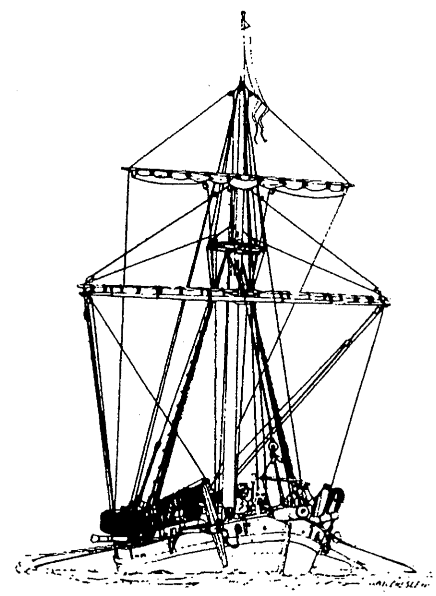
Technical Report No. 28

# Lake Champlain Underwater Cultural Resources Survey

## Volume 1: Lake Survey Background and 1996 Results



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for
Lake Champlain Basin Program

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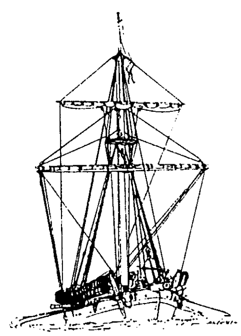


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***Cover Illustration***

Conjectural view of the American gondola *Philadelphia*, 1776 (Lundeberg 1995:20).

***Questions or Comments***

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

**Lake Champlain Basin Program Technical Reports**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

15. *Zebra Mussels and Their Impact on Historic Shipwrecks.* Lake Champlain Maritime Museum. January 1996.

16. *Background Technical Information for Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin.* Lake Champlain Basin Program. June 1996

17. (A) *Executive Summary. Economic Analysis of the Draft Final Plan for the Lake Champlain Management Conference.* Holmes & Associates and Anthony Artuso. July 1996

    (B) *Economic Analysis of the Draft Final Plan for the Lake Champlain Basin Management Conference.* Holmes & Associates and Anthony Artuso. July 1996

18. *Catalog of Digital Spatial Data for the Lake Champlain Basin* . Vermont Center for Geographic Information, Inc. September 1996.

19. *Hydrodynamic and Water Quality Modeling of Lake Champlain.* Applied Science Associates, Inc. July 1996.

20. *Understanding Phosphorus Cycling, Transport and Storage in Stream Ecosystems as a Basis for Phosphorus Management. Dr. James P.* Hoffmann, Dr. E. Alan Cassell, Dr. John C. Drake, Dr. Suzanne Levine, Mr. Donald W. Meals, Jr., Dr. Deane Wang. December 1996.

21. *Bioenergetics Modeling for Lake Trout and other Top Predators in Lake Champlain.* Dr. George W. LaBar and Dr. Donna L. Parrish. December 1996

22. *Characterization of On-Farm Phosphorus Budgets and Management in the Lake Champlain Basin.* Robert D. Allshouse, Everett D. Thomas, Charles J. Sniffen, Kristina Grimes, Carl Majewski - Miner Agricultural Research Institute. April 1997

23. (A) *Lake Champlain Sediment Toxics Assessment Program. An Assessment of Sediment - Associated Contaminants in Lake Champlain - Phase 11. Executive Summary.* Alan McIntosh, Mary Watzin and Erik Brown, UVM School of Natural Resources. October 1997

    *(B) Lake Champlain Sediment Toxics Assessment Program. An Assessment of Sediment - Associated Contaminants in Lake Champlain - Phase 11.* Alan McIntosh, Mary Watzin and Erik Brown, UVM School of Natural Resources. October 1997

24. *Development of Land Cover/Land Use Geographic Information System Data Layer for the Lake Champlain Basin and Vermont Northern Forest Lands Project Areas.* Dr. Thomas Millette. October 1997

25. *Urban Nonpoint Pollution Source Assessment of the Greater Burlington Area.* Urban Stormwater Characterization Project. James Pease, VT Dept. of Environmental Conservation. December 1997

26. *Long-Term Water Quality and Biological Monitoring project for Lake Champlain.* Cumulative Report for Project Years 1992- 1996.

27. *Cumberland Bay PCB Study.* Clifford W Callinan, NY State Dept. of Environmental Conservation; Lyn McIlroy, Ph.D., SUNY Plattsburgh; and Robert D. Fuller, PhD., SUNY Plattsburgh. October 1998.

28. *Lake Champlain Underwater Cultural Resources Survey. Volume 1: Lake Survey Background and 1996 Results.* Scott A. McLaughlin and Anne W. Lessman, under the direction of Arthur B. Cohn, Lake Champlain Maritime Museum. December 1998.

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

## DEDICATION

This report is dedicated first to the lake mariners who once made their livelihoods on Lake Champlain, transporting goods and passengers and providing lines of communication at a time when forms of transportation in the Champlain Valley were limited. The people who lived and worked along this vibrant waterway helped to spark economic growth along the lake's shores and provided a valuable link to outside markets and communities. Their way of life, which ended at the beginning of this century, has nearly been forgotten. It is our hope that this survey and the research it stimulates will help to preserve and interpret the important roles played by Lake Champlain mariners in the development of the Champlain Valley.

Today, few realize Lake Champlain's former significance as a strategic military and commercial highway. Public awareness, appreciation, and understanding of the Champlain Valley's history is largely due to a small number of dedicated professional and avocational archaeologists, geologists, and historians. These people have spent decades studying the cultural and geological history of Lake Champlain, instilling in many people a love and appreciation for the Champlain Valley's natural and cultural heritage. To these scholars we also dedicate this work.

# ACKNOWLEDGEMENTS


### *General Support*

A systematic survey of the entire body of Lake Champlain has long been a goal of the Lake Champlain Maritime Museum (LCMM), and the 1996 Lake Survey Project could not have succeeded without the support of LCMM's membership, staff, and volunteers. Their dedicated efforts to preserve and interpret Lake Champlain's cultural resources have given LCMM the authority and experience necessary to conduct this monumental task. This project also relies on the support and guidance of the Champlain Valley's knowledgeable advocates and researchers. Many individuals and organizations have contributed significantly toward the preparation, fieldwork, background research, analysis, and documentation of the 1996 Lake Survey.

### *Institutional Support*

Institutional support was provided by the New York-Vermont Citizens Advisory Committees on Lake Champlain, the office of Vermont Senator Patrick Leahy, the Lake Champlain Transportation Company, Middlebury College, the New York Bureau of Historic Sites, the Vermont Division for Historic Preservation, the University of Vermont, the Institute of Nautical Archaeology, and Triton Technology, Inc. Additional organizations that provided support for the Lake Survey were the Lake Champlain Management Conference and the Lake Champlain Steering Committee, the Technical Advisory Committee, and the Cultural Resources Working Group. Without the continued support and guidance of these institutions, a lake-wide survey would have been prevented by the imposing cost and effort necessary to complete the project.

### *Funding*

The 1996 Lake Survey could not have been completed without cooperative efforts and funds from a number of federal and state agencies and Vermont foundations. The federal and state funding for the 1996 field season was provided by the U.S. Environmental Protection Agency (EPA) through a contract with the New England Interstate Water Pollution Control Commission (NEIWPCC) (Contract #LC-DP95-4-VTRFP; 0080-026). The U.S. National Park Service (NPS), through a cooperative contract agreement with the Vermont Department of Forests, Parks, and Recreation (VDFPR) provided additional government funding (Grant #R-PLN/LCM-96-018). Technical and administrative oversight of all work performed under these contracts was provided by Ann Cousins of the Lake Champlain Basin Program (LCBP), in cooperation with the Lake Champlain Basin Program's Technical Advisory Committee (TAC). The Freeman Foundation and the Lintilhac Foundation provided substantial private funding for the 1996 Lake Survey. Public interpretation of the Lake Survey was provided by the NEIWPCC on behalf of the New York and Vermont Lake Champlain Citizens Advisory Committees under the New York-Vermont Citizens Advisory Committees 1997 Partnership Program (Grant #LC-E096-2-VT-M; 0082-004). LCMM thanks all of these organizations for their financial and technical support.

### *Field Crew and Analysis Team*

The project director and divemaster for the 1996 Lake Survey was Arthur B. Cohn; Fred Fayette, boat captain and engineer; A. Peter Barranco, Jr., navigator; Patricia L. Manley, geologist and sonar operator; Thomas O. Manley, geologist and sonar operator; and Dave Andrews, navigator and videographer. Other members of the field crew were Kathy Baumann, Pat Beck, Jonathan Eddy, Seth Haines, and Mark Manley. Patricia and Thomas Manley and Fred Fayette began post-processing a selected portion of the field data at Middlebury College. Nichole S. North analyzed the geological data from the Cumberland Bay area in partial fulfillment of a Bachelor of Arts degree at Middlebury College.

### *Video Production*

The production of the video *Lake Champlain Survey: 1996 Results* involved a number of individuals and organizations. Dave Andrews was the videographer, Fran Stoddard narrated, and Arthur Cohn wrote the script and directed the production. Future Images of Colchester, Vermont, produced the computer animation, and Steve Beatty of Advantage Video of Colchester, Vermont, performed the post-production editing. Benthos, Inc., of Falmouth, Massachusetts, provided the ROV footage; the New York State Archives and Special Collections at the University of Vermont provided photographs; and the New York State Sea Grant Program provided underwater footage from the Great Lakes.

### *Background Research*

The Lake Champlain Maritime Museum would like to thank A. Peter Barranco, Jr., for his support and assistance on the Lake Survey and for sharing the results of his extensive archival research of Lake Champlain's vessels with the survey team. The authors of this report also wish to thank James Carolina, Jr., of the Georgetown County Public Library in Georgetown, South Carolina, and John Pemberton of the Mariner's Museum in Newport News, Virginia, for locating photographs of *Henry Lloyd* at their respective institutions. The Bailey/Howe Library at the University of Vermont in Burlington, Vermont, provided most of the published sources and many images for this report. Craig Williams of the New York State Museum in Albany, New York, graciously permitted the authors to use the photographs of *U.S. La Vallee* from the Museum's Michon and O'Malley Collections. Special thanks are also due to Captain Merritt E. Carpenter, Captain Fred G. Godfrey, and Fred Valiquette, Sr., for sharing their recollections of *U.S. La Vallee*. Their contributions have added a personal dimension that greatly enhanced the story of the vessel.

### *Report Preparation*

Our most obvious debt in preparing this work is evident in the bibliography of this document, which demonstrates how many scholars have specialized in the study of the Champlain Valley. This report was written by Scott A. McLaughlin and organized by Scott A. McLaughlin and Anne W. Lessmann under the direction of Arthur B. Cohn, although individual researchers investigated select sections and wrote draft copies. Peter Barranco researched and wrote the preliminary *Historical Survey of U.S. La Vallee*. Patricia Manley and Thomas Manley contributed most of the *Geological Field*

*Results* section of the report and also assisted in locating the sources for the general environmental background of the Champlain Valley. Holly Noordsy assisted with the compilation and selection of illustrations, and Peter Barranco, Gordon Cawood, and Anne Lessmann assembled the maps of the surveyed areas. Anne Lessmann edited the report with assistance from Scott McLaughlin, Peter Barranco, Arthur Cohn, and Ann Cousins, and assembled the final report with the assistance of David Robinson.

# AUTHORS' NOTE

This report was planned as the first volume in a projected series of annual reports that will discuss the location, documentation, and management of Lake Champlain's underwater cultural resources. It was designed to set the background for the long-term lake survey, which is estimated to require between five and seven years for completion. It integrates previous underwater archaeological findings on Lake Champlain and makes initial recommendations for the long-term management of the cultural resources found during the 1996 survey. This report was developed after extensive research of a wide range of primary and secondary sources, including archaeological reports from previous investigations. The material includes natural, prehistoric, and historic background information that places Lake Champlain into a regional framework and links the lake's underwater resources to regional, cultural, and historical themes. One intended function of this report was to thoroughly describe the Champlain Valley's environmental and cultural history. The extensive background provided in this report will help the reader understand the diversity and significance of the region's history. This document is not a management plan for the lake's resources, but rather presents preliminary recommendations for the preparation of a comprehensive plan in the near future.

Information about historic and prehistoric resources gained through investigations using federal and state funds is a part of the public record and is usually made available to all who are interested. It is sometimes necessary, however, to withhold information about the specific location and character of certain sensitive archaeological resources from the public in order to protect these resources. The underwater cultural resources in Lake Champlain are often fragile and can easily be destroyed by theft, vandalism, and the anchor damage that often results from unauthorized public visitation. Federal and state agencies involved in funding the Lake Survey have requested that the location of the new cultural resources found during the 1996 Lake Survey be restricted until each resource has been adequately evaluated. To comply with this request, the location of each resource has been given in a general nature with no depths. We ask that divers please not try to locate these historically valuable resources while efforts to make them publicly accessible are underway.

The report is divided into three parts: Part I presents the report's data in a management summary. Part II outlines the goals of the Lake Champlain Cultural Resources Survey Project and the environmental and cultural contexts of the Champlain Valley. Part III is a technical report that presents the specific goals, methodology, logistics, and results of the 1996 field season. Following these three sections are several extensive appendices filled with supporting documentation.

This technical report and the archaeology performed during the survey meet the archaeological standards and guidelines of the National Park Service (1983), the State of Vermont (Peebles 1989), and the State of New York (New York Archaeological Council 1994). The style and format of the citations and bibliography are based on those of the Society for American Archaeology (1992).

## ABSTRACT

The recent introduction of zebra mussels and the inevitable approaching infestation of quagga mussels seriously threaten Lake Champlain's underwater cultural resources. These non-native aquatic nuisance species endanger the preservation of submerged cultural resources, obscure them, and hinder their documentation and survey. Mussel colonies also threaten to degrade underwater cultural resources physically as a result of their weight and corrosive action. As of this writing, an effective means to protect underwater historic resources from the impact of zebra and quagga mussels has not been found.

After studying this issue, the Lake Champlain Maritime Museum determined that one positive reaction to the situation would be to locate and document Lake Champlain's currently unknown underwater cultural resources. Once this task is completed, it will then be possible to develop a comprehensive management plan for them. A systematic lake-wide survey to locate the submerged resources penetrating above the lake bottom, which began in 1996, was the first step in this multi-year project. This report on the 1996 survey has been planned as the first in a series of annual reports presenting the results of the Lake Champlain Underwater Cultural Resources Survey, also known as the Lake Survey.

Volume I of the *Lake Champlain Underwater Cultural Resources Survey* was designed to help guide the multi-year program of mapping the bottom of Lake Champlain. It provides the background on the Champlain Valley's environmental and cultural history, and it supplies the guidelines for the fieldwork, research, and documentation of the survey. The report also outlines the survey results of the 1996 field season.

This volume was developed after extensive background research, fieldwork, and the collection of a wide range of primary and secondary sources. These investigations have been integrated into this comprehensive document, providing information that can eventually contribute toward the management of Lake Champlain's underwater cultural resources.

# MANAGEMENT SUMMARY

***Lake Champlain Underwater Cultural Resources Survey***

Lake Champlain is one of the most historic bodies of water in North America. Researchers estimate that as many as 300 shipwrecks have occurred during its maritime history, and dozens of undiscovered shipwrecks and hundreds of other underwater cultural resources still lie undiscovered on the lake floor. In an effort to learn more about the lake's history, the Champlain Maritime Society (1981-1987) began a long-term, systematic investigation of Lake Champlain's submerged cultural resources, especially shipwrecks, which was continued by the Lake Champlain Maritime Museum (founded 1986). This systematic survey project was expected to take decades to complete.

In 1993 zebra mussels were found for the first time in Lake Champlain. A non-native aquatic nuisance species, zebra mussels adversely affect submerged cultural resources, and their appearance in the lake dramatically increased the urgency of the survey project. During the spring of 1996, the Lake Champlain Basin Program (LCBP), a federally funded program created through the Lake Champlain Special Designation Act of 1990, authorized the Lake Champlain Maritime Museum to implement a lake-wide survey to inventory all cultural resources in Lake Champlain. This inventory (a Phase I or Stage I project) was to be completed in order to locate and document the lake's shipwrecks before they became encrusted with zebra mussels. Specific knowledge of Lake Champlain's archaeological properties will then permit the preparation of a comprehensive management plan for the lake's cultural resources.

The Lake Champlain Maritime Museum designed the Lake Champlain Underwater Cultural Resources Survey, also known as the Lake Survey, as a five- to seven-year project. The project began in May 1996 with the support of federal, state, and private funds from a number of sources. Federal and state funding was provided by the U.S. Environmental Protection Agency (EPA) through a contract with the New England Interstate Water Pollution Control Commission (NEIWPCC) (Contract #LC-DP95-4-VTRFP; 0080-026), as well as the U.S. National Park Service (NPS) through a cooperative contract agreement (Grant #R-PLN/LCM-96-018) with the Vermont Department of Forests, Parks, and Recreation (VDFPR). Technical and administrative oversight of all work performed under these contracts was provided by Ann Cousins of the Lake Champlain Basin Program (LCBP) in cooperation with the Lake Champlain Basin Program's Technical Advisory Committee (TAC). The Freeman Foundation and the Lintilhac Foundation provided substantial private funding for the 1996 Lake Survey. Public interpretation of the Lake Survey was provided by NEIWPCC on behalf of the New York and Vermont Lake Champlain Citizens Advisory Committees under the New York-Vermont Citizens Advisory Committees 1997 Partnership Program (Grant #LC-E096-2-VT-M; 0082-004).

This lake-wide survey will reveal new information that will greatly benefit archaeologists, historians, students, and the public through publications, exhibits, and the opening and maintenance of new underwater preserves. The broadest public benefit resulting from the survey will be the accumulation of archaeological information about a collection of previously unknown shipwrecks, allowing this archaeological data to be preserved in perpetuity. From this comprehensive inventory of shipwrecks, a management plan can eventually be developed that will make recommendations related to the preservation, protection, and interpretation of Lake Champlain's significant underwater archaeological sites.

***Methodology and Logistics***

The 1996 Lake Survey consisted of six distinct components: planning, background research, side scan sonar survey, diver survey, remote-operated vehicle (ROV) survey, and report preparation. Planning and background research began during the winter of 1995/96 and culminated in three weeks of intense strategy development and equipment preparation immediately prior to the survey, which began June 3 and continued until August 8, 1996.

The side scan sonar survey was carried out on board the 12.2-m (40-ft) research vessel (R/V) *Neptune*, owned and operated by Captain Fred Fayette. *Neptune* was navigated with a Northstar 941X Differential Global Positioning System (DGPS), a Cetrek auto pilot system, a video plotter, and a Raytheon R40 raster scan radar system, equipment that controlled and recorded the position of the research vessel throughout the survey. The team divided the survey area with a zone-and-grid system, setting survey lines 2-3 km (3.2-4.8 mi) long and 170 m (558 ft) apart. *Neptune* navigated over each grid line, towing a dual frequency Klein 595 side scan sonar towfish approximately 10 m (32.8 ft) off the lake floor, collecting and storing geophysical information. A Wesmar SS2645 sector scanning sonar alerted the crew to any obstacles ahead of the side scan sonar towfish, and depth information was gathered via a Furuno FCV667 color video sounder. A Triton ISIS data processing system on board *Neptune* then digitized the data it received from the side scan sonar towfish, storing it along with position, depth, and speed information.

Each subsequent transect overlapped the previous one, insuring complete and methodical coverage of the bottom. The final product of the field season was an optical disk record of the lake floor of the entire survey area, including sonar images of shipwreck sites, noting the exact position, heading, and speed of the research vessel and the precise location and depth of each underwater target. In a field season of forty days, the survey team examined approximately 110.6 $km^2$ (42.7 $mi^2$), or ten percent of Lake Champlain's total surface area.

***Lake Survey Form***

In an effort to standardize the data collected during the Lake Survey, a lake-wide survey form was created to document all cultural resources that might possibly be found in Lake Champlain. The form was developed after existing forms in use by the States of New York and Vermont. A draft of the survey form was circulated to both New York and Vermont historic preservation offices for review and modification.

### *Data Analysis*

The side scan sonar data was collected and managed by computer, allowing researchers to post-process and analyze the information in a more comprehensive manner. Once the 1996 field season had been completed, the survey team spent a part of the winter of 1996/97 working with this technological process. Fred Fayette, the team's technical specialist, collaborated with professors Patricia Manley and Thomas Manley of Middlebury College and some of their undergraduate students to manipulate and mosaic the side scan sonar data with computer software. Post-processing selected data then permitted Nichole S. North, a geology student at Middlebury College, to analyze the bottom topography of a portion of the surveyed area. Side scan sonar data will prove extremely valuable for future investigations of the lake's hydrology, morphology, bathymetry, and sedimentology.

Following the field survey, historians Scott McLaughlin, Peter Barranco, and Arthur Cohn analyzed the cultural targets and researched the newly discovered shipwrecks and background data for the survey areas. Their analysis efforts culminated in this research report.

### *Project Archive and Repository*

All of the data and documentation generated during the 1996 Lake Survey will be stored and made available for research at the Lake Champlain Maritime Museum's Nautical Archaeology Center. The project archives consist of navigational logbooks, field notes, photographs, videotape, computer disks, and the project log. The side scan sonar printouts, currently at Middlebury College, will be relocated to LCMM upon completion of the post-processing of the data. The complete project archives will be curated according to federal and state guidelines (National Park Service 1991). No artifacts or other materials were recovered from the sites located during the survey.

### *Background Research*

Conducting general background research of Lake Champlain, specifically the history of those regions surveyed in 1996, was a major component of the 1996 Lake Survey. It was important to know what events occurred in these areas in order to better understand the historical properties that might be found there. This historical framework will also be used to evaluate the significance of the archaeological resources that will undoubtedly be located during subsequent years of the survey. Research into maritime activities on Lake Champlain was limited to local and regional archives, municipal records, and newspapers. The research phase of the study was not intended to be exhaustive, but rather to indicate how much information was available regarding the archaeological resources and their significance. This research will eventually provide a detailed outline of the history and development of Lake Champlain and the specific project areas undertaken each year.

### *1996 Survey Area*

The project area chosen for the 1996 season of the Lake Survey was the section in the main body of Lake Champlain between Cumberland Head in Plattsburgh, New

York, and Colchester Point in Colchester, Vermont. In addition to this area, the survey team scanned the lake bottom in Willsboro Bay, New York, and Shelburne Bay, Vermont. The New York lake towns included in the survey area were Plattsburgh, Ausable, Peru, Chesterfield, and Willsboro. The Vermont lake towns within the survey area were Grand Isle, South Hero, Colchester, South Burlington, and Shelburne. The primary goal of the 1996 survey was to thoroughly and carefully map and inventory previously undocumented underwater cultural resources in New York and Vermont waters. The 1996 survey area, a region of approximately 110.6 $km^2$ (42.7 $mi^2$), was selected because little data had ever been gathered there. This region also included a variety of environments, ranging from open water to sheltered inlets, which allowed near-continuous survey operations in most weather conditions.

***Results of the 1996 Lake Survey***

The survey team identified and logged over three hundred cultural and geological targets, ten of which were previously undocumented shipwrecks. Five of these historical shipwrecks were located in water deeper than 55 m (180 ft) and will be examined in 1997 during a special ROV survey. The other five vessels located during the survey were in divable waters and unfortunately within the reaches of zebra mussel infestation. The deepest divable wreck site was in 33.5 m (110 ft) of water, the shallowest in about 18.3 m (60 ft) of water.

