Opportunities for Action

An Evolving Plan for the Future of the Lake Champlain Basin

Pollution Prevention, Control & Restoration Plan - October 1996

Prepared by the Lake Champlain Management Conference

To the Citizens of the Lake Champlain Basin:

On behalf of the States of New York and Vermont and the US Environmental Protection Agency, we are pleased to approve *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin*.

Opportunities for Action is comprehensive in its scope and focused in its mission. The Plan considers a number of critical issues, ranging from the improvement of water quality for Lake Champlain, to the protection of the Basin=s living natural resources, to the preservation of the region=s rich cultural heritage. From these, the Plan identifies three priorities for action: the reduction of phosphorus pollution, the prevention of toxic substance pollution, the prevention of toxic substance pollution, and the management of nuisance nonnative aquatic plants and animals.

Implicit in our approval is a commitment to direct the resources of our respective agencies towards the implementation of the recommendations set forth in the Plan, and a recognition that adequate funding will be crucial to the success of *Opportunities for Action*. As funding allows, we will work to accelerate the execution of priority actions, with special emphasis on the reduction of phosphorus pollution in targeted watersheds, so that the current generation may enjoy Lake Champlain as fully as future generations.

Opportunities for Action recommends that the Lake Champlain Steering Committee, created by the Memorandum of Understanding on Environmental Cooperation on the Management of Lake Champlain, oversee implementation of the Plan. We call on the Steering Committee to think broadly and use the Plan as a guide, but to also be responsive to issues as they arise. Occurrences of high lake levels and shoreline effects are not addressed in *Opportunities for Action* but may rightly deserve attention by the Steering Committee.

We applaud the 31 members of the Management Conference, as well as members of advisory committees and staff, for successfully completing their charge as described in the Lake Champlain Special Designation Act of 1990. This Plan is the result of tremendous dedication and hard work by hundreds of individuals over the last five years. In particular, we would like to acknowledge the thoughtful public input to this important planning process.

We look forward to continued cooperation among all of the parties involved to make the vision embodied in this Plan a reality.

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Vision Statement

The Lake Champlain Management Conference represents a broad-based diverse group of interests that share a common goal of developing a management program to protect and enhance the environmental integrity and the social and economic benefits of Lake Champlain and its watershed.

The Management Conference envisions a Lake Champlain which supports multiple uses -- including commerce, a healthy drinking water supply, wildlife habitat and recreation such as swimming, fishing and boating. These diverse uses will be balanced to minimize stresses on any part of the Lake system. The Management Conference recognizes that maintaining a vital economy which values the preservation of the agricultural sector is an integral part of the balanced management of the Lake Champlain Basin. Implementing a comprehensive management plan will ensure that the Lake and its Basin will be protected, restored and maintained so that future generations will enjoy its full benefits.

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This report was funded and prepared under the authority of the Lake Champlain Special Designation Act of 1990, P.L. 101-596, through the U.S. Environmental Protection Agency (EPA grant #EPA X 001840-01). Publication of this report does not signify that the contents necessarily reflect the views of the States of New York and Vermont, the Lake Champlain Basin Program, or the U.S. Environmental Protection Agency.

Chapter 1. Introduction

Lake Champlain Basin Resources

The Lake Champlain Basin, stretching from the peaks of the Adirondacks to the Green Mountains and north into Quebec, is renowned as one of the nation's most beautiful and valued resources (See Figure 1, inside front cover). Long home to Native Americans and inhabited by more than 600,000 people today, the Basin draws millions of visitors to its waters and other natural and historic features. Virtually everyone in the Basin depends on the resources the Lake provides for a wide variety of uses, from drinking water and recreation to agriculture, industry and waste disposal. The challenge is to define a future that sustains all of these uses.

The importance of the Basin's healthy natural resources to many of the region's industries and to the economy as a whole is indisputable. Agriculture, for example, which requires land for production and clean water for animals, generates about $415 million per year in sales of agricultural products including milk, cheese, maple syrup, and apples. Recreation-related industries also depend on a clean lake. Sport fishing generates millions in revenues annually. In 1991, people spent approximately $32 million while fishing in the Basin (Holmes & Associates and Artuso, [in press] 1996). Bird and other wildlife viewing activities contribute to the Basin's economy, generating over $50 million a year in Vermont (Vermont Agency of Natural Resources, 1996). Tourism brought an estimated $2.2 billion dollars overall to the Basin in 1990.

Dollar figures alone cannot convey the full value of Lake Champlain's resources. The biological riches of the area and unparalleled beauty of the mountains, agricultural landscapes, small towns and villages, and rivers that flow into the magnificent Lake provide us with experiences and opportunities unique to the Lake Champlain Basin. While these benefits of healthy resources are difficult to quantify, they are equally important to any evaluation of the costs and benefits of resource management decisions.

Resource Issues Facing Lake Champlain

Although Lake Champlain remains a vital lake with many assets, there are several serious environmental problems that demand action. Levels of phosphorus in parts of Lake Champlain are so high that they cause excessive algal growth which turns the water green, inhibits recreational use of the water, and can reduce oxygen levels and cause other problems for the aquatic life in the Lake. The phosphorus that is causing these problems is coming from both sewage treatment plant discharges and runoff from agricultural and urban surfaces. These phosphorus inputs must be reduced to promote a healthy ecosystem and full use and enjoyment of the Lake by people. This Plan presents strategies to begin these reductions.

Toxic substances such as polychlorinated biphenyls (PCBs) and mercury have resulted in health advisories about consuming certain fish from Lake Champlain. There are also three particular sections of Lake Champlain (Cumberland Bay, Inner Burlington Harbor, and Outer Malletts Bay)

that are contaminated with toxic substances at levels known to cause problems for aquatic biota or human health. This Plan presents ways to reduce toxic contaminants like mercury and PCBs and to identify appropriate restoration strategies for contaminated sections of the Lake.

The fish, wildlife, and other living resources of the Lake Champlain Basin have been impacted by the introduction of nuisance nonnative aquatic species such as sea lamprey, water chestnut, Eurasian watermilfoil, and, most recently, zebra mussels. These species also interfere with recreational use of the Lake, and zebra mussels can clog residential, municipal, and industrial water intake pipes, foul boat hulls and engines, and obscure priceless underwater archeological artifacts. A comprehensive action strategy to protect ecologically valuable habitats and to control the spread of these nuisance species is urgently needed. The Plan outlines a process to develop and implement such a strategy.

There are other resource issues in the Lake Champlain Basin as well, including continued wetland loss and habitat fragmentation, inadequate public access to the Lake and recreational user conflicts, and loss of cultural resources. The Plan also outlines strategies to address these issues.

Why Act Now

Abundant and diverse natural resources are a major reason why many Basin residents choose to live here. Research shows there is a clear connection between the economy and the health of the Lake's resources. If investments are not made now, clean-up costs will be far greater in the future. Continuing to work to protect and improve Lake Champlain and its natural resources now will sustain past investments, expand the Basin's economic potential and improve the quality of life for all Basin residents.

Lake Champlain Special Designation Act

On November 5, 1990, the Lake Champlain Special Designation Act was signed into law (See Appendix A). Sponsored by Senators Leahy and Jeffords from Vermont and Senators Moynihan and D'Amato from New York, this legislation designated Lake Champlain as a resource of national significance. The goal of the Special Designation Act was to bring together people with diverse interests in the Lake to create a comprehensive pollution prevention, control and restoration plan for protecting the future of Lake Champlain and its surrounding watershed. The act specifically required examination of water quality, fisheries, wetlands, wildlife, recreational and cultural resource issues. The challenge was both to identify particular problems requiring management action and to chart an integrated plan for the future of the Lake Champlain Basin. *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin*, covers a broad range of issues and incorporates the views of citizens, economic advisors, scientists and others.

Lake Champlain Basin Program

The Lake Champlain Basin Program (LCBP) was established to coordinate the activities envisioned by the Special Designation Act. The LCBP is a federally-funded initiative working in partnership with agencies, organizations and individuals to develop and implement *Opportunities for Action*. The program is guided by the Management Conference (LCMC), a 31-member board representing a broad spectrum of Lake-Basin interests and organizations from both New York and Vermont, including local government and citizen representatives, scientists, state legislators, state government and federal agencies. The Management Conference is advised by a Technical Advisory Committee, composed of resource managers, physical and social scientists and business and economic experts, and by the New York and Vermont Citizens Advisory Committees (CACs). The Management Conference is also advised by two subcommittees, the Education and Outreach Committee and the Plan Formulation Team, and works with the Lake Champlain Research Consortium (LCRC), formed by seven academic institutions in the Lake Champlain Basin.

The LCBP is jointly administered by the U.S. Environmental Protection Agency (USEPA), the States of Vermont and New York, and the New England Interstate Water Pollution Control Commission. Other cooperating agencies include the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Agriculture (USDA), the U.S. Geological Survey (USGS), the National Oceanographic and Atmospheric Administration (NOAA) and the National Park Service (NPS). Formal involvement of Quebec is through the Lake Champlain Steering Committee, which meets at least twice a year to coordinate Lake-related management activities.

Over the past five years, the LCBP has sponsored a variety of projects to educate and involve the public and gather information about Lake issues. It has also provided funding for education, planning, demonstration, research and monitoring projects to help in preparing the Plan. The Management Conference and its advisory committees are scheduled to complete their work in the fall of 1996 after a series of public hearings on the Plan. Existing agencies and organizations will be responsible for implementing the priority actions of the Plan. An institutional framework for the future must also be in place to revisit the Plan every two years and update the priorities based on new knowledge and changing environmental conditions (See Chapter 5).

Overall Themes of the Plan

Opportunities for Action is an evolving blueprint for coordinated action aimed at restoring and protecting water quality and the diverse natural and cultural resources of the Lake Champlain Basin. Many comments were received over the past five years through the public involvement process. Several themes emerged from this process which have been woven into the Plan:

Partnership Approach

Numerous agencies and organizations are currently involved in successful programs to manage the resources of the Basin. Implementation of the Plan should rely upon these groups to continue these successful efforts and expand their capabilities through the formation of partnerships. Partnerships can increase communication and coordination among various levels of government, the private sector and citizens. They can also reduce duplication of efforts; increase efficiency and effectiveness in the use of human and financial resources; be short and long-term and evolve as needed; accomplish much without the use of new regulations or new layers of government; and ensure a sharing of responsibility for implementing the Plan.

Ecosystem-based Approach

Opportunities for Action calls for an ecosystem-based approach to planning and management that considers the Lake and its entire drainage basin as a whole, interconnected, complex system. Each component of the system, including humans, can potentially affect other parts of the system. For instance, increased phosphorus levels in the Lake can cause algal blooms that can result in depleted oxygen levels, thereby affecting fish populations and populations of other Basin species which depend on fish as a food source. Sound resource management must take into consideration the ways in which various actions will affect other resources in the ecosystem.

Watershed Approach

Over 90% of the water in Lake Champlain passes through the 8,234 square miles of the Basin before reaching the Lake. As a result, land use activities and pollution sources throughout the Basin have a tremendous impact on the Lake and its ecosystems. Action based on watershed boundaries rather than political boundaries can better target polluted or threatened areas for restoration or protection. In addition to applying the watershed approach on a Basin-wide level, *Opportunities for Action* encourages the watershed approach at a more local level. This offers an opportunity for citizens to improve water quality based on their knowledge of their local watershed area, and for neighboring communities to link together to develop innovative ways to solve pollution problems within their local watersheds. Empowering local communities and their organizations to take action together gives any effort a better chance of real, sustained success. Implementation of the Plan will continue to use a watershed approach that links the Lake with activities in its watershed.

Integration of Environmental and Economic Goals

A healthy Lake Champlain is crucial to a strong regional economy, and a strong economy is good for the Lake. The Plan recommends actions to protect and restore the ecological and cultural resources of the Basin while ensuring economic benefits for long-term positive change in the Lake. Implementation of the Plan involves devising solutions to environmental problems while maintaining the economic integrity of the Basin. Finding the most cost-effective actions to protect and enhance the quality of the Lake while also maintaining the economic health of the region is an extremely important and difficult task in implementing the Plan.

Pollution Prevention

Pollution prevention focuses on reducing or eliminating the generation of pollutants at their source. Pollution prevention efforts often cut industrial and public costs in the long run by reducing the need for expensive waste treatment, hazardous waste disposal and clean-up. Such efforts can also reduce the need for regulatory compliance measures, which are costly and time-consuming. Pollution prevention is important because it is often more economically feasible than remediation of polluted sites and is a prime method of deterring future harm to ecosystems.

Consensus-based, Collaborative Approach to Decision-Making

Opportunities for Action is the result of numerous cooperating agencies, organizations, and individuals combining their efforts to protect and enhance the resources of the Lake Champlain Basin while solving identified problems. Implementing the Plan will continue to involve a broad

range of participants in a consensus-based approach to decision-making. Encouraging numerous stakeholders to provide input will strengthen the outcomes of the decision-making process and will broaden the base of citizens and organizations responsible for Plan implementation.

Flexibility

Opportunities for Action is an evolving plan to restore and protect water quality and the remarkable natural and cultural resources of the Lake Champlain Basin. Building flexibility into programs and organizations will ensure that this evolution can occur. Successful program implementation will require feedback loops between policy development and implementation and will require adaptable organizations which can change their programs accordingly.

Priorities for Action

Opportunities for Action contains recommended actions to protect and restore the ecological and cultural resources of the Basin while maintaining a vital economy for the region. Based on public and technical comments concerning the October, 1994 Draft Plan, the LCMC prioritized the actions contained in the Plan. Three action areas were designated as the highest priorities of the Plan:

$ **Reduce phosphorus in targeted watersheds of the Lake** (Actions 1-4 in the section on Reducing Phosphorus Pollution, p. XXX). Priority sub-basins have been identified through extensive research on phosphorus loadings to the Lake from tributaries. These actions suggest comprehensive ways to reduce phosphorus loadings from these tributaries and their watersheds and will require both point and nonpoint source controls.

$ **Prevent and control persistent toxic contaminants found lakewide or in localized areas of the Lake** (Actions 1 and 2 of the section on Preventing Pollution from Toxic Substances, p. XXX). These actions present a comprehensive strategy to restore areas of the Basin where pollution from toxic contaminants is a problem and to prevent future pollution from these contaminants.

$ **Develop and implement a comprehensive management program for nuisance nonnative aquatic species** (Action 1 of the section on Managing Nuisance Nonnative Aquatic Species, p. XXX). This management program would help stop the spread of nuisance nonnative aquatic species through a cooperative effort among agencies, organizations, and individuals.

The LCMC considers these three action areas to be the most important for addressing the long-term health of the Lake Champlain Basin. The LCMC recommends that agencies and organizations strive to make these their top priorities for action in managing and enhancing the resources of the Basin.

In addition to these highest priorities, the LCMC selected several other high priority actions in each of the issue areas. The LCMC feels that these actions are needed to accomplish the goals of each issue area and should be implemented as soon as possible. Priority actions were also designated for each subject area. These priority actions are considered important to a management program which addresses the issues facing the Lake Champlain Basin. Complementing the priority actions are other actions for consideration. The LCMC feels that

these actions contribute to the comprehensive nature of the Plan but are less crucial to the present health of the Lake and its basin. As time progresses and the Plan is updated as new issues emerge, the priority status of these actions could be re-evaluated.

In each of the issue areas, the actions have been listed according to their designated priority status: Highest Priority, High Priority, Priority, and Other Actions for Consideration. Implementation of all actions, regardless of priority status, is contingent upon the availability of funds. Refer to Chapter 5 for information on funding strategies for the Plan.

An Evolving Plan

Since 1991, the LCBP has worked hard to involve the public and respond to research results in developing this Plan. Numerous public input meetings, citizen perception surveys, focus group discussions, technical workshops, and research, monitoring and demonstration projects have all helped to identify the issues and priority actions presented in this Plan.

In the fall of 1994, *Opportunities for Action* was released to the public. In the spring of 1995, a series of six public input meetings were held throughout the Basin to receive feedback on the Draft Plan. Hundreds of written comments along with input from the public meetings and focus group sessions provided the Management Conference and its subcommittees with the information needed to revise the Draft Plan. Many of the revisions in this Plan are a direct result of recommendations by the citizens of the Basin. Some of these recommendations (in bold) include:

$ The Plan should be shorter and easier to read. The Plan was changed to focus only on the issues and recommended actions. The majority of background information and research results have been included in a separate technical report published by the LCBP. See Appendix B for a list of technical, demonstration, and education reports published by the LCBP.

$ The actions presented in the Plan should be prioritized. The LCMC discussed the actions at length and agreed on priorities which are indicated in this Plan.

$ Additional economic information should be presented with the Plan. Chapter 6 focuses specifically on this issue and provides additional economic information. A supplemental economic analysis of the Plan is also available.

$ The Plan should oppose any inclusion of unfunded mandates. The LCMC worked hard to ensure that the actions presented in this Plan do not include unfunded mandates.

$ The Plan should emphasize education rather than expanded regulation. The LCMC agreed that education is preferable to regulation and emphasized it along with action at the local level as the primary means for implementing the Plan (See Chapter 5).

$ The Plan should promote and foster the vitality of existing organizations. The LCMC recommends that existing organizations should be responsible for the implementation of the Plan (See Chapter 5).

Over the last five years, the public has played an integral role in the development of *Opportunities for Action.* It is hoped that readers will find that most of their concerns and suggestions have been incorporated and that these individuals will continue to provide input into the planning

process. To help promote this input, formal public hearings on this draft of the Plan were held in New York and Vermont in the summer of 1996. Please contact the LCBP at 1-800-468-5227 for more information on these hearings or to receive a copy of the responsiveness summary.

What is in the Plan?

Opportunities for Action is divided into six chapters. This chapter presents the overall themes and priorities of the Plan. Chapter 2 presents the actions to protect and enhance water quality in Lake Champlain. Chapter 3 concerns living natural resources, and Chapter 4 focuses on recreation and cultural resources of the Basin. Chapter 5 identifies strategies for Plan implementation, including recommendations for an institutional framework for the future. It also includes sections concerning local-level involvement in Plan implementation, informing and involving the public, measuring and monitoring success, and securing funding. These sections were placed in the implementation chapter because they are the primary means through which Plan recommendations will be implemented. Chapter 6 describes the economic analyses of the Plan, and a list of references, glossary, abbreviations and appendices are at the end of the document.

Chapter 2. Water Quality and the Health of the Lake

As recently as 20 years ago, the Basin experienced serious water pollution and public health problems from the discharge of untreated sewage and wastes. Since then, water quality has improved as a result of required industrial waste treatment, and a large investment of state, federal, municipal and private funds for sewage treatment facilities. But these successes represent the easiest solutions. Additional clean-up must also address nonpoint source pollutants from urban and agricultural areas such as nutrients, low levels of persistent toxic substances, and pathogens. Pollution from nonpoint sources is harder to manage, but is a major cause of water quality problems in the Basin.

Lake Champlain serves as a catch basin for pollutants delivered directly to it and those washed from the land or air into tributary rivers. Several indicators of the health of the Lake show its tendency to accumulate pollutants. The most obvious indicators are excessive weed and algae growth due to nutrient enrichment, fish consumption advisories due to PCBs and mercury in some lake fish, elevated levels of toxic substances in lake bottom sediments, and periodic beach closings because of pathogens.

This chapter includes the following subjects:
$ Reducing Phosphorus Pollution
$ Preventing Pollution from Toxic Substances
$ Protecting Human Health

Reducing Phosphorus Pollution

Goal: Reduce phosphorus inputs to Lake Champlain to promote a healthy and diverse ecosystem and provide for sustainable human use and enjoyment of the Lake.

Phosphorus is the nutrient that poses the greatest threat to clear and nuisance free water in Lake Champlain. Nutrients act as fertilizers, promoting rapid growth of algae and plants. Human activities can greatly increase nutrient inputs to the Lake. These "cultural" nutrient sources accelerate eutrophication, the natural aging process of lakes where biological and chemical material accumulates, causing lakes to become more productive. When the amount of phosphorus entering the Lake increases and remains high over time, the Lake becomes over-fertilized and produces excessive amounts of algae and other aquatic plants. Algal blooms turn water green, reduce water transparency, deplete the oxygen supply, and create odor problems. Ultimately, these blooms alter fish and wildlife habitat, impair scenic views, reduce recreational appeal, impair water supplies, and lower property values.

Phosphorus levels are elevated in many parts of Lake Champlain, and in some areas levels are comparable to those found in the most polluted parts of the Great Lakes (Saginaw Bay and the western end of Lake Erie) during the 1970s. Missisquoi Bay, St. Albans Bay and the South Lake are the segments of Lake Champlain with the highest phosphorus levels (See Table 1). Nuisance algal conditions exist nearly half of the time in these areas.

Wastewater treatment and industrial discharges are the main point sources of phosphorus, contributing about 30 percent of the total phosphorus entering Lake Champlain. Nonpoint sources, which account for 70 percent of the phosphorus loading, include lawn and garden fertilizers, dairy manure and other agricultural wastes, pet wastes, and exposed or disturbed soil. At the local scale, nonpoint sources may include malfunctioning septic systems and streambank erosion.

The major categories of land use within the Lake Champlain Basin are agricultural land (28% of Basin area), forested land (62% of Basin area), and urban and other developed land (3% of Basin area). Agricultural activities contribute approximately 66% of the annual nonpoint phosphorus load to the Lake. Forests cover a majority of the Basin's surface area but are estimated to contribute only 16% of the average annual nonpoint source phosphorus load to Lake Champlain. Urban land produces approximately 18% of the average annual nonpoint source phosphorus load to the Lake but contributes much more phosphorus per unit area than either agricultural or forested land (Budd and Meals, 1994). Natural background sources of phosphorus are estimated to account for only 24% of the present day total load, indicating that human activities in the Basin have increased phosphorus loading to Lake Champlain four-fold over the original pre-development levels.

Table 1. Lake Champlain Interim Total Phosphorus Criteria and Existing Phosphorus Concentrations

Lake Segment[1]	Phosphorus Criterion (Fg/l)	Existing Phosphorus Concentration[2] (Fg/l)	Trophic Status[3]
Main Lake	10	11.4	M
Malletts Bay	10	9.8	O
Shelburne Bay	14	14.5	M
Burlington Bay	14	13.2	M
Cumberland Bay	14	13.5	M
Northeast Arm	14	14.5	M
Isle LaMotte	14	13.3	M
Otter Creek	14	14.4	M
Port Henry	14	14.4	M
St. Albans Bay	17	24.7	E
Missisquoi Bay	25	37.3	E
South Lake A	25	33.3	E
South Lake B	25	56.9	E

[1]Segment boundaries are shown on the adjacent map.

[2]1990-1994 mean total phosphorus concentrations recorded by the New York and Vermont Long-term Monitoring Program for Lake Champlain (New York State DEC, *et al*., 1995).

[3]O = Oligotrophic = 0 - 10 ☞g/l (low plant growth and high water clarity)
M = Mesotrophic = 11 - 20 ☞g/l (moderate plant growth, moderate water clarity)
E = Eutrophic = more than 20 ☞g/l (low water clarity, excessive plant growth)

While phosphorus loads to Lake Champlain were not well monitored in the 1970s and 1980s, Vermont point source loads are estimated to have been reduced by at least 40% between the 1970s and 1991 as a result of banning phosphate detergents and regulating wastewater treatment plants and industrial discharges (Vermont Department of Water Resources and Environmental Engineering, 1981). Additional reductions are presumed to have resulted from New York's phosphate detergent ban, although amounts were not documented. The 1992 Vermont phosphorus reduction statute (requiring improved phosphorus treatment at larger municipal

treatment plants) along with decreased phosphorus discharges from several New York communities resulted in an additional 43% (107 metric tons per year) reduction between 1991 and 1995. USDA Natural Resource Conservation Service models estimate that phosphorus loads from nonpoint sources have been reduced by more than 65 metric tons per year (approximately 10%) since the 1970s through voluntary pollution control efforts on farms supported by USDA cost-share funds. These cooperative conservation programs have been strongly supported by the agricultural community. Many of the recommended actions at the end of this section are intended to build on these past successes.

In 1993, New York, Vermont and Quebec signed a Water Quality Agreement committing the three entities to use a consistent approach to phosphorus management. The agreement defined in-lake phosphorus concentration criteria (goals) for thirteen lake segments (see Table 1). The states of Vermont and New York subsequently completed a study to measure point and nonpoint source phosphorus loads to the Lake, develop a whole-lake phosphorus budget, and develop a load reduction strategy to attain the in-lake criteria (Vermont Department of Environmental Conservation and New York State Department of Environmental Conservation, 1994). The results of this study (called the "Lake Champlain Diagnostic-Feasibility Study") indicate that the annual phosphorus load to the Lake needs to be reduced by another 57 metric tons (relative to the 1995 load) in order to attain the in-lake criteria. This represents about 11 percent of the estimated 1995 total of 496 metric tons introduced each year. The challenge is to continue to reduce phosphorus loads from both point and nonpoint sources and to allocate load reductions throughout the Basin in a fair, efficient, and cost-effective manner.

In 1995, Holmes and Artuso developed an optimization procedure to determine the cost-effectiveness of various strategies for attaining the in-lake phosphorus criteria (Holmes and Artuso, 1995). Designed for use with the Diagnostic-Feasibility Study, the optimization procedure takes into account the costs of potential phosphorus reductions achievable from point and nonpoint sources as well as the manner in which changes to phosphorus levels in each lake segment are expected to affect phosphorus levels in all other lake segments. The procedure allows one to sort through the multitude of possible combinations of point and nonpoint source reductions that are predicted to attain the in-lake criteria.

In early 1996, representatives from the states of Vermont and New York and USEPA used the phosphorus model and optimization procedure to develop a new bi-state process for phosphorus reductions. Following extensive analysis of numerous reduction scenarios, the group selected a load reduction process considered both fair and cost-effective. The agreed upon process distributes the responsibility for phosphorus reductions among 12 of the 19 watersheds shown in Figure 2. The process has been endorsed by the Lake Champlain Management Conference and is based on the following principles and agreements[4]:

1) Lake Champlain is a priority for protection.

[4] For the complete text of the agreement, see appendix C.

2) The interim management goals (the phosphorus criteria in Table 1) specified in the 1993 New York, Vermont and Quebec Water Quality agreement are suitable goals for developing loading targets for Lake Champlain. The goals may be revised in the future, as appropriate, based on new information.

3) The Lake Champlain Diagnostic-Feasibility Study model in combination with the optimization procedure (referenced above) is a suitable tool for developing interim phosphorus loading targets for Lake Champlain. USEPA, NYSDEC and VT DEC will develop a program to enhance the model and to revise/finalize the phosphorus loading targets, as necessary, within five years.

4) The point and nonpoint source phosphorus loading targets presented in Table 2 for Lake segment watersheds[5] will be adopted by the states of New York and Vermont. These loading targets were generated by the phosphorus model and optimization procedure described above. The State of Vermont will seek an agreement with the Province of Quebec to ensure that both entities contribute to the attainment of the necessary phosphorus reductions in Missisquoi Bay.

5) Each state will have the opportunity to adjust its total loading targets by contributing watershed as it sees fit, as long as the adjusted loads continue to meet the in-lake phosphorus concentration goals. During this step each state will keep the other state's allowable loads fixed. The adjusted loads for each state will then be checked together to ensure that the in-lake goals will be achieved.

6) Each state will reduce the difference between existing (1995) loads by contributing watershed, and target loads by contributing watershed, by at least 25% per five year period for the next 20 years. This commitment is contingent on the availability of federal and/or state funds to support implementation, as specified in the full text of the agreement in Appendix C.

- ! The first 25% reduction must be incorporated in specific nonpoint source actions or specific point source permit modifications to be identified by October 1, 1996, and implemented in the next five years.

- ! The states are free to choose the appropriate mix of point and nonpoint source actions to be implemented in each contributing watershed.

- ! The specific actions to achieve the remaining 75% reduction will be identified within five years.

[5] Lake segment watersheds are the drainage areas for each of the lake segments, as shown in Figure 2. Because there may be more than one major tributary feeding into each lake segment, there may be several sub-basins within one lake segment watershed.

Table 2. Phosphorus loading targets (mt/yr), shown in comparison with the actual 1991 and 1995 point and nonpoint source (NPS) loads for contributing watersheds.

