UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
1 Congress Street, Suite 1100
BOSTON, MA 02114-2023

September 28, 2006

Arleen O'Donnell, Acting Commissioner
Department of Environmental Protection
1 Winter Street
Boston, MA 02108

SUBJECT: **Approval of Kickemuit River Watershed, Freshwater Portion TMDL**

Dear Commissioner O'Donnell:

Thank you for your submission of the joint Rhode Island and Massachusetts Total Maximum Daily Load (TMDL) for the Kickemuit River Watershed, Freshwater Portion, for pathogens, excess algal growth/chlorophyll-a, turbidity, phosphorus, and taste and odor. These water bodies are included on the two States' 2004 303(d) list and were prioritized for TMDL development. The purpose of the one TMDL for a Massachusetts water is to address impairments of contact recreation and aquatic life use due to pathogens from point and nonpoint source pollution.

The U.S. Environmental Protection Agency (EPA) hereby approves Massachusetts' September 22, 2006 TMDL for the Kickemuit River Watershed Freshwater Portion, originally received by EPA on May 11, 2006, and later with revisions. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). Attached is a copy of our approval documentation.

My staff and I look forward to continued cooperation with the MA DEP in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions, please contact Stephen Silva (617-918-1561) or Michael Hill (617-918-1398) of my staff.

Sincerely,

/s/

Linda M. Murphy, Director
Office of Ecosystem Protection

cc Glenn Haas, MA DEP
Rick Dunn, MA DEP
Russ Isaac, MA DEP
Stephen Silva, EPA
Michael Hill, EPA

EPA NEW ENGLAND'S TMDL REVIEW

TMDL: **Kickemuit River, Freshwater Portions**

Kickemuit Reservoir, RI	RI0007034L-01
Upper Kickemuit River, RI	RI0007034R-01
Kickemuit River, MA	MA 61-08_2004

Location: Towns of Warren, Rhode Island, and Swansea and Rehoboth, Massachusetts

STATUS: Final

IMPAIRMENT/POLLUTANT: These three water body segments are not meeting criteria for fecal coliform concentrations (pathogens), and the reservoir segment is impaired for excess algal growth/ chlorophyll-a, phosphorus, turbidity, and taste and odor. The segments in Rhode Island are designated Class A, as a source of public drinking water supplies, contact recreation, and for fish and wildlife habitat. The Massachusetts segment is designated Class B, for habitat for fish, other aquatic life, and wildlife, and for contact recreation. A TMDL submission is presented for fecal coliform and for phosphorus. The States believe that limits on phosphorus will address the other, non-pathogen impairments.

BACKGROUND: The Rhode Island Department of Environmental Management (RI DEM) and Massachusetts Department of Environmental Protection (MA DEP) submitted to EPA New England the final Total Maximum Daily Load Analysis for the freshwater portion of the Kickemuit River watershed (the "TMDL," "submission," or "Report") with a transmittal letter dated April 13, 2006 and May 11, 2006, respectively. RI DEM addressed EPA's June 15, 2006 written comments, and submitted a revised final TMDL for both States on September 22, 2006 with some clarifications requested by EPA.

The following review explains how the TMDL submission meets the statutory and regulatory requirements of TMDLs in accordance with § 303(d) of the Clean Water Act, and EPA's implementing regulations in 40 CFR Part 130.

REVIEWERS: Steven Winnett (617-918-1687) E-mail: winnett.steven@epa.gov
Michael Hill (617-918-1398) E-mail: hill.michael@epa.gov

REVIEW ELEMENTS OF TMDLs

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. § 130 describe the statutory and regulatory requirements for approvable TMDLs. The following information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation.

1. Description of Water Body, Pollutant of Concern, Pollutant Sources and Priority Ranking

The TMDL analytical document must identify the water body as it appears on the State/Tribe's 303(d) list, the pollutant of concern and the priority ranking of the water body. The TMDL submittal must include a description of the point and nonpoint sources of the pollutant of concern, including the magnitude and location of the sources. Where it is possible to separate natural background from nonpoint sources, a description of the natural background must be provided, including the magnitude and location of the source(s). Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as: (1) the assumed distribution of land use in the watershed; (2) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources; (3) present and future growth trends, if taken into consideration in preparing the TMDL; and, (4) explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments, or chlorophyl a and phosphorus loadings for excess algae.