In the initial proposal for the 1996 Lake Survey, the survey team planned to utilize a remote-operated vehicle (ROV) to verify and document sites located beyond safe diving limits. The formal arrangements for the ROV survey were made for 1996, but, due to scheduling difficulties, logistical problems, and the weather, the ROV survey was deferred until the summer of 1997. Since none of the deep water sites that were to be examined are at risk of immediate zebra mussel infestation, postponing the ROV operation did not result in the loss of any information.

In addition to archaeological data, the accumulated sonar information also recorded interesting geological features of the lake bottom and unexpected contradictions to previously documented depth contours. Post-processing of this geological data has begun at Middlebury College under the direction of geology professors Patricia Manley and Thomas Manley. This analysis will undoubtedly lead to new research in the study of Lake Champlain's bottom sediments, hydrology, and related studies.

***Shipwrecks Located and Verified in the 1996 Lake Survey***

Five of the vessels found during the 1996 side scan sonar survey were located at depths accessible to scuba divers. Each site was assessed to determine the vessel's condition, type, and dimensions, as well as to investigate each ship's purpose, date of origin, and the circumstances of its sinking. From August 5-8, 1996, archaeological divers obtained measurements, sketches, detailed descriptions, and video footage of each of these wrecks. The divers completed an initial physical evaluation of each site in order to verify each vessel and to determine its archaeological potential, the possibility of its inclusion into an underwater preserve program, its susceptibility to vandalism, and the likelihood of zebra mussel infestation.

Wreck C was a sailing canal sloop located in New York waters that dates to approximately the 1840s. The boat appeared to have been intentionally abandoned in this area after a long working life. The stem and sternpost were erect, but the deck was gone and the collapsed sides were lying on the bottom. The vessel was archaeologically significant in that it contained a wooden windlass, an interesting stern window construction, and a rounded, scow-shaped stern. Preliminary investigations indicated that the vessel's archaeological sensitivity was minimal, since the boat appeared to have been stripped of all its equipment and cargo prior to its sinking.

Wreck F (VT-GI-31), a sailing canal sloop of the mid-nineteenth century, was sitting completely intact on the bottom in Vermont waters and almost certainly sank in unplanned and extreme circumstances. All elements that made it a working watercraft were still present. The mast lay *in situ* in the mast tabernacle, the wood and paint were in an excellent state of preservation, the anchor was still hanging off the hawse pipe at the bow of the vessel, and the windlass was intact on the bow. The rear cabin still contained a wood stove, plates, dishes, cups, and water pitchers. The archaeological sensitivity and research potential of this shipwreck were both high; further investigation may lead to the identification of the vessel.

Wreck G was also located in New York waters. The vessel was a large, intact, late nineteenth-century standard canal boat, which, like Wreck C, appeared to have been intentionally scuttled. The site's archaeological sensitivity was minimal, and no artifacts were seen which would require stabilization or removal. The intact state of this vessel made its archaeological value high; a study of this shipwreck could provide information about many uncertain details regarding the construction of this vessel type.

Wreck I (VT-CH-814) was a wooden tugboat located in Vermont waters with its steam machinery still on board. The vessel was estimated to be 13.8 m (45.3 ft) long and 5.3 m (17.4 ft) wide, and it stood 2.3 m (7.5 ft) off the lake bottom. Based on its location and description, the vessel was identified as *U.S. La Vallee*, which was scuttled in the 1930s after a working life of over fifty years. This remarkably well-preserved vessel is the only known intact steam tugboat in Lake Champlain. Its towing bits, propeller, ship's wheel, steam stack, and machinery were clearly visible and in excellent condition due to the lake's cold water.

Wreck J (VT-CH-815) was a late nineteenth-century wooden construction scow 28.7 m (94 ft) long and 9.1 m (30 ft) wide. This heavily-built barge was designed to carry marine construction equipment around the lake to build the docks and the breakwaters that supported the maritime economy of the Champlain Valley. Probably intentionally scuttled, the vessel was missing its deck and had been badly burned, but it remained a very good example of this type of vessel. The extant hull preserved many interesting features, such as naturally shaped knees and extra support timbers designed to hold heavy deck loads. The archaeological potential of this vessel exists in the opportunity to study a once-common, workaday vessel type that is now barely preserved.

### *Underwater Historic Preserve Potential of the 1996 Sites*

In 1985 the Vermont Division for Historic Preservation (VDHP) established the Vermont Underwater Historic Preserve System, one of the first underwater historic preserve programs in the United States. This nationally recognized program has grown to include five shipwrecks, visited each year by hundreds of local and visiting divers. In 1991 the State of New York created a similar program in Lake George that now consists of three sites containing a total of ten vessels. In the spring of 1998, the State of New York is scheduled to create its first underwater preserve in Lake Champlain at the site of the steamboat *Champlain II* (1868), and the sailing canal boat *O.J. Walker* (1862 [VT-CH-0594]) will be opened to the public as the sixth site of the Vermont Underwater Historic Preserves.

All five of the shallow shipwreck sites located during the 1996 Lake Survey, three located in Vermont and two in New York, have underwater preserve potential. Before these sites can be included in an underwater preserve program, however, each requires additional archaeological documentation and a formal feasibility study. Each shipwreck site presents a different set of conditions, and each must be considered for inclusion into a preserve system on its own merit. Archaeological fragility and sensitivity, depth, bottom conditions, boat traffic, and accessibility are all issues that must be addressed. These issues need to be evaluated for the protection of the cultural resources as well as the safety of the diving public.

The management of the Vermont and New York preserve programs is currently undertaken with minimal infrastructure, restricted budgets, a strong dependency upon volunteers, and limited coordination between the states. If additional vessels were added to the New York and Vermont preserve systems, the existing programs may not be able to operate effectively, to offer the protection the vessels need, or to provide guidance to visiting divers. A formal relationship should be established between Vermont's and New York's underwater historic preserve systems in order to facilitate management of Lake Champlain's underwater resources before the programs can expand. With a more highly developed management system, a lake-wide preserve program could give Lake Champlain, and therefore both New York and Vermont, the potential to become one of the country's most dynamic historic diving destinations.

### *Final Report*

In addition to quarterly reports submitted to the Lake Champlain Basin Program, a final report was an essential component of the 1996 Lake Survey. The final report of the 1996 Lake Survey consists of three parts: a summary of the management of the 1996 Lake Survey, general background information about the environmental and cultural history of Lake Champlain, and the results of the 1996 Lake Survey. The report was designed to present the reasons why Lake Champlain is so culturally and geologically unique and why it is important to protect, study, and interpret the lake's underwater cultural resources. An additional result of the Lake Survey was the accumulation of data that will advance geological studies about the hydrology, sedimentology, and bathymetry of Lake Champlain.

### *Conclusions*

The 1996 season of the Lake Survey successfully initiated the large-scale survey of the bottom of Lake Champlain, undertaken in response to the recent appearance of zebra mussels in the lake. Despite such variables as unfavorable weather, the first-time implementation of new technologies, and a more ambitious operating schedule than was originally planned, the results of this first season met the goals and objectives established by the Lake Champlain Maritime Museum and the Lake Champlain Basin Program. Ten previously undocumented shipwrecks, five of which have been recorded on film, were located during the survey as a result of extremely reliable navigational control and remote-sensing procedures. The side scan sonar data was collected and stored in an easily accessible format on computer. This format makes the information very useful not only for further analysis by archaeologists, but also for limnology studies by researchers interested in topics such as the lake's groundwater supply and currents, both of which are important in analyses of geophysical process and pollution control on Lake Champlain.

An important part of this project was to begin discussion of a lake-wide management plan for Lake Champlain's cultural resources. Consequently, the Lake Champlain Maritime Museum formed a number of vital partnerships during the 1996 Lake Survey with state and local government agencies and academic institutions. These organizations contributed to the survey's achievements and will help ensure the project's continued success over the next five to seven years. LCMM has the important collaborative support of:

- Environmental Protection Agency, Region I, Boston, Massachusetts
- Institute of Nautical Archaeology, Texas A&M University, College Station, Texas
- Lake Champlain Basin Program, Grand Isle, Vermont
- Middlebury College, Middlebury, Vermont
- National Park Service, Washington, DC
- Naval Historical Center, Washington, DC
- New York State Department of Education, Albany, New York
- New York State Museum, Albany, New York
- New York State Office of Parks, Recreation, and Historic Preservation, Albany, New York
- University of Vermont, Burlington, Vermont
- Vermont Division of Historic Preservation, Montpelier, Vermont
- Vermont Senator Patrick Leahy, Montpelier, Vermont
- Vermont Senator James Jeffords, Montpelier, Vermont

### *Recommendations*

The 1996 Lake Survey has prompted the development of a number of recommendations related to Lake Champlain's cultural resources, addressed in depth within the body of the report. Many of these recommendations address the issues,

# Part II
# Background to the Lake Survey Project

# BACKGROUND TO THE LAKE SURVEY PROJECT

### *Lake Champlain's Cultural Resources*

Lake Champlain, located between the states of New York and Vermont, is considered to be among the most historic bodies of fresh water in North America. The extraordinary array of historic and archaeological resources in and around Lake Champlain are the physical evidence of a long and varied history spanning 11,300 years. Of singular importance are Lake Champlain's historic shipwrecks, which comprise one of the largest and most intact collections in North America. These wrecks, however, are not the only underwater resources in Lake Champlain; an unknown number of submerged prehistoric sites, historic dumpsites, naval battle sites, piers, cribs, and other maritime sites must also be included.

The human history of the Champlain Valley includes Native American settlement, French and British exploration and occupation, early Euro-American settlement, and a dynamic period of nineteenth-century commercial development. Past residents of the Champlain Valley have left behind a rich heritage of cultural resources, including historic structures and settlements, cultural landscapes, and archaeological resources. Many of these cultural sites are concentrated along the Lake Champlain shoreline and the lake's tributaries.

Lake Champlain and its history are shared between the states of New York and Vermont and the Canadian province of Quebec, and the lake has directly influenced the history of all of its lakeside towns and counties (Table 1). Settlement along Lake Champlain began in earnest in the 1790s along with the development of regional industries based on natural resources such as timber and iron ore. Lumber camps and mining towns sprang up in support of these industries, prompting the growth of additional economic activities such as farming to supply food and shipping to transport these raw materials. The region's economy soon diversified beyond timber and iron, but it continued to depend upon the exploitation of natural resources throughout the nineteenth century.

Lake vessels, so necessary for carrying goods in and out of the Champlain Valley during the early industrial years, were gradually replaced over the course of the nineteenth century as other forms of transportation and communication developed. With each new advance in transportation and communication technology, fewer vessels were used on Lake Champlain. The development of bridges, railroads, highways, telegraphs, telephones, airplanes, and pipelines ultimately ended Lake Champlain's carrying trade. Today the vestiges of Lake Champlain's once-active shipping industry are preserved almost exclusively on the lake bottom as submerged cultural resources.

The types of submerged cultural resources in Lake Champlain vary greatly, ranging from large, complex sites such as shipwrecks and harbor works to small, limited sites such as prehistoric fish weirs or canal boat trash sites. No matter how large or noteworthy, these archaeological resources all provide important information about everyday interactions between people, Lake Champlain, and the area's resources.

The primary goal of the Lake Survey was to locate and identify all cultural properties preserved on the floor of Lake Champlain to facilitate the development of a comprehensive resource management plan. The project had to be completed in five to seven years so that researchers would still be able to return to these resources and document the most significant finds before they became badly encrusted. This goal was made somewhat more difficult by the geography of the region; the top surface of the lake covers approximately 1130 $km^2$ (436 $mi^2$), but the deep, mountain-like bottom topography of Lake Champlain has a much greater surface area.

The most effective use of the time and funding available for the Lake Survey was to search first for the large cultural resources in Lake Champlain that penetrate above the lake bottom. These resources were most vulnerable to the adverse effects of nuisance species, vandalism, and theft. Once these sites were identified, then the survey would concentrate on the smaller, scattered assemblages and finally those properties buried in the lake's sediments.

Some parts of Lake Champlain have been investigated in the past, so the areas of Lake Champlain with the least amount of archaeological data were the first examined during the 1996 Lake Survey. Statistical information collected on zebra mussel infestations indicated that certain areas of the lake would experience earlier and greater zebra mussel colonization as a result of depth and current. These areas were given second priority for the survey. The selection of survey areas for each year, however, must remain flexible to allow for variables such as poor weather conditions and changes in priorities.

***Lake Survey Methodology***

A consistent general methodology for the Lake Survey was a priority to ensure that the procedures used throughout the multi-year project continue to meet the original goals. This general methodology guarantees the effectiveness and accuracy of the survey data collected in subsequent years. It will, however, need to remain flexible in order to reflect the availability of research tools, personnel, and funding. The stages in conducting the survey of an area should include background research, field survey, post-survey research, and analysis.

In an effort to find the locations of sites prior to conducting the search component of the field survey, the research team conductd documentary research, informant interviews, and a land-surface inspection of the shoreline surrounding the project area for potential evidence of submerged archaeological sites in the adjacent waters. A literature search and sensitivity assessment was completed prior to the lake-based survey of a project area. This information assisted in the determination of the appropriate field procedures for that area. The literature search gathered information concerning the environmental and cultural setting of each specific project area, since the relationship between the physical environment and the cultural setting provided the basis for the sensitivity assessment of the project area. The summary of the environmental setting of each project area included a consideration of relevant geology, geomorphology, hydrology, flora, fauna, climate, soils, and human and natural disturbances. The background research for the cultural setting included a preliminary review of manuscripts, maps, atlases, historical documents, unpublished notes of previous surveys, site inventories, and published material relevant to the project area. A preliminary examination of both environmental and cultural background may help locate possible sites and provide the basis for documenting the cultural setting for the project area.

Another viable source of information about Lake Champlain's cultural resources is the local population, especially those individuals interested in or living near a specific project area, who may have important information not available anywhere else. Such information can greatly enhance data gathered from the written record alone. Informant interviews with people who may be familiar with the project area and possible archaeological sites can make a valuable contribution to these investigations. A visit to the shoreline adjacent to the project area or an underwater survey of the area may also be undertaken with informants who know the locations of potentially significant sites.

This background information will provide for the development of general expectations or predictions regarding the nature and location of sites in the project area. The sources from which the background information will be drawn will vary according to the project size and location and the availability of documents. The information will be presented and analyzed to assist in the evaluation of the environmental and cultural resources within and surrounding the immediate project area.

The final, ultimate goal of the Lake Survey was to have total confidence that, when the survey team left a certain area, the area had been completely examined for the types of targets that the survey team hoped to locate. The survey team acknowledged, however, that no matter how rigorous and intense the survey approach, there would be no absolute certainty that archaeologically significant finds or sites did not remain hidden within the survey area. The fact that nothing was detected does not necessarily mean that nothing was there. The accuracy of the survey mapping and computerization of the survey data are crucial in this regard. The survey team needed to know what areas were covered and what areas were not. If some gaps appeared between survey areas, they could be evaluated during a later survey. A system of capturing the data was implemented for an easy, convenient way of reviewing the data.

Archaeology is a field that borrows from a number of disciplines. Developments within the fields of marine geophysics and deep-water surveillance have made available to underwater archaeology a range of scientific equipment. This technology allows for very effective archaeological investigations of previously inaccessible marine environments, such as the deeper areas of Lake Champlain. Remote sensing tools have the ability to collect large amounts of information quickly and at some distance from the source without risking the safety of scuba divers. Such equipment allows search patterns to be more widely spaced and survey work to be completed at a greater speed than divers can achieve. Remote sensing equipment can also operate in zero underwater visibility and can detect certain classes of information that are buried under bottom sediments. Additionally, remotely operated vehicles (ROVs) can perform many of the tasks of a diver, including visual searches, videography, and photography.

The Lake Survey required a search pattern that covered 100 percent of the lake bottom for depths greater than approximately 3.7 m (12 ft). Potential types of targets included shipwrecks, breakwaters, jetties, cribs, and other marine structures (Appendix M). These structures were largely made of wood, stone, earth, and a small amount of metal. Consequently, Lake Survey planners decided to utilize both electronic equipment and free-swimming divers to execute the project. The survey methodology was to use side scan sonar to locate cultural targets in water depths ranging from 5 to 125 m (15 to 400 ft) and to utilize free-swimming divers in the shallow water from 0 to 5 m (0 to 15 ft) when deemed necessary. This approach was determined to be the most efficient way to maximize the limited time available to complete the project, to investigate the shallow areas of Lake Champlain, and to locate the relatively large structures that were the survey's most immediate priority. Once the side scan sonar survey was completed, a different methodology will be implemented to locate smaller and buried cultural resources.

Critical to the effective use of side scan sonar to locate potential cultural resources on the lake bottom was the research vessel's speed, the width of the sonar band, the amount of overlap, and the survey team's ability to recognize cultural targets. The speed and efficiency of a survey is proportional to both the size and visibility of the targets, and the visibility of a site is largely due to its density of material and size in the horizontal and vertical planes above the bottom sediments.

All side scan sonar systems use returned acoustic energy to create an image of the lake bottom. The information is collected in strips of the lake bottom that are later pieced together to provide a more coherent image of the bottom morphology of the lake and any cultural features that might be preserved. A side scan sonar towfish transmits a fan-shaped sound beam to either side of its torpedo-shaped body rather than directing it only downward as conventional echo sounders do. Due to the high frequency (100 to 500 kHz) of side scan sonar waves, they can only image the surface of the lake bottom and do not penetrate significantly into the bottom sediments. Cultural features extending above the lake bottom and having slopes facing the towfish will return stronger signals than those features that are facing away. The sideways-oriented sound beam emitted from the towfish is narrow in the vertical direction and wide in the direction transverse to the towfish track, so that the data presents a skewed or slanted image of the lake bottom. Computer software later corrects the image to provide an accurate plan view.

After a potential cultural resource is located, the target can be verified by scuba divers or a remote-operated vehicle, depending upon its depth. The survey team's next task was to evaluate the site's boundaries, date, cultural origin, function, context, data potential, integrity, and the artifacts present at the site. Whenever possible, this information was collected during a general documentation of the site with still

### *Volunteer Involvement*

Underwater archaeological operations differ from land projects in that they often require more technical support. For every minute spent underwater working on an archaeological site, there are probably two or more hours of work on the surface and ashore. This non-diver work includes tending equipment, keeping logbooks, copying underwater notes, pre- and post-survey research, project planning, post-fieldwork recording and analysis, writing the archaeological report and publications, and presenting and interpreting the project results for the public. A large array of specialized equipment is necessary for underwater archaeology, including a boat, air compressors, side scan sonar, and ROVs. These technical pieces of equipment require professional operators. A large number of tasks, however, can be completed by diving and non-diving volunteers, such as maintaining the navigation log and the dive log, assisting in gear handling, taking project photographs, and assisting in prepping the divers. The Lake Survey attempted to utilize volunteers whenever possible.

### *Post-Survey Research*

Some LCMM staff and volunteers have been researching the history of Lake Champlain for nearly half a century. LCMM is currently developing an integrated computer database of its collection of documents and artifacts related to the history of Lake Champlain, a goal that should be accomplished within the next few years. LCMM is also building a complete record of all maritime sites in the Champlain Valley. Identification of the cultural resources located during the survey will be greatly dependent upon the existing archival records. Comparing the condition, age, construction, size, location, type of resource, and other distinguishing features with the archival records can identify some cultural properties.

### *Lake Survey Report Series*

At the conclusion of each year of the Lake Survey, the Lake Champlain Maritime Museum will present a report of the results of the year's investigations. The report will include the survey design and methodology, complete site survey records, and a list of all sites located that year. Each survey report will be included as part of the series called the Lake Champlain Underwater Cultural Resources Survey. Although each report will be able to stand alone, the reports following the 1996 Lake Survey report will not include the general environmental and cultural background data of the Champlain Valley, which is included in this document. The subsequent reports will address only the survey areas investigated in that particular year and the progress made in collecting additional data about the lake's resources.

It is important to provide information about the results of the survey to the public, government agencies, and other reviewers of this report, but, at the same time, it is our intention to protect these newly discovered, fragile archaeological resources from potential damage or danger. As a result, the exact location of the sites will be excluded from the body of the report and placed in an appendix that will be removed from the public version of the report.

At the conclusion of the Lake Survey, the next step will be the development of a lake-wide cultural resource management plan, which will be based largely upon the Lake Survey report series. The extensive archival research, informant interviews, fieldwork, and data analysis performed for the Lake Survey will provide much of the background necessary to develop the plan. The Lake Survey data will also help greatly in forming the recommendations for the responsible long-term management and development of Lake Champlain's cultural resources.

### *Project Archive and Repository*

The Lake Survey archives will be housed in the Nautical Archaeology Center at LCMM. This facility contains an archaeology/conservation laboratory, a research library, and a collections facility. The materials will be processed, documented, and curated at LCMM as outlined by the National Park Service (1983), the State of Vermont (Peebles 1989), and the New York Archaeological Council (1994). The survey archives will be made available to public and private organizations and individuals with sincere research interests. The exact policies and curation procedures regarding the survey archive are currently being discussed with the principal government agencies.

photographs, video documentation, sketches, basic recording of dimensions, and field notes.

In addition to cultural information, geophysical and sedimentological data will be gathered during the side scan sonar survey. Topography of the sediment surface as well as the physical characteristics of exposed cultural features, bedrock, sediments, and rocks affect the strength of the returned sound beam. The more uneven the lake bottom, the more energy that will be returned to the towfish. Therefore, a qualitative measurement of the sediment grain size can be determined by the strength of the return. This information will enable researchers to study the patterns in sedimentary beds and to develop models of bottom circulation within the lake.

### *Performance Standards*

The Lake Survey Project was carried out according to the principles and standards established by the National Park Service (1983), the Vermont Division for Historic Preservation (Peebles 1989), and the New York Archaeological Council (1994). All historical and archaeological research was conducted under the direct supervision of capable individuals who met the appropriate qualifications set forth in FR 36 CFR 61.

The methods and procedures used to document the archaeological and geological resources found during the survey were standards in the fields of archaeology and remote sensing. These underwater archaeological standards are discussed in a number of archaeological manuals (Anderson, Jr. 1988; Dean et al. 1995; Green 1990; Lipke et al. 1993; Steffy 1994). References to specific archaeological techniques, such as archaeological illustration and photography, also developed standards for the project (Addington 1986; Adkins and Adkins 1994; Dillon 1992; Dorrell 1989; Howell and Blanc 1995). The specific methods and procedures used during the project relied upon the knowledge of Lake Champlain Maritime Museum personnel, who have compiled significant backgrounds in archaeology and history from their training and experiences.

### *Safety*

It can not be overemphasized that safety is of prime importance on any archaeological project. No data is worth the risk of injury, a situation which automatically defeats all educational and research goals of the project. Throughout the entire project, safe scientific diving and work practices were conducted at all times following research and industry standards (Flemming and Max 1996; Miller 1991), since diving is a safe task if adequate precautions are taken. To ensure the safety of the diving staff, the survey team followed a general code of practice for scientific diving that adhered to federal, state, and industry safety standards (Flemming and Max 1996). A diving officer was selected for the project to coordinate diving operations and to deal with all matters concerning diving safety. This highly experienced divemaster was responsible for evaluating divers' qualifications, experience, and medical fitness for the project's activities. This person was also responsible for establishing the project's diving and safety procedures.

Conducting archaeology in Lake Champlain requires highly skilled scuba divers with experience in cold, dark, limited-visibility waters. The soft, muddy bottom of the lake creates a need for well-executed diving techniques. Project divers had to be comfortable in this setting and able to conduct documentation tasks. Due to the demanding work required in documenting the lake's cultural resources, most of the survey divers were professional underwater archaeologists and divers involved in previous survey projects.

