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June 27, 2005

**CERTIFIED MAIL**

The Honorable Susan D. Menard  
Mayor, City of Woonsocket  
City of Woonsocket  
169 Main Street  
Woonsocket, RI 02895

**RE: Woonsocket Wastewater Treatment Facility; RIPDES Permit No. RI0100111**

Dear Mayor Menard:

Enclosed is your final Rhode Island Pollutant Discharge Elimination System (RIPDES) permit modification assigning Total Nitrogen permit limitations to the Woonsocket Wastewater Treatment Facility. In accordance with State regulations, promulgated under Chapter 46-12 of the Rhode Island General Laws of 1956, as amended, this permit modification becomes effective on August 1, 2005. Also enclosed is the response to comments received on the draft permit modification which includes information relative to hearing requests and stays of RIPDES Permits. Please note that, as indicated in the response to comments, the months during which the final Total Nitrogen permit limits are in effect have been modified from the draft permits April through October to May through October. Therefore, the final Total Nitrogen permit limits are 10.0 mg/l for the month of April, 5.0 mg/l for the months of May through October, and monitor only for the months of November through March.

Since this facility will need to upgrade to comply with the Total Nitrogen permit limitations, the DEM is willing to enter into a consent agreement that will establish an enforceable compliance schedule for this facility to make the necessary improvements to comply with the Total Nitrogen limits. In order to enter into a consent agreement, it will be necessary for you to request a hearing and a permit stay for the Total Nitrogen limits within 30 days of receipt of this letter. For additional instructions regarding requesting a hearing and a permit stay you are referred to the attached instructions.

Should you have any questions concerning this modification, feel free to contact Joseph Haberek, P.E. of the RIPDES Staff at 401-222-4700, extension 7715.

Sincerely,

Angelo S. Liberti, P.E.  
Chief of Surface Water Protection

ASL/JBH:jbh

Enclosures

cc: Eric Beck, DEM (w/o attachments) David Turin, EPA (w/o attachments)  
Michael Annarummo, City of Woonsocket (w/o attachments)

MODIFICATION

AUTHORIZATION TO DISCHARGE UNDER THE  
RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of Chapter 46-12 of the Rhode Island General Laws, as amended, RIPDES Permit No. RI0100072 issued to the Narragansett Bay Commission on December 31, 2001 shall be modified as follows:

The Total Nitrogen, Total Nitrite, Total Nitrate, and TKN limits and monitoring requirements in Part I.A.3 of the permit shall be deleted in their entirety and replaced with the limits and monitoring requirements in Attachment A of this modification.

The remaining effluent limitations, monitoring requirements and other conditions in the original permit are unchanged and in effect.

This modification shall become effective on August 1, 2005.

This permit and the authorization to discharge expire at midnight, February 1, 2007.

This change modifies the permit issued on December 31, 2001.

This modification consists of two (2) pages.

Signed this 27th day of June 2005.

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Angelo S. Liberti, P.E., Chief of Surface Water Protection  
Office of Water Resources  
Rhode Island Department of Environmental Management  
Providence, Rhode Island

ATTACHMENT A

PART 1

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date and lasting through permit expiration, the permittee is authorized to discharge from outfall serial number(s) 001A (Secondary Treatment Discharge).

Such discharges shall be monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations Quantity - lbs./day		Monitoring Requirement Concentration - specify units		Sample Type
	Average Monthly	Maximum Daily	Average Weekly	Maximum Daily	
Nitrogen, Total [TKN + Nitrite + Nitrate, as N] (May - Oct) (Nov - April)	1293 lb/d -- lb/d <sup>1</sup>		5.0 mg/L -- mg/L <sup>1</sup>	-- mg/L -- mg/L	3/ Week 3/ Week Calculated Calculated
TKN (May - Oct) (Nov - April)			-- mg/L -- mg/L	-- mg/L -- mg/L	3/ Week 3/ Week 24-Hr. Comp. 24-Hr. Comp.
Nitrite, Total [as N] (May - Oct) (Nov - April)			-- mg/L -- mg/L	-- mg/L -- mg/L	3/ Week 3/ Week 24-Hr. Comp. 24-Hr. Comp.
Nitrate, Total [as N] (May - Oct) (Nov - April)			-- mg/L -- mg/L	-- mg/L -- mg/L	3/ Week 3/ Week 24-Hr. Comp. 24-Hr. Comp.

-- Signifies a parameter which must be monitored and data must be reported; no limit has been established at this time.

<sup>1</sup> The permittee shall operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through April, to the maximum extent possible using all available treatment equipment in place at the facility, except methanol addition.

Samples taken in compliance with the monitoring requirements specified above shall be taken Monday through Friday at the following locations:  
Outfall 001A.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
OFFICE OF WATER RESOURCES  
235 PROMENADE STREET  
PROVIDENCE, RHODE ISLAND 02908-5767

FACT SHEET

RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM (RIPDES) PERMIT TO DISCHARGE TO WATERS OF THE STATE

RIPDES PERMIT NO. RI0100072

NAME AND ADDRESS OF APPLICANT:

**The Narragansett Bay Commission**  
One Service Road  
Providence, Rhode Island 02905

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

**Bucklin Point Wastewater Treatment Facility**  
102 Campbell Avenue  
East Providence, Rhode Island  
and  
Associated Combined Sewer Overflows

RECEIVING WATER: Seekonk, Moshassuck, and Blackstone Rivers

CLASSIFICATION: SB1{a}; B1{a} & B{a}

**I. Proposed Action, Type of Facility, and Discharge Location**

The Rhode Island Department of Environmental Management proposes to issue a modification to the above-mentioned facility's RIPDES Permit to discharge into the designated receiving water. The facility is engaged in the treatment of domestic and industrial sewage. The discharge is from the Bucklin Point Wastewater Treatment Facility's outfall.

**II. Limitations and Conditions**

The effluent limitations, monitoring requirements, and any implementation schedule (if required) may be found in the permit. The DEM anticipates entering into an enforceable compliance schedule, either by modifying the existing consent agreement or entering into a new consent agreement, to allow the facility to construct the necessary improvements to comply with the Total Nitrogen limits contained in this permit modification.

**III. Permit Basis and Explanation of Effluent Limitation Derivation**

The Narragansett Bay Commission owns and operates the Bucklin Point Wastewater Treatment Facility (WWTF) located on Campbell Avenue in East Providence, Rhode Island and several associated Combined Sewer Overflows (CSOs). The discharge from the WWTF to the Seekonk River consists of treated sanitary sewage and commercial and industrial wastewater. Treatment consists of Screening, Grit Removal, Pre-aeration, Primary Settling, Activated Sludge, Secondary Settling, and UV Disinfection.

The Providence and Seekonk Rivers are impacted by low Dissolved Oxygen (DO) levels and high phytoplankton concentrations that are related to excessive nitrogen loadings. Significant areas of the Providence and Seekonk Rivers suffer from hypoxic (low DO) and anoxic (lack of DO) conditions and violate water quality standards. Available data shows that nitrogen loads are dominated by wastewater treatment facility inputs.

DEM hired a consultant and has been working with a technical advisory committee (TAC), consisting primarily of scientists and engineers representing, academic, municipal, state and federal organizations, to calibrate a model and develop a water quality restoration plan, or TMDL. It was recently concluded that the hydrodynamic model formulation could not adequately simulate conditions due to the relatively severe changes in the bathymetry in the Providence River. In spite of this obstacle DEM believes that nutrient reductions must be established for most facilities in the state. DEM has concluded that the best method available for evaluating impacts and setting nitrogen load reduction targets for the Providence River is to use the set of empirical relations developed from the Marine Ecosystems Research Laboratory (MERL) enrichment gradient studies at the University of Rhode Island. In February 2004, DEM developed and forwarded to the TAC an analysis titled "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers". This analysis indicated that even if the wastewater treatment facility (WWTF) discharges are reduced to the limit of technology (total nitrogen of 3 mg/l), the Seekonk River and portions of the Providence River would not fully comply with existing water quality standards (minimum of 5.0 mg/l "except as naturally occurs") and may not meet Environmental Protection Agency (EPA) guidelines established in October 2000, (*Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras* EPA-822-R-00-012). The EPA's guidelines allow instantaneous values below 4.8 provided the cumulative exposure to low DO levels do not exceed the duration criteria established to ensure that the cumulative percentage of larvae affected shall not exceed a 5% reduction in larval recruitment over the recruitment season.

While DEM believes that the MERL results provide an adequate representation of the relationship between nitrogen and oxygen levels in the Providence and Seekonk Rivers, some uncertainty remains regarding predicted water quality improvements and loading reduction necessary to meet water quality standards. For example, significantly lower mean Dissolved Inorganic Nitrogen (DIN) concentrations were observed in the Providence and Seekonk Rivers as compared to the MERL experiment for an equivalent loading rate, which may be the result of large differences between the field and experimental flushing times. Also the MERL experiment DO sampling protocol does not provide sufficient data to fully assess compliance with the recently established EPA guidelines. However, it is clear that the Providence and Seekonk Rivers are impacted by low DO levels and high phytoplankton levels related to excessive WWTF nitrogen loadings. For these reasons, an evaluation of phased implementation is indicated. Implementation of a phased approach is consistent with the EPA publication titled "Guidance for Water Quality Based Decisions: The TMDL Process", which states: "For Certain non-traditional, problems, if there are not adequate data and predictive tools to characterize and analyze the pollution problem, a phased approach may be necessary". For the reasons noted above, DEM has evaluated implementation costs, analysis of the performance of available technology, and estimates of water quality improvement to develop a phased plan for implementation of WWTF improvements which maximizes the DO levels relative to implementation cost.

Nine (9) different cases, representing various combinations of nitrogen reduction at three (3) Massachusetts and seven (7) Rhode Island WWTFs were examined. The WWTFs included in this analysis were: the Upper Blackstone Water Pollution Abatement District ("UBWPAD") located in Worcester, MA, the North Attleboro WWTF, the Attleboro WWTF, the Woonsocket WWTF, the Bucklin Point WWTF, the Fields Point WWTF, the East Providence Water Pollution Control Facility, the Cranston Water Control Facility, the West Warwick WWTF, and the Warwick WWTF. Estimates of capital costs to modify existing facilities to achieve the target levels on a seasonal basis were developed. These costs included allowances for planning, design, construction and administration and must be considered Order-

of-Magnitude estimates, since specific facility characteristics were not evaluated. This analysis has been added to the document "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", which is available upon request. Based on this evaluation of the sources of excessive nitrogen levels in the rivers and the capabilities of existing treatment processes, the DEM has determined that it would be appropriate to establish seasonal (May – October) WWTF total nitrogen limits that range from 5.0 mg/l to 8.0 mg/l. These limits will achieve a 50% reduction from the 1995-1996 Rhode Island WWTF loading, consistent with the recommendations from The Governor's Narragansett Bay and Watershed Planning Commission. In addition to adding a seasonal total nitrogen limit of 5.0 mg/l, this permit modification also requires that the permittee operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through April, to the maximum extent possible using all available treatment equipment in place at the facility. Assigning seasonal total nitrogen limits and requiring that the WWTF be operated year round in a manner to reduce the discharge of nitrogen to the maximum extent possible will result in substantial progress towards the mitigation of hypoxic/anoxic events and meeting water quality standards. The analysis contained in "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", indicates that the contribution of the Massachusetts WWTFs is significant and DEM will be working with the Massachusetts Department of Environmental Protection and the EPA to pursue appropriate nitrogen reductions.

