis
Sensitivity	Percent of censored data	NA	The minimum TDN concentration in samples was 2.13 mg N/L. The method detection limit was 0.1 mg N/L. No results were censored.
Data Completeness	Valid data for 90% of planned samples (9 samples at each WWTF)	Data Completeness Check	At least 9 samples were collected from each WWTF.

Table 3: Total Nitrogen Concentrations in Effluent Samples from Wastewater Treatment Facilities

WWTF	Date	Time	Effluent Flow	TDN	TN	TN Load	TN Load	TN Load	Comments
			(MGD-daily ave)	(mg N/L)	(mg N/L)	(kg N/day)	(lb N/day)	(tons N/yr)	
Kittery	02/20/08	12:00	1.872	8.713	10.082	71.445	157.508	28.685	
Kittery	03/13/08	9:50	1.764	8.016	8.779	58.618	129.229	23.535	Note 1
Kittery	04/11/08	11:55	1.234	10.084	12.219	57.079	125.837	22.917	
Kittery	05/05/08	14:05	1.400	8.322	14.257	75.558	166.574	30.336	
Kittery	06/11/08	10:45	0.776	18.872	27.284	80.145	176.687	32.178	
Kittery	07/09/08		0.900						Note 5
Kittery	08/14/08	11:10	1.050	13.564	20.468	81.355	179.356	32.664	
Kittery	09/12/08	9:55	1.151	5.609	10.515	45.813	100.999	18.394	
Kittery	10/06/08	10:30	1.005	7.953	16.948	64.477	142.146	25.887	
Kittery	11/04/08	12:25	0.895	14.918	23.372	79.182	174.564	31.791	
Kittery	**Average**		**1.205**	**10.672**	**15.992**	**72.926**	**160.773**	**29.280**	Note 2
Berwick	02/20/08	9:17	0.629	2.268	2.333	5.555	12.246	2.230	
Berwick	03/13/08	10:32	0.645	5.537	5.866	14.322	31.574	5.750	
Berwick	04/11/08	9:40	0.586	11.172	14.117	31.314	69.036	12.573	Note 1
Berwick	05/05/08	11:00	0.502	8.212	12.223	23.227	51.207	9.326	
Berwick	06/11/08	9:50	0.338	16.901	25.550	32.690	72.069	13.125	
Berwick	07/09/08	12:25	0.400	19.276	27.932	42.294	93.242	16.981	
Berwick	08/14/08	11:40	0.421	12.471	19.858	31.647	69.770	12.706	
Berwick	09/12/08	10:30	0.371	19.775	25.998	36.511	80.492	14.659	
Berwick	10/06/08	11:10	0.322	13.073	13.726	16.731	36.885	6.717	
Berwick	11/04/08	11:25	0.269	16.784	19.206	19.557	43.116	7.852	
Berwick	**Average**		**0.448**	**12.547**	**16.681**	**28.307**	**62.407**	**11.365**	Note 2
Newmarket	02/20/08	13:13	1.020	15.872	18.859	72.816	160.530	29.236	
Newmarket	03/13/08	13:17	0.984	17.468	20.089	74.829	164.969	30.044	
Newmarket	04/11/08	12:45	0.781	17.751	21.972	64.958	143.206	26.081	
Newmarket	05/05/08	12:50	0.792	20.425	33.108	99.259	218.827	39.853	

WWTF	Date	Time	Effluent Flow	TDN	TN	TN Load	TN Load	TN Load	Comments
			(MGD-daily ave)	(mg N/L)	(mg N/L)	(kg N/day)	(lb N/day)	(tons N/yr)	
Newmarket	06/11/08	12:15	0.474	29.871	42.890	76.957	169.659	30.898	
Newmarket	07/09/08	10:30	0.427	25.342	35.737	57.765	127.348	23.193	
Newmarket	08/14/08	9:45	0.578	11.055	19.456	42.568	93.846	17.091	
Newmarket	09/12/08	9:00	0.538	21.381	35.131	71.546	157.729	28.726	Note 1
Newmarket	10/06/08	13:05	0.678	18.950	43.297	111.122	244.981	44.616	
Newmarket	11/04/08	10:00	0.532	17.458	30.483	61.387	135.335	24.647	Note 1
Newmarket	**Average**		**0.680**	**19.557**	**30.102**	**77.531**	**170.925**	**31.129**	Note 2
Somersworth	02/20/08	9:35	2.230	2.274	2.555	21.571	47.554	8.661	
Somersworth	03/13/08	10:52	2.330	4.139	4.608	40.643	89.602	16.318	
Somersworth	04/11/08	10:00	2.300	2.134	2.455	21.372	47.117	8.581	
Somersworth	05/05/08	10:45	2.070	5.292	7.172	56.199	123.897	22.564	Note 1
Somersworth	06/11/08	10:10	1.670	4.495	5.151	32.564	71.790	13.074	
Somersworth	07/09/08	12:15	1.270	6.126	6.365	30.600	67.460	12.286	
Somersworth	08/14/08	12:00	1.620	3.000	3.689	22.623	49.875	9.083	
Somersworth	09/12/08	10:45	1.780	3.692	4.242	28.580	63.009	11.475	
Somersworth	10/06/08	11:20	1.920	6.672	6.942	50.456	111.236	20.258	
Somersworth	11/04/08	11:40	1.550	5.662	6.366	37.351	82.344	14.996	
Somersworth	**Average**		**1.874**	**4.349**	**4.955**	**35.147**	**77.485**	**14.111**	Note 2
Durham	02/20/08	11:00	1.780	7.425	9.359	63.062	139.027	25.320	
Durham	03/13/08	12:48	1.790	7.358	7.587	51.411	113.341	20.642	
Durham	04/11/08	11:25	1.410	6.410	6.697	35.745	78.803	14.352	
Durham	05/05/08	12:25	1.190	5.024	5.899	26.572	58.580	10.669	
Durham	06/11/08	11:45	0.480	7.262	7.375	13.400	29.542	5.380	
Durham	07/09/08	10:05	0.610						Note 3
Durham	08/14/08	9:15	0.850	8.401	8.375	26.948	59.409	10.820	Note 1
Durham	09/12/08	12:45	0.970	5.722	6.738	24.742	54.546	9.934	
Durham	10/06/08	12:45	1.220	7.698	9.032	41.709	91.952	16.746	

