Technical Report No. 4A

Lake Champlain Economic Database Project

Lake Champlain Basin Program

Executive Summary

Prepared by
Holmes & Associates
and Anthony Artuso

for
Lake Champlain Management Conference

March 1993

PUBLICATION SERIES

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This technical report is the fourth 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

   (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.

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The Economic Database Study is a survey of existing data and national literature intended to provide an overview of economic and demographic characteristics, and market-based approaches to facilitate water pollution control and prevention. Specific calculation of economic impacts of proposed actions will usually require additional information and data to apply principles from this compilation of existing data and literature to the Champlain Basin. In particular, current Lake Champlain Basin Program research in the areas of agriculture, recreation and fisheries will provide underlying data needed for refined estimates of costs and economic impacts of potential management actions.

March 1993

LAKE CHAMPLAIN ECONOMIC DATABASE PROJECT

EXECUTIVE SUMMARY

Prepared For

Lake Champlain Management Conference

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Purpose Of The Project

This executive summary presentation is one of four economic reports developed between June 1992 and March 1993, under the Lake Champlain Management Conference (LCMC) project: *Economic Database for the Lake Champlain Basin*. The goal of the project was to provide the following information: an accurate, accessible economic database for the entire Basin; a description and discussion of Lake Champlain-related economic sectors; and, an analysis of the economic implications of possible Lake Champlain pollution control programs.

Project Reports

The four project reports are published as separate volumes, titled as follows.

Volume I: Lake Champlain Economic Database Project Executive Summary (45 pages);

Volume II: Socio-Economic Profile, Database, and Description of the Tourism Economy for the Lake Champlain Basin (150 pages);

Volume III: Potential Applications of Economic Instruments for Environmental Protection in the Lake Champlain Basin (75 pages); and,

Volume IV: Conceptual Framework for Evaluation of Pollution Control Strategies and Water Quality Standards for Lake Champlain (25 pages).

Essentially, Volume II and the computerized database help to define the role of Lake Champlain in the region's economic well being, while Volumes III & IV describe alternative economic strategies for developing an efficient, fair, and effective pollution control program for the Basin.

Format Of This Report

This document has two main sections, the first summarizing the Volume II report, and the second, beginning on page 2-1, summarizing Volumes III and IV. An appendix provides a listing of the table of contents for volumes II, III, and IV.

SUMMARY OF VOLUME II

Project Overview

A primary objective of the Comprehensive Pollution Prevention, Control, and Restoration Plan being developed by the Lake Champlain Management Conference is to restore and maintain recreational

and economic activities in and on the lake. However, the economic interrelationships between and among Lake Champlain, its residents, and its visitors are complex. The purpose of this report was to identify and interpret socio-economic data necessary for defining the Lake's role in the economy of the Lake Champlain Basin area within Vermont and New York. The timely report and database provide socio-economic data necessary for evaluating the public and private implications of restoring and maintaining the chemical, physical, and biological integrity of Lake Champlain's waters. The specific goals for the report were:

- to compile available economic and demographic data;
- to provide a detailed discussion of lake related economic sectors; and,
- to describe the computerized database so that it can be easily accessed by Lake Champlain researchers and other interested parties.

To reach these goals, the study team has synthesized data and information obtained from a variety of sources, including federal and state databases, previous Lake Champlain-related reports and studies, the professional literature and journals, and personal interviews with a wide range of experts and practitioners. It should be noted that the economic data base project was conducted with a major emphasis on collecting a comprehensive and in-depth set of available economic information for the Basin. Since no particular economic models or analytic techniques (e.g., input/output analysis) are presently being developed for use in the Lake Champlain Basin, the study team concentrated its efforts on compiling socio-economic data, discussing Lake-related economic sectors, and presenting examples of socio-economic analyses that might assist in factoring human activities into environmental planning for the Lake Champlain Basin.

The study team has compiled the most complete and detailed socio-economic database for the Lake Champlain Basin that has yet been available. The report contains summary statistics gleaned from the socio-economic database, accompanied by an outline of the over 50 socio-economic variables that comprise the database. Two over-arching goals for the database and report have been accomplished. First, we have compiled and organized relevant socio-economic data in a manner to maximize accessibility for all interested parties. The database is clearly and consistently organized so that other researchers can perform statistical and GIS-based analysis.

Second, researchers can now begin a more rigorous analysis of the relationship between key socio-economic variables and the various water quality parameters currently being monitored. The database is comprised primarily of U.S. census data listed at the town level, with summary data computed for the Lake Champlain Basin and Shoreland areas in Vermont and New York. The town-level data for the 144 Vermont towns and the 54 New York towns within the Basin provide a much finer level of detail than was previously available. For example, the interested researcher can now extract type of sewage disposal system or per capita income for a specific sub-basin of the watershed by compiling the data for those towns lying within the particular sub-basin. In summary, the socio-economic database contains information necessary for linking human activities and characteristics with environmental processes and conditions, thereby providing the first opportunity to systematically integrate the needs of people and the environment within the Lake Champlain Basin.

An important component of this report is the detailed consideration of the tourism industry within the Basin. The study team documented the lack of Lake Champlain Basin tourism studies and compiled a wide variety of New York and Vermont economic data on tourism within the Basin. This research, for

the first time, estimates the significant economic expenditures by internal tourists (i.e., local residents within the region). The overall economic impact of tourism in the Basin and the contributions from distinct sectors are also assessed. A major recommendation is for systematic evaluation of the advantages and disadvantages of tourism development as a step towards sustainable tourism in the Lake Champlain Basin.

Along with characterizing the Lake Champlain Basin in demographic and economic dimensions, the report provides the file names, table numbers, and variable descriptions necessary for accessing the socio-economic database. Database disks will be available from the Lake Champlain Basin Program at the following address:

Lake Champlain Basin Program
Gordon-Center House
54 West Shore Road
Grand Isle VT 05458

Phone: 1-802-372-3213

The following summary of Volume II is presented in two sections: **Socio-Economic Profile and Database**, and, **Tourism Economy**. The data and findings reported here apply to the U.S. portion of the Lake Champlain Basin, unless otherwise noted.

Socio-Economic Profile and Database

Major Findings and Interpretations

1. **Over one-third of the Basin population and an undetermined number of businesses rely on Lake Champlain for their drinking water.**

   Preliminary data indicate that Lake Champlain is the source of drinking water for approximately 188,000 people, or 32% of the Basin population. Over 95% of the people relying on Lake Champlain for their drinking water are Vermont residents, and the vast majority of people who drink Lake Champlain water (98%) are connected to public or private water systems (i.e., supplying 5 or more housing units). For example, the Champlain Water District serves 50,000 people, the Burlington Water District serves 50,000 people, and the South Burlington Water District serves 12,670 people (Susan Mitchell, VT Water Supply Division, personal communication 8/28/92). Overall, the New York and Vermont Basin populations are very similar in the percentage of population relying on public or private systems, wells, and other sources.

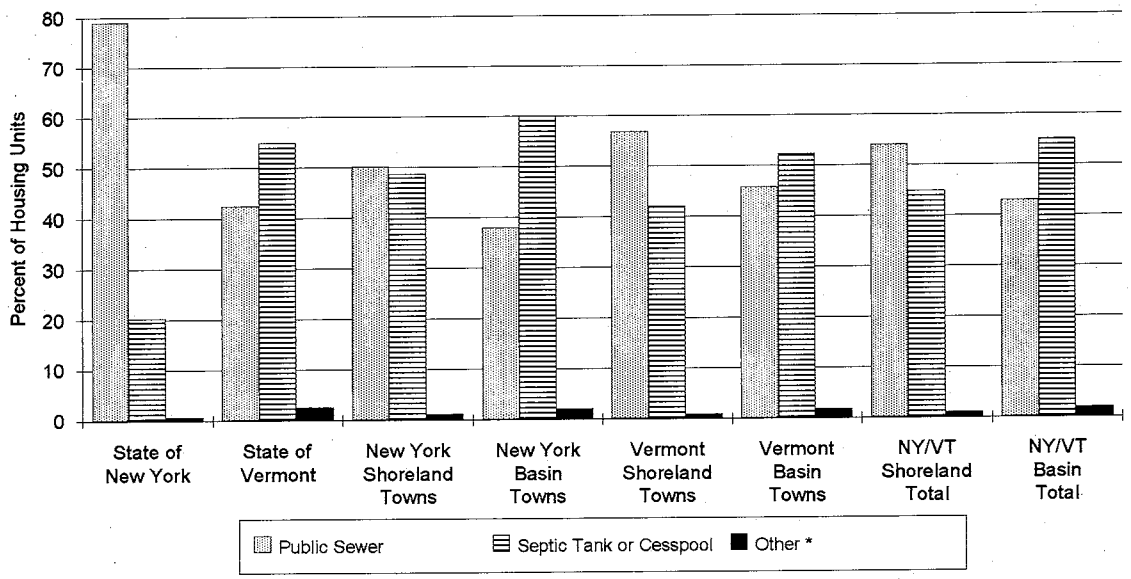
   Besides residential water use, an undetermined number of businesses rely on Lake Champlain for their water. Impending changes in surface water treatment regulations could have a tremendous economic impact on businesses that serve the public by requiring small, seasonal operations such as restaurants and campgrounds to purchase water treatment equipment to meet the new regulations. The study team perceives a need for research to

identify the potential economic impact of current or proposed water quality regulations on small businesses in the Basin.

2. **Over one-half of the households and many tourist facilities in the Basin are not connected to a public sewer system.**

More households in the Basin rely on septic tanks and cesspools (55%) than are connected to public sewer systems (43%). As shown in Figure 1-1, about 50% of the New York Shoreland population rely on septic tanks or cesspools, equaling 46,176 people or 17,760 households, while the same holds true for about 40% of the Vermont Shoreland population, equaling 49,910 people or 19,196 households. Considering that individual systems, if not properly constructed and maintained, could increase the amount of nutrients flowing into Lake Champlain Basin streams, the data indicate that a monitoring program for individual septic systems may be a priority management item. An undetermined number of these homes are seasonal tourist homes, campgrounds and other tourist facilities on Lake Champlain. Town planning regulations and enforcement likely play a major role with the management of these systems. Additionally, the data indicate that construction of public septic systems continues to be a high priority for some areas of the Basin.

Figure 1-1
Sewage Disposal by Type as a Percentage of All Housing Units: NY, VT, and Lake Champlain Basin Areas (1990)



* Other is defined by the Census Bureau as "dispose of sewage in some other way."

Source: Bureau of the Census, 1990 Census of Population and Housing, Census Summary File 3A.