An integral component of this phased implementation approach is monitoring and assessment of water quality changes to determine if additional reductions are necessary to meet applicable standards. DEM, in partnership with NERRS, the Narragansett Bay Commission, University of Rhode Island and Roger Williams University increased the number of Narragansett Bay continuous water quality monitoring stations from 7 to 9 in the summer of 2004. DEM has obtained funding from the federal Bay Window grant to increase the number of stations to at least 13 by the summer of 2005. This monitoring network will provide the data necessary to evaluate compliance with water quality standards, particularly temporal detail needed to evaluate compliance with EPA's DO guidelines.

The requirements set forth in this permit are from the State's Water Quality Regulations and the State's Regulations for the Rhode Island Pollutant Discharge Elimination System (RIPDES Regulations), both filed pursuant to Chapter 46-12, as amended. DEM's primary authority over the permit comes from EPA's delegation of the program in September 1984 under the Federal Clean Water Act (CWA).

The effluent monitoring requirements have been specified in accordance with RIPDES regulations as well as 40 CFR 122.41 (j), 122.44 (i), and 122.48 to yield data representative of the discharge.

#### IV. **Comment Period, Hearing Requests, and Procedures for Final Decisions**

All persons, including applicants, who believe any condition of the draft permit is inappropriate must raise all issues and submit all available arguments and all supporting material for their arguments in full by the close of the public comment period, to the Rhode Island Department of Environmental Management, Office of Water Resources, 235 Promenade Street, Providence, Rhode Island, 02908-5767. Any person may also present oral comments on the draft permit at the scheduled public hearing. In reaching a final decision on the draft permit the Director will respond to all significant comments, either received in writing during the public comment period or presented orally at the public hearing, and make these responses available to the public at DEM's Providence Office. Following the close of the comment period, and after the public hearing, the Director will issue a final permit decision and forward a copy of the final decision to the applicant and each person who has submitted written comments, presented oral testimony, or requested notice. Within thirty (30) days following the notice of the final permit decision any interested person may submit a request for a formal hearing to reconsider or contest the final decision. Requests for formal hearings must satisfy the requirements of Rule 49 of the Regulations for the Rhode Island Pollutant Discharge Elimination System.

V. **DEM Contact**

Additional information concerning the permit may be obtained between the hours of 8:30 a.m. and 4:00 p.m., Monday through Friday, excluding holidays, from:

Joseph B. Haberek, P.E.  
RIPDES Program  
Department of Environmental Management  
235 Promenade Street  
Providence, Rhode Island 02908  
Telephone: (401) 222-4700, Extension: 7715

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Date

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Angelo S. Liberti, P.E.  
Chief of Surface Water Protection  
Office of Water Resources  
Department of Environmental Management



MODIFICATION

AUTHORIZATION TO DISCHARGE UNDER THE  
RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of Chapter 46-12 of the Rhode Island General Laws, as amended, RIPDES Permit No. RI0100048 issued to the City of East Providence on December 20, 2001 shall be modified as follows:

The Total Nitrogen, Total Nitrite, Total Nitrate, and TKN limits and monitoring requirements in Part I.A.3 of the permit shall be deleted in their entirety and replaced with the limits and monitoring requirements in Attachment A of this modification.

The remaining effluent limitations, monitoring requirements and other conditions in the original permit are unchanged and in effect.

This modification shall become effective on August 1, 2005.

This permit and the authorization to discharge expire at midnight, February 1, 2007.

This change modifies the permit issued on December 20, 2001.

This modification consists of two (2) pages.

Signed this 27th day of June 2005.

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Angelo S. Liberty, P.E., Chief of Surface Water Protection  
Office of Water Resources  
Rhode Island Department of Environmental Management  
Providence, Rhode Island

ATTACHMENT A

PART 1

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date and lasting through permit expiration, the permittee is authorized to discharge from outfall serial number(s) 001A.

Such discharges shall be monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirement		Measurement Frequency	Sample Type
	Average Monthly	Maximum Daily	Average Weekly	Maximum Daily		
Nitrogen, Total [TKN + Nitrite + Nitrate, as N] (May - Oct) (Nov - April)	694 lb/d	—	8.0 mg/L	—	1/Week	Calculated
	— lb/d'	—	— mg/L	—	1/Week	Calculated
TKN (May - Oct) (Nov - April)	—	—	— mg/L	—	1/Week	24-Hr. Comp.
	—	—	— mg/L	—	1/Week	24-Hr. Comp.
Nitrite, Total [as N] (May - Oct) (Nov - April)	—	—	— mg/L	—	1/Week	24-Hr. Comp.
	—	—	— mg/L	—	1/Week	24-Hr. Comp.
Nitrate, Total [as N] (May - Oct) (Nov - April)	—	—	— mg/L	—	1/Week	24-Hr. Comp.
	—	—	— mg/L	—	1/Week	24-Hr. Comp.

— Signifies a parameter which must be monitored and data must be reported; no limit has been established at this time.

The permittee shall operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through April, to the maximum extent possible using all available treatment equipment in place at the facility, except methanol addition.

Samples taken in compliance with the monitoring requirements specified above shall be taken Monday through Friday at the following locations:  
Outfall 001A.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
OFFICE OF WATER RESOURCES  
235 PROMENADE STREET  
PROVIDENCE, RHODE ISLAND 02908-5767

FACT SHEET

RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM (RIPDES) PERMIT TO DISCHARGE TO WATERS OF THE STATE

RIPDES PERMIT NO. RI0100048

NAME AND ADDRESS OF APPLICANT:

**City of East Providence**  
145 Taunton Avenue  
East Providence, Rhode Island 02914

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

**East Providence Water Pollution Control Facility**  
1 Crest Avenue  
East Providence, Rhode Island 02915

RECEIVING WATER: Providence River

CLASSIFICATION: SB1{a}

**I. Proposed Action, Type of Facility, and Discharge Location**

The Rhode Island Department of Environmental Management proposes to issue a modification to the above-mentioned facility's RIPDES Permit to discharge into the designated receiving water. The facility is engaged in the treatment of domestic and industrial sewage. The discharge is from the East Providence Water Pollution Control Facility's outfall.

**II. Limitations and Conditions**

The effluent limitations, monitoring requirements, and any implementation schedule (if required) may be found in the permit. The DEM anticipates entering into an enforceable compliance schedule, by entering into a consent agreement, to allow the facility to construct the necessary improvements to comply with the Total Nitrogen limits contained in this permit modification.

**III. Permit Basis and Explanation of Effluent Limitation Derivation**

The City of East Providence owns and operates the East Providence Water Pollution Control Facility (WPCF) located at 1 Crest Avenue in East Providence, Rhode Island. The discharge from the WPCF to the Providence River consists of treated sanitary sewage and commercial and industrial wastewater contributed by the municipalities of East Providence and Barrington. Treatment consists of Coarse Screening, Comminution, Primary Settling, Aeration, Secondary Settling, Chlorination and Dechlorination.

The Providence and Seekonk Rivers are impacted by low Dissolved Oxygen (DO) levels and high phytoplankton concentrations that are related to excessive nitrogen loadings. Significant areas of the Providence and Seekonk Rivers suffer from hypoxic (low DO) and anoxic (lack of DO) conditions and violate water quality standards. Available data shows that nitrogen loads are dominated by wastewater treatment facility inputs.

DEM hired a consultant and has been working with a technical advisory committee (TAC), consisting primarily of scientists and engineers representing, academic, municipal, state and federal organizations, to calibrate a model and develop a water quality restoration plan, or TMDL. It was recently concluded that the hydrodynamic model formulation could not adequately simulate conditions due to the relatively severe changes in the bathymetry in the Providence River. In spite of this obstacle DEM believes that nutrient reductions must be established for most facilities in the state. DEM has concluded that the best method available for evaluating impacts and setting nitrogen load reduction targets for the Providence River is to use the set of empirical relations developed from the Marine Ecosystems Research Laboratory (MERL) enrichment gradient studies at the University of Rhode Island. In February 2004, DEM developed and forwarded to the TAC an analysis titled "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers". This analysis indicated that even if the wastewater treatment facility (WWTF) discharges are reduced to the limit of technology (total nitrogen of 3 mg/l), the Seekonk River and portions of the Providence River would not fully comply with existing water quality standards (minimum of 5.0 mg/l "except as naturally occurs") and may not meet Environmental Protection Agency (EPA) guidelines established in October 2000, (*Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras* EPA-822-R-00-012). The EPA's guidelines allow instantaneous values below 4.8 provided the cumulative exposure to low DO levels do not exceed the duration criteria established to ensure that the cumulative percentage of larvae affected shall not exceed a 5% reduction in larval recruitment over the recruitment season.

While DEM believes that the MERL results provide an adequate representation of the relationship between nitrogen and oxygen levels in the Providence and Seekonk Rivers, some uncertainty remains regarding predicted water quality improvements and loading reduction necessary to meet water quality standards. For example, significantly lower mean Dissolved Inorganic Nitrogen (DIN) concentrations were observed in the Providence and Seekonk Rivers as compared to the MERL experiment for an equivalent loading rate, which may be the result of large differences between the field and experimental flushing times. Also the MERL experiment DO sampling protocol does not provide sufficient data to fully assess compliance with the recently established EPA guidelines. However, it is clear that the Providence and Seekonk Rivers are impacted by low DO levels and high phytoplankton levels related to excessive WWTF nitrogen loadings. For these reasons, an evaluation of phased implementation is indicated. Implementation of a phased approach is consistent with the EPA publication titled "Guidance for Water Quality Based Decisions: The TMDL Process", which states: "For Certain non-traditional, problems, if there are not adequate data and predictive tools to characterize and analyze the pollution problem, a phased approach may be necessary". For the reasons noted above, DEM has evaluated implementation costs, analysis of the performance of available technology, and estimates of water quality improvement to develop a phased plan for implementation of WWTF improvements which maximizes the DO levels relative to implementation cost.