WWTF	Date	Time	Effluent Flow	TDN	TN	TN Load	TN Load	TN Load	Comments
			(MGD-daily ave)	(mg N/L)	(mg N/L)	(kg N/day)	(lb N/day)	(tons N/yr)	
Durham	11/04/08	13:20	1.140	7.216	7.608	32.830	72.376	13.181	
Durham	**Average**		**1.144**	**6.946**	**7.630**	**33.042**	**72.844**	**13.266**	Note 2
Rochester	02/20/08	10:08	4.817	17.785	20.356	371.186	818.316	149.031	
Rochester	03/13/08	11:43	5.585	16.957	17.031	360.056	793.780	144.563	
Rochester	04/11/08	10:30	7.212	13.755	13.511	368.858	813.184	148.096	
Rochester	05/05/08	11:35	5.430	16.428	20.933	430.269	948.571	172.753	
Rochester	06/11/08	9:20	3.230	34.699	44.443	543.394	1197.967	218.173	Note 1
Rochester	07/09/08	11:40	3.132	42.093	54.973	651.754	1436.858	261.679	
Rochester	08/14/08	12:30	6.166	20.652	29.226	682.169	1503.910	273.891	
Rochester	09/12/08	11:20	4.635	26.272	29.200	512.326	1129.473	205.699	
Rochester	10/06/08	11:50	3.967	29.128	29.589	444.324	979.558	178.396	
Rochester	11/04/08	12:05	3.200	29.264	41.858	507.038	1117.817	203.576	
Rochester	**Average**		**4.737**	**24.704**	**30.112**	**539.998**	**1190.480**	**216.809**	Note 2
Exeter	02/20/08	12:28	4.300	13.743	18.171	295.770	652.055	118.752	
Exeter	03/13/08	13:35	2.600	12.029	14.031	138.091	304.436	55.444	
Exeter	04/11/08	12:30	2.700	9.672	12.590	128.681	283.689	51.665	
Exeter	05/05/08	13:15	2.600	11.270	20.814	204.849	451.610	82.247	
Exeter	06/11/08	12:45	1.300	19.252	31.046	152.780	336.818	61.341	
Exeter	07/09/08	10:50	0.700	11.658	10.582	28.040	61.817	11.258	
Exeter	08/14/08	10:00	2.000	6.600	7.595	57.498	126.761	23.086	
Exeter	09/12/08	9:30	1.800	5.018	7.230	49.262	108.604	19.779	
Exeter	10/06/08	9:50	1.800	4.502	5.740	39.112	86.227	15.704	Note 1
Exeter	11/04/08	10:25	1.300	10.353	16.540	81.392	179.437	32.679	
Exeter	**Average**		**2.110**	**10.410**	**14.434**	**115.286**	**254.160**	**46.287**	Note 2
Dover	02/20/08	10:41	4.690	9.292	11.188	198.625	437.888	79.748	
Dover	03/13/08	12:25	4.290	12.223	13.205	214.439	472.753	86.097	

WWTF	Date	Time	Effluent Flow	TDN	TN	TN Load	TN Load	TN Load	Comments
			(MGD-daily ave)	(mg N/L)	(mg N/L)	(kg N/day)	(lb N/day)	(tons N/yr)	
Dover	04/11/08	11:00	3.540	13.986	16.898	226.434	499.197	90.913	
Dover	05/05/08	12:05	3.650	9.558	19.128	264.285	582.643	106.111	
Dover	06/11/08	11:30	2.160	25.299	37.556	307.071	676.969	123.289	
Dover	07/09/08	9:45	1.960	20.239	28.627	212.394	468.244	85.276	Note 1
Dover	08/14/08	13:00	3.020	15.283	24.578	280.969	619.423	112.809	
Dover	09/12/08	11:50	2.810	17.038	26.204	278.731	614.491	111.911	
Dover	10/06/08	12:20	2.880	12.800	20.011	218.158	480.952	87.591	
Dover	11/04/08	12:40	2.340	17.400	25.954	229.896	506.829	92.303	
Dover	**Average**		**3.134**	**15.312**	**22.335**	**264.967**	**584.146**	**106.384**	Note 1, 4
Portsmouth	02/20/08	8:37	9.095	6.549	8.278	284.999	628.309	114.427	Note 1
Average of all samples				**13.09**	**17.81**				

Note 1. Average of two field duplicate samples.
Note 2: Average load is calculated from the average flow and average TN concentration.
Note 3: Lab results for the sample (TDN=20.546 and TN=27.115) were rejected. These values were >2.7 standard deviations from the mean. They were obvious anomalies and were rejected during the quality assurance audit.
Note 4: Only one sample was collected at the Portsmouth WWTF. After the 2/20/08 sampling round, DES learned that this facility already tests its effluent for TN. Therefore, no additional samples were collected.
Note 5: The 7/9/08 sample was not collected at the Kittery WWTF because the decant discharge times at this facility did not fit with the rest of the sampling schedule.