3. **Of the ten major industrial divisions in the census, the service industry is the single largest employer in the Basin with 34% of all employed persons.**

Following services, the wholesale & retail trade industry comprises 22% and the manufacturing industry employed 15% of all employed persons. The Vermont and New York areas of the Basin are very similar in employment by industry. One difference is that public administration, referring to government establishments, employs 10% of New York Basin work force and only 5% of the Vermont Basin work force.

4. **Although manufacturing is the third largest employer in the Basin, between 1980 and 1990 it experienced the largest decline in employment among the 10 major sectors, decreasing from 22% to 15% of the work force.**

Industries showing an increase in percentage of employment were: services (+3%); wholesale & retail trade (+2%); construction (+2%); and, finance, insurance, and real estate (+1%). These findings for the Basin mirror that in the U.S. as a whole and indicate the growing importance of the service sector. Businesses within the service industry include hospitals, schools, and professional offices, as well as the tourism-related businesses such as hotels, amusement services, and museums.

5. **While the Basin economy continues toward a healthy diversification in such areas as education, health care, tourism, prisons, and manufacturing, the more traditional, rural industries of agriculture, timber harvesting, and mining continue to make significant contributions to local economies.**

In specific locations around the Basin, agriculture, mining, and forestry are the major employers. For example, the "agriculture, forestry, and fisheries" industry grouping accounts for over 25% of all employment in the Addison County, Vermont towns of Bridport, Shoreham, and Addison. Table 1-1 shows the 20 Basin towns in Vermont and the 20 in New York with the highest percentage of primary employment in natural resource-related industries. Even 20th on the list in Vermont, Pawlet Town, still has at least 15% of employed persons relying directly on agriculture, forestry, and mining. The New York town with the highest reliance on employment in the natural resource sector is Clinton Town, at 21% of all employed persons.

According to the 1990 U.S. census, the agriculture, forestry, and fishing industry directly employed 10,478 people, or about 4% of all employed persons in the Basin. The mining industry directly employed another 815 people. However, an accurate assessment of natural resource employment in the Basin would have to include secondary natural resource-related employment consisting of those individuals involved in the subsequent transportation, processing, packaging, and marketing of natural resources. According to agriculture experts in the Basin, an accurate profile of the Basin's agriculture-related economy would require a detailed input-output analysis of all agriculture-related income and employment, an effort beyond the scope of this project. While secondary employment is difficult to quantify, natural resource-related secondary employment undoubtedly comprises a significant percentage of employment in the predominately rural Lake Champlain Basin.

For example, secondary employment linked to agriculture would have to include employees classified in other sectors, such as manufacturing (e.g., ice cream, bread), wholesale trade (e.g., milk distributors), and retail trade (e.g., butchers, produce departments). One Vermont agricultural official estimated primary and secondary agricultural production at 16% of Vermont's Gross State Product (De Geus 1992). Primary and secondary employment in agriculture could then comprise 16% of all employment, while Healy (1984) estimated that Vermont forest products-related employment accounted for 8% of all Vermont employment. With the Lake Champlain Basin's employment situation being very similar to the State of Vermont's, at least 25% the Basin's work force could be employed in natural resource-related activities. Additional research is needed to accurately determine the importance of natural resource-related economic activity in the Lake Champlain Basin.

That there is a link between natural resource-related economic activity and Lake Champlain seems evident in the appearance of 17 Shoreland towns among the 40 towns listed in Table 1-1. In the New York part of the Basin, 10 of the 20 listed towns are Shoreland towns and comprise 59% of the New York Shoreland area. Although the majority of listed towns appear to have agriculture as their dominate economic activity, forest products and

Table 1-1
Natural Resource-Related Employment:
The 20 Towns in NY & VT with Highest Percentage of Primary Employment in the Two Major Natural Resource Industry Sectors

Town	County	Agriculture, Forestry, & Fishing Employment	Mining Employment	Percent of Total Employment in the Two Sectors	Total Employment within the Town
			Vermont		
Bridport town *	Addison	179	0	29.8%	600
Shoreham town *	Addison	149	2	25.7%	587
Addison town *	Addison	131	2	25.5%	521
Fairfield town	Franklin	193	0	23.7%	813
Berkshire town	Franklin	127	0	23.2%	547
Whiting town	Addison	45	0	20.6%	218
Orwell town *	Addison	112	2	20.1%	566
Panton town *	Addison	54	3	19.5%	293
Franklin town	Franklin	100	0	19.0%	527
Irasburg town	Orleans	75	0	18.2%	412
Newport town	Orleans	112	4	18.1%	640
West Haven *	Rutland	28	2	17.9%	168
Greensboro town	Orleans	61	0	17.8%	342
Glover town	Orleans	67	0	17.5%	382
Sheldon town	Franklin	150	0	17.1%	876
Danby town	Rutland	87	10	16.6%	584
Benson town *	Rutland	66	2	16.6%	410
Lowell town	Orleans	35	3	16.1%	236
Tinmouth town	Rutland	31	0	15.7%	197
Pawlet town	Rutland	86	17	15.0%	688
			New York		
Clinton town	Clinton	54	2	21.1%	266
Ellenburg town	Clinton	120	0	16.5%	729
Willsboro town *	Essex	44	43	10.6%	823
Argyle town	Washington	146	0	10.4%	1,405
Essex town *	Essex	10	19	10.0%	291
Belmont town	Franklin	48	0	9.3%	515
Hartford town	Washington	82	2	8.6%	980
Chazy town *	Clinton	154	0	8.3%	1,853
Mooers town	Clinton	102	0	7.5%	1,366
North Hudson town	Essex	5	0	7.4%	68
Westport town *	Essex	45	2	7.3%	644
Crown Point town *	Essex	45	0	6.4%	703
Altona town	Clinton	49	0	6.1%	803
Putnam town *	Washington	11	0	5.9%	188
Granville town	Washington	124	14	5.2%	2,658
Beekmantown town *	Clinton	109	13	4.9%	2,494
Champlain town *	Clinton	129	2	4.8%	2,738
Fort Ann town *	Washington	64	9	4.7%	1,562
Peru town *	Clinton	134	0	4.4%	3,018
Brighton town	Franklin	29	0	4.4%	661

* Shoreland towns.

Source: Bureau of the Census, 1990 Census of Population and Housing, Census Summary File 3A.

mining are also represented (e.g., Willsboro, Essex, Westport). One conclusion is that plans for managing and protecting the lake need to consider potential impacts on natural resource-related economic activities.

Besides their importance to local economies, the natural resource industries in the Basin have social and cultural importance to local areas. A tradition of working in the woods or working on the land has continued through many generations in some families and such work still carries a high degree of status. In the words of one local town official, forestry-related jobs are "real jobs", as compared to tourism-related employment. While open to interpretation, characteristics of real jobs include such attributes as working outdoors, requiring skill in operating and repairing equipment, and carrying on a family tradition, as well as characteristically higher wages. If local economic development efforts begin to consider the sustainable development programs currently being tested by international development organizations, the social and cultural attributes of natural resource industries in the Lake Champlain Basin will require further study and analysis. One of the criteria of sustainable development is that it be culturally appropriate, as well as environmentally appropriate.

6. **In comparing and contrasting the general socio-economic characteristics of the Basin populations in Vermont and New York, the differences are more pronounced in the Shoreland towns than they are in the Basin towns in general.**

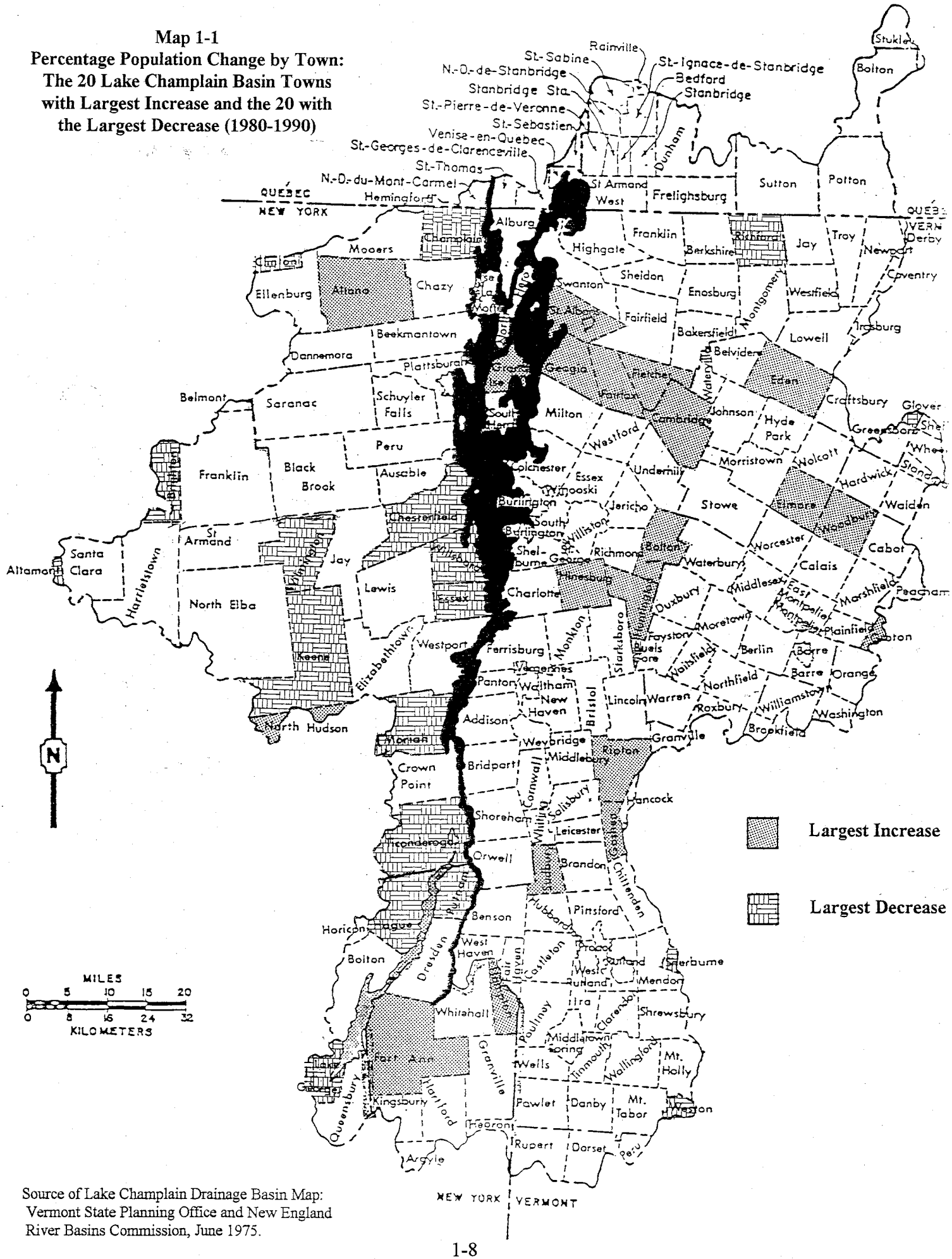
Population change between 1950 and 1990 is a prime example. The population grew by 58% in Vermont Basin towns and by 44% in New York Basin towns, while Vermont Shoreland towns grew by 85% and New York Shoreland towns grew by only 46%. Map 1-1 illustrates a similar relationship by showing those towns with the largest increases and decreases in population between 1980 and 1990. Eight New York Shoreland towns are among the twenty towns registering the largest decrease in population for the period, actually experiencing a population loss ranging from -1.3% to -20.1%, while none of the Vermont Shoreland towns experienced a net population loss.