Without exception, all diving activities conducted during the project were no-decompression dives. At the conclusion of every dive beyond the depth of 9 m (30 ft), divers conducted a safety stop at 5 m (15 ft) for a minimum of 3 min. Each diver was required to surface with a minimum of 21 bar (300 psi) remaining in his or her primary scuba tank. The buddy system was used in all cases, and each diver on the project carried a back-up breathing system. Diving operations involving depths less than 9 m (30 ft) required the diver to have an octopus or spare regulator, while deeper dives required divers to carry a pony bottle and regulator as an independent air source. If the dive required auxiliary lights, then each diver was expected to carry at least two light sources, one primary and one backup.

Lake Champlain's cold water requires divers to wear thermal protection in the form of a wetsuit or drysuit depending on the depth and time of the year. The suit also offers protection from abrasion. In most cases, research divers wore a drysuit, since wetsuits are effective over only a narrow temperature range. Drysuits can be used over a wide temperature range by varying the amount of insulation worn beneath the suit. These suits allowed for greater thermal protection, which allowed longer bottom times, reduced fatigue from the effects of cold water, and safer dives. Also, a full-face mask could help to keep a diver's face warm and dry; in the event of a failed primary regulator, however, the diver would lose both mask and air supply. For this reason, all divers on the project who chose to wear a full-face mask had to carry a spare mask while underwater.

The penetration of underwater structures such as shipwrecks was carried out with extreme care in order to prevent injury to either the shipwreck or the diver. In most cases, safety lines were not used, since such lines often created a greater danger by entanglement. No matter what the depth, penetration dives required the use of a pony bottle.

Shipwrecks and other structures attract fish, which in turn attract fisherman. The almost transparent monofilament fishing line that fisherman leave on these structures can easily entangle a diver. For the safety of the survey team, divers wore at least one dive knife, although two were strongly recommended. The primary knife was worn in the traditional location on the inside of the leg, while the second knife was placed closer to the chest area.

# ENVIRONMENTAL SETTING OF LAKE CHAMPLAIN

### *Natural History*

The physical environment of the Champlain Valley has played an important role in the geologic and human history of the region. The Champlain Valley has a distinctive combination of topography, climate, vegetation, and animal life, all of which have maintained a dynamic equilibrium throughout the past. It is important to understand these systems and the history behind them, which has shaped the interactions between humans and Lake Champlain over the past 11,300 years.

### *Physical Geography*

The topography and landforms visible today throughout the Champlain Valley are products of ancient mountain-building processes and the erosional forces of glaciers and rivers that gouged the valley and scoured the surfaces of the surrounding mountains. Lake Champlain is the focal point of the physical or geographical region called the Champlain Lowlands or the Champlain Valley. The complex character of the Champlain Valley is made up of rolling hills, islands, wetlands, river systems, and Lake Champlain. The Champlain Valley is cradled by the Adirondack Mountains to the west and the Green and Taconic Mountains to the east. The surrounding geographical regions are the Green Mountains, the Adirondack Mountains, the Taconic Mountains, and the Vermont Valley (Figure 1). The Green, Taconic, and Adirondack mountain ranges represent the highest elevations surrounding the Champlain Valley and form the headwater areas of tributaries entering Lake Champlain (Figure 2). The Vermont Valley is a small section containing the flood plain of Otter Creek, which eventually flows into Lake Champlain (Lake Champlain Basin Program [LCBP] 1994:State of the Lake—3).

After the Great Lakes, Lake Champlain is the sixth largest fresh water lake in the United States. The lake flows north from Whitehall, New York, across the U.S.-Canadian border to its outlet at the Richelieu River in Quebec. From the Richelieu River, the water joins the St. Lawrence River and eventually drains into the Atlantic Ocean at the Gulf of St. Lawrence. For much of its length, Lake Champlain defines the state border between Vermont and New York. The lake's watershed is bound to the east by the Connecticut River basin, and to the southwest by the Hudson River basin, which is connected to Lake Champlain by the Champlain Canal. The environmental setting of Lake Champlain is unique in part because of its narrow width, its great depth, and the size of its watershed (LCBP 1994:State of the Lake—1).

The total area of the Champlain Basin is 21,326 $km^2$ (8234 $mi^2$), 56 percent of which is in Vermont, 37 percent in New York, and 7 percent in Quebec (Fischer et al. 1976:13). Lake Champlain is a greatly elongated lake that occupies a portion of a long north-south valley that extends from the St. Lawrence River to Long Island Sound. Lake Champlain lies in this valley with the Hudson River to the south and the Richelieu River to the north. With a mean elevation of 29 m (95 ft) above sea level, Lake Champlain has a maximum length of 171 km (106 mi), a maximum depth of 121.7 m (399 ft), and a maximum width of 20.3 km (12.6 mi). The average width of the lake is

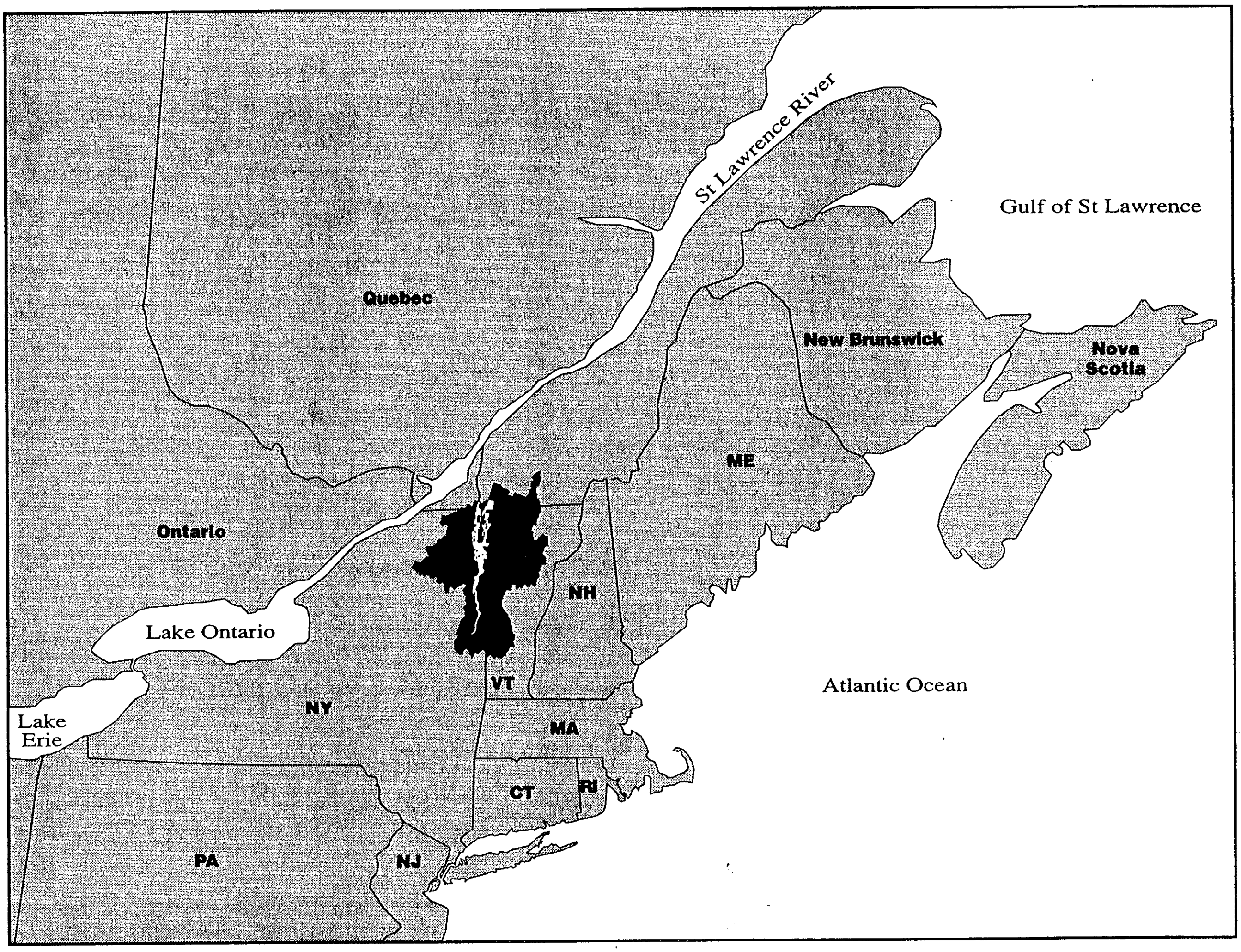


*Figure 1*. Location of the Lake Champlain drainage basin (Basin Program 1994: Facts about the State of the Lake – 1).

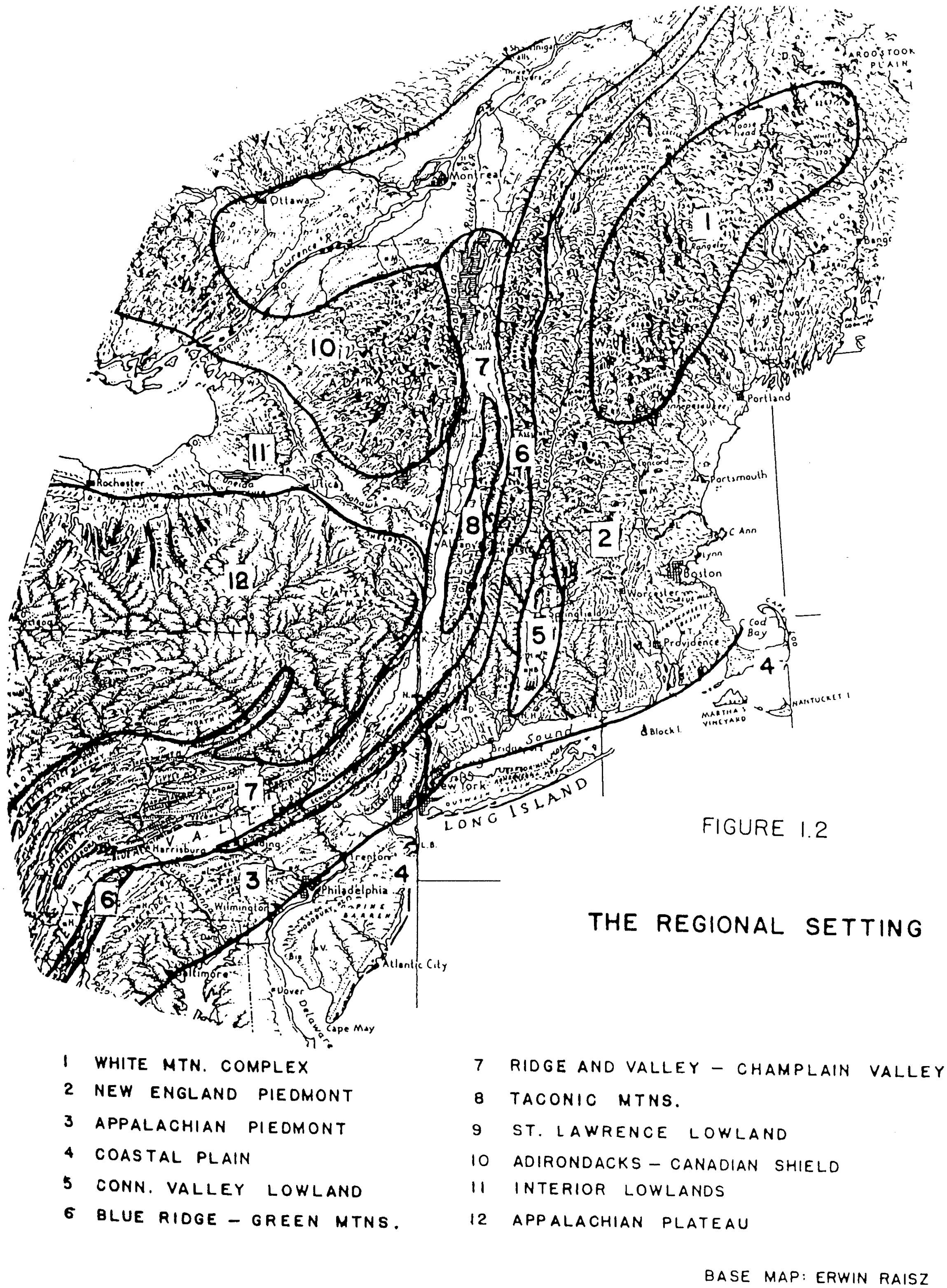


*Figure 2.* Physiographic regions of the Northeast (Meeks 1986:9).

6.6 km (4.1 mi), and the average depth is 19.4 m (63.6 ft). The lake's surface area is 1130 $km^2$ (436 $mi^2$), and it has a volume of 2.58 x$10^{10}$ $m^3$ (9.12 x $10^{11}$ $ft^3$) (Myer and Gruendling 1979:5 and 27). Of the total surface area of Lake Champlain, 699 $km^2$ (270 $mi^2$) or 62 percent lie in Vermont, 389 $km^2$ (150 $mi^2$) or 35 percent lie in New York, and 39 $km^2$ (15 $mi^2$) lie in Quebec. The shoreline of Lake Champlain is about 944 km (587 mi) long, 611 km (380 mi) or 65 percent of which lie in Vermont, 294 km (183 mi) or 31 percent lie in New York, and 39 km (24 mi) or 4 percent of which lie in Quebec (Fischer 1976:12).

In most areas surrounding Lake Champlain, the shoreline profile is quite gentle, although some areas of lakeshore along the New York side of the lake have extremely steep cliffs. Typically, the land topography adjacent to the lake and the basin bathymetry are closely related (Myer and Gruendling 1979:45). Unlike many other lakes, which are bowl-shaped and tend to be more evenly mixed, Lake Champlain is made up of lake segments, each with different physical and chemical characteristics, split apart by the lake's 80 islands. Morphologically, the lake is divided into three distinct but connected sections (Figure 3). The largest section is called the Main Lake, which extends from Isle aux Têtes or Ash Island, Quebec, to Crown Point, New York, west of the Champlain Islands. This segment contains about 81 percent of the volume of the entire lake and has the deepest, coldest water. This section reaches a maximum depth of 121.7 m (399 ft) near Split Rock Point, New York, and is at its broadest north of Burlington, Vermont, with a width of nearly 20.1 km (12.5 mi) (LCBP 1994:State of the Lake—1).

The Restricted Arm of the lake is located to the east of the Main Lake and is composed of three primary basins, including Mallets Bay, the Inland Sea (often referred to as the Northeast Arm or East Bay), and Missisquoi Bay. These primary basins are connected to each other and the Main Lake by shallow narrow passages, all of which are part of the Restricted Arm. Mallets Bay is along the Colchester, Vermont, shoreline southeast of Grand Isle, Vermont. The Inland Sea is east of the Champlain Islands, stretching from the Sand Bar causeway in Colchester north to Missisquoi Bay, and includes the narrow passages between the islands of Grand Isle and North Hero and Alburg Tongue. Missisquoi Bay begins from the southern end of Hog Island, Swanton, Vermont, and extends into Quebec. The third section of Lake Champlain is the South Lake. Resembling a river with an average depth of 6.1 m (20 ft) and a width of less than 1.6 km (1 mi), the South Lake runs from Crown Point to Whitehall, New York, where Lake Champlain is connected to the Hudson River by the Champlain Canal (LCBP 1994:State of the Lake—1-3).

The Champlain Valley can be divided into seven major sub-basins, each drained by one or more of the major tributaries feeding Lake Champlain (Figure 4). These drainages include the Missisquoi Basin, the Lamoille/Grand Isle Basin, the Winooski Basin, the Otter/Lewis Basin, the Poultney-Metawee/South Basin, the Saranac/Chazy Basin, and the Boquet/Ausable Basin. From north to south on the Vermont side of the lake, the major rivers that create these drainage basins are the Pike River, the Missisquoi River, the Lamoille River, the Winooski River, the LaPlatte River, Lewis

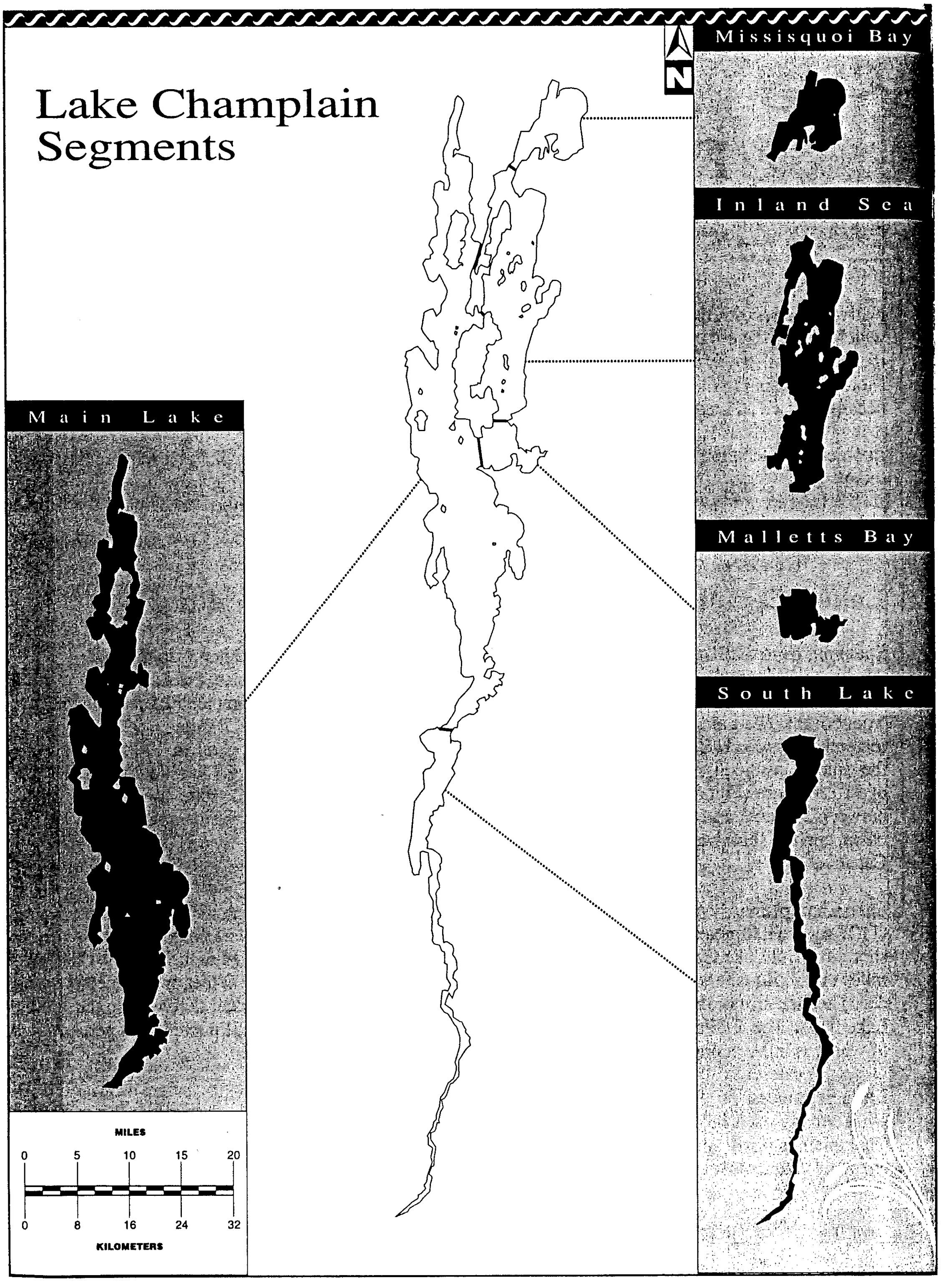


*Figure 3.* Segments of Lake Champlain (Basin Program 1994: Facts about the State of the Lake – 2).

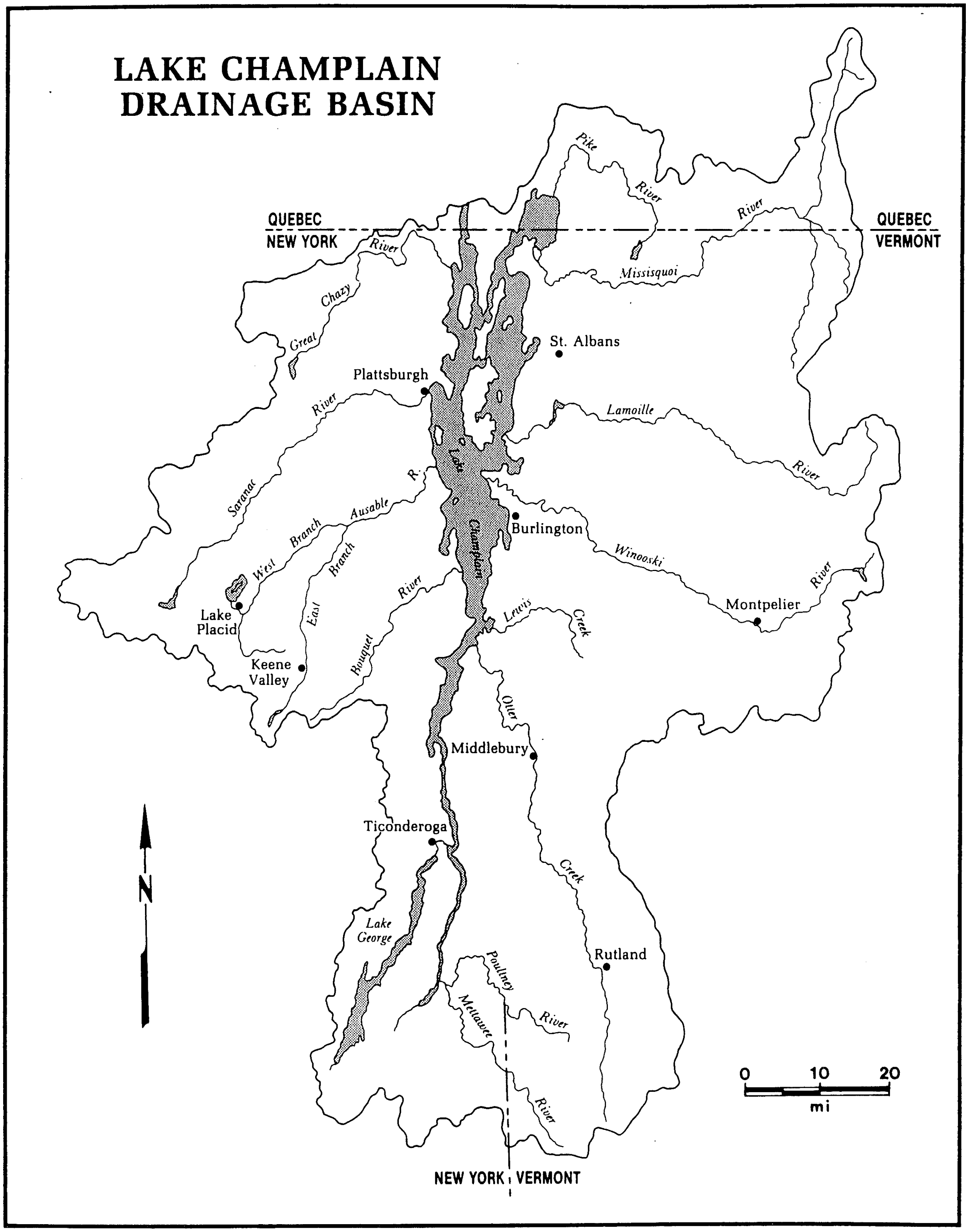


*Figure 4.* The Lake Champlain drainage basin (Versteeg 1987:6).