Figure 1: Wastewater Treatment Facilities Included in this Study

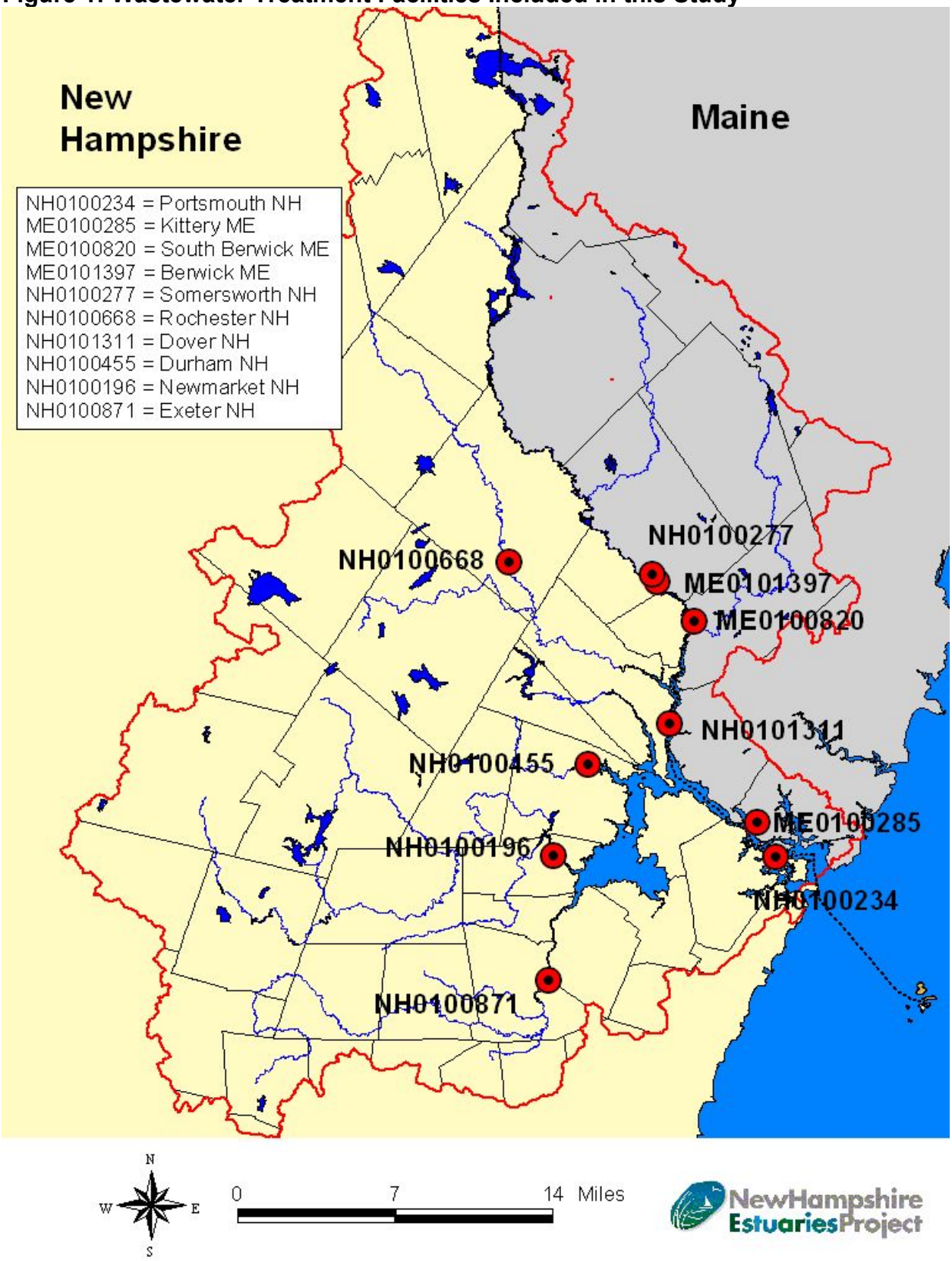
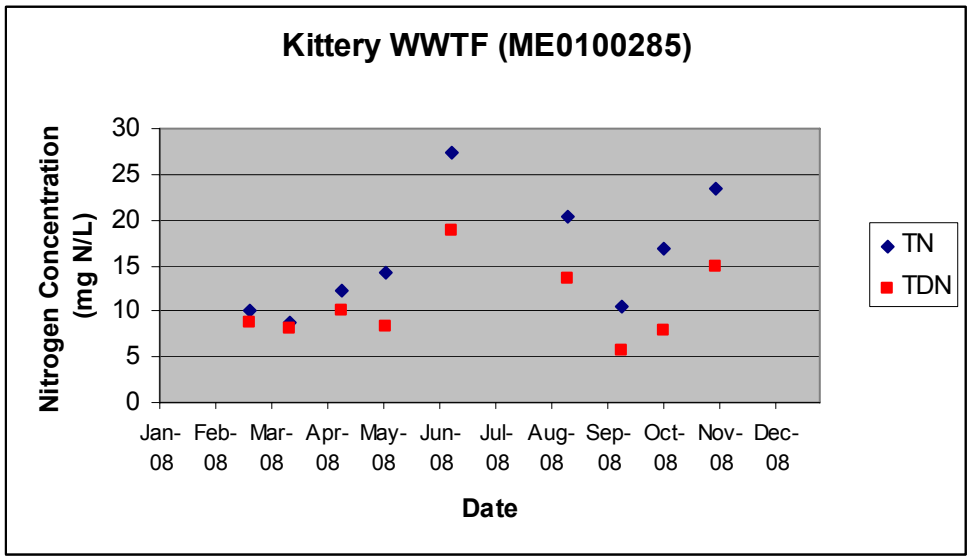
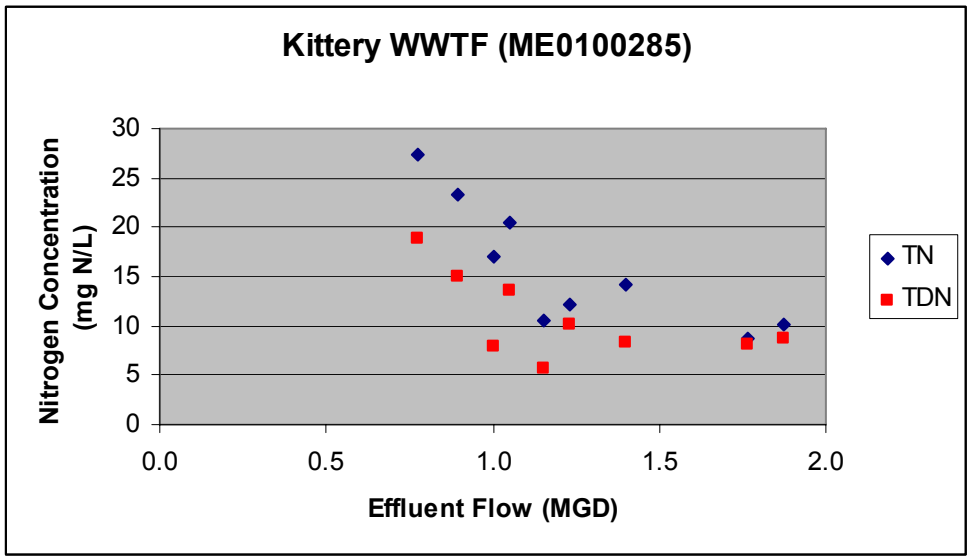


Figure 2


Kittery WWTF (ME0100285)
Nitrogen Concentration (mg N/L)
30
25
20
15
10
5
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Kittery WWTF (ME0100285)
Nitrogen Concentration (mg N/L)
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
Effluent Flow (MGD)
TN
TDN

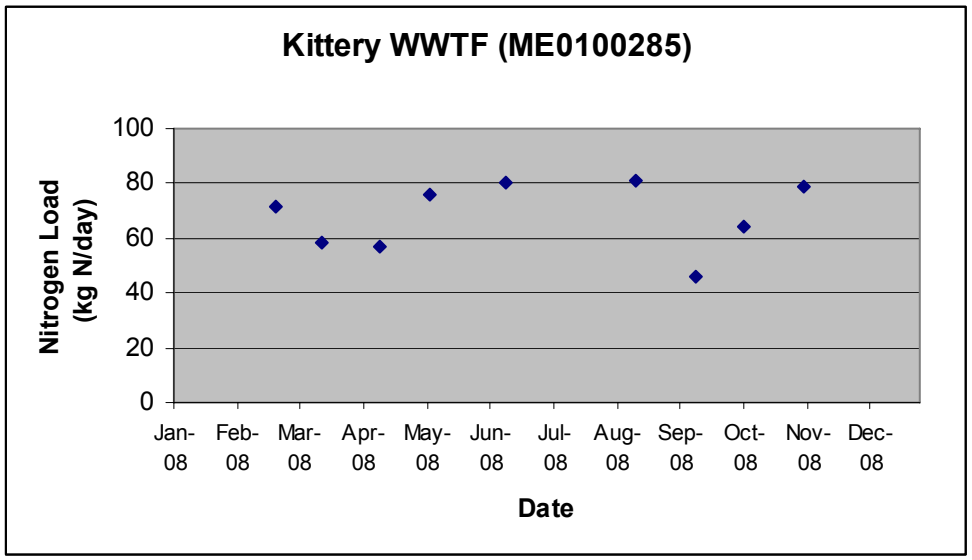
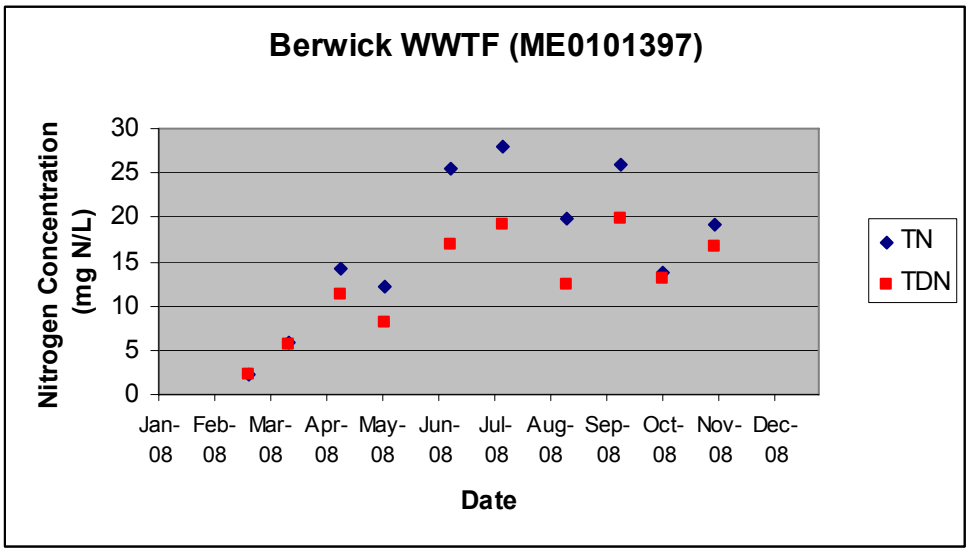
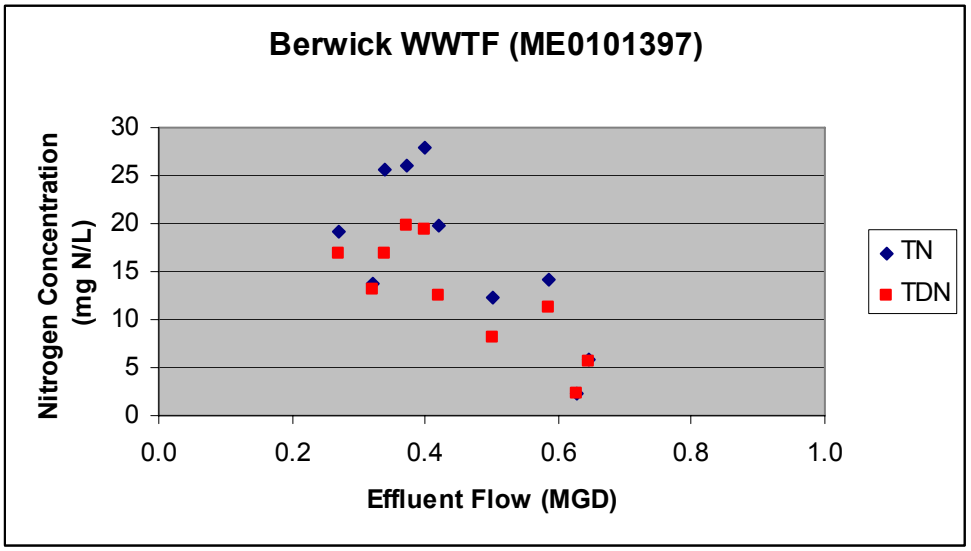

