November 4, 2002

Christopher Recchia, Commissioner
Vermont Department of Environmental Conservation
103 South Main St. 1 S
Waterbury VT 05671-0401

SUBJECT: **Notification of Approval of the Lake Champlain Phosphorus TMDL**

Dear Mr. Recchia:

Thank you for your final submittal of the Lake Champlain Phosphorus TMDL. The nine lake segments included in the Vermont portion of the TMDL are listed on Vermont's 2000 §303(d) list as high priorities for TMDL development.

The U.S. Environmental Protection Agency (EPA) hereby approves the Vermont portion of the September 25, 2002 Lake Champlain Phosphorus TMDL. EPA has determined that the TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). Enclosed is a copy of our approval documentation.

The completion of this TMDL represents an important milestone in Vermont's phosphorus management strategy for Lake Champlain, and I commend you and your staff for your hard work and perseverance on this challenging project.

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

Sincerely,

Linda M. Murphy, Director
Office of Ecosystem Protection

Enclosure

cc: Wally McLean, Eric Smeltzer, VT DEC
Rosella O'Connor, EPA Region 2
Lee Schroer, Hazel Groman, Donald Brady, EPA HQ

EPA NEW ENGLAND'S REVIEW OF THE VERMONT PORTION OF LAKE CHAMPLAIN PHOSPHORUS TMDL

TMDL: Vermont Portion of Lake Champlain (nine segments)

Waterbody IDs:VT04-01L01 Otter Creek, VT05-04L01 Northeast Arm, VT04-01L02 Port Henry, VT05-07L01 St. Albans Bay, VT04-02L01 South Lake A, VT05-10L02 Main Lake, VT04-02L01 South Lake B, VT05-11L01 Shelburne Bay, VT05-01L01 Missisquoi Bay

Counties: Franklin, Chittenden, Grand Isle, Addison and Rutland Counties, Vermont

STATUS: **Final**

DATE: October 30, 2002

IMPAIRMENT/POLLUTANT: Phosphorus enrichment. The TMDL is for total phosphorus.

BACKGROUND: The Vermont Department of Environmental Conservation (VTDEC) submitted to EPA New England several draft versions of the Lake Champlain Phosphorus TMDL prior to submitting the final TMDL and cover letter on September 25, 2002. The drafts and EPA comment letters on the drafts are listed below. The final TMDL was prepared jointly by VTDEC and New York State Department of Environmental Conservation (NYSDEC), however this review covers only the Vermont portion of the TMDL. The New York portion of the TMDL was reviewed and approved by EPA Region 2 (in coordination with EPA New England) via a separate letter to NYSDEC dated September 30, 2002. The TMDL is supported by a variety of separate studies, including especially the VTDEC and NYSDEC 1997 report titled "A phosphorus budget, model, and load reduction strategy for Lake Champlain," which provides the primary technical basis for the TMDL.

EPA's administrative record file includes, among others, the following documents:

- Working Draft Lake Champlain Phosphorus TMDL (Vermont portion), March 14, 2001, prepared by VTDEC.
- Memorandum containing preliminary EPA comments on the March 14, 2001 working draft TMDL (Eric Perkins, EPA to Eric Smeltzer, VT DEC, dated April 4, 2001, sent via email).
- June 22, 2001 draft Lake Champlain Phosphorus TMDL (Vermont portion), prepared by VTDEC and released for public comment.
- March 15, 2002 Lake Champlain Phosphorus TMDL draft for internal review (combined Vermont and New York portions), prepared by VTDEC and NYSDEC.
- EPA comment letter on March 15, 2002 draft TMDL cited above (Mario Del Vicario and Gerald Potamis, EPA to Richard Draper, NYSDEC and Thomas Willard, VTDEC, dated April 8,

2002).
- April 29, 2002 Lake Champlain Phosphorus TMDL draft for public comment (combined Vermont and New York portions), VTDEC and NYSDEC
- Public comments received by VTDEC on the April 29, 2002 draft Lake Champlain TMDL, transmitted via letter from Eric Smeltzer, VTDEC to Eric Perkins, EPA, dated July 12, 2002.
- EPA region 1 comments on April 29, 2002 draft Lake Champlain TMDL (email from Eric Perkins, EPA to Eric Smeltzer, VTDEC, dated August 8, 2002).
- EPA Region 2 letter of approval of the New York portion of the Lake Champlain Phosphorus TMDL (from Jane Kenny, EPA to Erin Crotty, NYSDEC, dated September 30, 2002).
- VTDEC's response to public comments on the April 29, 2002 draft Lake Champlain Phosphorus TMDL, transmitted via letter from Eric Smeltzer, VTDEC, to Linda Murphy, EPA, dated October 10, 2002.
- Lake Champlain Management Conference's 1996 plan "Opportunities for action: An evolving plan for the future of the Lake Champlain Basin. Pollution prevention, control, and restoration plan." Lake Champlain Basin Program. Grand Isle, VT.
- VTDEC and NYSDEC's 1997 report "A phosphorus budget, model, and load reduction strategy for Lake Champlain. Lake Champlain Diagnostic-Feasibility Study final report." Waterbury, VT and Albany, NY.