Creek, Otter Creek, and the Poultney River. The major river drainages on the New York side of Lake Champlain consist of, from north to south, the Great Chazy River, the Little Chazy River, the Saranac River, the Salmon River, the Little Ausable River, the Ausable River, the Boquet River, La Chute, and the Mettawee River (LCBP 1994:State of the Lake—4-5).

***Bedrock Geology***

In order to understand the geology of the Champlain Valley, the geological history of the region has to be explained in the context of the much larger processes that have shaped the surface of the earth. The thin crust or outer surface of the earth, called the lithosphere, is made up of seven major and at least seven smaller plates of dense rock. These floating plates, called continental and ocean plates, move constantly and independently, causing some of them to collide, rift apart, or grind sideways past each other, in a process called plate tectonics. The shifting of the crustal plates has been occurring for perhaps as long as 2 billion years. As a result, the positions, sizes and shapes of the continents and ocean basins are in a state of perpetual change. Ocean basins have repeatedly opened and closed. During plate collisions, mountain ranges have arisen along continental margins, and thick piles of sediments and volcanic materials have been squeezed under tremendous pressure. The results of these events along the eastern North America continent are the Adirondack, Green, and Taconic mountain ranges. The geology of the Champlain Valley and the adjacent physiographic regions tell a history of plate tectonics that is over 1 billion years old (Van Diver 1987:23-26).

About 1.2 billion years ago (BP), the continent that would become North America, called proto-North America, which included the Lake Champlain region, was largely covered by a shallow ocean. About 1.8 billion BP, the oceanic plate to the east of proto-North America began to be drawn under the continental plate. This subduction formed a mountain chain along the edge of the continent at the site of the collision. Over the next 100 million years, this entire oceanic plate was subducted, and the approaching continent collided with proto-North America. This collision, called the Grenville Orogeny, produced a large mountain range that extended from Labrador, Canada, to Mexico. The Grenville Orogeny created an archaic Appalachian Mountain system, similar in size to today's Himalayan Mountains. The core of the Adirondack and Green Mountains were created by this event (Figure 5). This Precambrian bedrock also forms the basement or foundation of the Champlain Valley, but it is not visible in most places because it lies under younger rocks and deep layers of sediment (Isachsen et al. 1991:16).

The Grenville Orogeny ended after all the world's continental plates joined into the Grenville supercontinent. Over the next 400 million years, the archaic Appalachian system was largely eroded away. Having all the continental plates on one side of the earth, however, created an unstable situation. This condition eventually came to an end about 640 million BP, when a large rift basin formed along the Grenville suture zone, which lies on the western margin of the Champlain Valley. Crustal stretching at this time may have created and caused the first movement of numerous faults that are now

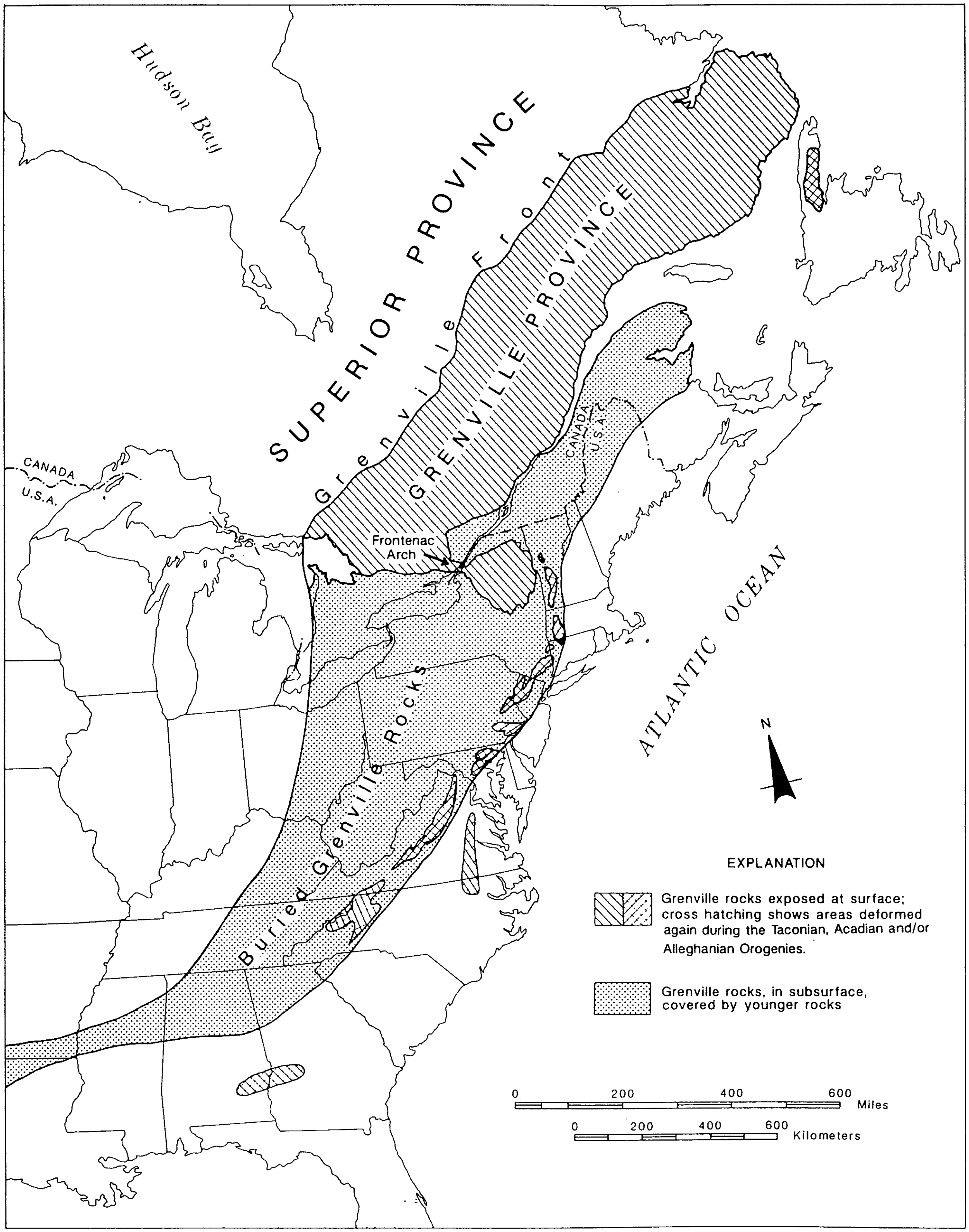


*Figure 5.* The extent of the Grenville Province in eastern North America, which makes up the core of the Adirondack and Green Mountains (New York State Museum 1991:26).

quite visible in the Champlain Valley. A shallow sea covered the area to the east of the rift including the eastern half of the Champlain Valley. From approximately 640 to 560 million BP, the rift basin continued to widen, forming a new body of water called the Iapetus Ocean with a mid-oceanic ridge. The eastern edge of the proto-North American continent, now located at the western edge of the Champlain Valley, became a passive margin and was no longer the eastern margin of the North American continental plate. Marine life flourished in the sea located in the area of today's Champlain Valley; it is recorded in the many fossils found in the sedimentary rocks of the area. Fossils of coral, sea snails, trilobites, and other organisms hint at the shallow tropical ocean that once covered the region (Isachsen et al. 1991:16-17).

Starting about 550 million BP, a large volcanic island arc, called the Taconic Island Arc, developed between the ocean plates in the Iapetus Ocean. The eastern ocean crust of the proto-North American plate was subducted beneath the Taconian Island Arc. About 460 million BP, the Taconic Island Arc collided with the North American continent. This collision, called the Taconic Orogeny, produced the Taconic Mountain Range along the eastern margin of the southern Champlain Valley. At the beginning of the collision, the eastern edge of proto-North America was bent upward in the west and down in the east. The uplift on the west arched and fractured the edge of the continent, raising the carbonate rocks of the continental shelf above sea level. As the oceanic crust plunged beneath the North American plate, it pushed the eastern bedrock up and on top of the western bedrock, stopping along the eastern shores of today's Lake Champlain. The enormous pressures and high temperatures accompanying the collision caused thrust faults with great north-south fractures deep in the bedrock, still evident today throughout the Champlain Valley (Isachsen et al. 1991:17-18).

The next two mountain-building episodes occurred during the creation of the supercontinent Pangaea and the closing of the Iapetus Ocean. The Acadian (390 million BP) and Alleghanian (320 million BP) Orogenies created the Applachian Mountains and uplifted the Green and Taconic Mountain Ranges. These mountain-building episodes caused additional folding and melting of the bedrock within the Green and Taconic Mountains. About 200 million BP, Pangaea began to break apart, forming a new Atlantic Ocean. When Pangaea separated into today's continents at approximately 220 million BP, the incident caused faulting and volcanism in the Champlain Valley. The deep trench in which Lake Champlain lies today is a block fault, or a block of bedrock that has dropped. This event was the result of crustal stretching that occurred when the North American continent separated from Pangaea (Isachsen et al. 1991:18-20). As the continents moved apart, erosion once again wore down the mountain systems. In the last 200 million years, the mountains surrounding Lake Champlain (Figure 6) have probably been reduced to at least half their original height (Johnson 1984:12).

Lake Champlain and its immediately adjacent bottomlands contain the most nearly horizontal and least altered rocks in the region. Limestone, dolomite, and shale are abundant over the entire region. In places, however, these sedimentary rocks were

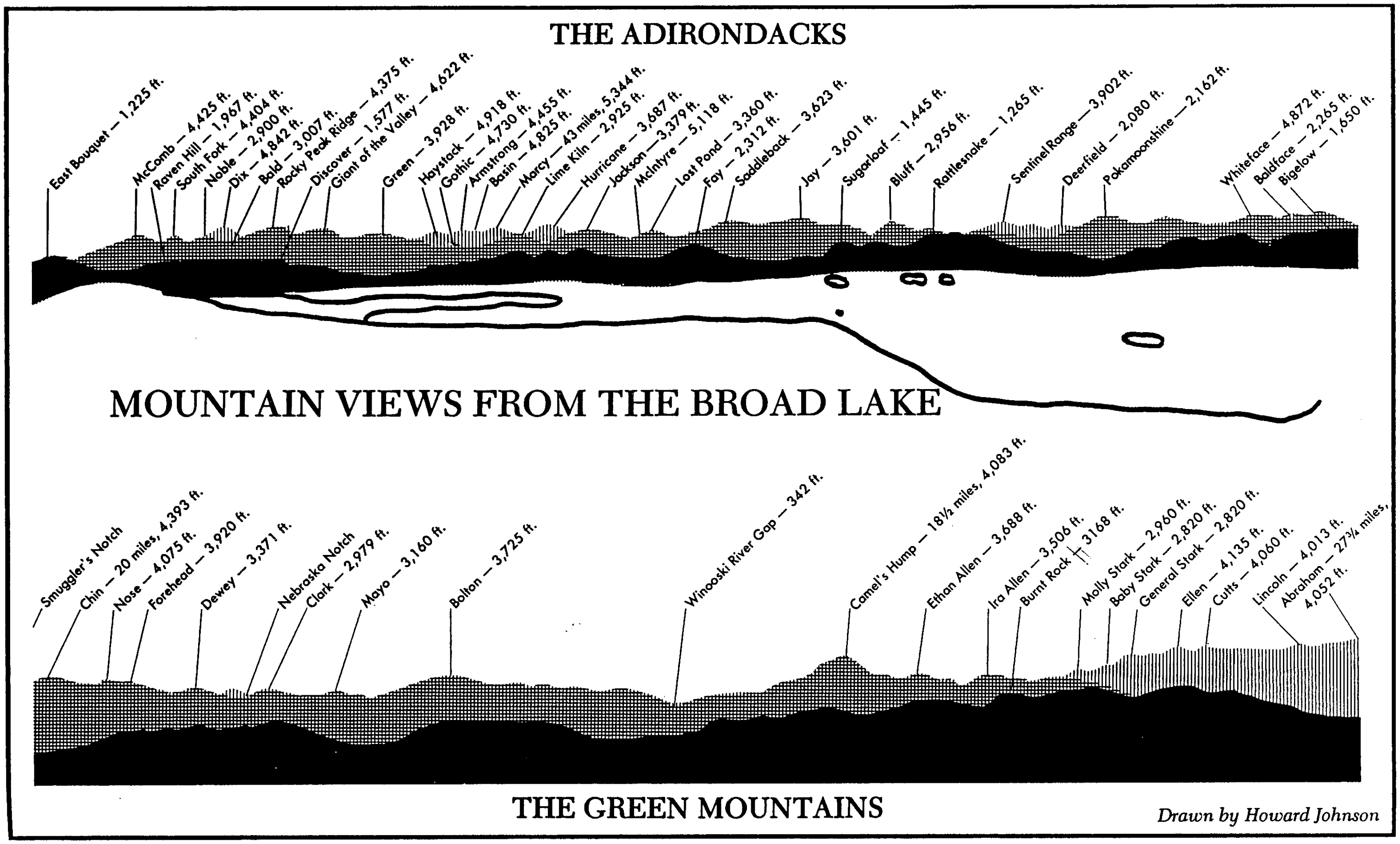


*Figure 6.* Mountains surrounding the Broad Lake segment of Lake Champlain (Hill 1995:278).

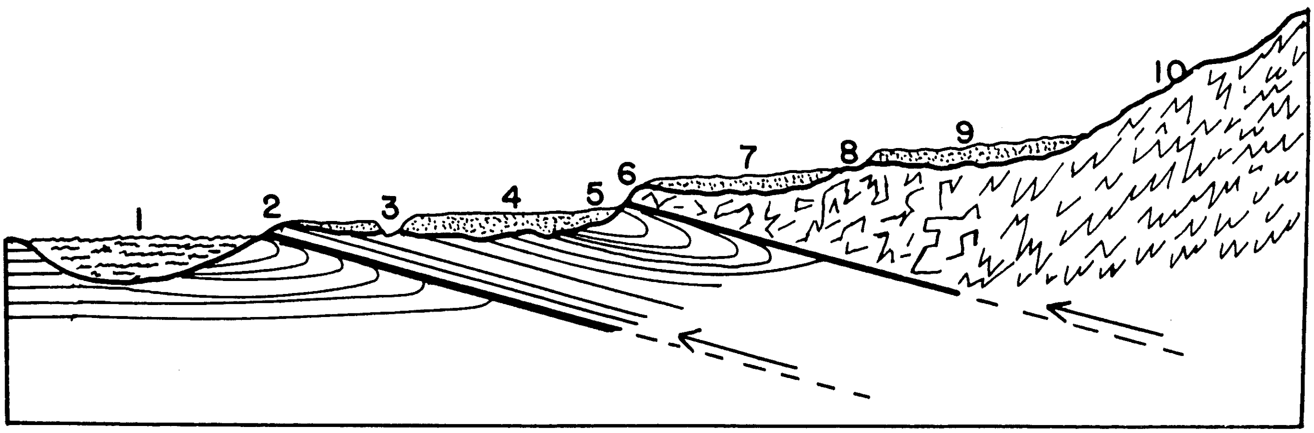


*Figure 7.* Cross section of the geology and surface deposits between Lake Champlain and Mount Mansfield, Vermont (Meeks 1986:64). (1) Lake Champlain. (2) Champlain thrust fault. (3) Winooski River. (4) Champlain Sea delta. (5) Essex Junction, Vermont. (6) Hinesburg thrust fault. (7) Fort Anne delta. (8) Jericho, Vermont. (9) Coveville delta. (10) Mount Mansfield.

metamorphosed into quartzite, marble, and slate during mountain-building episodes. The rocks visible along the New York shore are largely marine sedimentary rocks of the Paleozoic Era to the Late Proterozoic Era (1 billion BP to 260 million BP). These rocks were created from sediments deposited in shallow seas on the proto-North American continent and have remained tectonically passive. The rocks along the Vermont shore are also marine sedimentary rocks of an ancient continental shelf and slope, but also include rift volcanic and rift sedimentary rocks that are Ordovician to Late Proterozoic (1 billion to 440 million) in age (Figure 7).

***Surface Geology***

The soils and landscape of the Champlain Valley have been strongly influenced by the immense continental glaciers that repeatedly covered much of the northern portion of North America during the Pleistocene Epoch (1.6 million BP to 11,000 BP). Four major glacial stages occurred in North America during this period, each of which is named for the state in which deposits of the stage are particularly well exposed. Three interglacial periods separate the glacial stages. The most recent glacial stage was called the Wisconsin stage and is divided into the Early Wisconsin and Late Wisconsin stages. The glacier of the Late Wisconsin stage covered the Champlain Valley with ice 2.0 km (1.2 mi) thick called the Laurentian ice sheet. The weight of this continental glacier depressed the landmass of northeastern North America, sinking much of the Champlain Valley well below sea level.

As the glacier began to retreat northward and melt, large meltwater lakes were formed in the Hudson and Champlain Valleys (Figure 8). Several lake stages occurred during the last deglaciation. The first was the formation of a pro-glacial lake known as Lake Albany, which extended south of Glens Falls, New York, and drained out through

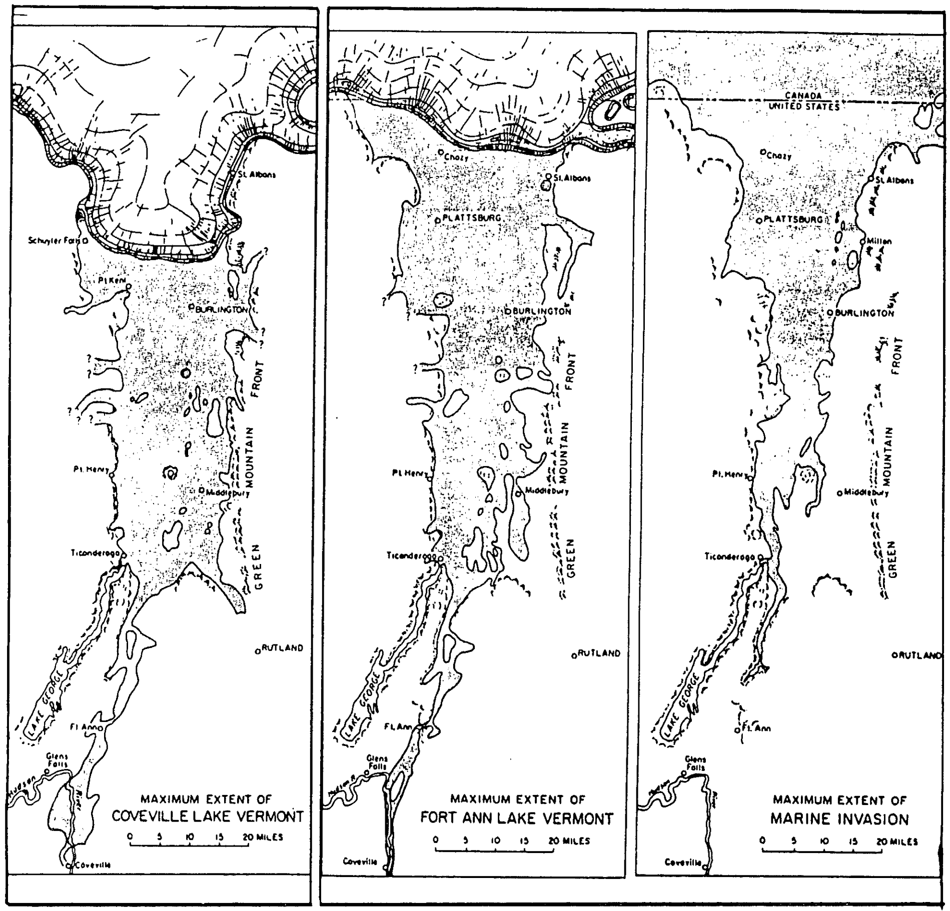


*Figure 8.* Late Quaternary evolution of the Champlain Valley (Meeks 1986:48-49).

the Hudson River at approximately 13,000 BP. As the glacier continued to melt, it retreated northward, and a larger region of the Champlain Valley known as Lake Coveville was covered by pro-glacial meltwater. During the Coveville stage, the lake drained southward through an outlet channel at Coveville, New York, and filled the southern Champlain Valley to an elevation of 183 m (600 ft) above the current sea level. The glacier continued to retreat northward, and the lake level slowly dropped until a more northerly outlet near Fort Anne, New York, formed at 143 m (470 ft) in elevation, forming Lake Fort Anne. Lake Coveville and Lake Fort Anne are often collectively known as Lake Vermont.

As the glacier moved steadily northward, the elevation of the Champlain Valley began to rise slowly as the weight of the ice was removed, a process called isostatic rebound. After the final glacial retreat, Lake Vermont was lower in elevation than the contemporary sea level. Marine waters flowed up the Richelieu River into Lake Vermont, turning it into the Champlain Sea by about 12,000 BP (Parren 1988:1). As the glacier retreated, it deposited glacial till throughout the valley in a wide variety of particle sizes, ranging from clay to large boulders. Most of the soils deposited in and immediately adjacent to Lake Champlain consist of well-sorted lake and marine sands and gravel, including beach gravel and deltas. These deposits both commonly occur above bedded silts and clays. The lake bottom and the surrounding area are also strewn with cobbles and boulders that were distributed throughout the valley by ice (Stewart 1973:22-23).

During the Champlain Sea phase, the Champlain Valley began to rebound rapidly to establish a state of equilibrium. Shoreline features of the Lake Vermont and Upper Marine stages of the Champlain Sea can now be seen surrounding the northern part of the valley well above Lake Champlain. These features are parallel to one another, leading researchers to conclude that the valley was rebounding at a constant rate across the area until the end of the Upper Marine stage. During the subsequent periods of the Champlain Sea, however, the northern end of the valley rebounded at a faster rate, possibly because it was depressed farther and over a longer period of time (Chapman 1937:116-7). The Champlain Sea underwent several stages; the lowest was the Port Henry stage, when the surface of the water was 24.4 to 27.5 m (80 to 90 ft) below the present lake level.

By 10,200 BP, the Champlain Valley's rebound had surpassed the elevation of the Richelieu Threshold, the fulcrum between the Champlain Valley and the Richelieu River, prohibiting ocean water from flowing into the valley. Shortly thereafter, the Champlain Sea was flushed of its saltwater and once again became a freshwater lake, Lake Champlain.

By about 8000 BP, Lake Champlain reached possibly its lowest level ever. The rate of rebound occurring at that time was about 10 cm over 1 km (1 ft over 2 mi) each year. Soil and peat cores taken throughout the Champlain Valley have established the water levels of Lake Champlain for different time periods. Analysis of the core data has revealed that at approximately 8000 BP Lake Champlain was 6.7 m (22 ft) below the present lake level; at 6824 BP about 5.2 m (17 ft); and at 2778 BP about 1.5 m (5 ft) (Howard and Worley 1977:53). The Champlain Valley is still rebounding today, but at a much slower rate (Thomas 1990).

The soils throughout the Champlain Valley originate from the piles of clay, silt, sand, gravel, and rocks that were left along the retreating glacier's margins during the last ice age. Streams and rivers have pulverized and redistributed this material and deposited the sediment in what is today Lake Champlain. The bottom sediments of the lake range in thickness from 0 to over 125 m (0 to over 410 ft). Over the last 12,000 years, these sediments have been deposited, re-suspended, and moved by bottom currents and the upward movements of groundwater and gases. Evidence of these actions is present in the surface topography and soil profiles of the lake bottom.