Kittery WWTF (ME0100285)
Nitrogen Load (kg N/day)
100
80
60
40
20
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

Figure 3


Berwick WWTF (ME0101397)
Nitrogen Concentration (mg N/L)
30
25
20
15
10
5
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Berwick WWTF (ME0101397)
Nitrogen Concentration (mg N/L)
30
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
Effluent Flow (MGD)
TN
TDN

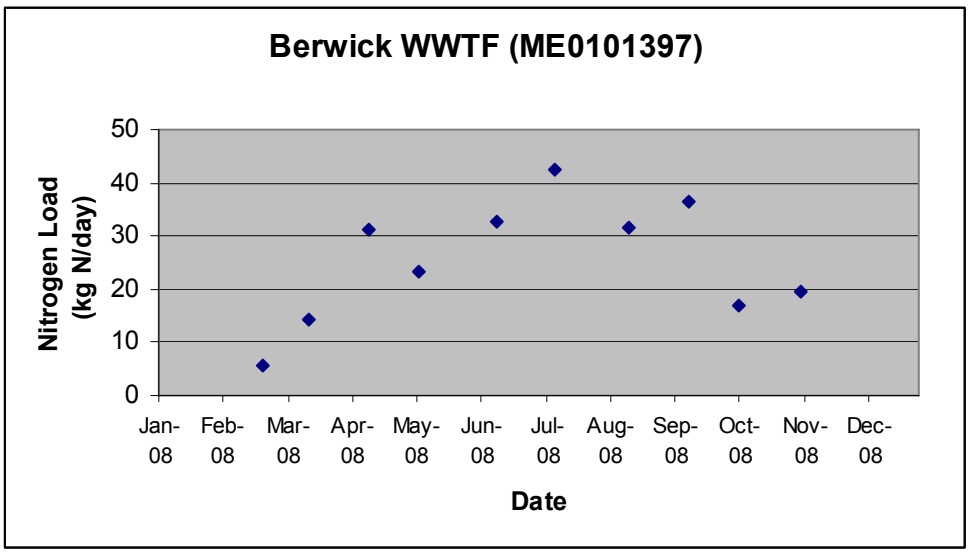
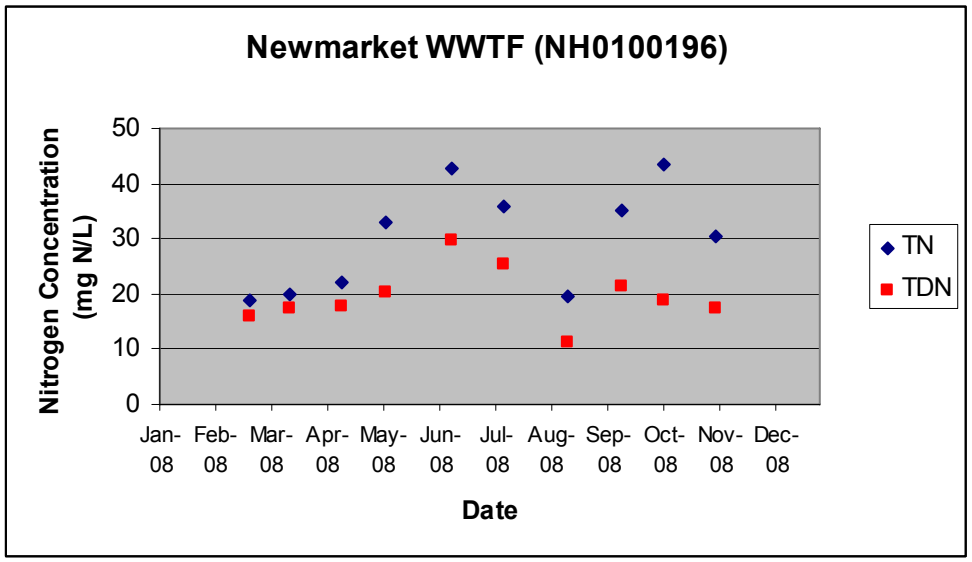
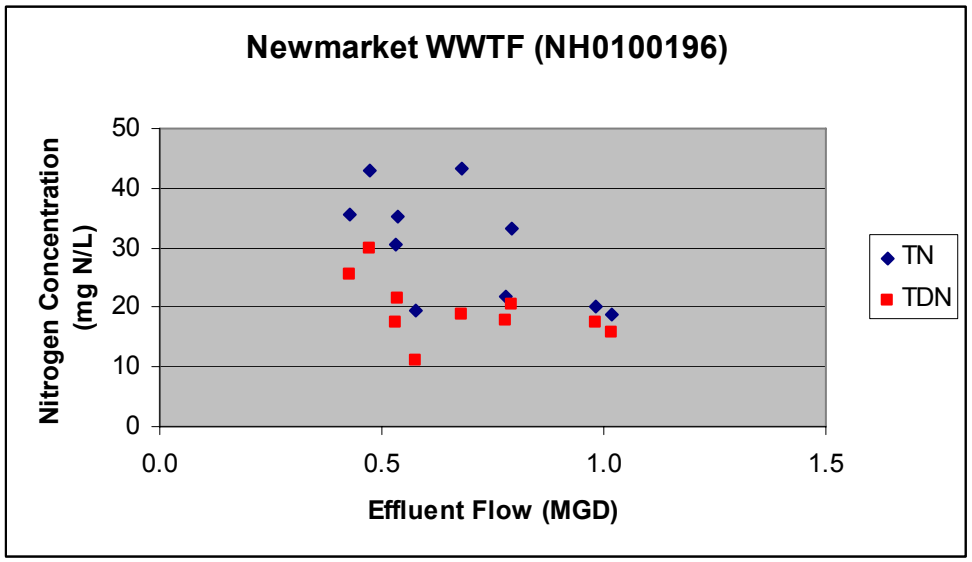