The following review explains how the TMDL submission meets the statutory and regulatory requirements for TMDLs in accordance with Section 303(d) of the Clean Water Act and 40 CFR Part 130.

TMDL REVIEW ELEMENTS

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 Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL analytical document must identify the waterbody as it appears on the State's /Tribe's 303(d) list, the pollutant of concern and the priority ranking of the waterbody. 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) an 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.

A. Description of Waterbody and Background Information

Lake Champlain is shared by the States of Vermont and New York and the Province of Quebec. The Lake is 120 miles long, with a surface area of 435 square miles and a maximum depth of 400 feet. The watershed is roughly 8,234 square miles and drains nearly half the land area of Vermont.

A Comprehensive Pollution Prevention, Control, and Restoration Plan for Lake Champlain (titled "Opportunities for Action") was prepared by the Lake Champlain Management Conference (1996) under the auspices of the Lake Champlain Special Designation Act of 1990. This plan described the phosphorus problem in Lake Champlain and identified the need to reduce phosphorus in targeted watersheds of the Lake as one of the top three priorities for action. The plan established a goal to "reduce phosphorus inputs to Lake Champlain to promote a healthy and diverse ecosystem for sustainable human use and enjoyment of the lake." The plan endorsed a phosphorus management process involving the establishment of numeric, in-Lake total phosphorus concentration criteria, and the assignment of watershed-based phosphorus loading targets designed to achieve the in-Lake criteria over a time period of 20 years. The 1996 Lake Champlain Management Conference plan was approved by the Governors of Vermont and New York and the USEPA Regional Administrators from Regions 1 and 2. The Government of Quebec also agreed, through a 1996 renewal of a Memorandum of Understanding on Environmental Cooperation on the Management of Lake Champlain, to participate in cooperative actions guided by the recommendations in the Management Conference plan. The Management Conference plan provides the initial framework for the Lake Champlain Phosphorus TMDL.

B. Pollutant of Concern

The pollutant of concern, for which the TMDL is being approved, is phosphorus. Lake Champlain is divided into 13 segments for phosphorus management purposes (Figure 1 of TMDL document). Total phosphorus concentrations vary among the Lake segments. Lake segments such as Malletts Bay and the Main Lake have phosphorus levels in the low-mesotrophic range of 0.009-0.012 milligrams per liter (mg/l). Eutrophic conditions exist in the South Lake, St. Albans Bay, and Missisquoi Bay segments where mean phosphorus concentrations are in the range of 0.024-0.058 mg/l.

C. Pollutant Sources

Phosphorus enters Lake Champlain from multiple point and nonpoint sources in Vermont, New York, and Quebec. A total phosphorus budget, annual mass balance model, and load allocation strategy was developed by the Lake Champlain Diagnostic-Feasibility Study (Vermont Department of Environmental Conservation (DEC) and New York State DEC, 1997).

Phosphorus sources to Lake Champlain were measured by an extensive field sampling program conducted during 1990-1992. The study assessed all significant phosphorus sources to the Lake, including loading from 31 major tributaries, 88 wastewater treatment plant discharges, ungaged areas, and direct precipitation. The loading data were used to identify and rank the major sources, and to support the development of a phosphorus mass balance model for Lake Champlain.

The total phosphorus load to Lake Champlain from all sources was estimated to be 647 metric tons per year (mt/yr) during the 1991 hydrologic base year. As shown in Figure 2 of the TMDL submittal, wastewater point sources in Vermont, New York, and Quebec accounted for 29% of the total load in 1991, with the remainder coming from cultural and natural nonpoint sources and stormwater. It is estimated that 56% of the nonpoint source load to Lake Champlain is derived from agricultural land and 7% from forested land. An additional 37% of the load comes from urban or developed land, and includes both point source and nonpoint source stormwater. Detailed information on phosphorus loads contributed by individual tributaries, wastewater discharges, and other sources can be found in the Lake Champlain Diagnostic-Feasibility Study (1997). A summary of the 1991 base year loads is given in Table 1 of the TMDL document.