Nine (9) different cases, representing various combinations of nitrogen reduction at three (3) Massachusetts and seven (7) Rhode Island WWTFs were examined. The WWTFs included in this analysis were: the Upper Blackstone Water Pollution Abatement District ("UBWPAD") located in Worcester, MA, the North Attleboro WWTF, the Attleboro WWTF, the Woonsocket WWTF, the Bucklin Point WWTF, the Fields Point WWTF, the East Providence Water Pollution Control Facility, the Cranston Water Control Facility, the West Warwick WWTF, and the Warwick WWTF. Estimates of capital costs to modify existing facilities to achieve the target levels on a seasonal basis were developed. These costs included allowances for planning, design, construction and administration and must be considered Order-of-Magnitude estimates, since specific facility characteristics were not evaluated. This analysis

has been added to the document "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", which is available upon request. Based on this evaluation of the sources of excessive nitrogen levels in the rivers and the capabilities of existing treatment processes, the DEM has determined that it would be appropriate to establish seasonal (May – October) WWTF total nitrogen limits that range from 5.0 mg/l to 8.0 mg/l. These limits will achieve a 50% reduction from the 1995-1996 Rhode Island WWTF loading, consistent with the recommendations from The Governor's Narragansett Bay and Watershed Planning Commission. In addition to adding a seasonal total nitrogen limit of 8.0 mg/l, this permit modification also requires that the permittee operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through April, to the maximum extent possible using all available treatment equipment in place at the facility. Assigning seasonal total nitrogen limits and requiring that the WWTF be operated year round in a manner to reduce the discharge of nitrogen to the maximum extent possible will result in substantial progress towards the mitigation of hypoxic/anoxic events and meeting water quality standards. The analysis contained in "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", indicates that the contribution of Massachusetts WWTFs is significant and DEM will be working with the Massachusetts Department of Environmental Protection and the EPA to pursue appropriate nitrogen reductions.

An integral component of this phased implementation approach is monitoring and assessment of water quality changes to determine if additional reductions are necessary to meet applicable standards. DEM, in partnership with NERRS, the Narragansett Bay Commission, University of Rhode Island and Roger Williams University increased the number of Narragansett Bay continuous water quality monitoring stations from 7 to 9 in the summer of 2004. DEM has obtained funding from the federal Bay Window grant to increase the number of stations to at least 13 by the summer of 2005. This monitoring network will provide the data necessary to evaluate compliance with water quality standards, particularly temporal detail needed to evaluate compliance with EPA's DO guidelines.

The requirements set forth in this permit are from the State's Water Quality Regulations and the State's Regulations for the Rhode Island Pollutant Discharge Elimination System (RIPDES Regulations), both filed pursuant to Chapter 46-12, as amended. DEM's primary authority over the permit comes from EPA's delegation of the program in September 1984 under the Federal Clean Water Act (CWA).

The effluent monitoring requirements have been specified in accordance with RIPDES regulations as well as 40 CFR 122.41 (j), 122.44 (i), and 122.48 to yield data representative of the discharge.

#### IV. **Comment Period, Hearing Requests, and Procedures for Final Decisions**

All persons, including applicants, who believe any condition of the draft permit is inappropriate must raise all issues and submit all available arguments and all supporting material for their arguments in full by the close of the public comment period, to the Rhode Island Department of Environmental Management, Office of Water Resources, 235 Promenade Street, Providence, Rhode Island, 02908-5767. Any person may also present oral comments on the draft permit at the scheduled public hearing. In reaching a final decision on the draft permit the Director will respond to all significant comments, either received in writing during the public comment period or presented orally at the public hearing, and make these responses available to the public at DEM's Providence Office. Following the close of the comment period, and after the public hearing, the Director will issue a final permit decision and forward a copy of the final decision to the applicant and each person who has submitted written comments, presented oral testimony, or requested notice. Within thirty (30) days following the notice of the final permit decision any interested person may submit a request for a formal hearing to reconsider or contest the final decision. Requests for formal hearings must satisfy the requirements of Rule 49 of the Regulations for the Rhode Island Pollutant Discharge Elimination System.

V. **DEM Contact**

Additional information concerning the permit may be obtained between the hours of 8:30 a.m. and 4:00 p.m., Monday through Friday, excluding holidays, from:

Joseph B. Haberek, P.E.  
RIPDES Program  
Department of Environmental Management  
235 Promenade Street  
Providence, Rhode Island 02908  
Telephone: (401) 222-4700, Extension: 7715

\_\_\_\_\_  
Date

\_\_\_\_\_  
Angelo S. Liberti, P.E.  
Chief of Surface Water Protection  
Office of Water Resources  
Department of Environmental Management

MODIFICATION

AUTHORIZATION TO DISCHARGE UNDER THE  
RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of Chapter 46-12 of the Rhode Island General Laws, as amended, RIPDES Permit No. RI0100315 issued to the Narragansett Bay Commission on December 31, 2001 shall be modified as follows:

The Total Nitrogen, Total Nitrite, Total Nitrate, and TKN limits and monitoring requirements in Part I.A.3 of the permit shall be deleted in their entirety and replaced with the limits and monitoring requirements in Attachment A of this modification.

The remaining effluent limitations, monitoring requirements and other conditions in the original permit are unchanged and in effect.

This modification shall become effective on August 1, 2005.

This permit and the authorization to discharge expire at midnight, February 1, 2007.

This change modifies the permit issued on December 31, 2001.

This modification consists of two (2) pages.

Signed this 27th day of June 2005.

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Angelo S. Liberti, P.E., Chief of Surface Water Protection  
Office of Water Resources  
Rhode Island Department of Environmental Management  
Providence, Rhode Island

ATTACHMENT A

PART 1

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date and lasting through permit expiration, the permittee is authorized to discharge from outfall serial number(s) 001A (Secondary Treatment Discharge).

Such discharges shall be monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirement		Measurement Frequency	Sample Type
	Average Monthly	Maximum Daily	Average Weekly	Maximum Daily		
Nitrogen, Total [TKN + Nitrite + Nitrate, as N] (May - Oct) (Nov - April)	2711 lb/d -- lb/d'		5.0 mg/L -- mg/L'		3/ Week 3/ Week	Calculated Calculated
TKN (May - Oct) (Nov - April)			-- mg/L -- mg/L		3/ Week 3/ Week	24-Hr. Comp. 24-Hr. Comp.
Nitrite, Total [as N] (May - Oct) (Nov - April)			-- mg/L -- mg/L		3/ Week 3/ Week	24-Hr. Comp. 24-Hr. Comp.
Nitrate, Total [as N] (May - Oct) (Nov - April)			-- mg/L -- mg/L		3/ Week 3/ Week	24-Hr. Comp. 24-Hr. Comp.

-- Signifies a parameter which must be monitored and data must be reported; no limit has been established at this time.

\* The permittee shall operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through April, to the maximum extent possible using all available treatment equipment in place at the facility, except methanol addition.

Samples taken in compliance with the monitoring requirements specified above shall be taken Monday through Friday at the following locations:  
Outfall 001A.



RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
OFFICE OF WATER RESOURCES  
235 PROMENADE STREET  
PROVIDENCE, RHODE ISLAND 02908-5767

FACT SHEET

RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM (RIPDES) PERMIT TO DISCHARGE TO WATERS OF THE STATE

RIPDES PERMIT NO. RI0100315

NAME AND ADDRESS OF APPLICANT:

**The Narragansett Bay Commission**  
One Service Road  
Providence, Rhode Island 02905

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

**Field's Point Wastewater Treatment Facility**  
2 Ernest Street  
Providence, Rhode Island 02905  
And  
Associated Combined Sewer Overflows

RECEIVING WATER: Providence, Seekonk, Moshassuck, West, and Woonasquatucket Rivers

CLASSIFICATION: SB1{a}; B1{a} & B{a}

**I. Proposed Action, Type of Facility, and Discharge Location**

The Rhode Island Department of Environmental Management proposes to issue a modification to the above-mentioned facility's RIPDES Permit to discharge into the designated receiving water. The facility is engaged in the treatment of domestic and industrial sewage. The discharge is from the Field's Point Wastewater Treatment Facility's outfall.

**II. Limitations and Conditions**

The effluent limitations, monitoring requirements, and any implementation schedule (if required) may be found in the permit. The DEM anticipates entering into an enforceable compliance schedule, either by modifying the existing consent agreement or entering into a new consent agreement, to allow the facility to construct the necessary improvements to comply with the Total Nitrogen limits contained in this permit modification.

**III. Permit Basis and Explanation of Effluent Limitation Derivation**

The Narragansett Bay Commission owns and operates the Field's Point Wastewater Treatment Facility (WWTF) located on Ernest Street in Providence, Rhode Island and several associated Combined Sewer Overflows (CSOs). The discharge from the WWTF to the Providence River consists of treated sanitary sewage and commercial and industrial wastewater. Treatment consists of Screening, Grit Removal, Pre-aeration, Primary Settling, Activated Sludge, Secondary Settling, Chlorination, and Dechlorination.

The Providence and Seekonk Rivers are impacted by low Dissolved Oxygen (DO) levels and high phytoplankton concentrations that are related to excessive nitrogen loadings. Significant areas of the Providence and Seekonk Rivers suffer from hypoxic (low DO) and anoxic (lack of DO) conditions and violate water quality standards. Available data shows that nitrogen loads are dominated by wastewater treatment facility inputs.

DEM hired a consultant and has been working with a technical advisory committee (TAC), consisting primarily of scientists and engineers representing, academic, municipal, state and federal organizations, to calibrate a model and develop a water quality restoration plan, or TMDL. It was recently concluded that the hydrodynamic model formulation could not adequately simulate conditions due to the relatively severe changes in the bathymetry in the Providence River. In spite of this obstacle DEM believes that nutrient reductions must be established for most facilities in the state. DEM has concluded that the best method available for evaluating impacts and setting nitrogen load reduction targets for the Providence River is to use the set of empirical relations developed from the Marine Ecosystems Research Laboratory (MERL) enrichment gradient studies at the University of Rhode Island. In February 2004, DEM developed and forwarded to the TAC an analysis titled "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers". This analysis indicated that even if the wastewater treatment facility (WWTF) discharges are reduced to the limit of technology (total nitrogen of 3 mg/l), the Seekonk River and portions of the Providence River would not fully comply with existing water quality standards (minimum of 5.0 mg/l "except as naturally occurs") and may not meet Environmental Protection Agency (EPA) guidelines established in October 2000, (*Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras* EPA-822-R-00-012). The EPA's guidelines allow instantaneous values below 4.8 provided the cumulative exposure to low DO levels do not exceed the duration criteria established to ensure that the cumulative percentage of larvae affected shall not exceed a 5% reduction in larval recruitment over the recruitment season.

While DEM believes that the MERL results provide an adequate representation of the relationship between nitrogen and oxygen levels in the Providence and Seekonk Rivers, some uncertainty remains regarding predicted water quality improvements and loading reduction necessary to meet water quality standards. For example, significantly lower mean Dissolved Inorganic Nitrogen (DIN) concentrations were observed in the Providence and Seekonk Rivers as compared to the MERL experiment for an equivalent loading rate, which may be the result of large differences between the field and experimental flushing times. Also the MERL experiment DO sampling protocol does not provide sufficient data to fully assess compliance with the recently established EPA guidelines. However, it is clear that the Providence and Seekonk Rivers are impacted by low DO levels and high phytoplankton levels related to excessive WWTF nitrogen loadings. For these reasons, an evaluation of phased implementation is indicated. Implementation of a phased approach is consistent with the EPA publication titled "Guidance for Water Quality Based Decisions: The TMDL Process", which states: "For Certain non-traditional, problems, if there are not adequate data and predictive tools to characterize and analyze the pollution problem, a phased approach may be necessary". For the reasons noted above, DEM has evaluated implementation costs, analysis of the performance of available technology, and estimates of water quality improvement to develop a phased plan for implementation of WWTF improvements which maximizes the DO levels relative to implementation cost.