Lake Segment Watershed	Vermont									
	1991 Loads			1995 Loads			Target Loads			Required Changes relative to 1995
	Point	NPS	Total	Point	NPS	Total	Point	NPS	Total	
South Lake B	3.2	24.8	28.0	3.1	24.5	27.6	1.5	19.3	20.8	-6.8
South Lake A	0.1	2.4	2.4	0.1	1.1	1.2	0.1	0.6	0.6	-0.5
Port Henry	0.0	0.4	0.4	0.0	0.2	0.2	0.0	0.1	0.1	-0.0
Otter Creek	62.8	58.9	121.7	9.8	51.4	61.2	7.1	49.0	56.1	-5.1
Main Lake	27.7	60.3	88.0	21.6	59.1	80.7	18.3	58.2	76.6	-4.1
Shelburne Bay	5.3	11.1	16.4	0.7	11.1	11.8	0.9	11.0	12.0	0.1
Burlington Bay	11.2	0.3	11.5	2.2	0.3	2.5	2.8	0.3	3.1	0.6
Malletts Bay	3.1	29.8	32.9	2.7	26.9	29.7	2.6	26.1	28.6	-1.1
Northeast Arm	0.0	3.2	3.2	0.0	1.4	1.4	0.0	1.2	1.2	-0.2
St. Albans Bay	0.8	7.2	8.0	1.6	7.2	8.9	2.4	7.0	9.5	0.6
Missisquoi Bay*	15.4	151.9	167.3	6.9	142.1	149.1	5.3	104.4	109.7	-39.4
Isle LaMotte	0.0	0.6	0.6	0.0	0.3	0.3	0.0	0.3	0.3	-0.0
TOTAL	129.6	350.8	480.4	48.7	325.8	374.5	41.1	277.5	318.6	-55.8 (net)

*Includes loads from Quebec

Lake Segment Watershed	New York									
	1991 Loads			1995 Loads			Target Loads			Required Changes relative to 1995
	Point	NPS	Total	Point	NPS	Total	Point	NPS	Total	
South Lake B	3.9	24.3	28.2	2.7	24.3	27.0	1.9	24.3	26.2	-0.8
South Lake A	9.6	3.5	13.1	6.9	3.1	10.1	7.4	2.0	9.4	-0.7
Port Henry	1.8	2.6	4.3	2.7	1.8	4.5	0.7	1.8	2.5	-2.0
Otter Creek	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	-0.0
Main Lake	7.1	31.8	38.9	6.7	30.8	37.5	4.3	30.8	35.0	-2.4
Cumberland Bay	29.2	8.8	38.0	11.8	8.3	20.2	17.2	8.3	25.5	5.3

Isle LaMotte	7.4	20.9	28.3	2.5	19.5	22.0	2.0	19.5	21.5	-0.5
TOTAL	59.0	91.9	150.9	33.3	88.0	121.3	33.5	86.8	120.2	-1.0 (net)

Source: The 1991 base year loads were measured by the Lake Champlain Diagnostic-Feasibility Study (VT DEC and NYSDEC, 1994). The 1995 point source loads were estimated from effluent monitoring data. The 1995 nonpoint source loads represent 1991 base year measured loads minus phosphorus load credits for recently implemented agricultural best management practices.

Table 2 shows current (1995) phosphorus loads along with phosphorus loading targets generated by the targeting procedure. It also shows the reductions required (relative to 1995 loads) to attain the target loads for each lake segment. While Table 2 shows that most watersheds are targeted
for some level of phosphorus reduction, the majority of the reduction is targeted to Missisquoi Bay (39 mt/yr). Other watersheds targeted for substantial reductions include South Lake B (Vermont portion), Otter Creek (Vermont portion), and the Main Lake (both New York and Vermont portions). The location of all watersheds targeted for some level of reduction is shown in Figure 2. The increased loadings indicated for some watersheds in the "required change" column of Table 2 take into account anticipated flow increases (allowed by state permit) resulting from excess capacity at a number of waste water treatment plants. Significant excess capacity (equating to 5.3 mt/yr of additional phosphorus) at several plants in the Cumberland Bay watershed, for example, accounts for why the net reduction for New York is only 1.0 mt/yr even though reductions totaling 6.4 mt/yr are indicated for other New York watersheds. For a more complete explanation of how point source load targets were calculated, refer to Appendix C.

Considerations for Implementation:

Focusing Phosphorus Reduction Resources on Targeted Watersheds
The Lake Champlain targeting procedure targets 12 watersheds for phosphorus load reductions (see Table 2). While basic statewide phosphorus reduction activities, such as implementation of Vermont's mandatory Accepted Agricultural Practices, should continue to occur in all watersheds (in Vermont), watershed targeting allows for more efficient use of any additional available resources. Many of the recommended actions in this section are directed to targeted watersheds.

Reducing Phosphorus at the Local Level
The Lake Champlain Management Conference recommends that the sub-basin planning process currently underway in the LaPlatte River watershed in Vermont and the Little Ausable watershed in New York be applied elsewhere in the Basin as well. This process includes the following steps: 1) determine phosphorus loadings from all sources in the watershed; 2) determine the amount and cost of reduction achievable from each source; and 3) select an economically and politically feasible method to attain the phosphorus reduction target. Since implementation will require significant funding, the development of funding strategies is an important final step in the sub-basin planning process.

The completion of sub-basin strategies will help the states comply with the 1996 phosphorus agreement among Vermont, New York and USEPA; sub-basin strategies will identify the type of specific actions that the agreement calls for.

Preventing Increases in Phosphorus Loads to the Lake
For watersheds where no additional reduction is targeted, management efforts should focus on preventing increases in phosphorus levels. For targeted watersheds, management efforts should focus on both the reduction from existing sources and the prevention of increases from new sources. One way to minimize loading increases is to ensure that new development complies with appropriate management practices to control phosphorus export. It is much less expensive to prevent phosphorus discharges at the initial stage of development than to attempt to reduce phosphorus runoff after project completion. Both New York and Vermont have programs in place to control erosion, sedimentation and stormwater runoff from new development. There are opportunities for strengthening these programs and for much more local government involvement in stormwater management.

Focusing Agricultural Efforts on Improved Nutrient Management
While it is important to continue with effective structural improvements to farms (such as the construction of manure pits and barnyard runoff systems), additional emphasis needs to be placed on nutrient management. Nutrient management is an integrated approach to maximizing the efficient use of plant nutrients. The agricultural community is increasingly recognizing the economic benefits of improved nutrient management, and there is now more demand for nutrient management assistance than can be provided by existing trained consultants.

Objectives: (not listed in priority order)

1. Attain the phosphorus loading targets for lake segment watersheds included in the 1996 New York, Vermont and USEPA phosphorus reduction agreement.

2. Attain the in-lake phosphorus criteria specified in the 1993 New York, Quebec, and Vermont Water Quality Agreement.

Highest Priority Actions

1. Identify Specific Actions by October 1, 1996 for Attaining the first 25% of the Targeted Phosphorus Load Reduction Listed in Table 2

Pursuant to the 1996 New York, Vermont and USEPA phosphorus reduction agreement (Appendix C), the states of New York and Vermont should identify (by 10/1/96) specific nonpoint source actions or point source permit modifications that will attain at least 25% of the phosphorus load reduction indicated in Table 2 (or an adjusted Table 2 as provided for in the agreement). Implementation should be completed within the next five years, contingent on the availability of federal and state funding as specified in the agreement. Specific actions for attaining the remaining 75% reduction should be identified within the next five years.

Potential key players: NYSDEC, VT DEC
Cost estimate: In-kind services
Potential funding source: NYSDEC, VT DEC
Time-frame: October, 1996 for the identification of actions; 1996-2001 for implementation
Benchmark: Identification of specific actions, as described

2. Focus Phosphorus Reduction Efforts on Targeted Watersheds

Focus phosphorus reduction efforts on the targeted watersheds identified through the Lake Champlain Phosphorus Targeting Procedure and shown in Figure 2: South Lake A (VT), South Lake A (NY), South Lake B (VT), South Lake B (NY), Port Henry (NY), Otter Creek (VT), Missisquoi Bay (VT), Main Lake (VT), Main Lake (NY), Malletts Bay, Northeast Arm, Isle LaMotte (NY). This list of Lake segment watersheds will hereafter be referred to as the "targeted watersheds".

Potential key players: All organizations, governmental agencies and private entities involved in phosphorus reduction activities
Cost estimate: not applicable
Potential funding source: Not applicable
Time-frame: ongoing
Benchmark: Targeting of phosphorus reduction activities to the above list of watersheds

3. Develop and Begin Implementing Phosphorus Reduction Strategies for Targeted Watersheds

To attain the phosphorus load targets specified in Table 2, develop reduction strategies that coordinate all local and regional watershed protection efforts and address both point and nonpoint sources of phosphorus. Reduction strategies should be developed for each sub-basin (sometimes there are several sub-basins within a targeted watershed) and should include the following steps:

a. evaluate phosphorus sources and estimate loadings from parcels within each major land use category;
b. determine the technological reliability and effectiveness of management practices for each source category, and the total amount of phosphorus reduction achievable from each source;
c. determine costs of reductions for different sources (including both point and nonpoint sources);

d. determine the minimum-cost strategy to achieve the phosphorus reduction target;
e. modify the minimum-cost strategy as needed to ensure public acceptance and economic and political viability;
f. develop a realistic and detailed funding plan for implementing the preferred strategy
g. coordinate initial implementation of the preferred strategy.

Potential key players: NYSDEC, VT DEC, NYSDAM, VT DAFM, NYS SWCDs, VT NRCDs, New York County Water Quality Coordinating Committees, VT DFPR, USEPA, USDA, USGS, VCGI, AAC, counties, regional planning commissions, municipalities, landowners, watershed associations
Cost estimate: the strategies for the LaPlatte (VT) and Little Ausable (NY) sub-basins are underway and are costing about $160,000 and $80,000 respectively; because the methodologies developed for the LaPlatte and Little Ausable were designed to be transferred to other sub-basins, strategies for the remaining targeted sub-basins of comparable size to the LaPlatte are expected to cost from $50,000 to $75,000 each, but will vary depending on size, complexity and availability of land use data. Implementation costs will be determined as part of strategy development (elements c-e).
Potential funding source: USEPA, USDA, federal and state appropriations
Time-frame: 1995-1996 for the LaPlatte and Little Ausable sub-basin strategies; 1997-2000 for the others, if funding is available. Implementation will occur incrementally over the next 20 years.
Benchmark: development and initial implementation of strategies for targeted watersheds such that a reduction of at least 25% of the difference between current (1995) loads and target loads (see Table 2) is attained in every five year period for the next 20 years.

4. Provide Funding for Point Source Phosphorus Reductions

Provide sufficient funding to make the improvements to waste water treatment plants necessary to attain the point source reduction targets specified in Table 2.

a. In Vermont, continue to provide state funding for implementation of the state phosphorus reduction statute which requires all treatment plants discharging more than 200,000 gallons per day (except aerated lagoon facilities) to lower effluent phosphorus concentrations to 0.8 mg/l. Improvements at 17 of the total 28 affected plants have been completed or are under construction at a cost of $15.6 million; the remaining 11 plants are scheduled to be upgraded by the year 2000.
b. In New York, provide funding and develop a schedule for implementing the treatment plant upgrades necessary to attain the load reduction targets specified for New York in Table 2. New York will make any adjustments to Table by October 1, 1996, as provided for in the phosphorus agreement in Appendix C.

Potential key players: VT DEC, NYSDEC, Municipalities
Cost estimate: Vermont: $8.3 million for remaining upgrades and $1 million/yr for O&M. New York has not yet indicated a specific plan for point sources, but if it follows Vermont's approach the cost is estimated to be $3.4 million for construction and $0.9 million/yr for O&M[5]
Potential funding source: state and federal appropriations
Time-frame: 1996-2015
Benchmark: Point source phosphorus reductions which in combination with nonpoint source reductions achieve at least 25% of the total targeted reduction for each watershed (see Table 2) per five year period for the next 20 years.

[5] Cost estimates for both states are from Holmes and Associates and Artuso (1996).

High Priority Actions

5. Expand and Accelerate Implementation of Existing Federal Agricultural Nonpoint Source Pollution Programs

Provide sufficient funding to accelerate implementation of USDA-Natural Resources Conservation Service (NRCS), USDA-Farm Services Agency (FSA), USEPA, and other federal programs that provide technical and cost-share assistance for management practices on farms, emphasizing waste and nutrient management and pollution prevention. Focus assistance on the targeted watersheds identified in Action 2, and ensure that allocation of funds is consistent with sub-basin strategies, where applicable.

Potential key players: USDA-NRCS, USDA-FSA, USDA-FMHA, USEPA
Cost estimate: $2.3 million/yr (estimate from Holmes & Associates and A. Artuso, 1996)
Potential funding source: federal appropriations
Time-frame: 1996-2015
Benchmark: Acceleration of on-farm implementation of phosphorus reduction measures

6. Expand Implementation of State Agricultural Nonpoint Source Programs

Continue development, coordination and implementation of respective state agricultural nonpoint source programs. Specifically, this action is to:

a. Target state cost-share funds provided through Vermont's voluntary agricultural Best Management Practices (BMP) program and New York's Environmental Protection Fund to the watersheds identified in Action 2. These funds should be used, where appropriate, to supplement federal cost-share programs to reduce the farmers' share of project costs and increase participation rates.

b. Continue implementation of recommended state management practices. In New York, encourage increased implementation of appropriate practices (as described in the state's Agricultural Management Practices Catalogue, 1992) in targeted sub-basins. In Vermont, encourage voluntary implementation of the NRCS's recommended management practices in targeted watersheds. These practices, which are referenced in Vermont's Agricultural BMP rules, go beyond the state's mandatory Acceptable Agricultural Practices.

Potential key players: NYSSWCC, VT DAFM, NYSDAM, NYSDEC, VT DEC
Cost estimate: $460,000/yr in VT; $100,000/yr in NYS (estimates from Holmes & Associates and Artuso, 1996)
Potential funding source: state appropriations
Time-frame: 1995-2015
Benchmark: improved implementation of recommended management practices and the provision of funds to increase participation in federal cost-share programs within targeted watersheds

Priority Actions (not listed in priority order)

7. Promote the Implementation of Nutrient Management Plans

Effective ongoing nutrient management on the farm is essential to phosphorus reduction efforts. This action is to provide additional training on nutrient management and to promote sustained implementation of nutrient management plans that should accomplish

the following[6] :

a. increase the use of combined soil testing with manure analysis for greater field phosphorus management to help farm owners and operators avoid applying more phosphorus fertilizer than necessary;
b. broaden the support (educational, financial and technical) for integrated crop management services; promote accurate record-keeping;
c. promote implementation and maintenance of buffer strips between croplands and surface water conveyances;
d. encourage farmers to keep livestock out of surface water by providing additional technical and financial assistance for streamside fencing and alternative watering systems;
e. promote the non-farm use of manure (e.g., distribute and market as compost);
f. promote grassland agriculture and rotational grazing as a means of reducing the demand for more intensively managed row crops and to reduce the reliance on phosphorus imports to the farm;
g. explore ways to reduce the amount of phosphorus imported to the farm, such as the phosphorus contained in animal feed supplements and other products which ultimately enter the farm waste stream;
h. promote the reduced use of cleansers containing phosphorus.

Potential key players: Farmers, University Extensions, SWCDs, NRCDs, CMAs/private consultants, USDA-FSA, USDA-NRCS, NYSDAM, VT DAFM, fertilizer dealers
Cost estimate: for a, $5 per acre; for b and d, $100,000 each beyond what is provided for in Action 5; for others, $25,000/yr (2 staff position)
Potential funding source: NYSDAM, VT DAFM, University Extensions, USDA-NRCS, USDA-FSA, CWA Section 319 program, federal appropriations
Time-frame: ongoing
Benchmark: increased implementation of practices described above

8. Expand NRCS/FSA, USFWS, and Other Agency Cost-Sharing for Streambank Restoration and the Installation of Buffer Strips

Develop or expand programs which cost-share or offer tax rebates for the voluntary restoration or protection of buffer strips on perennial streams, rivers and lakes.

Potential key players: USDA-NRCS, USDA-FSA, USFWS, NYSDEC, VT DEC, Municipalities, NY Counties, Conservation Districts, Watershed associations
Cost estimate: $100,000/yr
Potential funding source: federal appropriations, community development grants, land trusts, etc.
Time-frame: ongoing
Benchmark: identification and provision of funding for streambank restoration and the installation of buffer strips

9. Implement Retrofitted Stormwater Management Systems and other Measures for Reducing Phosphorus from Urban and Developed Land within Targeted Sub-basins identified in Action 2 above.

[6] Nutrient management plans are site specific and will vary from farm to farm. The list of activities included in this action will not apply to all farm situations.

a. utilize funding from federal programs and state bonding to construct wet ponds and other devices to reduce nutrient concentrations in stormwater runoff;
b. establish or expand street sweeping programs, educational programs on alternatives to lawn fertilizers, and other "non-structural" phosphorus reduction programs for developed areas.

Potential key players: NYSDEC, VT DEC, Municipalities, NY Counties, USEPA
Cost estimate: Will be determined as part of Actions 1 and 3, above
Potential funding source: federal and state appropriations
Time-frame: 1996-2010
Benchmark: Will be determined following completion of Actions 1 and 3

10. Research and Demonstrate the Effectiveness of Nutrient Management Practices

While some research on the effectiveness of agricultural management practices has been conducted in the Basin (Meals, 1990; Vermont Rural Clean Water Program Coordinating Committee, 1991), the following additional work is needed:

a. design and implementation of a series of carefully controlled and monitored long term demonstration projects to build a better record of the benefits of agricultural management practices;
b. research and demonstration of the effectiveness of urban management practices in cold regions;
c. research and demonstration of alternative wastewater treatment technologies and appropriate policies.

Potential key players: NYSDEC, VT DEC, NYSDAM, VT DAFM, USDA-ARS, USDA-NRCS, USEPA, USGS, LCRC, Universities
Cost estimate: for the monitoring component of a, $45,000 per demonstration site per year; costs for implementing the management practices will vary depending on the site
Potential funding source: federal and state appropriations
Time-frame: 1995 - 2005
Benchmark: completion of the research and demonstration projects listed above

Other Actions for Consideration (not listed in priority order)

11. Continue to Support the Agricultural Advisory Council (AAC)

This action recommends continuation of the Agricultural Advisory Council to improve communication between farmers and government agencies and enhance coordination of agricultural nonpoint source management activities throughout the Basin.

Potential key players: farm owners/operators, USDA-NRCS, USDA-FSA, NYSDEC, VT DEC, universities, VT DAFM, NYSDAM, NRCDs, SWCDs
Cost estimate: $20,000/year
Potential funding source: USDA
Time-frame: ongoing
Benchmark: Coordination of agricultural nonpoint source management activities

12. Develop and Implement an Awards Program for Basin Farmers

Establish an awards program to recognize farmers in the Basin who are voluntarily implementing management practices designed to improve water quality. The program could be administered separately by the states of New York and Vermont, but should

focus on the Lake Champlain Basin. The lead agencies in each state should coordinate the development of criteria for selecting award recipients. Unlike other awards programs, this program will be water quality based, will require farmers to submit applications, and will include a plaque and a monetary award for top entries in each state.

Potential key players: NYSSWCC, VTNRCC, NYSDAM, VT DAFM, NYSDEC, VT DEC, farmers
Cost estimate: $1,500/yr per state, and limited in-kind participation of agency staff
Potential funding source: USDA, USEPA, or private sponsors
Time-frame: ongoing
Benchmark: development of criteria, application, and evaluation procedures, and initial distribution of awards to at least 1 farmer in each state

13. Upgrade State Stormwater Control Programs

This action is to upgrade state stormwater programs to reflect current technical and programmatic knowledge on stormwater control. There are opportunities to enhance Vermont's program by incorporating some requirements now common in state programs in other parts of the country, and to strengthen New York's program by increasing state or local capacity to review stormwater pollution prevention plans for new development.

Potential key players: NYSDEC, VT DEC, Municipalities, NY Counties, professional organizations
Cost estimate: $100,000 ($25,000/yr for two years for each state to fund 2 staff positions. In New York, staff would develop a program in the Basin to review pollution prevention plans and conduct site visits to monitor compliance. In Vermont, staff would upgrade requirements and conduct plan reviews and inspections)
Potential funding source: USEPA, state appropriations
Time-frame: 1996-1998
Benchmark: revisions to state stormwater control programs which improve their scope and/or effectiveness

14. Encourage Local and State Implementation of BMPs for Road Construction, Repair and Maintenance.

Elements of this action could include:

a. encourage the adoption of local road maintenance and construction standards, such as those contained in the handbooks "Maintaining the Backroad" (Vermont Local Roads Program), "Vermont Backroad Erosion Control Handbook" (Ottauquechee Regional Planning Commission, 1979), and "New York Guidelines for Urban Erosion and Sediment Control" (USDA-SCS, 1989);
b. promote nongovernmental participation in reviews of projects involving road construction through processes such as Vermont's Act 250.

Potential key players: those indicated for Action 1, above, and SWCDs, NRCDs
Cost estimate: for a, $50,000 for each state
Potential funding source: state appropriations
Time-frame: ongoing
Benchmark: enhanced implementation of the above BMPs

15. Encourage Local Governments to Implement BMPs for New Development

Encourage local governments to:

a. establish water quality stormwater management through local zoning and subdivision regulation and appropriate use of the National Pollutant Discharge Elimination System (NPDES) and State Pollution Discharge Elimination System

(SPDES) permit system;

b. emphasize erosion and sedimentation control requirements in local zoning and subdivision regulations;
c. use infiltration and other BMPs in new developments;
d. use surface water setbacks and buffer strips in new developments;
e. employ appropriate growth management options;
f. assess cumulative impacts of new development.

Potential key players: municipal governments, NYSDEC, VT DEC, regional planning commissions, county planning offices, private developers
Cost estimate: in-kind participation of agency representatives
Potential funding source: same as key players
Time-frame: ongoing
Benchmark: enhanced implementation of the above BMPs

16. Encourage Cooperative Development of Local Shoreland Restoration and Protection Tools

Encourage continued coordination among government, academic, and private institutions to develop and publicize shoreland restoration and protection methods that can be adapted and used at the local level. A number of the activities listed here are currently underway (e.g., within the VT Department of Environmental Conservation's Water Quality Division). This Action is to support the continuation and expansion of these activities in both Vermont and New York. Elements could include:

a. convene various groups with expertise to summarize the best management practices and shoreland protection and restoration tools available;
b. publicize and distribute guidelines for communities, organizations and individual landowners on how, when and where to use different methods and techniques;
c. make available model shoreland management plans that can be used by private landowners, municipalities, and state agencies for individual properties;
d. encourage the formation of watershed associations;
e. support the development of volunteer programs for shoreland restoration.

Potential key players: NYSDEC, VT DEC, LCRC, USACOE, universities
Cost estimate: $50,000/yr (2 staff position per state)
Potential funding source: USEPA, USACOE, state appropriations
Time-frame: 1996-1998
Benchmark: provision of technical assistance to shoreland communities, watershed associations and landowners in shoreland protection

17. Encourage Continued Implementation of State Management Practices for Forestry Activities

In Vermont, continue implementation of Acceptable Management Practices for forest harvesting activities developed by the Commissioner of the Vermont Department of Forests, Parks and Recreation (VT DFPR). In New York, encourage implementation of the Silviculture Management Practices in the New York Silvicultural Management Practices Catalogue (1993).

Potential key players: NYSDEC, VT DFPR, landowners, loggers, VT Forest Products Association
Cost estimate: in-kind participation of agency representatives

Potential funding source: same as key players
Time-frame: 1996 and ongoing
Benchmark: improved implementation of management practices

18. Demonstrate the Use of Constructed Wetlands for Treating Wastewater and Improving Water Quality

One alternative to treating wastewater is the creation of a "constructed" wetland which simulates the water quality functions of a natural wetland. The technology for constructing wetlands is currently in the experimental stage of development and can be applied to the treatment of municipal wastewater, agricultural wastes and urban runoff.

Potential key players: USEPA, NBS, state and local agencies, LCRC, universities
Cost estimate: $25,000-$50,000 per year
Potential funding source: federal appropriations
Benchmark: completion of 3 - 5 demonstration projects

19. Investigate Cumulative Water Quality Impact Methodologies and Demonstrate their Utility in Sub-basins

This action would include research on how to track the cumulative effects of development, and the demonstration of selected water quality impact assessment methods in sub-basins. At a minimum, a system for recording development characteristics related to cumulative impacts should be set up as a demonstration project.

Potential key players: NYSDEC, VT DEC, USDA-NRCS, LCRC, universities
Cost estimate: $130,000 over a two year period
Potential funding source: federal appropriations
Time-frame: 1996-1997
Benchmark: improved understanding of cumulative impact assessment methods

Preventing Pollution from Toxic Substances

Goal: Reduce toxic contamination to protect public health and the Lake Champlain ecosystem.

Toxic substances are elements, chemicals or chemical compounds that can poison living plants and animals, including humans. Recent efforts to improve our understanding of toxic pollution in Lake Champlain suggest that, while levels are low compared to more industrialized areas such as the Great Lakes, there is still cause for concern. While certain toxic substances may come from natural sources, the increasing use and release of chemicals in our daily lives may be threatening the high quality of our Lake environment.

Toxic substances are an issue of concern in the Basin, in part because of health advisories in both New York and Vermont regarding the consumption of fish species with elevated levels of mercury and polychlorinated biphenyls (PCBs). An extensive survey of Lake bottom sediments revealed elevated levels of mercury in many parts of the Lake, and several other toxic substances in specific locations. The presence of toxic substances raises concern about their impacts on the Lake ecosystem, as well as on drinking water and the Lake's other uses.

Issues:

Focusing Efforts on Sites of Concern and Substances of Concern

Research results have shown that three sites in Lake Champlain - Cumberland Bay, Inner Burlington Harbor and Outer Malletts Bay - have the most significant toxic contamination. This knowledge will allow managers to geographically target toxic reduction and prevention actions in those areas where there are known problems, or where future problems can be prevented. The Lake Champlain Basin Program has reviewed the substances found to date in Lake Champlain and has ranked them based on the extent and levels at which they are found and the risk that they may pose to human health and the ecosystem. Groups 1 and 2 toxic substances of concern (See Table 3) merit highest priority for management action because they are found in Lake Champlain sediment, water or biota at levels above appropriate standards or guidelines, indicating potential risks to human health or the ecosystem.

Identifying Sources and Quantifying Loads of Toxic Substances

Although work has begun to identify sources of toxic substances within the Basin, few active sources have been identified. Major questions remain concerning the sources, routes of transport, and delivery of toxic substances within and outside the Basin. Current information suggests that regulated point source wastewater discharges are not the primary sources of PCBs and mercury; PCBs have been banned from discharges, and mercury limited to very low levels. Remaining questions include: 1) how much of these substances comes from outside the Basin and 2) what role do historical sources and contaminated sediments play. These information gaps on sources and transport of toxic substances pose significant questions with respect to future management options.

Table 3. Toxic Substances of Concern Found in the Lake's Biota, Sediment and Water

Priority	Toxic Substance	Criteria for Selection
Group 1	PCBs, mercury[1]	Persistent contaminants found Lake-wide (in either sediment, water or fish) at levels above standards indicating potential risk to human health, wildlife, or aquatic biota. These are highest priority for management action.
Group 2	Arsenic, cadmium, chromium, dioxins/furans, lead, nickel, PAHs, silver, zinc[2]	Persistent contaminants found in localized areas (in either sediment, water or fish) at levels above standards or guidelines indicating potential risk to human health, wildlife, or aquatic biota. These are next highest priority for management action.
Group 3	Ammonia, persistent chlorinated pesticides, phthalates, chlorinated phenols, chlorine, copper	Contaminants that are found above background levels in localized areas of the Lake, but below appropriate standards or guidelines.
Group 4	e.g., VOCs such as benzene, acetone, pesticides such as atrazine and alachlor, strong acids and bases, other potential pollutants such as fluoride	Contaminants known to be used or known to occur in the Lake Champlain Basin environment.

[1]Based on US Food and Drug Administration (FDA) standards
[2]Based on a variety of guidelines (NOAA, Ontario, USEPA) regarding toxics in sediments

Limitations of Current Information on Fate and Effects of Toxic Substances

Even if all sources of toxic substances were eliminated tomorrow, it would take a very long time to rid the ecosystem of these pollutants. Toxic substances accumulate in lake bottom sediments, where they remain for long periods if undisturbed. They may be resuspended, consumed or directly absorbed into organisms, and enter the food web. Since scientists do not know much about these interactions, additional research is needed.