7. **The ecologic-economic zone analyses performed by the study team extend traditional socio-economic analysis by providing valuable insights into the characteristics of sub-Basin areas distinguished by their ecological, rather than their jurisdictional, attributes.**

The zone-level analyses demonstrate the socio-economic diversity that exists among major Lake Champlain Basin areas, and illustrate the type analysis necessary for incorporating human dimensions into the Lake Champlain Basin planning and management process. Vanguard approaches to resource management and environmental conservation are focusing on helping the economy and ecology to flourish together. The emphasis of the new strategies is on addressing the entire inhabited landscape, not just individual species or habitats, and recognizing that humans, too, must be treated as part of the ecosystem (Stevens 1992). The ecologic-economic zone analyses presented in the Volume II report illustrate the following three benefits of this approach.

- First, the zones provide a framework for describing the social and economic characteristics of those areas of the Basin that are ecologically linked to each of the five lake areas. The zone level analysis provides a more direct link of environmental characteristics with socio-economic characteristics than is possible at the Basin, state, or county level of analysis.

Map 1-1
Percentage Population Change by Town: The 20 Lake Champlain Basin Towns with Largest Increase and the 20 with the Largest Decrease (1980-1990)



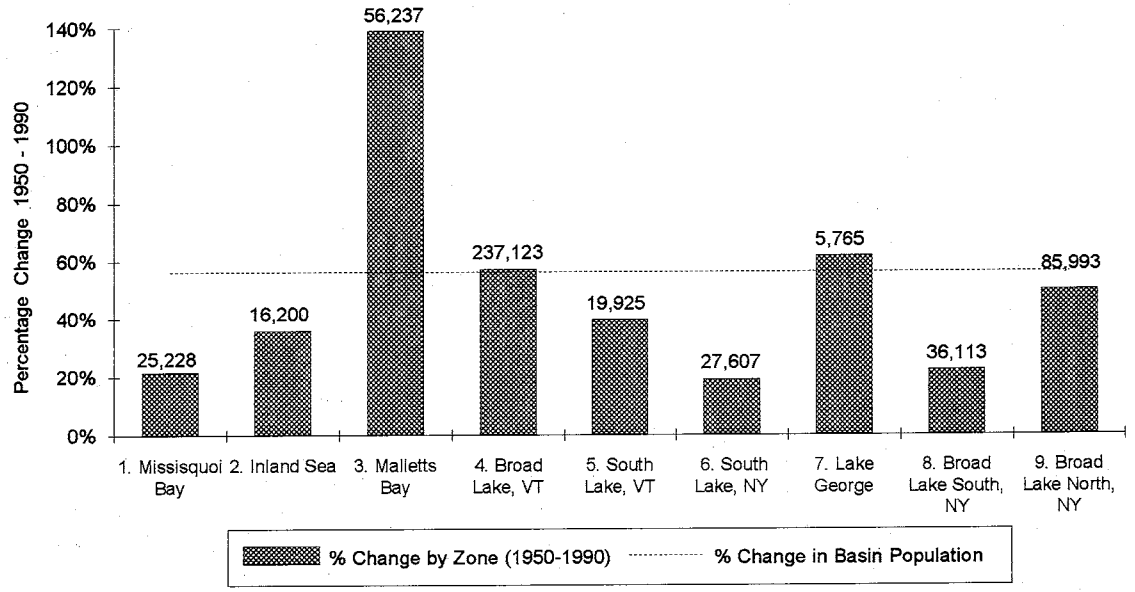
Source of Lake Champlain Drainage Basin Map: Vermont State Planning Office and New England River Basins Commission, June 1975.

- Second, by analyzing and presenting data for nine distinct ecologic-economic zones comprising the Lake Champlain Basin, the study team has provided the LCMC with a valid basis for comparing and contrasting different areas in the Basin. This type of information can be used to tailor programs to specific zones and to more accurately assess the potential social and economic impacts of management schemes directed at specific lake regions.

- Third, since the rationale for the Basin planning process is one of bioregionalism, a logical extension is to pursue sub-basin policy and planning along bioregional lines. As the LCMC begins to incorporate research findings into the planning process, one powerful motivation must be to link the physical and environmental aspects of the Basin with socioeconomic characteristics and economic well-being. Research and policy development on a bioregional basis, such as the ecological-economic zones discussed in the report, is a definite step in this direction.

One finding from the ecologic-economic zone analysis is the chart in Figure 1-2, illustrating how population growth in the Malletts Bay zone has far out-paced that of the other eight ecologic-economic zones. Those towns that comprise the Malletts Bay zone experienced a population increase of 139% between 1950 and 1990, as compared to 58% for the U.S. Basin area as a whole.

Figure 1-2
Population Change between 1950 and 1990:
Lake Champlain Ecologic-Economic Zones



Note: Numbers indicate the zone's 1990 population.

Source: Bureau of the Census, 1950, 1960, 1970, 1980, and 1990 Census of Pop and Housing, Census Summary File 1A.

8. **Local government expenditure data, analyzed only for the New York portion of the Basin, indicates that local governments in the New York Basin area (i.e., county, city, town, village, school districts, fire districts) expended $460.6 million in 1990.**

   On a per capita basis, the local governments paid out $2,383 per person for such items as education, police, fire, and transportation. The "cultural-recreation" category comprises an average of only 2% of per capita expenditures, a relatively minor portion of local government budgets. One conclusion is that some local governments do not perceive a relationship between cultural-recreation expenditures and tourism income. More likely, many local governments are simply unable to fund the category at higher levels. The LCMC could play a role in encouraging and funding improvements in lake-related cultural and recreation facilities. The Partnership Program administered by the New York - Vermont Citizens Advisory Committees on Lake Champlain is a positive step that direction.

Other Findings

9. **Including Canadian residents, the total 1990 population of the Basin was 607,788 people, with the U.S. population totally 581,467 people. Approximately 64% of the U.S. Basin population are Vermont residents.**

10. **The general Basin areas of highest population growth during the past decade were the Vermont Shoreland (13%) and the Vermont Basin (11%)**

11. **According to 1990 census data, there are approximately 9,118 seasonal housing units in the Shoreland and 38,530 seasonal housing units in the Basin.**

12. **Median family income in 1989 was highest in Vermont Shoreland towns ($38,709) and lowest in New York Shoreland towns ($31,605).**

13. **The appraised fair market value of taxable real property in the Basin totaled $27.5 billion in 1990/91, with 79% of the value in Vermont property and 21% in New York property. The Shoreland towns around Lake Champlain contain almost one-third (32%) of the total value of real property in the Basin, yet comprise only one-fifth (21%) of the Basin land area.**

14. **The average 1991 property tax bill for a year-round Basin household in Vermont was $1,659, equaling an average assessment of $15.06 per $1,000 in market value. For the New York Basin year-round household, the average 1990 total property tax bill was $1,365, equaling an average assessment of $24.93 per $1,000 in market value.**

15. **Retail trade sales in the Lake Champlain Basin during 1991 totaled $4.5 million, with 65% occurring in Vermont and 35% in New York. The Shoreland towns accounted for 38% of all retail trade sales.**

16. **Manufacturing value-added in the Lake Champlain Basin during 1987 totaled $2.8 million, with 69% occurring in Vermont and 31% in New York. The Shoreland towns accounted for 41% of all manufacturing value-added.**

Policy And Research Recommendations

1. **The LCMC should develop policy and procedures for integrating data and analyses from the physical sciences with that supplied by socio-economic research. A component of this would be the establishment of a data clearing house and a request that all Research Consortium members and other active Lake Champlain researchers provide descriptions of research findings and unpublished databases for a Basin-wide data repository.**

The overlap of environmental management and human activities should be at the heart of the planning process. Where specific recommendations are predicted to have an economic impact on the Basin or a sub-area within, the description of the activity should be accompanied by economic data obtainable from the socio-economic database that specifically describes the economy and the human population of the area to be affected. The LCMC should challenge all researchers to attempt a more rigorous analysis of the link between human activities and water quality to account for human needs and economic conditions while striving to protect and enhance the Lake's water quality.

Furthermore, the LCMC should request that raw data itself be made available to other researchers and interested parties (in the appropriate machine-readable form). This would allow motivated members of a broader community to contribute to the analysis and discussion of policy-relevant materials in a timely and relevant manner. The research team is prepared to assist in the initiation of this task.

In addition, we recommend that Lake Champlain Basin Program (LCBP) staff solicit and publish summaries of relevant research and thereby alert the public to on-going research. The tabloid "Casin' the Basin" might be an appropriate vehicle, or perhaps a semi-annual special report would be feasible. This is not to detract from existing reporting efforts, but to recommend that the net be cast wider to include all State, Federal, Province and, where possible, privately funded research efforts. The intention would be to allow wider access (both academic and public) to the data and information that has been and is being gathered. This recommendation is central to the planning and public participation process in the Basin.

2. **The LCMC should evaluate the appropriate spatial and political level of policy initiatives.**

In other words, at what level will a particular incentive be most effective: basin, state, county, town or village? While the socio-economic database points out the homogeneity of the Basin on many characteristics, there are some other very real differences between the states, between the Shoreland, between sub-basins, and especially between individual towns within the Basin.

For example, the LCMC should consider the adoption and extension of study team's ecologic-economic zones as a basis for planning and policy. It represents a bio-regional approach that allows for analysis at a more local level than the county, but with a clear physical rationale that provides a link between the environment and peoples' lives. It makes the resource of the lake much more tangible for local populations if they feel that others in their physical zone are discussing and developing solutions. It also helps to overcome interstate disagreements by de-Stating the process and bio-regionalizing it. This does not have to mean another layer of bureaucracy, rather some clearing house-type staffing relying on the cohesion of interests of different towns. Also, geographically specific problems, such as weeds in the South Lake and phosphorus in Malletts Bay and the Inland Sea, become socio-economically situated in this holistic and bio-regional framework.