Nine (9) different cases, representing various combinations of nitrogen reduction at three (3) Massachusetts and seven (7) Rhode Island WWTFs were examined. The WWTFs included in this analysis were: the Upper Blackstone Water Pollution Abatement District ("UBWPAD") located in Worcester, MA, the North Attleboro WWTF, the Attleboro WWTF, the Woonsocket WWTF, the Bucklin Point WWTF, the Fields Point WWTF, the East Providence Water Pollution Control Facility, the Cranston Water Control Facility, the West Warwick WWTF, and the Warwick WWTF. Estimates of capital costs to modify existing facilities to achieve the target levels on a seasonal basis were developed. These costs included allowances for planning, design, construction and administration and must be considered Order-of-Magnitude estimates, since specific facility characteristics were not evaluated. This analysis

has been added to the document "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", which is available upon request. Based on this evaluation of the sources of excessive nitrogen levels in the rivers and the capabilities of existing treatment processes, the DEM has determined that it would be appropriate to establish seasonal (May – October) WWTF total nitrogen limits that range from 5.0 mg/l to 8.0 mg/l. These limits will achieve a 50% reduction from the 1995-1996 Rhode Island WWTF loading, consistent with the recommendations from The Governor's Narragansett Bay and Watershed Planning Commission. In addition to adding a seasonal total nitrogen limit of 5.0 mg/l, this permit modification also requires that the permittee operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through April, to the maximum extent possible using all available treatment equipment in place at the facility. Assigning seasonal total nitrogen limits and requiring that the WWTF be operated year round in a manner to reduce the discharge of nitrogen to the maximum extent possible will result in substantial progress towards the mitigation of hypoxic/anoxic events and meeting water quality standards. The analysis contained in "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", indicates that the contribution of Massachusetts WWTFs is significant and DEM will be working with the Massachusetts Department of Environmental Protection and the EPA to pursue appropriate nitrogen reductions.

An integral component of this phased implementation approach is monitoring and assessment of water quality changes to determine if additional reductions are necessary to meet applicable standards. DEM, in partnership with NERRS, the Narragansett Bay Commission, University of Rhode Island and Roger Williams University increased the number of Narragansett Bay continuous water quality monitoring stations from 7 to 9 in the summer of 2004. DEM has obtained funding from the federal Bay Window grant to increase the number of stations to at least 13 by the summer of 2005. This monitoring network will provide the data necessary to evaluate compliance with water quality standards, particularly temporal detail needed to evaluate compliance with EPA's DO guidelines.

The requirements set forth in this permit are from the State's Water Quality Regulations and the State's Regulations for the Rhode Island Pollutant Discharge Elimination System (RIPDES Regulations), both filed pursuant to Chapter 46-12, as amended. DEM's primary authority over the permit comes from EPA's delegation of the program in September 1984 under the Federal Clean Water Act (CWA).

The effluent monitoring requirements have been specified in accordance with RIPDES regulations as well as 40 CFR 122.41 (j), 122.44 (i), and 122.48 to yield data representative of the discharge.

#### **IV. Comment Period, Hearing Requests, and Procedures for Final Decisions**

All persons, including applicants, who believe any condition of the draft permit is inappropriate must raise all issues and submit all available arguments and all supporting material for their arguments in full by the close of the public comment period, to the Rhode Island Department of Environmental Management, Office of Water Resources, 235 Promenade Street, Providence, Rhode Island, 02908-5767. Any person may also present oral comments on the draft permit at the scheduled public hearing. In reaching a final decision on the draft permit the Director will respond to all significant comments, either received in writing during the public comment period or presented orally at the public hearing, and make these responses available to the public at DEM's Providence Office. Following the close of the comment period, and after the public hearing, the Director will issue a final permit decision and forward a copy of the final decision to the applicant and each person who has submitted written comments, presented oral testimony, or requested notice. Within thirty (30) days following the notice of the final permit decision any interested person may submit a request for a formal hearing to reconsider or contest the final decision. Requests for formal hearings must satisfy the requirements of Rule 49 of the Regulations for the Rhode Island Pollutant Discharge Elimination System.

V. **DEM Contact**

Additional information concerning the permit may be obtained between the hours of 8:30 a.m. and 4:00 p.m., Monday through Friday, excluding holidays, from:

Joseph B. Haberek, P.E.  
RIPDES Program  
Department of Environmental Management  
235 Promenade Street  
Providence, Rhode Island 02908  
Telephone: (401) 222-4700, Extension: 7715

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Date

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Angelo S. Liberti, P.E.  
Chief of Surface Water Protection  
Office of Water Resources  
Department of Environmental Management

ATTACHMENT A

PART 1

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date and lasting through permit expiration, the permittee is authorized to discharge from outfall serial number(s) 001A (Secondary Treatment Discharge).

Such discharges shall be monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirement		Measurement Frequency	Sample Type
	Average Monthly	Maximum Daily	Average Monthly	Average Weekly		
Nitrogen, Total [TKN + Nitrite + Nitrate, as N] (May - Oct) (Nov - April)	2711 lb/d		5.0 mg/L		3/ Week	Calculated
	--- lb/d'		--- mg/L'		3/ Week	Calculated
TKN (May - Oct) (Nov - April)			--- mg/L		3/ Week	24-Hr. Comp.
			--- mg/L		3/ Week	24-Hr. Comp.
Nitrite, Total [as N] (May - Oct) (Nov - April)			--- mg/L		3/ Week	24-Hr. Comp.
			--- mg/L		3/ Week	24-Hr. Comp.
Nitrate, Total [as N] (May - Oct) (Nov - April)			--- mg/L		3/ Week	24-Hr. Comp.
			--- mg/L		3/ Week	24-Hr. Comp.

--- Signifies a parameter which must be monitored and data must be reported; no limit has been established at this time.

The permittee shall operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through April, to the maximum extent possible using all available treatment equipment in place at the facility, except methanol addition.

Samples taken in compliance with the monitoring requirements specified above shall be taken Monday through Friday at the following locations:  
Outfall 001A.

MODIFICATION

AUTHORIZATION TO DISCHARGE UNDER THE  
RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of Chapter 46-12 of the Rhode Island General Laws, as amended, RIPDES Permit No. RI0100111 issued to the City of Woonsocket on July 15, 2000 shall be modified as follows:

The Total Nitrogen, Total Nitrite, Total Nitrate, and TKN limits and monitoring requirements in Part I.A.2 of the permit shall be deleted in their entirety and replaced with the limits and monitoring requirements in Attachment A of this modification.

The remaining effluent limitations, monitoring requirements and other conditions in the original permit are unchanged and in effect.

This modification shall become effective on August 1, 2005.

This permit and the authorization to discharge expire at midnight, July 1, 2005.

This change modifies the permit issued on July 15, 2000.

This modification consists of two (2) pages.

Signed this 27th day of June 2005.

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Angelo S. Liberti, P.E., Chief of Surface Water Protection  
Office of Water Resources  
Rhode Island Department of Environmental Management  
Providence, Rhode Island

ATTACHMENT A

PART 1

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date and lasting through permit expiration, the permittee is authorized to discharge from outfall serial number(s) 001A (Secondary Treatment Discharge).

Such discharges shall be monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations		Monitoring Requirement		Sample Type
	Average Monthly	Maximum Daily	Average Weekly	Maximum Daily	
Nitrogen, Total [TKN + Nitrite + Nitrate, as N] (April) (May - Oct) (Nov - March)	— lb/d		10.0 mg/L	— mg/L	3/ Week Calculated
	667 lb/d		5.0 mg/L	— mg/L	3/ Week Calculated
	— lb/d <sup>1</sup>		— mg/L	— mg/L	3/ Week Calculated
TKN (April - Oct) (Nov - March)			— mg/L	— mg/L	3/ Week 24-Hr. Comp.
			— mg/L	— mg/L	3/ Week 24-Hr. Comp.
Nitrite, Total [as N] (April - Oct) (Nov - March)			— mg/L	— mg/L	3/ Week 24-Hr. Comp.
			— mg/L	— mg/L	3/ Week 24-Hr. Comp.
Nitrate, Total [as N] (April - Oct) (Nov - March)			— mg/L	— mg/L	3/ Week 24-Hr. Comp.
			— mg/L	— mg/L	3/ Week 24-Hr. Comp.

— Signifies a parameter which must be monitored and data must be reported; no limit has been established at this time.

<sup>1</sup>The permittee shall operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through March, to the maximum extent possible using all available treatment equipment in place at the facility, except methanol addition.

Samples taken in compliance with the monitoring requirements specified above shall be taken Monday through Friday at the following locations:  
Outfall 001A.

RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT  
OFFICE OF WATER RESOURCES  
235 PROMENADE STREET  
PROVIDENCE, RHODE ISLAND 02908-5767

FACT SHEET

RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM (RIPDES) PERMIT TO DISCHARGE TO WATERS OF THE STATE

RIPDES PERMIT NO. RI0100111

NAME AND ADDRESS OF APPLICANT:

**City of Woonsocket**  
167 Main Street  
Woonsocket, Rhode Island 02895

NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:

**Woonsocket Wastewater Treatment Facility**  
Cumberland Hill Road  
Providence, Rhode Island 02895

RECEIVING WATER: Blackstone River

CLASSIFICATION: B1

**I. Proposed Action, Type of Facility, and Discharge Location**

The Rhode Island Department of Environmental Management proposes to issue a modification to the above-mentioned facility's RIPDES Permit to discharge into the designated receiving water. The facility is engaged in the treatment of domestic and industrial sewage. The discharge is from the Woonsocket Wastewater Treatment Facility's outfall.

**II. Limitations and Conditions**

The effluent limitations, monitoring requirements, and any implementation schedule (if required) may be found in the permit. The DEM anticipates entering into an enforceable compliance schedule, either by modifying the existing consent agreement or entering into a new consent agreement, to allow the facility to construct the necessary improvements to comply with the Total Nitrogen limits contained in this permit modification.

**III. Permit Basis and Explanation of Effluent Limitation Derivation**

The City of Woonsocket owns and operates the Woonsocket Wastewater Treatment Facility (WWTF) located on Cumberland Hill Road in Woonsocket, Rhode Island. The discharge from the WWTF to the Blackstone River consists of treated sanitary sewage and commercial and industrial wastewater contributed by the municipalities of Woonsocket, North Smithfield, and Blackstone, Massachusetts. Treatment consists of Coarse Screening, Comminution, Aerated Grit Removal, Primary Settling, Mechanical Aeration, Secondary Settling, Chlorination, and Dechlorination.



