Technical Report No. 14A

Preliminary Economic Analysis of the Draft Plan for the Lake Champlain Basin Program - Part 2

Lake Champlain Basin Program

Executive Summary

Prepared by
Timothy P. Holmes & Associates and
Anthony Artuso, Institute for Public Affairs
and Policy Studies, University of Charleston

for
Lake Champlain Management Conference

November 1995

PUBLICATION SERIES

THIS PROGRAM IS SPONSORED BY U.S.E.P.A. AND THE STATES OF NEW YORK AND VERMONT.

This technical report is the fourteenth in a series of reports prepared under the Lake Champlain Basin Program. Those in print are listed below.

Lake Champlain Basin Program Technical Reports

1. *A Research and Monitoring Agenda for Lake Champlain.* Proceedings of a Workshop, December 17-19, 1991, Burlington, VT. Lake Champlain Research Consortium. May, 1992.

2. *Design and Initial Implementation of a Comprehensive Agricultural Monitoring and Evaluation Network for the Lake Champlain Basin.* NY-VT Strategic Core Group. February, 1993.

3. (A) *GIS Management Plan for the Lake Champlain Basin Program.* Vermont Center for Geographic Information, Inc., and Associates in Rural Development. March, 1993.

   (B) *Handbook of GIS Standards and Procedures for the Lake Champlain Basin Program.* Vermont Center for Geographic Information, Inc. March, 1993.

   (C) *GIS Data Inventory for the Lake Champlain Basin Program.* Vermont Center for Geographic Information, Inc. March, 1993.

4. (A) *Lake Champlain Economic Database Project. Executive Summary.* Holmes & Associates. March 1993.

   (B) *Socio-Economic Profile, Database, and Description of the Tourism Economy for the Lake Champlain Basin.* Holmes & Associates. March 1993

   (B) *Socio-Economic Profile, Database, and Description of the Tourism Economy for the Lake Champlain Basin. Appendices.* Holmes & Associates. March 1993

   (C) *Potential Applications of Economic Instruments for Environmental Protection in the Lake Champlain Basin.* Anthony Artuso. March 1993.

   (D) *Conceptual Framework for Evaluation of Pollution Control Strategies and Water Quality Standards for Lake Champlain.* Anthony Artuso. March 1993.

5. *Lake Champlain Sediment Toxics Assessment Program. An Assessment of Sediment - Associated Contaminants in Lake Champlain - Phase 1.* Alan McIntosh, Editor, UVM School of Natural Resources. February 1994.

   Lake Champlain Sediment Toxics Assessment Program. An Assessment of Sediment - Associated Contaminants in Lake Champlain - Phase 1. Executive Summary. Alan McIntosh, Editor, UVM School of Natural Resources. February 1994.

6. *(A) Lake Champlain Nonpoint Source Pollution Assessment.* Lenore Budd, Associates in Rural Development Inc. and Donald Meals, UVM School of Natural Resources. February 1994.

   (B) Lake Champlain Nonpoint Source Pollution Assessment. Appendices A-J. Lenore Budd, Associates in Rural Development Inc. and Donald Meals, UVM School of Natural Resources. February 1994.

7. *Internal Phosphorus Loading Studies of St. Albans Bay. Executive Summary.* VT Dept of Environmental Conservation. March 1994.

(A) *Dynamic Mass Balance Model of Internal Phosphorus Loading in St. Albans Bay, Lake Champlain.* Eric Smeltzer, Neil Kamman, Karen Hyde and John C. Drake. March 1994.

(B) *History of Phosphorus Loading to St. Albans Bay, 1850 - 1990.* Karen Hyde, Neil Kamman and Eric Smeltzer. March 1994.

(C) *Assessment of Sediment Phosphorus Distribution and Long-Term Recycling in St. Albans Bay, Lake Champlain.* Scott Martin, Youngstown State University. March 1994.

8. *Lake Champlain Wetlands Acquisition Study.* Jon Binhammer, VT Nature Conservancy. June 1994.

9. *A Study of the Feasibility of Restoring Lake Sturgeon to Lake Champlain.* Deborah A. Moreau and Donna L. Parrish, VT Cooperative Fish & Wildlife Research Unit, University of Vermont. June 1994.

10. *Population Biology and Management of Lake Champlain Walleye.* Kathleen L. Newbrough, Donna L. Parrish, and Matthew G. Mitro, Fish & Wildlife Research Unit, University of Vermont. June 1994.

11. (A) *Report on Institutional Arrangements for Watershed Management of the Lake Champlain Basin. Executive Summary.* Yellow Wood Associates, Inc. January 1995.

(B) *Report on Institutional Arrangements for Watershed Management of the Lake Champlain Basin.* Yellow Wood Associates, Inc. January 1995.

(C) *Report on Institutional Arrangements for Watershed Management of the Lake Champlain Basin. Appendices.* Yellow Wood Associates, Inc. January 1995.

12. (A) *Preliminary Economic Analysis of the Draft Plan for the Lake Champlain Basin Program. Executive Summary.* Holmes & Associates and Anthony Artuso. March 1995

(B) *Preliminary Economic Analysis of the Draft Plan for the Lake Champlain Basin Program.* Holmes & Associates and Anthony Artuso. March 1995

13. *Patterns of Harvest and Consumption of Lake Champlain Fish and Angler Awareness of Health Advisories.* Nancy A. Connelly and Barbara A. Knuth. September 1995.

14. (A) *Preliminary Economic Analysis of the Draft Plan for the Lake Champlain Basin Program. Executive Summary - Part 2.* Holmes & Associates and Anthony Artuso. November 1995

(B) *Preliminary Economic Analysis of the Draft Plan for the Lake Champlain Basin Program - Part 2.* Holmes & Associates and Anthony Artuso. November 1995

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.

PRELIMINARY ECONOMIC ANALYSIS OF THE DRAFT PLAN FOR THE LAKE CHAMPLAIN BASIN PROGRAM, PART 2

Executive Summary

Submitted to

THE LAKE CHAMPLAIN MANAGEMENT CONFERENCE

Prepared by

Timothy P. Holmes, Holmes & Associates

and

Anthony Artuso, Institute for Public Affairs and Policy Studies,
University of Charleston

with

Tommy L. Brown, Cornell University, Department of Natural Resources

November 1995

NOTICE

The dollar amounts used in this report represent the best available data at the time of this research. The process of refining the benefits and costs of Lake Champlain restoration and protection activities is on-going. A major purpose of this work was to develop economic analysis tools that are responsive to incremental changes in any of the benefit or cost estimates, and that can be easily up-dated with new data, information, and scenarios as they become available through the work of the Lake Champlain Management Conference and the Lake Champlain Basin Program.

Acknowledgments

The study team appreciates the assistance of the individuals who are members of the Lake Champlain Management Conference (LCMC), the Technical Advisory Committee (TAC), and the Economics Subcommittee of the TAC in the successful completion of this project. The contributions and suggestions of the Project Review Panel also are greatly appreciated.

The staff of the Lake Champlain Management Conference and the Lake Champlain Basin Program were consistently generous with their time and information, most notably Jim Connolly, Lisa Borre, Eric Perkins, Ann Cousins, Elizabeth Soper, Stephanie Clement, Kathy Wolcott, Coleen Hickey, and Jane Potvin. We also appreciate the assistance of Lee Steppacher, Wendy Cohen, and Terry Faber at the U.S. Environmental Protection Agency, and Jennie Bridge at the New England Interstate Water Pollution Control Commission.

A special note of thanks goes to the 23 individuals, primarily involved in private business and industry around the basin, who took time out of their busy schedules to attend and actively participate in two economic focus group sessions. Their serious consideration of economic issues involved in Lake Champlain water quality restoration and improvement is presented in this report. The type of understanding and insights that they brought to the table are crucial to a successful Lake Champlain planning effort, as is their continued involvement in the process.

We would like to thank a few individuals who were especially helpful in providing detailed information to the study team, in organizing Technical Advisory Committee subcommittee meetings, or who reviewed early drafts of the Part 2 report. They include:

Susan Bulmer, VT Forests, Parks, and Recreation;
David Clough, VT DEC Water Quality;
Ann Cousins, Lake Champlain Basin Program;
Kelly Dziekan, New York State Office of Parks, Recreation & Historic Preservation;
Larry Gobrecht, NYS Office of Parks, Recreation & Historic Preservation;
Michael Hauser, VT Agency of Natural Resources;
Bob Inslerman, NYSDEC;
William Johnston, Essex County NY Planning Office;
Kenneth Kogut, NYSDEC;
Bob Kort, USDA, NRCS;
Alan McIntosh, UVM School of Natural Resources;
Dave Tilton, US Fish & Wildlife; and,
Mary Watzin, UVM School of Natural Resources;

We greatly appreciate their insights and suggestions, as well as the comments of many others who discussed economic issues with the study team.

Barry Lawson, of Barry Lawson Associates, facilitated the two economic focus group meetings, and advised the study team on carrying out that aspect of the research. Nadia Korths, of Crystal Clear Impressions in Saranac Lake, provided editing services.

List of Abbreviations

BMP	Best Management Practices
CAST	Council for Agricultural Science and Technology
CSO	Combined sewer overflows
FTE	Full time equivalent
GIS	Geographic Information System
GLC	Great Lakes Consortium
HK	Human capital
LCBP	Lake Champlain Basin Program
LCMC	Lake Champlain Management Conference
mg/L or mg/l	Milligrams per liter. .01 mg/l = 10 μg/l.
NRCS	Natural Resources Conservation Service (formerly the Soil Conservation Service)
NYSDEC	New York State Department of Environmental Conservation
NYSOPRHP	New York State Office of Parks, Recreation & Historic Preservation
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
ppm	Parts per million
SDWA	Safe Drinking Water Act
TAC	Technical Advisory Committee
μg/L or μg/l	Micrograms per liter. 10 μg/l = .01 mg/l.
USEPA	U.S. Environmental Protection Agency
VTDEC	Vermont Department of Environmental Conservation
WTP	Willingness to pay
WWW	World Wide Web (Internet)

Table of Contents

List of Tables

PRELIMINARY ECONOMIC ANALYSIS OF THE DRAFT PLAN FOR THE LAKE CHAMPLAIN BASIN PROGRAM, PART 2

1. Introduction and Summary of Major Findings

1.1 Introduction

The Lake Champlain Management Conference (LCMC) was established in 1990 by federal legislation and charged with creating a comprehensive plan for protecting and enhancing Lake Champlain and its watershed area. Early on, the LCMC expressed an interest in integrating protection of Lake Champlain with vital local economies. One of the LCMC goals has been to promote economic strategies for the long-range economic future of the watershed that are compatible with other goals contained in the Draft Pollution Prevention, Control and Restoration Plan for Lake Champlain (i.e., draft Plan), and to tailor pollution prevention and control strategies for economic efficiency as well as environmental effectiveness. The following excerpt from the LCMC *Vision Statement* summarizes that goal of integrating environmental protection and economic vitality, in that the plan:

> *...supports multiple uses -- including commerce, a healthy drinking water supply, fish and 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 agriculture sector is an integral part of the balanced management of Lake Champlain....*(Lake Champlain Basin Program 1994).