D. Priority Ranking

Lake Champlain was given a high priority ranking on the Vermont Year 2000 303(d) List, with TMDL completion scheduled for 2001. Lake Champlain includes the following nine lake segments listed on the Vermont Year 2000 List of Waters as "impaired waters," due to phosphorus pollution: VT04-01L01 Otter Creek, VT05-04L01 Northeast Arm, VT04-01L02 Port Henry, VT05-07L01 St. Albans Bay, VT04-02L01 South Lake A, VT05-10L02 Main Lake, VT04-02L01 South Lake B, VT05-11L01 Shelburne Bay, VT05-01L01 Missisquoi Bay.

Assessment: EPA finds that the TMDL meets the requirements for describing the waterbody, pollutant of concern, pollutant sources, and priority ranking.

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 waterbody, 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.

Numeric, in-lake total phosphorus concentration criteria for each segment of Lake Champlain were incorporated into the Vermont Water Quality Standards in 1991 following a public rule-making process. EPA approved Vermont Water Quality Standards containing these criteria in

1996 and 1999. The criteria were derived, in part, from a lake user survey analysis of the relationship between aesthetic values and uses and total phosphorus concentrations. Based on a 1993 report of the Lake Champlain Phosphorus Management Task Force, these criteria were endorsed, with the addition of the Cumberland Bay segment in New York and a modification for the South Lake B segment, as a set of consistent phosphorus management goals for the lake in a New York, Quebec, and Vermont Water Quality Agreement. The 1993 Water Quality Agreement established in-lake total phosphorus concentration goals ranging from 0.010-0.025 mg/l for 13 segments of Lake Champlain, as listed in Table 2 of the TMDL.

Vermont's Water Quality Standards state that the phosphorus criteria "shall be achieved as the annual mean total phosphorus concentration...of each lake segment." Lake samples obtained during the open-water season (April-November) were used to estimate annual mean phosphorus concentrations, and to support a modeling analysis that established phosphorus loading targets consistent with attaining the in-lake criteria as annual mean values.

Assessment: EPA concludes that the TMDL adequately describes the applicable water quality standard, including the designated uses, and numeric water quality criteria for phosphorus.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody 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 waterbody'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 waterbody 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 waterbody 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.

A. Loading Capacity

The loading capacity for each segment is shown in Table 3 of the TMDL document. The total loading capacity for the Vermont segments (including Missisquoi Bay which is partly in Quebec) is 307.3 mt/yr of phosphorus. The baseline (existing load) for the Vermont/Quebec segments is 480.4 mt/yr. For comparison purposes, the total loading capacity for the Lake, including New York segments, is 427.1 mt/yr.

B. Cause-and-Effect Relationship between Numeric Target and Pollutant

A phosphorus mass balance model for Lake Champlain was developed through the Lake Champlain Diagnostic-Feasibility Study (Vermont DEC and New York State DEC, 1997). This model considered the circulation patterns within the Lake, and established a predictive link between the in-Lake total phosphorus concentrations and the phosphorus loading from each Lake segment watershed.

The Lake Champlain phosphorus model was based on a modified version of the U.S. Army Corps of Engineers BATHTUB program. The model used an annual steady-state approach with spatial segmentation that accounted for diffusive exchange mixing and advective transport of water and phosphorus between 13 Lake segments. The model was used to analyze alternative combinations of load reductions from each Lake segment watershed in Vermont, Quebec, and New York, and to predict the load reductions required to attain the in-Lake phosphorus criteria in each Lake segment.

The model was successfully calibrated using chloride and total phosphorus concentrations from a two-year data set (1990-1992).

C. Critical Condition(s)

The TMDL is targeted to meet the water quality criteria, expressed as annual mean values. Therefore, the TMDL is expressed as annual loadings of phosphorus. Although critical conditions occur during the summer season in some Lake segments when algae growth is more likely to interfere with uses, water quality in Lake Champlain is generally not sensitive to daily or short term loading. As described in the "Annual Loads and Seasonal Variation" section of the TMDL document, the Lake has a residence time of about two years and generally responds to loadings that occur over longer time periods such as a year. This analysis is consistent with EPA guidance (EPA 440/4-90-006, p. 71, 73), specifically, "Eutrophication models are geared to predicting average water quality conditions over a growing season or year" (p.73). Since lakes store nutrients in their water columns and bottom sediments, water quality responses are related to the total nutrient loading that occurs over a year or growing season. Because the water quality standards (as annual mean values) are set at levels that take into account critical summer growth conditions, the annual loading capacity is protective under these critical conditions.

Assessment: EPA concludes that the water quality model used to develop the TMDL has been adequately documented and calibrated and that the loading capacity has been properly identified.

EPA also concludes that the critical condition has been appropriately described and applied in the data and modeling analyses, and, subsequently, in development of the TMDL.