The Providence and Seekonk Rivers are impacted by low Dissolved Oxygen (DO) levels and high phytoplankton concentrations that are related to excessive nitrogen loadings. Significant areas of the Providence and Seekonk Rivers suffer from hypoxic (low DO) and anoxic (lack of DO) conditions and violate water quality standards. Available data shows that nitrogen loads are dominated by wastewater treatment facility inputs.

DEM hired a consultant and has been working with a technical advisory committee (TAC), consisting primarily of scientists and engineers representing, academic, municipal, state and federal organizations, to calibrate a model and develop a water quality restoration plan, or TMDL. It was recently concluded that the hydrodynamic model formulation could not adequately simulate conditions due to the relatively severe changes in the bathymetry in the Providence River. In spite of this obstacle DEM believes that nutrient reductions must be established for most facilities in the state. DEM has concluded that the best method available for evaluating impacts and setting nitrogen load reduction targets for the Providence River is to use the set of empirical relations developed from the Marine Ecosystems Research Laboratory (MERL) enrichment gradient studies at the University of Rhode Island. In February 2004, DEM developed and forwarded to the TAC an analysis titled "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers". This analysis indicated that even if the wastewater treatment facility (WWTF) discharges are reduced to the limit of technology (total nitrogen of 3 mg/l), the Seekonk River and portions of the Providence River would not fully comply with existing water quality standards (minimum of 5.0 mg/l "except as naturally occurs") and may not meet Environmental Protection Agency (EPA) guidelines established in October 2000, (*Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras* EPA-822-R-00-012). The EPA's guidelines allow instantaneous values below 4.8 provided the cumulative exposure to low DO levels do not exceed the duration criteria established to ensure that the cumulative percentage of larvae affected shall not exceed a 5% reduction in larval recruitment over the recruitment season.

While DEM believes that the MERL results provide an adequate representation of the relationship between nitrogen and oxygen levels in the Providence and Seekonk Rivers, some uncertainty remains regarding predicted water quality improvements and loading reduction necessary to meet water quality standards. For example, significantly lower mean Dissolved Inorganic Nitrogen (DIN) concentrations were observed in the Providence and Seekonk Rivers as compared to the MERL experiment for an equivalent loading rate, which may be the result of large differences between the field and experimental flushing times. Also the MERL experiment DO sampling protocol does not provide sufficient data to fully assess compliance with the recently established EPA guidelines. However, it is clear that the Providence and Seekonk Rivers are impacted by low DO levels and high phytoplankton levels related to excessive WWTF nitrogen loadings. For these reasons, an evaluation of phased implementation is indicated. Implementation of a phased approach is consistent with the EPA publication titled "Guidance for Water Quality Based Decisions: The TMDL Process", which states: "For Certain non-traditional, problems, if there are not adequate data and predictive tools to characterize and analyze the pollution problem, a phased approach may be necessary". For the reasons noted above, DEM has evaluated implementation costs, analysis of the performance of available technology, and estimates of water quality improvement to developed a phased plan for implementation of WWTF improvements which maximizes the DO levels relative to implementation cost.

Nine (9) different cases, representing various combinations of nitrogen reduction at three (3) Massachusetts and seven (7) Rhode Island WWTFs were examined. The WWTFs included in this analysis were: the Upper Blackstone Water Pollution Abatement District ("UBWPAD") located in Worcester, MA, the North Attleboro WWTF, the Attleboro WWTF, the Woonsocket WWTF, the Bucklin Point WWTF, the Fields Point WWTF, the East Providence Water Pollution Control Facility, the Cranston Water Control Facility, the West Warwick WWTF, and the Warwick WWTF. Estimates of capital costs to modify existing facilities to achieve the target levels on a seasonal basis were developed. These costs included allowances for planning, design, construction and administration and must be considered Order-of-Magnitude estimates, since specific facility characteristics were not evaluated. This analysis

has been added to the document "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", which is available upon request. Based on this evaluation of the sources of excessive nitrogen levels in the rivers and the capabilities of existing treatment processes, the DEM has determined that it would be appropriate to establish seasonal (May - October) limits for total nitrogen of 5.0 mg/l to your WWTF. These limits will achieve a 50% reduction from the 1995-1996 Rhode Island WWTF loading, consistent with the recommendations from The Governor's Narragansett Bay and Watershed Planning Commission. In addition to adding a seasonal total nitrogen limit of 5.0 mg/l, this permit modification also requires that the permittee operate the treatment facility to reduce the discharge of total nitrogen, during the months of November through March, to the maximum extent possible using all available treatment equipment in place at the facility, and carries over the 10.0 mg/l total nitrogen limit during April from the previous permit. Assigning seasonal total nitrogen limits and requiring that the WWTF be operated year round in a manner to reduce the discharge of nitrogen to the maximum extent possible will result in substantial progress towards the mitigation of hypoxic/anoxic events and meeting water quality standards. The analysis contained in "Evaluation of Nitrogen Targets and WWTF Load Reductions for the Providence and Seekonk Rivers", indicates that the contribution of Massachusetts WWTFs is significant and DEM will be working with the Massachusetts Department of Environmental Protection and the EPA to pursue appropriate nitrogen reductions.

An integral component of this phased implementation approach is monitoring and assessment of water quality changes to determine if additional reductions are necessary to meet applicable standards. DEM, in partnership with NERRS, the Narragansett Bay Commission, University of Rhode Island and Roger Williams University increased the number of Narragansett Bay continuous water quality monitoring stations from 7 to 9 in the summer of 2004. DEM has obtained funding from the federal Bay Window grant to increase the number of stations to at least 13 by the summer of 2005. This monitoring network will provide the data necessary to evaluate compliance with water quality standards, particularly temporal detail needed to evaluate compliance with EPA's DO guidelines.

The requirements set forth in this permit are from the State's Water Quality Regulations and the State's Regulations for the Rhode Island Pollutant Discharge Elimination System (RIPDES Regulations), both filed pursuant to Chapter 46-12, as amended. DEM's primary authority over the permit comes from EPA's delegation of the program in September 1984 under the Federal Clean Water Act (CWA).

The effluent monitoring requirements have been specified in accordance with RIPDES regulations as well as 40 CFR 122.41 (j), 122.44 (i), and 122.48 to yield data representative of the discharge.

#### **IV. Comment Period, Hearing Requests, and Procedures for Final Decisions**

All persons, including applicants, who believe any condition of the draft permit is inappropriate must raise all issues and submit all available arguments and all supporting material for their arguments in full by the close of the public comment period, to the Rhode Island Department of Environmental Management, Office of Water Resources, 235 Promenade Street, Providence, Rhode Island, 02908-5767. Any person may also present oral comments on the draft permit at the scheduled public hearing. In reaching a final decision on the draft permit the Director will respond to all significant comments, either received in writing during the public comment period or presented orally at the public hearing, and make these responses available to the public at DEM's Providence Office. Following the close of the comment period, and after the public hearing, the Director will issue a final permit decision and forward a copy of the final decision to the applicant and each person who has submitted written comments, presented oral testimony, or requested notice. Within thirty (30) days following the notice of the final permit decision any interested person may submit a request for a formal hearing to reconsider or contest the final decision. Requests for formal hearings must satisfy the requirements of Rule 49 of the Regulations for the Rhode Island Pollutant Discharge Elimination System.

V. **DEM Contact**

Additional information concerning the permit may be obtained between the hours of 8:30 a.m. and 4:00 p.m., Monday through Friday, excluding holidays, from:

Joseph B. Haberek, P.E.  
RIPDES Program  
Department of Environmental Management  
235 Promenade Street  
Providence, Rhode Island 02908  
Telephone: (401) 222-4700, Extension: 7715

\_\_\_\_\_  
Date

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Angelo S. Liberti, P.E.  
Chief of Surface Water Protection  
Office of Water Resources  
Department of Environmental Management

RCH NUM	ELE NUM	Flow cfs	NH3N MG/L	NO2N MG/L	NO3N MG/L	NH3N lb/day	NO2N lb/day	NO3N lb/day	DIN lb/day
1	1	12.31	0.13	0	0.55	8.63	0.00	36.49	45.12
1	2	12.36	0.15	0	0.54	9.99	0.00	35.98	45.97
1	3	12.42	0.16	0	0.54	10.71	0.00	36.15	46.86
1	4	12.48	0.18	0	0.53	12.11	0.00	35.65	47.76
2	1	12.66	0.19	0	0.53	12.97	0.00	36.17	49.13
2	2	12.84	0.2	0	0.52	13.84	0.00	35.99	49.83
2	3	13.02	0.21	0	0.52	14.74	0.00	36.49	51.23
2	4	13.2	0.23	0	0.51	16.36	0.00	36.29	52.65
2	5	13.38	0.24	0	0.51	17.31	0.00	36.78	54.09
2	6	13.56	0.31	0	0.69	22.66	0.00	50.43	73.09
2	7	100.38	1.75	0	5.31	946.83	0.00	2872.97	3819.80
2	8	100.39	1.7	0	5.34	919.87	0.00	2889.49	3809.36
2	9	100.41	1.66	0	5.38	898.41	0.00	2911.71	3810.12
3	1	100.42	1.62	0	5.42	876.85	0.00	2933.65	3810.50
3	2	100.44	1.58	0	5.45	855.37	0.00	2950.48	3805.84
3	3	100.45	1.54	0	5.49	833.80	0.00	2972.43	3806.22
3	4	100.47	1.5	0	5.53	812.30	0.00	2994.68	3806.98
3	5	100.48	1.47	0	5.57	796.13	0.00	3016.64	3812.77
3	6	100.5	1.43	0	5.6	774.62	0.00	3033.49	3808.12
4	1	100.57	1.38	0	5.64	748.06	0.00	3057.29	3805.35
4	2	100.63	1.33	0	5.69	721.39	0.00	3086.23	3807.62
4	3	100.7	1.28	0	5.73	694.75	0.00	3110.09	3804.84
4	4	101.98	1.22	0	5.71	670.60	0.00	3138.63	3809.23
4	5	102.05	1.18	0	5.75	649.06	0.00	3162.78	3811.84
4	6	102.11	1.14	0	5.79	627.43	0.00	3186.66	3814.08
4	7	102.18	1.1	0	5.83	605.83	0.00	3210.87	3816.70
5	1	102.61	1.02	0	5.88	564.13	0.00	3252.04	3816.17
5	2	103.05	0.91	0	5.97	505.45	0.00	3315.97	3821.42
5	3	103.48	0.82	0	6.06	457.36	0.00	3380.01	3837.37
6	1	107.73	0.87	0	6.29	505.18	0.00	3652.38	4157.56
6	2	107.8	0.79	0	6.37	459.02	0.00	3701.24	4160.26
6	3	107.87	0.72	0	6.44	418.62	0.00	3744.34	4162.96
6	4	107.94	0.66	0	6.5	383.99	0.00	3781.68	4165.66
7	1	108.16	0.61	0	6.53	355.62	0.00	3806.88	4162.49