### *Late Quaternary Climate and Ecology*

During the last 13,500 years, the Champlain Valley has undergone a tremendous transformation, largely due to changes in global climates that directly affected the average weather patterns of the region. Climate is the most influential factor in determining the vegetation, animal life, soils, and geomorphology of a particular region. All of these elements also determine the human population an area can support. The Champlain Valley has undergone several climatic changes since the retreat of the Laurentian ice sheet that covered the region. Prior to 13,500 BP, a glacial climate characterized the Champlain Valley and the rest of the Northeast. The landscape was dominated by ice and snow with very little exposed soil, and the ground was frozen year-round with an average temperature below 0°C (32°F) every month of the year. Only a very limited number of animals and plants could survive in this harsh climate (Thomas 1994:38).

By roughly 12,600 BP, the Laurentian ice sheet had retreated north of the Champlain Valley, leaving behind a tundra climate in which the warmest month of the year averaged between 0 and 10°C (32 and 50°F). The developing soils, frozen most of the year, sustained a barren landscape with a few mosses, lichens, and stunted shrubs. These hearty small plants were shallowly rooted so that the frozen subsoil was of no hindrance. The plants remained dormant during most of the year and had the ability to mature and reproduce very quickly during the short, cool summer. These summers did not provide sufficient heat to allow ground thawing deeper than 30 cm (1 ft). As the climate moderated, the number and variety of plant and animal species in the Champlain Valley increased (Thomas 1994:40).

As the Laurentian ice sheet withdrew farther north between approximately 11,300 and 10,000 BP, a subarctic climate dominated the Champlain Valley. With less than four months of the year averaging over 10°C (50°F), a more temperate climate existed in the region, but the weather patterns were still greatly affected by the ice sheet to the north that produced severe winters. The region was constantly moist from precipitation that fell throughout the year. With the warmer climate, the region could support a lush growth of tundra vegetation, attracting a wider variety of animal life and Paleo-Indians, the first humans to move into the Champlain Valley (Thomas 1994:40).

Between approximately 10,000 and 9000 BP, the climate of the Champlain Valley had moderated to the point that the average temperature of the year's warmest month was between 10 and 22°C (50 and 72°F). There was a scatter growth of spruce, fir, larch, and birch, with open areas consisting of grasses, sedges, willow, and alder. Moose, beaver, lynx, porcupine, snowshoe rabbit, spruce grouse, mice, and voles probably migrated from the south as small stands of trees began to take hold. The Champlain Sea that covered the basin was able to sustain all types of marine mammals, such as whales, walrus, and seals. Cold climate fish and mussels also flourished (Parren 1988:1-2). As the climate changed, the area developed an open, park-like, spruce/fir forest, which sustained mastodons, woolly mammoths, moose-elk, woodland caribou, musk ox, elk, wolf, and smaller arctic animals, such as arctic shrews and lemmings (Thomas 1994:40).

Approximately 9000 BP, the valley's climate warmed enough to support a pine-dominated forest of red and jack pine. The continental forest climate provided less precipitation throughout the year, with warmer summers but cold winters. Seasonal temperature extremes may have been characteristic of this period. Current estimates are that the average solar radiation was 4.4°C (8°F) higher in July and 4.4°C (8°F) lower in January in comparison to today's extremes. By 9000 BP, the cold-adapted megafauna, including woolly mammoth, mastodon, and moose-elk, either became extinct or moved northward out of the Champlain Valley, following the receding glacier and tundra environment, as did the musk-ox, elk, and caribou. The shorelines of Lake Champlain had become completely forested with white pine, hemlock, oak, poplar, elm, ash, alder, birch, sweet gale, and ferns (Thomas 1994:41).

After 8200 BP, these seasonal radiation extremes decreased towards more modern values. The amount of precipitation began to increase slowly, as did the average temperatures throughout the year. Small seasonal temperature variations and mild winter temperatures characterized this climate period, called continental forest climate-hot summer. The water level of the Champlain Sea about 8000 BP was possibly the lowest the basin had been during the Holocene Epoch (11,000 BP-present). There was not only a transition in basin level, but also the beginning of a hypsithermal period, a time when the climate was much drier and warmer then it had ever been in the Champlain Valley during post-glacial times. With this drastic change in climate came another change in wildlife, aquatic life, and vegetation. The number of pines dropped sharply, giving way to a high percentage of deciduous trees, including oak, beech, birch, sugar maple, elm, and ash, although hemlock and white pine remained the dominate conifers (Thomas 1994:41).

Between 7500 and 5300 BP, weather conditions changed greatly, creating a fairly warm and moist climate. Precipitation may have been as much as 25 to 30 percent higher than at present, and major flooding was probably common along the river systems draining into Lake Champlain. An oak-hemlock forest dominated the Champlain Valley during this period (Thomas 1994:41).

The subsequent period, dating from 5300 to 2900 BP, was marked by a climatic shift to drier conditions. The average summer temperatures were from 2 to 4°C (4 to 7°F) higher than at present, while winter temperature extremes diminished from the previous period. The tributaries of Lake Champlain became entrenched, and flooding was infrequent due to a significant decrease in precipitation. From 5000 to 2100 BP, an oak-hickory forest dominated the area. The hypsithermal period ended about 3000 BP; as the climate cooled, yet another change in wildlife, aquatic life and vegetation took place, giving rise to an oak-chestnut forest and animal populations which remained constant until the time of European discovery (Parren 1988:2; Thomas 1994:41-42).

Warmer temperatures prevailed in the region between 2810 and 1730 BP, supporting an oak-chestnut forest that remained until it was clear-cut during the nineteenth century. Between 1725 and 1250 BP, average temperatures increased again. Around 1250 BP, precipitation levels increased throughout the Northeast, but no substantial changes occurred in vegetation or animal life. The water level of Lake Champlain dropped between 1250 to 450 BP, a result of a decrease in the amount of precipitation and an increase in average yearly temperatures. A shift to cooler and moister conditions began about 450 BP, a period called continental forest climate-cool summer that has continued to the present. For the lack of data, little can be said about the changes in mammal, reptile, amphibian, bird, and fish populations that must have occurred since the forest closed around Lake Champlain (Thomas 1994:42).

Owing to the protection offered by mountains on three sides and the moderating effect of Lake Champlain, the climate in the Champlain Valley is the mildest in Northern New York and Vermont. The temperatures of the region are moderated year-round by the lake. Cool breezes blow inland off the lake in the summer. In the winter, the lake holds more heat than the land and air, so nearby land areas stay warmer as well. Of all the surrounding regions, the Champlain Valley receives the least amount of precipitation. Ample rainfall, moderately warm summers, and fairly cold winters are characteristic of the Champlain Valley. The north-south orientation of the Champlain Valley creates prevailing winds in the same direction. They tend to blow from the south in the summer, although north winds and south winds are about equal in frequency in the winter. The frost-free season is longer, the precipitation less, and the temperatures not so extreme in the Champlain Valley as in the other surrounding regions (Thomas 1994:42).

The current climate in the Champlain Valley varies from the surrounding geographic regions because of three main factors: the distance from the valley to the North Atlantic Coast, the shape and orientation of the valley, and the moderating influence of Lake Champlain. When the prevailing winds from the west reach the mountains and rise to move over them, the air is cooled, causing rain in the summer and snow in the winter. For this reason the higher elevations surrounding the valley receive greater amounts of precipitation. The average annual precipitation in the mountains reaches over 127 cm (50 in), compared with about 76 cm (30 in) in the valley. The growing season also varies in different parts of the valley, lasting only 105 days in the higher, cold pockets of the basin, in comparison to 150 days along Lake Champlain. The longer growing season coupled with fertile soil makes the valley a rich agricultural area (LCBP 1994:State of the Lake—5-6).

***Non-Native Aquatic Nuisance Species***

One of the most significant effects of human activity on Lake Champlain has been the relatively recent introduction of several non-native aquatic nuisance species. These plants and animals, most of which were inadvertently carried into the Champlain Valley via the Champlain Canal and the Richelieu River, are causing severe problems for the lake's cultural resources. Although zebra mussels are demonstrating the most profound impact on the lake's shipwrecks, other organisms such as water chestnuts and Eurasian watermilfoil, introduced to Lake Champlain in the 1940s and 1962 respectively, have also created problems. These nuisance plants form dense mats on the surface of the water that severely restrict boat traffic and limit access to the lake's underwater cultural resources. Such conditions make it extremely difficult to locate and document submerged resources in the shallow waters where the plants grow (LCBP 1994:Nuisance Aquatics—1-6).

No methods have yet been found that will successfully eradicate these invaders from the lake system or prevent other non-native nuisance species from entering. The

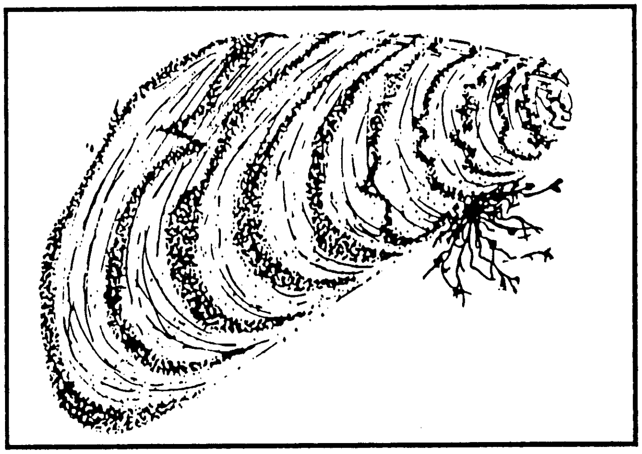

*Figure 9.* Zebra mussel (Cohn 1996:11).

nature of any species introduced to Lake Champlain in the future and their effect on the cultural resources are unknown, but past experience has shown that control of any non-indigenous species is extremely difficult.

***Threat of Zebra and Quagga Mussels***

The most profoundly disruptive phenomenon to have occurred in Lake Champlain during human history is the introduction of the zebra mussel (*Dreissena polymorpha*), a small freshwater mollusk native to the Eurasian Caspian and Black Seas (Figure 9). The zebra mussel was accidentally introduced to North America in 1987, ejected into Lake St. Clair with the ballast water from a transatlantic vessel in the same manner as many other non-native species now thriving in North America. Zebra mussels were first discovered in the Great Lakes region in 1988. Since then, the mussels have spread across eastern North America by following the flow of water, by attaching themselves to boat hulls, and by the inadvertent transport of zebra mussel juveniles, called veligers.

In 1993, zebra mussels were found in the southern section of Lake Champlain and in the north near Rouses Point, New York. After gaining a foothold in the Champlain Valley, they have rapidly expanded their range within the lake. The microscopic planktonic zebra mussel larvae, which are free-swimming, can be unknowingly transported in bait buckets, bilge water, scuba equipment, and boat engine cooling systems. Once the mussels mature enough to grow a shell, they settle out of the water column and generally attach to a hard surface. The mussels grow rapidly, with adult colonies reaching densities as high as 700,000 mussels per 1 $m^2$ (1.2 $yd^2$). Zebra mussels encrust boat hulls, engine cooling systems, and intake/outtake pipes, and they can cover the lake bottom within their optimum depth range. These mussels also threaten to encrust any historic object lying on the lake bottom, thus presenting the single largest threat to Lake Champlain's cultural resources. Once the mussels have covered these resources, documentation is nearly impossible, an eventuality which has generated the current urgency to locate, inventory, and document the collection of cultural resources on the bottom of Lake Champlain (Hauser 1995:4; LCBP 1994:Nuisance Aquatics—3).

In February 1995, LCMM was selected to identify the effects of zebra mussels on underwater historic shipwrecks and to outline the available methods for protecting and treating these resources. The museum sent delegates to the Fifth Annual Zebra Mussel Conference in Toronto, Canada. The delegates produced a comprehensive report that presented an overview of all known information about the potential impact of zebra mussels on historic shipwrecks, as well as known protection and treatment options, and made recommendations about the probable effects of zebra mussels on the lake's historic shipwrecks (Cohn 1996).

LCMM has also worked with the joint New York/Vermont Department of Environmental Conservation Zebra Mussel Monitoring program. At the museum's suggestion, two shipwreck sites were included in the monitoring program. The additional sites significantly expanded the database that the states of Vermont and New York were compiling about the density and distribution of zebra mussel veligers. The museum established a water analysis laboratory to test for the presence and density of the microscopic zebra mussel veligers at four shipwreck sites around the lake. The facility was staffed by a lab technician/educator who performed the dual role of analyzing the water samples and interpreting for the public the issues surrounding zebra mussels and techniques for slowing their spread to other Vermont and New York water bodies. Museum visitors were oriented to basic water quality testing and the connection between zebra mussels, historic shipwrecks, and Lake Champlain's ecosystem (Cohn 1996:9).

The results of LCMM's zebra mussel survey did not suggest promising results for Lake Champlain. The study determined that Lake Champlain's water chemistry and food supply is sufficient to sustain zebra mussels throughout the entire lake. Despite all of the research in the biological control of zebra mussels, no easily applicable method can be used to eliminate the zebra mussel or to protect Lake Champlain's submerged cultural resources. Since the study was completed in 1995, no solution to the problem has been discovered, and zebra mussels are now found in even greater numbers throughout Lake Champlain (Cohn 1996:29 and 51).

In 1991, the quagga mussel (*Dreissena bugensis*), another non-native mussel, was discovered in the Great Lakes. This species is now present in the Erie Canal System and is migrating eastward. No one knows how long it will take for quagga mussels to reach Lake Champlain, but it is almost inevitable that they will become part of Lake Champlain's growing list of invasive species. The habitat of quagga mussels ranges from 0 to 107 m (0 to 350 ft) in water depth, which includes almost the entire bottom surface of Lake Champlain.

# PHYSICAL LIMNOLOGY OF LAKE CHAMPLAIN

### *Previous Studies*

Over the past 150 years, hundreds of projects have concentrated their efforts on studying different characteristics of Lake Champlain. Unfortunately much of the data on the lake's physical characteristics either was never published or was published in very limited numbers and has not yet been fully analyzed. Due to these circumstances, it is difficult to discuss the scope of the previous physical limnology studies of Lake Champlain without conducting a very time-consuming documentation survey. The most comprehensive volume on this subject is *Limnology of Lake Champlain* by Glenn E. Myer and Gerhard K. Gruendling (1979). Although this volume is outdated, it still remains the only guide to the physical study of Lake Champlain. This report was intended to serve as an environmental baseline for future studies, a duty which it has continued to perform to the present. Since 1979, government agencies and area universities have conducted an enormous amount of research on the physical limnology of Lake Champlain. Data regarding the physical characteristics of Lake Champlain has been compiled by the University of Vermont, Middlebury College, CUNY at Plattsburgh, and state agencies of New York and Vermont.

The data collected during the Lake Survey can add greatly to the previous studies of the physical limnology of Lake Champlain. The data collected during the Lake Survey may inadvertently prove significant in other areas of research. This situation depends strongly upon the search and documentation methods used during the Lake Survey. The primary research tool for the initial survey of Lake Champlain was side scan sonar and a data-capturing computer. In addition to information concerning cultural resources, the computer logged data about the lake's bottom sediments, bottom geomorphology, and depth. All of this information is significant to limnology studies of Lake Champlain.

### *Surface Bottom Sediments*

Several studies on the surface bottom sediments of Lake Champlain have been completed, but most of these studies have been restricted to selected regions of the lake or a very limited number of stations throughout the lake. In the early 1970s Professor Allen Hunt of the Department of Geology at the University of Vermont performed a comprehensive study of the entire lake bottom using standard instruments and consistent statistical spacing. During the study, about 2000 samples of surface bottom sediments were taken from sites spaced approximately 945 m (3100 ft) apart in the north-south direction and 823 m (2700 ft) apart in the east-west direction.

The side scan sonar data collected during the Lake Survey can be used to obtain a gross characterization of the bottom sediments. The sonar data will not provide an accurate determination of sediment composition, but it can provide comprehensive information about the entire lake bottom. The sonar echo that returns to the towfish reflects the lake bottom's density. For example, gravel will absorb little sound and therefore returns a strong signal to the towfish. This situation would provide a clear signature on the side scan sonar, which would distinguish a gravel bottom from a clay, sandy, or silty bottom.

***Lake Bottom Geomorphology***

The hydrodynamics of Lake Champlain are still very much unknown. The water of Lake Champlain is constantly moved by complex processes that change both seasonally and over longer periods of time. In the last two decades scientists have begun to study these flow patterns within the lake, which control the transport of sediment, nutrients, and toxic substances in Lake Champlain. Most of these studies have examined actual movement of the lake water at varying depths. A few of these studies have also looked at bottom sediment features created by currents (LCBP 1994:State of the Lake—7).

The greatest benefit that the Lake Survey side scan sonar data can provide is the identification of the location and geomorphology of bottom sediment features. Varying bottom currents affect the lake's sediment erosion, transport, and deposition, but they create predictable geomorphic features. Oceanographers have identified and defined a number of bottom sediment features related to predictable situations. Most of these features can be found in the bottom geomorphology of Lake Champlain. The most efficient and effective way to map these features is with side scan sonar and computer technology that can create a mosaic of the lake bottom. This type of research has been completed in a limited fashion in Lake Champlain only during the last few years. The Lake Survey can potentially accelerate this research.

Previous studies have generated several facts about Lake Champlain. For example, the general flow of water in the Main Lake is from south to north. Water movement is different in the Restricted Arm, however, where the water generally moves south and west to reach the Main Lake through the narrow openings between the Champlain Islands and the modern transportation causeways. The variation of the flow patterns in the Restricted Arm changes with the seasons and the weather. Like other deep lakes, Lake Champlain stratifies in the spring and summer into water layers with distinctly different temperatures (Figure 10). In the spring, the sun warms the surface of the lake. This warmer water is less dense than the colder, deeper water, so it floats on the surface and forms a layer called the epilimnion. This layer is typically about 10 m (33 ft) deep in the Main Lake during the summer. Below this layer sharp transitions in temperature define the boundary of the next layer, called the metalimnion, and the much colder waters below, called the hypolimnion (LCBP 1994:State of the Lake—7).

Wind and temperature primarily drive the water currents in the lake. Once the lake stratifies by temperature in the early summer, changing wind directions and speeds can set up an internal wave called a seiche within the lake. This large wave, which involves water at the surface and at deeper depths, causes the general northward flow of bottom water to reverse direction. A few days of consistent winds from the south gradually pile up warm surface waters at the northern end of the lake, pushing the colder, deep water to the southern end of the lake. When the wind slows or reverses its direction, surface water flows southward and the bottom current flows northward,

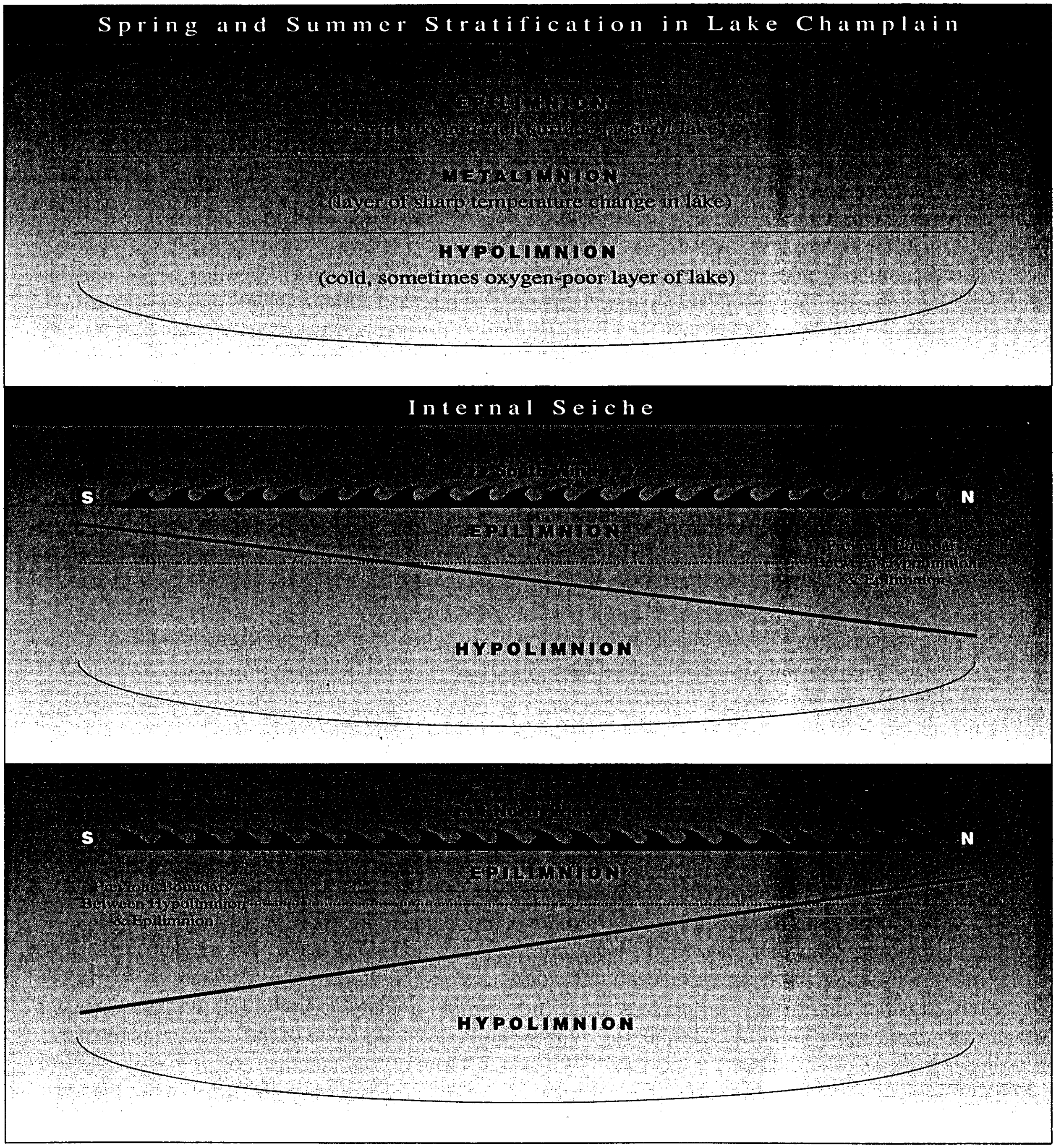


*Figure 10*. Lake stratification and the internal seiche (Basin Program 1994: Facts about the State of the Lake – 6).

causing a sloshing motion of the lake water. This very long wave creates currents of up to 1.6 kmph (1 mph) in the Main Lake. The internal seiche causes a mixing of water and also a turbulent resuspension of sediments that creates unique sedimentary features on the lake bottom. As the surface waters cool in late fall, they become more dense than the underlying water, causing them to sink. As the denser, colder water sinks, it mixes with the water below. In the winter the temperature of the entire lake approaches 4° C (39° F), while the surface waters are cooled to the freezing point and form ice (LCBP 1994:State of the Lake—7-9).

The Restricted Arm is shallower and smaller than the Main Lake, resulting in different thermal stratification and water movement patterns. This area also has an internal seiche and variable currents, but they are not as pronounced as those observed in the Main Lake. Most of the Restricted Arm is readily mixed with strong winds (LCBP 1994:State of the Lake—9).

Some bottom sediment features are caused by the movement of groundwater rather than water currents. These features can provide significant information about the locations of groundwater sources in Lake Champlain. Bottom sediment features created by groundwater movement also reveal the whereabouts of faults that lie deep within the underlying bedrock.

***Bathymetry of Lake Champlain***

To date, Hunt and Boardman (1968) have created the most detailed bathymetric contour map of Lake Champlain, although more detailed bathymetric mapping has been completed for selected areas throughout Lake Champlain. Hunt and Boardman's map has 3.1-m (10-ft) contour intervals and a scale of 1:80,000. The Lake Survey data will be able to provide a highly accurate and detailed two-dimensional or three-dimensional contour map of the lake bottom.