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 TMDL document provides LAs by land use category for each of the nine segments in the Vermont portion of the Lake (see Table 10 of the TMDL document). The total load allocation for nonpoint sources is 118.6 mt/yr. This allocation includes phosphorus from agricultural and forested land use categories, and the "other load allocation" category for Missisquoi Bay which includes phosphorus from streambank erosion -- an especially important source in Missisquoi Bay. (Loads from streambank erosion in other segments are generally captured in the developed land or agricultural load categories.) The load from nonpoint sources within the developed land category is included in the wasteload allocation for reasons described in Section 5, below.

Total nonpoint source load allocations for each Vermont lake segment watershed were calculated by subtracting the wasteload allocations for wastewater discharges in each watershed (TMDL Table 6) from the TMDL total loading capacities (TMDL table 3). Developed land phosphorus sources were treated as nonpoint sources in this section for the purpose of deriving load allocations for the other land use categories (forest and agriculture). However, developed land sources (which include a mixture of point and nonpoint sources) were ultimately placed on the wasteload allocation side of the TMDL, based on the considerations and requirements discussed in the Vermont Wasteload Allocation section of the TMDL and in Section 5, below.

The basis for subdividing the load allocation into individual land use categories was as follows. Phosphorus loads allocated to forest land (including natural background) were held at their 1991 baseline levels. Loads allocated to agricultural and developed lands were reduced by equal proportions from their 1991 baseline levels to meet the total load allocation for each lake segment watershed.

The proportions of the 1991 baseline nonpoint source loads attributed to each land use category were estimated using the Lake Champlain Basin land use and land cover data set (ca. 1993) and phosphorus export modeling analysis. A loading function model (with animal unit corrections) was used to estimate the proportions of the total 1991 nonpoint source loads derived from each land use category in each lake segment watershed. These proportions were applied to the 1991 nonpoint source loads measured by Vermont DEC and New York State DEC as shown in Table 9 of the TMDL.

The allocations assigned to each land use category are shown in Table 10 of the TMDL. Table

10 also provides an overall summary of the wasteload allocations and the load allocations developed for the Vermont portion of the Lake Champlain Phosphorus TMDL. The 1991 agricultural and developed land loads estimated for each lake segment watershed (TMDL Table 9) were reduced by equal proportions until the total allowable loads were attained. The allocations presented in Table 10 do not require any net reductions in forest loads below the 1991 baseline levels.

Future nonpoint source loads are addressed in the TMDL implementation plan, but not assigned part of the load allocation. The TMDL acknowledges that new loads from future growth will have to be offset by nonpoint source reductions. The implementation plan notes that most of the implementation actions discussed in the plan have benefits in reducing existing phosphorus sources, as well as preventing or mitigating future loading increases as land use change occurs.

Assessment: EPA concludes that the TMDL has identified load allocations for nonpoint sources of phosphorus. The allocations for nonpoint sources are reasonable and can be achieved through Vermont's nonpoint source-related programs (see Section 10, Reasonable Assurances, below). The TMDL provides for evaluation and reassessment of the control actions needed to achieve water quality standards.

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 Vermont portion of the TMDL includes two major WLA categories: 1) wastewater treatment plant facility wasteload allocations, and 2) developed land wasteload allocations (which include a variety of stormwater discharges).

Wastewater Treatment Plant WLAs

The TMDL document (Table 4) includes individual facility WLAs for all 60 currently permitted industrial and municipal wastewater discharges in the Vermont portion of the Lake Champlain watershed. The total allocated load from Vermont facilities is 55.8 mt/yr, representing a 22.3

mt/yr reduction from the currently permitted load of 78.1 mt/yr. The facility wasteload allocations were arrived at following extensive analysis and public participation, and stem in part from two changes the TMDL proposes to Vermont's current phosphorus removal policy for wastewater treatment facilities. The first change proposed in the TMDL is that the statutory exemption for aerated lagoon plants should be removed in 10 V.S.A. §1266a. This change will mean that eight municipal aerated lagoon facilities with greater than 0.2 mgd permitted flow that are now exempt from the 0.8 mg/l treatment requirement will be required to remove phosphorus to 0.8 mg/l on a monthly average basis. The second change will apply an annual average load limit, calculated at an effluent phosphorus concentration of 0.6 mg/l at the currently permitted flow, to all facilities that are currently required to achieve a 0.8 mg/l limit. This reduction will apply to 25 of the largest facilities in the Vermont portion of the basin.