7	2	109.82	0.57	0	6.47	337.40	0.00	3829.79	4167.19
7	3	110.04	0.55	0	6.48	326.21	0.00	3843.39	4169.60
7	4	110.25	0.52	0	6.5	309.01	0.00	3862.61	4171.62
7	5	110.47	0.5	0	6.51	297.72	0.00	3876.27	4173.99
7	6	110.69	0.48	0	6.52	286.38	0.00	3889.96	4176.33
7	7	110.9	0.46	0	6.53	274.97	0.00	3903.31	4178.28
7	8	111.12	0.44	0	6.54	263.53	0.00	3917.05	4180.58
8	1	111.16	0.41	0	6.56	245.65	0.00	3930.44	4176.09
8	2	111.86	0.38	0	6.56	229.11	0.00	3955.19	4184.30
8	3	111.9	0.36	0	6.58	217.13	0.00	3968.67	4185.80
8	4	111.95	0.33	0	6.55	199.13	0.00	3952.34	4151.46
8	5	119.63	0.3	0	6.21	193.44	0.00	4004.24	4197.69
8	6	119.68	0.28	0	6.22	180.62	0.00	4012.37	4192.99
9	1	119.71	0.28	0	6.23	180.67	0.00	4019.83	4200.49
9	2	119.75	0.28	0	6.23	180.73	0.00	4021.17	4201.90
9	3	119.78	0.28	0	6.23	180.77	0.00	4022.18	4202.95
9	4	119.82	0.28	0	6.24	180.83	0.00	4029.98	4210.81
10	1	122.34	0.37	0	6.36	243.98	0.00	4193.86	4437.85
10	2	122.41	0.36	0	6.36	237.52	0.00	4196.26	4433.79
10	3	122.47	0.36	0	6.36	237.64	0.00	4198.32	4435.96
10	4	122.54	0.36	0	6.35	237.78	0.00	4194.12	4431.89
10	5	122.6	0.36	0	6.35	237.89	0.00	4196.17	4434.06
10	6	122.66	0.36	0	6.35	238.01	0.00	4198.22	4436.23
10	7	122.73	0.35	0	6.35	231.53	0.00	4200.62	4432.15
10	8	122.79	0.35	0	6.34	231.64	0.00	4196.05	4427.70
10	9	122.86	0.35	0	6.34	231.78	0.00	4198.45	4430.22
10	10	122.92	0.35	0	6.34	231.89	0.00	4200.50	4432.38
11	1	123	0.35	0	6.33	232.04	0.00	4196.60	4428.64
11	2	123.08	0.34	0	6.33	225.56	0.00	4199.33	4424.89
11	3	123.17	0.34	0	6.32	225.72	0.00	4195.76	4421.48
11	4	123.25	0.34	0	6.32	225.87	0.00	4198.49	4424.35
11	5	123.33	0.34	0	6.32	226.01	0.00	4201.21	4427.23
11	6	123.41	0.34	0	6.31	226.16	0.00	4197.29	4423.45
11	7	123.5	0.33	0	6.31	219.67	0.00	4200.35	4420.02
11	8	123.58	0.33	0	6.3	219.81	0.00	4196.41	4416.22
12	1	123.7	0.33	0	6.3	220.03	0.00	4200.48	4420.51
12	2	123.82	0.33	0	6.29	220.24	0.00	4197.88	4418.12

12	3	123.95	0.32	0	6.28	213.79	0.00	4195.61	4409.40
12	4	124.07	0.32	0	6.28	214.00	0.00	4199.67	4413.67
13	1	124.23	0.31	0	6.27	207.58	0.00	4198.39	4405.97
13	2	124.4	0.31	0	6.26	207.86	0.00	4197.43	4405.29
13	3	124.56	0.31	0	6.25	208.13	0.00	4196.12	4404.24
13	4	124.73	0.3	0	6.24	201.69	0.00	4195.12	4396.81
13	5	124.89	0.3	0	6.23	201.95	0.00	4193.77	4395.72
13	6	125.06	0.3	0	6.22	202.22	0.00	4192.74	4394.96
13	7	125.22	0.29	0	6.2	195.73	0.00	4184.60	4380.33
13	8	125.39	0.29	0	6.19	196.00	0.00	4183.52	4379.52
13	9	125.55	0.29	0	6.17	196.25	0.00	4175.33	4371.58
14	1	126.67	0.28	0	6.12	191.17	0.00	4178.44	4369.61
14	2	126.72	0.28	0	6.11	191.25	0.00	4173.26	4364.50
14	3	126.76	0.28	0	6.1	191.31	0.00	4167.74	4359.05
14	4	126.8	0.27	0	6.09	184.53	0.00	4162.22	4346.75
14	5	126.85	0.27	0	6.08	184.60	0.00	4157.03	4341.63
14	6	126.89	0.27	0	6.06	184.66	0.00	4144.66	4329.32
15	1	126.94	0.27	0	6.04	184.74	0.00	4132.61	4317.34
15	2	127	0.28	0	6.02	191.67	0.00	4120.87	4312.54
15	3	127.05	0.28	0	6	191.74	0.00	4108.80	4300.54
15	4	127.11	0.29	0	5.98	198.69	0.00	4097.03	4295.72
15	5	127.16	0.29	0	5.96	198.76	0.00	4084.94	4283.70
15	6	127.22	0.3	0	5.94	205.71	0.00	4073.15	4278.87
15	7	127.27	0.3	0	5.91	205.80	0.00	4054.17	4259.97
15	8	127.33	0.31	0	5.88	212.76	0.00	4035.50	4248.25
16	1	127.51	0.3	0	5.68	206.18	0.00	3903.74	4109.93
17	1	152.51	0.27	0	4.82	221.95	0.00	3962.18	4184.13
17	2	152.53	0.27	0	4.82	221.98	0.00	3962.70	4184.68
17	3	152.54	0.27	0	4.81	221.99	0.00	3954.74	4176.73
17	4	152.56	0.27	0	4.81	222.02	0.00	3955.26	4177.28
17	5	152.58	0.28	0	4.8	230.27	0.00	3947.55	4177.82
17	6	152.6	0.28	0	4.76	230.30	0.00	3915.17	4145.47
17	7	166.26	0.26	0	4.4	233.00	0.00	3943.02	4176.02
17	8	166.28	0.26	0	4.4	233.02	0.00	3943.50	4176.52
17	9	166.29	0.26	0	4.39	233.04	0.00	3934.77	4167.81
17	10	166.31	0.27	0	4.39	242.03	0.00	3935.24	4177.27
17	11	166.33	0.27	0	4.38	242.06	0.00	3926.75	4168.81

17	12	166.35	0.27	0	4.38	242.09	0.00	3927.22	4169.31
18	1	166.48	0.27	0	4.37	242.28	0.00	3921.32	4163.60
18	2	166.61	0.27	0	4.36	242.47	0.00	3915.40	4157.87
18	3	166.74	0.27	0	4.35	242.66	0.00	3909.47	4152.13
18	4	166.88	0.27	0	4.34	242.86	0.00	3903.76	4146.62
18	5	167.01	0.28	0	4.34	252.05	0.00	3906.80	4158.85
18	6	167.14	0.29	0	4.34	261.26	0.00	3909.84	4171.10
18	7	171.15	0.38	0	4.43	350.55	0.00	4086.67	4437.22
18	8	171.28	0.39	0	4.42	360.05	0.00	4080.54	4440.59
18	9	171.41	0.39	0	4.42	360.32	0.00	4083.64	4443.96
18	10	171.54	0.39	0	4.41	360.59	0.00	4077.49	4438.08
18	11	171.68	0.39	0	4.4	360.89	0.00	4071.56	4432.45
18	12	171.81	0.39	0	4.39	361.16	0.00	4065.39	4426.55
18	13	171.94	0.39	0	4.38	361.44	0.00	4059.19	4420.63
18	14	172.07	0.39	0	4.38	361.71	0.00	4062.26	4423.97
18	15	172.2	0.39	0	4.37	361.98	0.00	4056.05	4418.03
18	16	172.33	0.4	0	4.36	371.54	0.00	4049.82	4421.37
18	17	172.47	0.4	0	4.35	371.85	0.00	4043.82	4415.66
18	18	172.6	0.4	0	4.34	372.13	0.00	4037.56	4409.69
18	19	172.73	0.4	0	4.33	372.41	0.00	4031.29	4403.70
18	20	172.86	0.4	0	4.33	372.69	0.00	4034.33	4407.01
19	1	172.95	0.4	0	4.32	372.88	0.00	4027.11	4399.99
19	2	173.03	0.41	0	4.32	382.38	0.00	4028.97	4411.35
19	3	173.12	0.41	0	4.31	382.58	0.00	4021.73	4404.31
19	4	173.2	0.41	0	4.3	382.75	0.00	4014.26	4397.01
19	5	173.29	0.42	0	4.29	392.29	0.00	4007.00	4399.30
20	1	173.34	0.42	0	4.28	392.41	0.00	3998.82	4391.22
20	2	173.39	0.42	0	4.27	392.52	0.00	3990.62	4383.14
20	3	173.45	0.43	0	4.26	402.01	0.00	3982.65	4384.66
20	4	173.5	0.43	0	4.25	402.12	0.00	3974.45	4376.57

**DWS3**

NH3-N NO3-N Flow NH3-N NO3-N Total						
BAC	Reach	mg/l	mg/l	cfs	lb/day	lb/day
BAC01	1	0.05	0.18	0.23	0.06	0.22
BAC02	2	0.05	0.18	1.26	0.34	1.22
BAC03	3	0.05	0.18	0.12	0.03	0.12
BAC04	4	0.05	0.18	0.46	0.12	0.45
BAC06	5	0.05	0.18	1.30	0.35	1.26
	6	0.05	0.18	0.28	0.08	0.27
BAC07	7	0.05	0.18	1.73	0.47	1.68
BAC10	8	0.05	0.18	0.27	0.07	0.27
BAC12	9	0.05	0.18	0.14	0.04	0.13
BAC13	10	0.05	0.18	0.64	0.17	0.62
BAC14	11	0.05	0.18	0.66	0.18	0.64
BAC15	12	0.05	0.18	0.49	0.13	0.47
BAC16	13	0.05	0.18	1.48	0.40	1.44
	14	0.05	0.18	0.26	0.07	0.25
BAC17	15	0.05	0.18	0.44	0.12	0.42
BAC19	16	0.05	0.18	0.18	0.05	0.18
	17	0.05	0.18	0.22	0.06	0.21
BAC21	18	0.05	0.18	2.63	0.71	2.55
BAC22	19	0.05	0.18	0.43	0.12	0.42
BAC24	20	0.05	0.18	0.21	0.06	0.20