Questions also remain about human and ecosystem health effects from toxic substances in the Basin environment. These unknowns, including the risk to humans from eating contaminated fish, complicate decisions regarding the appropriate public policy response. Public awareness and understanding of fish consumption advisories must be improved, along with coordination of state and federal fish tissue monitoring programs. There is also a need to evaluate impacts of toxic substances on sites of concern and on the Lake's ecosystem. Important information can be gained from other ecosystems, including the Great Lakes and the Chesapeake Bay, that have had the benefit of longer term monitoring and research efforts.

Setting Appropriate Goals and Standards

Despite the success of current programs to reduce toxic substances in the environment, some problems, such as PCBs and mercury in fish, continue to defy easy solutions. These and other substances that are persistent and tend to bioaccumulate to some degree, challenge the existing regulatory structure because: 1) existing programs were designed to deal primarily with "simpler" contaminants; 2) certain sources of these contaminants are unregulated; and 3) significant quantities of these substances have built up in the environment (in sediment, biota, etc.) and continue to cycle through the ecosystem.

Many of these issues are gaining attention in other areas of the country, including the Great Lakes and the Chesapeake Bay region. Managers charged with solving pollution problems in the Great Lakes have adopted a general, long-term goal to "virtually eliminate" sources of certain high priority toxic substances. Confronting the challenges posed by persistent and bioaccumulating contaminants in the Lake Champlain Basin will require establishing firm and defensible toxic reduction goals and implementation of mechanisms capable of attaining these goals.

Adopting a Strategy to Prevent Pollution Rather Than Manage It
Faced with the increasing costs and liabilities associated with end-of-pipe waste management practices, agencies and waste generators are turning to pollution prevention as a cleaner, safer and more cost-effective strategy. Pollution prevention means altering methods and processes so a pollutant is never generated, rather than treating or controlling the contamination after generation and disposal. It includes such techniques as reducing the use of toxic substances, substituting non-toxic raw materials if available, and modifying manufacturing processes.

Objectives: (not listed in priority order)

1. Prevent pollution from toxic substances in the Lake Champlain Basin.

2. Focus management efforts on reducing those toxic substances (such as PCBs and mercury) found at or above levels known to exceed human health standards or adversely affect aquatic life.

3. Identify and target sites of concern with respect to toxic contamination, and make these areas or watersheds high priorities for management activities.

4. Reduce all types of toxic substances from point sources.

5. Reduce nonpoint sources of toxic substances to the Lake.

6. Meet all existing standards for drinking water and fish consumption.

7. Protect living resources from the effects of toxic substances.

8. Improve public understanding of the impacts of toxic substances in Lake Champlain and the research and management programs related to toxics.

Highest Priority Actions

1. **Focus on Toxic Substances of Concern and Sites of Concern, but Reduce other Toxic Substances Throughout the Basin**
   This action represents the strategy selected by the LCMC for 1) restoring areas where pollution is a problem, and 2) preventing future problems by reducing the use of toxic substances at their source. Specifically, the action calls for focusing reduction efforts on Toxic Substances of Concern (at this time, Group 1 - PCBs and mercury, and Group 2 - arsenic, cadmium, chromium, dioxins/furans, lead, nickel, PAHs, silver and zinc) - substances that have been identified as creating known or suspected human health and

ecosystem risks; Sites of Concern (at this time, Inner Burlington Harbor, Cumberland Bay and Outer Malletts Bay) - areas where one or more toxic substances are known to occur at levels potentially creating risks; and Voluntary Pollution Prevention Measures for all toxic substances used or produced in the Basin. Elements of this strategy would include the following:

a. develop an iterative process for revising the list of Toxic Substances of Concern based on new data (using risk-based criteria);
b. target source identification in watersheds based on tributary monitoring and other data;
c. develop and implement multi-media reduction strategies (see Action 2);
d. evaluate alternatives for sites of concern (see Action 4);
e. implement common-sense, "low cost/low tech" pollution prevention measures immediately (see Actions 3, 5);
f. develop incentive programs for business and citizen participation.

For contaminated areas, efforts could focus on establishing a consistent approach for identifying sites, characterizing the extent of contamination, tailoring research efforts to answer critical management questions, and cooperatively developing alternative clean-up scenarios.

Potential key players: partnership of federal, state and local agencies, Province of Quebec, research institutions, LCRC, and private and non-profit entities
Cost estimate: $50,000 per year for coordinator, with in-kind participation of agency and research representatives
Potential funding source: federal appropriations
Time-frame: 1994 - 2001 (ongoing)
Benchmark: adoption of toxic substances reduction strategy by key players

2. Develop and Implement Pollution Prevention and Control Strategies for Groups 1 and 2 Toxic Substances of Concern

For each pollutant identified as a Group 1 or 2 toxic substance of concern, develop and implement a Basin-wide strategy for preventing and controlling that substance in order to meet established standards and guidelines for water, air, sediment and biota. Group 1 toxic substances of concern are persistent contaminants found lakewide above FDA standards. Group 2 toxic substances of concern are persistent contaminants found in localized areas at levels above NOAA, Ontario or USEPA guidelines for toxic contaminants in sediments. Elements of each prevention and control strategy would include:

a. characterize and assess extent and effects;
b. identify sources (both point and nonpoint sources), targeting likely "source" watersheds based on tributary testing;
c. evaluate prevention and control alternatives, including fiscal and economic impacts and effectiveness;
d. implement reduction measures based on existing regulations and pollution prevention activities.

These strategies would include measurable load reduction goals, environmental measures

or indicators of success, and a schedule for implementation. Cost-effective pollution prevention measures for any active sources of these substances should be implemented immediately (see Actions 3, 5). Controlling distant sources (including atmospheric pollutants) may present a special challenge.

Potential key players: for planning elements a-c, a partnership of federal, state and local agencies, research institutions, industry and nonprofit entities, etc.; for d, those identified above, and all users of toxic substances in the Basin
Cost estimate: for a-c, $250,000-$1,000,000 per year (additional staff and monitoring, depending on scope of effort); for d, to be determined
Potential funding source: state and federal appropriations and in-kind participation
Time-frame: ongoing (For PCBs and mercury: a and b underway; completion of a - c, three years; d, 1996-2001)
Benchmark: development of toxic substance-specific strategies through a series of workshops; endorsement and implementation by states and other key players; restoration of fisheries use without restrictive health advisories

High Priority Actions

3. Accelerate Implementation of Pollution Prevention Programs in Targeted Watersheds

This action recommends that New York and Vermont implement pollution prevention programs in the Basin to the fullest non-regulatory extent possible. Possible elements would include the following:

a. negotiating toxics reduction goals for major dischargers or hazardous material generators;
b. increasing the availability of waste reduction assessments and technical assistance to reduce end-of-pipe loadings of pollutants;
c. encouraging states or municipalities to implement toxic waste reduction programs;
d. establishing economic incentives for private-sector pollution prevention;
e. promoting waste exchanges (e.g., regional waste exchanges).

Potential key players: state and local agencies, USEPA, businesses, nonprofits
Cost estimate: $250,000 for training and staff support; in-kind participation of state and federal agencies
Potential funding source: USEPA, federal and state appropriations
Time-frame: ongoing
Benchmark: increase in technical assistance to businesses and municipalities; improved implementation of non-regulatory pollution prevention programs

Priority Actions (not listed in priority order)

4. Evaluate Management Alternatives for Sites of Concern

For Sites of Concern identified by ongoing research and monitoring (Inner Burlington Harbor, Outer Malletts Bay and Cumberland Bay to date), characterize the extent of contamination, evaluate alternative remedial actions, and make recommendations to the States of New York and Vermont and the USEPA based upon findings. Elements would include:

a. identify site;
b. characterize extent and severity of contamination, and effects;
c. consider restoration alternatives, including no action, source identification,

pollution prevention, remediation (for example, dredging, containment, *in situ* treatment, etc.) and other alternatives; and

d. recommend best alternative to local government, states, USEPA and U.S. Army Corps of Engineers (USACOE).

Potential key players: for a-b, LCRC with NYSDEC and VT DEC, USEPA, USFWS, and other federal agencies; for c-d, a partnership of interested parties
Cost estimate: for a-b, $200,000-$500,000 per site; for c-d, cost of supporting coordinating committee and supporting studies
Potential funding source: USEPA and federal appropriations
Time-frame: 3-5 years per site, with ongoing process for site identification
Benchmark: report documenting above elements a-d

5. Encourage Industries and Businesses, and Public Institutions to Implement Pollution Prevention and Recycling Measures

Examples of pollution prevention or source reduction measures which could be implemented by businesses, industries, or public institutions include:

a. switching to non-toxic or less toxic products and raw materials;
b. promoting the development and implementation of pollution prevention plans and activities for direct and indirect dischargers of toxic substances of concern;
c. conducting public education programs on source reduction, use of non-toxic alternatives, and recycling measures.

Examples of recycling measures include:

a. recycling mercury from light switches and fluorescent light bulbs;
b. initiating periodic collection programs for mercury and PCB-bearing substances.

Potential key players: NYSDEC and VT DEC (including Pollution Prevention and Solid/Hazardous Waste Management Divisions), municipalities, industries, non-profit entities and USEPA
Cost estimate: $50,000-$100,000
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: commitment from municipalities, businesses and industries to prevent pollution

6. Continue Research on the Fate and Effects of Toxic Substances

There are major information gaps regarding the fate and effects of toxic substances in the Lake Champlain ecosystem. Initial results of research indicate that toxic substances such as PCBs in Lake bottom sediments can enter the food web. However, researchers do not fully understand the impacts of toxic substances on the Lake Champlain ecosystem. Examples of key research needs include:

a. assessment of the effects of chronic exposure on key food web components, particularly vulnerable life stages;
b. determination of how toxic substances like PCBs and mercury cycle through the Lake;
c. coordinated, cooperative data exchange and analysis;
d. identification of and response to emerging issues.

Potential key players: Research institutions and the LCRC, in coordination with NYSDEC and VT DEC, and

researchers from Quebec
Cost estimate: $250,000 per year (minimum)
Potential funding source: federal and state appropriations
Time-frame: 1994-1999
Benchmark: completion of research elements a and b, and publication of results

7. Assess the Importance of Sites of Concern as Sources of Toxic Substances

In certain areas, processes such as water currents, bioturbation and bioaccumulation provide mechanisms for toxic substances in sediments to be redistributed to "cleaner" areas of the Lake. An estimation of a site, such as Cumberland Bay, to be a significant source of toxic substances to other parts of the Lake would be an important factor in clean-up decisions. This action will be coordinated with research efforts of Action 6.

Potential key players: Research institutions, LCRC, NYSDEC and VT DEC, USFWS, NOAA
Cost estimate: $200,000 per site (low estimate)
Potential funding source: federal and state appropriations
Time-frame: ongoing
Benchmark: completion and publication of research on above; development of recommendations regarding clean-up

8. Establish Consistent Water Quality Standards, Ecosystem Goals and Ecosystem Indicators for Toxic Substances Reductions

This action recommends that New York and Vermont establish consistent water quality standards, biological criteria and indicators of ecosystem health, and a time frame for implementing/achieving them. Consistency does not predetermine that standards will be more restrictive or less restrictive than present standards. There would be a strong public participation element in developing locally acceptable goals. States would have flexibility in how they choose to achieve these goals.

Potential key players: partnership of state agencies, USEPA, USFWS, LCRC, Lake Champlain Steering Committee, public
Cost estimate: in-kind participation of agencies
Potential funding source: same as key players
Time-frame: ongoing
Benchmark: development and adoption of consistent standards for toxic substances in Lake Champlain

9. Evaluate Existing Regulatory Framework with Respect to Toxic Substance Reduction and Control

This action recommends that the USEPA, states and municipalities evaluate and revise where appropriate, the existing regulatory framework with regard to the detection, control, and remediation of toxic substances. Program elements to evaluate could include the following:

a. monitoring and assessment: establish sufficient resolution in ambient monitoring to enable timely and effective response to environmental contamination;
b. source control: revisit existing waste load allocation policy with respect to substances that bioaccumulate;
c. standards: revise and expand ambient standards with specific emphasis on substances that bioaccumulate, sediment criteria and biological criteria;
d. full enforcement of existing programs.

Potential key players: state agencies, USEPA, USFWS, LCRC, universities, industries, and local governments

Cost estimate: (to be determined - this may require additional research or monitoring)
Potential funding source: federal and state appropriations
Time-frame: ongoing
Benchmark: completion of evaluation based on series of facilitated meetings with key players; implementation of any recommended revisions

Other Actions for Consideration (not listed in priority order)

10. Establish or Improve Household Hazardous Waste Collection Programs

This action recommends that Lake Champlain Basin municipalities collect and properly dispose of household hazardous waste on a continuous basis.

Potential key players: NYSDEC and VT DEC, USEPA, municipalities, non-profits
Cost estimate: $50,000 for seed money to New York communities, and $50,000 for disposal costs in Vermont; $50,000 for technical assistance, including staff support; in-kind participation of local, state and federal agencies
Potential funding source: USEPA, federal and state appropriations
Time-frame: ongoing
Benchmark: establishment of several community-based collection programs

11. Target Watersheds for Accelerated Source Identification and Implement Reductions

Building on existing or ongoing monitoring efforts (tributary monitoring, Lake sediment screening, biota sampling, etc.), implement a geographically-targeted identification ("track down") of contaminants of concern. Include nonpoint and non-regulated sources in this effort. These efforts should be coordinated across state boundaries and with Quebec using a shared data base and GIS.

Potential key players: partnership of state, federal and local agencies, Province of Quebec, LCRC, and watershed associations
Cost estimate: $100,000-$200,000 per year ($250,000 for increased NYS sampling), with in-kind support from state agencies
Potential funding source: federal and state appropriations
Time-frame: 1994-2001
Benchmark: development of criteria for targeting watersheds; completion of NY and VT source identification and reduction reports detailing geographic track-down of sources on a watershed basis (with associated maps)

12. Adopt a Mass Balance Approach for Toxic Substances of Concern

Modelling is one approach which resource managers use to understand the transport of toxic substances through ecosystems. It can also improve our ability to estimate the relative magnitude and importance of sources of these toxic substances. This action calls for adapting and refining existing mass balance models for PCBs and mercury. This work would include:

a. evaluating and filling gaps in existing data collection and monitoring efforts;
b. using the modelling approach to organize data and target sources;
c. evaluate the influence of sources within vs. outside the Basin.

Potential key players: NYSDEC and VT DEC, LCRC, USEPA
Cost estimate: $50,000 (for each substance, if using existing data and model); for additional data collection, $200,000 for PCB monitoring, $300,000 for mercury monitoring
Potential funding source: federal and state appropriations
Time-frame: 1995-1996
Benchmark: compilation of data; calibration and application of mass balance model

13. Continue to Review Discharge Data for Sources of Toxic Substances of Concern
This action would include the following elements:

a. screen all existing data for known or suspected sources of these substances;
b. encourage enforcement of all existing programs;
c. evaluate the Toxic Substances Release Inventory data for the Lake Champlain Basin for additional sources.

Potential key players: NYSDEC and VT DEC, USEPA, Province of Quebec
Cost estimate: in-kind participation of state and federal agencies
Potential funding source: NYSDEC and VT DEC, USEPA
Time-frame: ongoing
Benchmark: completion of report detailing the identification and remediation/control of sources of toxic substances of concern

Protecting Human Health

Goal: Minimize the risks to humans from water-related health hazards in the Lake Champlain Basin.

Everyday we are faced with a variety of voluntary risks (e.g., cigarette smoking or driving a car) and involuntary risks (e.g., breathing air of poor quality or being struck by lightning). Determining what is an acceptable level of voluntary risk is an individual decision based on knowledge of the risks. Many environmental regulatory actions are directed towards reducing involuntary risk from exposures to substances in air, water and food. Such actions involve determining what is an acceptable level of risk and limiting exposure to the level thought to be acceptable.

This section focuses on potential health threats associated with poor water quality in Lake Champlain and is limited to assessing risks from drinking water, eating fish and wildlife, and swimming in the Lake. It does not address ground water quality, other surface water bodies in the Basin, or air quality issues in the Basin. A more complete examination of human health issues throughout the Basin will be added over time, as resources permit.

Issues:

Controlling Sources of Pathogens Particularly from Septic Systems

Pathogens are disease-causing agents such as bacteria, viruses and parasites. Examples of water-related pathogens include giardia and cryptosporidium which cause gastrointestinal illnesses when ingested. Exposure is primarily through ingestion, either accidentally while swimming, or when drinking water from the Lake. The presence of pathogens causes occasional beach closings around the Lake, mostly in Chittenden County, VT. Many sources of pathogens are addressed by recommendations included elsewhere in this Plan that are designed to control contaminants such as phosphorus or toxic substances. For example, agricultural wastes, an important source of pathogens, are addressed in the phosphorus section. Since failed septic systems are a source of pathogens not addressed elsewhere, it is important to investigate them as areas of potential contamination and devise flexible solutions to the problems they pose.

Difficulties Facing Small Public Water Systems Attempting to Meet the Requirements of the Safe Drinking Water Act (SDWA)

The SDWA presently requires all public water systems serving the same population for more than six months to monitor for 84 contaminants in drinking water. Public water systems serving a transient population are required to monitor for acute contaminants including bacteria, nitrate and nitrite. Additional requirements are to be phased in (25 new contaminants every three years, initiated in 1993) until 200 contaminants are to be monitored by the year 2000. Of particular concern is the "surface treatment rule," which will require filtration of all surface water sources unless the water supplier can meet certain strict criteria related to the protection of the supply from sources of contamination. Although these requirements may be amended as part of the upcoming reauthorization of the Act, it is clear that there will be an increasing burden placed on public water supply systems in the near future. It is widely agreed that this burden will fall most heavily on small water systems, many of which are privately owned. Costs imposed by these

requirements will be difficult for small systems to bear, and technical expertise often will not be as readily available to them. For drinking water systems not under the auspices of the SDWA, education is the best approach to protecting the health of the users.

Availability of Comprehensive, Statistically Valid Fish Tissue Data
The fish sampling programs of the two states and Quebec are currently not well coordinated, and do not provide a comprehensive data base over time. One reason the state programs are limited is the high cost associated with sampling fish for the types of contaminants of concern. However, it is difficult to discover trends or provide statistically valid conclusions without a more extensive data base.

Communication of Potential Human Health Risks to the Public
Communicating risks is an important part of any effort to protect human health. New York and Vermont have worked together to the extent that they inform each other of any press releases or health advisories before they are released, and both states are beginning to use similar methods of educating the public and communicating risks. New York hands out information on all fish advisories with every fishing license issued and Vermont initiated a similar practice in 1994. Neither state coordinates closely with Quebec on these issues.

Objectives: (not listed in priority order)

1. Control sources of pathogens found in the Lake and its Basin in order to ensure drinkable water and eliminate the need for closing beaches.

2. Improve public understanding of the reasons for beach closings and preventive measures to protect human health.

3. Ensure that public water systems, especially the small privately owned systems, are able to meet the requirements of the Safe Drinking Water Act, both technically and financially.

4. Improve public understanding of drinking water issues including such things as lead in drinking water, conservation, water testing labs and general water quality conditions.

5. Identify potential human health risks from eating fish caught in Lake Champlain including toxic substances of concern, populations of concern, fish species of concern.

6. Where a health risk is identified, communicate results to public and implement plans to reduce that risk.

High Priority Actions

1. Encourage the States and Federal Government to Provide Funds to Implement the Safe Drinking Water Act

The SDWA provides the mechanisms to protect human health; however, its requirements are expensive, particularly for small water systems. This action would recommend that funds be made available so that water systems, especially small water systems which are presently regulated under the SDWA, can implement the requirements of the SDWA.

Water systems which are presently exempted from the requirements of the SDWA will remain exempted. There is an urgency to this action because federal and state governments are making funding decisions.

Potential key players: USEPA, VT DEC, NYSDOH, water system operators, citizens
Cost estimate: in-kind participation
Potential funding source: not applicable
Time-frame: immediate
Benchmark: letters to state and federal representatives documenting the difficulties faced in implementing the SDWA, followed up by phone calls, testimony, etc. as appropriate

Priority Actions (not listed in priority order)

2. Investigate Areas with Potential Contamination Problems Due to Faulty Septic Systems and Devise Flexible Solutions to the Problems

In areas where there are problems with pathogens in the water, and reason to suspect contamination from septic systems, this action would recommend performing investigations, in close cooperation with the municipalities, using dye tests and other methods to locate problems, devise solutions and provide the technical assistance necessary to make changes. Following the examples of Vermont On-site Sewage Committee's examination of septic system regulations and the Alternative Wastewater Technologies Conference sponsored by the Lake Champlain Basin Program, this recommendation encourages the consideration of alternative solutions to septic system problems. Municipalities should receive cost sharing funds from state or federal agencies for any remediation or upgrades required.

Potential key players: VT DOH, VT DEC, NYSDOH, NYSDEC, local health units (in Vermont), private health organizations, municipalities
Cost estimate: $60,000 (the equivalent of one person in each state)
Potential funding source: state and federal appropriations, CWA Section 319 Program
Time-frame: ongoing
Benchmark: documentation of at least 50 septic system investigations, in targeted areas, with demonstration of progress towards solutions

3. Develop a Coordinated Approach to Risk Communication

This action would coordinate fish advisories and include a strong public education and outreach effort lakewide to ensure similar information reaches people in all three jurisdictions surrounding the Lake. This effort would also include an aggressive attempt to educate individuals regarding what constitutes risk, what the risks are to particular groups of individuals, and what an individual can do to minimize the risks he/she may face from eating fish and wildlife from the Lake. Care should be taken to ensure that risks are neither overstated nor understated.

Potential key players: VT DEC, VT DOH, VT FWD, NYSDEC, NYSDOH, USEPA, counties, private health organizations, Province of Quebec - Ministry of the Environment, Fish and Wildlife Management Cooperative
Cost estimate: in-kind participation
Potential funding source: same as key players
Time-frame: ongoing
Benchmark: Protocols will be developed to share results of sampling efforts and report them to the public through joint press releases and joint health advisories regarding fish consumption and other risk related issues

Other Actions for Consideration (not listed in priority order)

4. Provide Opportunities for Technology/Information Transfer Focusing on the Needs of Small Systems

This action would provide a forum for a transfer of expertise from large systems to small systems. This assumes that personnel at large systems may have had greater training and educational opportunities which would be of benefit to those individuals responsible for small systems. VT ANR provides required, free training to small system operators already, so this action may just expand the existing training. New York water system operators are required to be trained, so this may be incorporated into the existing training.

Potential key players: VT DEC, NYSDOH and water system operators
Cost estimate: in kind participation of agencies
Potential funding source: same as key players
Time-frame: ongoing
Benchmark: expanded training programs for water system operators which focus on the issues facing small systems

5. Undertake Further Focused Research and Risk Assessment Based on Results of the Fish Consumption Survey

Based on the results of the first fish consumption survey, assess the need for further research. This assessment should focus on research needs addressing the following four issues:

a. because the first consumption survey focused only on licensed anglers, assess consumption patterns of other fish consumers, particularly local populations, including Native American and Asian populations which may consume larger amounts of fish from the Lake;
b. because of the particular sensitivity of children and women of childbearing years to consumption of contaminated fish, assess their consumption patterns;
c. based on the discovery of elevated levels of PCBs in Cumberland Bay, conduct an assessment of PCBs levels in perch populations in the Bay;
d. because fish consumption rates are higher for Lake Champlain anglers than the average for the U.S. population as a whole, develop a risk assessment specific to the population around Lake Champlain.

Potential key players: VT DEC, VT DOH, VT FWD, NYSDEC, NYSDOH, USEPA contractor support, private health organizations, universities
Cost estimate: $50,000-$100,000
Potential funding source: state and federal appropriations
Time-frame: 1996-1998
Benchmark: completion of reports identifying the fish consumption patterns of and risks posed to particular populations, including unlicensed anglers; report assessing the health of perch in Cumberland Bay

Chapter 3. Living Natural Resources

The living natural resources of the Lake Champlain Basin are part of a very complex ecosystem. Fish and wildlife, including the nuisance nonnative aquatic species such as sea lamprey, occupy a mosaic of interconnected aquatic and terrestrial habitats. These habitats include the broad open waters of the Lake, the rivers and streams that flow into it, wetlands and shallow water flats, islands, forests, agricultural lands and other areas. Although fish may be one of Lake Champlain's most obvious resources, many other animals and plants also depend on the Lake for breeding, wintering and migration habitat. The Basin's living natural resources can be divided into six major groups: fish, invertebrates, amphibians and reptiles, birds, mammals and plants. Humans are also part of the ecosystem, and in many places the effects of human activities and development have had severe adverse consequences on local ecosystems.

This chapter includes the following subjects:
$ Managing Fish and Wildlife
$ Protecting Wetlands
$ Managing Nuisance Nonnative Aquatic Plants and Animals

Managing Fish and Wildlife

Goal: Manage fish and wildlife populations and ecological communities to provide continuing social and environmental benefits

The Basin's fish and wildlife resources provide tremendous social, economic and environmental benefits to the region. For example, the abundance of certain fish and wildlife species attracts recreational hunters, bird watchers and anglers who spend money in local communities. In 1988, people spent over $32 million while fishing in the Basin. Bird and other wildlife viewing activities contribute to the Basin's economy, too, generating over $50 million a year in Vermont (Vermont Agency of Natural Resources, 1996). This complex array of plants and animals also provides innumerable environmental benefits, such as pollution and sediment filtration by some wetland communities, and aquatic food web support by Lake Champlain's plankton and forage fish populations. Although the role of many species in the Lake's ecosystem is poorly understood, their presence is highly valued as part of the region's natural heritage.

Issues:

Enhancing Application of an Ecosystem Approach to Fish and Wildlife Management
Lake Champlain supports an abundance of fish and wildlife species, and current management efforts have achieved a measure of success. The Plan calls for these management activities to be expanded and integrated to incorporate additional components of the Lake Champlain ecosystem. Recreational use and enjoyment of fish and wildlife resources is an important feature to be considered.

A number of ongoing and proposed management actions for Lake Champlain may have significant effects on other natural communities. For example, the lamprey control program and salmonid stocking efforts are increasing the numbers of predators feeding on forage fish in the Lake. Also, Basin-wide management of phosphorus inputs, by decreasing the nutrient concentrations in the Lake, will alter the phytoplankton food base available to zooplankton and smaller fish. We cannot yet predict how the Lake Champlain aquatic community will respond to these changes (See Figure 3).

Managing Threatened and Endangered Species
Populations of some rare, threatened and endangered plant and animal species in the Lake Champlain Basin are declining as a result of habitat degradation, invasions of exotic species, collection and other factors. Of the approximately 487 vertebrate species of fish and wildlife thought to be in the Basin, 27 species are officially listed by federal and state agencies as being endangered and threatened. More information on the status of - and threats to - these species and natural communities, in addition to more public education, is necessary for their protection and restoration. A comprehensive inventory of these species and their habitats for the entire Lake Champlain Basin is critical, as is close coordination by various agencies on all aspects of protection and restoration.

Conserving, Enhancing and Restoring Habitat
Although the Lake Champlain Basin provides a rich and varied habitat for aquatic and terrestrial

species, much habitat has been lost due to residential and commercial development. Because of this, strategies to conserve, enhance and restore habitat should be implemented. Further study is needed to document land use practices which can cause adverse direct and indirect impacts to important habitats. It's important that the many agencies involved share data and coordinate management efforts especially with willing landowners who wish to conserve, enhance or restore fish and wildlife habitat.

Objectives: (not listed in priority order)

1. Enhance integration of current fish and wildlife management programs to facilitate application of a comprehensive, ecosystem approach to management.

2. Conduct research on food web dynamics, and use this information in management programs.

3. Manage top aquatic predators (e.g., salmon, lake trout and walleye) as an integral component of the Lake Champlain ecosystem.

4. Coordinate protection and management strategies for federally-listed threatened and endangered species and species that are listed in both states under their respective endangered species laws.

5. Identify, inventory, and conserve federal and state-listed rare, threatened and endangered species and their habitats and the most outstanding wetland and upland natural communities.

6. Maintain, enhance, restore, and protect habitat quality, quantity, and diversity necessary to support the living resources of the Lake Champlain Basin.

7. Maintain the biodiversity of the Lake Champlain ecosystem and restore native species that are missing from the system when biologically feasible, socially acceptable and environmentally beneficial.