3. **The LCMC should fund a research project that examines the economic, social, and environmental relationship between small businesses and Lake Champlain.**

Our knowledge about the economic impacts of tourism on local businesses is incomplete because New York and Vermont State databases rely almost exclusively on employment-related business reports for estimating tourism impacts. Therefore, information on the many family owned and operated businesses who have no employees -- a common business arrangement in much of rural Vermont and New York -- is virtually non-existent. Determining the economic perspective of the small business owner would clarify the economic development potential around the lake, however, visitor and user surveys dominate socio-economic survey efforts in the Lake Champlain Basin. A systematic survey of small business would provide accurate, contemporary data on the relationship between Lake Champlain and local, rural economies. Such information would also provide a means for comparing pre- and post-Plan economic conditions.

Tourism Economy

Major Findings and Interpretations

1. **There is an obvious lack of a Lake Champlain focus in tourism information, research, planning or development.**

Lake Champlain has not been highlighted as a key tourist image within the Basin. Instead, the major tourist image-regions of the Basin are Quebec, the Adirondacks and Vermont. The study team found no previous tourism studies of either Lake Champlain or the Basin. (We note recreation studies are on-going, with findings available at a later date.) Also, the study team found no coordination between New York, Vermont or Quebec concerning tourism marketing, research, or planning for the Lake Champlain Basin. Finally, no systematic effort has been made to compile detailed tourism research, statistics, or related survey data for Lake Champlain as a whole.

2. **Total tourism-related expenditures in the Basin are estimated at $2.2 billion in 1990, with roughly 71% in the Vermont portion of the Basin ($1.6 billion) and 29% in the New York portion ($638 million).**

In comparison, the Basin produced roughly $2.8 billion in value-added to manufacturing, $4.5 billion in total retail sales, and $1.8 billion in service industry receipts during 1991. Thus, tourism-related expenditures are a major component of the Basin economy.

   a. **Roughly 40%, or $880 million, of the total Basin tourism expenditures occur in Shoreland towns.**

Given the limitations in statistical reporting, it is not possible to determine the amount that is directly lake-related, as opposed to tourist expenditures that just happen to occur within Shoreland towns.

   b. **Marinas on Lake Champlain in 1990 employed approximately 344 people, with a total annual payroll of $5.4 million.**

c. **Fishing related expenditures are estimated at $61.6 million for the Basin and $24.8 million for the Shoreland towns in 1988.**[1]

3. **Three distinct kinds of tourists have an economic impact in the Lake Champlain Basin: international, U.S., and internal tourists.**

a. **The tourism-related expenditures of internal tourists (i.e., persons living within the Lake Champlain-Adirondack region) in the Basin are estimated at $968 million in 1990, accounting for 44% of total tourist expenditures.**

Although previous studies ignored their economic impact, this research estimates that internal tourist expenditures constitute 44% of total tourist expenditures within the Basin. The distribution of internal tourists varies considerably throughout the Basin. Some towns have predominantly internal tourist expenditures, while others experience more international or out of state tourist expenditures. Unraveling the different tourist components is important for effective tourism planning in the Basin.

b. **During 1992 fiscal year (i.e., October 1991 through September 1992) a total of 7.9 million non-U.S. residents entered the United States through the 14 points that serve as ports of entry to the Lake Champlain Basin.**

An average of 6,496,752 non-U.S. citizens per year, or 541,396 per month, have been crossing into the Lake Champlain Basin during the past five years. The number of non-citizens crossing the border monthly is almost equal to the entire population of the Lake Champlain Basin.

As shown in Figure 1-3, while there is a background level of approximately 350,000 crossings a month into the Basin in the period November - February, that number jumps by a factor of almost three in July, to approximately one million people. Close to one-third (29%) of annual border crossings occur in July and August. While it is true that not all those people are tourists, and, that not all of them make a stop within the Lake Champlain Basin, a significant number of them do favorably influence the Basin economy. One attraction contacted for this study, Ausable Chasm in the shoreland town of Ausable, New York, reported that Quebec is their main market, providing approximately 39% of the over 100,000 annual visitors (Russell Blaise, Ausable Chasm, personal communication 11/2/92).

Over the past five years, boat border crossings into Lake Champlain at Rouses Point have annually averaged 26,343 people traveling in 7,318 boats.

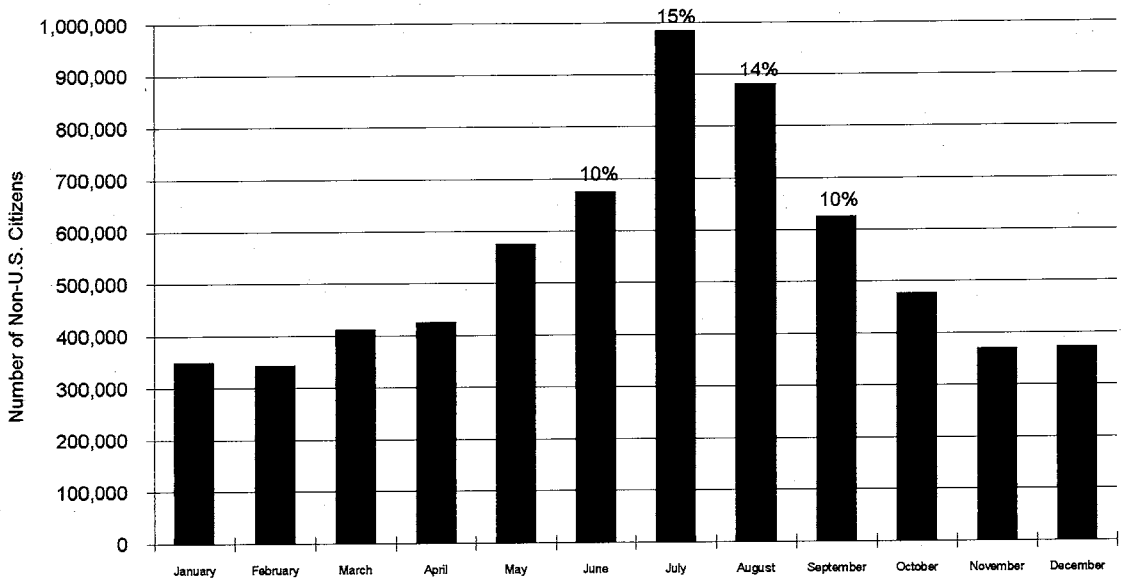
Relationship of Findings To The Draft Plan

Draft Plan Economic Chapter

The two and one half pages of the Economic Chapter mention the word recreation once, but never tourism. The "Action Items" in this chapter include five items and specify a total of $195,000 in particular projects from 1991-94. The Plan objective of restoring and maintaining "recreational and economic activities in and on the lake" appears under funded

[1] However, forthcoming research by Dr. A. H. Gilbert at the University of Vermont for the Salmonid Restoration Program estimates 1991 fishing-related expenditures for Lake Champlain alone in excess of $80 million (nondurable) and $120 million (durable).

Figure 1-3
Average Monthly Border Crossings by Non-U.S. Citizens at the 14 Ports within the Lake Champlain Basin (FY1987 - FY1992)



Note: The percentages indicate the proportion of annual crossings occurring during the month.

Source: U.S. Department of Justice, Immigration and Naturalization Service, 1993.

in comparison with other Plan objectives. Assuming annual funding of $2.3 million (1992) over three years, the economic action items specified herein constitute less than 3% of the total conference budget.

Draft Plan Recreation Chapter

The three page Recreation Chapter considers recreation on Lake Champlain from a public sector viewpoint. However, the Action Items do not concentrate on the tourism industry or the economic issues of tourism planning. The $210,000 in Action Items specified amount to 3% of the total conference budget. National Park Service funding is not specified. Given that the tourism related expenditures in the Basin are estimated at $2.2 billion, with $880 million in Shoreland towns, more research and demonstration projects that focus on sustainable tourism development appear to be warranted.

Policy And Research Recommendations

1. **The LCMC should encourage a Lake Champlain perspective in tourism information, research, planning or development.**

The states of New York and Vermont have primarily focused their tourism efforts on the images and development of the upland areas of the Basin, including mountains, cows,

and the rural landscape. Much less systematic attention has been given to promoting Lake Champlain tourism. Without a Lake Champlain outlook, it will be difficult to develop sustainable tourism.

Potential Action Items include:

a. **Develop interpretive nature trails for Lake Champlain.**

b. **Develop a Lake Champlain bicycle trail system.**

c. **Develop a joint New York-Vermont Lake Champlain fishing license agreement.**

d. **Compile reports and statistics about tourism and serve as an information clearinghouse for tourism planning in the Lake Champlain Basin.**

e. **Develop an historic Lake Champlain highway designation.**

2. **The LCMC should take the initiative in advocating sustainable tourism development.**

Recent studies of the economic impacts of tourism in the Basin tend to emphasize only the positive impacts of tourism, without realistically addressing problems, limitations, or negative impacts. In the Lake Champlain Basin literature the study team reviewed for this project, analysts primarily commented on the enormous economic multipliers and tremendous overall economic impacts. What these studies and overall estimates, including those within this report, usually fail to consider are the costs of related public impacts. Thus, the study team recommends Lake Champlain Basin research into evaluating local government's use of growth management techniques and fiscal impact analysis in the evaluation of economic development proposals. This may include the development of public balance sheets and/or improved methods for local capital improvement planning. Whatever the precise direction of this research, it should address the advantages and disadvantages of tourism, consider a full range of social and environmental impacts, analyze the question of who benefits and who pays for a given development, and consider carrying capacities and other measures of tourism potential in developing guidelines for sustainable tourism development. An example of sustainable tourism guidelines is offered by the Tourism Industry Association of Canada, as listed in Table 1-2.

Potential Action Items include:

a. **Establish and fund a Lake Champlain Tourism group to coordinate sustainable tourism research and demonstration projects regarding sustainable Lake Champlain tourism.**

b. **Fund demonstration projects that promote sustainable tourism.**

c. **Support the tourist industry in the development of a code of ethics for sustainable tourism.**

Table 1-2
Sustainable Tourism Ethics

Code of Ethics for Tourists

1. Enjoy our diverse natural and cultural heritage and help us to protect and preserve it.

2. Assist us in our conservation efforts through the efficient use of resources including energy and water.

3. Experience the friendliness of our people and the welcoming spirit of our communities. Help us to preserve these attributes by respecting our traditions, customs, and local regulations.

4. Avoid activities which threaten wildlife or plant populations, or which may be potentially damaging to our natural environment.

5. Select tourism products and services which demonstrate social, cultural, and environmental sensitivity.

Code of Ethics for the Industry

1. Commit to excellence in the quality of tourism and hospitality experiences provided to our clients through a motivated and caring staff.

2. Encourage an appreciation of, and respect for, our natural, cultural and aesthetic heritage among our clients, staff, and stakeholders, and within our communities.

3. Respect the values and aspirations of our host communities and strive to provide services and facilities in a manner which contributes to community identity, pride, aesthetics and the quality of life of residents.