Berwick WWTF (ME0101397)
Nitrogen Load (kg N/day)
50
40
30
20
10
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

Figure 4


Newmarket WWTF (NH0100196)
Nitrogen Concentration (mg N/L)
50
40
30
20
10
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Newmarket WWTF (NH0100196)
Nitrogen Concentration (mg N/L)
50
40
30
20
10
0
0.0
0.5
1.0
1.5
Effluent Flow (MGD)
TN
TDN

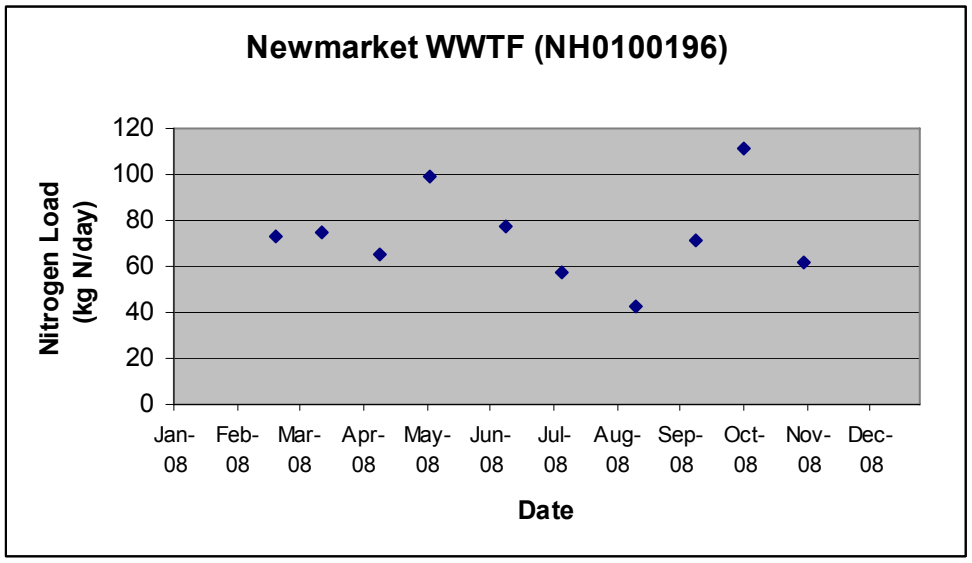
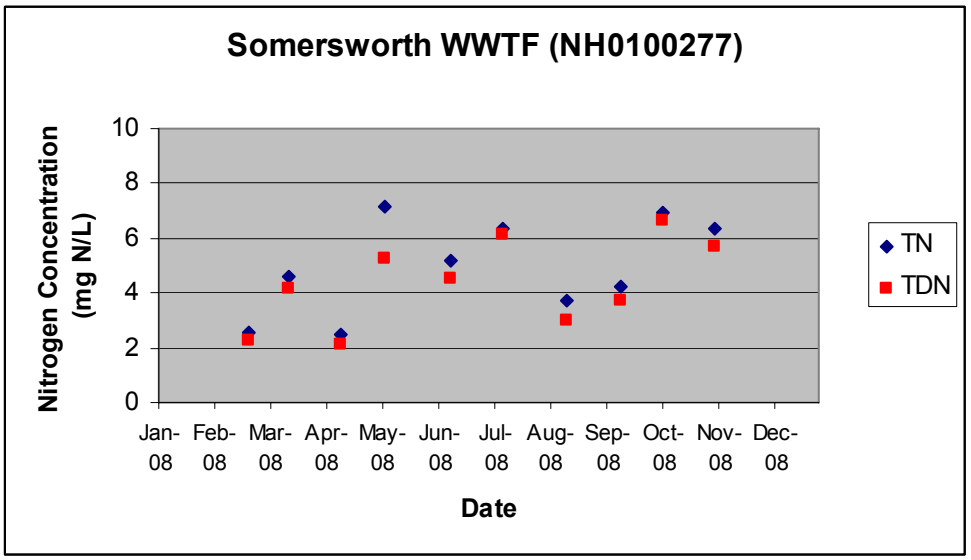
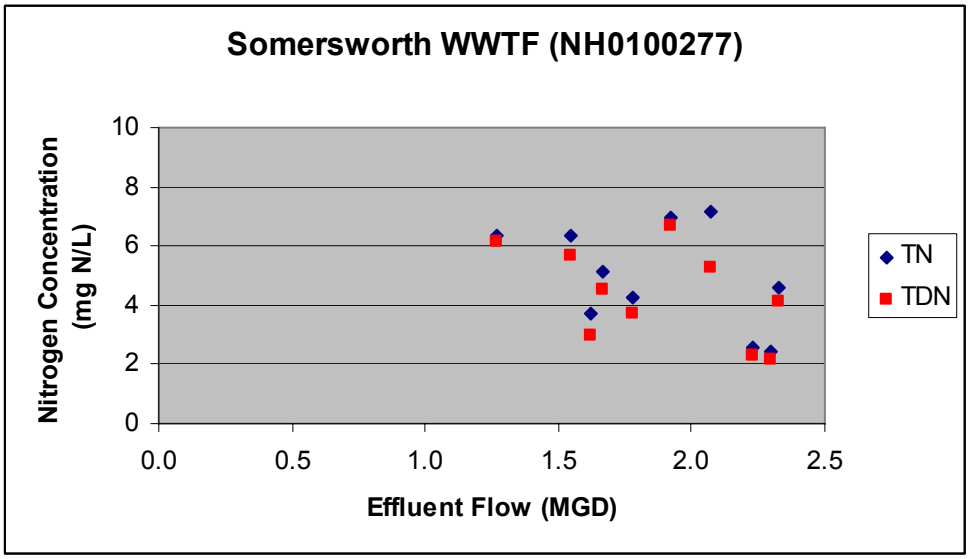

Newmarket WWTF (NH0100196)
Nitrogen Load (kg N/day)
120
100
80
60
40
20
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

Figure 5


Somersworth WWTF (NH0100277)
Nitrogen Concentration (mg N/L)
10
8
6
4
2
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Somersworth WWTF (NH0100277)
Nitrogen Concentration (mg N/L)
10
8
6
4
2
0
0.0
0.5
1.0
1.5
2.0
2.5
Effluent Flow (MGD)
TN
TDN