8. Coordinate fishery harvest regulations between New York and Vermont.

9. Complete the experimental sea lamprey control program and develop a long-term policy on sea lamprey management for Lake Champlain.

10. Coordinate the management of migratory wildlife.

11. Ensure effective toxic substance monitoring in fish and wildlife species and improve coordination on toxic substance monitoring with the Province of Quebec, focusing on the effect of toxic substances on fish and wildlife.

12. Enhance current education and outreach programs that inform the public about the ecological, economic and social importance of fish and wildlife, management goals, and the meaning of fish and wildlife-related health advisories.

13. Address problems associated with native nuisance species and their management that impact fish and wildlife resources and unique ecosystems or cause potential human health and safety problems.

High Priority Actions

1. Identify and Restore Habitats and Conserve Vulnerable Habitat Corridors

Under this action, non-regulatory measures would be initiated, with willing landowners, to identify the habitat losses adversely affecting threatened and endangered species, as well as existing vulnerable habitat corridors, and develop programs for restoration and conservation of those habitats. These actions would also effectively protect other, non-endangered species. Where feasible, this action should use GIS to aid in the voluntary habitat identification process. Elements of this action would include:

a. identify, to the extent practical, present and former habitats of state and federally-listed species in the Lake Champlain Basin;
b. conduct genetic analyses and measures of vulnerability to species extinction by chance;
c. select species whose habitat history indicates the species' decline may be halted or reversed through restoration of habitat corridors, and develop programs for habitat restoration;
d. select species whose present habitats are vulnerable to destruction and develop programs for habitat conservation.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, and other academic and private sector cooperators
Cost estimate: $100,000 per year
Potential funding source: federal appropriations, Endangered Species Act '6 funds, and private partners
Time-frame: ongoing
Benchmark: development of report identifying habitat needs of listed species along with recommendations for specific conservation measures

Priority Actions (not listed in priority order)

2. Refine Current Management of Lake Champlain's Fish and Wildlife Resources to Enhance the Application of an Ecosystem Approach

Lake Champlain's top aquatic predators, primarily the Lake's salmonids, bass, walleye and pike, have an extremely active and effective constituency: the sport fishing community. Similarly, game animal conservation is strongly supported by sport hunters. Recreational hunting and fishing and the species they affect have been managed and regulated very effectively by the States of Vermont and New York and the U.S. Fish and Wildlife Service under the Lake Champlain Fish and Wildlife Management Cooperative (LCFWMC). To ensure the continued success of an interstate fish and wildlife management program that mutually benefits game species and nongame species, this action would use knowledge gained from Action 3 and include the following activities:

a. review current fish and wildlife management plans and reports in terms of their

consideration of the long-term sustainable yield of the fishery and wildlife resources;

b. examine specifically the interrelationships between management programs for top aquatic predators including salmonids, bass, walleye and pike;
c. incorporate appropriate additional key species into the management of Lake Champlain fisheries, such as white perch, yellow perch and cormorant;
d. build management strategies for native species that become nuisances into wildlife programs;
e. perform site-specific species or habitat enhancements, such as nuisance wildlife control and pond reclamation, while protecting wetlands and threatened and endangered species.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, and USDA Animal Damage Control
Cost estimate: staff biologist/coordinator, $50,000 per year, and continued in-kind services of participating agencies.
Potential funding source: USFWS (e.g., federal aid funds), state and federal appropriations
Time-frame: ongoing
Benchmark: development of an ecosystem-based management plan for key species in the Lake Champlain watershed

3. Integrate Aquatic Food Web Models into Fisheries Management Decisions

Food web or "bioenergetics" models allow managers to predict how changes in populations of one species or community of species will affect other components of the ecosystem. One important purpose of constructing and maintaining food web models is to allow fisheries managers to adjust salmonid stocking rates to meet both forage base and angler needs. The LCBP has funded two initial food web model studies designed to predict the ecosystem implications of alternative management actions. In Lake Champlain, the effects of the recent invasion of the zebra mussel and efforts to reduce nutrient levels would be better evaluated using a systematic approach. The food web model may be used to assist with the following specific activities:

a. continue to fill the critical gaps in knowledge about Lake Champlain food webs (Information on linkages and rates of consumption at each level in the system is especially important in order to develop predictive management models);
b. target management actions to increase grazing of undesirable phytoplankton by organisms higher in the food web;
c. coordinate various efforts to control point and nonpoint sources of nutrients entering Lake Champlain with food web management activities;
d. determine the effects of human activities on the food web.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, LCRC, NBS, universities
Cost estimate: $100,000 per year
Potential funding source: state and federal appropriations
Time-frame: 3-5 years
Benchmark: complete development and refinement of food web models for use in management programs

4. Use Biological Indicators of Ecosystem Change

The purpose of this action is to enhance the efficiency of government and private expenditures used for living resources management by reducing the need to monitor large numbers of species. Fish and wildlife management decisions affecting the Lake Champlain

Basin are often made on the basis of limited data, which has been made available through sparsely funded federal and state data collection activities. To improve this situation, a plan would be developed that uses biological indicators to monitor ecosystem change and to help guide management decisions regarding fish and wildlife conservation. For example, data demonstrating declines or increases in indicator species or communities could provide information about the expected trends of associated species, as well as by providing early notice of the need for management action. Specific elements of this effort would include:

a. select biological indicators of ecological change;
b. classify and select reference sites for these species and communities;
c. inventory fish and wildlife species and habitats (i.e., build a bi-state biological database for the Basin);
d. determine and monitor the population characteristics (e.g., age-class structure, growth, reproduction and recruitment) of selected species and communities;
e. determine and monitor physical and chemical characteristics of the habitat of the selected species and communities;
f. use this information in addition to public input to assist in future management decisions.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, LCRC, NBS, USEPA, universities
Cost estimate: $150,000 per year for a and b (for staff and operating expenses); $300,000-$400,000 per year in subsequent years for c through e
Potential funding source: state and federal appropriations
Time-frame: 5 year demonstration project
Benchmark: completion of Basin-wide species and habitat database, selection of appropriate indicator species and communities; selection of reference sites; implementation of long-term biological indicator monitoring

5. Improve Species-by-Species Protection Strategies for Managing Threatened and Endangered Species

To ensure that threatened and endangered species in the Lake Champlain Basin are adequately protected, coordinate the implementation of recovery strategies. This effort would be carried out by, and in coordination with, appropriate state and federal agencies and regulatory committees. Elements of this effort would include the following activities:

a. compile a summary of federal and state laws protecting threatened and endangered species;
b. seek consensus on endangered and threatened species listing criteria for lake-related species;
c. identify new cooperative efforts to ensure enforcement of applicable threatened and endangered species protection laws;
d. identify new cooperative efforts to promote projects to identify, restore, enhance, and create habitats for selected threatened and endangered species;
e. identify new cooperative efforts to resolve the status of candidate species;
f. establish a mechanism to set priorities for species recovery/protection efforts.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, and other academic and private sector cooperators
Cost estimate: $75,000 per year

Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: to the extent compatible with b above, completion of Basin-wide species list; Management Cooperative task force on endangered species management

6. Work with Landowners to Conserve, Enhance and Restore Fish and Wildlife Habitat

Often, private landowners and managers of public lands designated for non-conservation purposes are eager to support habitat restoration and enhancement efforts, including pollution abatement measures, wetland hydrology restoration, riparian tree plantings and other measures, because they recognize the many public and private benefits of such measures. Conversely, poor habitat management can seriously affect Lake Champlain's water quality through erosion/sedimentation, nutrient loading and contamination with pesticides. A number of programs, such as the U.S. Fish and Wildlife Service's Partners for Wildlife Program and the National Fish and Wildlife Foundation's Challenge Grant Program, could increase their focus in the Lake Champlain Basin. Under this action, habitat conservation, restoration and enhancement activities would be identified by participating agencies in partnership with willing private landowners and managers of public lands. Specific actions would include:

a. implement wetland, riparian habitat and shoreline restoration and protection measures;
b. design and construct fish passage facilities and stream flow management regimes at existing dams to provide access and habitat value for desired, non-nuisance migratory fish;
c. develop measures (such as stream bank fencing, constructed wetlands, and buffer strips) to control nonpoint source pollution that causes habitat degradation;
d. encourage landscape practices which are beneficial to living resources and their habitats;
e. develop measures to identify, monitor and manage important in-lake and tributary fishery habitat values;
f. prevent, limit the spread, or eradicate water chestnut and other exotic plants (see section on Managing Nuisance Nonnative Aquatic Plants and Animals);
g. develop and distribute a user's guide to government services and conservation organizations that assist landowners interested in habitat restoration;
h. explore opportunities to provide tax incentives to landowners in exchange for beneficial land management practices.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, USDA-NRCS, and other private sector cooperators
Cost estimate: $250,000 per year
Potential funding source: Partners for Wildlife (USFWS), federal appropriations, and private partners, including utilities
Time-frame: ongoing
Benchmark: establishment of taskforce to identify high priority projects; development of mechanisms to target available state/federal funds for habitat improvement

7. Acquire Land and Easements from Willing Landowners

One straightforward approach to habitat conservation is to acquire fee-title or easements from willing landowners for important parcels of fish and wildlife habitat, and manage

those lands primarily for conservation of the fish and wildlife resources they support. Under this action, coordination of existing acquisition programs and development of a habitat conservation program would be based on land acquisition and easements from willing landowners, and would be implemented by participating state and federal agencies and private organizations. Specific elements of this effort would include:

a. work with agencies and other key stakeholders to identify criteria and an approach for targeting the most important habitat areas, and acquire those areas;
b. identify and protect rare and environmentally-sensitive habitats;
c. identify management needs and policies regarding public use of rare and sensitive habitats to prevent their degradation;
d. coordinate acquisition decisions with existing "open space" and federal, state and local habitat protection programs.

Potential key players: partnership of USFWS, NYSDEC, VT ANR, LCFWMC, appropriate state, regional, and local entities, academic institutions, and private and nonprofit organizations
Cost estimate: in-kind participation of agency representatives; costs for acquisition to be determined
Potential funding source: Land and Water Conservation Act funds, North American Conservation Act funds, state bond programs, various migratory bird accounts, numerous other sources
Time-frame: ongoing
Benchmark: development of annual report on public and private habitat protection efforts

Protecting Wetlands

Goal: Protect and conserve Lake Champlain Basin wetlands and the functions and values they provide.

Wetlands are a vital part of Lake Champlain's ecosystem. In addition to providing critical habitat and nourishment for fish and wildlife, the more than 300,000 acres of wetlands in the Lake Champlain Basin improve water quality by filtering sediments, pollutants and nutrients. Wetlands also help control flooding, protect groundwater and drinking water supplies, stabilize shorelines, prevent erosion and provide recreational opportunities. Lake Champlain wetlands support extensive wildlife and fisheries resources. For example, Lake Champlain is part of the Atlantic Flyway, a migratory corridor for waterfowl and other wetland birds. Between 20,000 and 40,000 ducks and geese that depend on the Lake for critical resting and feeding sites have been counted during October flights. Despite federal, state and local wetlands protection regulations, however, threats to wetlands in the Lake Champlain Basin persist. Many people are unaware of the function and benefits of wetlands and, as a result, wetlands are often drained or filled for agricultural, residential or commercial purposes.

Issues:

Wetland Restoration and Permanent Protection

Because wetlands provide critical functions which range from improving water quality in the Lake Champlain Basin to providing important habitat for wildlife, existing wetland acreage needs protection. Nationally, over 50 percent of the wetlands resource base has been lost. Approximately 35 percent of Vermont's wetlands have been lost since European settlement and an estimated 200-400 acres continue to be lost each year. Estimates of wetland loss in the New York portion of the Basin are similar to national trends except within the Adirondack Park, where less than 10 percent of the wetlands have been lost. The acquisition and restoration programs currently underway in the Basin are an important non-regulatory approach to wetlands protection and conservation. Securing funds will be critical to the success of these non-regulatory programs.

Adopting Local Watershed Approaches to Protecting Wetlands

Since wetland loss is often incremental, involving small wetlands which add up to a significant loss over time, municipalities need to be fully aware of the locations, functions and values of wetlands within their communities. Local watershed approaches need to increase public awareness about wetland values and improve wetlands protection while providing more certainty to the development community in the permitting process.

Objectives: (not listed in priority order)

1. Achieve no net loss of the remaining Lake Champlain Basin wetlands and increase the quantity and quality of the wetlands resource base over the long-term.

2. Complete an up-to-date and standardized inventory of wetlands in the Lake Champlain Basin.

3. Achieve a consistent and coordinated approach to protecting and managing wetlands in Vermont and New York.

4. Expand wetlands acquisition and restoration programs in cooperation with willing landowners in the Lake Champlain Basin.

5. Promote the development of regional or local watershed plans which build upon advanced identification and protection of wetlands.

6. Understand the role of wetlands in improving water quality, fish and wildlife habitat, erosion control and other functions; the impacts of land use on the ability of wetlands to provide important functions; and the cumulative impacts of wetland loss and alteration in the Lake Champlain Basin.

7. Improve public understanding of the importance of wetlands and the programs designed to protect the resource.

High Priority Actions

1. Continue to Secure Funding and Implement all Four Phases of the Lake Champlain Wetlands Acquisition Strategy

Funds have been secured through the North American Wetlands Conservation Act for phase one of the Lake Champlain Wetlands Acquisition Strategy. Funding applications should be submitted every other year for the next eight years to fully implement the strategy. Wetland acquisitions resulting from this action will be consistent with the New York State Open Space Conservation Plan in the New York portion of the Basin and the Vermont Wetlands Conservation Strategy in Vermont. Public agencies, private non-profit organizations and willing landowners have a role in implementing this action.

Potential key players: The Nature Conservancy, NYSDEC, VT ANR and USFWS
Cost estimate: $630,000 for the first phase (already approved), future costs to be determined
Potential funding source: USFWS (North American Wetlands Conservation Act funding), various state and private funding sources
Time-frame: 1993 - 2001 (four phases over eight years)
Benchmark: protection of 1,500 acres of wetlands (Phase I); protection of 9,000 acres of wetlands (all four phases)

Priority Actions (not listed in priority order)

2. Update Wetland Inventory Maps Using Current Land Cover Data

Because the National Wetlands Inventory (NWI) maps for many areas of the Lake Champlain Basin are almost 20 years out of date, an ongoing program to update these maps and reflect changes in the distribution of wetlands over time needs to be established. This program could be implemented using up-to-date, high resolution aerial photography, satellite imagery or other technologies, assisted by field verification.

Potential key players: NYSDEC, APA, VT ANR, and USFWS NWI
Cost estimate: $50,000 per year
Potential funding source: federal appropriations
Time-frame: ongoing

Benchmark: an updated wetland inventory map showing, where possible, changes in wetland distribution over time

3. Expand Wetland Restoration Efforts in the Basin

The Lake Champlain Basin Program began sponsoring a Basin wetland restoration project in 1993. The project is modeled after the USFWS Partners for Wildlife program, and is being implemented with a combination of funding from USEPA and technical assistance from the USFWS, the New York State Department of Environmental Conservation (NYSDEC) and the Vermont Agency of Natural Resources (VT ANR). Under this action, an expanded wetland restoration program would be carried out through cooperative efforts among government agencies and private partnerships. The expanded program would focus on the conservation of biological diversity through careful selection, design, and implementation of wetland restoration projects. Future efforts will require securing adequate funds and continuing to identify willing landowners.

Potential key players: USFWS, NYSDEC, VT ANR, USDA-NRCS, and landowners
Cost estimate: $80,000-$100,000 per year for projects; $50,000 per year for project oversight and technical assistance by a staff biologist
Potential funding source: USFWS (Partners for Wildlife Program)
Time-frame: 1993 - 1998 (3 - 5 year demonstration project)
Benchmark: restoration of 100 - 500 acres of wetlands annually

4. Develop Incentives for Local Municipalities and Private Landowners to Protect, Restore and Enhance Wetlands

Tax incentives are another way to encourage private wetlands protection and restoration efforts. Under this option, a task force could be established to develop legislation to alleviate part of the tax burden for landowners who practice wetland conservation on their property.

Potential key players: NYSDEC and VT ANR
Cost estimate: in-kind services of state agencies
Potential funding source: same as potential key players
Time-frame: 1996
Benchmark: a task force report identifying draft state legislation to alleviate tax burden for landowners

5. Promote Local Watershed Planning Efforts Throughout the Basin

Local approaches at the watershed level can be used to identify and protect wetlands in advance of permit applications. Components of this approach could include:

a. develop more accurate wetland inventory maps (NWI maps may not be accurate enough for use in protecting wetlands at the local level);
b. assess wetland functions and values;
c. use results of natural heritage and biological surveys of the Basin to determine important and unique wetlands, including those which provide important habitats for rare, threatened and endangered species; birds, reptiles, amphibians and invertebrate species such as mussels; and significant natural communities. Complete surveys where necessary;
d. assess the impacts of cumulative wetland losses in the watershed;
e. assist communities with the use of local planning and zoning for protecting wetlands and other critical habitats.

Potential key players: Federal, state and local agencies as well as non-profit watershed organizations
Cost estimate: $50,000-$100,000 per year
Potential funding source: USEPA, federal appropriations, and in-kind services
Time-frame: 3 - 5 year demonstration project
Benchmark: completion of one local watershed plan per year

Other Actions For Consideration (not listed in priority order)

6. Explore the Feasibility of Establishing a Mitigation Banking Program for Wetlands in the Lake Champlain Basin

Mitigation banking, if carefully controlled, offers positive opportunities for market-based wetland regulation. Mitigation banking consists of treating wetland impacts as debits, and wetland creation, restoration and enhancement as credits. Any mitigation banks should be established consistent with state and federal regulatory policies, in advance of wetland impact activities and should be located in the watershed where permitted activities would occur. Careful monitoring, record-keeping and standardization of mitigation measures are all important considerations for a viable mitigation banking program. Because of the uncertainty in creating wetlands, enhancement and restoration of existing wetlands should be encouraged over wetland creation. Other considerations include potential problems with contractual arrangements, time delays, monitoring effectiveness and accessibility of the bank for smaller projects. In considering the establishment of a mitigation bank, early attention should be given to the process for determining how and when mitigation credits are applied. In November, 1995, the federal government released Guidance for the Establishment, Use and Operation of Mitigation Banks which contains important details on the construction, operation, and oversight of banks associated with federally permitted activities. Any banking efforts should start with a task force of appropriate state and federal agencies (also known as a mitigation review team) to oversee the development and operation of the bank.

Potential key players: NYSDEC, APA, VT ANR, USEPA, USACOE, USFWS, NYSDOT, VT AOT, and private partners from the development community
Cost estimate: $25,000 per year (2 time of a wetlands biologist to examine the feasibility of a mitigation bank), in-kind services of participating agencies and unspecified mitigation costs
Potential funding source: Federal or state appropriation for start-up, private sector funding to support the mitigation bank
Time-frame: one year to explore feasibility
Benchmark: completion of a feasibility study and, if appropriate, a design for a mitigation banking program in the Lake Champlain Basin

Managing Nuisance Nonnative Aquatic Plants and Animals

Goal: Exclude or manage nuisance nonnative aquatic species to preserve the ecological integrity of the Lake Champlain Basin aquatic communities.

Nonnative aquatic plants and animals that become established in the Lake Champlain Basin can pose serious threats to native fish and wildlife and impede recreational activities. In some cases, they can have substantial ecological and economic impacts. These species, labeled "nuisances," enter Lake Champlain via the Champlain Canal, the Richelieu River, and over land through human activities such as boating and bait transport. Examples of nuisance nonnative species include zebra mussels, Eurasian watermilfoil, water chestnut, flowering rush, purple loosestrife and sea lamprey. Gizzard shad and white perch are examples of recent nonnative introductions that could become nuisances.

Issues:

Implementing a Comprehensive Management Program

Strategies for controlling, eliminating or preventing nuisance nonnative aquatic species in the Lake Champlain Basin currently exist only for sea lamprey, Eurasian watermilfoil, water chestnut, and zebra mussels. Because of many unanswered questions, managers are forced to use a "species-by-species" approach to remediation and control of nuisance nonnative aquatic species. A comprehensive program is needed to more effectively manage nuisance nonnative aquatic species in the Lake Champlain Basin.

Improving the Information Base

Management of nuisance nonnative aquatic species is complicated by the lack of knowledge concerning the presence and extent of many of these species within the Basin and the impact that introduced species have on indigenous species, habitats and the food web. Adequate information, based on surveys and monitoring programs, is essential to forming effective management strategies for nuisance nonnative aquatic species. The evaluation of technologies for the exclusion or elimination of these species and coordination with research and management efforts in other areas outside the Basin area are also important to the development of a comprehensive management program in the Basin.

Evaluating and Demonstrating New and Existing Control Technologies

Attacks by adult sea lamprey on salmon, lake trout and other fish species have limited the full development of a Lake Champlain fishery, and restricted recreational and associated economic opportunities. Efforts are underway to reduce sea lamprey populations in the Lake as part of an experimental control program initiated in 1990. In addition, the installation of physical controls or barrier dams, including those on Lewis Creek in Vermont and the Great Chazy River in New York, may alleviate the need for chemical lamprey treatment in certain tributaries.

Zebra mussels can clog residential, municipal and industrial intake pipes, foul boat hulls and engines, cover recreational beaches and lake bottoms, and obscure underwater and archeological artifacts. Since their arrival in the Great Lakes in 1988, the combined impacts of zebra mussels

have resulted in millions of dollars of damage and lost revenues. Zebra mussels may also have long-term effects on the aquatic food web by disrupting the food base of fish, fish-eating birds and mammals. In certain segments of Lake Champlain, zebra mussel densities have increased dramatically since their arrival in 1993. Zebra mussel studies have yet to yield effective strategies for controlling zebra mussel populations within waterbodies. Management actions have focused on controlling the mussels' attachment to surfaces and water intake pipes and on preventing further spread, but additional effort is needed in each of these areas, particularly in regard to educating people about zebra mussel issues. The impacts of zebra mussel infestations on the ecosystem are also not well understood, but information from the Great Lakes and Europe may offer some understanding of possible effects.

Eurasian watermilfoil, first discovered in the Basin in 1962, is found in many areas throughout the Lake and Basin. In some areas infestations are severe. Detailed watermilfoil studies have been conducted for many of Lake Champlain's bays and for 34 other lakes within the Basin, but many areas have little or no study regarding the presence and extent of infestation. Because Eurasian watermilfoil is spread by plant fragments transported by waves, wind, currents, people, and to some extent, animals, it is not easily controlled. Control mechanisms that have been employed in the Basin include mechanical harvesting, diver-operated suction harvesting, hydro-raking, installation of bottom barriers, lake level drawdown, fragment barriers, and handpulling.

Like Eurasian watermilfoil, water chestnut displaces other aquatic plant species, is of little food value to wildlife, and forms dense mats which change habitat and interfere with recreational activities. While there has not been a detailed survey of the extent of water chestnut in the Lake Champlain Basin, populations are established as far north in the Lake as Ferrisburgh, Vermont, and in a few other lakes in the Basin. The most extensive infestations are limited to southern Lake Champlain. Despite mechanical harvesting and handpulling of water chestnut since 1982 on Lake Champlain, budget constraints in recent years have prevented effective management of the plant. The South Lake infestation severely restricts boat traffic and other recreational uses, and water chestnut continues to spread in the Basin.

Objectives: (not listed in priority order)

1. Document the extent of infestation for nuisance nonnative aquatic species in the Lake Champlain Basin.

2. Prevent the introduction of, slow the spread of, and control, where possible and appropriate, nuisance nonnative aquatic species which currently or potentially may cause damage to the social or biological benefits of the Lake Champlain Basin.

3. Manage nuisance nonnative aquatic species using current and new technologies.

4. Through education, increase public understanding of, and involvement in, spread prevention and control of nuisance nonnative aquatic species.

Highest Priority Action

1. Develop and Implement a Comprehensive Management Program for Nuisance

Nonnative Aquatic Species in the Lake Champlain Basin

This program would integrate existing programs with the management of other nuisance nonnative aquatic species. Successful implementation of this program would require technical and financial assistance to local groups working in partnership with state and federal agencies to control nuisance nonnative aquatic species, and a strong public involvement component. Elements of this program would include:

a. select target nuisance species;
b. fill information gaps (Actions 3,10);
c. evaluate management alternatives (Actions 4-8,11);
d. implement controls that eradicate and/or prevent the spread of nuisance nonnative aquatic species in the Basin (Action 2, 9).

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, LCRC, universities, NBS, USACOE, non-profit organizations
Cost estimate: $100,000 per year (2 coordinators to develop a program in accordance with a, b, and c above, and provide long term coordination and other support for item d. Approximate costs of measures likely to be part of implementing the comprehensive management program are specified in the actions below, and in actions in Chapter 5 which pertain to nuisance species. Costs are subject to revision (up or down) as information becomes available. Additional costs for specific projects, such as development of electronic barriers, may also be specified in this comprehensive management program.
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: development of a document detailing a management plan for the Basin

Priority Actions (not listed in priority order)

2. Continue a Sea Lamprey Control Program

Continue a sea lamprey control survey and monitoring program, and integrate it into an overall nuisance nonnative aquatic species management program.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC
Cost estimate: $355,000 per year
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: completion of evaluation of the success of current lamprey control efforts in reducing the sea lamprey population; implementation of long-term control program

3. Study the Ecological Role of Nuisance Nonnative Aquatic Species

Conduct research regarding the ecological role of nuisance nonnative aquatic species, including sea lamprey and zebra mussels, to understand ecosystem linkages with a focus on developing and employing effective control strategies. Assess the potential ecological consequences and impacts of nuisance nonnative aquatic species on native plants and animals and recreation and cultural heritage resources. Especially assess the potential effects of zebra mussels on the Lake Champlain food web and nutrient levels in the Lake.
Potential key players: NYSDEC, VT ANR, USFWS, LCRC, universities
Cost estimate: $50,000 per year
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: increase knowledge of ecological role and innovative control techniques for nuisance nonnative aquatic species

4. Evaluate and Demonstrate Zebra Mussel Control Strategies

Investigate existing zebra mussel anti-biofouling technologies and population control strategies, and new ones as they become available.

Potential key players: USFWS, NYSDEC, VT ANR, LCRC, universities
Cost estimate: $50,000 per year
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: development of a strategy and implementation of control demonstration projects

5. Study the Feasibility of Barriers and Other Control Methods for Sea Lamprey

Two barrier dams have been installed on Lake Champlain tributaries with funding by the LCBP. This action recommends examining the feasibility of installing sea lamprey barriers on other Lake Champlain tributaries, and researching other control mechanisms for sea lamprey.

Potential key players: NYSDEC, USFWS, VT ANR, LCRC, universities
Cost estimate: $35,000 per year
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: completion of the feasibility study, and, if appropriate, design, and installation of barriers

6. Accelerate Water Chestnut Control Efforts

Since 1991, the LCMC has funded mechanical controls of water chestnut in the South Lake of Lake Champlain. This action is to continue control and cutting programs and to expand them where appropriate based on relative effectiveness, efficiency, need for spoil sites, access to difficult areas and cost.

Potential key players: NYSDEC, VT ANR, USFWS, LCRC, universities
Cost estimate: $200,000 per year
Potential funding source: state and federal appropriations
Time frame: ongoing
Benchmark: decrease in amount of water chestnut in South Lake; demonstration projects as appropriate

7. Evaluate and Demonstrate Eurasian Watermilfoil Control Strategies

Continue the use of Eurasian watermilfoil control techniques, especially the use of the native aquatic weevil, *Euhrychiopsis lecontei*. Investigate new Eurasian watermilfoil population control technologies as they become available.

Potential key players: NYSDEC, USFWS, VT ANR, LCRC, universities
Cost estimate: $175,000 per year
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: development of a strategy and implementation

8. Evaluate the Effectiveness of Biological Controls for Nuisance Nonnative Aquatic Species

Investigate biological control agents for applicability to control programs, such as the use of *Galerucella spp.*, and *Nanophyes spp.* and *Hylobius spp.* for purple loosestrife control.

Potential key players: USFWS, NYSDEC, VT ANR, LCFWMC, LCRC, USEPA
Cost estimate: $50,000 per year

Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: completion of demonstration projects

Other Actions For Consideration (not listed in priority order)

9. Enforce Existing Laws Controlling the Transport of Nuisance Nonnative Aquatic Species and Consider New Legislation Controlling the Propagation and Sale of Nuisance Nonnative Aquatic Species

Encourage state and federal governments to enforce laws preventing the transport, propagation, importation, sale, possession and release of nuisance nonnative aquatic species.