The freshwater portions of the Kickemuit River watershed are located in the Towns of Warren, Rhode Island, and Swansea and Rehoboth, Massachusetts. The Report describes the pollutants of concern. For the Kickemuit Reservoir, the pollutants are pathogens, excess algal growth/chlorophyll-a, phosphorus, turbidity, and taste and odor. For the Upper Kickemuit River in Rhode Island and the Kickemuit River in Massachusetts, the pollutant is pathogens. The Report lists the water bodies as they appear on the States' 2004 303(d) list (TMDL p.2), and explains that these waters are a high priority for TMDL development (TMDL p.2). The document also describes the TMDL study area and its land uses (TMDL pp. 7-9).

The submission includes a detailed discussion of the point and nonpoint sources that contribute to the water quality impairments (TMDL pp. 18-26), as well as in-depth discussions of the water monitoring and data that indicate the condition of the water bodies (TMDL pp. 10-17). The major sources of pollution to the watershed include stormwater outfalls, failing septic systems, agricultural activities, waterfowl, wildlife, and pets, and piped input from Shad Factory Reservoir (a source of water supply).

Assessment: RI DEM and MA DEP have adequately identified the water bodies, the pollutants of concern, the magnitude and location of the sources of pollution.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribe water quality standard, including the designated use(s) of the water body, the applicable numeric or narrative water quality criterion, and the antidegradation policy. Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. A numeric water quality target for the TMDL (a quantitative value used to measure whether or not the applicable water quality standard is attained) must be identified. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, usually site specific, must be developed from a narrative criterion and a description of the process used to derive the target must be included in the submittal.

The numeric water quality targets are set for all waters at the appropriate numeric water quality standards for bacteria and for phosphorus. For the Rhode Island segments, the applicable water quality standards are for Class A, with special designations for water supply. These water bodies are designated as a source of public water supply, for contact recreation, and for fish and wildlife habitat. Rhode Island's fecal coliform water quality standard for Class A waters is a geometric mean value of 20 fc/100 ml, with not more than 10% of the samples exceeding a value of 200 fc/100 ml. The State has both a numeric and narrative standard for phosphorus, which includes that average total phosphorus shall not exceed 0.025 mg/l (25.0 ug/l).

For the Massachusetts segment, the applicable water quality standards are for Class B. These waters are designated as habitat for fish, other aquatic life, and wildlife, contact recreation, and as a source of water supply with treatment. Massachusetts' fecal coliform water quality standard for Class B is a geometric value of 200 fc/100 ml, with not more than 10% of the samples exceeding a value of 400 fc/100 ml. At the point at which the river enters Rhode Island, it must meet Rhode Island's Class A criteria. The State has no numeric standard for phosphorus, but has narrative standards for aesthetics and nutrients that are applicable to all waters (TMDL pp. 4-7). Massachusetts is using a numeric target of 22.5 ug/l for phosphorus to meet the downstream standards, as the river must meet Rhode Island standards at the point it enters that state.

Assessment: EPA New England concludes that RI DEM and MA DEP have properly presented their water quality standards when setting a numeric water quality target.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

As described in EPA guidance, a TMDL identifies the loading capacity of a water body for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a water can receive without violating water quality standards (40 C.F.R. § 130.2(f)). The loadings are required to be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. § 130.2(i)). The TMDL submittal must identify the water body's loading capacity for the applicable pollutant and describe the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In most instances, this method will be a water quality model. Supporting documentation for the TMDL analysis must also be contained in the submittal, including the basis for assumptions, strengths and weaknesses in the analytical process, results from water quality modeling, etc. Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation.

In many circumstances, a critical condition must be described and related to physical conditions in the water body as part of the analysis of loading capacity (40 C.F.R. § 130.7(c)(1)). The critical condition can be thought of as the "worst case" scenario of environmental conditions in the water body in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards.

RI DEM and MA DEP set the numeric water quality targets at the applicable water quality criteria or standard for each of the segments in the TMDL study area, depending on each water segment's classification, as outlined in the TMDL report.

The States describe the rationale for the methods used to establish the cause-and-effect relationship between the numeric targets (WQS) and the identified pollutant sources. For fecal coliform, they set a reduction goal for each impaired water body area or segment (as a whole) by comparing current fecal coliform concentrations to the applicable water quality target, then calculate the percent reduction required to reach that target (Table 4.1, p. 33). The water quality standards specify both geometric mean and 90^{th} percentile criteria, and they use the higher percent reduction to set each segment's necessary percent reduction. The States treat phosphorus similarly, although it does not have both geometric mean and 90^{th} percentile criteria (Table 4.2, Total Phosphorus Allocation by Season; and Table 4.3, Sample Spring Phosphorus WLA/LA by Segment; pp. 36-37). They provide a discussion of the strengths and weakness in the analytical process for linking water quality to sources of pollutants (TMDL p. 37).