### *Native American History*

The Champlain Valley's cultural history began nearly 11,300 years ago, when Paleo-Indians moved into the region following the retreating Laurentian ice sheet. Native Americans have been living in the Champlain Valley continuously from that time to the present. The lake has served as a resource for food, water, tools, spiritual guidance, and transportation. During prehistory, Native Americans lived in small campsites and villages along the lake's shoreline, utilizing specific techniques and tools to extract the lake's resources. Vestiges of their occupation sites and lakeside workshops have been discovered throughout the Champlain Valley.

An unknown number of prehistoric sites now lie submerged as a result of changing lake levels and isostatic rebound in the Champlain Valley. These sites have not been well-documented, and this lack of information has greatly affected modern understanding of Native Americans' utilization of the lake's resources. There is no doubt that Lake Champlain and its preceding water bodies have played a significant role in the lives of all Native Americans living in the Champlain Valley.

Paleo-Indians were probably the first to use watercraft on Lake Champlain, then part of the Champlain Sea, hunting and fishing along the lakeshore and presumably building small skin craft to harvest the lake's food resources. Generations of their descendents, the Archaic and subsequently the Woodland peoples, built small craft from tree bark, skins, or hollowed-out logs (Figure 11). Unfortunately, few examples of prehistoric craft have been found, and little is known about their design, appearance, or use. Evidence of bark and skin boats has not been found in the archaeological record, since the organic materials from which they were made are not preserved well in the climate of this area. At least a dozen dugout canoes, however, have been found in lakes and ponds throughout the Champlain Valley. These simple boats probably date between the Late Woodland period (2900-400 BP) and the nineteenth century (Crisman 1986:6).

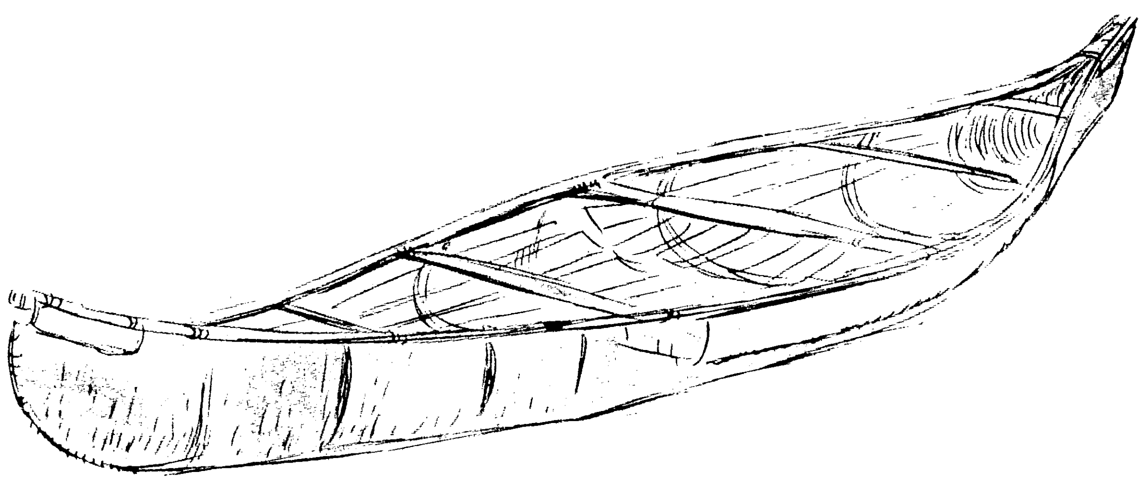

*Figure 11.* Birchbark canoe (Adney and Chapelle 1983:53).

Early historical documents reveal that Native Americans referred to Lake Champlain by several traditional names. The Mohawk called the lake *Rodsio Canyatare*, which means "cowardly spirit's lake." Western Abenakis are known to have used the name *Petonbowk* or *Petow Bowk*, meaning "waters that lie between," a reference to the mountains rising to the west and east of the lake. The Mahicans called Lake Champlain *Petow Pargow*, meaning "double pond" or "two great ponds joined." The Native Americans who used Lake Champlain recognized it as a body of water divided into three major segments. The South Lake was called the *Andiarocte*, *Yotenyatarokte*, or *Caniaderi-Oit* by the Mohawk, which means "where the lake narrows," "tail of the lake," "dead end of waterway," "where the lake tapers off to an end," and "end of the lake." The Main Lake was called the *Caniaderi Guarunte*, *Caniadari Quaront*, *Kanyatatakwaronte* or *Ganyadaragwa-ronde* by the Mohawk, which means "the lake with a bulge in it" or "wide lake" (Huden 1962:24, 42, 74, 184, 212, 298).

The Western Abenaki believed that Tabaldak, the Creator, made the world, but that Odzihozo, the Man Who Made Himself, created the Champlain Valley. Before he had legs, Odzihozo dragged himself around, gouging out the Champlain Valley and the river valleys in the land's surface. He piled up dirt with his hands to build the Adirondack, Green, and Taconic Mountains. Finally, he made Lake Champlain and was so satisfied with his work that he decided to stay there forever. Climbing on a bedrock knob in the middle of the lake, Odzihozo transformed himself into a rock. The Abenaki called this rock the Guardian's Rock, and for generations they have left offerings of tobacco there. Today this formation, located just west of Burlington, Vermont, is also known as Rock Dunder.

Native American mythology indicates that Lake Champlain is also the home of a number of underwater creatures, such as *Manôgemassak*, or "little people," and a giant serpent, currently called Champ by the general public. Modern Western Abenaki consider Lake Champlain a sacred place (Calloway 1989:23). The daily importance of Lake Champlain to Native Americans living in the Champlain Valley today has diminished greatly since even their grandparents' time, but the lake still holds great importance to their culture and heritage.

### *Paleo-Indian Period (11,300-9000 BP)*

The first Native Americans, called Paleo-Indians, probably moved into the Champlain Valley from the Hudson Valley after the last continental glacier had retreated from the region about 11,300 BP. Marine waters had already flooded the Champlain and St. Lawrence Lowlands, creating the Champlain Sea before the Paleo-Indians arrived in the area. Their movement seems to have been gradual, brought about by both population growth and the northward migration of animals and plants in the wake of the receding Laurentian ice sheet. The tundra environment of the Champlain Valley supported a lush growth of tundra vegetation, attracting a wide variety of animals including mastodons, woolly mammoths, and large herds of caribou. The first Paleo-Indian settlers in the region were hunters of these large herd animals (Haviland and Power 1994:33-34).

Paleo-Indians ranged over large areas, including upland and lowland regions, following the seasonal migration routes of the tundra's herd animals. These animals moved back and forth between the upland and lowland regions following the major watercourses. Isolated Paleo-Indian projectile points are most frequently found near these drainages. Paleo-Indian campsites, however, are never found in the bottoms of river valleys, but on well-drained sand, including old marine beaches, deltas, and outwash terraces along the valley's margins. Sites with a good view of the surrounding territory and sometimes in close proximity to a wetland also seem to have been preferred. Some Paleo-Indian sites at the southern end of the Champlain Valley may be submerged under the present Lake Champlain, due to subsequent changes in the basin's water level (Haviland and Power 1994:34).

During the Paleo-Indian Period, Native American populations in the Champlain Valley seem to have been small, and densities were probably less than ten people per 100 km$^2$ (62 mi$^2$). Based on recent studies of northern hunters, these populations were probably broken up into small family groups, such as single families or small bands consisting of a few related families. Perhaps most of the people lived near the Champlain Sea, with its rich marine resources. No direct evidence has been found to suggest how Paleo-Indians used the marine resources of the Champlain Sea, but it is unlikely that they ignored the large populations of seabirds, fish, and marine mammals. As early as 9000 BP, people were harvesting food offshore along the Northwest Coast. Early sites have yielded harpoons, along with the remains of sea mammals, marine fish, and seabirds, suggesting also the existence of boats (Kopper 1986:210). Whether the Paleo-Indians of the Champlain Valley had boats is unknown, but it is likely.

Very few Paleo-Indian sites have been discovered throughout the Champlain Valley; indeed, this period remains a mystery for much of the Northeast. Much of the speculation about their diet, technology, settlement patterns, site types, and religion is based on a small number of sites and the ethnographic records of modern arctic and tundra hunters. It is unknown at this point if any cultural resources from this period exist submerged in Lake Champlain (Haviland and Power 1994:37).

### *Archaic Period (9000-2900 BP)*

As the climate became warmer in the Champlain Valley, the Paleo-Indian way of life changed because of the climate's affect on the wildlife and plants in the region. Over 100 species of large mammals, such as the mammoth, mastodon, and moose-elk, became extinct. Other animals, including the caribou and musk ox, moved north with the tundra as the Champlain Valley became densely forested. The animals upon which the Paleo-Indians depended for food, clothing, and shelter were no longer available to them, and the Paleo-Indians had to adapt to the forested environment that was developing in the region. The animals that remained in the forest were generally smaller, more solitary in their habits, and not as easy to hunt. By 9000 BP, the Paleo-Indians had developed a new way of life that is today called the Archaic culture, which characterized the period from 9000 to 2900 BP. This period is further divided into the Early Archaic Period (9000-7500 BP), the Middle Archaic Period (7500-600 BP), and

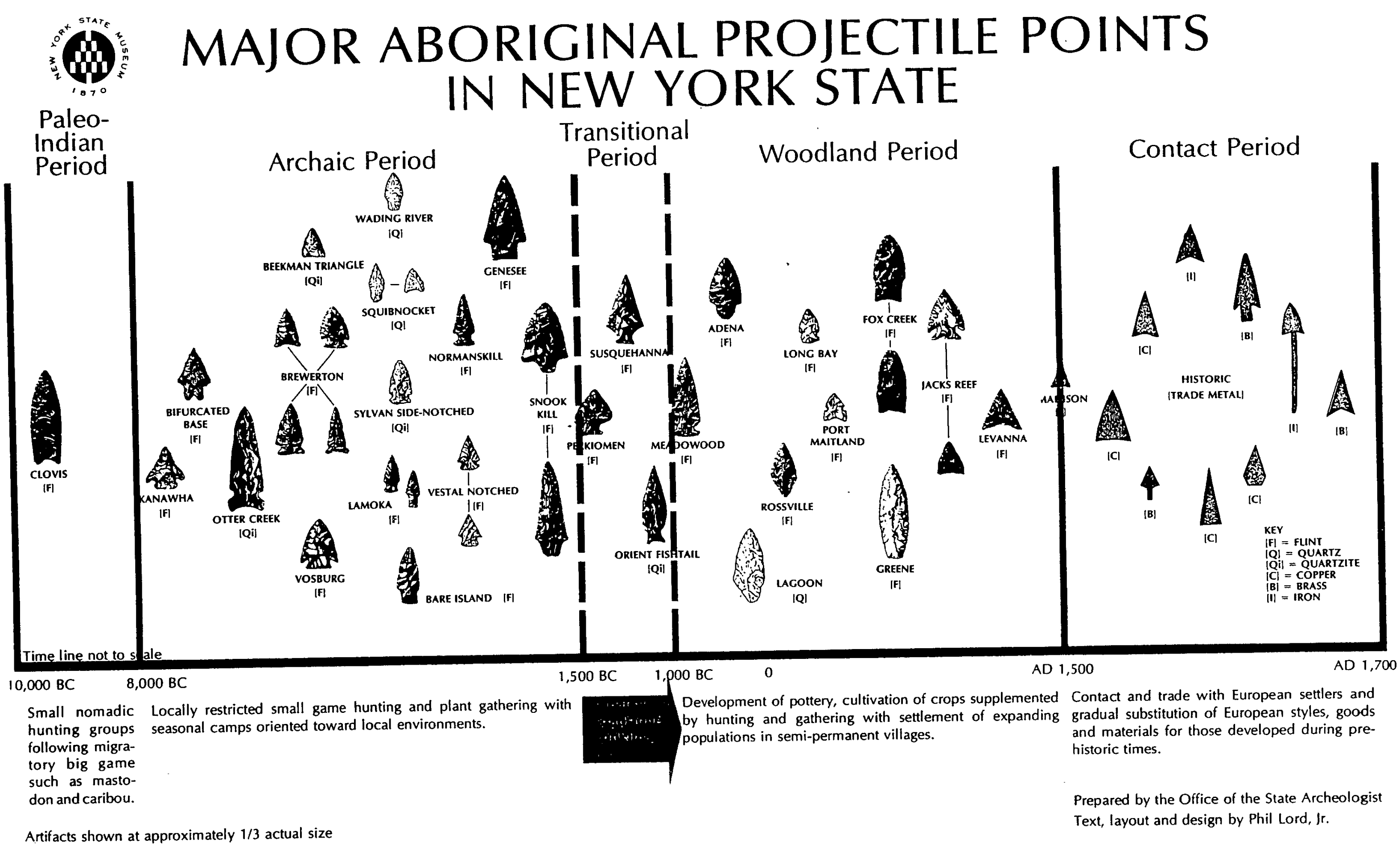


*Figure 12.* Progression of Native American projectile point styles in the Champlain Valley (Lord n.d.).

the Late Archaic Period (6000-2900 BP). These subdivisions are largely a reflection of changes that archaeologists have noted in artifact assemblages and subsistence strategies (Figure 12; Haviland and Power 1994:38).

The Archaic people in the Champlain Valley subsisted by hunting, gathering, and fishing for a wide variety of wild foods. The equipment employed for the procurement and processing of food included a variety of stone, native copper, shell, antler, and bone implements, some of which were introduced from outside sources. Much of the equipment associated with procuring and processing land-based foods seems to have come from peoples from the south and west, and techniques used for processing river and lake foodstuffs may have come in part from the Maritime people to the north and east. The presence of a large variety of woodworking tools suggests that watercraft were used for travel, fishing, and probably other hunting activities. The form of these boats is unknown, but it is assumed that dugout and possibly skin and bark canoes were used (Haviland and Power 1994:83).

The archaeological record suggests that Archaic people did not range over large areas as did the Paleo-Indians before them. Instead, these people carried out most of their activities in specific watersheds, utilizing the watercourses as highways. Lake Champlain, no doubt, played a very important role as a transportation route between watersheds. The lake also served as a source of food, water, and as a highway for the transport of ideas, people, and materials. The people of the Champlain Basin were highly influenced by groups in the Great Lakes, the St. Lawrence Valley, the Maritime Provinces, the Connecticut River Valley, and the Hudson Valley. The quick movement of ideas and technologies was possible through the use of watercraft, since the geomorphology of the Champlain Valley allowed for easy access by water to these regions. Ties between groups strengthened throughout the Archaic Period. The cultural boundary between the Archaic people of the Champlain Valley and those to the west appears to have been the Adirondack Mountains, as evident by differences in their material culture (Haviland and Power 1994:83).

During the Archaic Period, the Champlain Basin experienced its lowest water levels since the last ice age. No doubt numerous prehistoric sites lie submerged in Lake Champlain today, but no effort has yet been undertaken to determine their location or condition. If buried under the right conditions, any organic material may be extremely well preserved. Such a situation would allow archaeologists a glimpse of the perishable objects involved in the lives of Archaic people of the Champlain Valley and may yield an enormous amount of data about Archaic peoples and their interactions with Lake Champlain.

### *Woodland Period (2900-400 BP)*

The Woodland Period is the most complex prehistoric period in the Champlain Valley. By this time, Native Americans in the region had developed a culture based on the selective borrowing of ideas and innovations from other people with whom they had come in contact over the past 9000 years. The people of the Woodland Period were becoming more sedentary in their living habits, gathering into substantial settlements on the floodplains of the major rivers. The subsistence patterns of prehistoric Champlain Valley residents gradually changed from mobile hunting and fishing to a dependence upon horticulture and the gathering of a greater diversity and quantity of wild plant foods. Long-distance trade decreased dramatically, which suggests an apparent isolation of Champlain Valley residents at this time. This period is further divided into the Early Woodland Period (2900-2100 BP), the Middle Woodland Period (2100-950 BP), and the Late Woodland Period (950-400 BP), based upon changes in artifact assemblages and subsistence strategies (Haviland and Power 1994; Thomas 1994).

At the beginning of the Woodland Period, the Iroquois seem to have moved in and asserted their dominance over the Brewerton people living west of the Champlain Valley. By Middle Woodland times, Lake Champlain had become the boundary between two cultural groups, the Iroquois to the west and the Western Abenaki, another distinct group, to the east. By the Late Woodland or Contact Period, the Champlain Valley was home to the St. Lawrence Iroquois, the Western Abenaki, the Mahican, and the Mohawk. Currently archaeologists do not understand when, where, or why the different groups moved into the Champlain Valley, since boundaries between the Champlain Valley's native groups are impossible to define with the current archaeological data. Much analysis of the archaeological data collected throughout the valley remains to be completed in order to learn more about each of these groups and how they utilized Lake Champlain and its natural resources.

***Contact Period (1609-1666 AD)***

In the early sixteenth century, the St. Lawrence Iroquois, the Mohawk Iroquois, the Mahican, and the Western Abenaki peacefully occupied the Champlain Valley. In 1534, French explorer Jacques Cartier entered the Gulf of St. Lawrence while looking for the Northwest Passage. During the following two years, Cartier attempted to develop trade relations with the St. Lawrence Iroquois and other tribes living along the banks of the St. Lawrence River. The French attempt to establish a colony in the St. Lawrence Valley during the sixteenth century failed, although sporadic trade for furs in exchange for metal tools did occur between the French and the St. Lawrence tribes. This trade with the St. Lawrence Iroquois continued until 1603, when they vanished from the area. The reason for their disappearance is unknown, but it appears that they were devastated by warfare with neighboring tribes over the possession of metal tools and from European diseases to which they had no natural immunity. The St. Lawrence Iroquois monopoly over European metal may have upset the balance between the St. Lawrence Iroquois and neighboring tribes, who apparently waged war with the St. Lawrence Iroquois in order to secure metal tools and weapons for themselves. Archaeological evidence also suggests that the St. Lawrence Iroquois were assimilated with the Western Abenaki (Haviland and Power 1994:152-153; Trigger and Pendergast 1978:357-361).

The diseases which the St. Lawrence Iroquois contracted from the French no doubt spread quickly throughout the Champlain Valley, decimating the native population. The struggle over French trade also caused great unrest in the Champlain Valley. The Mohawk Iroquois, who inhabited primarily the Mohawk Valley, became the dominant tribe from Quebec to Connecticut. By 1609 the Western Abenaki had retreated from the Champlain Valley in an effort to escape destruction at the hands of the Mohawk (Fenton and Tooker 1978:466; Graymont 1988).

In 1609 the Mahican living in the Hudson Valley came in contact with Dutch explorer Henry Hudson. Shortly thereafter, the Dutch began to trade metal tools to the Mahican in exchange for furs. The Mahican also developed alliances with the French. When the English captured New Amsterdam in 1664, a region which included much of the Mahicans' traditional territory, the Mahican were forced to develop alliances with the British. By 1700 the Mahican population had been decreased from an estimated 4000 to about 500 through European diseases, famine, wars, and political pressures. Many of the Mahican merged with other groups, including the Dutch, the Western Abenaki, the French, and the Mohawk Iroquois. By 1720 the Mahican no longer existed as an organized native tribe in the Champlain and Hudson Valleys (Brasser 1978:198-206).

The influx of Europeans to the Northeast caused great upheaval among the region's Native American populations. Disease, confusing political and economic relations, and continuous warfare split native communities apart and forced them to join outlying groups. The area inhabited by the Western Abenaki at the northern end of Lake Champlain became a haven for Native American refugees from all over the Northeast, who were displaced by European settlements and wars. The Champlain Valley's community of Native Americans also relocated numerous times due to military and political conflicts in the region throughout the eighteenth and nineteenth centuries, but they always returned to Lake Champlain and their homeland (Calloway 1990).

### *Euro-American History (1609-Present)*

Since its discovery by Europeans, the Champlain Valley has consistently played an important role in North American history. The prominence of this area is due solely to the fact that Lake Champlain creates a north-south corridor that links the St. Lawrence Valley to the heart of the North American continent. The lake has served as a highway for the transport of ideas, communication, commerce, and people, and it has provided food, water, and spiritual guidance. Lake Champlain has been described as "a living body, not a passive witness to history" (Muller 1987:vi).

### *Exploration/Contact Period (1609-1664)*

French explorer Samuel de Champlain (Figure 13) was the first European to see the lake and valley that now bear his name. In July 1609 Champlain joined a war party of Algonquin, Huron, and Montagnais who paddled up the lake with twenty-four canoes in search of their enemy the Mohawk Iroquois. Champlain and his war party confronted a group of Mohawk warriors at Ticonderoga, where Champlain killed three Mohawk with his arquebus (Figure 14). Thus were established French allies and enemies that endured for nearly two centuries (Bellico 1992:9-12).

For Europeans, one of the important results of Champlain's exploration in the Champlain Valley was the discovery of a nearly complete water route from the St.

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*Figure 13.* French explorer Samuel de Champlain (Graffagnino 1983:219).

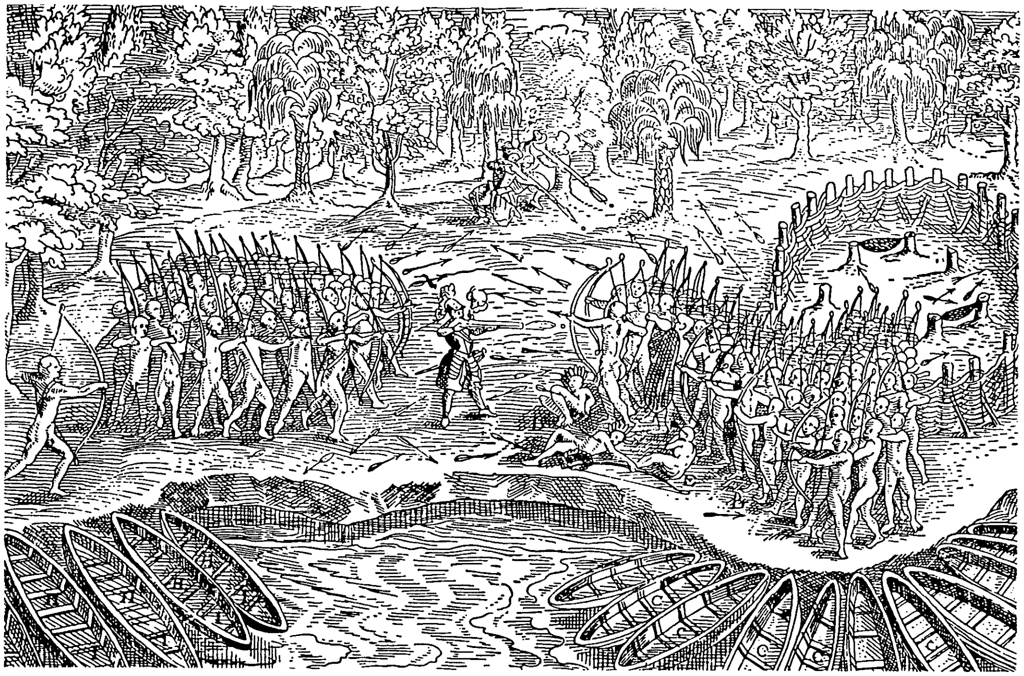

*Figure 14.* Battle between the Iroquois and Samuel de Champlain with his Canadian Algonquin allies at Ticonderoga, 1609 (Hill 1995:24).