This is the second of two reports on a preliminary economic analysis of the draft Plan. Together, the two reports provide a preliminary assessment of the overall fiscal and economic implications of the draft Plan for Lake Champlain, published as the ***Opportunities for Action*** by the Lake Champlain Basin Program (LCBP) in October 1994. The Part 1 preliminary economic analysis addressed economic issues in six of the eleven Plans for Action. The Part 2 document provides a preliminary economic analysis for the five major Plans not covered in the Part 1 report: Toxics, Human Health, Wetlands, Non-Native Nuisance Aquatics, and Cultural Heritage. In addition, this report includes continuation of the preliminary economic analysis of the Action Plans for Reducing Nutrients and Managing Nonpoint Source Pollution, that was initiated in Part 1.

Now that the LCMC has put the draft Plan before the public for review and discussion, they have begun the difficult process of selecting and prioritizing the proposed actions into a final plan. The draft Plan contains 11 major "Plans for Action" and approximately 170 individual plan elements. In their deliberations and decision making, the LCMC will be evaluating each Plan element with a wide variety of criteria, including the effectiveness in meeting environmental goals, the reliability of possible funding sources, the degree of public support for the activity, and the cost effectiveness of the element in addressing a particular Lake Champlain issue. This report, and the previ-

ously published Part 1 document, provide information to the LCMC and the public on costs, benefits, and cost effectiveness of various plan elements.

This phase of the preliminary economic analysis also addressed three additional tasks requested by the Economics subcommittee of the Technical Advisory Committee. First, the study team organized and carried out two economic focus group sessions. Those sessions included participants representing a variety of organizations and businesses in both Vermont and New York. The main findings from the focus group sessions are presented in the report, and detailed summaries of the two sessions are presented as Appendices.

Second, the study team carried out economic discussion sessions with representatives from most of the subcommittees of the Technical Advisory Committee (TAC) to review and revise cost estimates provided in the draft Plan. The meetings proved very valuable to the study team for understanding the latest thinking on the draft Plan recommendations by those most involved in formulating those recommendations. Since there were concurrent efforts by the TAC subcommittees, the Plan Formulation Team (PFT), and LCMC in revising, prioritizing, and finalizing plan elements, the discussion sessions aided the study team in stay abreast of the current status of the final draft Plan. The economic discussion sessions also helped the study team to focus their efforts most efficiently. Although there was not a considerable amount of new economic data forthcoming from the sessions, each workshop resulted in the study team gaining new insights into the economic considerations within each chapter, and we obtained additional references and contacts for further information. The analysis presented in this report reflects the benefit of those insights and references.

Third, Anthony Artuso lead the study team in developing an economic analysis framework for prioritization and implementation of draft Plan elements. The framework is particularly focused on policy development and implementation in situations where costs and benefits are uncertain and new information can be generated over time. The framework draws upon basic concepts of decision theory, an analytic technique that is widely used in economics, policy analysis and business planning.

A complete benefit cost study requires that all probable economic costs and benefits of a given action be identified and quantified. That level of economic analysis is anticipated in the next phase of economic research, an economic analysis of the final plan. The goal for this work was to compile and analyze as much of the needed economic information as possible within the project time frame and budget. The study team perceived the present Lake Champlain planning effort as part of an ongoing process of scientific research, policy development, implementation, and adjustment. Therefore, a portion of our research efforts were devoted to creating economic analysis tools and frameworks that will continue to be useful to Lake Champlain planning and protection efforts. Illustrative of the utility of our approach is the *economic optimization model of phosphorus control*, developed and described in the Part 1 report, that continues to be up-dated and refined as part of the phosphorus reduction targeting procedure for the Lake Champlain basin.

Although this report is written so as to be assessable to the lay person, various economic terms and concepts may be unfamiliar to the reader. Attached to the full report is a **List of Abbreviations**, preceding the Table of Contents, and a **Glossary** preceding the Bibliography. In addition, the study team adhered to rigorous academic standards in referencing all sources of information and providing full citations in an extensive **Bibliography** located at the end of the report.

1.2 Summary of Major Findings

1.2.1 Economic Benefits of Lake Champlain Water Quality Improvement, Revisited

1. **Table 1 is a revised presentation of the available Lake Champlain recreation use and expenditure data.** Table 1 contains preliminary data on a number of the main lake user categories, such as state park beach users, anglers, boaters, etc. The preliminary annual recreation expenditure estimate for Lake Champlain is over $40 million in direct lake-related expenditures. The available data is heavily weighted towards fishing expenditures. The information on use is not complete at this point, represented by blanks in the chart, and continues to be up-dated by on-going Lake Champlain research.

Table 1: Recreation Data Summary for Lake Champlain (Revised)

Activity or Facility	Year	Area	Number of Facilities	Annual Count	Average Expenditure per Person, per Day	Estimated Annual Expenditure	One Day Count
State Park*							
Vermont State Parks Along Lake Champlain[1,13]	1994	Lake shore	9	195,426	$17	$3,322,242	
New York State Parks Along Lake Champlain[2,13]	1994	Lake shore	5	274,000	$17	$4,658,000	
Fishing							
Fishing License Purchases[4]	1991	Basin		168,000			
Number of Anglers: Lake Champlain, NY & VT[12]	1991	Lake		141,379			
Angler Days: Lake Champlain, NY & VT[5]	1990	Lake		1,608,486	$20	$32,169,720	
Boating							
Lake Champlain Boat Count[3]	7/25/92	Lake					12,425
Canadian Boat Border Crossings @ Rouses Pt[4]	Avg	Lake		7,318			
Slips & Moorings Count, Vermont[6]	1994	VT shore	2,901				
Slips & Moorings Count, New York[6]	1994	NY shore	2,994				
Boat Launch Sites, Vermont[6]	1994	VT shore	79				
Boat Launch Sites, New York[6]	1994	NY shore	28				
Commercial & Public Marinas, Vermont[6]	1994	VT shore	37				
Commercial & Public Marinas, New York[6]	1994	NY shore	26				
Lake Champlain Commercial Marina Employment[12]	1990	Lake shore	56	448			
Other Activities, Expenditures per person/day*							
Divers[8]	1992	Lake			$110		
Transient marina users[8]	1992	Lake	64		$44		
Park users[6,8]	1994	Lake shore	114		$31		
Bicyclists[9,10]	1994	Basin			$52		
Beach users[6,12]	1987	Lake shore	64		$17		
Boaters[13]		Lake			$26		
Employment, Demographics, Property Values							
Annual Lake Related Tourism Employment[4]	1989	Lake shore		16,400			
Lake Champlain Basin Population[4,12]	1995	Basin		650,000			
Lake Champlain Basin Households[4]	1990	Basin		211,000			
Basin residents over the age of 18[4]	1990	Basin		450,000			
Shoreland Town Property Values[4]	1991	Lake shore		$8.8 billion			

Preliminary Total: $40,149,962

Note: This is an update of a table presented in the Part 1, Preliminary Economic Analysis (Table 7-1, p 122).
* Only includes State Parks with beaches on Lake Champlain.
Data sources: 1. Simino (1994), 2. NYOPRHP (1994b), 3. Bulmer (1993), 4. Holmes & Associates (1993), 5. Connelly and Brown (1990), 6. Farnum (1995), 7. Gilbert (1991), 8. Dzeikan (1995) and personal communication, 9. Holmes & Associates (1994), 10. Burgess (1994), 11. NYSDEC & USF&W (1990), 12. Holmes & Associates estimate from available data., 13. Brown, Tommy (personal communication 9/95).

2. **As distinct from recreational expenditures, Table 2 illustrates how the relevant water quality studies on indirect benefits from other areas can be applied to Lake Champlain.** Estimates of the indirect benefit of water quality improvement are presented using the appropriate Lake Champlain measure, listed in column 2. The Lake Champlain economic benefits shown in column three of Table 2 represent the value of maintaining or improving water quality to users and basin residents, over and above the actual expenditures of lake users. While not capturing completely the option, existence, and bequest values of maintaining and improving the water quality of Lake Champlain, the preliminary $18.6 million in annual benefits begins to approximate the value of Lake Champlain to users and residents. At this point, the estimated benefit value is heavily weighted by the threat of toxics (i.e., $12.6 million). Whether or not that value is inflated may be determined in subsequent research; however, it is almost certain that the benefit values related to reduced nutrients and the control of macrophyte will increase once estimates are developed for the South Lake and Missisquoi Bay areas of Lake Champlain.

Table 2: Summary of Benefit Transfer Values Applied to Lake Champlain

Water Quality Improvement Benefit Value Transferred	Lake Champlain Measure	Estimated Lake Champlain Benefit per Year ($ millions)	Dollar Year	Source
$1.27 - $6.52 per fishing trip, reduce point & non-point source pollution (nitrogen)	1,608,486 angler days	$2.0 to $10.5*	1982	Kaoru et al. (1995)
$28 per capita, removal of toxics	450,000 Basin residents > age 18	$12.6**	1989	Montgomery & Needelman (1994)
$3.29 per resident, eliminating eutrophication & bacteria	450,000 Basin residents > age 18	$1.5	1989	Needelman & Kealy (1994)
$123 current users, $93 former; from reduced nutrients and macrophytes	St. Albans Bay specific; other lake areas affected to be determined	$0.5	1984	Ribaudo et al. (1984)
20% increase in property values, from reduced nutrients	St. Albans Bay specific; other lake areas affected to be determined	$2.0	1981	Young & Teti (1984)
	Preliminary Total:	$18.6		

NOTE: This table provides preliminary estimates on the economic benefit of improved Lake Champlain water quality. Research is on-going to refine the benefits and costs of Lake Champlain protection and restoration efforts. This table is an update of a similar table presented in the Part 1, Preliminary Economic Analysis (Table 4-3, p 62).