Developed Land WLAs

EPA interprets 40 CFR 130.2(h) to require that allocations for point source discharges subject to the requirement for an NPDES permit must be included in the wasteload allocation portion of the TMDL. Hence the TMDL's developed land wasteload allocation category includes the following types of NPDES permitted stormwater discharges:

- Discharges subject to Phase 2 municipal separate storm sewer system (MS4) permits
- Discharges subject to certain individual stormwater permits
- Combined sewer overflows (CSOs)
- Discharges subject to Phase 1 and 2 construction site stormwater permits
- Discharges subject to Phase 1 permits for stormwater associated with industrial activities

Since sources such as CSOs and stormwater outfalls discharge to receiving waters via discreet conveyances, they are by definition point sources for regulatory purposes under the Clean Water Act. However, unlike domestic sewage or industrial wastewater, the stormwater-related sources listed above originate as nonpoint source runoff. Nonpoint source runoff is driven by brief and intermittent rainstorms or snowmelt events, and is highly variable in quantity and phosphorus content from one event to the next. Monitoring and accounting for phosphorus loads in stormwater runoff is technically difficult and expensive because of the variable nature of these events, making it difficult to assign and enforce facility-specific effluent limits. Data are not available from CSOs and stormwater outfalls to characterize their individual phosphorus loads for the purpose of the TMDL. Because of these monitoring difficulties and the geographic scale of the Lake Champlain Phosphorus TMDL, it was not technically feasible to separate the allocations for phosphorus sources requiring NPDES permits from more general nonpoint source load allocation categories based on land use. Therefore, the developed land wasteload allocation includes both the NPDES stormwater-related phosphorus sources listed above and runoff from nonpoint sources such as residential and commercial areas, small construction sites, back roads, and erosion of streambanks and stream channels caused directly or indirectly by development of the landscape.

Phosphorus loading from developed land can be estimated using land use and phosphorus export modeling methods. The base-year phosphorus loading to Lake Champlain from developed land

sources was estimated using these modeling methods, and allocations for developed land, agricultural land, and forest land sources were derived for each lake segment watershed as described in the Vermont Load Allocation section of the TMDL.

Stormwater and process water discharges from Concentrated Animal Feeding Operations (CAFOs) are also subject to NPDES permits and, therefore, require wasteload allocations. However, Vermont DEC, in consultation with the Vermont Department of Agriculture, Food, and Markets, does not believe there are any farms in Vermont that currently require an NPDES permit, given that the state's Large Farm Operation Rules and Program are administered to ensure that large farms do not create a discharge below the 25-year/24-hour storm event. In the future, any NPDES permits issued by the Vermont DEC for CAFOs in Vermont would eliminate and prohibit discharges to waters below that storm event. Therefore, any CAFOs that may be identified in the future are given a wasteload allocation of zero in the Lake Champlain Phosphorus TMDL, with respect to discharges below the 25-year/24-hour storm event. Discharges from large farm operations during larger, more infrequent storm events are currently accounted for in the load allocation portion of the TMDL. If such facilities are identified in the future that require an NPDES permit, allocations for discharges above the 25-year/24-hour storm event will be considered to be wasteload allocations.

Future growth in loads from wastewater treatment facilities is addressed in the Vermont Wasteload Allocation section of the TMDL. Capacity for future growth in wastewater flows is built into the design and permitting of wastewater treatment facilities, and future growth capacity is therefore included in the individual facility wasteload allocations. Future loads associated with stormwater discharges from new development are addressed in Section 4, above.

Asessment: Ideally, if data are available, separate wasteload allocations for each NPDES stormwater discharge would be established. Given data limitations in the Lake Champlain basin, however, it is acceptable to group all NPDES eligible stormwater discharges within a lake segment watershed into one wasteload allocation for stormwater. In addition, given the difficulty of separating out regulated from unregulated stormwater discharges in this case (as described above), it is also acceptable to include both discharges subject to NPDES as well as nonpoint source runoff in this aggregate wasteload category.

EPA concludes that the TMDL has appropriately established WLAs for both wastewater treatment plant facilities and NPDES regulated stormwater discharges.

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 TMDL includes an implicit margin of safety provided by two conservative assumptions in the phosphorus model used to determine the loading capacity of the lake. The first conservative assumption is that changes in the ratio of particulate to dissolved phosphorus entering the lake after the TMDL is achieved will not affect the internal phosphorus sedimentation balance in the lake. The ratio of particulate to dissolved phosphorus is important because dissolved phosphorus remains in the water column over time and contributes to total phosphorus levels in the lake more than does particulate phosphorus, the fraction of phosphorus bound up in sediment. Some of the settled particulate phosphorus is recycled back into the water column and some is buried in the sediment, becoming unavailable. In the Lake Champlain model, the net flux of phosphorus into the sediments is reflected in the internal net sedimentation terms for each lake segment.