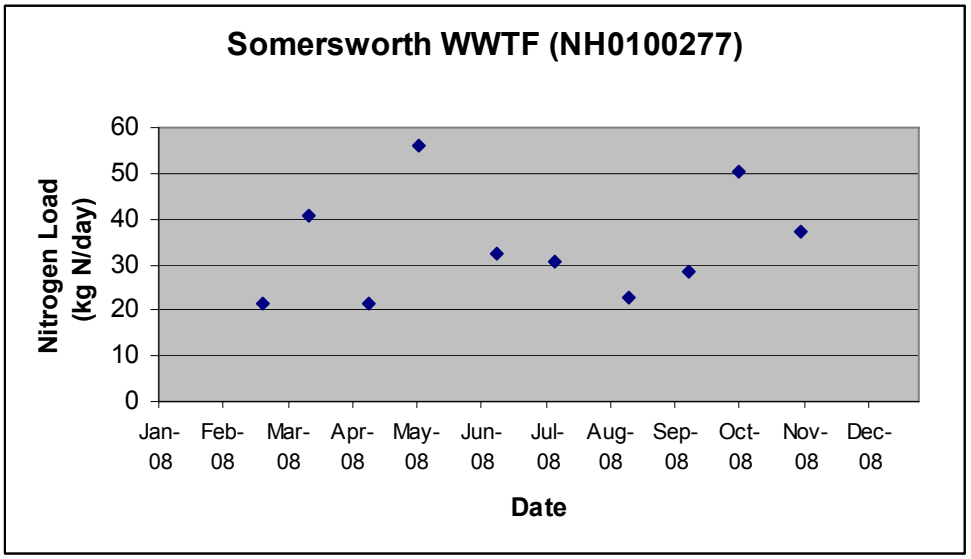
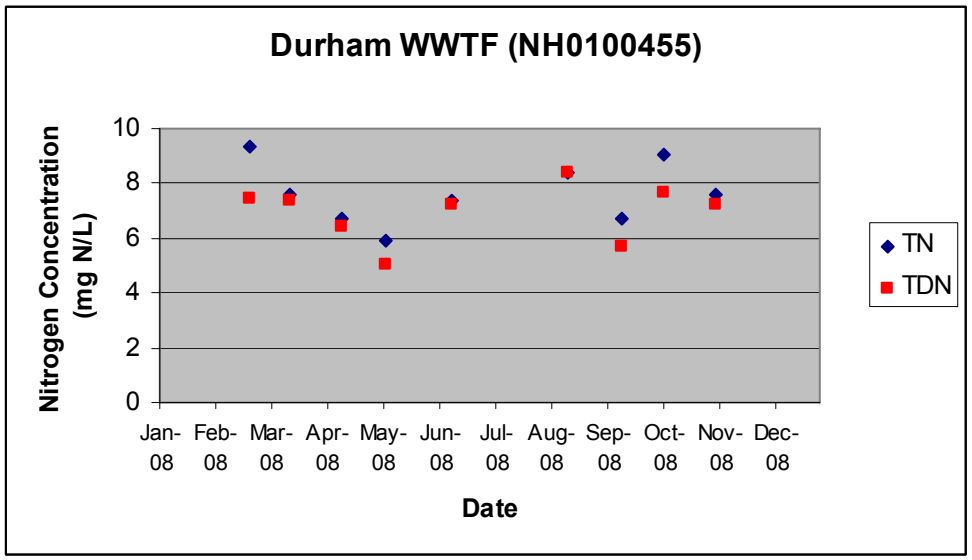
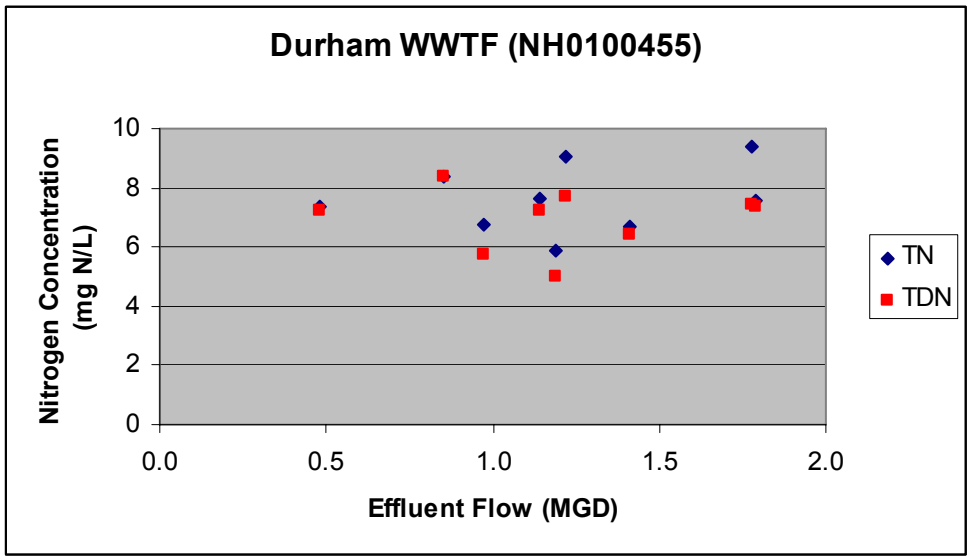

Somersworth WWTF (NH0100277)
Nitrogen Load (kg N/day)
60
50
40
30
20
10
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

Figure 6


Durham WWTF (NH0100455)
Nitrogen Concentration (mg N/L)
10
8
6
4
2
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Durham WWTF (NH0100455)
Nitrogen Concentration (mg N/L)
10
8
6
4
2
0
0.0
0.5
1.0
1.5
2.0
Effluent Flow (MGD)
TN
TDN

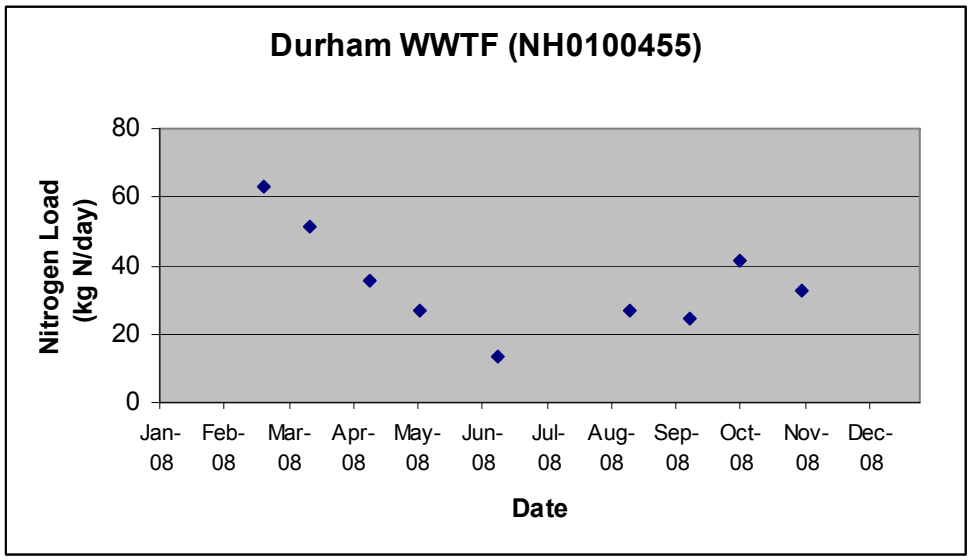
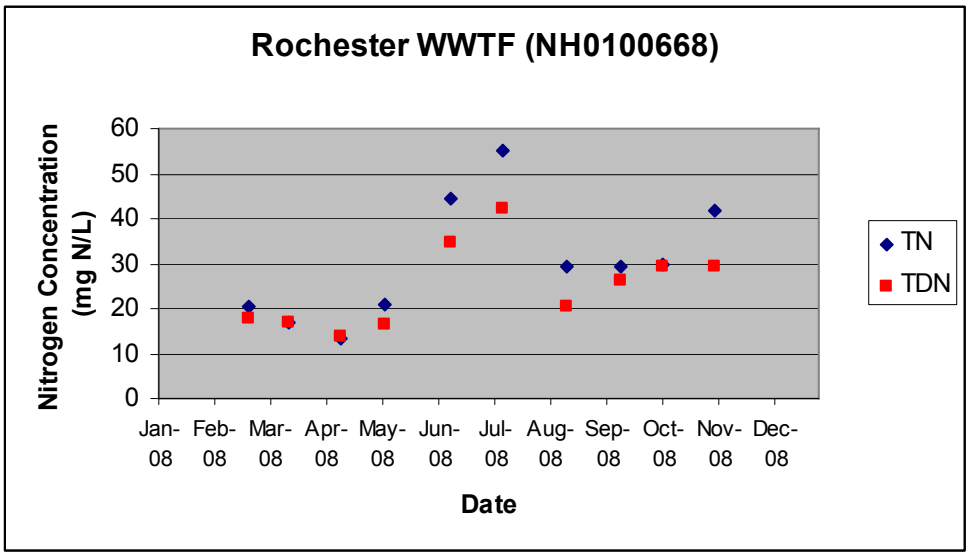
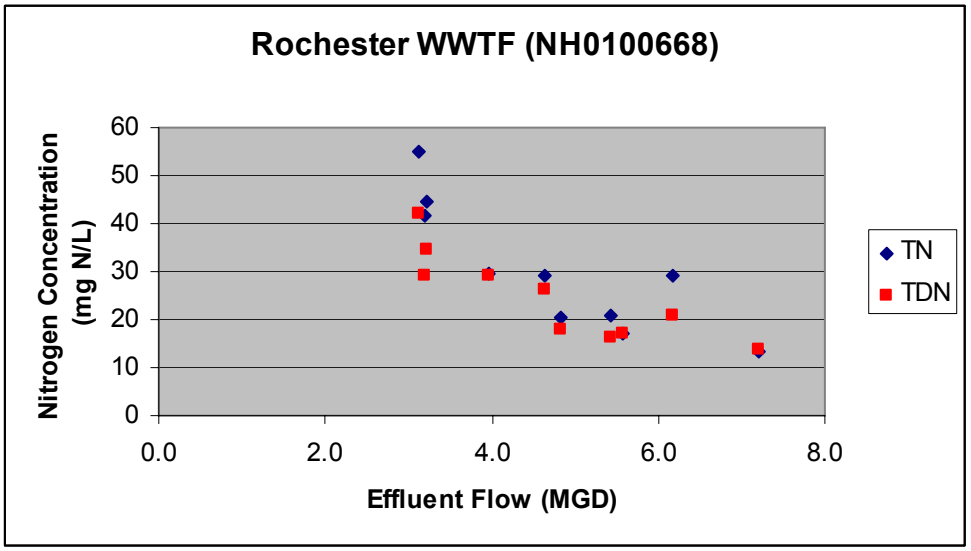