Potential key players: USFWS, NYSDEC, VT ANR, local government
Cost estimate: in-kind participation
Potential funding source: same as potential key players
Time-frame: ongoing
Benchmark: reduction in the number and spread of nuisance nonnative aquatic species in the Basin

10. Create a Central Database for Nuisance Nonnative Aquatic Species

Create a central repository of information on nuisance nonnative aquatic species of concern to the Lake Champlain Basin, including emerging control strategies. Establish and maintain communication links with experts in other locations.

Potential key players: NYSDEC, VT ANR, USFWS, LCRC, universities
Cost estimate: $35,000 per year
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: creation of an up-to-date data base at a central location

11. Evaluate and Demonstrate Exclusion Devices for Nuisance Nonnative Aquatic Animals

Investigate the broad applicability of electronic and other exclusion devices for nuisance nonnative aquatic animals in the Lake Champlain Basin.

Potential key players: NYSDEC, USFWS, VT ANR, LCRC, universities
Cost estimate: $35,000 per year
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: development and demonstration of the effectiveness of exclusion techniques

Chapter 4. Recreation and Cultural Resources

The human history of Lake Champlain and its Basin is long and varied. Spanning more than 10,000 years, it includes Native American settlements, early Euro-American settlement, French and British explorations and occupation, numerous and pivotal military conflicts, and a dynamic period of commercial development in the 19th century. Past residents of the Basin have left behind rich cultural heritage resources, including historic structures and settlements, agricultural landscapes, archeological treasures both on land and under water, and Native American cultural properties. These remnants from earlier times provide a context and sense of place to people enjoying the Lake and Basin today. Although strong stewardship exists in the Basin, public awareness and understanding of cultural heritage resources is often limited.

The Lake also provides a multitude of recreational opportunities to Basin residents and tourists who enjoy activities such as swimming, biking, skiing and hiking. Many types of boating, particularly motorboating, sailing, canoeing, jetskiing and kayaking are also popular on the Lake. There is a large sport fishing community on the Lake as well. However, the increased activity on the Lake in the past decade has, in some areas, created congestion, conflicts between the different types of users, and safety concerns.

This chapter includes the following subjects:
! Managing Recreation
! Protecting Cultural Heritage Resources

Managing Recreation

Goal: Manage Lake Champlain, its shorelines and its tributaries for a diversity of recreational uses while protecting its natural and cultural resources.

Lake Champlain is a popular resource for Basin residents and visitors alike. Swimming, fishing, scuba diving and sailing are just a few of the activities enjoyed on the Lake. Others enjoy shoreline activities such as biking, hiking, sightseeing and bird watching. Recreation also contributes a great deal to the local economy. For example, total tourism-related expenditures in the Basin were estimated at $2.2 billion in 1990. In comparison, the Basin produced roughly $2.8 billion in manufacturing and $4.5 billion in total retail sales during 1991. These figures illustrate the important effect tourism and recreation have on the Basin's economy. Lake Champlain's recreationists affect, and are affected by, the state of the natural, cultural and historic resources in the Lake Champlain Basin. Protection and enhancement of the environment and cultural and historic resources is clearly important to recreationists as these resources are often the main focus of the recreational experience.

Issues:

Expanding or Enhancing Public Access

Public access to the Lake is restricted in many areas by the lack of access facilities and some inadequate existing facilities. The overall management issue concerning public access on Lake Champlain is how to expand and enhance access opportunities in a manner that allows for a diversity of experiences while also minimizing congestion, user conflicts and impacts to the natural environment. In providing more and better access, the challenge is to accommodate a diversity of users. Many of the problems associated with public access are caused by conflicts between the various user types. Options for addressing such conflicts include designing and organizing sites to meet a variety of needs, or separating different uses by establishing designated use areas. Establishing specific management objectives for each access site on the Lake would help alleviate conflicts among users. Another challenge is to accommodate people with low incomes and those with disabilities at public access facilities.

Alleviating Congestion and Conflicting Uses

Certain areas of Lake Champlain experience high levels of congestion and conflicting uses which can be addressed through regulation, education or a combined approach on a site by site basis depending on the severity of problems and the nature of conflicts. Rather than attempting to establish a carrying capacity for the Lake (which research has shown to be ineffective), one option is for communities to develop overall management objectives for areas of concern. The LCBP recently funded a demonstration project (completed in 1995) that identified solutions to the boating congestion and other problems in Malletts Bay. The Malletts Bay Recreation Resources Management Plan addresses ways to manage the public waters in Malletts Bay, the density of moorings and marinas, and the allocation of recreational uses to reduce conflicts among the various boaters, swimmers, paddlers, etc., who frequent the Bay area. This project should serve as a model for addressing similar issues in other parts of the Lake.

Improving Safety and Enforcement

In addressing boating safety and related concerns, the major management issue is whether increased and more consistent regulation and/or enforcement is needed in addition to education measures. At what level these actions should be pursued, and in what combination, also needs to be considered. Increased enforcement may be critical in certain areas of the Lake to address safety concerns. Coordination among the various enforcement entities on Lake Champlain is key to addressing safety issues and improving law enforcement.

Exploring the Advantages and Implications of Tourism Promotion
The overall management issue in addressing tourism in the Lake Champlain Basin is the need to explore the advantages of the Basin as a tourist destination, and to determine the possible implications that promotion might create. In promoting tourism, care should be taken to protect the array of resources that make the Basin so attractive. A strategy is needed to develop a sustainable approach to tourism promotion and development. It is important that existing tourist resources and infrastructure are fully used before developing additional facilities.

Objectives: (not listed in priority order)

1. Increase and improve public access opportunities to the Lake for a diversity of water and non-water activities.

2. Minimize congestion and conflicting uses in high use areas by developing management strategies appropriate to the localized area.

3. Develop a public education and information program which emphasizes recreational user ethics, boating safety and wise use of resources.

4. Increase enforcement in areas of need; improve coordination among all enforcement entities.

5. Explore sustainable tourism development that highlights the natural, cultural and historic character of the Lake Champlain Basin and instills a sense of appreciation and stewardship of the resources.

6. Identify appropriate locations for shoreline recreational uses that do not adversely impact upon shoreline environments.

7. Coordinate overall Lake use planning with municipal shoreland planning.

8. Secure funding to achieve recreation management objectives.

9. Increase coordination of recreation management for Lake Champlain between the multiple managing agencies in New York, Vermont and Quebec.

High Priority Actions

1. Develop and Implement a Strategy to Provide New Public Access Opportunities
At the state level, New York and Vermont will cooperatively establish and implement a

strategy to develop and maintain new public access opportunities along the shores of Lake Champlain. This action has two parts:

a. Complete the public access strategy. This will include: locating potential sites (on a willing seller basis) for future access (both boating and non-boating sites); establishing priority for potential access sites based on results of recreation studies in progress and municipal priorities; exploring options for funding; and considering the use of public-private partnerships to secure new access through cooperative agreements, conservation easements, and land trusts.
b. Implement the strategy by securing new access at prioritized sites.

Potential key players: NYSOPRHP, VT DFPR, VT ANR Facilities Division, NYSDEC, VT FWD, Non-profit organizations, Municipalities, Chambers of Commerce, businesses
Cost estimate: for a, $50,000; for b, to be determined following completion of part a
Potential funding source: Federal, State and Municipal appropriations
Time-frame: 1996-onward
Benchmark: development of new access sites as recommended in the public access strategy

Priority Actions (not listed in priority order)

2. Pursue Funding Alternatives for Public Access Site Enhancement

a. Establish a dedicated trust fund specific to public access improvement on Lake Champlain that could be supported by redirecting existing funds, or generating additional revenue through mechanisms such as the creation of a special license plate. (This is already under consideration in Vermont, but a dedicated trust fund specific to Lake Champlain is not favored by New York agencies.)
b. Establish a statewide boating facilities program fund to be used exclusively for the enhancement of public boating access sites. Thirty states earmark a portion of their state fuel tax to a dedicated account for boating access site enhancements. (The NYSDEC and the NY Office of Parks, Recreation and Historic Preservation [NYSOPRHP] currently support this potential revenue source.)

Potential key players: NYSOPRHP, NYSDEC, VT DFPR, VT FWD
Cost estimate: in-kind participation of agency representatives initially; $60,000 to $80,000/yr to administer program
Potential funding source: dedicated funds to administer program after a and b are completed
Time-frame: 1996-0nward
Benchmark: the securement of funding mechanisms to maintain and improve existing public access sites

3. Provide Funds to Local Governments and Non-profits to Develop Additional Public Access Sites

Establish a grant program at the state level to provide funds to government entities and non-profit organizations on a competitive basis for the development of new boating and non-boating access opportunities.

Potential key players: NYSOPRHP, VT DFPR, NYSDEC, VT FWD, Non-profit organizations, Municipalities
Cost estimate: $60,000-$80,000/yr to administer program; $250-$500,000/yr for grants
Potential funding source: state appropriations or dedicated funds
Time-frame: 1996-onward
Benchmark: establishment of a grant program as described above

4. Encourage New Opportunities for Recreation in the Lake Champlain Basin

Seek a recreational focus in the development of tourism in the Lake Champlain Basin. Review tourist promotion efforts for consistency with other resource management goals of the Plan. Promote the Basin as a total package, and improve coordination between tourism organizations in New York, Vermont and Quebec. Develop and implement a tourism strategy that promotes the types of tourist activities that are sustainable over the long term with minimal impact on natural and cultural resources. Examples of actions that should be a part of this strategy include:

a. develop natural and cultural heritage interpretative trails;
b. continue to develop the Lake Champlain Bikeways system on existing public roadways around Lake Champlain and the Richelieu River;
c. continue to develop the Lake Champlain Paddlers Trail;
d. develop a joint New York and Vermont Lake Champlain fishing license agreement;
e. establish a lakewide underwater historic preserves program;
f. develop a comprehensive guide to all types of public access opportunities on Lake Champlain and its tributaries (including winter access sites);
g. use existing tourism information centers to coordinate and disseminate information on opportunities for year round use of recreational, natural, cultural and historical resources of the Lake Champlain Basin;
h. consider scenic byway designation for routes through significant scenic, recreational and/or historic resources around Lake Champlain, subject to local or county government approval;
i. expand and create interpretive and education programs regarding the Basin's natural, cultural and historic resources to inform tourists and local users about wise use of these resources;
j. expand tourist facilities and services along the Lake, such as restaurants, lodging and equipment rentals;
k. promote and link cultural heritage resources and build them into existing tourism marketing programs.

Potential key players: Tourism and Business Organizations, Chambers of Commerce, State and County Tourism Departments, State Agencies, Local and Regional Planners, Municipalities
Cost estimate: for a, e, and k, see Cultural Resources section; for c, d and g, in-kind contributions from affected organizations, for b, $25,000-$50,000/yr; for f, $5,000-$15,000; cost for developing overall strategy, $25,000
Potential funding source: local, state and federal appropriations
Time-frame: ongoing
Benchmark: development of an overall strategy incorporating a through k

5. Determine and monitor the Impact of Increased Recreational Use in Ecologically Sensitive Areas.

Identify and monitor ecologically sensitive areas potentially impacted by recreational use and establish a monitoring program to provide early warning of these impacts.

Potential key players: LCRC, VT FWD, VT DEC, VT DFPR, NYSDEC, NYSOPRHP, Nonprofit Organizations, universities
Cost estimate: $5,000-$30,000/site depending on level of research
Potential funding source: local, state, federal appropriations
Time-frame: 1996-onward

Benchmark: Identification and initial evaluation of 2-4 sites

6. Evaluate the Need for Local Recreation Management Plans in other High Use Areas of the Lake

Determine whether the planning process used in the Malletts Bay Project is likely to be an effective solution to congestion and user conflicts occurring in the other high use areas of the Lake.

Potential key players: NYSOPRHP, NYSDEC, VT DFPR, VT FWD, and Municipalities
Cost estimate: in-kind participation from local and state agency representatives
Potential funding source: same as key players
Time-frame: 1996-onward
Benchmark: evaluation of the Malletts Bay Project and identification of high use areas likely to benefit from similar local recreation management plans

7. Assist Communities Who Wish to Develop Local Recreation Management Plans

Provide assistance to communities or groups of communities identified through Action 6, above, who wish to develop management plans similar to that recently developed for Malletts Bay.

Potential key players: NYSOPRHP, NYSDEC, VT DFPR, VT FWD, and Municipalities
Cost estimate: $15,000-$50,000 per site depending on the size of the area and complexity of issues to be resolved
Potential funding source: NPS, state appropriations, municipalities
Time-frame: 1995-onward
Benchmark: the development of local recreation management plans for communities needing and desiring this assistance

Other Actions for Consideration (not listed in priority order)

8. Use Regional Partnerships to Manage Public Access Improvements

Encourage the establishment of regional partnerships of local, state and federal governments, non-profit organizations, and private enterprises to manage boating and non-boating public access improvements for specific areas including those listed in Table 4. The partnerships will establish priorities for improvement needs and pursue federal, state and local funding options to accomplish needed improvements. Encourage the development of public-private cooperative agreements which describe the responsibilities of various parties to improve and maintain access opportunities.

Potential key players: NYSOPRHP, VT DFPR, NYSDEC, VT FWD, municipalities, land trusts, APA, USFWS, VT DEC (Public Facilities Division), Sporting Groups, businesses
Cost estimate: in-kind participation of key players; additional costs to be determined on a site by site basis
Potential funding source: NPS, States of NY and VT (e.g., VT Housing and Conservation Board), USFWS, ISTEA Program
Time-frame: 1995-1997
Benchmark: the securement of management agreements and funds to improve priority sites listed in Table 4 and other identified sites

9. Encourage Adopt-An-Access Programs

Encourage Adopt-An-Access programs to help local citizens' groups become directly involved in the enhancement of public access sites on Lake Champlain. Local groups would be responsible for guiding access improvements for a given section of the Lake, with overall program coordination at the state level.

Potential key players: NYSOPRHP, VT DFPR, NYSDEC, VT FWD, Non-profit organizations, Municipalities
Cost estimate: $20,000/yr ($10,000 per state) to administer program
Potential funding source: state appropriations, in-kind contributions from non-profits and volunteers
Time-frame: 1996-onward
Benchmark: establishment of adopt-an-access program as described

10. Evaluate and Improve Consistency of Regulations and Enforcement

There are many differences in recreation-related regulations among New York, Vermont and Quebec. Improving consistency does not predetermine that regulations and enforcement will be more or less stringent than they are at present.

a. Evaluate existing boating and non-boating regulations and measures of enforcement and make recommendations for potential changes. Establish a committee with broad representation (see potential key players, below) to evaluate existing federal, state, provincial and municipal boating and recreational use regulations for their ability to impose and enforce safe boating and recreation on Lake Champlain. Using the Recreation Technical Reports (1-3) as baseline information, assess the status, limitations, and consistency of federal, state and provincial boating laws and enforcement, and recommend any changes necessary to improve the safety and quality of recreation on Lake Champlain.

b. Implement a. with an emphasis on devising ways to make regulation and enforcement more consistent across political boundaries by establishing interstate/ provincial agreements for recreation management and law enforcement.

Potential key players: NYSOPRHP, NYSDEC, VT ANR, State, Provincial, County and Local Police Depts., US and Canadian Coast Guard, Canadian and US Power Squadrons, Boating Advisory Boards, Marine Trade Associations, state legislatures
Cost estimate: in-kind participation of agency representatives
Potential funding source: same as key players
Time-frame: 1996-onward
Benchmark: improved consistency of boating and non-boating regulations and law enforcement

11. Continue to Evaluate Navigational Charts

In coordination with the U.S. and Canadian Coast Guard and NOAA, encourage continued evaluation and updating of navigational aids and charts, identifying areas where safety has become an increasing issue.

Potential key players: US and Canadian Coast Guard, NOAA, State Police, NYSOPRHP, NYSDEC
Cost estimate: in-kind participation of agency representatives
Potential funding source: US Coast Guard, NOAA
Time-frame: 1996-onward
Benchmark: the development of updated navigational aids and charts, as necessary

Table 3. Priority needs at Vermont Fish and Wildlife Access Sites, New York State DEC Fishing Access Sites and New York State Office of Parks Recreation and Historic Preservation Boat Launching Sites Identified by Public Access Site User Survey Respondents, Public Involvement Efforts and New York and Vermont Boating Access Improvement Plans.

NYSDEC Boating Access	Identified Need	Estimated	Agency Priority

Sites/NYSOPRHP Boat Launch Sites		**Improve-ment Costs**	**Rank for Existing Site Improvements***
Chazy Landing (OPRHP)	restrooms (installed toilet 1991)	NA	Recently Improved in 1991
Crown Point Reservation (DEC)	launch ramp & dock improvements, restrooms, parking capacity	$650,000	8
Ticonderoga (DEC)	dock improvement, launch ramp improvement & parking capacity	$400,000	2
Westport(DEC)	launch ramp; parking and dock improvements; site prone to flooding-raise parking area	$600,000	1
Peru Dock (DEC)	Site supervision, security lighting, restroom improvement	$150,000	6
Point Au Roche Boat Launch (OPRHP)	restrooms, dock improvements	NA	Recently Improved Site
Point Au Roche State Park (OPRHP)	access site recently reconstructed in 1991	NA	Recently Improved Site
Port Douglas (DEC)	restroom, launch ramp & dock improvements	$150,000	5
Port Henry (DEC)	restroom improvements, expand parking capacity	$400,000	4
South Bay (DEC)	restroom improvements, site maintenance, fishing pier (handicapped accessible)	$335,000	3
Willsboro (DEC)	restroom & dock improvements	$100,000	7
VT FWD Access Sites	**Identified Need**	**Estimated Improve-ment Costs**	**Agency Priority Rank for Existing Site Improvements****
Shelburne Bay	launch ramp & dock improvement, dredging	$95,000	5
Malletts Bay	restroom	$25,000	7
Hathaway (St Albans Bay)	restroom, increased parking, acquisition	$75,000	8
Fort Cassin	dock improvement, increased parking, universal shore fishing platform	$40,000	21
Dillenbeck Bay	docks & dredging, breakwater	to be determined	to be determined
Vantines	launch ramp reconstruction, breakwater, increased parking, docks	$140,000	16
Holcomb Bay	parking expansion	$15,000	10
Rock River	ramp reconstruction, dredging, parking improvement	$45,000	11

Larabees Point	port-o-let, north ramp reconstruction, docks	$55,000	13
Laphams Bay	port-o-lets	to be determined	4
Bensons Landing	port-o-lets, dock improvement, universal shore fishing platform	$45,000	15
Stoney Point (Isle La Motte)	breakwater, ramp reconstruction	$110,000	22
South Slang	parking improvements, ramp reconstruction	$55,000	25
Tabor Point	ramp reconstruction, breakwater, docks	$165,000	23
Van Everest	ramp reconstruction, dock improvements, parking	$165,000	19
West Swanton	parking and dock improvements, port-o-let	$50,000	12
Winooski River (Rte 127)	universal shore fishing platform, parking improvements	$100,000	3
Converse Bay	parking improvement, universal shore fishing platform	$45,000	28
Chimney Point	breakwater, new ramp construction, parking improvements, universal shore fishing platform	$110,000	6
Stephenson Point	future improvements as needed	to be determined	29
Keeler Bay	ramp reconstruction, dredging	$75,000	17
Lamoille River	dock improvements, port-o-let, shoreline stabilization	$25,000	14
Burlington Waterfront Park Boat Access (Joint project with City of Burlington)	new concrete ramp, parking, docks, landscaping	$150,000	2
Grand Isle Shore Fishing Access	fishing pier and parking	$12,000	1
Pelot's Point	construct boat ramp, new parking, universal shore fishing area	$95,000	9
Lewis Creek	land acquisition	$45,000	18
Missisquoi River	land acquisition	$35,000	20
Lewis Creek	land acquisition, parking	$55,000	24
McCuen's Slang	ramp reconstruction, dock, channel improvement	$85,000	27
Shelburne Bay	universal shore fishing	$30,000	26

*Priorities for improvement identified by NYSDEC for the next five years (1996-2001)

**Priorities for improvement identified by VT ANR for the next seven years (1996-2003)

Note: Some of the needs identified in Table 4 may have been addressed since data were collected.

Protecting Cultural Heritage Resources

Goal: To identify and preserve the irreplaceable cultural heritage resources of the Champlain Basin for the public benefit, now and for generations to come, and to promote an appreciation of their value as a vital aspect of the Basin's economic and community life.

The many historic and archeological resources around Lake Champlain's shores, under its water and throughout the Basin, tell of a long history spanning more than 10,000 years. Cultural heritage resources are the places that link us to our past. In the Lake Champlain Basin these include historic structures and settlements, sites of archeological interest on land and under water, and traditional cultural properties.

The Basin's cultural resources help us learn about our heritage. The Abenaki and Iroquois who live here today have long called the Basin home, and many Native American sites are of traditional sacred importance. Some Basin residents can trace their heritage to French and British explorers, or to farmers, industrialists and merchants who settled here. In addition, many military battles were fought on Lake Champlain, and the Lake's historic shipwrecks are believed to be the largest, best preserved collection in North America. These resources contribute spiritual, recreational and educational value to our contemporary life. They help make our communities attractive and memorable places in which to live, work and play and they draw thousands of visitors to the region.

Issues:

Lack of Public Awareness and Appreciation

Public awareness, appreciation and understanding of the Basin's cultural resources is limited. This is due partly to incomplete or cursory documentation of resources, and partly to varying perceptions of what constitutes cultural heritage resources. Lack of recognition and appreciation results in missed opportunities for stewardship, economic development, recreation and education.

Protection of Privately Owned Heritage Resources

Private property owners are the primary custodians of the Basin's cultural heritage resources. There is often a perception by landowners that recognition, including designation, of their property as a cultural heritage resource invariably means restriction on its use. However, most federal and state laws regulating heritage resources have little or no impact on private landowners. It is critical that the stewardship role and concerns of private landowners be fully acknowledged, and that stewardship programs that support private property owners' preservation efforts, such as Vermont's Historic Barn Grants, the Federal Investment Tax Credits Program, and the LCBP Cultural Resources Technical Assistance Grants Program, be continued and expanded.

Current Management and Protection: Government Issues

Management of cultural heritage resources within states, and then across state and provincial boundaries, lacks coordination. Protection of resources, even on public lands and under public waters, is far from comprehensive. With numerous players, the challenge is to reach a consensus

on a system of management and protection and coordinate its application across all jurisdictions and all levels of government within the Basin community.

Limitations with Current Information
Inventories of cultural heritage resources in the Basin are incomplete and, in some areas, non-existent. It is impossible to protect, interpret, and promote resources that are unknown. Existing inventories focus on small discrete areas (e.g., towns) rather than the region. They also under-represent (or ignore) many types of resources, and employ varying methodologies and levels of documentation.

Improving Cultural Resource Data, Regional Data Management and Information Access
Existing cultural heritage resource inventories do not take advantage of current computer technologies, such as geographic information systems (GIS), and consequently are not well integrated into local and regional land use or economic development plans. Since the following actions rely on sound, current data that can be interpreted across the entire Basin, immediate action is necessary to make cultural heritage resource data comprehensive and accessible.

Expanding Economic Opportunities of Cultural Resources
The cultural heritage resources around Lake Champlain are integral, yet often unrealized, components of the region's economic base. Economic opportunities are linked to the continued commercial use of historic buildings, history-based tourism, and recreation within historic districts, landscapes, historic sites, museums and the Underwater Historic Preserves. It is important to realize the contribution historic resources have made to economic development in the region, and market these resources without compromising their long-term protection.

Objectives: (not listed in priority order)

1. Increase recognition and appreciation of the Basin's cultural heritage resources.

2. Develop strong economic support for cultural heritage preservation by expanding awareness of undeveloped economic opportunities and identifying new financial resources.

3. Protect underwater archeological resources in the Basin, most specifically historic shipwrecks.

4. Foster stewardship of cultural heritage resources by private landowners and communities.

5. Improve current management and protection practices.

6. Support and increase historical and archeological research (where it is lacking).

7. Establish a more effective mix of protection strategies (public/private; federal/state/local; regulatory/non-regulatory).

8. Accelerate the identification, evaluation and protection of the Basin's cultural heritage resources, based upon Basin-specific priorities.

9. Better integrate cultural heritage protection with ongoing and future environmental and natural resources protection programs being carried out by federal, state, regional, town and non-profit efforts.

10. Develop coordinated preservation and management plans for cultural heritage resources in cooperation with governments and organizations at all levels in Vermont and New York, and involving Quebec.

High Priority Actions

1. Develop and Promote Locally Planned, Approved and Managed Networks of Heritage Trails and Programs around the Lake

Heritage trails are simply a network of sites and places that provide direct, unobtrusive and economical access to historic communities and resources, whether for walkers, cyclists, motorists or boaters. These trails can link publicly-owned natural, historic and/or scenic vistas, historic districts, prehistoric and historic sites, museums, recreational areas, campgrounds, tourist attractions and services (shops, restaurants, lodging), and lake access in self-directed trails through public and private land (with the permission of willing landowners). These networks can have themes, such as the Revolutionary War, the industrial past or Native American sites. Specific components of such networks will be developed through local planning initiatives and, where feasible, could be developed using GIS technology.