Lawrence River to the Hudson River. Shortly after Champlain's expedition into the valley, the Dutch explorer Henry Hudson sailed up the river that now bears his name in search of the Northwest Passage. He sailed as far as present-day Albany, New York, and claimed the lands north into the Champlain Valley. Although the French and Dutch did not initially settle the Champlain Valley, they both had a great interest in the area's natural resources. Both colonial powers were heavily involved in the fur trade and depended upon the Native Americans of the Champlain Valley for their fur supply.

Throughout the early seventeenth century, the Iroquois raided Native American and French settlements in the St. Lawrence Valley using Lake Champlain as their invasion route. In the 1640s, French Jesuit missionaries began an effort to develop peaceful relationships with the Western Abenaki and Iroquois and to Christianize them by establishing missions within their villages. Jesuit attempts to make alliances with the Iroquois in northeastern New York largely failed, however, because the Iroquois felt threatened by the Jesuits and believed that they brought bad luck. By 1655 relentless Iroquois raids had spread fear throughout the farms and villages of the St. Lawrence Valley. Numerous fortified outposts had been constructed throughout the Richelieu and St. Lawrence Valleys, but they failed to stop the Iroquois war parties (Coolidge 1989:16-21).

***French and British Military Conflict (1664-1763)***

Between 1664 and 1763, the Champlain Valley witnessed a continuous struggle between the French and British Empires for control of Lake Champlain and its tributaries. These water routes were strategic highways that provided access into the interior of the Northeast in a period when the only viable means of transportation in a rugged land was by water. Expeditions and forts were continually raised in defense of rival claims of the Champlain Valley and its waterways. Armies and war parties transported themselves on Lake Champlain in fleets of canoes, bateaux, radeaux, row galleys, schooners, and sloops. This period came to an end after the French and Indian War, when Britain assumed control of most of France's territorial claims in North America.

Conflicts between the French and the British began to arise after 1664, when the British captured the colony of New Amsterdam from the Dutch. The Dutch struggled to regain control of New Amsterdam, but they were permanently driven from North America by 1675. British royal grants to Massachusetts in 1620 and to New York in 1664, confirmed by a treaty in 1665, also gave the British vague claims to the Champlain Valley. Taking note of French expansion south into the Champlain Valley (Figure 15), the British sent scouts to find out the extent of the French operations on Lake Champlain. The British managed to avoid direct conflict on Lake Champlain at this time, by cleverly playing upon the traditional ill will the Iroquois bore against the French and urged their Indian allies to actively oppose French expansion into Lake Champlain. Until 1690, the British minimized direct contact with the French; all conflicts appeared to be struggles between the French and the Iroquois (Bellico 1992:13-15).

By 1664, the Iroquois grew bolder, attacking isolated French farms and towns and spreading fear throughout New France. The increased threat led to the rebuilding of Fort Richelieu and the construction of several new fortifications along the St. Lawrence and Richelieu Rivers. A regiment of veteran French regulars was sent from France in 1665 to establish the military power of New France and to crush the Iroquois in the Mohawk Valley, even though the Iroquois were attempting to make peace with the French at that time. In January 1666, the French made a daring mid-winter raid on the Iroquois villages of the Mohawk Valley. Nearly 600 troops wearing snowshoes trekked over a frozen Lake Champlain, then overland to the Hudson Valley. By February, however, the troops had become lost following their Indian guides and found themselves near the Dutch village of Schenectady instead of the Iroquois settlements on the Mohawk River (Bellico 1992:13-14).

The troops eventually had a minor skirmish with the Mohawk, then retreated northward with the Iroquois in pursuit. Sixty soldiers died of starvation and exposure or were taken prisoner by the Iroquois before the French returned to Canada in March 1666. New France did not, however, abandon its plan to crush the Iroquois villages. Some of the French regulars were sent to Isle La Motte to build a fort that was later named Fort St. Anne, the southernmost French outpost of that time. This fort was intended to defend the colonists in the Richelieu and St. Lawrence Valleys from Iroquois war parties.

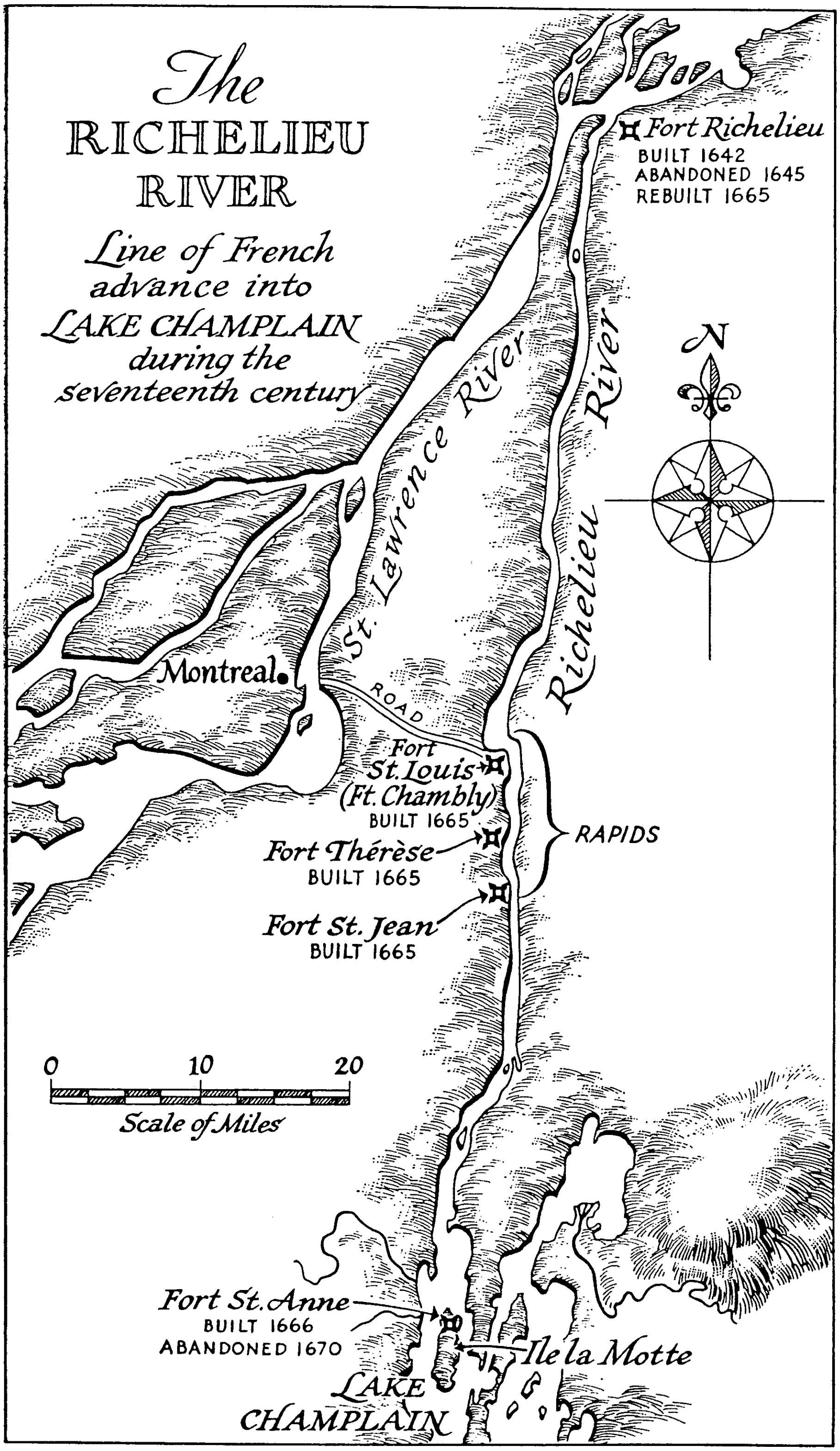


*Figure 15.* Seventeenth-century forts in the Richelieu River Valley and northern Lake Champlain (Bird 1962:2).

In September 1666, the French organized 1300 troops and 300 bark canoes and bateaux for an expedition to the Mohawk Valley. The army moved south on Lake Champlain, left some troops with provisions to build a stockade fort at Ticonderoga, portaged to Lake George, and proceeded to its southern end, where they hid their boats for the return trip. The French army then marched to the Mohawk River and burned four Iroquois villages. This drastic action lead to a Mohawk peace treaty with the French in the spring of 1667 (Bellico 1992:14).

Questions over the control of Lake Champlain arose as tensions escalated in Europe, where James II, supported by French King Louis XIV, and William of Orange were engaged in a struggle for the British crown. New France decided in 1688 to fortify Crown Point on the western side of Lake Champlain to prepare for renewed fighting. In 1689, King William's War (1689-1697) broke out, and the colonists became involved in a brutal struggle to decide whether Lake Champlain should be English or remain French (Bellico 1992:14-15).

French officials had spent several years developing elaborate proposals to attack the English colonies via Lake Champlain. In June of 1689, Louis XIV finally approved an assault, but 1300 Mohawk Iroquois invaded Canada in 250 canoes at the urging of the English before the plan could be put into action, destroying the village of La Chine on the island of Montreal. Beginning in February 1690, the French responded to this English-backed raid with a series of attacks on English settlements in New York, New Hampshire, and Massachusetts (Bellico 1992:15).

As the French planned an ambitious invasion through the Champlain Valley, the British colonies prepared to mount a defensive against the rumored French invasion. In March 1690, the English established a small stone fort at Chimney Point, directly across the lake from Crown Point. Other English parties were sent to the mouth of Otter Creek and to Fort Chambly on the Richelieu River. The British planned a two-pronged attack, with one force moving north on Lake Champlain and the other traveling by sea to face Quebec on the St. Lawrence River. The plans of both the French and the British ultimately failed, however, due to bad luck and poor planning (Bellico 1992:15-16).

Although both sides formulated grand plans of major expeditions, King William's War never really progressed beyond the activities of raiding parties on Lake Champlain. Finally, in 1697, the Peace of Ryswick ended the open hostilities. By 1700, the governors of both New France and the Colony of New York had granted land to settlers in the Champlain Valley. The French had established small settlements at Isle La Motte, Missisquoi, Crown Point, and Chimney Point. These outposts were short-lived, however, since the threat of renewed warfare continued to loom in the future. Peace in the Champlain Valley ended when the European War of Spanish Succession resulted in Queen Anne's War (1702-1713) in North America. In 1702, the British Queen Anne succeeded her brother-in-law, William III, and war was declared anew between England and France. In 1703 the French in Canada proposed to destroy all of the English settlements along the entire New England frontier, and the British revived their plan of 1690 to attack Canada using Lake Champlain. Once again Lake Champlain was chosen as the primary invasion route, and raids were routinely run through the Champlain Valley into the Hudson, Mohawk, and Connecticut Valleys. These raids led hundreds of people to abandon the frontier settlements in New France, New York, New Hampshire, and Massachusetts (Bellico 1992:16-17).

In 1704 a French and Indian force of 250 destroyed Deerfield, Massachusetts, by following a route through Lake Champlain and across the Green Mountains into the Connecticut Valley. In 1709 the British planned an invasion of Canada similar to the strategy attempted in 1690. An expeditionary force of approximately 1600 men cut a road from Schuylerville, New York, to Wood Creek, a tributary at the southern end of Lake Champlain. Along the way the British built three forts and outposts. At Wood Creek, about 100 bateaux and many canoes were constructed to transport the troops on Lake Champlain. Meanwhile, the governor of New France had raised 1500 troops and advanced up the Richelieu River as far as Chambly. The British colonial troops waited for word that the British naval force had attacked Quebec, but they learned that the vessels had instead been sent to Lisbon, Portugal. Ravaged by smallpox and dysentery, the discouraged British army burned their bateaux, canoes, and forts before returning home (Bellico 1992:17-18).

In 1711 another British expedition called for a force to move north on Lake Champlain to attack Quebec while a naval fleet with marines launched an assault by way of the St. Lawrence River. This strategy again resembled the British plan of 1690. A convoy of 70 ships from Boston with 6400 English soldiers and 1500 provincial or colonial troops set sail for Quebec. The colonies assembled 2000 troops to invade Lake Champlain from Albany, where 600 bateaux were built for the expedition. The colonial troops rebuilt the ruins of Fort Schuyler, destroyed in the 1709 retreat, and renamed the outpost Fort Anne. By September 1711, advance units of the army had reached Lake George, but disaster struck the British naval fleet in the St. Lawrence River, where ten of the British ships were blown onto the river's rocky shores. Shaken by the catastrophe, the fleet abandoned the expedition and sailed back to England. Upon hearing the bad news, the army once again had little choice but to abandon the campaign (Bellico 1992:17-18).

The Treaty of Utrecht, signed on April 11, 1713, marked the end of another period of open hostilities between England and France. This treaty obliged France to give up her rights of sovereignty over the Five Nations and made Split Rock on Lake Champlain the southern limit of New France, a boundary which the colony never accepted. English and French colonists saw clearly that they would never be able to share jurisdiction over Lake Champlain. Control over this important waterway was necessary to ensure the safety of the colonies from enemy attack.

War broke out in the Champlain Valley again in 1723, but this time it was a conflict between Native Americans banished from New England and English colonists, rather than turmoil related to war in Europe. Native Americans had come to settle in New France along the frontier of the wilderness that separated them from their former

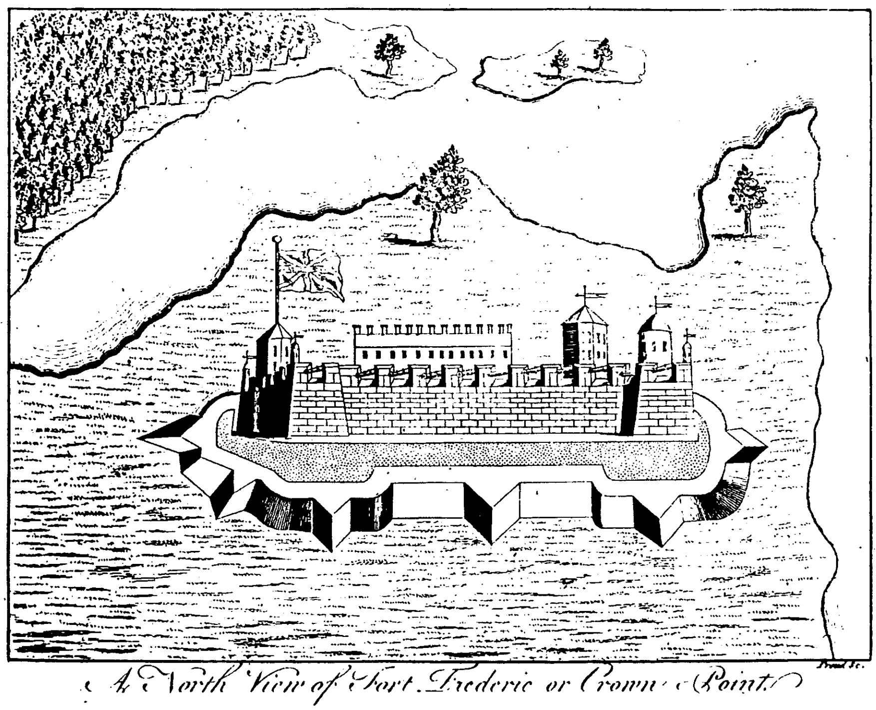


*Figure 16.* A north view of Fort St. Frederic at Crown Point, 1776 (Chambers 1984:xxiv).

homeland. From 1723 to 1725, the celebrated Indian chief Gray Lock was the scourge of English settlements along the Connecticut.

With anxiety growing over the French claim to the Champlain Valley, King Louis XV of France approved the construction of a log stockade fort opposite Crown Point in 1731. The fort was built at Chimney Point and called Pointe a la Chevelure. The English colonies protested the fort as an encroachment of their territory shortly after its construction. The French ignored the protest, however, and Louis XV approved the construction of a redoubt on Crown Point in 1734, later named Fort St. Frederic (Figure 16). By 1742, the fort was second in size and armament only to the French stronghold at Quebec. That same year the lake's first major sailing vessel, a sloop of 45 tons, was built at Crown Point. The vessel, named *St. Frederic*, was used to transport supplies from Chambly to Crown Point (Bellico 1992:18).

By 1744, England and France became entangled in the War of Austrian Succession, which became known as King George's War (1744-1748) in North America. Fort St. Frederic served as a military base for French assaults into New England and New York, which intensified in the fall of 1745, when a French party of 509 regulars and Indians attacked and destroyed Saratoga. Large-scale French raids from Fort St. Frederic continued through 1747, but no English expedition ever materialized. In 1748 France and England signed the Treaty of Aux-la-Chapelle, ending the war, but the two countries failed to clarify the boundary between New France and the English colonies just south of the Champlain Valley. Fort St. Frederic remained a French stronghold, terrifying the English colonies (Bellico 1992:20-21).

In 1754 the French renewed their raids with an assault on British Fort Number 4, located in New Hampshire along the Connecticut River. This event marked the beginning of the French and British conflict known as the French and Indian War (1754-1763) in North America (Figure 17). The conflict spread to Europe in 1756, where it was known as the Seven Years War. In 1755, New York and the New England colonies organized an army to erect their own fortress on the lake and to eliminate the French presence on Lake Champlain. The English colonies assembled nearly 4000 troops at Albany, in addition to hundreds of bateaux and canoes. The English built a road from the Hudson River to Lake George in order to transport supplies and watercraft to the Champlain Valley. While the English were constructing forts along the frontier road, the French, informed of the British approach, mounted an expeditionary force of 2500 troops to Ticonderoga to build the fortification later called Fort Carillon. The French rowed to South Bay and marched overland to the southern end of Lake George, where they attacked the British. Vastly outnumbered, the French were defeated at the Battle of Lake George (Bellico 1992:21-37).

That winter the two forces planned their strategies for the upcoming campaign, but the well-organized plans fell apart once summer arrived. The French and British fortifications remained at a standoff at opposite ends of Lake George throughout the 1756 season. Military activity on Lake Champlain consisted mostly of French vessels moving troops and tons of supplies from the northern end of the lake to Crown Point, Chimney Point, and Ticonderoga. The vessels consisted of canoes, barges, bateaux, small sailing galleys, and *St. Frederic*. The skirmishes that did occur during the 1756 season were between spies on reconnaissance missions. The daring Rogers Rangers, a New Hampshire regiment, even carried vessels around the mountains west of Ticonderoga into Lake Champlain north of the fort to spy on French movement in the Champlain Valley (Bellico 1992:39-40).

In March 1757 the French made the first advance on Lake George with an assault launched by an expedition of 1600 men on Fort William Henry, constructed by the British in 1755. The French attacked the lightly garrisoned fort and burned its outbuildings and all of the British vessels, but they failed to capture the fort itself. In August the French renewed their siege of Fort William Henry, this time taking the fort within a week. The aftermath of the victory turned out to be a massacre of the British prisoners, when hundreds of unarmed troops, women, and children were killed at the hands of New France's Native American allies. Native American leaders blamed their actions on the French decision to not allow them to take the spoils of war, which they had been promised when the campaign began. After the atrocity, the Native American warriors returned to Canada through the Champlain Valley with their plunder (Bellico 1992:43-57).

The defeated British force retreated into the Hudson Valley, leaving the French in control of Lake Champlain and Lake George. The 1757 campaign came to a close, but

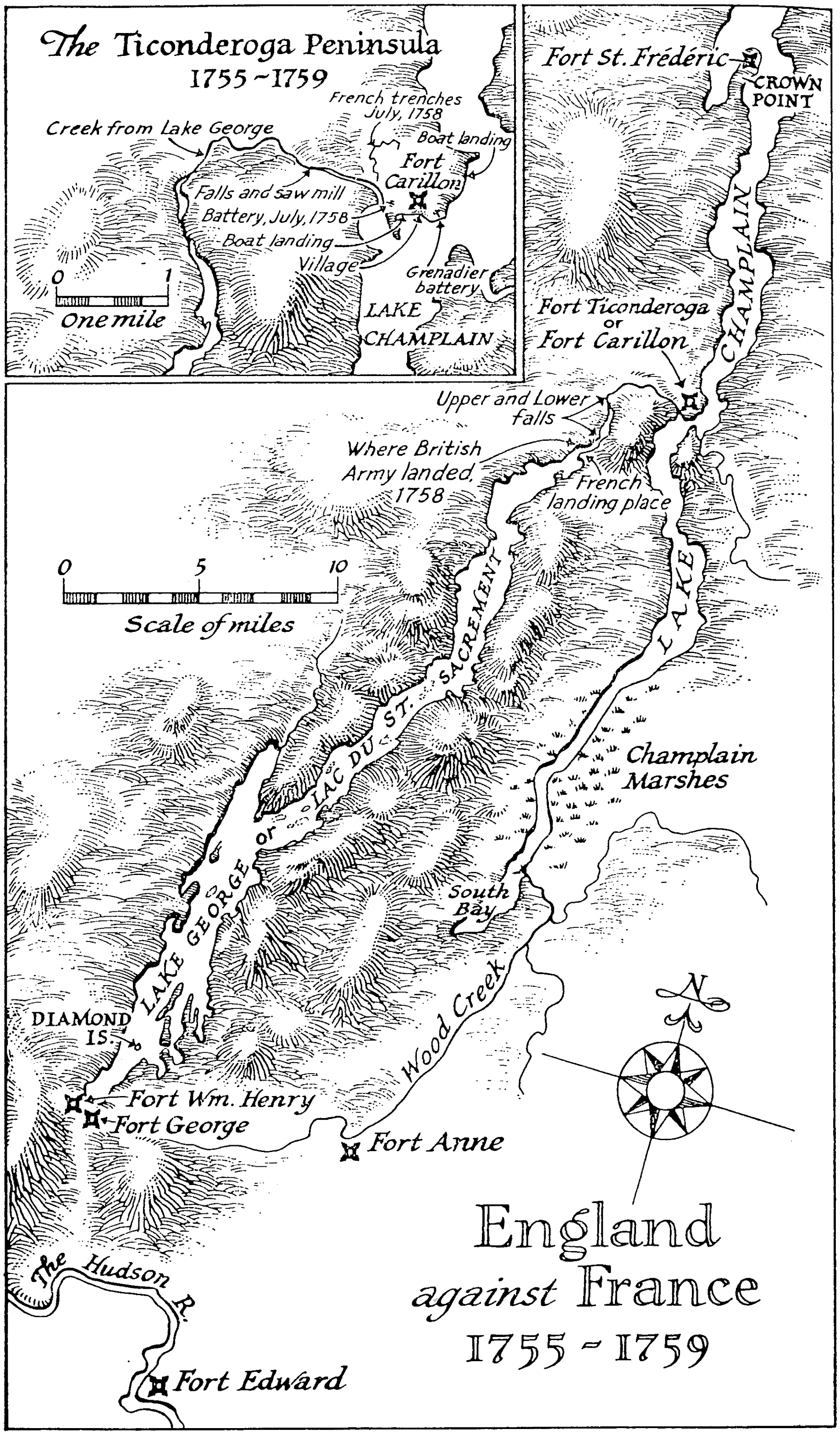


*Figure 17.* Forts of the French and Indian War on Lake George and southern Lake Champlain (Bird 1962:44).

the British immediately began planning for the following season. In early July 1758, a force of 6367 British regulars and 9024 provincial troops gathered at the ruins of Fort William Henry. Their plan was to attack Fort Carillon and Fort St. Frederic, then to advance to Montreal. In a splendid show of military power, the English army crossed Lake George in approximately 900 bateaux and 135 whaleboats with their artillery on a number of pontoon rafts. The massive British army slowly approached Fort Carillon, which was only occupied by approximately 3500 troops. The British commander James Abercromby made a tragic blunder, however, by insisting that the well-fortified stronghold be taken by a frontal assault in broad daylight after learning that a large French reinforcement that would be arriving there shortly. Nearly 2000 British troops were killed or wounded in this ill-fated attempt. The British army, discouraged and confused, abandoned provisions and wounded during their retreat toward the southern end of Lake George. Abercromby's expedition to Fort Carillon was a major failure (Bellico 1992:62-73).