	Flow	NH3-N mg/l	NO3-N mg/l	NH3-N lbs/day	NO3-N lbs/day	Ntot lbs/day
Singleton Brook	1.22	0.08	0.25	0.53	1.64	2.17
Spring Brook	1.45	0.07	0.37	0.55	2.89	3.44
Cronin Brook	0.65	0.12	0.88	0.42	3.08	3.50
Quinsigamond Riv	7.64	0.08	0.10	3.29	4.12	7.41
Mumford Riv	24.98	0.07	0.01	9.42	0.67	10.10
West Riv	13.64	0.07	0.01	5.15	0.37	5.51

**DWS3**

Point Sources	Flow cfs	NO3-N mg/L	NH3-N mg/L	NO3-N lb/day	NH3-N lb/day	DIN lb/day
UBWPAD WWTF	86.6	6.1	2	2847.3214	933.548	3780.87
Millbury WWTF Grab	4.18	9.9	5	223.04898	112.651	335.70
Grafton WWTF Composite	2.46	13	5	172.3722	66.297	238.67
Uxbridge WWTF Composite	3.88	9.3	5	194.49276	104.566	299.06

**DWS3 with current permit limit established by the 1997 Blackstone River  
Dissolved Oxygen WLA (note Northbridge WWTF discharge was not included  
since sampling data indicated that the impact was negligible)**

			lb/day	both	%
BAC01	Reach 1	Headwater (BAC01)	44.24		99.35
		GW reach1	0.29		0.65
		Total amount	44.53		
BAC02	Reach 2	QUAL2E	47.76		
		loss of nitrogen	-3.23	-7.25	
		Incoming nitrogen	before	corrected	
		Headwater (BAC01)	44.24	47.47	99.04
		GW reach1	0.43	0.46	0.96
		Total amount		47.93	
		Contribution in the reach			
		UBWPAD	3780.87		
		GW reach2	1.56		
		Total amount	3830.36		
BAC03	Reach 3	QUAL2E	3810.22		
		loss of nitrogen	20.14	0.53	
		Incoming nitrogen	before	corrected	
		Headwater (BAC01)	47.47	47.22	1.24
		UBWPAD	3780.87	3760.83	98.71
		GW reach1	0.46	0.46	0.01
		GW reach2	1.56	1.55	0.04
		Total amount		3810.06	
		Contribution in the reach			
		GW reach3	0.15		
		Total amount	3810.21		
BAC04	Reach 4	QUAL2E	3808.12		
		loss of nitrogen	2.09	0.05	
		Incoming nitrogen	before	corrected	
		Headwater (BAC01)	47.22	47.19	1.24
		UBWPAD	3760.83	3758.95	98.70
		GW reach1	0.46	0.46	0.01
		GW reach2	1.55	1.55	0.04
		GW reach3	0.15	0.15	0.00
		Total amount		3808.30	
		Contribution in the reach			
		GW reach4	0.57		
		Singletary Br.	2.17		

BAC06	Reach 5/6	Total amount	3811.04		
		QUAL2E	3816.70		
		loss of nitrogen	-5.66	-0.15	
		Incoming nitrogen	before	corrected	
		Headwater (BAC01)	47.19	47.27	1.24
		UBWPAD	3758.95	3764.59	98.63
		GW reach1	0.46	0.46	0.01
		GW reach2	1.55	1.55	0.04
		GW reach3	0.15	0.15	0.00
		GW reach4	0.57	0.57	0.01
		Singletary Br.	2.17	2.17	0.06
		Total amount		3816.76	

Contribution in the reach

GW reach5	1.61
GW reach6	0.35
WWTF Millbury	335.70

BAC07	Reach 7	Total amount	4154.42		
		QUAL2E	4165.66		
		loss of nitrogen	-11.24	-0.27	
		Incoming nitrogen	before	corrected	
		Headwater (BAC01)	47.27	47.39	1.14
		UBWPAD	3764.59	3774.75	90.62
		GW reach1	0.46	0.46	0.01
		GW reach2	1.55	1.56	0.04
		GW reach3	0.15	0.15	0.00
		GW reach4	0.57	0.57	0.01
		Singletary Br.	2.17	2.18	0.05
		GW reach5	1.61	1.61	0.04
		GW reach6	0.35	0.35	0.01
		WWTF Millbury	335.70	336.61	8.08
		Total amount		4165.64	

Contribution in the reach

GW reach7	2.14
Spring Br.	3.44

BAC10	Reach 8	Total amount	4171.22		
		QUAL2E	4180.58		
		loss of nitrogen	-9.36	-0.22	
		Incoming nitrogen	before	corrected	
		Headwater (BAC01)	47.39	47.50	1.14
		UBWPAD	3774.75	3783.06	90.50
		GW reach1	0.46	0.46	0.01
		GW reach2	1.56	1.56	0.04
		GW reach3	0.15	0.15	0.00
		GW reach4	0.57	0.57	0.01
		Singletary Br.	2.18	2.18	0.05

GW reach5	1.61	1.62	0.04
GW reach6	0.35	0.35	0.01
WWTF Millbury	336.61	337.35	8.07
GW reach7	2.14	2.14	0.05
Spring Br.	3.44	3.45	0.08
Total amount		4180.40	

Contribution in the reach

GW reach8	0.34
Cronin Br.	3.50
Quinsigamond R.	7.41

Total amount 4191.65

BAC12 Reach 9

QUAL2E 4192.99

loss of nitrogen	-1.34	-0.03
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	47.50	47.51	1.13
UBWPAD	3783.06	3784.19	90.25
GW reach1	0.46	0.46	0.01
GW reach2	1.56	1.56	0.04
GW reach3	0.15	0.15	0.00
GW reach4	0.57	0.57	0.01
Singletary Br.	2.18	2.18	0.05
GW reach5	1.62	1.62	0.04
GW reach6	0.35	0.35	0.01
WWTF Millbury	337.35	337.45	8.05
GW reach7	2.14	2.15	0.05
Spring Br.	3.45	3.45	0.08
GW reach8	0.34	0.34	0.01
Cronin Br.	3.50	3.50	0.08
Quinsigamond R.	7.41	7.41	0.18
Total amount		4192.90	

Contribution in the reach

GW reach9	0.17
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Total amount 4193.07

BAC13 Reach 10

QUAL2E 4210.81

loss of nitrogen	-17.74	-0.42
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	47.51	47.71	1.13
UBWPAD	3784.19	3800.09	90.25
GW reach1	0.46	0.46	0.01
GW reach2	1.56	1.57	0.04
GW reach3	0.15	0.15	0.00
GW reach4	0.57	0.58	0.01
Singletary Br.	2.18	2.19	0.05
GW reach5	1.62	1.63	0.04
GW reach6	0.35	0.35	0.01
WWTF Millbury	337.45	338.87	8.05

GW reach7	2.15	2.15	0.05
Spring Br.	3.45	3.46	0.08
GW reach8	0.34	0.34	0.01
Cronin Br.	3.50	3.52	0.08
Quinsigamond R.	7.41	7.44	0.18
GW reach9	0.17	0.17	0.00
Total amount		4210.68	

Contribution in the reach

GW reach10	0.80
WWTF Grafton	238.67

BAC14 Reach 11

Total amount	4450.15		
QUAL2E	4432.38		
loss of nitrogen	<table border="1"><tr><td>17.77</td><td>0.40</td></tr></table>	17.77	0.40
17.77	0.40		

Incoming nitrogen	before	corrected	
Headwater (BAC01)	47.71	47.52	1.07
UBWPAD	3800.09	3784.89	85.39
GW reach1	0.46	0.46	0.01
GW reach2	1.57	1.56	0.04
GW reach3	0.15	0.15	0.00
GW reach4	0.58	0.57	0.01
Singletary Br.	2.19	2.18	0.05
GW reach5	1.63	1.62	0.04
GW reach6	0.35	0.35	0.01
WWTF Millbury	338.87	337.51	7.61
GW reach7	2.15	2.15	0.05
Spring Br.	3.46	3.45	0.08
GW reach8	0.34	0.34	0.01
Cronin Br.	3.52	3.50	0.08
Quinsigamond R.	7.44	7.41	0.17
GW reach9	0.17	0.17	0.00
GW reach10	0.80	0.80	0.02
WWTF Grafton	238.67	237.72	5.36
Total amount		4432.35	

Contribution in the reach

GW reach11	0.82
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BAC15 Reach 12

Total amount	4433.17		
QUAL2E	4416.22		
loss of nitrogen	<table border="1"><tr><td>16.95</td><td>0.38</td></tr></table>	16.95	0.38
16.95	0.38		

Incoming nitrogen	before	corrected	
Headwater (BAC01)	47.52	47.34	1.07
UBWPAD	3784.89	3770.50	85.38
GW reach1	0.46	0.46	0.01
GW reach2	1.56	1.56	0.04
GW reach3	0.15	0.15	0.00
GW reach4	0.57	0.57	0.01
Singletary Br.	2.18	2.18	0.05

GW reach5	1.62	1.61	0.04
GW reach6	0.35	0.35	0.01
WWTF Millbury	337.51	336.23	7.61
GW reach7	2.15	2.14	0.05
Spring Br.	3.45	3.44	0.08
GW reach8	0.34	0.34	0.01
Cronin Br.	3.50	3.49	0.08
Quinsigamond R.	7.41	7.39	0.17
GW reach9	0.17	0.17	0.00
GW reach10	0.80	0.79	0.02
WWTF Grafton	237.72	236.81	5.36
GW reach11	0.82	0.82	0.02
Total amount		4416.33	

Contribution in the reach

GW reach12 0.61

Total amount 4416.94

BAC16 Reach 13/14 QUAL2E 4413.67

loss of nitrogen	3.27	0.07
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	47.34	47.31	1.07
UBWPAD	3770.50	3767.86	85.36
GW reach1	0.46	0.46	0.01
GW reach2	1.56	1.55	0.04
GW reach3	0.15	0.15	0.00
GW reach4	0.57	0.57	0.01
Singleary Br.	2.18	2.18	0.05
GW reach5	1.61	1.61	0.04
GW reach6	0.35	0.35	0.01
WWTF Millbury	336.23	335.99	7.61
GW reach7	2.14	2.14	0.05
Spring Br.	3.44	3.43	0.08
GW reach8	0.34	0.34	0.01
Cronin Br.	3.49	3.49	0.08
Quinsigamond R.	7.39	7.38	0.17
GW reach9	0.17	0.17	0.00
GW reach10	0.79	0.79	0.02
WWTF Grafton	236.81	236.65	5.36
GW reach11	0.82	0.82	0.02
GW reach12	0.61	0.61	0.01
Total amount		4413.84	