Durham WWTF (NH0100455)
Nitrogen Load (kg N/day)
80
60
40
20
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

Figure 7


Rochester WWTF (NH0100668)
Nitrogen Concentration (mg N/L)
60
50
40
30
20
10
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Rochester WWTF (NH0100668)
Nitrogen Concentration (mg N/L)
60
50
40
30
20
10
0
0.0
2.0
4.0
6.0
8.0
Effluent Flow (MGD)
TN
TDN

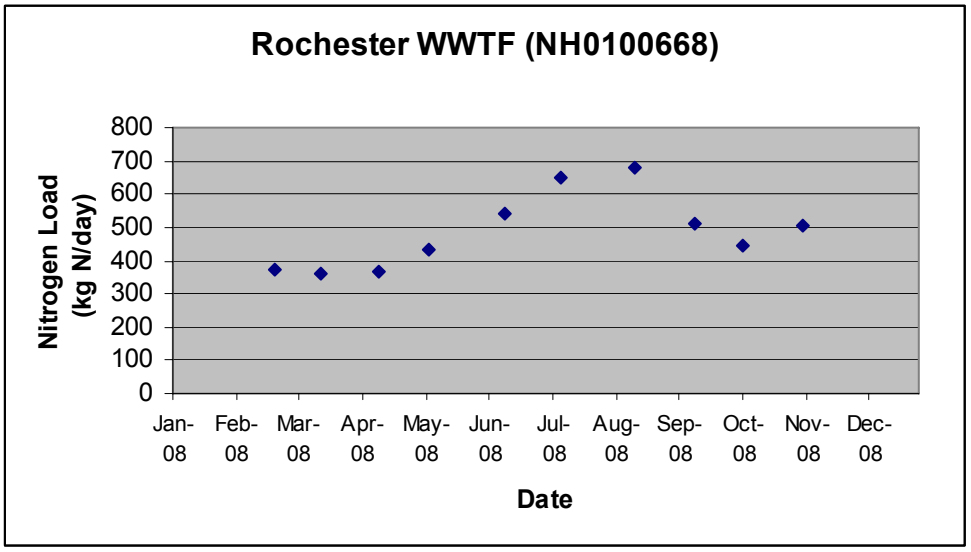
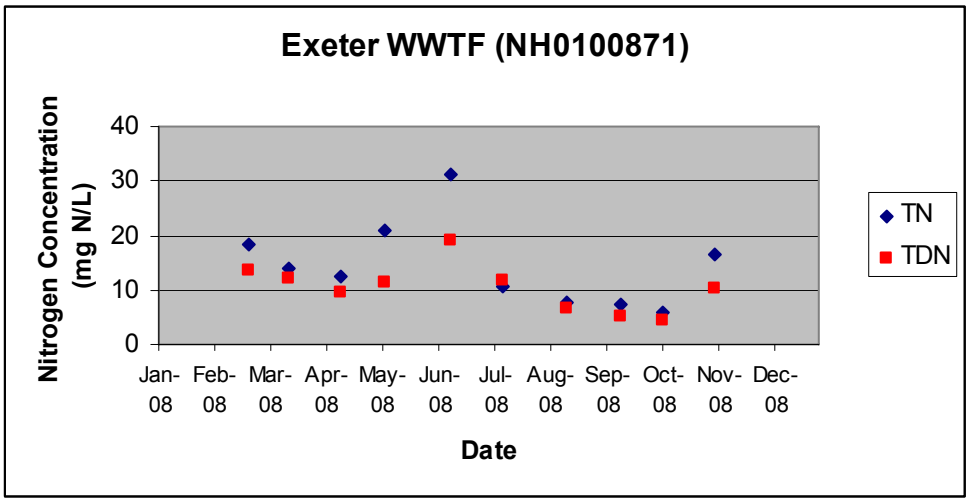
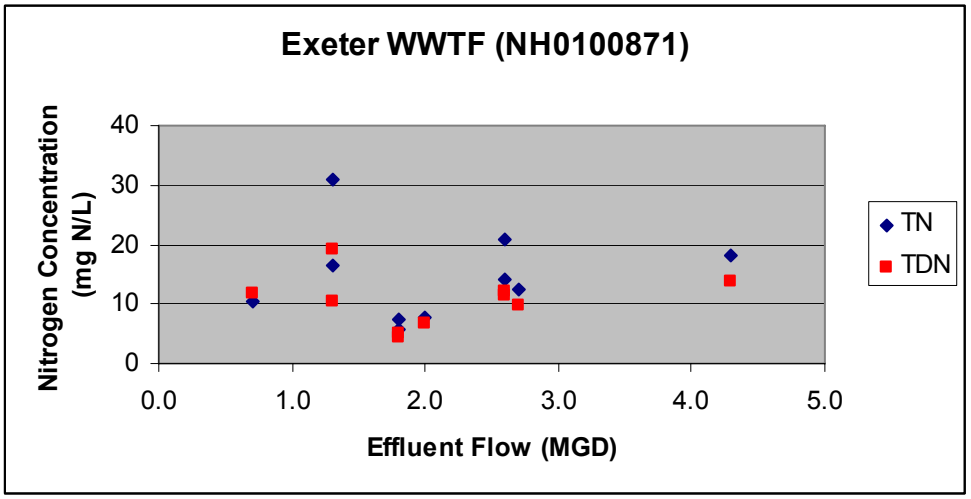