* The low end ($2.0 million) is used in computing the preliminary total ($18.6 million).

**The $12.6 million estimate for annual benefits related to removing the threat of toxics should be viewed as the upper limit of this expected benefit measure. The report provides discussion and caveats on applying benefit measures from other areas to Lake Champlain.

See Tables 2-1 and 2-2 for descriptions of the source studies.

Source: Holmes & Associates (1995), data compiled for this study.

1.2.2 Action Plans for Reducing Nutrients and Managing Nonpoint Source Pollution

1. **Substantial work has been done in quantifying the costs of point and nonpoint source phosphorus control and of determining what facilities and watersheds should be targeted for implementation of treatment upgrades as well as agricultural and urban best management practices (BMP's).** Continuation of this work is being undertaken by the nutrient and nonpoint source subcommittees using the model developed by Artuso as part of the preliminary economic analysis of the draft Plan (Holmes & Associates and Artuso 1995).

2. **The Artuso model can be used to identify individual treatment plants, watersheds and urban/suburban areas where additional controls would be most cost-effective in achieving established in-lake phosphorus concentration targets.** Nevertheless, further refinements in the model and in the nutrient management strategy are required. Much of the information in the model on the costs of point source controls and urban BMP's and the effectiveness of agricultural BMP's requires further refinement. The model also does not include the nonpoint source contribution that will result from new development. Moreover, the model is only useful in targeting specific point sources and establishing general targets for phosphorus control from nonpoint sources in critical lake segment watersheds. What is required now is an iterative planning, implementation, monitoring and reevaluation process, described in detail in this report.

3. **The current watershed targeting procedure for phosphorus control indicates that Policy 2 combined with cost effective targeting of nonpoint source controls is the least cost of the three policy options outlined for achieving in-lake phosphorus concentrations** (see draft Plan, Lake Champlain Basin Program, 1994). However, further cost reductions can be realized by targeting point source controls to achieve the greatest reduction in phosphorus discharge per dollar of control expenditure. The phosphorus control model described in the prior Part 1 *Preliminary Economic Analysis*, can assist in this targeting effort. It is also important to identify funding mechanisms that will ensure that control costs do not fall disproportionately on only a few communities.

1.2.3 Action Plan for Preventing Pollution from Toxic Substances

1. **The most well publicized indicator of toxic pollution in the Lake Champlain ecosystem is the presence of high levels of mercury and PCBs in certain species of lake fish.** Concurrently, one of the main direct economic costs of toxic pollution are the detrimental human health effects that can occur from excessive consumption of contaminated fish species. Toxic contamination of fish also can reduce the number of fishing trips anglers make to Lake Champlain and reduce the net benefits they receive from each trip. There may also be secondary effects on other recreational activities and expenditures due to public perceptions about toxic contamination.

2. **In a recent study, Montgomery and Needelman (1994) used a discrete choice, travel cost model to estimate the recreational fishing benefits that would result from elimination of toxic pollutants that are responsible for fish consumption advisories in New York State lakes.** They estimated that the combination of increases in fishing participation rates and increases in net benefits per fishing trip would result in total net benefits of $28 per capita, per year to New York residents. To understand the implications of these findings for Lake Champlain, it is important to realize that there is no guarantee that implementation of the Action Plan for Preventing Pollution from Toxic Substances will permit the lifting of all fish consumption advisories. In addition, the Montgomery and Needelman study estimated the benefits that the average New York Sate resident would receive from the opportunity to fish in any lake in the state without worrying about toxic contamination of fish. The annual benefit of $28 per person should therefore be viewed as an estimate of the upper limit of the direct recreational benefits to basin residents of the draft Action Plan for Preventing Pollution from Toxic Substances.

3. **Economic analysis of the benefits of remediation of contaminated sites requires information generated from risk assessment studies and engineering analyses of remediation costs and effectiveness.** Risk assessments of contaminated sites are normally summarized in the form of increased probabilities that members of the affected population will de-

velop various illnesses or health impairments as a result of direct contact with or movement of toxics from the site via physical or biological processes. Risk assessments have not yet been completed for all of the three priority sites of concern identified in the draft Plan, nor have the costs and effectiveness of potential remediation measures been completely determined.

4. **Economic analysis of remediation efforts for sites of concern must also consider potential effects on property values.** A recent study by Mendelsohn et al. (1992) provides relevant information for considering the property value impacts of PCB pollution in Cumberland Bay. The Mendelsohn et al. study used panel data (i.e. before and after sales of the same houses) to estimate the negative effect of PCB contamination in the harbor of New Bedford, Massachusetts. The results of the study showed that after 1982, knowledge of PCB contamination in the most polluted parts of the harbor had depressed property values in adjacent neighborhoods by approximately 8% or $7,000 to $10,000 in 1989 dollars. PCB pollution in the somewhat less contaminated outer harbor was estimated to have depressed adjacent property values by 3% to 7%. These negative effects on property values were estimated for neighborhoods as much as a mile from the harbor. Whether PCB contamination of Cumberland Bay will have similar effects on property values in nearby neighborhoods will depend on several factors, including: the proximity of the neighborhoods to the contaminated site, the degree and extent of contamination relative to New Bedford Harbor, and expectations about remediation of the site.

5. **The draft Plan recognizes that in addition to the direct public health risks and recreational costs of contaminated fish species, toxic pollution may create indirect economic costs as a result of more widespread ecosystem effects.** Preliminary tests of microorganisms, freshwater shrimp, and fish species in Lake Champlain indicate that elevated levels of toxic pollutants at certain sites may already be having some detrimental ecological effects. While, these findings are cause for concern, further research is needed on trends in levels of contamination as well as fate and effects of contaminants of concern before any estimates can be made of the potential economic costs of indirect ecological effects of toxic pollution in the lake.

6. **Although the draft Action Plan prioritizes sites and substances on the basis of the risks they pose to public health and the Lake Champlain ecosystem, the Toxics Action Plan could be more explicit in outlining how this risk based approach affects the sequence of research and remedial actions that are proposed.** Given the current uncertainty over sources, fate, effects and remediation options for toxic substances in the Lake Champlain basin, expenditures on toxic pollution prevention and control should be made in a sequential fashion contingent on the results of continued research, risk assessments and source identification efforts. There also appears to be some overlap and duplication between items in this action plan and between parts of this and other action plans, particularly Fish and Wildlife, indicating that cooperation between agencies and among research efforts could lead to significant cost savings.

1.2.4 Action Plan for Protecting Human Health

1. **There are approximately 137,803 residents of Vermont who are served by 25 municipal and 6 private drinking water supply systems that draw their source water from Lake Champlain, indicating that at least one quarter (24%) of Vermont's population relies on Lake Champlain for drinking water.**[1]

2. **Overall, Lake Champlain compares very favorably to surface drinking water sources throughout the nation, and the lake seems to be a more cost effective source of water than alternative sources.** Water withdrawn from Lake Champlain has nutrient levels and turbidity that are below national averages for surface water sources of drinking water; however, there are direct economic implications for drinking water suppliers should there be an increase in nutrient levels in Lake Champlain.

3. **Using the data gathered for this study, Lake Champlain drinking water could be partially valued at $3.2 million, considering only its wholesale value, and accounting only for those individuals served by the 11 municipalities in the Champlain Water District.** Using the same wholesale value for the other one third of Lake Champlain drinking water users outside the 11 municipal water districts, the wholesale value of Lake Champlain water would be in the range of $8 million. An economic analysis of the net value of Lake Champlain as a water source would need to consider the cost of an alternative water source for those estimated 156,400 users. The analysis would also examine the economic implications on water treatment costs of improvement, as well as decline, in the lake's water quality.

4. **Between September 1, 1992 and August 31, 1993, 66% of anglers who fished Lake Champlain ate some of the fish they caught, averaging 26.2 meals per year (Connelly and Knuth 1995).** About 5% of anglers indicated they ate species for which health advisories exist at levels beyond those recommended by the advisories. The New York advisory is more strict than Vermont's advisory for children under 15 years of age and women of childbearing age. As a result, 9% of New York anglers exceeded the New York advisories, while only 1% of anglers exceeded the Vermont advisories. Another 18% ate species for which advisories exist but stayed within the recommended consumption advisories. Of the 5% who exceeded the advisories, nearly all (90%) were New York women of childbearing age, for whom eating any fish for which advisories exist constituted exceeding the New York recommended limits. A plurality of these women (48%) indicated they did not know what the advisories were for women of childbearing age.

5. **Reinert et al. (1991) point out that while disclosure to anglers and the public at large of the risks of consuming fish containing contaminants is important and essential, the public needs an improved framework for evaluating the information.** Citing other studies, they place the lifetime risk of contracting an environmentally-related cancer in the 2% to 5% range. These authors cite studies that have estimated the lifetime cancer risk of drinking one pint of milk per day, eating 4 tablespoons of peanut butter per day, and drinking one diet soda per day containing saccharin. In addition to cancer-related risks, they point out the risk associated with driving to and from the fishing site, and the risk of boating while fishing. Thus, in addition to improving the visibility of health advisories related to fish consumption, it is important to provide the public comparative data on other risks and an improved framework for deciding which risks to accept or reject.

---

[1] An estimated 156,426 people use Lake Champlain for drinking water. This a correction of the 189,000 figure presented in the Socio-Economic Database report (Holmes & Associates (1993). In addition to the Vermont water systems, there are 3 municipal systems and 2 private systems in New York drawing drinking water from Lake Champlain, serving 5,236 New York residents. Another 5,149 households (13,387 people) in New York and Vermont are estimated to draw Lake Champlain water for use by their individual households.

6. **Beach closings result in lost income to local businesses.** In his 1984 research involving Cumberland Bay Park, NY on Lake Champlain, Tommy Brown found that most users were primarily interested in swimming, and spent on average $12.18 per person. By subtracting out the entrance fee, and converting the expenditure to 1995 dollars, the average Lake Champlain beach user spends approximately $16.60 per person per day. Without a detailed analysis of beach attendance and beach closings by date, it is difficult to estimate the economic impact of beach closings. Just by example, if a beach with an average use of 500 people on a weekend day were closed on a Saturday, using the $16.60 figure, the direct economic loss would be $8,300 per closed day, not including entrance fees or lodging fees.