Wastewater treatment plant discharges contain primarily dissolved phosphorus (typically more than 90%), whereas nonpoint source and storm water loads contain primarily the particulate form of phosphorus derived from sediments in storm water and other sources such as eroding streambanks. The internal sedimentation terms in the Lake Champlain phosphorus model reflects the sedimentation rate present in 1991, when 180.1 mt/yr of phosphorus came from wastewater treatment plants and 385.0 mt/y came from nonpoint sources in Vermont and New York (see Table 3 of the TMDL document), representing a particulate/dissolved ratio of approximately 2:1. Under the load and wasteload allocations specified in the TMDL for Vermont and New York, wastewater treatment plant discharges will be reduced disproportionately, creating a new particulate/dissolved ratio of approximately 3:1 (296.9 mt/y from nonpoint and storm water, and 91.3 mt/y from treatment plants). While the actual particulate/dissolved ratios are likely to be a little different from these because treatment plant and nonpoint source categories are not comprised of 100% dissolved and particulate phosphorus respectively, the ratios presented are a reasonable approximation of the expected change. The new 3:1 ratio is likely to produce a higher rate of internal sedimentation than the ratio that existed when the model was calibrated, resulting in more total phosphorus being removed from the system than what was calculated by the model and used to establish the loading capacities. The model's assumption of constant net sedimentation rates in each lake segment is therefore a conservative assumption.

Other factors in addition to the particulate/dissolved phosphorus ratio may affect the net sedimentation balance after load reduction. For example, it is common for internal loading from phosphorus stored in lake sediments after years of excessive external loading to delay recovery, especially in shallow bays or lakes. Such internal loading could result in lower net phosphorus sedimentation after load reductions are achieved. However, this situation would be expected to resolve over time (sometimes decades) as the historical phosphorus accumulation in the sediments gradually becomes depleted.

A second implicit margin of safety is provided by the fact that the model's mean predicted phosphorus concentrations are below the applicable phosphorus criteria for most lake segments. The goal of the modeling effort was for the mean predicted levels to meet the phosphorus criterion for each lake segment following implementation of the load and wasteload allocations. In actuality, the mean predicted levels are below criteria for most (10 of 13) lake segments (see

Figure 4 of the TMDL). The difference between the criteria and the mean predicted levels averages 0.0028 mg/l, and represents an additional margin of safety for these lake segments. For the three remaining segments, the mean predicted phosphorus concentration is equal to the criterion.

In addition to the implicit margin of safety described above, the following factors, while not being relied upon as providing a margin of safety, combine to produce a high level of confidence that the overall goals of the TMDL will be met.

Vermont treatment plant wasteload allocations allow for full permitted (i.e. design capacity) wastewater flows at all facilities. It is unlikely that all facilities in the basin will experience flow increases up to their full permitted capacities. Even with growth and point source trading, loadings are likely to remain below the total wasteload allocation for wastewater treatment facilities. In addition, Vermont facilities with phosphorus concentration limits specified in their permits are operated to achieve discharges below the required concentrations. This is because, in order to achieve consistent monthly compliance with permit requirements, plant operators must apply treatment chemical doses that are targeted to achieve an effluent phosphorus level somewhat below the permit level.

In New York, the treatment plant wasteload allocations were based in part on either permitted (design) flow or 1.5 times the 1995 flow, whichever was less. From a loading perspective, a comparison of the wasteload allocation of 214.4 lbs/day (Table 8) to the current load of 185.5 lbs/day (the sum of the individual discharge wasteload allocations or existing discharge loads, whichever is less) shows that there is an excess load of 28.9 lbs/day available. This represents a buffer of 16% over the current load. Based on recent basin population trends in the New York portion of the basin (<1% increase per year) it is unlikely, within the time frame of this plan, that basin facilities will collectively experience flow or load increases that would result in the wasteload allocation being reached.

Assessment: EPA concludes that the TMDL incorporates an adequate margin of safety.

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)).

As described above in Section 3 (Loading Capacity), the TMDL is targeted to meet the water quality criteria, expressed as annual mean values. Therefore, the TMDL is expressed as annual loadings of phosphorus. Although critical conditions occur during the summer season in some lake segments when algae growth is more likely to interfere with uses, water quality in Lake Champlain is generally not sensitive to daily or short term loading. As described in the TMDL

document, the lake has a residence time of about two years and generally responds to loadings that occur over longer time periods such as a year. This analysis is consistent with EPA guidance (EPA 440/4-90-006, p. 71, 73), specifically, "Eutrophication models are geared to predicting average water quality conditions over a growing season or year" (p.73). Since lakes store nutrients in their water columns and bottom sediments, water quality responses are related to the total nutrient loading that occurs over a year or growing season. Because the water quality standards (as annual mean values) are set at levels that take into account critical summer growth conditions, the annual loading capacity is protective under these critical conditions.