4. Strive to achieve tourism development in a manner which harmonizes economic objectives with the protection and enhancement of our natural, cultural and aesthetic heritage.

5. Be efficient in the use of all natural resources, manage waste in an environmentally responsible manner, and strive to eliminate or minimize pollution in all its forms.

6. Cooperate with our colleagues within the tourism industry and other industries, towards the goal of sustainable development and an improved quality of life for all Lake Champlain Basin residents.

7. Support tourists in their quest for a greater understanding and appreciation of nature and their neighbors in the global village. Work with and through national and international organizations in helping to build a better world through tourism.

Source: D'Amore, 1992.

SUMMARY OF VOLUMES III & IV

Objectives and Contents of Volumes III and IV

Volume III of this project summarizes and interprets a review of the literature on innovative approaches to environmental regulation. The focus of the analysis was on the applicability of market mechanisms and economic incentives for protection of environmental quality in the Lake Champlain basin. Section 1 of Volume III summarizes the objectives of environmental regulation and the theoretical strengths and weaknesses of alternative regulatory mechanisms. Section 2 presents ten case studies of the use of discharge fees and transferable discharge permits for environmental protection and pollution control. Section 3 integrates theoretical and empirical insights from the literature review with lessons drawn from the case studies. Section 4 discusses potential uses of economic instruments for environmental protection in the Lake Champlain Basin, recommends a process for further policy analysis, and outlines critical areas for further research. Appendix A contains complete references and brief abstracts of seventy of the most relevant publications obtained in the literature review. Appendix B contains more detailed documentation for several of the case studies.

Volume IV of this project outlines the analytical techniques, data requirements, and decision criteria involved in developing and evaluating alternative water pollution control programs and water quality standards. Volume IV is intended to provide a comprehensive analytical framework that can be utilized to guide the LCMC's research activities and policy formulation process. Sections 1 and 2 of Volume IV summarize the basic elements of the framework and provide an introduction to costs benefit analysis and decisionmaking under uncertainty. Section 3 through 5 discuss data requirements and techniques for estimating the benefits and costs of water quality improvements, the evaluation of alternative pollution control strategies and the establishment of water quality standards.

A Framework for Environmental Policy Analysis

To obtain the information necessary for sound policy analysis, the research program of the Lake Champlain Management Conference (LCMC) should be guided by a comprehensive analytical framework for developing a water pollution control program and evaluating water quality standards. This report proposes the use of an analytical framework based largely on benefit-cost (B/C) analysis, but with added emphasis on evaluating risk and uncertainty, the distribution of benefits and costs, and the institutional and administrative issues involved in successful implementation of pollution control programs. The basic elements of the proposed framework are outlined below.

1. Determination of the sources of pollution in the Basin and the effect of changes in pollution discharges on key water quality parameters.
2. Estimation of technically feasible costs for increasingly stringent levels of pollution control.
3. Valuation of user and nonuser benefits associated with water quality improvements.

4. Evaluation of changes in regional income and employment under alternative pollution control strategies and water quality standards.
5. Identification of sources of risk and uncertainty and, whenever possible, quantification of potential variability in cost and benefit estimates.
6. Development of a preferred pollution control strategy based upon criteria of cost-effectiveness; distribution of costs and benefits; relationship to existing institutional and legal framework; administrative, monitoring and enforcement requirements; incentives for innovation; flexibility in response to change; and clarity and intelligibility to the public.
7. Comparison of the expected benefits and costs of achieving alternative water quality standards, given the preferred pollution control strategy.
8. Presentation of proposed water quality standards and pollution control strategy to the public and adjustment of the standards or control strategy based on public comment and debate.

Uses and Abuses of Benefit-Cost Analysis

Benefit-cost (B/C) analysis is a methodology for systematically comparing the consequences of alternative policy options. As described in Section 2 of Volume IV, a well designed B/C analysis can take account of risk and uncertainty, provide information on the distribution of benefits and costs across segments of society, and provide the basis for consistent comparison of policy options where the timing of benefits and costs differ. B/C analysis can be a useful tool in the policy development process, but it is not a substitute for personal judgments, public debate, and democratic decisionmaking. The assumptions, forecasts, and preferences reflected in the B/C analysis should provide a starting point for public discussion rather than a final decision. A thorough, well documented B/C analysis that quantifies the effects of a reasonable range of assumptions and risk factors on the outcomes of alternative polices can provide public officials and interested parties with important information for formulating and critically examining their own conclusions. .

Sources of Pollution and Costs of Pollution Control

In order to evaluate alternative policies and programs, the LCMC should ensure that ongoing and subsequent studies will provide the following information.

- Total mass, chemical characteristics, and annual pattern of discharges of priority pollutants (e.g. phosphorus, pathogens, heavy metals, pesticides) from all point and nonpoint sources.
- Minimum costs of controlling these priority pollutants from all major sources at increasingly stringent levels of pollution control. For example, the costs of reducing phosphorus export from cropland should be determined at reduction levels of say 25%, 50%, 75%, and 90%. The costs of a similar range of pollution reduction levels should be determined for dairy and other

livestock operations, urban/suburban runoff, construction sites, municipal treatment plants, and industrial facilities.

- Degree of variability in the effectiveness of pollution control measures for all sources of pollution.

Estimating the Benefits of Pollution Control

1. The first step in estimating the benefits of pollution control is to understand how reductions in discharges of a given pollutant, such as phosphorus, will affect water quality parameters.
2. The next step is to determine how changes in water quality parameters affect human health, ecological processes, recreational enjoyment, and aesthetic appreciation.
3. Finally, it is important to translate these public health, recreational, aesthetic, and ecological effects into estimates of monetary value.

The LCMC has made an impressive start toward developing the information it requires for analysis of the benefits of pollution control. Nevertheless, it is important to ensure that critical linkages and data requirements are not being overlooked. **Given the diverse resources, recreational opportunities, economic activities, and aesthetic pleasures associated with Lake Champlain, it would be beneficial to employ several techniques to develop a composite estimate of the value of improving or maintaining water quality in the lake.** These techniques include dose-response response models, travel-cost studies, comparative analyses of property values, and contingent valuation surveys. Sections 3.2 of Volume IV categorizes the potential benefits of water quality improvements, describes the benefit estimation techniques listed above, and summarizes the data requirements of each benefit estimation methodology.

Regional Economic Effects

The Lake Champlain pollution control and restoration program is an investment in the region's economy and quality of life. This investment will result in various direct benefits and costs as well as numerous secondary or multiplier effects.

On the benefit side, improved water quality can be expected to attract new vacationers to the Lake Champlain Basin. Every dollar of increased recreational expenditures will result in added income and employment not only at hotels, restaurants, and campsites, but also in other economic sectors that provide goods or services to the recreation industry. Similar multiplier effects can be expected if new businesses are attracted to the region. In addition, new pollution control requirements will also increase output and employment as a result of increased capital, operating and maintenance expenditures.[1]

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[1] Pollution control expenditures funded from local revenues would primarily shift local resources from one use to another with little effect on regional income or employment. However, if a portion of the pollution control program is funded from federal, state and provincial revenues,

Balanced against the beneficial effects of a pollution control program are the detrimental impacts of higher pollution control costs on industries, farmers, municipalities, and developers. Higher sewer rates and pollution control requirements can be expected to increase prices and reduce income and employment in some economic sectors. Although these detrimental impacts will be at least partially offset by the economic stimulus of increased pollution control expenditures, the net effects may be unevenly distributed across sectors of the regional economy.

The Bureau of Economic Analysis of the U.S. Commerce Department has developed an updated regional input-output model (RIMS II) that can be used to estimate multiplier effects for any state, or any region composed of one or more counties. This kind of regional economic model together with data on anticipated increases in recreational and pollution control expenditures could be utilized to estimate the secondary effects of the pollution control program on the regional economy of the Lake Champlain basin. It is important to note however, that changes in gross output and employment that could result from the Lake Champlain pollution control program cannot simply be added to or subtracted from the direct benefits and costs of the proposed program. The full cost of producing each additional unit of output must be subtracted from the market price of that output in order to derive an estimate of the net benefits of additional production or of the net costs of reduced output in negatively affected economic sectors.

Comparing Alternative Pollution Control Strategies

In addition to estimating the potential benefits and technically feasible costs of pollution control, it is important that the LCMC begin to evaluate alternative regulatory strategies. **An effective pollution control program is likely to involve a combination of legal mandates, economic incentives, public information, and direct public expenditures for pollution control or remediation. Criteria for comparing alternative pollution control strategies should include:**

- Cost-effectiveness
- Financing mechanisms
- Distribution of cost and benefits
- Relationship to existing institutional and legal framework
- Administrative, monitoring, and enforcement requirements
- Incentives for innovation, and flexibility in response to change
- Clarity and intelligibility to the public.

All regulatory programs involve some tradeoffs between ease of administration, cost-effectiveness and equity in the distribution of costs. Simple regulatory approaches, such as technology standards or uniform reductions in pollution discharges, are easy to understand and administer, but they can often be much more costly than other pollution control strategies. A well designed system of transferable discharge permits can result in both a highly cost-effective pollution control program, an equitable distribution of pollution control costs, and increased

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an increase in income and employment in the Lake Champlain Basin could be expected.

flexibility and incentives for innovation. However, an efficient system of transferable discharge permits for a large, ecologically complex watershed such as the Lake Champlain Basin could be more difficult to administer than pollution control programs based upon more traditional regulatory requirements. Volume III of this project includes a detailed discussion of the strengths and weaknesses of various regulatory approaches including economic incentives and market mechanisms.

Whatever balance between cost-effectiveness, fair distribution of costs, simplicity, and flexibility is ultimately selected, it is important that the essential characteristics of the preferred pollution control strategy are reasonably well defined prior to comparing the costs and benefits of alternative levels of pollution control.

Establishing Water Quality Standards

The benefits of improving the water quality of Lake Champlain include increased economic vitality for the region, reduced public health risks, enhanced recreational and aesthetic opportunities, and the satisfaction that comes from protecting a unique ecosystem and historic region. However, these benefits come at a price. Water quality improvements can only be achieved by increasing the costs of water pollution control for businesses, farmers, local governments and property owners. **A set of water quality standards should be established for Lake Champlain that maximizes expected net benefits, assuming implementation of the preferred pollution control strategy.**

As illustrated in Figure S1, net benefits are maximized when the expected cost of incrementally increasing water quality standards (i.e. increasing pollution control) begins to exceed the expected benefits of the resulting water quality improvements. Figure S1 also illustrates that a more cost-effective pollution control strategy will increase the net benefits of water quality improvements, and result in lower pollution control costs and/or a higher level of pollution control.