7. **The economic impact of beach closings would appear to go far beyond the one day impact in the example given above.** For some, when a beach is closed once, they chose not to return to that beach for the rest of the year. Similarly, when a "Beach Closed" sign appears repeatedly, another percentage of the user group will chose to travel to a beach that is open more consistently. On a broader, public perception level, beach closing notices give the impression that the lake is somehow polluted, regardless of the localized nature of the problem. For that segment of the population, use of any beach on the lake, and lake use in general, may be curtailed.

8. **In the case of both drinking water and fish consumption advisory messages, further education and communication efforts appear to be justified**. The cost associated with these efforts will be closely related to the number of messages and how they are delivered. As discussed in this section, including positive aspects of Lake Champlain water quality and fisheries might be appropriate in some cases to help to re-direct use, rather than simply discourage it. In addition, risk should be put in some type of context, such as in relation to risk related to other common activities.

1.2.5 Action Plan for Protecting Wetlands

1. **There are over 300,000 acres of wetlands in the Lake Champlain basin that provide a wide variety of ecological functions, including**: improving water quality by filtering sediments, pollutants, and nutrients; protecting groundwater and drinking water; contributing to overall biological diversity; providing habitat for fish and wildlife; and, providing habitat for some rare and endangered species and natural communities. Wetlands also help stabilize shorelines and prevent erosion, provide recreational and educational opportunities, and contribute to the aesthetics of the region.

2. **Wetlands also provide critical temporary habitat for many migratory bird species and migratory bird hunting generates significant levels of expenditures that benefit local economies**. These hunting expenditures are not known for the Champlain basin, but in Vermont, slightly over half of which lies within the basin (55%) and likely contains the majority of Vermont's prime duck hunting habitat, approximately 7,300 migratory bird hunters spent $383 each in 1991, for a total of $2.8 million (US Fish and Wildlife Service 1993). Better data are needed to determine expenditures made within the basin, what portion of those expenditures represent new dollars coming into the basin, and the secondary economic impacts of that spending. In addition it is important to determine how migratory bird species are affected by incremental changes in the quantity and quality of wetlands.

3. **Respondents to a recent survey of New England residents were willing to pay an average of between $74 and $80 per year (over a five-year period) for wetlands providing flood protection, water supply, and water pollution control.** They were willing to pay between $81 and $96 per year for wetlands containing rare species of plants. The authors con-

cluded that the survey results suggest that most of this value is nonuse value, and that failure to consider nonuse values in decision making can understate the value of wetland preservation by a substantial margin (Stevens et al. 1995).

4. **From the perspective of the basin as a whole there is no shortage of undeveloped land and limiting development in wetland areas is unlikely to restrain growth in the near future**. If only a fraction of the developable land is defined as wetlands the effect on general land prices will be quite small. Given reasonable estimates of the numerous benefits that wetlands provide, this aggregate, regional perspective would argue for strong wetlands protection. However, for some landowners and communities, the costs of wetlands regulation may be quite high. This raises a second policy issue which is whether the benefits that wetlands provide are public property which private landowners have no right to impair, or whether the costs of wetlands protection should be shared between private landowners and the public. This issue has implications for the appropriate mix of acquisition programs, financial incentives, and market mechanisms to use in wetlands protection programs.

5. **One of the most promising market mechanisms for minimizing wetlands loss is mitigation banking**. Mitigation banking refers to a wide range of public programs and private business ventures that involve the creation, restoration or enhancement of wetlands as an advance offset for degradation or conversion of wetlands elsewhere (Silverstein 1994). For example, a developer might receive mitigation credits for restoring a previously drained agricultural wetland. The developer could bank these credits and exchange them at some future time for the right to convert a similar or smaller area of wetlands as part of a separate development. Reppert (1992) indicated that at least 37 mitigation banks are operating in the U.S. and at least 64 others are in the planning stage. One of the principal benefits of mitigation banking are that it can reduce the cost of adhering to a no net loss policy. Mitigation banks can also ease the burden of wetlands regulation on individual landowners and communities by providing them with additional opportunities for development. In addition, mitigation banking permits regulators and conservation organizations to take a landscape approach and focus on a larger wetland system for creation, restoration, or enhancement. Ecologists and resource managers now realize that the cumulative effects of habitat loss at a landscape level may prove significantly more harmful to biodiversity than the sum of the individual habitat losses. Mitigation banking can help ensure a coordinated approach that avoids "postage stamp" wetlands.

6. **In the midst of wetlands protection controversy, there are at least two points of general agreement**. First all parties to the debate seem to agree that the confusing and duplicative mix of current wetlands regulatory programs and responsibilities unnecessarily increase costs and create uncertainty for landowners and developers. Second, there is broad agreement that certain types of wetlands provide very substantial public benefits and should be protected. Building upon these areas of agreement and the impressive degree of public/private and intergovernmental cooperation already underway within the basin, the Lake Champlain Basin Program has an opportunity to fashion an integrated set of regulation, acquisition programs, and economic incentives that strike an appropriate balance between public benefits and private costs.

1.2.6 Action Plan for Managing Non-Native Nuisance Aquatic Plants and Animals

1. **On Lake Champlain, the Vermont Coalition of Water Suppliers has been intently studying the economic impacts of zebra mussels on their eleven water suppliers.** Presently, they are estimating a total of $1.6 million dollars in capital costs over the next few years for

those eleven facilities. Cost estimates per facility range from $60,000 to $334,000. At least three systems now have chlorination control in operation (personal communication: John Coate, Champlain Water District, October 1995).

2. **The Town of Willsboro NY has been studying the possible impacts of zebra mussels on their community water system for two years, and recently budgeted $60,000 to address the problem using a chlorine infuser.** The necessary work has an estimated cost of $120,000, however they anticipate cost savings by doing some of work with current staff (personal communication: Teresa Sayward, Town of Willsboro, October 1995).

3. **Lake Champlain is the source of drinking water for approximately 60,000 households (156,426 people), with 55,015 households receiving their water through community drinking water systems, and an estimated 5,149 households drawing drinking water directly from the lake.** Zebra mussels will affect each of these households directly or indirectly. For those households on community systems, they will likely see an increase in their water bills reflecting the costs of deterring or removing zebra mussels from in-take pipes. Households that draw drinking water from the lake through personal systems will have direct costs related to keeping their water pipe clear of zebra mussels, with an estimated initial cost of $300 to $1,500 (personal communication: John Choate, Champlain Water District, October 1995).

4. **In terms of recreational related expenditures related to zebra mussels, Lake Erie research found that 13% of 109 responding boat owners reported expenditures for protective paints, with an average cost of $94.** Four percent reported additional boat maintenance at an average cost of $171, 3% reported increased insurance costs averaging $207, and one respondent reported $50 in boat motor damages directly attributable to the zebra mussel (Vilaplana and Hushak 1994:8). In addition to some increased costs related to boating, the impacts of zebra mussels on recreational boaters require behavioral changes, such as storing their boat out of the water, painting or aggressively cleaning the bottom, and flushing the motor. Other costs of zebra mussels relate to beach clean-up when large quantities of zebra mussels wash up on shore. The mussels have to be dumped in a land fill, so hauling costs and tipping fees, as well as labor, are all economic concerns.

5. **There are mixed blessings related to zebra mussels and underwater historic resources.** On one hand, the zebra mussel has contributed to a significant increase in water clarity in some lakes. Parts of Lake Erie went from four foot visibility to 40 feet. Increased water clarity has had a positive effect on the Great Lakes diving industry in terms of increased visibility and enjoyment of ship wrecks on the bottom of the lake. Unfortunately, zebra mussels are attracted to any hard surface, and will readily attach themselves to the wrecks. Some of the historic resources at the bottom of Lake Champlain are already being covered by zebra mussels. In addition, there is a danger that the weight of accumulating mussels will collapse the 200 year old wooden vessels. Art Cohn, of Champlain Maritime Museum, predicts that shipwrecks in 80 ft of water or less will be covered by zebra mussels. A detailed report on the overall impacts on underwater historic resources in Lake Champlain is in currently in progress (personal communication: Art Cohn, November 1995).

6. **There needs to be an explicit link between the studies and information gathered in this action, and the decision-making process on when, where, what type, and how much effort is going to be devoted to a particular nuisance problem.** All of these actions are difficult to assess economically, without illuminating the links between a defined problem (e.g., recreational, ecological, environmental) and the resulting information gathering, monitoring, and action. The sea lamprey eradication program provides an example of an aggressive effort to address one nuisance problem. Efforts like this seem to be most cost effective when the program is directed at a specific problem, in that case, to control the sea lamprey in order to improve sport fishing, among other goals.

1.2.7 Action Plan for Protecting Cultural Heritage Resources

1. **A recent report on the economics of historic preservation defines historic preservation as the careful management of a community's historic resources, avoidance of wasted resources by careful planning and use, and the thrifty use of those resources.** Historic preservation also includes the concepts of using or managing those historic resources with thrift or prudence, avoiding their waste or needless expenditure, and reducing expenses through the use of those historic resources (Rypkema 1994). As defined, the essence of historic preservation is economizing and avoiding waste. In addition to being fiscally responsible, the benefits of historic preservation and protecting cultural heritage include improved quality of life, increased sense of community, and improved economies due to tourism expenditures.

2. **A 1986 survey of Great Lakes divers found a number of interesting characteristics indicating the economic opportunity for diving to submerged cultural heritage resources in Lake Champlain.** For example, the average diver took 6 trips in 1986, while participating in 31 individual dives. Each diver had an average investment of $2,500 in their diving gear, and spent an average of $141 per person, per trip while in the vicinity of the underwater preserve. Total trip expenditures were $245. Of their local expenditures, 12% were for dive shop services, 12% were charter fees, 8% were boat related expenditures, and 3% were in marina fees and boat rentals. So at least 35% of the $141, or $49, was in direct lake-related expenditures. The remaining $92 was spent in the vicinity of the lake area (Peterson et al. 1987b).

3. **Among the more crucial attributes influencing the selection of a diving location by divers in the Great Lakes were: dive shop services, information about diving sites, availability of diving charters, quality of shipwrecks, and well marked diving sites (Peterson et al. 1987b).** Close to 60% of first time divers and 46% of seasoned divers prefer to use charter diving services. About two-thirds of Great Lakes divers participate in the activity in July or August (Peterson et al. 1987a). These findings seem to indicate that there is significant economic opportunity in an expanded underwater preserve system on Lake Champlain, especially if promotion and services are expanded concurrently.