Potential key players: Local and county governments, tourism promotion organizations, regional commissions, businesses, non-profits, NYSDEC, NYSOPRHP, VT DHP, NYS and VT Departments of Travel and Tourism.
Cost estimate: $25,000 per year for development of maps, brochures, etc., and in-kind participation of key players
Potential funding sources: federal and state appropriations, National Park Service, NY and VT capital construction budgets, ISTEA, HPF (through states), private sector
Time-frame: 1995-2005
Benchmark: completion of planning for heritage network and development of maps and brochures to publicize it

Priority Actions (not listed in priority order)

2. Develop a Stewardship Program to Strengthen Non-regulatory Protection of Heritage Resources

Because most historic resources in the Basin are privately-owned, landowners are the most effective stewards of the land and its heritage resources. While regulatory mechanisms exist to protect a small percentage of cultural resources, there are many organizations, groups and individuals who work to protect heritage resources in informal, voluntary ways. A good example of an effective, non-regulatory, stewardship program is the LCBP Archeology on the Farm project which provided a professional archeologist to assist farmers in planning water quality improvement projects. A stewardship program focusing on significant heritage resources would enhance resource protection through education and technical assistance rather than increased regulation. This program would:

a. explore tax incentives for cultural resource protection;
b. increase landowner awareness of non-regulatory protection tools, such as sale of development rights, tax benefits through donating easements, tax credits, barn

grants and other incentive programs;

c. build stewardship capabilities of non-profits groups;

d. create a staff position dedicated to stewardship in the Basin, with an emphasis on lakeshore areas, to expedite and coordinate these efforts.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, non-profits, VHCB, local and county governments, businesses, chambers of commerce, landowners
Cost estimate: $100,000 per year
Potential funding sources: NPS, VHCB, non-profits, USDA-NRCS, HPF, HUD, National Trust for Historic Preservation, USDA-FMHA
Time-frame: 1995 and ongoing each year
Benchmark: hiring of staff person; creation of stewardship program

3. Develop and Implement a Management Strategy for Lake Champlain's Underwater Historic Resources

Underwater historic and archeological sites are under increasing threat from the recent invasion of zebra mussels in Lake Champlain as well as from new technologies that allow people to locate and disturb these unique resources. This action recommends the development of a bi-state, lake-wide management strategy to preserve and protect underwater historic and archeological sites (including Lake George). Development of this strategy would include the following activities:

a. survey, identify, inventory, and evaluate resources;

b. integrate the results of this work with other resource protection efforts (coordinating collection of bathymetry data with hydrodynamic modeling effort, etc.);

c. develop and implement a management program to protect these resources.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, Lake Champlain Maritime Museum (LCMM), Bateau Below, Lake George Commission, non-profits, NY State Office of General Services, local and county governments, diver groups, charters and other related businesses
Cost estimate: $150,000 per year for a (acquire boat, complete inventory and evaluation); $150,000 per year for c (hire staff to develop and implement program)
Potential funding sources: NY and VT State capital construction budgets, NY and Vermont State Historic Sites budgets, HPF, NPS, NOAA, Sea Grant, universities, local governments, and user fees
Time-frame: 1995 and ongoing each year
Benchmark: completion of management strategy, including above elements

Other Actions for Consideration (not listed in priority order)

4. Develop and Implement Cultural Heritage Resource Management Plans

Bi-state management plans for each major category of cultural heritage resources on the shores and at the bottom of Lake Champlain are needed, focusing first on those that are particularly threatened (such as historic shipwrecks and lakeshore sites). These management plans would include:

a. criteria for selecting priority heritage resources;

b. consistent policies for protecting them;

c. guidelines for county and town protection efforts;

d. recommendations for building staff capacity at state, regional and local levels and

within non-profits devoted to land and resource protection;

e. mechanisms for providing technical assistance to and building positive relationships with landowners, communities, non-profits and other resource protection and economic development agencies;

f. improved levels of compliance with federal and state historic preservation laws.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, NYSDOT and VT AOT, local and county governments, non-profits, business community, chambers of commerce
Cost estimate: $100,000 per year
Potential funding sources: National Park Service, ISTEA, Historic Preservation Fund, Community Block Grants (HUD), State Coastal Zone Management Programs
Time-frame: 1995-2005 (2-5 plans each year)
Benchmark: completion of management plans, including above elements

5. Protect Lake Champlain's Historic Shipwrecks from Zebra Mussels

The arrival of zebra mussels in the Lake in 1993 sounded the alarm for protecting the Lake's fragile historic shipwrecks. Zebra mussels in the Great Lakes have virtually encapsulated and buried wrecks and any other objects to which they have become affixed. In 1995, the LCBP sponsored a study to identify alternatives for protection, and non-destructive mussel removal. A plan of action is needed to inventory and document submerged cultural resources before they are covered and destroyed, and to test any promising alternatives for protection.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, VT ANR, LCMM, local and county governments, private foundations
Cost estimate: $10,000 for pilot program
Potential funding sources: federal and state appropriations, NY and VT State Capital Construction budgets
Time-frame: 1995-96
Benchmark: completion of protection plan and implementation of measures

6. Review and Revise Protective Legislation for Cultural Heritage Resources

Protection of heritage resources on state-owned land requires governments to be both vigilant and swift in their response to potential impacts within their jurisdiction. As budgetary shortfalls, staff reductions, physical distances and general lack of capacity have combined to reduce their effectiveness, new procedures and relationships need to be explored to strengthen existing legislation and ensure enforcement. Because underwater heritage resources are all state-owned, laws and regulations that affect these sites should be evaluated and revised first. Such laws should be consistent and enforceable on the entire Lake. Difficulties with the existing regulatory process are compounded by the lack of public awareness of the importance, goals and procedures of these laws and regulations. This lack of knowledge and outreach about these processes leads to misunderstanding, loss of trust, possible delays and, sometimes, loss of resources. It is imperative to build stronger communication and understanding among regulators, landowners, farmers, developers, and many others to accomplish resource protection. It is also necessary to generally improve regulatory processes to make them clearer and more effective.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, VT ANR, U.S. Forest Service (USFS), USDA-NRCS, other federal agencies, LCMM, business community and chambers of commerce, landowners, developers
Cost estimate: in-kind participation of key players
Potential funding sources: state and federal agency budgets, NPS, USFS, NRCS
Time-frame: 1994 and ongoing

Benchmark: review of state legislation and recommendation of revision, if needed; development of public outreach tools on existing laws and regulations

7. Demonstrate the Links between Cultural Resources and Economic Development

While visitation to historic sites is an obvious benefit to the area economy, hard data about demographics or economic impact (i.e., employment, sales tax income, purchase of supplies and services from the community, spin-off income from tourism, etc.) is lacking. This action proposes a study to detail the contribution of heritage resources to the economic vitality of the Basin. This information would be used in future regional economic development plans. Baseline data about cultural heritage tourism would be collected, such as who's visiting, how they heard about sites, what sites they are going to, how much they are spending, how long they are staying, what they want out of the experience, what else they are visiting in the area and what special character of the Basin people value. Analysis of this data will result in appropriate marketing and promotion strategies (see Action 8) and will provide objective information about the role of heritage tourism in the economy of the Basin.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, NY and VT Departments of Travel and Tourism, tourism promotion organizations, local and county governments, regional commissions, businesses, non-profits
Cost estimate: $35,000 per year and in-kind participation of key players (Phase I funding of $15,000 already earmarked by NPS)
Potential funding sources: federal and state appropriations, NPS, NY and VT capital construction budgets, ISTEA, HPF (through states), private sector
Time-frame: 1994-1999
Benchmark: completion of study and use in future economic development planning

8. Link Cultural Heritage into Existing Recreation/Tourism Marketing Programs

A regional approach to marketing the Basin's rich heritage resources would be an efficient means to promote its attractions to a wider audience. This would greatly enhance economic development while giving a measure of control over the amount and type of access a site requires. Following the study proposed in Action 7, this action would 1) establish goals and targets for marketing cultural heritage resources; and 2) build them into existing tourism and recreation marketing plans.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, NY and VT Departments of Travel and Tourism, tourism promotion organizations, local and county governments, regional commissions, businesses, non-profits
Cost estimate: in-kind participation of key players
Potential funding sources: federal and state appropriations, NPS, NY and VT capital construction budgets, ISTEA, HPF (through states), private sector
Time-frame: 1996 and ongoing
Benchmark: development of regional marketing goals and their integration into recreation/tourism plans

9. Encourage Local Efforts to Coordinate Heritage and Economic Development Projects

While a region-wide plan and promotional strategy would make an important contribution to economic development in the Basin, it is crucial that local communities and organizations maintain autonomy in developing their own plans and initiatives. Communities should be assisted in securing funding for innovative projects which demonstrate economic development through heritage resource protection.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, local and county governments, regional commissions,

regional development corporations, businesses, Chambers of Commerce, non-profits
Cost estimate: $25,000 per year (for hire of part-time staff) and in-kind participation of key players
Potential funding sources: NPS, ISTEA, HPF (through states), HUD, Economic Development Administration
Time-frame: 1996 and ongoing
Benchmark: provision of technical and financial assistance to communities for projects linking Cultural Heritage Resource protection and economic development

10. Create a Basin-wide Cultural Heritage Resource Data Base

Compile cultural resource survey data from New York, Vermont and Quebec and create a region-wide inventory on a GIS-linked computer data base which provides an up-to-date historic record and promotes integration in broader planning applications. To achieve this, Vermont, New York and Quebec will need to cooperate in developing a uniform cultural resource inventory and evaluation process and computerized system for all areas of study, analysis, evaluation, designation, protection, interpretation and promotion. The inventory process should reflect this integration in both its planning and applications. Since the need for a comprehensive inventory is immediate, it is important to plan this action within a fixed timetable at the outset of implementing the overall Basin Plan, and to list survey areas according to priority.

Potential key players: NYSDEC, NYSOPRHP, VT DHP, VCGI
Cost estimate: in-kind participation of key players
Potential funding sources: NPS, state and federal agencies
Time-frame: 1994 and ongoing
Benchmark: completion of database, including plan for public access

Chapter 5. A Strategy for Implementing the Plan

Numerous cooperating agencies, organizations and individuals have contributed their time and ideas toward producing a comprehensive pollution prevention, control and restoration plan for Lake Champlain. The result of these efforts, *Opportunities for Action*, outlines strategies for protecting and enhancing the environmental, cultural, recreational and economic activities of the Lake. The challenge now is to implement those strategies.

Several themes have emerged from the planning process which will guide agencies, organizations and individuals as they implement *Opportunities for Action*. These themes include:

$ a **partnership approach** that relies on existing agencies, organizations and individuals to implement the Plan while building capabilities through the formation of innovative partnerships;
$ an **ecosystem approach** that stresses management decisions which recognize the complex inter-relationships among the physical, biological and chemical components of the Lake Champlain Basin;
$ a **watershed approach** that recognizes that Lake Champlain is affected by activities throughout its Basin and that water quality protection and ecosystem restoration efforts should be focused along watershed boundaries;
$ **integration of environmental and economic goals** in the decision-making process and in selecting the most cost-effective actions to protect and enhance the resources of the Basin;
$ **pollution prevention** as a cost-effective means to protect the environment by eliminating pollution before it is generated;
$ a **consensus-based, collaborative approach** that strengthens the outcomes of decisions by facilitating a dialogue among multiple interested parties;
$ **flexibility** built into programs and organizations so that they can adapt according to emerging issues, resources and technology.

The Management Conference has analyzed the capabilities of existing local, regional, state and federal organizations and determined that these organizations should be responsible, as part of an integrated effort, for implementing the Plan. Informing and involving the public at the local level is an important means through which recommended actions will be successfully carried out.
The Management Conference discussed new approaches to sustained coordination and successful implementation of *Opportunities for Action*. This chapter describes functions that the LCMC deemed necessary for successful Plan implementation. It outlines the LCMC's recommendations for a future framework that will build upon existing institutions to carry out the functions necessary for successful implementation. Detailed actions for informing and involving the public, building local-level implementation and measuring and monitoring success are also included in this chapter.

Key Players and Their Potential Roles in Plan Implementation

The actions presented in Chapters 2, 3, and 4 list a number of Potential Key Players who could be

pivotal in carrying out steps contained in the Plan to protect the Lake. Several of these organizations are government agencies already involved in resource protection efforts at the federal, state, regional and local level. Existing agencies and organizations should continue their roles in managing resources in the Basin. The Plan does not advocate replacing these agencies and organizations or usurping their authority. However, in some cases implementing the actions may require that existing programs shift their priorities or form inter-governmental partnerships to maximize scarce human and financial resources. Many of the actions recommend including additional players in resource management decisions and supporting public/private partnerships for action. The following section describes the general roles and responsibilities that may fall to the various levels of government, the private sector and the public in meeting the demands of protecting Lake Champlain.

Local Government

Most of the issues affecting the Lake, such as nonpoint source pollution from urban and agricultural land uses, failing septic systems, planning for future development, and recreation conflicts are best addressed at the local level. The Plan suggests several actions that local governments can implement to address these matters. Key players likely to implement such actions are local boards and commissions. Because local governments have primary authority over planning and zoning (in all cases except agriculture in Vermont) and some public health issues, authority by other groups is not envisioned in most situations. Local governments can also incorporate a watershed planning focus into local comprehensive plans.

Regional Government Organizations

Protecting Lake Champlain requires cooperation among the communities within its watershed. Watersheds often cross town boundaries, and one town acting alone may not be sufficient to address all issues. Protection of the Lake and its surrounding resources demands a high level of attention from all municipalities in the watershed. Regional organizations such as the Regional Planning Commissions in Vermont and the County Planning Offices in New York work with a number of jurisdictions to coordinate efforts that address issues of mutual concern. They could be key players in focusing implementation efforts in a watershed approach to planning and ensuring that the recommendations of the Plan are carried out equitably.

State Agencies

State and provincial agencies in New York, Vermont and Quebec have several key roles in protecting Lake Champlain's resources. They administer several critical resource management programs, including water quality protection programs, wetlands protection programs, fish and wildlife management programs, recreation and cultural resource programs, etc. States also provide technical and financial assistance to ensure that the appropriate people have the expertise to implement their programs, such as training for wastewater treatment plant operators, and funding for local nonpoint source pollution control projects.

Although several state agencies are listed in the Plan, the NYSDEC and VT ANR will have major roles in implementation. As the leading environmental agencies in both states, DEC and ANR will have critical responsibilities in every major action plan area in the Plan. Other key state agencies are the Vermont Department of Agriculture, Food and Markets (for agricultural land use, nonpoint source and pesticide issues) and the New York Department of Agriculture and Markets (for nonpoint source issues), NY and VT Departments of Health (for health advisories), and VT

Division for Historic Preservation and New York State Office of Parks, Recreation and Historic Preservation (for recreation and cultural resource issues).

Federal Agencies
Many of the activities necessary to implement the Plan will occur at the local level and, to some degree, at the state level. However, federal agencies will have responsibilities, as well. USDA provides financial support and technical information on best management practices for controlling nonpoint source pollution, and especially for preventing pollution from agricultural runoff. USEPA provides financial and technical support to the states for implementing several federal environmental programs which ensure consistent levels of protection for drinking water, surface water and air quality. The USFWS cooperates with the states in the management of fish and wildlife resources, operates a National Wildlife Refuge and a National Fish Hatchery in the Basin, and helps to ensure that the actions of other federal agencies are consistent with the needs for fish and wildlife conservation.

Business and Industry
The activities of private industry, business, and Chambers of Commerce are a critical component of protecting the resources that support the economic vitality of the Basin. Voluntary efforts to recycle and prevent pollution, as well as educational partnerships within the community, are examples of how the private sector has already begun to implement elements of the Plan. Chambers of Commerce have been effective at drawing together business interests to provide input into the planning process and will continue to contribute knowledge and ideas as the plan is implemented.

Academic Institutions and Research Organizations
Academic institutions and research organizations have served vital roles in studying Lake Champlain and its basin. They also have been valuable in educating students about Lake Champlain issues. Many actions in the Plan call for research concerning lakewide issues and emerging problems. Successful Plan implementation will require continued participation by academic institutions and research organizations and will depend greatly on the soundness of data and information collected by them.

Non-governmental Organizations
Many actions in the Plan list non-profit, citizen-based organizations as potential key players. Watershed associations and environmental groups have long been active in organizing and supporting the activities of individual interests in the Basin. Examples of activities by non-profit/non-governmental organizations which implement elements of the Plan include water quality monitoring, educational workshops, public forums and restoration of tributary environments.

Legislative Bodies
Legislative bodies in the Basin are responsible for passing laws and appropriating funds for many programs important to the Lake. Several actions in the Plan call for consistent policies among the states and countries. This will require extensive cooperation among their legislative bodies. Successful Plan implementation will also require that legislative bodies respond to the will of their constituents and act decisively and creatively to protect and enhance the Lake's resources in the face of enormous technical, political and financial obstacles.

Residents and Visitors

It is the cumulative results of many individual actions that make a difference in the complex issues facing the Lake Champlain Basin. Over 600,000 people live, work and play in the Lake Champlain Basin, which they share with over six million visitors annually. Underlying all of the actions in the Plan is the need for public involvement. Residents of the Basin can be involved in the implementation process in many ways. They can change activities in their own households, maintain septic systems properly, and reduce the use of toxic chemicals in cleaning and lawn care. They can support local initiatives for action, and be prepared to demand action if none is taken. They can also volunteer for local boards, monitor their activities and participate in citizen groups. Most importantly, residents can educate themselves about their watershed.

Visitors are involved in the implementation of the Plan through supporting the economic and environmental integrity of the Basin. They spend numerous dollars in the Basin and can act in environmentally sound ways when they are here. For the Plan to be accepted and implemented, it will require the active support and involvement of a majority of the Basin's residents and visitors.

Coordinating Organizations

The need for state and international communication and cooperation regarding the management of Lake Champlain has been apparent since the 1940s. There have been numerous successful efforts to bring the two states and countries together since that time, including the International Joint Commission, the Lake Champlain Fish and Wildlife Management Cooperative, the Lake Champlain Research Consortium, the Steering Committee and the Citizens Advisory Committees. (For specific information on these organizations, see Framework for Plan Implementation below.) Each of these organizations and others like them have played vital roles in drawing together key players to produce coordinated research and consistent policies for Lake Champlain and the Basin. Plan implementation will depend greatly on cooperation and coordination among key players.

Framework for Plan Implementation

Over the past five years, the Lake Champlain Basin Program has been the institutional framework for coordinating the development of a comprehensive pollution prevention, control and restoration plan for the future of Lake Champlain. The Management Conference served as the program's primary decision-making body, committing five years to the development of the Plan. Implementation of the Plan will require unprecedented coordination among all levels of government, organizations and individuals.

Existing Frameworks

Several arrangements among agencies and organizations in the Lake Champlain Basin were formed prior to the passage of the Lake Champlain Special Designation Act and will be in place when the Management Conference completes its work on the Plan. The arrangements described below have played important roles in bringing together some of the key players identified in this Plan, including government agencies, academic institutions and citizens.

The Boundary Waters Treaty of 1909 created the **International Joint Commission** (IJC) to resolve disputes regarding the use of boundary waters. IJC membership is composed of six

commissioners appointed by the President of the United States and the Prime Minister of Canada. The IJC convened a Champlain-Richelieu Board to examine regulation of water levels in Lake Champlain during the 1970s.

Created by the Memorandum of Understanding on Environmental Cooperation on the Management of Lake Champlain in 1988, the **Steering Committee** consists of top-level environmental officials representing state and provincial government in New York, Quebec and Vermont. The Steering Committee serves as forum for information exchange and a mechanism to coordinate state and provincial policies and programs. It is the only formal, international, tri-party, government-based institution currently focused on Lake Champlain. Current membership on the Steering Committee does not include representatives of federal agencies, local governments or stakeholders.

Citizens Advisory Committees in New York, Quebec and Vermont were initially created by the Steering Committee. Consisting of appointed representatives, the CACs make recommendations on the condition and management of Lake Champlain to the Steering Committee. During the five-year planning effort which resulted in this Plan, the CACs also advised the Management Conference. In 1990, the Vermont Citizens Advisory Committee was expanded to include four legislators and was given a legislative charge. The New York CAC has fourteen members appointed by the Commissioner of NYSDEC; the Vermont CAC has fourteen members appointed by the Governor and the Legislature; and the Quebec CAC has eight members appointed by the Minister of Environment.

The **Lake Champlain Fish and Wildlife Management Cooperative** was created through written agreement in 1973 by the U.S. Fish and Wildlife Service, New York State Department of Environmental Conservation and the Vermont Department Fish and Wildlife. The Cooperative Agreement, which was updated in 1995, created a Policy Committee consisting of program directors from the three agencies, and Management and Technical Committees of agency staff responsible for preparing management programs and providing technical assistance. Organizations in Quebec are not formal partners to the Cooperative but coordinate and communicate with the Cooperative.
Seven academic institutions formed the **Lake Champlain Research Consortium** to establish a multi-disciplinary research and education program for Lake Champlain. Membership in the Consortium currently consists of selected academic institutions within the Basin boundaries.

The Lake Champlain Basin and Adirondack region was designated as one of the United Nations Education, Scientific, and Cultural Organization=s (UNESCO) international biosphere reserves. This designation is strictly honorary and carries with it no restrictions, regulations or funding.

All of these organizations have been involved in important research and management activities for the Lake Champlain Basin. Continued coordination of these programs and activities is paramount to successful Plan implementation.

Key Functions for Plan Implementation

The LCMC identified a list of functions that must be accomplished to successfully implement the Plan. These functions include the following:

Coordinate Programs and Implementation Activities
Coordination among government agencies, regional and local governments, the public and private sector, non-governmental/non-profit organizations, and residents and visitors, is critical to successful implementation of the Plan. Coordination involves facilitating information exchange and data sharing and improving efficiency among key players, while not duplicating programs or creating new layers of bureaucracy.

Inform and Involve the Public
Public education and involvement efforts are required for successful implementation of the Plan. A public that understands the Basin's water quality and resource management issues will make informed choices about the long-term protection and restoration of the Lake. A commitment to life-long education about Basin resources is needed to facilitate this process. Furthermore, involving the public in the planning process and implementation increases the sphere of responsibility for action and increases support for recommended actions. Refer to section on Informing and Involving the Public (p. 87) for actions dedicated to accomplishing this function.

Build Local-level Implementation
Participation at the local-level is the cornerstone of successful Plan implementation. Addressing pollution problems at the local level is important because people most affected by an issue will be best able to address that issue. Many communities have existing resources and organizations to help implement programs, but may lack technical expertise, adequate funding or access to additional human and financial resources. Building local capacity for Plan implementation will require a strengthening of technical assistance to community groups, and may require additional financial support for local programs. Refer to section on Building Local-level Implementation (p. 91) for actions dedicated to accomplishing this function.

Measure and Monitor Success against Plan Benchmarks
A critical component of watershed planning is monitoring. Monitoring must accomplish two roles. First, it must be a source of information regarding the health of the Lake and Basin. Management capacity hinges to a large extent on the availability and reliability of a comprehensive monitoring program for ecosystem characteristics of the Basin. The second purpose for monitoring is to measure success of programs and to ensure accountability to the public. Monitoring can help determine if goals are being met and whether priorities need to be adjusted. Refer to section on Measuring and Monitoring Success (p. 94) for actions dedicated to accomplishing this function.

Provide a Linkage to Legislative Bodies
Successful Plan implementation depends greatly on the ability to gain political support for recommended actions. A framework is needed to communicate needs and recommend actions concerning the Lake to legislative bodies who help to formulate federal, state and local laws, and appropriate funds to various programs.

Provide a Linkage to Interest Groups
Implementation of the recommended actions in the Plan will depend greatly on continued support from numerous individuals and groups. Decisions concerning the management of the resources in the Lake Champlain Basin must be made through a consensus-based collaborative process that encourages the expression and understanding of diverse viewpoints. This process will help

integrate economic and environmental goals into Plan implementation and will ensure that a focus on implementation at the local level is maintained.

Research
The Plan identifies several areas where additional research is needed. Research has been an important component of preparing the Plan and will continue to play a role in providing critical information as implementation evolves. Improved knowledge of the physical, chemical, biological, and social characteristics of the Lake and Basin will help resource managers make effective policy and management decisions in the future.

Secure and Direct Funding
The cost of implementing the Plan will be high, but not as high as the potential costs of no action. The ability to implement watershed programs rests heavily on the availability of, and access to, funding sources. A mechanism must be in place to seek out public and private funding for program implementation and to allocate resources to appropriate entities based upon recommended priorities. Refer to the section on Strategies for Funding Implementation of the Plan (p. 99) for a discussion of funding implementation efforts.

Update Plan Recommendations
Because environmental conditions in the Basin will change over time and new technologies will be discovered, priorities for action in the Plan may change. Some management programs may become more important while the need for other programs may lessen. It is intended that the Plan be reviewed and updated periodically to reflect these changing conditions.

Advise and Encourage those Agencies Responsible for Implementation
As the Plan evolves, various agencies will accept responsibility for implementing certain actions. Benchmarks have been provided under each action that list the expected outcome of those actions. These benchmarks can be used to monitor success. A mechanism is needed that encourages those responsible for implementing actions to follow through with their commitments.

A Framework for Carrying out Key Functions

The following section provides recommendations for building upon existing institutional frameworks to encourage successful Plan implementation. A partnership approach involving numerous key players is recommended to respond to the functions described above.

1. **Continue the Present Steering Committee and Include Additional Representatives to Broaden the Perspectives for Decision-making**
   The existing Steering Committee should continue to function in its present role as a forum for key state/provincial environmental agency leaders of New York, Vermont and Quebec to discuss issues of Lake Champlain and coordinate policies and programs. The Steering Committee should be guided by the following principle:

   > The guiding principle for all Steering Committee actions and policies is to ensure that the Lake gets better.

The states of New York and Vermont and the province of Quebec should consider including the following key players on the Steering Committee to broaden the diversity of perspectives represented:

Three New York State agency representatives New York should consider NYSDEC, NYS Department of Economic Development and NYS Department of Agriculture and Markets. New York should also have the option to include a fourth state agency of its choice as needed, such as APA, NYS Office of Parks, Recreation, and Historic Preservation or the NYS Department of Transportation, depending on the issue);
Three Vermont State agency representatives (Vermont should consider VT ANR, VT Department of Agriculture, Food, and Markets and one other state agency, such as VT Agency of Development and Community Affairs or the VT Agency of Transportation, to be selected by the State depending on the issue. Vermont should also have the option to include a fourth state agency of their choice as needed);
Three Quebec representatives (Quebec should consider provincial representatives for agriculture, environment and economic development. Quebec should also have the option to include a fourth representative as needed to be selected by the Province from provincial or Canadian federal agencies according to the issue);
Three local government representatives (1 from each state and Quebec; local governments should nominate representatives and the governors/premier select from that list);
Three CAC chairs or designees (see below);
One TAC chair or designee (see below);
Three U.S. federal agency representatives (the U.S. Department of Agriculture, the U.S. Environmental Protection Agency, and the U.S. Department of the Interior should be considered for these positions).

Modifying the membership of the present Steering Committee to include additional key players will help to ensure that decisions concerning the management of Lake Champlain Basin resources are made through a consensus-based collaborative process. The roles of the modified Steering Committee should include:

a. facilitate communication and coordination among key players working to implement the Plan;
b. monitor and evaluate progress against Plan benchmarks and communicate that information by producing an annual State of the Lake report;
c. secure and direct funding;
d. reassess and update Plan recommendations every two years based on changing environmental conditions, management programs and public input;
e. develop annual budget to ensure implementation;
f. negotiate commitments among agencies and groups;
g. seek consistency in regulatory programs and standards such as those concerning wetlands and toxic substances (consistency does not predetermine that standards will be more restrictive or less restrictive than present standards);
h. provide technical and financial assistance to local communities and organizations.

Time-frame: 1996-(ongoing)

Benchmark: commitments for implementation from key players identified for priority actions; production of annual status report; preparation of annual budget; achievement of coordinated and consistent policies and programs; 6-12 Steering Committee meetings per year at a time convenient for members
Cost estimate: to be determined through an annual budget development process
Potential funding source: State and federal appropriations, in-kind participation, public/private partnerships

2. Continue the Present Citizens Advisory Committees (CACs) and Ensure that Various Stakeholders are Represented

The CACs should continue in their present role as liaisons to the public. As positions become available on the CACs, the states and Quebec should strive to ensure that representatives from environmental groups, agriculture, business/industry, sportspersons, and local government be included on the CACs in a timely fashion. Organizations for these stakeholder groups should nominate representatives, and the persons/agencies in each state and Quebec who have the authority to appoint representatives to the CACs should select from that list. The CACs should also include two citizens at large and two legislative appointees. All members of the CACs should serve two year appointments. The CACs include:

a. advise the Steering Committee about public concerns;
b. inform and involve the public in issues concerning the Lake and the Basin;
c. link the Steering Committee to state legislative bodies and groups implementing the Plan at the local level;
d. provide a regular forum for interest groups and local governments to discuss the issues facing Lake Champlain;
e. provide recommendations to the Steering Committee about the reassessment of Plan recommendations;
f. advise and encourage agencies which accept responsibility for implementing Plan recommendations to follow through with their commitments.

Time-frame: 1996-(ongoing)
Benchmark: assistance to the Steering Committee in production of annual report; provision of annual recommendations concerning the Lake to the Steering Committee and legislative bodies; inclusion of representatives from environmental groups, agriculture, business/industry, sporting groups and local governments on the CACs; 4 meetings of joint Citizens Advisory Committees per year
Cost estimate: to be determined through an annual budget development process
Potential funding source: State and federal appropriations, in-kind participation, public/private partnerships

3. Restructure and Continue the Technical Advisory Committee

The Steering Committee should appoint a Technical Advisory Committee composed of professionals from academia, management agencies and other appropriate sectors to accomplish the following functions:

a. present the Steering Committee with technically sound information to be used in the decision-making process;
b. advise the Steering Committee about emerging issues with management implications and the necessary research or actions to address those issues;
c. oversee and facilitate the technical aspects of implementation projects;
d. interpret the results of monitoring programs and other technical information to help determine success or redirection of projects.

Organizations and partnerships established independent of the LCMC to address technical issues in the Basin will continue to function in their own right, but may also provide input to the TAC. These organizations include the Lake Champlain Fish and Wildlife Cooperative, the Agricultural Advisory Council, the Zebra Mussel Task Force, the Lake Champlain Research Consortium, and the Lake Champlain Bikeways Steering Committee.

Time-frame: 1996-(ongoing)
Benchmark: assistance to the Steering Committee in production of annual status report; development of recommendations to the Steering Committee on annual workplan for research, monitoring, and technical assistance to implementation projects; 4 meetings of Technical Advisory Committee per year
Cost estimate: to be determined through an annual budget development process
Potential funding source: State and federal appropriations, in-kind participation, public/private partnerships

Informing and Involving the Public

Goal: To promote a better understanding and appreciation of the Lake Champlain Basin and its resources in order to encourage greater public participation and individual responsibility and action for protecting these resources.

The future of the Lake Champlain Basin rests in the hands of its citizens and leaders. Public education and involvement efforts must be continued and expanded to involve people actively in protecting and truly appreciating the Lake's resources. Ultimately, a public that understands the Basin's water quality and related resource management problems as well as possible solutions to those problems can best make informed choices about its long-term protection and restoration.

Education and direct citizen involvement are ways to achieve many of the priority actions discussed in this Plan. Each priority action in this Plan recognizes the need for strong public support and individual action. For example, an effective way to help control the spread of zebra mussels is to educate boaters and other water users to inspect and clean their boats if they have been in an infected waterbody. This could be done through interpretive signs or displays, literature, presentations and/or citizen task forces. This has been accomplished successfully in Minnesota, where boater survey results indicate that boater education programs have been effective in changing boater behavior and in reducing the spread of harmful exotic species.