Economic Objectives of Environmental Regulation

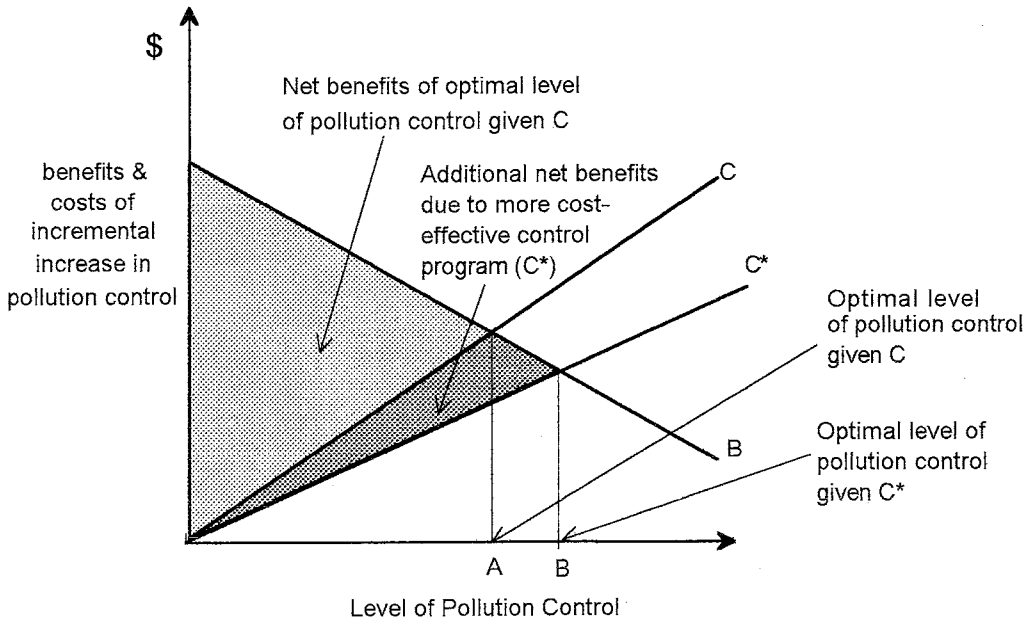
From the perspective of economic theory the two primary objectives of environmental policy are efficiency and equity. A secondary, or more accurately second best, objective of environmental regulation is cost-effectiveness.

- An efficient environmental policy maximizes the aggregate level of net benefits in comparison with all other available policy options.
- An equitable policy fairly distributes the costs and benefits of environmental protection among affected individuals and organizations.
- A cost-effective policy achieves a given environmental objective at least cost.

Environmental quality objectives are normally expressed in the form of maximum pollutant concentrations known as ambient standards. Ideally, any given set of standards would seek to maximize net benefits to society through an analysis of the costs and benefits of achieving

alternative environmental quality objectives. Even if a formal benefit-cost analysis is not performed, the pollution control program should still seek to be cost-effective (i.e. minimizing the total costs of achieving whatever standards have been established), while ensuring an equitable distribution of the costs and benefits of the program.

Figure S1 The Optimal Level of Pollution Control



Notes to Figure S1

The optimal level of pollution control occurs where the benefits of an additional unit of pollution control are just offset by the resulting increase in pollution control costs. The shaded area above the incremental cost curve (C) and below the incremental benefit curve (B) represents the net benefits of pollution reduction up to the level of pollution control designated by point A.

The more cost-effective pollution control strategy, depicted in the figure by cost curve C*, can achieve any given level of pollution control at lower cost. As a result, the optimum level of pollution control is higher, as are the net benefits resulting from this more cost effective pollution control program.

Command and Control Regulation

In the past, pollution control strategies intended to achieve some ambient standard of environmental quality have relied primarily on mandatory regulatory requirements combined with legal action for non-compliance. This approach has often been referred to as command and control regulation. Although it is theoretically possible to design an efficient or cost-effective command and control regulatory program, public officials normally do not have sufficient information on the benefits or costs of pollution control to achieve an efficient or even cost-effective outcome. In addition, command and control regulation necessarily requires a tradeoff between cost-effectiveness and an equitable distribution of costs. Finally, even if regulators had sufficient information to design a regulatory program that resulted in an acceptable combination of cost-effectiveness, a lengthy and expensive process of political and regulatory review would be necessary in order to modify the regulatory program in response to changing economic or technological conditions. **In summary, command and control regulatory approaches will result in some combination of higher costs, an inequitable distribution of costs, little incentive for innovation, and inflexibility in response to changing circumstances.** More detailed discussion of the strengths and weakness of command and control regulatory approaches is contained in Section 1.2 of Volume III.

Economic Instruments for Environmental Protection

In recent years, regulators have increasingly sought to develop more efficient and equitable environmental protection programs by incorporating a more flexible set of economic incentives and market mechanisms. The many forms of economic instruments that can be devised to promote environmental protection can generally be divided into two categories. The first category is defined by the use of monetary incentives or disincentives intended to promote environmentally beneficial behavior or reduce environmentally harmful activities. Discharge fees, pollution taxes, subsidization of "green" technologies and deposit-refund systems all depend on the use of direct monetary incentives and disincentives. The second type of economic instruments rely on the creation of markets for common property natural resources such as air, water or biological diversity. This category of economic instruments would include transferable or marketable discharge permits, transferable development rights, and the creation of transferable boating, fishing, harvesting, or other resource use rights.

Discharge Fees

The basic rationale for using discharge fees as an environmental policy instrument is to provide polluters with a price signal that indicates the cost to society of each unit of pollution. If a discharger's marginal pollution control costs are less than the discharge fee, cost savings could be realized by reducing pollution discharges. In an ideal system, the revenues raised from the discharge fees would be utilized to reimburse parties who sustained damages from any remaining discharges of pollution.

The technical and political difficulties of designing and implementing an optimal system of discharge fees have caused most governments to employ them primarily as a means of recovering the costs of pollution control programs which rely on more traditional regulatory mechanisms such as technology standards or discharge limits. The case studies presented in Section 2 of Volume III illustrate this point. Nevertheless, analyses the German, French, and Dutch systems of wastewater discharge fees and even the U.S. experience with sewer surcharges indicate that even relatively modest discharge fees provide important incentives for pollution control beyond the requirements imposed by regulatory standards

The essential characteristics of a politically and administratively feasible effluent discharge system are summarized quite well by Brown and Johnson (1984) and include the following.

1. **Fees cover a small number of pollutants.**
2. **Fees are used in conjunction with discharge permits or other regulatory standards.**
3. **Charges begin at a low level and escalate over a pre-defined transition period.**
4. **Charges are set with the involvement of all interested parties.**
5. **Measurement and pricing systems are straightforward.**
6. **Revenues are made available to subsidize investments in abatement technologies.**
7. **A hardship clause provides for temporary exemptions under exceptional circumstances.**
8. **The implementation process is clearly defined.**

There are numerous other forms of financial incentives for environmental protection that share many characteristics with discharge fee systems including deposit-refund mechanisms, cross compliance requirements for agricultural programs, subsidization of best management practices, and use of performance bonds to promote environmentally sound construction or resource extraction techniques. In addition, fees intended to protect water resources have been applied not only to wastewater discharges but also to pesticides and fertilizers (including manure) in several European countries and a few states in the U.S (Opschoor and Vos 1989, 45; Stavins 1988, 54-5). A more extensive discussion of other applications of direct financial incentives for environmental protection, with emphasis on controlling nonpoint source pollution from agriculture construction and forestry activities is contained in Section 3.1 of Volume III.

Transferable Discharge Permits

Various terms are used in the literature when referring to pollution control systems that allow trading of permitted levels of pollution from one source to another. These terms include transferable discharge permits, marketable discharge rights, pollution trading, transferable discharge allocations, and pollution reduction credits. This report will generally utilize the term

transferable discharge permits (TDP's) when referring to pollution control systems that allow trading of permitted levels of pollution.

While Western European countries have emphasized the use of discharge fees and pollution taxes, the U.S. has provided more fertile ground for exploring the potential applications of transferable discharge permits. The U.S. preference for TDP systems can be explained in part by their similarity to many existing air and water pollution control programs that are based largely on the issuance of nontransferable emissions or effluent permits. Some of the earliest applications of the basic concept of transferable discharge permits were for air pollution control. The evolution of TDP programs under the Clean Air Act is summarized in Section 3 of Volume III. Several case studies of nutrient discharge trading programs for water pollution control are also presented in Section 3.

The basic steps involved in establishing a TDP system are to:

1. **adopt a set of environmental quality standards, hopefully after considering the costs and benefits of achieving them.**
2. **calculate the total pollution discharges that can be permitted without violating the standards.**
3. **allocate this permitted level of pollution to the various sources of pollution in the control area.**
4. **establish a set of guidelines and administrative procedures to promote cost-saving transfers of discharge permits from one source to another.**

An Illustrative Example

A simple example that illustrates the benefits of a TDP system can be constructed for a hypothetical watershed with several point and nonpoint sources of phosphorus discharge. In this fictitious watershed there are two types of publicly owned treatment plants (POTW's), one industrial facility, and two distinct types of agricultural land uses, as well as nonpoint source discharges from urban and suburban areas. The quantities of phosphorus discharged from each of these sources, and the per unit costs of increasing levels of pollution control, are summarized in Table S1.

Let's assume that after several years of study, public officials have determined that phosphorus discharges must be reduced by fifty percent in order to protect the recreation based economy of this imaginary watershed. One seemingly equitable means of achieving this objective would be to simply require all sources of phosphorus pollution to reduce their discharges by fifty percent. Given the baseline discharges and pollution control costs assumed in this example, a uniform fifty percent reduction in phosphorus discharges would require a total expenditure of $9.7 million, as shown in Table 5. However, a quick review of Table S2 indicates that a uniform control requirement of fifty percent would result in a highly uneven distribution of pollution control costs. The high total cost and uneven distribution of costs could be expected to lead to the investigation of other options.

In this example, since accurate information on marginal control costs of all dischargers is available, a least cost command and control strategy could easily be developed for pollution control in the watershed. Dischargers with the lower per unit control costs would be required to reduce their discharges by higher percentages than those with relatively high phosphorus control costs. As summarized in Table S2, this approach would reduce total phosphorus control expenditures required in this fictitious watershed by more than one third, to $5.2 million. Unfortunately, this alternative would still result in a very uneven distribution of costs.