The bacteria concentrations are considered to apply daily, in that daily values are used in calculation of geomeans, % variability, and daily percentage reduction targets. The allowable daily load is the criteria concentration times the daily flow in the receiving water. For phosphorus, the daily load is the seasonal load divided by the number of days in the season.

Assessment*:* EPA New England concludes that the loading capacities, having been set equal to the WQSs, have been appropriately set at levels necessary to attain and maintain applicable water quality standards. The TMDL is based on a reasonable approach for establishing the relationship between pollutant loading and water quality.

EPA New England also concurs with expressing the bacteria TMDLs as concentrations in lieu of mass-per time because these units are the same as the state water quality standards. In addition, concentration is mathematically related to per time loading (concentration multiplied by stormwater flow volume per time results in mass per time).

EPA's regulations at 40 C.F.R. §130.7(c)(1) require that TMDLs identify water quality targets that are consistent with all applicable water quality standards. EPA New England has accepted the percent reduction approach for bacteria and phosphorus TMDLs in some rivers and streams under an assumption that the reductions needed to meet applicable water quality standards (WQS) at ambient stations are representative of the reductions needed to meet the applicable standards throughout the water body.

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity allocated to existing and future nonpoint sources and to natural background (40 C.F.R. § 130.2(g)). Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. § 130.2(g)). Where it is possible to separate natural background from nonpoint sources, load allocations should be described separately for background and for nonpoint sources.

If the TMDL concludes that there are no nonpoint sources and/or natural background, or the TMDL recommends a zero load allocation, the LA must be expressed as zero. If the TMDL recommends a zero LA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero LA implies an allocation only to point sources will result in attainment of the applicable water quality standard, and all nonpoint and background sources will be removed.

The submission contains a load allocation (LA) for each segment (or tributary station) not meeting standards that is expressed as the percent reduction required to meet the applicable water quality criteria (please see the Appendix for the specific allocations). The runoff from NPDES regulated stormwater sources is considered the wasteload allocation (WLA–see Section 5, below). The LA is the remaining stormwater runoff (not associated with Phase 2 permitted sources of stormwater), plus other nonpoint, or diffuse sources of pollution (calculated as 100% minus the WLA).

Assessment: EPA New England concludes that load allocations are adequately specified in the TMDLs.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to existing and future point sources (40 C.F.R. § 130.2(h)). If no point sources are present or if the TMDL recommends a zero WLA for point sources, the WLA must be expressed as zero. If the TMDL recommends a zero WLA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero WLA implies an allocation only to nonpoint sources and background will result in attainment of the applicable water quality standard, and all point sources will be removed.

In preparing the wasteload allocations, it is not necessary that each individual point source be assigned a portion of the allocation of pollutant loading capacity. When the source is a minor discharger of the pollutant of concern or if the source is contained within an aggregated general permit, an aggregated WLA can be assigned to the group of facilities. But it is necessary to allocate the loading capacity among individual point sources as necessary to meet the water quality standard.

The TMDL submittal should also discuss whether a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur. In such cases, the State/Tribe will need to demonstrate reasonable assurance that the nonpoint source reductions will occur within a reasonable time.

The submission contains a waste load allocation (WLA) that is expressed as the percent reduction required to meet the applicable water quality criteria (please see the Appendix for the specific allocations). There are no permitted, wastewater point sources in the TMDL study area. However, because the study area is in Phase 2 regulated MS4 communities, sources of

stormwater from developed areas which contribute to runoff through identified culverts, pipes, or other conveyances are therefore NPDES-permitted point sources. Consequently, the submission contains wasteload allocations (WLA) for the stormwater runoff from those permitted sources.

The WLA is expressed as the percent reduction required for the water bodies to meet the water quality standards. Because of the difficulties of determining the relative amount of point source and nonpoint source runoff, the WLA for these TMDLs is set by estimating the percentage of the watershed that would be expected to contribute to the point source loading. This is done by making the relative contribution of point sources to the required load reduction equal to the percent impervious cover of the area discharging to the location (TMDL Tables 4.1-4.3). This approach recognizes that stormwater from impervious cover is more likely to be collected and conveyed to the receiving water by stormwater collection systems than non-impervious areas. EPA notes that the contributing area for pathogens and phosphorus are defined differently, so the contributions are not necessarily the same for the pollutants and their allocations (TMDL Figures 4-1 and 4-2).