Seasonal variation in loading was accounted for in the modeling analysis by using tributary annual mean load estimates based on phosphorus vs. flow relationships for each tributary measured across all seasonal flow conditions. It was found that mean loading values and their standard errors were generally similar across a range of alternative load estimation methods used, including annual vs. seasonal phosphorus load estimates. The annual loading estimates used in the model therefore adequately account for seasonal loading variation.

Assessment: EPA concludes that the TMDL has adequately considered seasonal variation to ensure that water quality standards are achieved throughout the year.

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.

Although this TMDL was not developed using the phased approach, a monitoring plan is provided in the TMDL which will continue to evaluate in-Lake phosphorus concentrations and processes, monitor loadings of point and nonpoint sources, and evaluate the effectiveness of BMPs. These studies, in addition to several others listed in the TMDL document, are currently being funded through the Lake Champlain Basin Program and the States of Vermont and New York.

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.

Although implementation plans are not a requirement for approving a TMDL, the Vermont portion of the TMDL is accompanied by a thorough implementation plan designed to achieve water quality standards. The implementation plan describes a wide range of programs and actions aimed at reducing phosphorus loads to the lake. The plan includes detailed strategies for river basin planning, wastewater treatment plants, phosphorus reduction from agricultural, developed, and forested land, stream stability and streambank erosion, and many other action areas.

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 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."

Overall responsibility for the planning and coordination of phosphorus reduction efforts in the Lake Champlain Basin rests with the states and the Lake Champlain Basin Program Steering Committee, which is the executive body charged with overseeing the implementation of the Lake Champlain Management Conference plan. The Lake Champlain Management Conference plan *Opportunities for Action* listed a number of specific action items relating to phosphorus reduction from both point and nonpoint sources. Many of the action items in *Opportunities for Action* have been pursued by the states and other management agencies, but substantial further efforts are necessary (Lake Champlain Basin Program 1999, 2000b).

The Lake Champlain Basin Program (2000a) evaluated progress toward the phosphorus reduction goals and presented a number of potential next steps to be taken to achieve the target loads. The Lake Champlain Basin Program (2000a) report found that implementation efforts by state and federal agencies since 1996 have generally met or exceeded the first five-year phosphorus reduction targets established by the Lake Champlain Management Conference (1996). However, relying solely on existing point and nonpoint source phosphorus reduction programs will not be sufficient to achieve the ultimate 20-year phosphorus loading targets, at least for some lake segment watersheds. Current programs will need to be sustained and enhanced, and new approaches will need to be developed and implemented.

Many of these new programs or approaches for Vermont are described in detail in the Vermont

implementation plan. For example, Vermont's new stormwater program controls discharges from new development more rigorously than ever before, by requiring compliance with state of the art technical standards contained in the new state stormwater management manual. In addition, the recently adopted Watershed Improvement Program requires retrofitting of selected existing stormwater discharges in certain Lake Champlain watersheds, which is something that has never been required before.

Vermont has also adopted a new approach to managing rivers and streams which seeks to restore whole stream systems to a stable condition, addressing erosion issues in both the stream and the watershed. The rivers program is building on a strong foundation of geomorphic-based assessments, and is addressing erosion and sedimentation issues in a way that they have not been addressed before, with excellent results thus far.

Vermont's agricultural nonpoint source program has recently received a major boost from the new Farm Bill (the Farm Security and Investment Act of 2002), which is expected to provide at least triple the annual funding for conservation cost-share programs in Vermont through the year 2007. This funding will allow water quality issues on farms to be addressed more quickly and completely than was previously possible.

These new efforts to control sources previously unaddressed, combined with the strong track record of the ongoing agricultural programs, provide reasonable assurance that the nonpoint source and stormwater reductions will occur. Furthermore, Vermont's "Upgrade for Enhanced Nonpoint Source Management Program"(VT DEC, 1999) places a new emphasis on water quality results, including five and fifteen-year phosphorus load reduction targets for Lake Champlain consistent with the TMDL.

The progress to date in reducing phosphorus loads to Lake Champlain has been possible because of a sustained commitment of state and federal funding for point and nonpoint source programs (Lake Champlain Basin Program 1999, 2000a). This track record of successful implementation efforts, and the continued commitment of the states and the relevant federal agencies to the Lake Champlain Basin Program, provide further reasonable assurances that progress will continue to be made in meeting the phosphorus load allocations established by the TMDL.

Assessment: EPA concludes that the TMDL provides reasonable assurance that the nonpoint source load reductions will be achieved.

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.

The Vermont DEC provided for extensive public participation in the development of the Vermont portion of the Lake Champlain TMDL.