Table S1 Phosphorus Discharges and Control Costs for a Hypothetical Watershed

Discharger	Baseline Discharge (lbs. of P/yr.)	Per Unit Cost ($/lb.) of Reducing Phosphorus From 0-10%	10-25%	25-50%	50-75%	75-90%
POTW 1	165,000	1	2	5	20	60
POTW 2	75,000	15	30	50	80	150
Agric. 1	250,000	2	4	8	15	50
Agric 2	105,000	5	12	25	50	110
Urban NPS	150,000	10	30	75	150	350
Suburban NPS	155,000	15	20	40	100	200
Industry	100,000	5	8	15	25	100
Total	1,000,000					

Table S2 Pollution Control Costs of Two Nontransferable Discharge Allocations for a Hypothetical Watershed

Discharger	Baseline Discharge (lbs. of P/yr.)	Uniform Reduction: Required Reduction	Uniform Reduction: Pollution Control Cost	Least Cost Alternative: Required Reduction	Least Cost Alternative: Pollution Control Cost
POTW 1	165,000	50%	272,250	75%	1,097,250
POTW 2	75,000	50%	1,387,500	10%	112,500
Agric. 1	250,000	50%	700,000	75%	1,637,500
Agric 2	105,000	50%	897,750	50%	897,750
Urban NPS	150,000	50%	3,637,500	10%	150,000
Suburban NPS	155,000	50%	2,247,500	25%	697,500
Industry	100,000	50%	545,000	75%	1,170,000
Total	1,000,000	50%	9,687,500	50%	5,762,500

In order to minimize the total cost of phosphorus control and ensure an equitable distribution of those costs, public officials in our hypothetical watershed should consider implementing a system of transferable discharge permits. Table S3 presents one initial allocation

of transferable discharge permits that would achieve the desired reduction in phosphorus discharges at least cost, and result in a relatively fair cost distribution.

Table S3 An Initial Allocation of Transferable Discharge Permits and the Resulting Distribution of Pollution Control Costs for a Hypothetical Watershed

Facility	Baseline Discharge (lbs. of P/yr.)	Initial Allocation	Direct Pollution Control Costs	Costs (Revenues) from Purchase (Sale) of TDP's[1]	Total Net Pollution Control Costs
POTW 1	165,000	48,500	1,097,250	(199,375)	897,875
POTW 2	75,000	52,000	112,500	426,250	538,750
Agric. 1	250,000	87,000	1,637,500	(673,750)	963,750
Agric. 2	105,000	60,000	897,750	(206,250)	691,500
Urban NPS	150,000	105,000	150,000	825,000	975,000
Suburban NPS	155,000	107,500	697,500	240,625	938,125
Industry	100,000	40,000	1,170,000	(412,500)	757,500
Total	1,000,000	500,000	5,762,500	0	5,762,500

[1] Transferable discharge permits are assumed to be bought and sold at a price of $27.5/lb. which is the average per unit cost of buyers and sellers at the required level of pollution as defined in Table S1.

Necessary Conditions for Success of Transferable Discharge Permit Systems

A list of critical conditions for the development of a successful program involving the transfer of permitted pollution discharges from one source to another is outlined below. Many of these conditions are not unique to TDP systems but rather are common to any effective environmental regulatory program.

1. **Ability to determine the maximum level of pollutant discharge in the control region that is consistent with the achievement of environmental quality objectives.**
2. **Publicly supported methodology for allocating the total allowable discharge to individual sources of pollution.**
3. **Clear definition of the pollution discharge and transfer rights conferred by the initial allocation.**
4. **Clear guidelines governing permissible trades of permitted discharge allocations.**
5. **Existence of differences in the per unit pollution control costs of affected dischargers at the start of the program.**
6. **Well defined, efficient procedures for review of proposed transactions.**

7. **Ability for the regulatory agency to maintain record of all transfers of permitted discharge allocations.**

8. **Ability for the regulatory agency to satisfactorily monitor pollution discharges from all sources or establish baseline emissions and reliably determine effectiveness of pollution control measures.**

9. **General support for the program from the regulatory and regulated communities as well as environmental groups and other key constituencies.**

Other Applications of Transferable Permits

There are many other types of environmental protection programs that employ some variation of transferable rights or permits. Transferable development rights are widely used to protect farmlands and historic districts as well wildlife habitats, aquifer recharge areas, wetlands, and other ecologically valuable lands. Other examples of transferable property rights that may have applications to Lake Champlain are for the management of recreational boating and shoreline development. These potential applications of transferable property rights are discussed in Section 3.2.1 of Volume III.

Potential Applications of Economic Instruments for Environmental Protection in the Lake Champlain Basin

The basic requirements for the effective use of economic incentives and market mechanisms exist in the Champlain Basin. In particular, the Basin contains over seventy point sources of water pollution as well as thousands of nonpoint sources that presently face dramatically different costs for increasing their pollution control.[2] In addition, the Lake Champlain Special Designation Act has imposed an integrated, basin-wide perspective on federal, state and local environmental panning in the region. These factors alone indicate that there is the potential to realize significant cost savings and a more equitable distribution of costs by incorporating economic instruments into the pollution control program being developed for the Basin.[3]

The success of any regulatory program is closely linked to the manner in which that program is developed and implemented. As indicated by the case studies in Section 2 of Volume III, this is particularly true for programs that incorporate the use of discharge fees and transferable

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2 The Vermont Agency of Natural Resources 1990 Phosphorus Reduction Plan indicates that the per unit costs of increasing phosphorus removal from municipal treatment plants in the region vary from $3 to $655 per pound. National studies of nonpoint source controls indicate the costs of best management practices for nutrient control can vary from no net cost for conservation tillage to several hundred dollars per pound for urban best management practices and septic tank renovations (Sessions and Fillmore 1989). However, corn production in Vermont is usually for silage and a change to conservation tillage for most Vermont corn farmers typically will involve net costs.

3 A recent EPA report listed Lake Champlain watersheds as having the necessary conditions for application of point/nonpoint source nutrient trading programs (Apogee Research 1992).

permits. Given, the potential benefits from the use of economic instruments for pollution control and the importance of participatory planning in developing such programs;

It is recommended that the Lake Champlain Management Conference convene a special working group consisting of representatives from major industries, local trade associations, municipalities, water supply and wastewater treatment districts, recreational users groups, state and federal regulatory officials, and environmental organizations in order to further investigate and propose potential uses of economic instruments as part of the pollution control program being developed for the basin.

The activities of this working group would need to be coordinated with those of the Plan Formulation Team, the Technical Advisory Committee ,and the Citizens Advisory Committees, but whatever the organizational arrangements it is critically important that all affected and interested constituencies are represented.

Initial Allocation of Discharge Permits

The first step in developing a program of transferable discharge permits, is to determine the total level of pollution discharge that is consistent with environmental quality objectives and to allocate this acceptable discharge level to the various sources of pollution in the region. Preferably the total permissible level of discharge will take account of both the expected benefits and costs of pollution control. In addition the allocation process will need to consider not only the basin as a whole but also the assimilative capacity of the lake's five major ecological zones. If the discharge permits are not transferable, the initial allocation will affect both the total cost and cost distribution of the pollution control program. However, as illustrated in the above example, the initial allocation primarily affects the distribution of costs in a transferable discharge permit system. Mutually beneficial trades between dischargers will still approximate the least cost outcome under any reasonable initial allocation of permits.

To achieve an equitable distribution of costs in a TDP system public officials should consider a number of factors when determining the initial point source discharge allocations including;

- current levels of phosphorus discharge,
- incremental pollution control costs,
- prior pollution control investments
- the population served by municipal treatment plants,
- and the economic status of the industry or community.

Staggering the terms of the discharge permits and reserving a portion of the acceptable level of discharge for allocation in future years would provide the regulatory agency with some flexibility to accommodate economic growth and adjust to changing circumstances or new information.

As part of a pollution control program that incorporates transferable discharge permits or pollution reduction credits, the regulatory agency could address nonpoint sources of pollution in several different ways. For example the regulatory program could;

1. Explicitly allocate a portion of permitted phosphorus discharges to nonpoint sources and then permit transfers of these allocations with point sources and other nonpoint sources. (The allocation could be on a simple per acre basis, as in Maine's lake management program (See Section 2 of Vol. III.), or the allocation might be adjusted to account for current land uses, economic conditions, etc.)
2. Allow point sources and/or new development projects to earn phosphorus reduction credits by financing nonpoint source controls, but without requiring nonpoint sources to meet specific discharge allocations.

Trading Rules and Guidelines

In addition to allowing for more cost-effective control of existing sources of pollution, the use of transferable discharge permits or pollution reduction credits is an ideal way to accommodate continued growth without jeopardizing environmental quality. As municipalities apply for permits to expand their treatment plants or developers apply for building permits, they would be required to offset any additional phosphorus loads they create by financing equal or greater reductions at other point or nonpoint sources. **A phosphorus discharge trading system could include various combinations of the following trading arrangements.**

1. **Direct agreement between existing dischargers.**
2. **Contributions to a basin-wide phosphorus control fund by dischargers that exceed their permitted allocations .**
3. **Purchasing of phosphorus reductions that have been "banked" with the regulatory agency.**
4. **Periodic voluntary auctions of discharge permits that had previously been allocated. Under this arrangement, parties wishing to buy or sell discharge permits would submit sealed bids which would be reviewed and ultimately approved by the appropriate regulatory agency. All approved transactions would be consummated at one market clearing price.**
5. **Provision of phosphorus reduction credits for investments in certain natural methods of phosphorus attenuation and extraction such as the construction of artificial wetlands, restoration of filled wetlands, or harvesting of lake plants. Analysis of nutrient cycling in wetlands and nutrient uptake by shoreline plants would provide the necessary information to evaluate these alternatives.**

Many pollution control programs involving transferable discharge permits require new sources of pollution and dischargers seeking to exceed their permitted allocation to offset existing sources on a greater than one to one basis. A trading ratio of greater than one to one may be required due to uncertainty over the effectiveness of pollution control measures as well as to ensure continued improvement in environmental quality. For transactions involving the transfer of

pollution reduction credits from a nonpoint source to a point source, a ratio of two or three to one may be desirable in order to account for variability in the effectiveness of nonpoint source control measures.

In order to evaluate various ratios for transfer of phosphorus discharge allocations between point and nonpoint sources, the LCMC's should ensure that ongoing projects to estimate the total loading and control costs of the major sources of nonpoint source pollution should consider both the marginal costs and the variability in the effectiveness of various control measures. Additional analyses of the costs and effectiveness of point source controls as well as some carefully selected and managed demonstration projects may also be necessary to verify costs and effectiveness under various conditions.

Guidelines for a nutrient discharge trading program in the Lake Champlain watershed will also need to account for the different conditions existing within the lake's five major ecological zones. For example, the required ratio for trades between dischargers in the watershed of the Main Lake and dischargers in the watershed of the Inland Sea would need to take account of the rates of nutrient transfer between the two bodies of water. In addition, the trading or offset ratios between pollution sources that are located close to the lake or tributary streams and those located far up the watershed might take account of the effects of nutrient attenuation and deposition. The Management Conference's ongoing and planned projects for hydraulic modeling and nutrient transport should provide critical information for the evaluation of these conditions.