Contribution in the reach

GW reach13 1.84

GW reach14 0.32

Total amount 4416.00

BAC17 Reach 15 QUAL2E 4329.32

loss of nitrogen	86.68	1.96
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	47.31	46.36	1.07
UBWPAD	3767.86	3692.51	85.32
GW reach1	0.46	0.45	0.01
GW reach2	1.55	1.52	0.04
GW reach3	0.15	0.15	0.00
GW reach4	0.57	0.56	0.01
Singletery Br.	2.18	2.13	0.05
GW reach5	1.61	1.58	0.04
GW reach6	0.35	0.34	0.01
WWTF Millbury	335.99	329.27	7.61
GW reach7	2.14	2.09	0.05
Spring Br.	3.43	3.37	0.08
GW reach8	0.34	0.33	0.01
Cronin Br.	3.49	3.42	0.08
Quinsigamond R.	7.38	7.23	0.17
GW reach9	0.17	0.17	0.00
GW reach10	0.79	0.78	0.02
WWTF Grafton	236.65	231.91	5.36
GW reach11	0.82	0.80	0.02
GW reach12	0.61	0.60	0.01
GW reach13	1.84	1.80	0.04
GW reach14	0.32	0.31	0.01
Total amount		4327.68	

Contribution in the reach

GW reach15 0.54

Total amount 4328.22

BAC19 Reach 16/17

QUAL2E 4248.25

loss of nitrogen	79.97	1.85
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	46.36	45.48	1.07
UBWPAD	3692.51	3622.35	85.31
GW reach1	0.45	0.44	0.01
GW reach2	1.52	1.49	0.04
GW reach3	0.15	0.14	0.00
GW reach4	0.56	0.55	0.01
Singletery Br.	2.13	2.09	0.05
GW reach5	1.58	1.55	0.04
GW reach6	0.34	0.34	0.01
WWTF Millbury	329.27	323.02	7.61
GW reach7	2.09	2.05	0.05
Spring Br.	3.37	3.30	0.08
GW reach8	0.33	0.33	0.01
Cronin Br.	3.42	3.35	0.08
Quinsigamond R.	7.23	7.10	0.17
GW reach9	0.17	0.16	0.00
GW reach10	0.78	0.76	0.02
WWTF Grafton	231.91	227.51	5.36
GW reach11	0.80	0.78	0.02



GW reach12	0.60	0.59	0.01
GW reach13	1.80	1.77	0.04
GW reach14	0.31	0.31	0.01
GW reach15	0.54	0.53	0.01
Total amount		4245.99	

Contribution in the reach

GW reach16	0.23
GW reach17	0.27
Mumford R.	10.10
West R.	5.51

Total amount 4262.10

BAC21 Reach 18

QUAL2E 4169.31

loss of nitrogen	92.79	2.18
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	45.48	44.48	1.07
UBWPAD	3622.35	3542.66	84.99
GW reach1	0.44	0.43	0.01
GW reach2	1.49	1.46	0.04
GW reach3	0.14	0.14	0.00
GW reach4	0.55	0.54	0.01
Singletary Br.	2.09	2.05	0.05
GW reach5	1.55	1.52	0.04
GW reach6	0.34	0.33	0.01
WWTF Millbury	323.02	315.91	7.58
GW reach7	2.05	2.01	0.05
Spring Br.	3.30	3.23	0.08
GW reach8	0.33	0.32	0.01
Cronin Br.	3.35	3.28	0.08
Quinsigamond R.	7.10	6.94	0.17
GW reach9	0.16	0.16	0.00
GW reach10	0.76	0.75	0.02
WWTF Grafton	227.51	222.50	5.34
GW reach11	0.78	0.77	0.02
GW reach12	0.59	0.57	0.01
GW reach13	1.77	1.73	0.04
GW reach14	0.31	0.30	0.01
GW reach15	0.53	0.52	0.01
GW reach16	0.23	0.22	0.01
GW reach17	0.27	0.26	0.01
Mumford R.	10.10	9.88	0.24
West R.	5.51	5.39	0.13
Total amount		4168.33	

Contribution in the reach

GW reach18	3.25
WWTF Uxbridge	299.06

Total amount 4470.64

BAC22 Reach 19

QUAL2E 4407.01

loss of nitrogen	63.63	1.42
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	44.48	43.86	0.99
UBWPAD	3542.66	3493.06	79.24
GW reach1	0.43	0.43	0.01
GW reach2	1.46	1.44	0.03
GW reach3	0.14	0.14	0.00
GW reach4	0.54	0.53	0.01
Singleary Br.	2.05	2.02	0.05
GW reach5	1.52	1.49	0.03
GW reach6	0.33	0.32	0.01
WWTF Millbury	315.91	311.49	7.07
GW reach7	2.01	1.98	0.04
Spring Br.	3.23	3.18	0.07
GW reach8	0.32	0.31	0.01
Cronin Br.	3.28	3.23	0.07
Quinsigamond R.	6.94	6.84	0.16
GW reach9	0.16	0.16	0.00
GW reach10	0.75	0.74	0.02
WWTF Grafton	222.50	219.39	4.98
GW reach11	0.77	0.76	0.02
GW reach12	0.57	0.57	0.01
GW reach13	1.73	1.71	0.04
GW reach14	0.30	0.30	0.01
GW reach15	0.52	0.51	0.01
GW reach16	0.22	0.22	0.01
GW reach17	0.26	0.26	0.01
Mumford R.	9.88	9.74	0.22
West R.	5.39	5.31	0.12
GW reach18	3.25	3.20	0.07
WWTF Uxbridge	299.06	294.87	6.69
Total amount		4408.05	

Contribution in the reach

GW reach19	0.54
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Total amount	4408.59
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BAC24 Reach 20

QUAL2E	4399.30
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loss of nitrogen	9.29	0.21
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Incoming nitrogen	before	corrected	
Headwater (BAC01)	43.86	43.76	0.99
UBWPAD	3493.06	3485.73	79.23
GW reach1	0.43	0.43	0.01
GW reach2	1.44	1.44	0.03
GW reach3	0.14	0.14	0.00
GW reach4	0.53	0.53	0.01
Singleary Br.	2.02	2.01	0.05
GW reach5	1.49	1.49	0.03
GW reach6	0.32	0.32	0.01
WWTF Millbury	311.49	310.83	7.07

GW reach7	1.98	1.98	0.04
Spring Br.	3.18	3.18	0.07
GW reach8	0.31	0.31	0.01
Cronin Br.	3.23	3.22	0.07
Quinsigamond R.	6.84	6.83	0.16
GW reach9	0.16	0.16	0.00
GW reach10	0.74	0.73	0.02
WWTF Grafton	219.39	218.93	4.98
GW reach11	0.76	0.76	0.02
GW reach12	0.57	0.56	0.01
GW reach13	1.71	1.70	0.04
GW reach14	0.30	0.30	0.01
GW reach15	0.51	0.51	0.01
GW reach16	0.22	0.22	0.01
GW reach17	0.26	0.26	0.01
Mumford R.	9.74	9.72	0.22
West R.	5.31	5.30	0.12
GW reach18	3.20	3.20	0.07
WWTF Uxbridge	294.87	294.25	6.69
GW reach19	0.54	0.54	0.01
Total amount		4399.34	
Contribution in the reach		Check (%)	100.00
GW reach20	0.26		
Total amount	4399.60		

Incoming nitrogen	before	corrected	
Headwater (BAC01)	43.86	43.76	0.99
UBWPAD	3493.06	3485.73	79.23
GW reach1	0.43	0.43	0.01
GW reach2	1.44	1.44	0.03
GW reach3	0.14	0.14	0.00
GW reach4	0.53	0.53	0.01
Singletery Br.	2.02	2.01	0.05
GW reach5	1.49	1.49	0.03
GW reach6	0.32	0.32	0.01
WWTF Millbury	311.49	310.83	7.07
GW reach7	1.98	1.98	0.04
Spring Br.	3.18	3.18	0.07
GW reach8	0.31	0.31	0.01
Cronin Br.	3.23	3.22	0.07
Quinsigamond R.	6.84	6.83	0.16
GW reach9	0.16	0.16	0.00
GW reach10	0.74	0.73	0.02
WWTF Grafton	219.39	218.93	4.98
GW reach11	0.76	0.76	0.02
GW reach12	0.57	0.56	0.01
GW reach13	1.71	1.70	0.04
GW reach14	0.30	0.30	0.01
GW reach15	0.51	0.51	0.01

GW reach16	0.22	0.22	0.01
GW reach17	0.26	0.26	0.01
Mumford R.	9.74	9.72	0.22
West R.	5.31	5.30	0.12
GW reach18	3.20	3.20	0.07
WWTF Uxbridge	294.87	294.25	6.69
GW reach19	0.54	0.54	0.01
GW reach20	0.26	0.26	0.01

Total amount 4399.60

Check (%) 100.00

SUMMARY INITIAL INPUT VERSUS CORRECTED AT THE RIVER MOUTH.

Incoming nitrogen	Input	corrected	% Contribution	% Delivered
Headwater (BAC01)	44.24	43.76	0.99	98.9%
EBWPAID	3780.87	3485.73	79.23	92.2%
GW reach1	0.43	0.43	0.01	98.9%
GW reach2	1.56	1.44	0.03	92.2%
GW reach3	0.15	0.14	0.00	92.7%
GW reach4	0.57	0.53	0.01	92.7%
Singletary Br.	2.17	2.01	0.05	92.7%
GW reach5	1.61	1.49	0.03	92.6%
GW reach6	0.35	0.32	0.01	92.6%
WWTF Millbury	335.70	310.83	7.07	92.6%
GW reach7	2.14	1.98	0.04	92.3%
Spring Br.	3.44	3.18	0.07	92.3%
GW reach8	0.34	0.31	0.01	92.1%
Cronin Br.	3.50	3.22	0.07	92.1%
Quinsigamond R.	7.41	6.83	0.16	92.1%
GW reach9	0.17	0.16	0.00	92.1%
GW reach10	0.80	0.73	0.02	91.7%
WWTF Grafton	238.67	218.93	4.98	91.7%
GW reach11	0.82	0.76	0.02	92.1%
GW reach12	0.61	0.56	0.01	92.4%
GW reach13	1.84	1.70	0.04	92.5%
GW reach14	0.32	0.30	0.01	92.5%
GW reach15	0.54	0.51	0.01	94.4%
GW reach16	0.23	0.22	0.01	96.2%
GW reach17	0.27	0.26	0.01	96.2%
Mumford R.	10.10	9.72	0.22	96.2%
West R.	5.51	5.30	0.12	96.2%
GW reach18	3.25	3.20	0.07	98.4%
WWTF Uxbridge	299.06	294.25	6.69	98.4%
GW reach19	0.54	0.54	0.01	99.8%
GW reach20	0.26	0.26	0.01	100.0%
Total amount		4399.60	100.00	

UBWPAD	79.23
WWTF Millbury	7.07
WWTF Uxbridge	6.69
WWTF Grafton	4.98
Headwater (BAC01)	0.99
Mumford R.	0.22
Quinsigamond R.	0.16
West R.	0.12
Spring Br.	0.07
Cronin Br.	0.07
Singletary Br.	0.05

UBWPAD	79.23
WWTF Millbury	7.07
WWTF Uxbridge	6.69
WWTF Grafton	4.98
Headwater (BAC01)	0.99
Mumford R.	0.22
Groundwater	0.35
Quinsigamond R.	0.16
West R.	0.12
Spring Br.	0.07
Cronin Br.	0.07
Singletery Br.	0.05