4. **A recent study of divers who visited Lake Champlain found that their average trip expenditures while at Lake Champlain were $209, with divers having average daily expenditures of $110 per person.** An additional $100 was spent in preparation for the trip and while in transit. Of the $209 spent in the vicinity of Lake Champlain, 43%, or $90, was in direct lake-related expenditures for diving rentals, boat supplies, launching fees, etc. The most popular diving areas appear to be in the vicinity of Plattsburgh and Willsboro, NY and Burlington, VT. Three quarters of respondents indicated that they dive at designated Vermont underwater historic preserve sites on Lake Champlain, and that the average diver visited those sites about 5 times per year. A majority of divers indicated the need for more diving sites, and indicated a willingness to pay an average of $5 per dive for the development and maintenance of underwater sites (Dziekan 1995).

5. **According to a Michigan State University Sea Grant Agent who has studied shipwreck diving since the creation of Michigan's first underwater preserve, diving to shipwrecks in the Great Lakes is a very popular activity that appears to be seeing increasing numbers of users each year.** One example is that some of the remote sites on Lake Superior that were explored by only a few divers a year prior to receiving underwater preserve status, now are visited by 1,000 or more divers annually (personal communication: Ronald Kinnunen, Michigan State University Extension).

1.2.8 Economic Focus Group and Technical Advisory Committee Economic Discussion Sessions

As requested, the study team organized and facilitated two economic focus group sessions, the first on July 17, 1995 at Clinton County College south of Plattsburgh, NY, and the other on September 8, at Champlain College in Burlington, VT. The sessions were designed as 3.5 hour morning sessions, to facilitate participation among the private sector. Twenty industry, business, and local government officials attended the first session, and nine participated in the second. Six individuals attended both sessions, so a total of 23 individuals representing economic interests around the basin became involved in these formal discussions on the economic issues involved in the Lake Champlain planning effort. While somewhat limited in the numbers, those in attendance represented a very wide cross-section of economic interests around the lake, including: marinas, the paper industry, City of Burlington, Plattsburgh Chamber of Commerce, local government, agriculture, forestry, recreation, banking, watershed associations, and others. Both meetings were attended by six staff, consultants, and resource persons, who answered questions and took notes.

The first session involved a certain degree of disagreement, and there was lively discussion on a number of basic economic issues, including the following:

1. **Disagreement on the use and interpretation of economic benefits of Plan items.** Some felt that the benefits have to be area specific and should not reflect the value of the lake to greater basin population, many of whom may not receive any direct economic benefit from the lake; while other felt that since this is a Plan for the future, a wide variety of possible present and future benefits should be considered. One aspect of the basin-wide benefits of a clean lake was expressed in terms of the lake as asset to local industry in attracting higher caliber employees.
2. **Disagreement on the allocation of costs.** Some felt that primary, secondary, and tertiary costs should be quantified for specific areas around the lake and that the estimated benefits should only be accounted for in relation to those specific areas. Others pointed out that recreational benefits of cleaner water could occur throughout the lake, so it will difficult to reconcile costs and benefits for a particular bay or other location on the lake.
3. **Concern expressed over the timing, budget, and time-frame for the economic analysis.** Can an accurate economic analysis be completed in the time allotted, can it be integrated into the planning process, and if it has errors, will there be time to correct them and to incorporate the corrections into the final plan? Concern expressed that the economic analysis to date is primarily a fiscal analysis. Some expressed the notion that many times decisions are made with little or no economic analysis, and that the economic analysis should focus on recommendations with obvious economic impact, making the timeframe and budget more realistic.

A related concern centered on the methodologies being used by the economics consultants, and what role cost-benefit analysis, risk assessment, discounting, and other research techniques should play in the analysis of each action item.

A portion of the session was devoted to identifying those plan items that appear to have adverse economic impact in the basin. Another part of the session focused on identifying those plan items that are beneficial to the short and long term interests of the basin economy. A third area of discussion was on remaining information gaps, in terms of economics.

While there was no organized attempt to reach concensus during the session, there seemed to be general agreement around a few points. One particpant made the following comment on the over-all approach to Lake Champlain planning. It seems to summarize views of many around the table.

The Plan starts to look at a sub-basin approach, and that is good and should be expanded. It results in a more ecologically sensitive approach, is more efficient, and is more cost effective. The Basin Program people deserve a great deal of credit for introducing the sub-basin concept, but do not take it nearly far enough. It is long over-due in dealing with this lake. There are many hot spots around the Lake, such as Wilcox Bay (toxics) and Malletts Bay (boat traffic, recreation), but Malletts Bay is not Rouses Point. So you need to look at specific areas. Not one size fits all. In many areas of the lake, state and federal involvement or funding is not necessary (comment by a Lake Champlain economic focus group participant).

During the second session, the main discussion centered on specific measures to boost economy and business while protecting Lake Champlain, and at least 11 distinct proposals were offered and discussed. Most seemed to be heartily supported by the group present, although there was no attempt at a group consensus. Some of the main themes running through the ideas include the following:

1. **Innovation, ideas, creativity -- all need to be encouraged in the private sector and supported by government.** This is how economically efficient and equitable environmental change comes about. There are already numerous examples at the state and national levels. The EPA's "Golden Carrot Award" and the NYSDEC Governor's Award are two examples, whereby government recognizes and rewards innovation in business in terms of protecting the environment. One problem is that while government sponsors these awards, they do not seem to participate themselves. Would like to see an award program for innovation and efficiency for government employees and departments.

2. **Pollution prevention is key to cleaning up the lake, and prevention is tied to the encouragement of innovation, as noted in the previous idea.** Prevention is good for business, and industry continues to develop new ideas for pollution prevention. Industry knows that It is less expensive to prevent pollution at the source, than it is to remove it after it leaves the end of the pipe. The organization of retired engineers (REAP) and other organizations are already working in the basin to facilitate the move towards pollution prevention. In addition, solving pollution problems can directly help the local economy. One example is Living Technologies in VT, recently awarded a $1 million contract in the UK. Pollution prevention also involves revising our approach to regulation. There are pilot projects in Addison County, where performance based septic systems, rather than design based, are being installed. Design based regulations can result in bigger lots, rather than addressing the real problem of controlling waste.

3. **There is a role for government in protecting local economies while preventing pollution of Lake Champlain.** Government has helped start loan programs, such as the Northern Community Investment Corporation, that has helped numerous businesses in northern VT and NH. The City of Burlington has been involved in developing the new wood-chip gasifier plant and the Lake Champlain Science Center on the waterfront. Marketing, tax issues, and identifying business opportunities are other areas where government can play a positive role. From an economic viewpoint, government can be more effective as a catalyst, than as a regulator.

4. **On-going Lake Champlain planning efforts must facilitate and accommodate the participation of economic interests.** There does not seem to be that much disagreement between economic and environmental concerns, but problems inevitably arise when economic interests are not invited to the table. However, a number of barriers effectively prevent the business community from participating, including: too many meetings already; the business person cannot afford to be away from the business; small business people often do not have paid

staff who attend meetings for them; and, there is an intimidation factor for the small business person. Implementation plans need to address how to facilitate the participation of economic interests, given these barriers to involvement.

1.2.9 A Prioritization and Implementation Framework for the Lake Champlain Basin Program

To take advantage of new information as it becomes available, the Lake Champlain Basin Program must incorporate periodic review procedures into the process established for implementation of the Plan. As new information becomes available, the benefits, costs and remaining uncertainties involved in taking action should be reevaluated. Similarly, for programs and other actions involving continued public expenditures or other costs over time, monitoring and evaluation efforts should be implemented to periodically determine whether these programs, regulations, etc. should continue unchanged, be revised, or eliminated altogether.

Although there is some danger of oversimplification, the framework outlined above can be summarized in the form of a checklist.

- Do expected benefits exceed expected costs?
- Can financing arrangements be implemented that will ensure an equitable distribution of costs and benefits?
- Is there a high level of uncertainty in benefit and/or cost estimates?
- Can this uncertainty be reduced at relatively low cost through further study or pilot projects?
- Could taking little or no action cause irreversible damage, greatly increase costs, or significantly reduce benefits?
- Have institutional arrangements been established to ensure periodic reevaluation of the benefits and costs of taking action or revising ongoing programs?

The numeric examples presented in the report are intended only to illustrate the types of judgments that can and should be made in considering the priority and timing of various action items. Costs and benefits should be understood in the broadest sense. Included should be direct public expenditures, administrative costs, and additional private sector costs as well as direct public health, recreational, and aesthetic benefits. Also important are indirect benefits in the form of increased business profits and employment, and maintenance of ecological health.

For many of the environmental protection and restoration efforts outlined in the draft Plan, costs and benefits cannot be completely quantified. Qualitative judgments must be made about net benefits of each action item to society. This does not affect the basic conclusions or reduce the importance of the proposed decision framework. On the contrary, the framework and accompanying outline of benefit cost analysis categories are useful because they are effective tools for identifying and re-evaluating what is know and unknown.

If there is little confidence in cost or benefit estimates but a significant probability that benefits or avoided costs could be substantial, then gathering further information and establishing a formal process of review and reevaluation in light of this new information probably makes sense. If pilot or provisional programs can be implemented at relatively low cost, they may be the most effective means of gathering additional information, given clear guidelines for program review and re-evaluation. In situations where the most likely estimate of benefits exceed anticipated costs and delay in taking action would cause irreversible damage or significantly increase costs, then immediate action is likely to be the best choice.

1.2.10 Conclusion and Recommendations

In conclusion, priority action items should continue to be examined and revised to generate improved estimates of costs, benefits, and remaining levels of uncertainty. As this new information becomes available, the net benefit of taking further action needs to be reevaluated. Similarly, for action items involving continued public expenditures or other costs over time, monitoring and evaluation efforts should be implemented to periodically determine whether these programs, regulations, etc. should continue unchanged, be revised, or eliminated altogether. In situations where delay or inaction could significantly increase costs, reduce benefits, or result in irreversible changes, immediate implementation of targeted actions is likely justified.