It is the cumulative results of many individual actions that make a difference in the complex issues facing the Lake Champlain Basin. Education about individual responsibility in protecting a shared resource is very important; people must become aware of how they may contribute to pollution before they can take responsible actions to reduce and prevent it. When people are given the opportunity to develop awareness, knowledge, skills and commitment towards a Basin issue, they can make informed decisions and take constructive actions. When people know how they can make a difference, they will.

Issues:

The Need for Increased Public Awareness and Understanding of Basin Issues
Public awareness and understanding of Lake Champlain Basin issues and the priority actions needed to address them is limited. This is especially true of communities located further from the Lake who may be unaware that they are within the Lake Champlain drainage basin and therefore connected to the quality of Lake resources. People need to become aware of an issue before they can understand how they contribute to the problem and assume responsibility for solving it.

The Need for Local Community Involvement
The real power in public involvement comes from a local or community level. Programs which bring together students, professionals and community members are a powerful and cost-effective tool for getting people involved. Unfortunately, programs such as these are limited in the Basin. Community involvement is important for addressing local issues that occur in only specific areas of the Basin. People most affected by an issue will be best able to address that issue; if this is done at a community or watershed level, partnerships can be created and local action taken.

The Need for More Individual Action

Public awareness of the Basin's problems is growing, but there is a definite lack of information about how each of us can help to solve these issues. People must understand their responsibility as stewards of the Basin, and must speak out for its protection. It is important to use the public's skills, energy and enthusiasm when addressing priority Basin issues. Currently there is a lack of opportunities that allow individuals to become involved and take action. Programs that emphasize how each person can make a difference need to be developed.

Objectives: (not listed in priority order)

1. Promote public and governmental awareness and understanding of Lake Champlain Basin issues and the priority actions needed to address them.

2. Facilitate public participation in the development of public policy for the Lake Champlain Basin and in activities relating to its clean-up and protection.

3. Build community awareness and stewardship of the Lake Champlain Basin ecosystem and its value to the region.

4. Increase individual responsibility for Basin issues by developing programs that allow individuals to become involved and take individual action.

5. Increase communication and cooperation among the diverse groups involved in Lake Champlain Basin education and outreach.

6. Develop a flexible, sustainable, community-based organizational framework supported by public and private funds for public involvement and education in all aspects of Basin management.

7. Develop a long-term sense of environmental stewardship and understanding of the Lake Champlain Basin by enhancing educational opportunities at all educational levels.

Actions (not listed in priority order)

1. Build Awareness and Understanding of Basin Resources

Work with the general public, interest groups and decision makers to build awareness and understanding of the key natural resource issues in the Basin and the priority actions needed to address them. This would include information on how these priority issues and actions contribute to and interact with social and economic values. Specific components of this action include:

a. develop printed and other educational materials such as citizen action guides, slide shows, videos, public service announcements, press releases, mobile displays and computer models for specific audiences;
b. conduct presentations to special interest groups, communities and local government decision makers;
c. display exhibits at conferences, fairs and expositions;

d. hold public forums and field trips on priority Basin issues and actions and serve as a vehicle for translating local Basin issues and priority actions;
e. hold a "State of the Lake" conference every two years to bring together those interested in the Basin and to share progress, address challenges and provide public education and involvement;
f. develop a speakers bureau on priority Basin issues;
g. provide a comprehensive Resource Room where individuals can obtain historic and current information on the Basin;
h. help coordinate communication between existing education and outreach organizations - work on developing partnerships.

Potential key players: federal agencies, state agencies, municipalities, schools, Universities/Colleges and private/non-profit organizations
Cost estimate: $125,000 per year
Potential funding source: federal grants, state funds, in-kind match (private and non-profit)
Time-frame: annually
Benchmark: development and distribution of products listed in a, d, and e; completion of b, c, f , g and h

2. Produce Coordinated Education Programs for Students

Work with state and local educators to organize Basin educational materials and produce coordinated education programs for students based on priority issues and actions. Ensure coordination with existing education and outreach organizations. Components of this approach include:

a. conduct teacher training workshops;
b. complete comprehensive teacher training institutes;
c. develop a comprehensive Basin Resource Guide for educators to use in developing units on Lake Champlain (the Resource Guide will be based on protecting and enhancing the environmental integrity of the Lake Champlain Basin, taking into consideration social and economic benefits);
d. work with state education departments to integrate Basin education into classrooms;
e. provide opportunities for teachers and students to participate in Basin-related field trips and restoration projects;
f. provide Basin-related presentations to schools;
g. develop a volunteer Education Advisory Committee consisting of educators throughout the Basin to help coordinate Basin-wide educational efforts.

Potential key players: federal agencies, state agencies, municipalities, schools, Universities/Colleges and private/non-profit organizations
Cost estimate: $100,000 per year
Potential funding source: federal grants, in-kind match (private and non-profit)
Time-frame: annually
Benchmark: completion of components a - g above, including the distribution of Lake Champlain Resource Guide to Basin educators

3. Provide Opportunities for Hands-on Citizen Action and Implementation of the Plan

Provide and encourage opportunities for direct citizen involvement in Basin issues and priority actions to aid in the implementation of the Plan. Examples of possible programs include:

a. increase opportunities to prevent pollution such as toxic reduction programs, recycling opportunities and citizen action guides;
b. coordinate nutrient management and toxics reduction outreach to farmers;
c. develop opportunities for citizens to become more aware of and help monitor the spread of nuisance nonnative aquatic species;
d. organize river and lake clean-ups;
e. coordinate and support partnership opportunities through the Lake Champlain Partnership Program to increase public involvement opportunities;
f. develop and organize a Lake Champlain Basin Conservation Corps utilizing existing ongoing programs such as the Vermont Youth Conservation Corps (VYCC).

Potential key players: federal agencies, state agencies, municipalities, schools, Universities/Colleges and private and non-profit organizations
Cost estimate: $125,000 per year
Potential funding source: federal grants, state funding, in-kind match (private and non-profit)
Time-frame: annually
Benchmark: development and implementation of hands-on activities such as river and lake clean-ups

Building Local-Level Implementation

Goal: Support and enhance cooperative watershed planning efforts to protect and improve water quality.

Chapters 2 through 4 identify specific actions for reducing various pollutants and enhancing cultural and recreational attributes within the Basin. This section addresses the process at the regional, municipal and grass roots levels that is necessary to achieve many of these management goals. It focuses on watershed planning at the local scale, as this is the level at which most planning occurs in the Basin.

River and Lake Associations play a key role in organizing watershed protection efforts. These associations can accomplish a great deal through education and outreach programs, democratic participation in the development review process, participation in citizen monitoring activities, etc. Watershed associations may also act as catalysts for developing non-regulatory protection programs, and can effectively advocate for improved conservation-oriented land use practices. River and Lake associations can be regional in scope and encompass several local jurisdictions. Examples of river and watershed associations include the Boquet River Association in New York, and the Lewis Creek Association, the Mt. Mansfield Riverwatch Network, and the Friends of the Mad River in Vermont. Watershed Associations work closely with local government, and respect a wide variety of interests including property rights, environmental protection and economic development.

Most land use planning in the Basin occurs at the municipal level, where watershed planning can be very effective to the extent that watershed boundaries are contained within municipal boundaries. Municipalities may develop watershed districts that have special review criteria for new development based on a long term water quality protection strategy. Additionally, local measures such as the designation of riparian "buffer" zones along streams, lakes and wetlands can be important water resources protection tools. Local capabilities for watershed planning vary greatly throughout the Basin in both New York and Vermont. In some areas (often near urban centers) municipalities have already developed watershed plans and instituted aggressive water quality protection measures. Municipalities in these areas typically benefit from ongoing technical support from local staff, watershed associations, regional planning commissions, county planning offices or conservation districts. In other parts of the Basin, municipalities have very limited local capacity for any type of planning or land use regulation.

Issues:

Insufficient Technical and Financial Assistance

One of the major impediments to the development and implementation of watershed protection plans at the local and regional level is insufficient financial and technical support. Watershed groups may develop the necessary awareness and enthusiasm for a project, but may flounder without technical and organizational assistance from appropriate professionals. Some assistance is currently provided to watershed associations in VT through the State Agency of Natural Resources, and in NY through the Department of Environmental Conservation, the Cornell Cooperative Extension, and county and regional planning commissions. However, there is a need

for additional technical and financial assistance to municipalities and to help watershed associations hire their own paid staff. Developing a local capacity grant program for watershed associations may be one effective way to address this shortage.

The Need for Better Communication
There is often insufficient communication among communities and regions within the Basin on watershed planning. An effective process for disseminating information on successful watershed planning approaches is needed. Likewise, the difficulties and problems encountered in less successful watershed planning efforts need to be documented and communicated to help others avoid these problems.

The Need for Innovative Partnerships
Experience in a number of communities/regions has pointed to the value of innovative partnerships in developing and implementing effective watershed plans. For example, the Mad River Valley Planning District in Vermont has developed a strong watershed planning capability through the formation of a three-way partnership among district towns, a private nonprofit environmental organization and the State of Vermont. This arrangement provides for a funding base, extensive grass roots involvement, strong local political support though the district board membership, and technical assistance from the state. There often may be an important role for state and federal governments, as well and county and regional planning commissions, in this process (e.g., funding and technical assistance).

Objectives: (not listed in priority order)

1. Support formal and informal local and regional partnerships to pursue watershed protection efforts.

2. Increase public participation in watershed protection efforts.

3. Encourage citizens, state and local governments, and formal and informal local and regional partnerships to adopt a proactive approach to watershed protection that considers cumulative impacts on water resources.

4. Demonstrate new and emerging models for watershed planning within the Basin, especially those based on local and regional initiatives.

5. Ensure that nutrient and nonpoint source management efforts are coordinated with local and regional watershed planning initiatives throughout sub-basins.

6. Promote public education and informed discussion about regional land use patterns in the Basin.

7. Preserve the region's economic vitality by capitalizing on the unique qualities of the Basin.

Actions: (not listed in priority order)

1. Expand Technical and Financial Assistance for Watershed Planning at the Local

Level
Elements of this action include:

a. provide technical assistance to communities on the full range of options available for addressing issues such as shoreline protection, soil erosion, sediment control, wetland conservation and on-site septic system troubleshooting; emphasize non-regulatory approaches and make available model standards appropriate for adoption by local communities;
b. provide state and federal financial support to watershed associations; funding could be used to enable watershed organizations to hire staff and pursue specific identified needs in each watershed; both start-up and ongoing support funds are needed;
c. assist local and regional planning commissions to evaluate and respond to development trends and estimate future impacts of these trends on water quality.

Potential key players: USDA-NRCS, NYSDEC, VT DEC, USFWS, County and Regional Planning Commissions, NRCDs, SWCDs, Nonprofits/Private Organizations, Municipalities and Businesses
Cost estimate: $100,000/yr for a, $100,000/yr for b, $100,000/yr for two years for c
Potential funding source: federal and state appropriations
Time-frame: ongoing (except for c = two year period)
Benchmark: improved technical and financial assistance to communities as described

2. Develop a Program to Facilitate Information Exchange among Local Watershed Associations

This action would develop a program to continue the type of information exchange initiated by the successful LCBP Mad River Watershed Planning Demonstration Project. The Mad River Project included a series of meetings to share lessons learned from watershed planning efforts throughout the Basin. Existing and emerging local watershed organizations were invited in the hope that the insights of older, experienced organizations could aid newer organizations in their development. Based on the success of these meetings, this action is to establish a program to continue this information exchange.

Potential key players: Watershed Associations, NYSDEC, VT DEC, Regional Planning Commissions, County Planning Offices
Cost estimate: $25,000/yr
Potential funding source: federal and state appropriations
Time-frame: 1995 and ongoing
Benchmark: Establishment of a forum for information exchange among watershed organizations

3. Conduct Watershed Planning Demonstration Projects

Undertake demonstration projects to illustrate local/regional watershed approaches to planning and water quality protection, restoration and improvement. These demonstration projects should identify the full range of local water quality concerns along with recommended solutions. Additionally, local watershed projects should contribute to the attainment of water quality goals in downstream waters such as Lake Champlain.

Potential key players: USDA-NRCS, NYSDEC, VT DEC, Watershed Associations, Universities, Extension Service, Municipalities and Nonprofit/Private Organizations
Cost estimate: $50,000-$100,000/yr
Potential funding source: state and federal appropriations
Time-frame: ongoing

Benchmark: completion of one or more watershed planning demonstration projects per year

Measuring and Monitoring Success

Goal: Document progress and achievements resulting from implementation of the Plan

Monitoring of environmental conditions in the Lake and Basin is an essential part of Plan implementation. Ongoing monitoring projects in the Basin cover a wide range of topics from forest health and biodiversity to atmospheric and surface water chemistry. These monitoring programs were designed for a wide variety of purposes and are described in *A Research and Monitoring Agenda for Lake Champlain* (Watzin, 1992). Recent monitoring programs on Lake Champlain include the Long-Term Water Quality and Biological Monitoring Program for Lake Champlain (New York State DEC, *et al.*, 1995), the Lake Champlain Diagnostic-Feasibility Study (Vermont DEC and New York State DEC, 1994), the Lake Champlain Biomonitoring Program conducted by the University of Vermont Water Resources and Lake Studies Center (Brown *et al.*, 1993), and the Vermont Lay Monitoring Program which has provided lakewide monitoring of eutrophication related parameters during the summer season using citizen volunteers and a consistent methodology every year since 1979 (Picotte, 1994). In addition, the Lake Champlain Sediment Toxics Assessment Program (McIntosh, ed., 1994) has provided a current database on concentrations of organic and inorganic toxic substances in the sediments in many areas of the Lake. The Vermont Lay Monitoring Program and the Long-Term Water Quality and Biological Monitoring Program are still operating and are intended to be long-term programs.

A variety of routine monitoring activities also occur every year in selected parts of the Lake and Basin such as the monitoring of fish flesh for the presence of toxic substances and the monitoring of bacterial levels at swimming areas. Regular tributary monitoring programs in the Basin include the New York State DEC's state-wide Rotating Intensive Basin Studies (RIBS) which focus primarily on toxic substances at tributary mouths, Vermont's Ambient Biological Monitoring Program (which focuses on the biological integrity of stream communities), and the Lake Champlain tributary mouth sampling (mostly for nutrients) that is part of the Long-Term Water Quality and Biological Monitoring program.

Issues:

Continuing the Long-Term Water Quality and Biological Monitoring Program

During the winter of 1994-1995, the LCBP held several workshops to design the future scope of the Long Term Water Quality and Biological Monitoring Program for Lake Champlain. Participants concluded that this program should be sustained over the long-term and serve as one primary means of meeting the objectives listed below. In order to monitor more comprehensively for environmental change, workshop participants also concluded that consideration should be given to expanding the scope of the program to incorporate a number of additional parameters. These parameters include: toxic substances in the water, sediment, air and biota; biological indicator organisms including selected species of fish or other higher level organisms; exotic invader species; and meteorologic data. A follow-up workshop and additional research on indicator species is needed to develop consensus on these and other topics. Improved integration of these monitoring activities will make more efficient use of available funds and strengthen monitoring efforts.

Without statistically sound information about the water quality, living resources, and habitats of the Lake Champlain Basin, it will be impossible to evaluate whether the management actions outlined in this Plan are achieving our goals.

Improving Coordination and Data-sharing

While many monitoring programs exist in the Basin, aside from current efforts by the LCBP and its Technical Advisory Committee and Subcommittees, there is no formalized mechanism for coordination or data-sharing among agencies in New York, Vermont or Quebec. The Province of Quebec, for example, has developed a data base on metals in fish starting from the 1980s, but few resource managers in New York or Vermont have seen this information. Likewise, there has been little opportunity to share results from recent U.S. monitoring programs with Quebec agencies or research institutions. Increased coordination among managers responsible for water quality, fish and wildlife, nuisance species, and human health, is needed within each state and across the Basin. A formal process to facilitate data-sharing and interpretation is essential to Plan implementation. Equally important is the regular production of summary reports for the general public.

Objectives: (not listed in priority order)

1. Monitor key indicators of environmental quality in the Lake Champlain Basin.

2. Use the data assembled to: a) document environmental change; b) predict the effects of management actions on the Lake Champlain ecosystem; and c) guide changes to management actions over time.

Actions (not listed in priority order)

1. Continue to Monitor Key Baseline Parameters in the Lake Champlain Basin

a. continue measurements initiated by the states of New York and Vermont with funding from the LCBP (see Table 5);
b. continue stream gauging;
c. continue basic meteorologic monitoring.

Potential key players: NYSDEC, NYS Biological Survey, VT DEC, USFWS, USGS, other relevant state and federal agencies, LCRC
Cost estimate: for a, $250,000/yr; for b, $150,000/yr; for c, $25,000/yr
Potential funding source: federal and state appropriations, and in-kind participation of other federal and state agencies
Time-frame: ongoing
Benchmark: continuation of above listed monitoring programs into the next century

2. Continue and Expand Monitoring Programs Essential for Particular Management Concerns

a. provide a statistically sound data set on toxic substances in fish and wildlife tissue for use by both human health officials and fish and wildlife managers;
b. document the spread of nuisance species;

c. measure toxic substances in the water column and sediment;
d. monitor point source wastewater discharges, as necessary, to help measure success towards phosphorus and other point source reduction goals;
e. expand monitoring at tributary mouths, as necessary, to help measure success towards phosphorus reduction goals;
f. periodically update information on land use, agricultural practices, and extent of natural habitats in the Lake Champlain Basin;
g. provide other specific information as necessary.

Potential key players: partnership of federal, state, and local agencies (including USGS, NOAA, NBS, USFWS), LCRC, lay monitoring programs, watershed associations, and the Province of Quebec
Cost estimate: $250,000/yr
Potential funding source: federal appropriations and in-kind participation of other federal and state agencies; USEPA's EMAP Program, Clean Lakes program, federal and state appropriations
Time-frame: ongoing
Benchmark: periodic reports on a through f; incorporation of these activities into the long-term monitoring program (in Action 1) where appropriate

3. Expand the Monitoring Program (in Action 1) to Include Indicators of Environmental Quality

a. identify indicators through a cooperative research effort;
b. identify appropriate monitoring sites throughout the Basin;
c. ensure that all major habitats and management concerns are addressed.

Potential key players: LCRC, USFWS, NYSDEC, VT ANR, VT DOH, NYSDOH, LCFWMC, USEPA, universities
Cost estimate: $150,000 and in-kind participation of agency representatives
Potential funding source: state and federal appropriations
Time-frame: 1996-1999
Benchmark: Identification of indicators and monitoring sites

4. Implement the Expanded Monitoring Program as Rapidly as Possible to Provide the Information Necessary to Judge Management Successes and Failures

Potential key players: same as for Action 1, above
Cost estimate: to be determined following completion of 3, above
Potential funding source: state and federal appropriations
Time-frame: ongoing
Benchmark: implementation of the expanded monitoring program

5. Establish a Process for Coordination and Data Sharing among Those Responsible for Managing Water Quality, Fish and Wildlife, Nuisance Species, Toxic Substances, and Human Health, and Produce Timely Summary Reports for the General Public

Potential key players: partnership of federal, state, and local agencies (including USFWS, NBS), LCRC, universities, lay monitoring programs, watershed associations, and the Province of Quebec
Cost estimate: $25,000-$50,000 per year
Potential funding source: state and federal appropriations, and in-kind contributions
Time-frame: 1996-1998
Benchmark: establishment of a process for data-sharing; publication of status and trends report for the public

Table 4. Parameters Monitored by the New York State and Vermont Long-Term Monitoring Program in 1995.

Parameter	Number of Stations	Sampling Frequency*
Lake Champlain		
Physical		
Temperature	12	Tri-weekly
Dissolved oxygen	12	Tri-weekly
Underwater irradiance	12	Tri-weekly
Secchi transparency	12	Tri-weekly
Specific conductance	12	Tri-weekly
pH	12	Tri-weekly
Alkalinity	12	3
Chemical		
Total phosphorus	12	Tri-weekly
Dissolved phosphorus	12	Tri-weekly
Total nitrogen	12	Tri-weekly
Dissolved reactive silica	12	Tri-weekly
Total organic carbon	12	Tri-weekly
Dissolved organic carbon	12	Tri-weekly
Total suspended solids	12	Tri-weekly
Chloride	12	Tri-weekly
Metals (Ca, Mg, Na, K, Fe, Pb)	12	3
Biological		
Chlorophyll	12	Tri-weekly
Phytoplankton	12	Tri-weekly
Zooplankton	12	Tri-weekly
Benthos	12	3
Mysids	5	Monthly
Zebra mussel adults	8	Biannually
Tributaries to Lake Champlain		
Physical		
Temperature	18	20
Specific Conductance	18	20
Chemical		
Total phosphorus	18	20
Dissolved phosphorus	18	20
Total nitrogen	18	20
Total organic carbon	18	20
Dissolved organic carbon	18	20
Total suspended solids	18	20
Chloride	18	20
Metals (Ca, Mg, Na, K, Fe, Pb)	18	3

* Lake sampling frequencies apply to a six-month sampling season (e.g., tri-weekly, May-October); tributary sampling frequencies apply to a full year (e.g., 20 per year).

Strategies for Funding Implementation of the Plan

Each action in *Opportunities for Action* has an estimated cost and a potential funding source(s) associated with it. The identified potential funding sources reflect the most probable sources of funding for the action, but do not indicate a monetary commitment from any organization. As various groups take responsibility for implementing actions, the funding sources available to these organizations will become more clear.

In several instances in the Plan, specific funding sources are identified for actions. For example, in the section on Protecting Wetlands, Action 1, to Continue to Secure Funding and Implement all Four Phases of the Lake Champlain Wetlands Acquisition Strategy, lists the USFWS North American Wetlands Conservation Act funding as a potential source of funding for the action. This source was identified because it has been used in the past for programs such as the Lake Champlain Wetlands Acquisition Strategy. However, in addition to such specific funding sources, the action also lists general funding sources, such as various state and private funds. By listing these general funding sources, the Plan allows for innovation wherever possible and does not limit itself to seeking funding from traditional, earmarked sources.

The Institutional Arrangements report (Yellow Wood Associates, 1995) suggests four principles to guide successful funding of watershed programs: 1) the sources and products of funding should be clearly understood by the public; 2) funding should be flexible and not solely tied to political sources; 3) funding sources should be diversified to reduce dependence on any specific organizations; and 4) funding must be adequate to fully carry out the intended purpose of the action.

Opportunities for Action provides benchmarks under each action which are indications of what will be accomplished when the action is implemented. These benchmarks can be used by the public to understand how the funding for each action will be used. For several actions, the cost-estimate also outlines what the funding will provide (e.g., $50,000 to hire a wetland biologist and coordinator of state programs). Each action also lists an expected time-frame for implementation. The public can use these estimates to hold agencies and organizations accountable to the recommended actions.

Opportunities for Action seeks out diverse funding sources and does not limit itself to money allocated by traditional federal and state programs, local cost share contributions, and costs borne directly by the private sector. Several actions in the Plan call for the formation of public/private partnerships as a key means to reducing dependence on one source of funding. For example, private entities could help maintain or improve public parks or Lake accesses in exchange for publicity and other incentives (see section on Managing Recreation, Actions 1, 8).

Because of its evolving nature, *Opportunities for Action* is intended to be updated and evaluated every two years, at which time new priority actions and sources of funding may emerge and be incorporated. The Plan has built in some flexibility with a range of potential key players and funding sources identified for certain actions. If funding from one source diminishes, other sources may be tapped. In addition to this, because the Plan covers a wide range of issues which have different funding sources, many of the actions will not compete with each other for scarce

financial resources. Financing options can be mixed and matched to successfully fund the priority actions in the Plan.

Chapter 6. Economics

In order to integrate environmental and economic goals for the Basin, the LCMC considered a variety of economic factors in its planning process. Recently, the LCMC funded several studies (Holmes and Artuso, 1995a, 1995b) to address the fiscal and economic implications of the actions proposed in the Draft Plan and discuss the economic benefits of improved water quality resulting from pollution control. The LCMC used the recommendations of these reports to help select the priority actions in this Plan.

In addition to the economic analyses of the Draft Plan, a final economic analysis (Holmes and Artuso, 1996 [in press]) of this Plan is available. This report contains extensive information on the benefits of implementing each of the high priority actions as well as the direct and indirect costs incurred by the public and private sectors. The study also provides a brief description of the basic concepts and analytical methods used in environmental economics and analyzes the strengths and weaknesses of these methods. Readers should consult these documents for a comprehensive description of economic considerations concerning the actions recommended in the Plan.

This chapter uses information extracted from the economic analyses of the Draft Plan to characterize briefly the economy of the Lake Champlain Basin and to provide key economic findings concerning the highest priority actions in the Plan.

Lake Champlain Basin Economy

The economy of the Lake Champlain Basin has traditionally been a rural resource-based economy. In addition to agriculture, both renewable natural resources (such as timber, tannin, fish, game, ice, maple syrup) and non-renewable natural resources (such as iron ore, marble, gravel, slate, wollastonite) have played a central role in the economic history of the Basin. Settlement in the Lake Champlain area by Europeans began in earnest in the early 1800s with the cutting of timber and mining of iron ore. The lumber camps and mining towns that supported these industries fueled additional economic activities such as farms to supply food, and railroad and canal boats to move timber and iron to market. The economy quickly diversified in the 1800s with extensive economic development after the Civil War. "Vacationing" soon began to form a tourism industry in the Basin.

Today, natural resources still play a significant role in the Basin's economy. Log homes, paper products, milk, ice cream, apples, fish, fowl, venison, slate, and granite are a few of the natural resource commodities presently produced in the Basin. Agriculture generates approximately $415 million per year in sales of agricultural products. In 1994, maple syrup production contributed over $10 million to the Basin's economy (Miller, 1994). The only mine for wollastonite (a mineral that replaces asbestos in floor tile, plastic, paint, and brake linings) in the United States is found in Essex County, NY and is world renowned for its quality. Natural resource activities such as farming, forestry, mining and guiding also provide employment in rural areas where opportunities are otherwise limited.

Non-consumptive natural and cultural resources-related activities also factor greatly in the

region's economy. Tourism in the Basin contributed approximately $2.2 billion to the Basin in 1990, with 40% ($880 million) of that being Lake-related. Natural, cultural and historical sites generate millions of dollars annually and employ numerous Basin residents. The natural resources of the Basin also have significant ecological value which may not be reflected in traditional monetary worth, but is equally important to the well-being of the region. For example, wetlands improve water quality by filtering pollutants; contribute to overall biological diversity; and provide habitat for fish, wildlife and some rare and endangered species. These ecological values are integral to the welfare of Basin residents and will continue to be important for future generations.

The economy of the Basin exhibits a diversity that helped it weather the late 1980s fairly well. In addition to tourism, major sectors of the Basin economy include manufacturing, agriculture, retail and wholesale trade, health care, universities, prisons and state government. The Economic Database Project (Holmes & Associates and Artuso, 1993) found that service sector employment comprises 35% of the Basin employment by industry, followed by trade (22%), and manufacturing (15%). Overall, the worth of economic activity in the Basin in 1992 was estimated at $9.1 billion with value-added manufacturing contributing around $2.8 billion, retail sales contributing $4.5 billion, and the service sector contributing $1.8 billion. The trend since 1980 has been towards an increase in the service and trade sectors and a decrease in the manufacturing sector.

Role of Lake Champlain in the Basin Economy

Although the role of Lake Champlain in the economic well-being of the region is not yet fully understood, research shows that there is a clear connection between the economy and the health of the Lake's resources. About forty percent of the Basin-wide total tourism expenditures in 1990 were Lake-related, and as many as 16,400 jobs depended directly on Lake Champlain-related tourism in New York and Vermont. Sailing, swimming, motorboating, sailboarding, kayaking, canoeing and fishing are among the most popular activities on the Lake and depend to a great extent upon the water quality of the Lake. Fishing generated approximately $81 million in revenues in the Basin in 1991, while other recreational activities, such as bicycling and hiking, benefit from the spectacular vistas that the Lake provides.