The first public draft of the TMDL was released by Vermont DEC on June 22, 2001. The June 22, 2001 draft was a Vermont document, and did not include aspects specific to New York This draft was mailed to an extensive mailing list of over 400, along with a cover letter from the Vermont DEC Commissioner and a schedule of public briefing sessions. At the same time, the draft TMDL document, the cover letter, and a fact sheet were placed on the Water Quality Division website. The cover letter explained the context and importance of the TMDL as part of the phosphorus management strategy for Lake Champlain. The cover letter, draft TMDL document, and public meeting schedule were distributed to a wide range of organizations in the basin, including: all municipalities, all other direct wastewater discharge permit holders with phosphorus allocations, regional planning commissions, environmental groups, The Vermont Farm Bureau, other statewide agricultural groups, Associated Industries of Vermont, and many other state and local groups.

The Vermont Agency of Natural Resources (ANR) issued a press release on June 25, 2001 announcing the Draft Lake Champlain Phosphorus TMDL. The press release explained the scope and importance of the TMDL and encouraged Vermonters to participate in the upcoming public meetings. An opinion column about the importance of the Lake Champlain TMDL written by the Vermont ANR Secretary was published in a major state daily newspaper on July 17, 2001. An article about the Lake Champlain Phosphorus TMDL was provided to Vermont newspapers as part of the Vermont ANR's "Reflections on the Environment" series on September 10, 2001. This article included the schedule of public meetings.

Nine public informational meetings were held in Vermont at various locations within the Lake Champlain Basin during August and September, 2001. At each meeting, a presentation was made by Vermont DEC staff giving an overview of the TMDL and an explanation of the wasteload allocation alternatives and other policy choices to be made. Participants at the meetings were encouraged to send follow-up written comments to the Vermont DEC for consideration as the draft TMDL was revised. The Vermont ANR provided a written progress report on the Lake Champlain Phosphorus TMDL to the Vermont Legislature in January 2002.

After considering public comments received on the June 22, 2001 draft and conducting further analysis, the Vermont DEC released a second public draft of the TMDL on April 29, 2002. The April 29, 2002 draft was a joint Vermont and New York document, and included allocations and implementation plans for both states. The April 29, 2002 draft also included revisions requested by the USEPA following informal technical review and consultation.

A letter from the Vermont DEC Commissioner announcing the April 29, 2002 draft TMDL was sent to the same mailing list described above. The letter established a public comment period

extending to June 14, 2002 and provided a schedule of public meetings. Paid notices were placed in four Vermont daily newspapers, and the Vermont ANR provided a press release on the TMDL to state media outlets. Four public informational meetings were held during May 2002 at various locations in the Vermont portion of the Lake Champlain Basin. The new draft TMDL, the public meeting schedule, a summary of changes since the June 22, 2001 draft, and an updated fact sheet were placed on the Water Quality Division website.

The Vermont DEC considered all written comments received on the April 29, 2002 draft in making final revisions to the TMDL. All major public comments were compiled, and responses to each comment were provided in a Response Summary document. This document was submitted to EPA on October 10, 2002.

Assessment: EPA has concluded that the State of Vermont provided adequate public participation and has responded to comments.

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 waterbody, the pollutant(s) of concern, and the priority ranking of the waterbody.

On September 25, 2002, the State of Vermont signed and submitted its final TMDL to EPA for review and approval under CWA Section 303(d).

References

Lake Champlain Basin Program. 1999. Progress 1999: An Opportunities for Action implementation Report. Grand Isle, VT.

Lake Champlain Basin Program. 2000a. Preliminary evaluation of progress toward Lake Champlain Basin Program phosphorus reduction goals. A Lake Champlain Basin Program internal report prepared for the Lake Champlain Steering Committee. Grand Isle, VT.

Lake Champlain Basin Program. 2000b. Progress 2000: An Opportunities for Action implementation report. Grand Isle, VT.

Lake Champlain Phosphorus Management Task Force. 1993. Report to the Lake Champlain Steering Committee.

Lake Champlain Management Conference. 1996. Opportunities for action. An evolving plan for the future of the Lake Champlain Basin. Pollution prevention, control, and restoration

plan. Lake Champlain Basin Program. Grand Isle, VT.

Vermont Department of Environmental Conservation and New York State Department of Environmental Conservation. 1997. A phosphorus budget, model, and load reduction strategy for Lake Champlain. Lake Champlain Diagnostic-Feasibility Study final report. Waterbury, VT and Albany, NY.

Vermont Department of Environmental Conservation. 1999. Upgrade for Enhanced Nonpoint Source Management Program, Including an Evaluation of the Vermont Nonpoint Source Program. Waterbury, VT.