From a local economic perspective, as gleaned from the two Lake Champlain Economic Focus Group sessions, the following four points seem necessary to a successful Lake Champlain protection and restoration program:

1. **The LCBP must encourage strong support from local communities.** Representation on a basin-level committee alone is insufficient to ensure that all the various interests are included in the process. Many communities are already involved in lake protection activities, such as up-grades to waste water treatment plants, and others would like to do more. Local communities should be allowed to adapt proposed land use and lake use recommendations to their own circumstances, and to have expertise available to assist them in their efforts.
2. **Local communities, economic interests, and residents need to be active participants in the LCBP projects and programs**. The priority issues and programs need to be generated at the grass-roots, from the bottom up, as well as at the state and federal agency level. People recognize the benefits of a clean lake more clearly if they see it having an effect in their own communities. Similarly, they respond more positively to information and education programs, than to regulation and enforcement. The Lake-Champlain Partnership Program is an excellent example of this approach, and appears to be a very successful aspect of the Lake Champlain Basin Program.
3. **Existing local watershed organizations need to be supported and new ones need to be encouraged.** While a lake wide LCBP is necessary to communicate and coordinate activities between Vermont, New York, and Quebec, the real change in peoples attitudes and activities related to water is occurring at the local level. The Boquet River Association in New York, Friends of the Mad River in Vermont, and others have a successful track record that should be built upon. Attempts should be made to avoid competition for funding, and some procedure should be developed whereby a certain percentage of LCBP funding is distributed to citizen-based river and lake associations within the basin.
4. **The state governments in Vermont and New York must provide adequate operating funds for the LCBP**. Vermont state legislators recognize more readily the importance of Lake Champlain to their state's economy, while the New York North Country delegation could be more effective than they have in the past in encouraging legislative approval of Lake Champlain related funding. By any measure, the New York counties along Lake Champlain are among the most economically troubled in the state; concurrently, Lake Champlain is shown to be an important component of local economies. The counties are unable to support the LCBP on their own. With adequate operating funds provided by New York and Vermont, the LCBP should be able to leverage additional project funds from donations, grants, and other fund raising efforts.

The Lake Champlain planning effort has involved a number of economic studies and community case studies. An additional economic analysis of the final Plan will be undertaken before the planning process is complete. There are few simple answers in economic analysis, just as there are few easy solutions to the environmental issues of concern around Lake Champlain. A major goal of this preliminary economic analysis, including the previously published Part 1 analysis, has been to incorporate economic and socio-economic considerations into the Lake Champlain planning effort. The approach has included: presenting summaries of relevant scientific literature, creating models for cost optimization, establishing baseline data for future evaluation, and developing economic decision-making frameworks that are all understandable and useable by anyone involved in Lake Champlain study and planning. At the same time, most of these Lake Champlain-specific economic tools and datasets can be easily up-dated and modified as necessary to account for changing characteristics and issues within the basin. As was repeatedly expressed in the economic forums organized for this study, flexibility is key to addressing environmental problems and developing effective, equitable solutions.

Glossary of Economic Terms and Concepts

Benefit (Recreation) - A proxy for the economic value of all the psychological satisfactions from outdoor recreation activities. This is identical to a widely accepted meaning of the economic term "utility" (Walsh 1986:44-45). Total benefit is the maximum amount of money consumers would be willing to pay rather than give up the recreation activity (Walsh 1986:130).

Benefits Transfer - The use of information from existing nonmarket valuation studies to develop value estimates for another valuation problem. In can reduce both the calendar time and resources needed to develop original estimates of values for environmental commodities (USEPA Policy, Planning, and Evaluation 1993:3).

Benefit Valuation (Economic) - Measuring in dollars how much the people affected by some policy will gain from it. They are not forecasts, and they usually do not attempt to predict other exogenous influences on people's behavior. Instead, a predefined set of conditions is assumed to characterize the nonpolicy variables. Then benefit estimates are derived by focusing on the effects of the conditions assumed to be changed by the policy (USEPA Policy, Planning, and Evaluation 1993:45).

Bequest Values - Bequest values are based on the satisfaction that individuals derive from knowing their children, or future generations in general, will be able to enjoy a clean(er) environment.

Carrying Capacity - The maximum population of a given species which a particular habitat can support indefinitely (under specified technology and organization, in the case of the human species).

Cost/Benefit Analysis - Ratio of dollar cost of project to dollar benefit it will produce, used to compare worthiness of various proposed projects.

Comprehensive Income - An economic measure of the total benefits from all life's activities, including recreation. It is the sum of how much consumers would be willing to pay for each of life's activities rather than forego them. There are four components of comprehensive income: (1) the market value of goods and services that consumers purchase with dollars from regular income or savings; (2) the willingness to pay for self-sufficiency goods and services that consumers produce for themselves; (3) the opportunity cost of leisure time that consumers commit to the activities; and (4) the consumer and producer surplus to individuals, representing the net benefits of all life's activities over and above consumer costs in dollars, effort, and time (Walsh 1986:57).

Consumer Surplus - The value to consumers of the opportunity to buy units of a good at a particular price. In terms of recreation, the value that participants derive from the recreation activity above and beyond what the actual spend on the activity. Asking people what they are willing to pay is a way of assigning dollar values to this consumer surplus and obtaining a more complete estimate of how much the recreation activity is worth to the participants (Vermont Department of Forests, Parks, and Recreation 1995). (see also: Recreation Benefit Valuation, Willingness to Pay).

Contingent Valuation Approach - As a method of providing acceptable economic measures of the benefits of recreation activities and resources, this approach relies on the stated intentions of a cross-section of the affected population to pay for recreation activities or resources contingent on hypothetical changes in their availability depicted in color photos or maps. The values reported represent the maximum willingness to pay rather than forego the recreation opportunity or resource (Walsh 1986:195).

Culture - A system of socially acquired and transmitted standards of judgment, belief, and conduct; the total set of beliefs, customs, or way of life of particular groups.

Demand (marginal benefit) - The quantity of any particular commodity that will be purchased on a market or groups of markets at a given price or series of prices.

Diminishing Marginal Utility - As the amount consumed of a good increases, the extra utility added by one extra last unit (or marginal utility) tends to decrease.

Existence Values - Existence value is any additional satisfaction, apart from direct use, option, or bequest values, that individuals receive simply from knowing that an important ecosystem has been protected. Also referred to as nonuse values.

Externalities (External Costs) - Costs of production that fall on others and for which the producer bears no financial responsibility; uncompensated adverse effects usually borne by others.

Hedonic Pricing - Hedonic price analysis utilizes a statistical technique known as multiple regression to estimate the property price effects attributable solely to variations in local environmental quality.

Household Production - Household production refers to the fact that consumers provide inputs of time and effort as well as dollars. Economists suggest that there is an implicit market within each household. Recreation activity is produced by households (i.e., consumers), with purchased goods and services, as well as their own self-sufficiency, leisure time, and other inputs that are publicly provided such as park facilities and a natural environment (Walsh 1986:57).

Hypothetical Behavior Valuation Methods - The contingent valuation approach is the primary "hypothetical" behavior method for assigning nonmarket values.

Intergenerational (or Intertemporal) Transfer - Economic decisions based on the perceived needs of future generations.

Leisure Time - Discretionary time to be used as one chooses.

Margin - The point at which the value of an added output equals the value of the unit of input that produced it; the point of maximum net return.

Marginal Benefit - The change in total benefit resulting from a change in the number of trips. It is the willingness to pay for an additional trip. The concept of diminishing marginal benefit states that as consumers take more and more trips, other things being equal, the benefit of each additional trip will decrease (Walsh 1986:130).

Nonmarket Good Valuation - Assessing the value of a good or service which is not traded in the market place and has no market value. Because it is not bought and sold some other measure than price must be used in establishing the value.

Nonuse Values - For wetlands, defined as the value derived from preservation independent of on-site or off-site use (Stevens et al. 1995). (also see existence value).

Observed Behavior Valuation Methods - Travel cost and hedonic pricing are examples of "observed" behavior methods for assigning nonmarket values.

Opportunity Costs - The return to the best alternative use by employing a unit of resource in a given manner.

Option Value - Option value is simply the value to the individual of preserving the opportunity to use a clean environment and is therefore closely related to -- but nevertheless conceptually distinct from -- direct use benefits. The annual payment of a kind of insurance premium to guarantee the possibility of future recreation use (in addition to the expected benefits of direct and indirect use)(Walsh 1986:85).

Recreation - Leisure time activity such as swimming, picnicking, boating, hunting, etc.; use of leisure time for personal satisfaction and enjoyment, a basic human need; an exceedingly variable term meaning almost anything people do with their leisure time.

A distinguishing characteristic of recreation is that individuals are producers as well as consumers of recreation activity. The individual consumer produces recreation days with a desired set of characteristics by combining: (1) his/her own inputs of knowledge, skill, and effort with nonmarket work time; (2) purchased goods and services produced by others; and (3) other inputs that are publicly provided such as a state park or reservoir (Walsh 1986:30).

Recreation Benefit Valuation - Total benefits are defined as the maximum amount that individuals would be willing to pay for a recreation activity -- a nonmarket good -- rather than forego it. Net benefits are total benefits less direct costs. As such, net benefits to consumers are analogous to net profits to business firms. In both cases, the value of the activity is determined by what is left over after all costs are met. Yet, some confusion results form the fact that the net benefits to consumers are not paid to anyone and thus do not appear in national accounts (Walsh 1986:59).

Recreation Day - A visit by one individual to a recreation area for recreation purposes during any reasonable portion or all of a 24-hour period of time. One person participating in an activity for any part of one calendar day (Walsh 1986:68).

Recreation Visitor Day (or User Day) - 12 person hours, which may be one person for 12 hours, 12 persons for one hour each, or any equivalent combination of individual or group use, either continuous or intermittently (Walsh 1986:68-69).

Secondary Data Analysis - Data collected and processed by one researcher are reanalyzed - Often for a different purpose - by another.

TP - Total phosphorus. In lake total phosphorus concentrations for Lake Champlain vary from 15 μg/l for the Main Lake, to 52 μg/l for the South Lake.

Travel Cost Approach - Used to estimate the value of recreation. Traditionally preferred by most economists because it is based on observed market behavior in a cross-section of users in response to direct out-of-pocket and time cost of travel. The basic premise of the approach is that the number of trips to a recreation site will decrease with increases in distance traveled, other things remaining equal. When determining the opportunity cost of work or leisure activities that are foregone for travel to and recreation at the site, this approach supports that both travel and

on-site time costs can be added to direct travel costs to determine the willingness to pay (Walsh 1986:94,195).

Trophic State Index (TPI) - Indicates a measure of the extent or condition of eutrophication in a body of water.

Unit Day Value Approach - Relies on expert judgement to develop an approximation of the average willingness to pay for recreation activities. An estimate is selected from a range of values approved by federal guidelines. Initially based on a survey of entrance fees at private recreation areas in 1962, the unit day values recommended by the guidelines have been adjusted for changes in the consumer price index since then (Walsh 1986:94,195).