Assessment: The WLA is based on the amount of developed land that would contribute to the stormwater runoff in these water bodies. Using the percent impervious cover of the contributing watershed areas is a reasonable way to estimate the percent of the total load to that location attributable to NPDES permitted, stormwater point sources. EPA New England concludes that the WLAs for this submission are acceptable and reasonable.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1)). EPA guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

The States identify the following conservative assumption as providing an implicit margin of safety in the TMDLs for pathogens:

- For bacteria, existing conditions are calculated from a data set that has more wet than dry surveys thus weighing the results disproportionably towards wet weather conditions which exhibit significantly higher fecal coliform concentrations than during dry weather. As the existing conditions, as defined, exhibit higher concentrations of fecal coliform bacteria, greater reductions are necessary to meet standards.

- The TMDL allocations are developed to meet the bacteria criteria during critical conditions when fecal coliform concentrations are typically higher, thus resulting in an implicit margin of safety at all other times.

- No allowances were made for either bacterial decay or losses due to settling, resulting in a more conservative assumption of existing conditions.

- In some areas, a water body segment with higher allowable fecal coliform bacteria limits discharges to a water body with more stringent criteria. In these places, such as at the border of the two States, the numeric water quality target is set to the more strict criteria of the two standards (in this case, Rhode Island's) at the point of discharge.

For phosphorus, an explicit MOS of 10% is included in the TMDL for loads, with the exception of direct inputs from the watershed and the loss to sediments in the upper reservoir.

Assessment: EPA New England concurs that an adequate MOS is provided by the conservative assumptions made in setting the TMDL target and in assigning load and wasteload allocations, including weighting the generally higher bacteria levels occurring during wet weather conditions more heavily in setting the TMDL targets for bacteria reductions. Also an adequate MOS is provided by the explicit 10% MOS for phosphorus.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The method chosen for including seasonal variations in the TMDL must be described CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1).

This TMDL addresses seasonal variation because the required reductions for pathogens were calculated for the conditions during the critical season for contact use. Therefore, the TMDL allocations protect designated uses during the entire year. For phosphorus, the TMDL Table 4.2 contains season-specific TMDLs.

Assessment: EPA New England concludes that seasonal variations have been adequately accounted. For pathogens, the TMDLs were developed to be protective during the critical periods for that pollutant, and will therefore be more than adequately protective during the other seasons. For phosphorus, specific seasonal loads are presented (Table 4.2).

8. Monitoring Plan for TMDLs Developed Under the Phased Approach

EPA's 1991 document, Guidance for Water Quality-Based Decisions: The TMDL Process (EPA 440/4-91-001), recommends a monitoring plan when a TMDL is developed under the phased approach. The guidance recommends that a TMDL developed under the phased approach also should provide assurances that nonpoint source controls will achieve expected load reductions. The phased approach is appropriate when a TMDL involves both point and nonpoint sources and the point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur. EPA's guidance provides that a TMDL developed under the phased approach should include a monitoring plan that describes the additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of water quality standards.

This TMDL proposes additional monitoring to ensure that water quality improvement activities are adjusted as monitoring indicates changes in the water quality of the impaired segments. The States discuss their monitoring plan in the TMDL report (TMDL p. 50).

Assessment: Addressed, though not required.

9. Implementation Plans

On August 8, 1997, Bob Perciasepe (EPA Assistant Administrator for the Office of Water) issued a memorandum, "New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs)," that directs Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired solely or primarily by nonpoint sources. To this end, the memorandum asks that Regions assist States/Tribes in developing implementation plans that include reasonable assurances that the nonpoint source load allocations established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. The memorandum also includes a discussion of renewed focus on the public participation process and recognition of other relevant watershed management processes used in the TMDL process. Although implementation plans are not approved by EPA, they help establish the basis for EPA's approval of TMDLs.

A detailed implementation plan is provided in the submission (TMDL pp. 40-48) which specifically addresses the major identified sources of pollution. The plan recommends use of several types of corrective actions, including measures to reduce agricultural runoff, stormwater runoff to the area from identifiable (regulated) point and nonpoint sources, improving septic system performance, and the control of other nonpoint source runoff, especially that from wildlife and waterfowl, and pets. The TMDL proposes an adaptive management approach to implementation, with adjustments as necessary, to ensure that WQSs are met.