One reasonable solution to the tradeoff between accurately accounting for all circumstances and the additional costs of administering an excessively complex TDP system is to allow dischargers seeking pollution reduction credits to make payments into a basin-wide pollution control fund. The payments might vary depending on the location of the discharger purchasing the pollution reduction credits, or, the payment rate may simply be established based upon a standard set of ecological conditions and the average per unit cost of additional phosphorus reductions for the basin as a whole. Whatever rates are established, it then becomes the responsibility of the regulatory agencies to use these funds most effectively and to adjust the contribution rates when necessary.

Administration, Monitoring and Enforcement

Active trading of discharge allocations is not likely to occur and contributions to any basin-wide pollution control fund are likely to be inadequate, unless there is prompt review of proposed trades, as well as efficient monitoring and enforcement efforts. Most pollution control programs that focus on a particular watershed or airshed have established a regional body to ensure coordinated planning, administration, local participation, and, in some cases, to assist with monitoring and enforcement. It is impossible to determine in advance whether the residents of the Lake Champlain Basin would perceive the creation of a regional environmental planning and administrative agency as an opportunity to increase local control over pollution control programs or simply as another layer of bureaucracy. If the impetus for such an agency came from local officials, and community leaders, and the membership of its managing board were designed to be fully representative of the diverse interests within the basin, it might receive widespread support and be capable of coordinating local, state, and provincial regulatory programs.

Discharge Fees

Although discharge fees can be an efficient mechanism for reducing water pollution, the added financial burden they place on dischargers makes it politically difficult to use them as the sole method of pollution control. In the Lake Champlain Basin a system of discharge fees covering phosphorus, and perhaps other pollutants such as biological oxygen demand or certain toxics, could be implemented in conjunction with a system of transferable discharge permits and other more traditional regulatory mechanisms. Even at relatively low levels, the fees would still provide incentives for dischargers to maintain efficient operations or utilize best management practices. If the revenues could be utilized only for administration of pollution control efforts within the Basin and to provide subsidies to dischargers for the implementation of pollution control measures, they might be viewed more favorably by affected parties. Final recommendations on whether and how to utilize discharge fees as part of the pollution control program for the Basin, should be developed by the working group proposed above.

Other Applications of Economic Instruments

Each of the other applications of economic instruments listed below has its own set of potential benefits, administrative requirements, and design considerations that should receive further investigation as part of the development of a comprehensive environmental protection program for the Lake Champlain Basin.

1. Environmental cross compliance requirements for agricultural programs operative within the basin.
2. Targeted, graduated incentives for agricultural nonpoint source control programs based on the expected benefits of these controls for various combinations of environmental conditions (e.g. soil, slope, distance to stream) and types of farm operations.
3. Performance bonds for use of best management practices during construction and forestry activities.
4. Transferable allocations of boat slips.
5. Transferable development rights for protection of wetlands, critical habitat, scenic areas and farmland or open space.

Recommendations for Further Research and Policy Analysis

The difficult task facing the LCMC and associated federal, state, and provincial regulatory agencies, is to devise a water pollution control program that will enhance the attractiveness of the region as a place to live, vacation and conduct business. If the LCMC can devise a highly cost-effective pollution control program with an equitable distribution of costs and benefits a higher level of water quality will be achieved without jeopardizing the competitiveness of key economic sectors. The inclusion of an appropriate set of financial incentives and market mechanisms as part of the Lake Champlain pollution control and environmental restoration strategy has the potential to reduce the costs, improve the equity, and increase the flexibility of the program. **The additional research and policy analyses recommended below are intended to provide the LCMC with the information necessary to develop an efficient, equitable, and administratively feasible pollution control program.**

1. **Ongoing and subsequent studies of sources of pollution and control costs should provide information on the mass, chemical characteristics, and annual pattern of discharges of priority pollutants (e.g. phosphorus, pathogens, heavy metals, pesticides) from all point and nonpoint sources.** It is essential that these studies attempt to quantify the minimum costs of controlling priority pollutants from all major sources at increasingly stringent levels of pollution control as well as the degree of variability in the cost and effectiveness of various pollution control measures.

2. **Potential public health benefits associated with water quality improvements in the Lake Champlain basin should be evaluated by the appropriate regulatory agencies from New York, Vermont and Quebec.** Any potential benefits should be categorized as to whether they could also be achieved through improved treatment of public water supplies, and the costs of the necessary improvements in water treatment should be quantified. Benefits of reducing pollutants that cannot be eliminated through water supply treatment should be evaluated using the dose-response methodology outlined in Section 3.2. of Volume IV.

3. **The LCMC should issue a request for proposals (RFP) for an estimation of the monetary value of enhanced recreational opportunities associated with improvements in key water quality parameters**. Respondents to the RFP should be required to propose a basic model, suggest data sources, and indicate the time and cost necessary to conduct the analysis. (See section 3.2.2 of Volume IV for a discussion of methodologies and data requirements.)

4. **The LCMC should issue an RFP for an analysis of the effect of a range of variations in water quality on lakefront and lake-access property values.** The analysis should be closely coordinated with the recreational benefits study to ensure that similar locations, income groups, and water quality parameters are included in both studies. (See section 3.2.3 of Volume IV for a discussion of methodologies and data requirements.)

5. **The LCMC should issue an RFP for one or more surveys of a representative sample of lake basin residents to estimate their willingness to pay for water quality improvements.** The willingness to pay survey(s) should be used primarily to estimate

benefits rather than as a means of allocating costs. The survey(s) should be closely coordinated with the other analyses recommended above to permit comparison of results and avoid double counting of benefits. The surveys should also focus on quantifying the existence value of improving Lake Champlain's water quality, to residents of New York, Vermont, and Quebec, particularly those residing outside of the basin. (See section 3.2.4 of Volume IV for a discussion of methodologies and data requirements.)

6. **The LCMC should convene a special working group consisting of representatives from major industries, local trade associations, municipalities, water supply and wastewater treatment districts, recreational users groups, state and federal regulatory officials, and environmental organizations in order to further investigate and propose potential uses of economic instruments and other innovative regulatory strategies as part of the pollution control program being developed for the basin.**

7. **The LCMC should issue an RFP for development of a mathematical programming model to estimate the potential cost savings attainable from the use of economic instruments as compared with various command and control regulatory approaches.** Data requirements include the volume, pollutant concentrations, pollutant removal efficiencies, and incremental costs of increasingly stringent pollution control measures for all major point and nonpoint sources of pollution.

8. **The LCMC should evaluate alternative institutional arrangements for planning, coordination, and administration of pollution control programs for the basin that include transferable discharge permits and other economic incentives**. This task should include an analysis of the legal, institutional, and administrative arrangements of other regional pollution control programs, particularly those involving interstate lakes, estuaries, or rivers.

9. **The LCMC should develop proposed trading guidelines and ratios for transfers of permitted discharge allocations between point and nonpoint sources and between ecological zones of the lake.** Data requirements include rates of hydrological mixing between zones of the lake, phosphorus attenuation in streams and soils, as well as the cost, effectiveness and reliability of point and nonpoint source control measures.

10. **The LCMC should evaluate alternative discharge fee systems for operation in conjunction with discharge permits.** Design considerations include the sources of pollution to be covered by proposed fees, volume and pollutant concentrations, population served and/or financial characteristics of the relevant sources of pollution, effective incentive mechanisms in lieu of high charge levels, billing and administrative needs, and specific guidelines for use of the fee revenues.

11. **The LCMC should conduct a review of existing pollution control efforts in the agricultural, construction and forestry sectors and design appropriate uses of economic incentives.** Policy instruments that should be considered include cross compliance requirements, targeted and graduated subsidies for implementation of best management practices, and performance bonds for construction and forestry activities.

12. **Once sufficient information is available on the direct benefits and costs of pollution control, the LCMC should issue an RFP to estimate the changes in regional income and employment associated with various water quality standards and pollution control strategies.**

The research and policy analysis tasks outlined in items eight through thirteen above should be conducted in consultation with the recommended working group on the use economic instruments. In all cases, a range of options should be presented to the group for discussion, further research and amendment. Eventually, the working group would present to the Technical Advisory Committee, the Plan Formulation Team and the Management Conference, a final set of recommendations regarding the incorporation of economic instruments into the Lake Champlain pollution control and restoration program. The proposed working group could also play a useful role by providing the LCMC with informed evaluation of the cost and benefit studies outlined in recommendations one through six above..

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APPENDIX: TABLE OF CONTENTS FOR VOLUMES II, III, AND IV

Volume II: Socio-Economic Profile, Database, and Description of the Tourism Economy For the Lake Champlain Basin

Volume III: Potential Applications of Economic Instruments for Environmental Protection in the Lake Champlain Basin

Volume IV: Conceptual Framework for Evaluation of Pollution Control Strategies and Water Quality Standards for Lake Champlain

DESCRIPTION OF THE STUDY TEAM

Holmes & Associates, a small research firm located in the Adirondack community of Saranac Lake, New York, specializes in accurately representing human social, economic, and cultural characteristics by use of scientific research methods.

Timothy P. Holmes: Mr. Holmes is a social scientist actively involved in socio-economic research in the private sector for over ten years. He has participated in 12 significant research projects in Alaska, Idaho, and the Adirondack-Lake Champlain region. Before establishing his firm in Saranac Lake in 1989, he was the field director on a three year study of the hunting and fishing activities of the Inupiat Eskimo in Barrow, Alaska. He has a MA in rural sociology from the University of Idaho and a BS in sociology from the University of Iowa.

Anthony Artuso: Mr. Artuso has extensive hands-on experience in the economics of resource management. In his various managerial positions, he has directed extensive water use and water pollution control programs. A Ph.D. student at Cornell, his specialty is the economic aspects of natural resource policy and management.

Dr. Bryan Higgins: Dr. Higgins is Chair of the Geography and Planning programs at SUNY-Plattsburgh. During the past ten years, Dr. Higgins has received a total of 11 planning and research grants, including detailed economic development studies in both New York and Vermont. In addition, he has served on a variety of public planning boards in the Lake Champlain basin, including the Clinton County Planning Board in New York and the Franklin-Grand Isle Regional Planning Board in Vermont. He has also chaired the Town of Grand Isle Planning Board in the Lake Champlain Islands. Dr. Higgins has recently returned from a research trip to Chile and Argentina, where he is developing a study of ecotourism in the Southern Cone of South America.

Dr. Richard S. Kujawa: Dr. Kujawa is assistant professor of geography at Saint Michael's College. He has extensive teaching and research experience related to economic development and environmental planning. While a resident of rural western Maine, he was involved in a number of planning/development projects.

Gordon DeVries: Mr. DeVries is currently the Information Services Manager in the Office of Analysis and Assessment, SUNY-Plattsburgh. He is the Census and State data resource person for Northern New York.