Use Value - For wetlands, economic value related to recreation, flood control, ground-water recharge, and water quality (Stevens et al. 1995).

Utility - The ability of a good to satisfy human wants.

Willingness to Pay - A dollar measure of benefits, meaning how much individuals enjoy recreation activities. Usually valued over and above expenditures actually made while participating in the activity. The psychological content of benefits includes all of the feelings of pleasure which lead participants to exclaim "what a good time they had" or "what a good buy" or possibly "it wasn't worth it." The latter possibility reflects the fact that recreation economic decisions are made before the fact and that actual benefits may not come up to expectations. Federal guidelines recommend willingness to pay as the appropriate economic measure of the benefits of recreation (Walsh 1986:45). (see also: Comprehensive Income, Consumer Surplus, Household Production, Recreation Benefit Valuation)

Bibliography

(From the Full Report)

American Cancer Society. 1995. *Cancer Facts and Figures - 1995.* Atlanta, GA: American Cancer Society.

Anderson, R. and M. Rockel. 1991. *Economic Valuation of Wetlands.* American Petroleum Instutute Discussion Paper #065. Washinton, D.C.

Artuso, Anthony 1993. *Potential Applications of Economic Instruments for Environmental Protection in the Lake Champlain Basin.* Lake Champlain Economic Database Project, Tech. Report No. 4C. Grand Isle VT: Lake Champlain Basin Program.

Artuso, Anthony 1993. *Conceptual Framework for Evaluation of Pollution Control Strategies and Water Quality Standards for Lake Champlain.* Lake Champlain Economic Database Project, Tech. Report No. 4D. Grand Isle VT: Lake Champlain Basin Program.

Bardecki, M. J. 1984. What value wetlands? *J. Soil & Water Conservation* 39:166-169.

Bartlett, Wesley. NYS Department of Parks Recreation and Historic Preservation, economist. Personal communication, September, 1995.

Bell, F. *Application of Wetland Valuation Theory to Florida Fisheries.* SGR-95. Sea Grant Publication. Florida State University, Tallahassee FL

Bergstrom, J. C., J. R. Stoll, J. P. Titre and V. L. Wright. 1990. Economic value of wetlands-based recreation. *Ecological Economics* 2:129-147.

Birkhead, G and R. L. Vogt. 1989. Epidemiologic surveillance for endemic Giardia Lamblia infection in Vermont. *American Journal of Epidemiology* 129(4): 762-768.

Bockstael, N.E., K.E. McConnell, and I.E. Strand.. 1989. Measuring the benefits of improvements in water quality. *The Chesapeake Bay. Marine Resource Economics* 6(1):1-18

Bockstael, N.E., K.E. McConnell, and I.E. Strand.. 1987. *Benefits from Improvements in Chesapeake Bay Water Quality.* Vol. 3 of Benefit Analysis Using Indirect or Imputed Market Methods. Maryland University. EPA-R-811043.

Bove, Ann. 1995. *1994 Water Chestnut Control Program, Lake Champlain Basin.* Vermont Agency of Natural Resources, Waterbury.

Brown, Tommy. Cornell Human Dimensions Research Unit. Personal communication, September, 1995.

Bulmer, Susan K. 1993. *The Lake Champlain Boat Study Report.* Technical report prepared for the Lake Champlain Recreation Management Plan and the Lake Champlain Basin Program. Waterbury: Vermont Agency of Natural Resources.

Burger, J. and M. Gochfeld. 1993. Fishing in contaminated waters: knowledge and risk perception of hazards by fishermen in New York City. *J. Toxicology and Environmental Health* 39: 95-105.

Burgess, Bruce. 1995. *Lake Champlain Bikeways: What it can do for your Community and Business.* Prepared for the Lake Champlain Bikeways program. Albany: NYS Office of Parks, Recreation and Historic Preservation.

Cabelli, V. J. 1989. Swimming-associated illness and recreational water quality criteria. *Water Science Technology* 21(2): 13-21.

Choate, John. Champlain Water District. Personal communication, October 1995.

Cohn, Art. Champlain Maritime Museum. Personal communication, November 1995.

Connelly, N. A. and T. L. Brown. 1988. *New York Statewide Angler Survey, 1988.* Albany, NY: New York State Department of Environmental Conservation.

Connelly, N. A. and B. A. Knuth. 1995. *Patterns of harvest and consumption of Lake Champlain fish and angler awareness of health advisories.* Final report for Lake Champlain Management Conference. Human Dimensions Research Unit, Cornell University.

Cooper, J. and J. L. Loomis. 1993. Testing whether waterfowl hunting benefits increase with greater water deliveries to wetlands. *Environmental and Resource Econ.* 3:545-561.

Council for Agricultural Science and Technology (CAST) 1994. *Wetland Policy Issues.* Ames, Iowa.

Crutchfield, S. R., P. M. Feather, and D. R. Hellerstein. 1995. *The benefits of protecting rural water quality.* U.S.D.A., Economic Research Service, Agricultural Economic Report 701.

Dennis, Donald F., Walter F. Kuentzel, Lousie M. Tritton, Deane Wang. 1995. *Wetland Externalities: Implications for Policy and Decisionmaking.* Paper presented at the 1995 NE Recreation Research Symposium. Forthcoming in Proceedings, 1996. USDA NE Forest Experiment Station, Burlington.

Desvousges, William H. 1987. Option price estimates for water quality improvements: A contingent valuation study for the Monongahela River. *Journal Of Environmental Economics And Management* 14:248-267

Dziekan, Kelly. 1995. *Developing a Recreation Plan for Lake Champlain: The Lake Champlain Recreational User Surveys.* Draft summary report prepared for the Lake Champlain Recreation Management Plan and the Lake Champlain Basin Program. Albany: NY Office of Parks, Recreation and Historic Preservation.

Farber, S. and R. Costanza. 1987. The economic value of wetland systems. *J. Environmental Mgmt* 24:41-51.

Farnum, Gregory ,J. 1995. *Lake Champlain Recreation Resources Inventory.* Draft tech report for the Lake Champlain Basin Program. Burlington: VT Dept of Forests, Parks, and Recreation.

Fay, James. Champlain Water District. Personal communication, August, 1995.

Feather, Timothy D. 1992. *Valuation Of Lake Resources Through Hedonic Pricing: Fort Belvoir, Va.* US Army Corps Of Engineers.

Gilbert, A. H. 1991. *Lake Champlain Angler Study.* Burlington: University of Vermont.

Gilbert, A. H. 1986. *Lake Champlain Marina Study.* Burlington: University of Vermont.

Gold, M. S. and E. O. van Ravenswaay. 1984. *Methods for Assessing the Economic Benefits of Food Safety Regulations: A Case Study of PCBs in Fish.* Michigan State Univ. Agric. Econ. Report 460.

Great Lakes Consortium. World Wide Web site text, October, 1995. WWW address: http://www.great-lakes.net:2200/0/glinhome.html.

Hauser, Mike. VT DEC Water Quality Division. Personal communication, August, 1995.

Holmes & Associates and Anthony Artuso. 1995. *Preliminary Economic Analysis Of The Draft Plan For The Lake Champlain Basin Program.* Lake Champlain Basin Technical Report No. 12B, prepared by Timothy P. Holmes, Anthony Artuso, Tommy L. Brown, Robert L. Bancroft, and James F. Dunne for the Lake Champlain Management Conference. Lake Champlain Basin Program, Grand Isle VT.

Holmes & Associates 1994. *Bicycle Master Plan for the Adirondack North Country Region of New York State.* Prepared by Holmes & Associates for the Adirondack North Country Association (ANCA) and the NYS Department of Transportation. Saranac Lake NY: ANCA.

Holmes & Associates. 1993. *Lake Champlain Economic Database Project.* Technical Report No. 4B prepared for the Lake Champlain Management Conference and the U.S. Environmental Protection Agency. Grand Isle VT: Lake Champlain Basin Program.

Hushak, Leroy J., Yuming Deng, and Mary Bielen. 1995. *Water Use Expenditures on Zebra Mussel Monitoring and Control.* June update. Ohio Sea Grant College Program, Ohio State University, Columbus.

Josephson, R. M. 1993. Economics of agricultural encroachment on wildlife habitat in southwest Manitoba. *Can. J. Agr. Econ.* 41:429-435.

Kaoru, Yoshiaki, V. Kerry Smith, and Jin Long Liu. 1995. Using random utility models to estimate the recreational value of estuarine resources. *Amercian Journal of Agricultural Economics* (forthcoming: Feb, 1995).

Kealy, Mary Jo and Richard C. Bishop. 1986. Theoretical and empirical specifications issues in travel cost demand studies. *Amercian Journal of Agricultural Economics* :660-67.

Kinnunen, Ronald. Michigan State University Extension. Personal communication, October, 1995.

Kinnunen, Ron, Jon Peterson, Steve Stewart, Carol Swinehart. 1985. *Sea Grant Research and Community Development Make Michigan's Bottomland Preserve a Reality.* Pp77-84 in Jon Lien and Robert Graham, eds., Marine Parks & Conservation Challenge and Promise, edited by Jon Lien and Robert Graham. National and Provincial Parks Association of Canada.

Kramer, Randall .A. and L. Shabman. 1993. The effects of agricultral and tax policy reform on the economic return to wetland drainage in the Mississippi Delta Region. *Land Economics* 69:249-62

Lake Champlain Basin Program. 1994. *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin.* Grand Isle, VT: Lake Champlain Basin Program,

Leitch, J. A. and D. F. Scott. 1984. Improving wetland policy through amelioration of adverse effects on local economies. *Water Resources Bulletin* 20(5): 687-693.

Lindquist, Peter. Grand Island Charters, Munising MI. Personal commnication, October, 1995.

Loomis, J., M. Hanemann, and B. Kanninen. 1991. *Willingness to pay to protect wetlands and reduce wildlife contamination from agricultural drainage.* Chapter 21 IN Dinar, A. and D. Zilberman, The economics and management of water and drainage in agriculture. Kluwer Academic Publishers, Boston.

Lynne, G.D., P. Conroy, and F.J. Prochaska. 1981. Economic valuation of marsh areas for marine production processess. *Journal of Environmental Economics and Management.* 8:175-186.

Mendelsohn, R. D. Hellerstein, M. Huguenin. R. Unsworth and R. Brazee. 1991. Measuring hazardous waste damages with panel models. *Journal of Environmental Economics and Management.* 22:259-271.