Assessment: Addressed, though not required.

10. Reasonable Assurances

EPA guidance calls for reasonable assurances when TMDLs are developed for waters impaired by both point and nonpoint sources. In a water impaired by both point and nonpoint sources, where a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur, reasonable assurance that the nonpoint source reductions will happen must be explained in order for the TMDL to be approvable. This information is necessary for EPA to determine that the load and wasteload allocations will achieve water quality standards.

In a water body impaired solely by nonpoint sources, reasonable assurances that load reductions will be achieved are not required in order for a TMDL to be approvable. However, for such nonpoint source-only waters, States/Tribes are strongly encouraged to provide reasonable assurances regarding achievement of load allocations in the implementation plans described in section 9, above. As described in the August 8, 1997 Perciasepe memorandum, such reasonable assurances should be included in State/Tribe implementation plans and "may be non-regulatory, regulatory, or incentive-based, consistent with applicable laws and programs."

Reasonable assurance is not required because point sources are not given less stringent wasteload allocations based on the assumption of future nonpoint source load reductions.

Assessment: Not required.

11. Public Participation

EPA policy is that there must be full and meaningful public participation in the TMDL development process. Each State/Tribe must, therefore, provide for public participation consistent with its own continuing planning process and public participation requirements (40 C.F.R. § 130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval must describe the State/Tribe's public participation process, including a summary of significant comments and the State/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. § 130.7(d)(2)).

Inadequate public participation could be a basis for disapproving a TMDL; however, where EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

RI DEM and MA DEP provided a 30-day comment period to stakeholders to provide written comments to the agencies. Public meetings were held on January 9, 2006 in Warren, RI, and on January 11, 2006 in Swansea, MA. Approximately 40 people attended the first meeting, including residents, Senators and Representatives of the RI General Assembly, and representatives of state, federal and local governments. The agencies received several comment letters during the comment period, and addressed many verbal comments at the public meetings. The TMDL submission includes copies of all submitted comments and the Departments' responses as an attachment to the final TMDL submission.

Assessment: EPA New England has reviewed all comments and the agencies' responses to comments. EPA concludes that RI DEM and MA DEP involved the public during the development of the TMDL for the *Kickemuit River, Freshwater Portion*, has provided adequate opportunities for the public to comment on the TMDL, and has provided reasonable responses to the comments received.

12. Submittal Letter

A submittal letter should be included with the TMDL analytical document, and should specify whether the TMDL is being submitted for a technical review or is a final submittal. Each final TMDL submitted to EPA must be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final submittal, should contain such information as the name and location of the water body, the pollutant(s) of concern, and the priority ranking of the water body.

Comment: A letter with appropriate information was included with the final submission.

APPENDIX
(Tables reprinted from the submitted TMDL by permission of RI DEM and MA DEP)

Table 4.1 Fecal Coliform TMDL expressed as % Reduction to meet Concentration Targets

Segment Name	Station ID	Target Geomean MPN/ 100ml	Observed Geomean	Target 90th percentile	Observed 90th percentile	Required Reduction %	**Percent load reduction via WLA (%)**	**Percent load reduction via LA (%)**
Reach 1: Kickemuit River @ Warren Reservoir Outlet	K7	200	7	400	25	**0%** Meets MA WQS	N/A	N/A
Reach 2: Kickemuit River – Upper MA	K6	200	976	400	**3770**	**89.4%**	19	81
Reach 3: Kickemuit River - Lower MA	K5	20	**2785**	200	15000	**99.3%**	42	58
Reach 4c: Heath Brook @ MA / RI Border	K9 K3A	20	2180	200	**44100**	**99.5%**	25	75
Reach 4b: Upper Kickemuit River (Western Tributary)	K3	20	**4899**	200	12500	**99.6%**	19	81
Reach 4a: Upper Kickemuit Reservoir	K4	20	134	200	**2300**	**91.3%**	34	66
Reach 5: Upper Reach Lower Kickemuit Reservoir	K2	20	**59**	200	396	**66.1%**	19	81
Reach 6: Lower Reach Lower Kickemuit Reservoir	K1	20	**84**	200	780	**76.2%**	55	45