Rochester WWTF (NH0100668)
Nitrogen Load (kg N/day)
800
700
600
500
400
300
200
100
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

Figure 8


Exeter WWTF (NH0100871)
Nitrogen Concentration (mg N/L)
40
30
20
10
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Exeter WWTF (NH0100871)
Nitrogen Concentration (mg N/L)
40
30
20
10
0
0.0
1.0
2.0
3.0
4.0
5.0
Effluent Flow (MGD)
TN
TDN

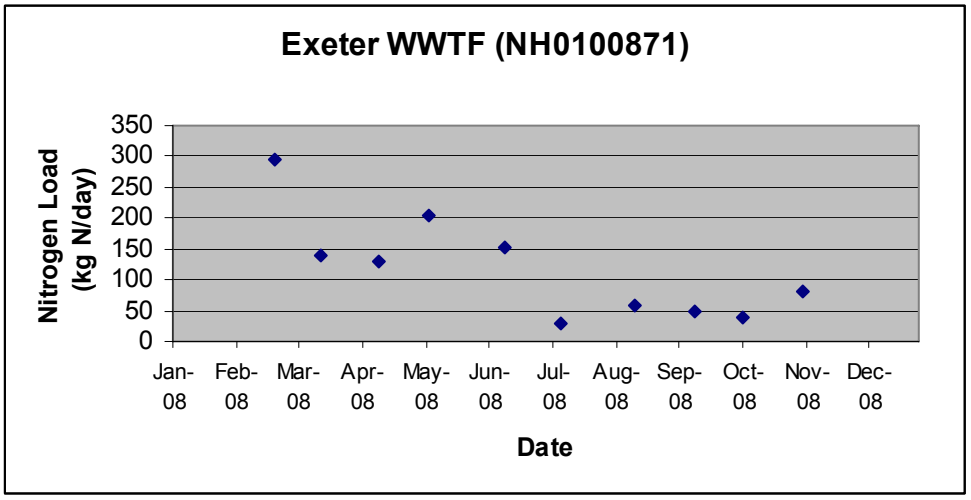
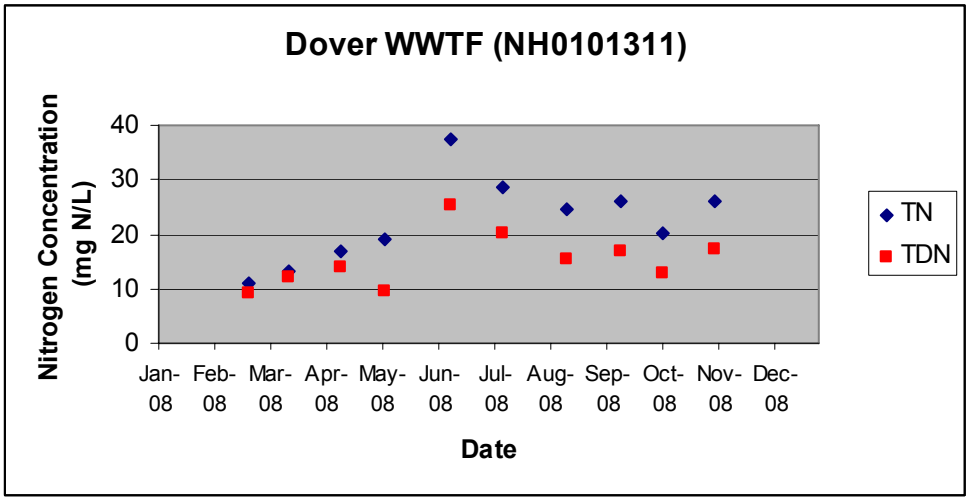
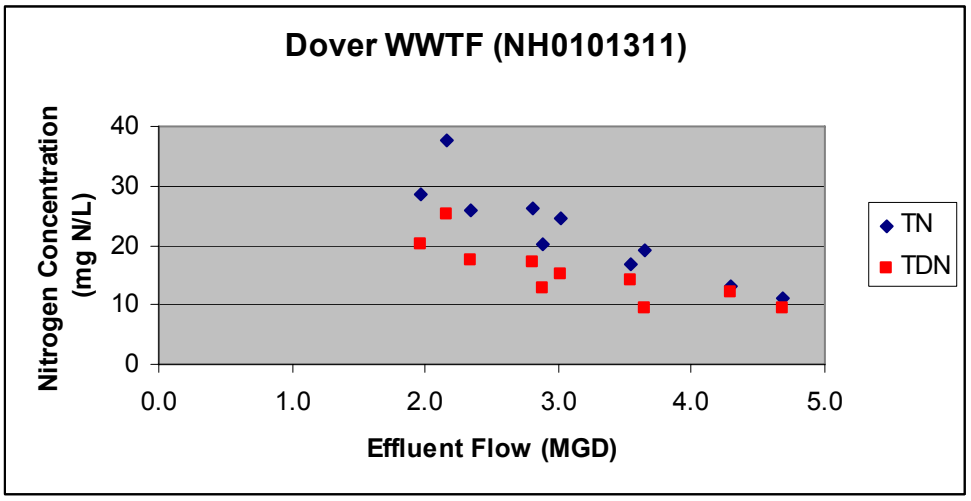
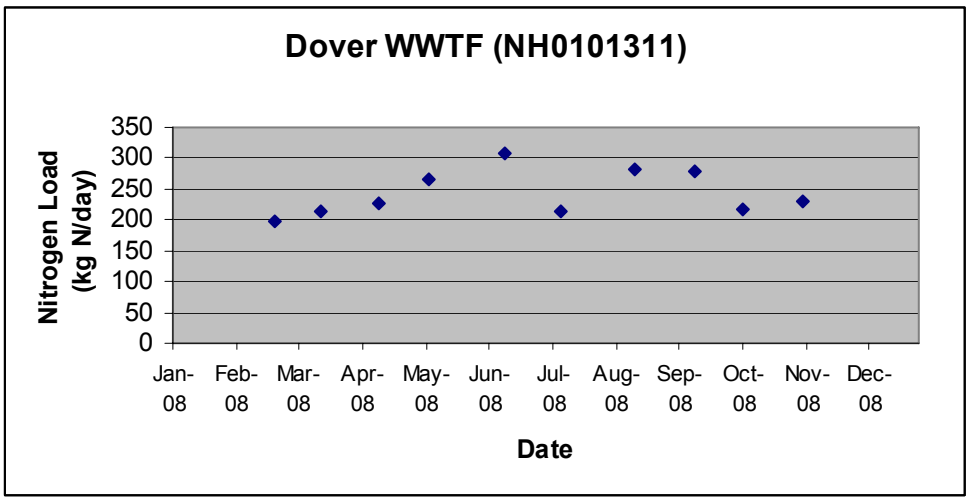

Exeter WWTF (NH0100871)
Nitrogen Load (kg N/day)
350
300
250
200
150
100
50
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

Figure 9


Dover WWTF (NH0101311)
Nitrogen Concentration (mg N/L)
40
30
20
10
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date
TN
TDN


Dover WWTF (NH0101311)
Nitrogen Concentration (mg N/L)
40
30
20
10
0
0.0
1.0
2.0
3.0
4.0
5.0
Effluent Flow (MGD)
TN
TDN


Dover WWTF (NH0101311)
Nitrogen Load (kg N/day)
350
300
250
200
150
100
50
0
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date