Montgomery, M. and M. Neddelman. 1994. *Welfare effects of toxic contamination in freshwater fish.* paper presented at the Western Economic Association Annual meeting. Vancouver BC. June 1994

Needelman, Michael and Mary Jo Kealy. 1994. (Unpublished paper). *Recreational Swimming Benefits of New Hampshire Lake Water Quality Policies: An Application of a Repeated Discrete Choice Model.* EPA, Economic Analysis and Research Branch, Washington, DC.

New York State Department of Environmental Conservation and U.S. Fish and Wildlife Service. 1990. *Use of Lampricides in a Temporary Program of Sea Lamprey Control in Lake Champlain with an Assessment of Effects on Certain Fish Populations and Sportfisheries.* Final Environmental Impact Statement, Volume I of II. NYSDEC, Albany.

New York State Department of Health, Bureau of Cancer Edipemiology. 1994. *Cancer Mortality by County, 1987-1991.* NYSDH, Albany.

New York State Office of Parks, Recreation & Historic Preservation. 1994b. *Acreage and Fiscal Year Attendance by Region (1987-1994).* NYSOPRHP, Albany.

O'Neil, Chuck. Personal Communication. New York Sea Grant Zebra Mussel Clearing House at SUNY Brockport, November 1995.

Peterson, Jon, Thord C. Sundstrom, Ronald Kinnunen. 1987a. *1986 Recreational Diving Activity in Michigan Bottomland Preserves.* Michigan Sea Grant Extension, Marquette.

Peterson, Jon, Thord C. Sundstrom, Steve Stewart. 1987b. *A Profile of Great Lakes Diver Activity, Travel, and Expenditure Patterns.* Michigan Sea Grant Extension, Marquette.

Phillips, W. W., T. J. Haney and W. L. Adamowicz. 1993. An economic analysis of wildlife habitat preservation in Alberta. *Can. J. Ag. Econ.* 41:411-418.

Piper, S., M.O. Ribando, and A. Lundern. 1987. The recreational benefits from an improvement in water quality at Oakland Lakes and Lake Poinsett, South Dakota. *North Central Journal of Agricultural Economics.* vol. 9(2): p. 279-287.

Plattsburgh Press Republican. 1995. Study: babies affected by mothers eating toxin-laced fish. *Plattsburgh Press-Republican* 9/25/95:12.

Reinert, R. E., B. A. Knuth, M. A. Kamrin, and Q. J. Stober. 1991. Risk assessment, risk management, and fish consumption advisories in the United States. *Fisheries* 6:5-11.

Reppert, R. 1992. *Fundamentals of wetlands mitigation banking.* Concept paper, U. S. Army Corps of Engineers, Institute for Water Resources Report 92-WMB-1.

Ribaudo, M.O. and S.L. Piper. 1991. Estimating changes in recreational fishing participation from national water quality policies. *Water Resources Research* 27:1757-1763.

Ribaudo, M., C.E. Young and D. Epp. 1984. *Recreation benefits from Improvement in Water Quality at St. Albans Bay.* USDA, Econ. Res. Service. Wash., D.C.

Ries, LAG, BA Miler, BF Hankey, CL Kosary, A Harras, BK Edwards (eds). 1994. *SEER Cancer Statistics Review, 1973-1991: Tables and Graphs, National Cancer Institute.* NIH Pub. No. 94-2789. Bethesda, MD.

Rypkema, Donovan D. 1994. *The Economics of Historic Preservation.* National Trust for Historic Preservation, Washington, DC.

Sanders, L.D., R.G. Walsh and J.B. Loomis. 1990. Toward empirical estimation of the total value of protecting rivers. *Water Res. Research.* 26:1345-57.

Sayward, Teresa. Supervisor, Town of Willsboro. Personal communication, October 1995.

Silverstein, J. 1994. Taking wetlands to the bank: the role of wetland mitigation banking in a comprehensive approach to wetlands protection. *Boston College of Environmental Affairs Law Review* 22:129-161.

Simino, Larry T. 1994 (personal communication). Data supplied for this project on attendance and revenue data for Vermont State Parks along Lake Champlain. Waterbury VT: Vermont Agency of Natural Resources.

Smith, Maja and Kelly Dziekan 1995. *Lake Champlain Recreation Assessment Report.* Draft report prepared by the NYS Office of Parks, Recreation, and Historic Preservation and the Vermont Department of Forests, Parks and Recreation. Albany: NYSOPRHP.

Smith, V. Kerry. 1993. Nonmarket valuation of environmental resources. *Land Economics*, Vol. 69, No.1.

Smith, V. Kerry, and William Desvousges. 1986. *Measuring Water Quality Benefits*. Boston MA: Kluwer-Nijhoff Publishing.

Stavins, R. N. and A. B. Jaffe. 1990. Unintended impacts of public investments on private decisions: the depletion of forested wetlands. *Amer. Econ. Review* 80(3):337-352.

Stevens, Thomas H., Samuel Benin, and Joseph S. Larson. 1995. Public attitudes and economic values for wetland preservation in New England. *Wetlands* 15(3):226-231.

Stoll, John, J. Bergstrom, and J. Titre. 1989. *Regional Valuation Models for Wetland Recreation Benefits.* In Benefits And Costs In Natural Resource Planning, K. Boyle and T. Heekin eds. Western Regional Regional Research Publication W-133. University of Maine

Stukel, T. A., E. R. Greenberg, B. J. Dain, F. C. Reed, and N. J. Jacobs. 1990. A longitudinal study of rainfall and coliform contamination in small community drinking water supplies. *Environmental Science and Technology* 24:571-575.

Tuner, K. 1991. *Sustainable Wetlands: An Economic Perspective*. Chapter 1 In K. Turner and T. Jones, Wetlands: Market and Intervention Failures. Earthscan publications, London.

Udd, E. and J. D, Fridgen. 1985. *Anglers' Perceptions of Toxic Chemicals in Rivers and Sport Fish*. In Lucas, R.C., compiler, Proceedings --National Wilderness Research Conference: Current Research. U.S. Forest Service, Intermountain Research Station, Technical Report INT-212. pp.245-250.

U.S. Fish and Wildlife Service. 1993. *1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. Washington, DC.

VT and NY Departments of Env. Cons. 1994. *A Phosphorus Budget, Model and Load reduction Strategy for Lake Champlain: Lake Champlain Diagnostic Feasibility Study Final Report.* Waterbury, VT.

Vermont Department of Employment and Training. 1995. *Vermont Travel & Tourism Indicators: 1994-1995.* Vermont Department of Employment and Training, Larbor Market Information Section, Montpelier.

Vermont Department of Forests, Parks, and Recreation. 1995. *Vermont State Parks: Economic and Social Values, Executive Summary*. Prepared in cooperation with the University of Vermont, School of Natural Resources. Vermont Department of Forests, Parks, and Recreation, Waterbury.

Vermont Department of Health. 1995. *The Health Status of Vermonters*. Burlington, VT.

Vilaplana, Jorge V. and Leroy J. Hushak. 1995. *Outdoor Recreation at Lake Erie.* Draft Report. Ohio Sea Grant College Program, Ohio State University, Columbus.

Vilaplana, Jorge V. and Leroy J. Hushak. 1994. *Recreation and the Zebra Mussel in Lake Erie, Ohio.* Technical Summary OHSU-TS-023. Ohio Sea Grant College Program, Ohio State University, Columbus.

Walsh, Richard G. 1986. *Recreation Economic Decisions: Comparing Benefits and Costs*. State College PA: Venture Publishing, Inc.

Walsh, Richard G., Donn M. Johnson, John R. McKean. 1992. Benefit transfer of outdoor recreation demand studies, 1968-1988. *Water Resources Research* 28(3):707-713.

Wardlaw. L. A. and, W. H. Bruvold. 1989. Evaluation of consumer notification under the Safe Water Drinking Act. *Water Resources Bulletin* 25(4):837-844.

Weems, W. A. and L. W. Canter. 1995. Planning and operational guidelines for mitigation banking for wetland impacts. *Environmental Impact Assessment Review* 15:197-218.

White, T. A., C. L. Blair, and K. B. MacDonald. 1992. Wetland replacement: the art and science of renewing damaged ecosystems. *Renewable Resources Journal* 10(4):18-24.

Whittington, D. et al. 1994. *The Economic value of Improving the Environmental Quality of Galveston Bay: A Contingent Valuation Study*. Draft Final Report. U.S. EPA Contract # 68-C2-0134

Young, C.E. and J.S. Shortle. 1989. Benefits and costs of agricultural nonpoint-source pollution of St. Albans Bay. *Journal of Soil and Water Conservation.* vol. 44(1): p. 64-67.

Young, C. Edwin, and Frank A. Teti. 1984. *The Influence of Water Quality on the Value of Recreational Properties Adjacent to St. Albans Bay, Vermont.* U.S. Department of Agriculture, Economic Research Service.

Description of the Study Team

Holmes & Associates is a socio-economic research and consulting firm located in Saranac Lake, New York. Since 1989, Holmes & Associates has focused on illuminating the human dimensions of economic, social, and environmental policy issues in the Lake Champlain - St. Lawrence River region of New York, Vermont, Quebec, and Ontario.

Timothy P. Holmes holds an MA degree in sociology, with an emphasis in rural sociology. His background in lake-related research dates back to his thesis research in 1980, when he studied the relationship between human activities and the trophic status of 90 Idaho lakes. Holmes has developed a thorough knowledge of socio-economic conditions in the Lake Champlain Basin through development of the Lake Champlain Economic Database, as well as through his research for lake associations, local governments, and economic development organizations throughout the region.

Anthony Artuso holds a Ph.D. in natural resource policy and management, with a concentration in resource economics. He has over ten years of professional experience in economic analysis and public policy development with particular emphasis on water resources and protection of biodiversity. His previous work for the Lake Champlain Management Conference involved the analysis of potential applications of economic instruments for environmental protection in the Basin and the development of a comprehensive analytical framework for development of pollution control programs. He is currently a team leader in the newly created Public Policy Institute at the University of Charleston.

Tommy L. Brown holds an MS degree in forest recreation and has been a national leader in the human dimensions of fish and wildlife field. He has over 20 years of experience in conducting studies to determine how various stakeholder groups use fish and wildlife resources, how they want these resources managed, and how they are affected by various management alternatives. Brown heads the Human Dimensions Research Unit at Cornell University, which has a 20-year research partnership with New York's Department of Environmental Conservation - Division of Fish and Wildlife.