Table 4.2 Total Phosphorus load allocations

Waterbody Segment	Season	Flow Millions M^3 From Model Data	Existing TP Load (KG) (BES,2002)	Allowable TP Load (KG)	TMDL (KG)	Percent Reduction	MOS
Sources to Reach 4a:							
Kickemuit River (Including Heath Brook and unnamed tributary)	winter	3.03	107.09	75.75	68.18	36%	10%
	spring	1.81	87.48	45.25	40.73	53%	10%
	summer	0.52	43.81	13.00	11.70	73%	10%
	fall	0.94	64.64	23.50	21.15	67%	10%
	annual	6.30	303.02	157.50	**141.75**	53%	10%
Upper Kickemuit River (Western Tributary)	winter	0.42	21.85	10.50	9.45	57%	10%
	spring	0.25	14.96	6.25	5.63	62%	10%
	summer	0.05	4.88	1.25	1.13	77%	10%
	fall	0.13	10.02	3.25	2.93	71%	10%
	annual	0.85	51.71	21.25	**19.13**	63%	10%
Direct Inputs from Watershed	winter	0.43	20.93	20.93	20.93	0%	
	spring	0.26	12.90	12.90	12.90	0%	
	summer	0.06	4.59	4.59	4.59	0%	N/A
	fall	0.12	11.75	11.75	11.75	0%	
	annual	0.87	50.17	50.17	**50.17**	0%	
Loss to Sediments Upper Kickemuit Reservoir	winter	N/A	-3.18		-3.18		
	spring	N/A	-6.55		-6.55		
	summer	N/A	-13.16		-13.16		N/A
	fall	N/A	-8.90		-8.90		
	annual	N/A	-31.79		**-31.79**		
Reach 4a: Upper Kickemuit Reservoir	winter	3.88	149.87	97.00	95.38	36%	
	spring	2.32	115.34	58.00	52.70	54%	
	summer	0.63	53.28	15.75	4.26	92%	
	fall	1.19	86.41	29.75	26.93	69%	
	annual	8.02	404.90	200.50	**179.26**	56%	11%
Sources to Reaches 5 and 6:							
Contribution of Upper Kickemuit Reservoir to Lower Kickemuit Reservoir (Total load minus sink)	winter	N/A	146.69		95.38	35%	
	spring	N/A	108.79		52.70	52%	
	summer	N/A	40.12		4.26	89%	
	fall	N/A	77.51		26.93	65%	
	annual	N/A	373.11		**179.26**	52%	
Direct Inputs from Watershed (Including stormdrains)	winter	0.24	12.67		8.87	30%	
	spring	0.14	6.15		4.31	30%	
	summer	0.05	2.67		1.87	30%	
	fall	0.07	7.44		5.21	30%	
	annual	0.50	28.93		**20.25**	30%	
Shad Factory Pipe	winter	0.24	7.99		5.59	30%	
	spring	0.34	23.02		16.11	30%	
	summer	0.70	37.97		26.58	30%	
	fall	0.49	16.37		11.46	30%	
	annual	1.77	85.35		**59.75**	30%	
	winter	N/A	-9.97		-9.97		

Table 4.3 Phosphorus TMDL expressed as Allowable Load and % Load Reduction

Segment Name	Station ID	Receiving reach	Allowable Load (KG)	WL + LA Load reduction (%)	Percent load reduction via WLA (%)	Percent load reduction via LA (%)	MOS %
Reach 3: Kickemuit River	K5	4a	157.5	53	29	71	10
Reach 4b: Upper Kickemuit River	K3	4a	21.25	63	19	81	10
Direct inputs (source)	n/a	5 and 6	20.25	30	37	63	0
Shad Factory Pipe (source)	K10	6	59.75	30	100	0	0

Data for entry in EPA's National TMDL Tracking System and the R1 TMDL website

MASSACHUSETTS

TMDL Name	**Kickemuit River, Freshwater Portion**
Number of TMDLs*	1
Lead State	Massachusetts (MA)
TMDL Status	Final
Pollutant ID	41 (Pathogens)
TMDL End Points/ Water body codes and names	Class B (200 fecal coliform/100 ml: 400 fecal coliform/100 ml): Kickemuit River MA 61-08_2004
TMDL Type	Point & Nonpoint Source
List ID (from system)	See above
Impairment ID (from system)	Contact Recreation, Aquatic Life and Wildlife Use
Cycle (list date)	2004
Establishment Date (approval)	September 28, 2006
EPA Developed	No
Towns affected*	Swansea and Rehoboth, MA