To better define the relationship between Lake Champlain and local economies, the Lake Champlain Basin Program conducted economic case studies in the town of Champlain, NY (Yellow Wood Associates, 1993) and the city of Vergennes, VT (Economic and Financial Consulting Associates, 1993). The Champlain study showed among other things that an estimated 15% of sales tax revenues for the community were generated by consumers using the Lake. The study in the area near Vergennes estimated that Lake-related business generates an annual average revenue of $14.7 million for the firms in the area, and additional Lake-related income when multiplier effects are taken into consideration. Up to 43% of business people surveyed felt that there was a direct relationship between the health of their business and maintenance of the existing level of water quality in the Vergennes area. Approximately 33% of Vergennes business people felt that their business would be enhanced if the Lake's water quality was improved. Although these local economic studies were conducted for only two communities, the economic importance of a healthy Lake Champlain is clear.

Key Economic Findings Concerning Plan Priorities

The economic analyses of the October, 1994 draft of the Plan (Holmes and Artuso, 1995a, 1995b) contain important findings about the potential fiscal and economic impacts of many of the actions in the Plan. The following are some of the key findings that pertain to the highest priorities of the Plan. More complete information on the economic impacts of Plan recommendations is included in the reports cited above and in the economic analysis of the Final Plan (Holmes and Artuso, 1996 [in press]).

1) Reduce phosphorus in priority sub-basins of the Lake (Actions 1-3 in the section on Reducing Phosphorus Pollution).

$ Based on benefit estimates derived from studies conducted in other parts of the country, the total use (e.g. fishing, swimming, boating) and non-use benefits (aesthetic, option, bequest and existence value) of the water quality improvements in Lake Champlain envisioned in the Plan could range from $11 to $80 million per year, with most estimates clustering in the range of $11 to $30 million per year.

$ Direct use benefits of the water quality improvements envisioned in the Plan (e.g., fishing, swimming, boating) could range from $2.4 million to $28 million per year with several detailed studies indicating total direct use benefits in the vicinity of $9 million.

$ The annualized cost of a mid-range phosphorus reduction strategy that would effectively achieve all in-lake phosphorus standards except those established for the southern portion of the Lake and Missisquoi Bay is estimated to be approximately $12.6 million.

$ The need for government cost sharing for manure management systems tends to decrease with increasing farm size. The majority of farms in need of a manure management system are the smaller farms. Since the economic cost of moving from daily spreading to an alternative manure management system outweighs the benefits on small farms, cost share funds will be necessary to incorporate phosphorus control measures on agricultural land in the Basin. In the short term, careful targeting of livestock BMPs in critical sub-basins based on the location and size of the farms appears to be the most equitable and cost effective approach to reducing phosphorus input from dairy farm manure.

$ New York local governments in the Lake Champlain Basin are less able than other areas of the state to fund significant new expenditures for wastewater treatment or other programs relying on local revenues. The combination of below-average fiscal capacity and above-average dependence on state and federal aid suggest that improvements proposed at the local level be supported fully or substantially with non-local funds. State-wide rather than local funding for phosphorus reduction at wastewater treatment plants is the approach used in Vermont.

2) Prevent and control persistent toxic contaminants found lakewide or in localized areas of the Lake (Actions 1 and 2 of the section on Preventing Pollution from Toxic Substances).

$ Toxic pollution in Lake Champlain can cause direct economic costs through possible reductions in the number of fishing trips anglers make to Lake Champlain per year and reductions in the net benefits gained from each trip. It also may cause detrimental human health effects resulting from excessive consumption of contaminated species.

$ A recent study of the cost of toxic contamination in New York State lakes found a net cost of $28 per adult state resident, based on the travel expenditures of anglers who traveled to fishing sites where toxic substances were not a problem. Because toxic contaminants are causing fish consumption advisories for Lake Champlain, it can be assumed that some portion of that cost applies to the Lake Champlain Basin economy as well.

3) Develop a comprehensive management program for nuisance nonnative aquatic species (Action 1 of the section on Managing Nuisance Nonnative Aquatic Species).

Sea Lamprey

$ Economic analysis of sea lamprey control in Lake Champlain found that anglers were annually willing to pay approximately $11.50 each for sea lamprey control to protect lake trout and salmon. Based on this estimate, the value of sea lamprey control to Lake Champlain anglers is approximately $1.1 million per year (Gilbert, 1991).

$ The sea lamprey control program has cost approximately $320,000 per year for the past five years and appears to be effective in addressing the problem. The final impact analysis for the program, expected in 1996, will evaluate the program's overall cost-effectiveness.

Water Chestnut

$ Between 1982 and 1990, a total of $1.7 million has been spent by Vermont, the State of New York, and the U.S. Army Corps of Engineers on water chestnut control. The average annual expenditure during that period was approximately $177,000. However, since 1991, the average annual expenditure has dropped to $74,000, and the water chestnut infestation has spread.

Zebra Mussels

$ The environmental costs of zebra mussel invasion are extremely high, as zebra mussels colonize and potentially eliminate native mussel species, and feed upon extensive amounts of the plankton which support the food chain of the Lake.

$ The town of Willsboro, NY which has a water system extending 2500 feet into the Lake and which serves approximately 1600 people, estimates that installing a chlorine infuser into their system to prevent zebra mussel colonization will cost $120,000. At least three systems in Vermont currently have chlorine controls in their systems.

$ A Vermont Coalition of Water Suppliers estimates that $1.6 million will be required in capital costs to install zebra mussel controls in their facilities.

$ Approximately 200,000 people use Lake Champlain as a source of drinking water, including an estimated 4,149 households with private water systems drawing from the Lake. Private water system owners will face direct costs of preventing and controlling zebra mussel colonization in their intake pipes. Public water system users may face indirect costs of control and prevention.

$ The costs of controlling zebra mussels at the Vermont Fish and Wildlife Department's Edgar Weed Fish Culture Station are expected to reach $2 million in capital expenses and $100,000 per year in operating expenses (Dan Marchant, personal communication).

Cost Estimates in the Plan

In addition to the information provided by the economic analyses of the Plan, cost estimates have been listed for each action in the Plan. These cost estimates were developed by the Technical Advisory Committee and its subcommittees with the aid of economic consultants, and cover the costs of personnel, capital and operating expenses. In some instances, the cost estimates pertain to annual costs. For example, Action 6 of the section on Managing Nuisance Nonnative Aquatic Plants and Animals, lists an annual cost of $200,000 to successfully control water chestnuts in the Lake. In other cases the costs are total costs, such as in Action 5 of the section on Protecting Cultural Heritage Resources which estimates that $10,000 is needed for a pilot program to demonstrate possible ways to protect Lake Champlain's historic shipwrecks from zebra mussels.

Every cost estimate in the Plan is tied to the benchmarks listed with the actions. These benchmarks describe the expected outcomes of implementing the actions and can be used by the

public to measure success of implementation.

Why Act Now?

Continuing to protect and improve the resources of the Lake Champlain Basin will sustain past investments, expand the Basin's economic potential and improve the quality of life in the Basin. As evidenced in lake and coastal regions around the country the value of waterfront areas hinges on the quality of the water and shoreline. Clean water is a valuable, limited commodity that supports multiple uses, including recreation, drinking water, industrial uses, natural habitat and aesthetic enjoyment. The cost of cleaning and treating water for those uses increases as the water quality decreases.

As with any neglected public or private property, refraining from making any public or private investment in the Basin's resources will cause the economic and social value of Lake Champlain to deteriorate. Lake Champlain clean-up costs will be far greater in the future than at present; therefore, implementing strategies in the Plan which guide the region to a sustainable future, both economically and environmentally, is in the interest of all residents.

The Lake Champlain Basin's natural and cultural resources provide a foundation to support important aspects of the area economy. Abundant and diverse natural resources are a major reason many Basin residents choose to live where they do. Electing to protect healthy ecosystems and the organisms they support limits future costs and conserves options for future direct economic return. Implementing this Plan will help ensure that Lake Champlain continues to be a resource of national significance that bolsters the economic well-being of the region.

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A

Acceptable management practices (AMPs) - a phrase used in Vermont to indicate a forestry practice or pollution control mechanism that is effective in reducing nonpoint source pollution to surface water and ground water.

Acquisition - in the context of wetlands, to obtain through direct purchase, easement, donation, or other means, in order to protect, enhance, or restore habitat functions and values.

Algae - small aquatic plants which occur as single cells, colonies or strands. Algae use carbon dioxide and nutrients such as nitrogen and phosphorus to make their own food through photosynthesis. Algae form the base of the aquatic food chain.

Algae bloom or **algal bloom** - a situation often caused by excess nutrients whereby algae grow and reproduce rapidly, often forming dense mats on the surface of the water. Algae blooms can cause unpleasant conditions for swimmers or boaters.

Alternative wastewater treatment technologies - ecologically engineered systems which remove nutrients, solids, bacteria and trace metals from wastewater. Examples include constructed wetlands and ponds containing aquatic plants which rely on natural methods of wastewater treatment.

Alternative watering systems - arrangements that provide drinking water for farm animals and which keep livestock away from streambanks and riparian zones and out of streams and rivers; for example, a trough or tank served by a pipeline from a spring or well.

Aquatic - growing in, living in, or dependent upon water.

B

Barnyard runoff system - an installed system for the interception, collection and safe disposal of runoff water from a barnyard or concentrated feedlot.

Basin - the surrounding land that drains into a waterbody. For Lake Champlain, the land that drains through the many rivers and their tributaries into the Lake itself.

Benchmark - a standard against which the success of a program or action may be measured.

Best management practices (BMPs) - a practice or activity that reduces the amount of pollution entering a body of water.

Bioaccumulation - the ability of a contaminant to be retained and build up in the tissues of an organism from breathing contaminated air, drinking contaminated water or eating contaminated food.

Biocriteria (biological criteria) - numerical or descriptive measures of the characteristics of a biological community. Biocriteria are used as an index of the health of the community.

Biodiversity - the variety of plants and animals, their genetic variability, and their interrelationships and ecological processes, and the communities and landscapes in which they exist.

Bioenergetics - the study of energy flow through the food web.

Bioenergetics models - mathematical or conceptual illustrations of an ecosystem that account for all or some of a food web's known characteristics. By using bioenergetics models, one can predict how changing one part of the food web will affect the rest of the food web.

Biological indicators (bioindicators) - biological characteristics at the cellular, organism, population, or community level that are representative of a given habitat or its ecological condition.

Biomagnification - process whereby harmful substances become increasingly concentrated in tissues or internal organs of organisms with each step up the food chain.

Biota - the animal or plant life of a region.

Bioturbation - the stirring up of sediments due to biological activity.

Buffer zones (strips) - protective land borders that reduce runoff and nonpoint source pollution loading to critical habitats or water bodies; areas created or sustained to lessen the negative effects of land development on animals and plants and their habitats.

C

Carrying capacity - in recreation management, the amount of use a recreation area can sustain without deterioration of its quality. In wildlife management, the maximum number of animals an area can support. Carrying capacity depends upon the conditions of the habitat.

Catch basin - a usually human-made area which drains to a water course or waterbody.

Concentration - the amount of a material dissolved in a solution.

Contaminant - a substance that is not naturally present in the environment or is present in amounts that can adversely affect the environment.

Contamination - in water resources, the impairment of water quality by waste to a degree that creates a hazard to public health or living resources through poisoning or the spread of disease. Air and soil can also be contaminated in a similar way.

Cost-effective - in environmental policy-making, the least cost means of achieving a pre-determined environmental objective. Costs include long-term, short-term, direct and indirect

costs to producers, society and the environment.

Cost-share - a method for sharing installation costs for conservation practices, including BMPs, between a governmental body (federal, state, local) and a farmer or landowner/land user.

Criteria - a standard, rule or test by which something can be judged; a measure of value.

Critical habitat - any area which has unique or fragile natural, historical, geological, archeological or wildlife value; areas which are essential to the conservation of an officially-listed endangered or threatened species and which may require special management considerations or protection are also considered critical habitats.

Cryptosporidium - a disease-causing microorganism that is found in water contaminated by fecal matter and that can cause stomach and intestinal illness when ingested.

Cultural eutrophication - eutrophication that is caused by additions of extra nutrients from human activities (see **eutrophication**).

Cultural heritage - historical and archeological past.

Cultural heritage resources - the physical record and memory of the past.

Cumulative impacts - environmental impacts that add up over time and space from a series of similar or related individual actions, contaminants or projects. Although each action may seem to have a negligible impact, the combined effect can be severe.

D

Database - a collection of data arranged for ease and speed of retrieval.

Dioxin - any of a family of compounds known chemically as dibenzo-p-dioxins. Dioxins are sometimes generated by industrial processes, and can contaminate water and soil. Tests on laboratory animals indicate that it is one of the most toxic man-made chemicals known.

Drainage basin - land area from which water flows into a river or lake, either from streams, groundwater, or surface runoff (see **Watershed**).

E

Easement - an agreement by which a landowner gives up or sells one of the rights on his/her property. For example, a landowner may donate a right of way across his/her property to allow community members access to the Lake.

Ecological communities - a group of interacting plants and animals inhabiting a given area.

Ecological integrity - a structurally sound and fully functional ecosystem is one that is said to

have "ecological integrity." Such an ecosystem is self-maintaining and resilient when disturbed.

Ecologically sensitive areas - an area that is prone to disruption of the ecological processes if there is alteration of biotic or abiotic systems in the area. Also commonly used to mean any area which contains rare and endangered species.

Ecosystem - a group of plants and animals occurring together, and the physical environment with which they interact.

Ecosystem approach - a way of looking at socio-economic and environmental information based on the boundaries of ecosystems such as the Lake Champlain Basin, rather than based on town, city and county boundaries.

Ecosystem-based management - an approach to making decisions based on the characteristics of the ecosystem in which a person or thing belongs. This concept takes into consideration interactions between the plants, animals and physical characteristics of the environment when making decisions about land use or living resource issues.

Elevated levels - levels that are higher than natural, background levels for an area.

Endangered species - a species in immediate danger of becoming extinct.

End-of-pipe - at the point of discharge to the environment.

Erosion - the loosening and subsequent transport of soil away from its native site. Erosion often results from wind or the removal of vegetation. OR The wearing away of the land surface by running water, wind, ice or gravity.

Eutrophic - from Greek for "well-nourished," it describes a lake with low water clarity and excessive plant growth due to high concentrations of nutrients.

Eutrophication - the slow, natural process of aging of a lake, estuary, or bay. Dissolved nutrients enter the water body, often leading to excess plant growth and decreased water quality. As the plants die, they are decomposed by microorganisms which use up dissolved oxygen vital to other aquatic species such as fish. Over very long periods of time, the decaying plant matter builds up and causes the lake to fill in to form a bog or marsh. **Cultural eutrophication** speeds up this natural process.

Exotic species - a species which is not native or which is introduced from another location.

F

Failed, failing or faulty septic system - a septic system that releases untreated or inadequately treated wastewater to surface or groundwater by surfacing and overland flow of effluent or by subsurface percolation.

Fee title - ownership of the land. One owns land when one has fee title.

Fishery - the act, process, occupation or season for taking fish.

Fish passage facility - a structure that is built, installed or established to help fish bypass impediments in a waterway.

Food web - the pattern of food consumption in a natural ecosystem. A food web is composed of many interconnecting food chains.

Furan - a colorless liquid, prepared from wood tar and used as a solvent for resins and plastics or as a tanning agent.

G

Giardia - a protozoan which causes stomach and intestinal illness.

Geographic Information Systems (GIS) - a computer system that is used to compile, store, analyze and display geographic and associated data tables. This system can be used to produce maps which overlay information layers of locations of various environmental and physical features.

Grassland agriculture - the use of grass, legumes and/or hay to achieve livestock dietary requirements without the need for corn silage.

Guidelines - standards or principles by which to make a judgement or determine a policy or course of action.

H

Habitat - the place where a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be free of harmful contaminants.

Habitat conservation - the protection of an animal or plant's habitat to ensure that the use of that habitat by the animal or plant is not altered or reduced.

Habitat corridor - a strip of habitat that joins two larger blocks of habitat that permits movement of wildlife during dispersal or migration, e.g., a wooded area along a river.

Habitat degradation - reduction of the quality of the environment in which an organism or biological population usually lives or grows.

Habitat restoration - the artificial manipulation of a habitat to restore it to its former condition.

Hazardous waste - any solid, liquid or gaseous substance that is a by-product of society and classified under state or federal law as potentially harmful to human health or the environment. Hazardous wastes are subject to special handling, shipping, storage and disposal requirements and

possess at least one of the following four characteristics: ignitability, corrosivity, reactivity or toxicity.

Health risks - anything which may reduce human health. These may be ranked according to high, moderate and low risk.

Household hazardous waste - substances found in the home which contain hazardous materials (which should be disposed of properly to prevent pollution to the air, groundwater and surface water.)

Hydrodynamics - the study of how water flows from one area to another.

I

Infiltration - a process in which something passes into or through (a substance) by filtering or permeating, such as rainwater filtering through the soil to the roots of plants.

Institutional framework - formal and informal relationships among organizations, agencies and individuals who will be responsible for implementing the Plan.

Integrated crop management - an agricultural practice which uses a systems approach to manage the application of nutrients and pesticides in an efficient and environmentally sound manner to reduce pollution of water, land, or air, and to preserve soil fertility.

Iterative process - a process which involves repetition and gradual refinement.

Invertebrate - small organisms like worms and clams that do not have a backbone.

L

Land trusts - organizations dedicated to conserving land by purchasing land, receiving donations of land, or accepting conservation easements from landowners.

Load (also loading) - the amount of a material entering a system from all sources over a given time interval.

Load allocation - the maximum desirable pollutant load from one or more sources needed to meet desired load reduction.

Local watershed - in this Plan, any watershed within a sub-basin of Lake Champlain.

M

Manage - to control the movement or behavior of; to manipulate.

Management (natural resources management) - to make a conscious, deliberate decision on a

course of action to conserve, protect, restore, enhance, or control natural resources, or to take no action.

Mass balance approach - an approach to managing chemicals that relies on balancing inputs and outputs.

Mesotrophic - a moderately nutrient-enriched lake, between oligotrophic and eutrophic.

Mitigation - actions taken to compensate for the negative effects of a particular project. Wetland mitigation usually takes the form of restoration or enhancement of a previously damaged wetland or creation of a new wetland.

Mitigation bank - a system of credits and debits used to account for habitat restoration, creation or enhancement undertaken as mitigation prior to future development actions that will incur unavoidable habitat losses.

Multi-media reduction strategies - approaches to controlling toxic contaminants that prevent them from entering water, air, sediment and biota.

N

Nongame species - wildlife species, such as songbirds and raptors, which are not commonly hunted, killed or consumed by humans.

Nonnative - in this Plan, not originating naturally in the Lake Champlain Basin.

Nonpoint source pollution - nutrients or toxic substances that enter water from dispersed and uncontrolled sites, rather than through pipes. Sources of nonpoint source pollution include runoff from agricultural practices, urban and forest land, and on-site sewage disposal.

Nuisance species - species having adverse ecological and/or economic impacts.

Nutrient - a substance or ingredient which nourishes life. These are essential chemicals needed by plants or animals for growth. If other physical and chemical conditions are appropriate, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation and subsequent decay of plants, especially algae. Some nutrients can be toxic to plants and animals at high concentrations.

Nutrient management - an integrated approach designed to maximize the efficient use of nutrients, particularly phosphorus which is found in animal manure and fertilizer.

O

Oligotrophic - from the Greek for "poorly nourished"; Describes a lake, with low plant growth and high clarity. Oligotrophic lakes contain little organic matter and have a high dissolved oxygen level.

Optimum sustainable yield - the amount harvested which is best economically for humans but that also ensures that the resource is not depleted.

P

PAH - polycyclic or polynuclear aromatic hydrocarbons. A class of complex organic compounds, some of which do not easily break down and may cause cancer. PAH compounds are formed from the combustion, or burning, of organic material and are widespread in the environment. PAHs are commonly formed by forest fires and by the combustion of gasoline and other petroleum products. They often reach the environment through atmospheric fallout and highway runoff.

Pathogens - organisms, usually viruses, bacteria or fungi, capable of causing disease.

PCBs - polychlorinated biphenyls. A group of manufactured chemicals, including about seventy different but closely related compounds made up of carbon, hydrogen and chlorine, used in transformers and capacitors for insulating purposes. If released to the environment, PCBs do not break down for long periods and can biomagnify in food chains. PCBs are suspected of causing cancer in humans and other animals. PCBs are an example of an organic toxic chemical.

Perennial streams - streams where surface waters flow sufficiently to produce a defined channel year round.

Persistent contaminants - harmful compounds that do not readily degrade in the environment.

Phosphorus coefficient - an average value for the amount of phosphorus that runs off from a unit area per year. This number is used to estimate phosphorus loading from nonpoint pollution sources to waterbodies.

Phytoplankton - very small, free-floating plants found in water bodies.

Point source pollution - nutrients or toxic substances that enter a water body from a specific entry point, such as a pipe. For example, the discharge from a sewage treatment plant is point source pollution.

Pollutant - something that pollutes.

Pollution - impairment of land, air or water quality caused by agricultural, domestic or industrial waste that negatively impacts beneficial uses of the land, air or water, or the facilities that serve such beneficial uses.

Pollution prevention - any action such as the efficient use of raw materials, energy, and water, that reduces or eliminates the creation of pollutants. In the Pollution Prevention Act, pollution prevention is defined as source reduction (see **Source reduction**).

Pond reclamation - the control or restoration of an unbalanced population of fish in a pond

through the use of chemicals, nets, weirs, biological control, regulations or water level control. The pond is then restocked with a balanced population of fish.

Population - the number of inhabitants in a country or region; in ecology, a population is a group of organisms of the same species living in a specified area and interbreeding.

Population of concern - a population that has been designated as one in distress or need of help (see **Population**).

R

Rare species - a species not presently in danger, but of concern because of low numbers

Restoration - any action taken to repair, maintain, protect, and enhance the ecological integrity of the Basin.

Retrofitted stormwater management - the installation of best management practices (BMPs) in existing developed areas to improve water quality and lessen other negative impacts associated with urbanization.

Riparian (habitat or zone) - habitat occurring along rivers, streams and creeks that provides for a high density, diversity and productivity of plant and animal species.

Rotational grazing - a pasture management system which uses several paddocks during a grazing season, alternating paddocks to allow for forage regrowth. Livestock generally graze for less than a week before being rotated to another paddock. This system improves vegetative cover and reduces erosion and nutrient runoff.

Runoff - water from rain, melted snow, or agricultural or landscape irrigation that flows over the land surface into a water body.

S

Sale of development rights - the process of selling the legal right to develop a parcel of land.

Salmonids - a member of the family *Salmonidae*, which includes salmon, trout and whitefishes.

Sedimentation - the deposition or accumulation of sediment, such as sand, silt or clay.

Scenic byway - a transportation route and adjacent area of particular scenic, historic, recreational, cultural and archeological values which is managed to protect such values and encourage economic development through tourism and recreation.

Sites of concern - areas where toxic substances are found in concentrations greater than acceptable levels, or where several toxic substances are found together.

Source reduction - any practice which reduces the amount of any hazardous substance, pollutant or contaminant entering wastewater. Source reduction decreases the hazards to public health and the environment associated with the release of such substances, pollutants or contaminants. Technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training or inventory control are all examples of source reduction.

Spoil sites - places where waste material is deposited.

Stewardship - the concepts of responsible caretaking; based on the premise that we do not own resources, but are managers of resources and are responsible to future generations for their condition.

Stormwater runoff - precipitation running off of saturated soils and impervious surfaces such as paved parking lots, streets or roofs.

Stream flow management regimes - different management scenarios of stream flow past a dam, including management of the upstream impoundment and the flows downstream. Each management scenario selected could have positive effects on some fish and wildlife species and negative effects on others.

Sub-basin - a smaller drainage area within a large drainage basin, such as the Saranac River sub-basin of the Lake Champlain Basin. In this Plan, "sub-basin" refers to one of the 34 drainage areas (larger than 26 km^2) to Lake Champlain.

Surface water conveyance - a mechanism for transporting water from one point to another, including pipes, ditches, and channels. OR The drainage facilities, both natural and man-made, which collect and provide for the flow of surface water and stormwater from the highest points on the land down to a receiving water. Natural systems include swales, a wetlands streams, etc. Man-made systems include gutters, ditches, pipes, etc.

Sustainable yield - the amount of harvest of a natural resource able to be maintained over a long period of time with no destruction of the resource's productivity.

Sustainable tourism - see **Carrying capacity**.

T

Terrestrial species - species which live on the ground rather than in the water.

Threatened areas - areas which are in imminent danger of being degraded by pollution.

Threatened species - a species with high possibility of becoming endangered in the near future (see **Endangered species**).

Toxic substances - any substance which upon exposure, ingestion, inhalation or assimilation into any organism, causes death, disease, genetic mutations, physiological malfunctions or physical deformation. Examples of toxic substances are cyanides, phenols, pesticides and heavy metals.

Toxic - poisonous, carcinogenic, or otherwise directly harmful to life.

Tributary - a stream or river that flows into a larger stream or river or lake.

U

Urban runoff - stormwater from city streets and adjacent domestic or commercial properties that may carry pollutants of various kinds into the sewer systems and/or receiving waters.

W

Waste Exchange - any transaction whereby one person's, business', or industry's waste is another person's, business', or industry's raw materials.

Watershed - the geographic reach within which water drains into a particular river, stream or body of water. A watershed includes both the land and the body of water into which the land drains.

Watershed association - a citizen based group interested in protecting a nearby waterway and its surrounding drainage area.

Watershed planning - cooperative local and regional land use planning that recognizes watershed boundaries rather than political boundaries and considers water resources management is the central planning objective.

Wet ponds - a human-made basin with a permanent pool of water.

Wetland enhancement - to make a wetland more complete (see **Wetlands**).

Wetland restoration - any action that aids in preserving, repairing, maintaining or enhancing wetlands (see **Wetlands)**.

Wetlands - lands that are transitional between land and water where the water table is usually at or near the surface of the land. Wetlands are characterized by unique hydric soils and contain plant and animal communities adapted to aquatic or intermittently wet conditions. Swamps, bogs, wet meadows and marshes are examples of wetlands. The boundary of Lake Champlain wetlands has been defined at 105 feet (31.1 meters) above mean sea level.

Wildlife - for the purposes of this Plan, the term "wildlife" includes any non-domesticated mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod and other invertebrate or plant.

Willing seller basis - the owner of land volunteers to participate in a land purchase or acquisition.

List of Abbreviations

AAC	Agricultural Advisory Council
APA	Adirondack Park Agency
ARS	Agricultural Research Service
ASCS	Agricultural Stabilization and Conservation Service
BMPs	Best Management Practices
CACs	Citizens Advisory Committees
FSA	Farm Services Agency
CMAs	Crop Management Associations
CWA	Clean Water Act
EMAP	Environmental Monitoring and Assessment Program
FDA	U.S. Food and Drug Administration
FMHA	Farmers Home Administration
GIS	Geographic Information Systems
HPF	Historic Preservation Fund
HUD	United States Department of Housing and Urban Development
IJC	International Joint Commission
ISTEA	Intermodal Surface Transportation Efficiency Act
LCBP	Lake Champlain Basin Program
LCFWMC	Lake Champlain Fish and Wildlife Management Cooperative
LCMC	Lake Champlain Management Conference
LCMM	Lake Champlain Maritime Museum
LCRC	Lake Champlain Research Consortium
NBS	National Biological Service
NOAA	National Oceanographic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCD	Natural Resource Conservation District
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
NYSDAM	New York State Department of Agriculture and Markets
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
NYSOPRHP	New York State Office of Parks, Recreation and Historic Preservation
NYSSWCC	New York State Soil and Water Conservation Committee
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RIBS	Rotating Intensive Basin Studies
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SPDES	State Pollutant Discharge Elimination System (New York)
SWCD	Soil and Water Conservation District
USACOE	United States Army Corps of Engineers

USDA	United States Department of Agriculture
USDOI	United States Department of the Interior
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VCGI	Vermont Center for Geographic Information
VHCB	Vermont Housing Conservation Board
VOCs	Volatile organic compounds
VT ANR	Vermont Agency of Natural Resources
VT AOT	Vermont Agency of Transportation
VT DAFM	Vermont Department of Agriculture, Food and Markets
VT DEC	Vermont Department of Environmental Conservation
VT DFPR	Vermont Department of Forests, Parks and Recreation
VT DHP	Vermont Division for Historic Preservation
VT DOH	Vermont Department of Health
VT FWD	Vermont Fish and Wildlife Department
VT NRCC	Vermont Natural Resources Conservation Council

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