The late spring of 1759 saw the gathering of another British and provincial army on Lake George for the fifth consecutive year, once again with the objective of driving the French from Lake Champlain. The British expedition was directed by a more cautious commander-in-chief, Major General Jeffery Amherst. The British left their new fortification of Fort George, located at the southern end of Lake George, with over 11,000 troops in another impressive flotilla (Bellico 1992:87-88).

Although the French troops at Carillon were nearly equal in number to the previous year, their rations were short and disease ravaged the men inside the fort. The calm, precise, and methodical management of the British troops and artillery forced the small 400-man French army to retreat to Crown Point by bateaux and three sloops. The British army moved most of their fleet overland to Lake Champlain and recovered the vessels intentionally sunk by the French in Lake Champlain during their retreat. The fighting now concentrated in the Champlain Valley (Bellico 1992:92-93).

A small French naval fleet on Lake Champlain hampered the British advance. The larger vessels of the French fleet included the 10-gun schooner *La Vigilante* (*Vigilant*) and three sloops or xebecs named *La Musquelongy* (*Muskellunge*), *La Brochette* (*Pike*), and *L'Esturgeon* (*Sturgeon*). All of the vessels were constructed at St. Jean at the northern end of the lake between 1757 and 1759. The sloops carried eight guns each and a crew of 40 to 50 men. After the British moved most of their fleet into Lake Champlain, they quickly began the construction of two radeaux. Expecting a fight, the British then advanced to Crown Point, but to their surprise Fort St. Frederic had been destroyed and abandoned. The British immediately set out to build a larger fortification in its place called Fort Crown Point. After gaining intelligence about the size and strength of the French fleet, the British constructed the 6-gun radeau *Ligonier* at Crown Point and the 20-gun brig *Duke of Cumberland* and sloop *Boscawen* at Fort Carillon, renamed Fort Ticonderoga. The British fleet now consisted of *Ligonier*, *Duke of Cumberland*, *Boscawen*, two small radeaux, three row galleys, and a large number of bateaux and canoes (Bellico 1992:95-100).

In October 1759 the British naval fleet trapped the three French sloops and two long boats in Cumberland Bay. The French decided to scuttle two of their sloops and disable the third before walking back to Isle-aux-Noix. Only the two long boats escaped the British trap. The *Boscawen*'s crew recovered some of the sunken war materials and the two French sloops, which allowed the British to take command of Lake Champlain. In November the British fleet was sent to Fort Ticonderoga to be laid up for the winter at the King's Dock. The 1760 campaign, however, at last brought about the final collapse of the French Empire in North America. The British strategy involved a three-pronged attack on the French forces in Canada. One force moved west on the St. Lawrence River from the North Atlantic. The second force moved eastward from Lake Ontario toward Montreal, and the third force followed the easiest route, through Lake Champlain (Bellico 1992:102-103).

The action on Lake Champlain began in May with an amphibious assault on the French fort at Point au Fer on the western side of the lake. On the morning of August 11, 1760, the assembled British fleet at Crown Point departed to begin the assault on Canada. This diverse fleet included one brig, four sloops, three radeaux, three row galleys, two long boats, 263 bateaux, twelve canoes, and 41 whaleboats. The British army consisted of 3300 troops. On their trip north, the fleet lost one whaleboat and seven bateaux due to bad weather conditions. After reaching Isle-aux-Noix, the radeau *Ligonier* and the row galleys maintained a constant fire on the French fort and vessels to protect the British troops during the landing. Once on shore, the British constructed a breastwork nearly 1.6 km (1 mi) long on the eastern shoreline of the mainland and erected four batteries of guns. The British captured the remaining vessels of the French fleet and the fort, but most of the French troops escaped and retreated to Montreal. On their way, the French burned everything behind them, including the town of St. Jean. The British plan was successful, and, on September 8, 1760, the French signed the articles of surrender (Bellico 1992:104-108).

At the end of 1760, most of the British fleet and the captured French vessels were taken to Ticonderoga for winter storage. The forts on Lake Champlain were not abandoned, but their troops were reduced dramatically. Supplies for the forts largely came from the Hudson Valley and were transported on Lake Champlain. In October 1761, while delivering provisions to Crown Point, one of the transport vessels, the radeau *Grand Diable*, sank during a storm and was not recovered despite several attempts to do so. After the Treaty of Paris between England and France was signed in 1763, the lake became a highway for the transport of communication, supplies, troops, travelers, and early settlers (Bellico 1992:108-109).

***Early Settlement (1763-1775)***

The only settlement in the Champlain Valley between 1609 and 1755 was that of exiled Northeastern Indians, Jesuit missionaries, French soldiers, and settlers who generally stayed near the forts and outposts. All of these settlements were short-lived, since the threat of renewed warfare always loomed in the future. During the years of peace following the French and Indian War, the wilderness reclaimed many of the military outposts and forts in the Champlain Valley. Settlements started to appear throughout the Champlain Valley as the colonial governors of both New York and New Hampshire granted large tracts of land. These land grants often conflicted, since both New York and New Hampshire had once claimed jurisdiction over the area between the Connecticut River and Lake Champlain. After an appeal to the British government, it was determined that New York had legitimate claim to the land. New York then tried to force settlers with New Hampshire titles to pay for their land a second time. Those affected sought legal aid, but, when that failed, they organized an illegal militia, the Green Mountain Boys, who kept New York officials off their land (Hill 1995:73-74).

Mostly landlords settled on the western side of Lake Champlain with tenants to take up and clear the land, then build dams, sawmills, and gristmills in close settlements. Many of the landlords and tenants were former soldiers who had served in the valley and had been given land by the King in return for their military service. The settlers on the eastern side of the lake, however, were generally land speculators or self-made men. The most notorious land speculators were the Allen brothers, Ethan and Ira, of Litchfield, Connecticut. The Allen brothers accumulated thousands of acres of land on the eastern side of the valley through purchases of land grants issued by the governor of New Hampshire.

The settlements on both sides of the lake were very small and widely spread throughout the valley. They were also generally close to tributaries of Lake Champlain, which provided the settlers with power and transportation. There were very few roads, so the settlers depended heavily upon small watercraft and rafts to transport themselves and products to the Quebec market. Most settlers were involved in extracting resources from the virgin forests of the Champlain Valley, but their daily lives quickly became upset by the next military conflict.

### *Revolutionary War (1775-1783)*

The enormous national debt of Britain, largely caused by the French and Indian War, and the prospect of supporting thousands of British troops and government officials throughout North America resulted in proposals to raise revenue through taxation in the American colonies. Although the income of Americans was higher and the tax burden on the colonists was only a small fraction of that placed on British citizens, the American colonists were enraged at the tax increase and the fact that it was direct taxation from Britain. Over the previous 150 years, the colonies had largely been governing and taxing themselves independent of the British parliament (Bellico 1992:115-116).

As the possibility of conflict arose, Lake Champlain was immediately considered as a route of possible invasion. When hostilities broke out in Massachusetts, colonial forces immediately began to plan the seizure of Lake Champlain by capturing its forts, outposts, and vessels. The Green Mountain Boys, John Brown with the militia of Pittsfield, Massachusetts, and Benedict Arnold with the militia of New Haven, Connecticut, all planned independently to take Fort Ticonderoga. Despite arguments over the command of the expedition, the fort was captured on the evening of May 9, 1775, in a joint campaign led by Benedict Arnold and Ethan Allen. Another detachment simultaneously captured Skenesborough and the largest trading vessel on the lake, the 12.5-m (41-ft) schooner *Katherine*. The colonial force then took Fort Crown Point. The disagreement over who was to command the colonial force ended when the schooner *Katherine*, renamed *Liberty*, landed at Fort Ticonderoga. Arnold took command of *Liberty* and two bateaux and sailed north to St. Jean, where the expedition captured the royal sloop *Betsey*, renamed *Enterprise*, four bateaux, and provisions (Bellico 1992:116-117).

In June of 1775, the newly formed Continental Congress appointed Philip Schuyler as a major general and commander of the Northern Department, including the Champlain Valley. By July, Schuyler had established supply lines, work schedules, limits on drinking, and other necessities of military conduct at the forts and outposts between Albany and the Champlain Valley. He also began the task of creating a strong naval fleet that could keep control over the lake and transport men and supplies for an invasion of Canada. Most of the supplies for the American forces on Lake Champlain were transported from the Hudson Valley through Lake George to Ticonderoga. A large number of bateaux, canoes, and other vessels were engaged in supplying the men with everything they could possibly need (Bellico 1992:120-121).

The colonial leaders decided on a two-pronged assault on Canada (Figure 18), mistakenly expecting Canadians to gladly join the Americans in their cause. One army would move north through the wilderness of Maine and Quebec and the second through the Champlain Valley, once again assigning Lake Champlain a key role as a highway for invasion. Brigadier General Richard Montgomery, Schuyler's second-in-command, was chosen to lead the army north into Canada through the Champlain Valley, while Benedict Arnold took the second army. The capture of St. Jean on route to Montreal took two months, much longer than anticipated, but the victory yielded two prize vessels, the schooner *Royal Savage* and a row galley that was later rerigged as a schooner and called *Revenge*. After taking St. Jean, the Americans ran the two gondolas *Hancock* and *Schuyler* over the rapids at Chambly and followed the St. Lawrence River to Montreal. With bad weather, little Canadian support, diminishing supplies, little hard money, and diminishing enlistments, the rebel colonial army attacked the city of Quebec during a raging snowstorm with disastrous results. The American army's attempt to take Quebec was defeated, forcing the men to spend the winter outside the city's walls. Between September 1775 and April 1776, a dozen bateaux or sleighs loaded with provisions were required from Albany each day to supply the threadbare American Army in Canada. The Americans subsequently retreated through the Champlain Valley when British reinforcements arrived in the spring of 1776 (Bellico 1992:122-132).

During the last week in May, Schuyler rushed his fleet of supply ships to Isle-aux-Noix to rescue 7000 to 8000 American troops retreating from Canada. The army, ravaged by small pox and dysentery, was moved to Crown Point. The American army held St. Jean until June 18, 1776, thus preventing the British from constructing a naval force necessary to continue their attack into the colonies. Following the American

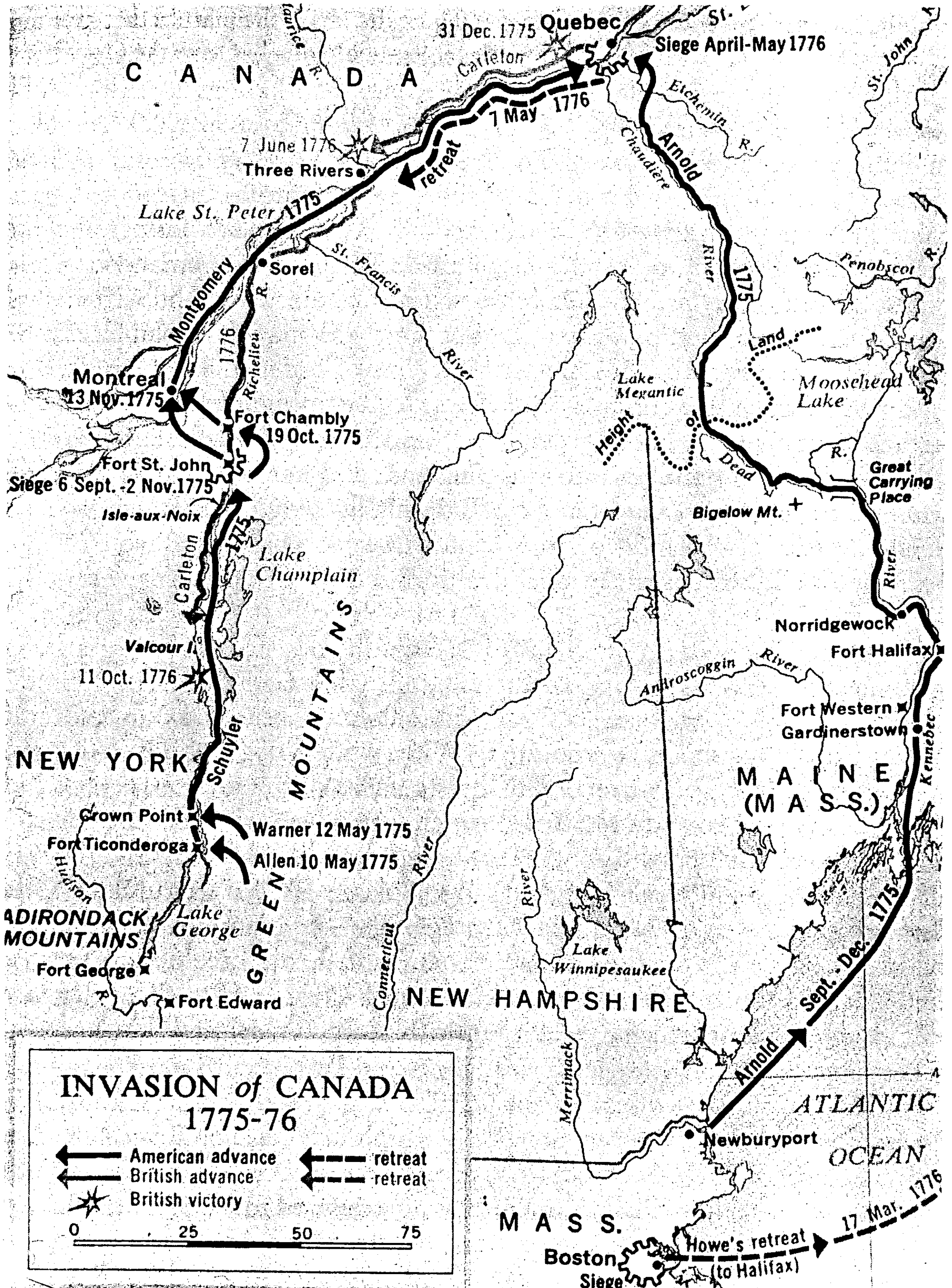


*Figure 18.* American and British movements and battles during the American invasion of Canada, 1775-1776 (Hill 1995:87).

retreat, the British began a furious race to construct a naval force at St. Jean to facilitate the British invasion. Recognizing Lake Champlain as the most important aspect of the southern corridor into the colonies, the Continental Congress immediately began to prepare a strong defensive system at Fort Ticonderoga and at the knoll across the lake called Mount Independence. The American forces also constructed eight gondolas or gunboats and four row galleys at Skenesborough for the defense of Lake Champlain. The new American fleet spent most of the summer scouting the lake and escorting work crews around the lake in search of timber. The British constructed many of their vessels in the St. Lawrence Valley and brought them over or around the rapids on the Richelieu River to Lake Champlain. By early fall the British fleet consisted of the schooner *Maria*, the ship *Inflexible*, the schooner *Carleton*, the gondola *Loyal Convert*, 30 long boats, gunboats, canoes, 400 bateaux, and the radeau *Thunderer* (Bellico 1992:135-138).

After a number of small skirmishes, the two fleets met at Valcour Island on October 11, 1776. The American fleet consisted of eight gondolas, three row galleys, two schooners, one sloop, one cutter, and some bateaux (Figure 19). The larger British fleet was faster, had almost twice the weight in cannon, and was crewed by professional sailors and gunners obedient to the most skilled officers (Figure 20). Benedict Arnold, the commander of the American fleet, clearly understood his situation and decided to take a defensive stand in the lee of Valcour Island on the western shore of Lake Champlain. He had no intentions of attacking the British on the open lake or fighting in a retreating gun battle. As Arnold had anticipated, the British sailed past Valcour Island on a stiff north wind before sighting the American vessels, then had to sail upwind to attack the rebel navy. To entice the British fleet into the trap, Arnold sent five vessels to the southern end of the island. The largest American vessel, *Royal Savage*, ran aground on the southwestern corner of Valcour Island after its masts and bowsprit were damaged and rigging shot away by shots fired from the British ship *Inflexible*. For several hours the British and American vessels engaged in a savage duel. The American fleet was badly damaged and lost 60 men (Figure 21).

*Figure 19*. A view of the American vessels at Valcour Bay on October 11, 1776 (Lundeberg 1995:28).

At the end of the engagement, the gondola *Philadelphia* sank from damage suffered in the cannonading, and settled in the channel between Valcour Island and the New York shore. At dusk Arnold called a council of war in his cabin aboard the galley *Congress*. With little choice, the officers agreed to retreat immediately to Crown Point with the crippled fleet. Shrouded in a dense fog in the darkness, the American fleet rowed south along the western shoreline. With the galley *Trumball* in the lead and a hooded lantern in the stern of each vessel that showed only directly behind, each vessel carefully passed single file by the British blockade without detection. That night the American fleet, already exhausted from the day's battle, rowed to Schuyler Island, 12.0 km (7.5 mi) south of Valcour Island. At the break of dawn, the British peered into Valcour Bay, ready to complete the destruction of the American fleet, but to their surprise the Americans were gone (Bellico 1992:154-155).

Early on the morning of October 12, the American fleet became widely separated. Some of the American vessels paused only briefly near Schuyler Island, while others remained for many hours to stop their leaks and mend sails. Two of the gunboats were so badly damaged that they were scuttled on the retreat; one of these vessels, the *Jersey*, was captured, while the other sank in deep water. The weary, battered American crews struggled against strong southerly headwinds on a retreat for their lives. On the morning of October 13, the wind direction changed from the north, allowing the pursuing British vessels to make better time on the lake than the shattered, leaky American gondolas and row galleys. The British caught the last vessels in the American fleet around Split Rock Point (Figure 22). A running gun battle ensued for approximately 14.5 km (9 mi) to Ferris Bay, now called Arnold's Bay, located in Panton, Vermont. With no hope for escape, Arnold ran the row galley *Congress* (VT-AD-0717) and four gondolas into the shallow bay and set them on fire, while the British continued a cannonade from a distance. Arnold and his men then fled through the woods toward Mount Independence with the British in pursuit. When the defeat of the American fleet was known and the advance of the British imminent, the American force at Crown Point burned the buildings and evacuated to Ticonderoga. The Americans at Fort Ticonderoga

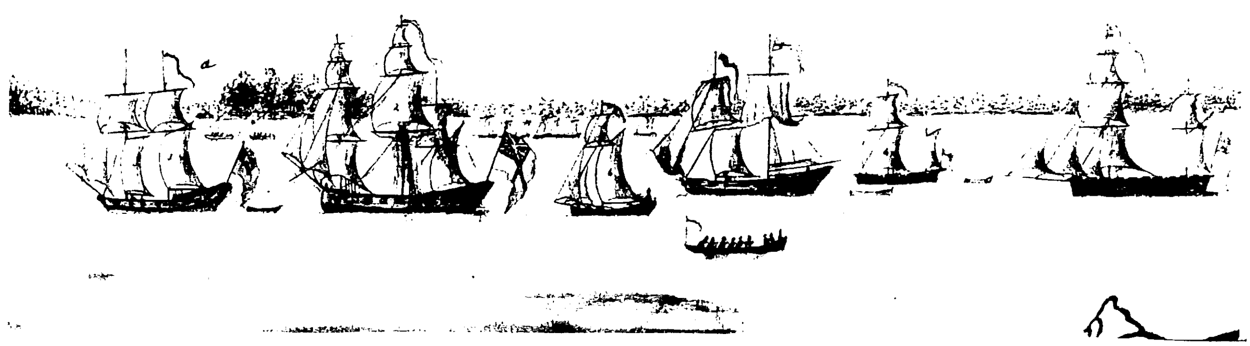

*Figure 20*. A view of the British vessels at Valcour Bay on October 11, 1776 (Lundeberg 1995:29).

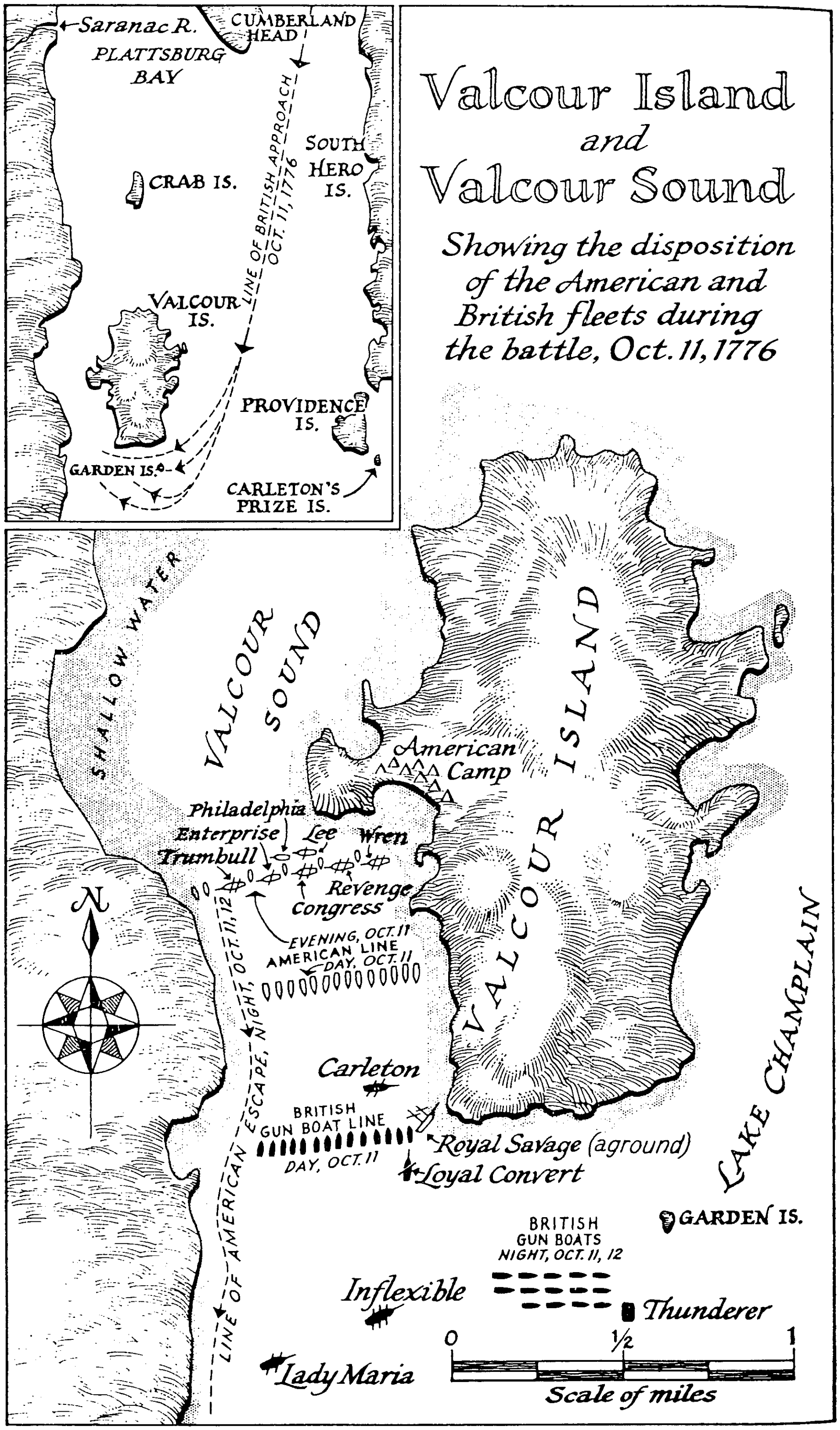


*Figure 21.* Battle of Valcour Island, October 11, 1776 (Bird 1962:120).

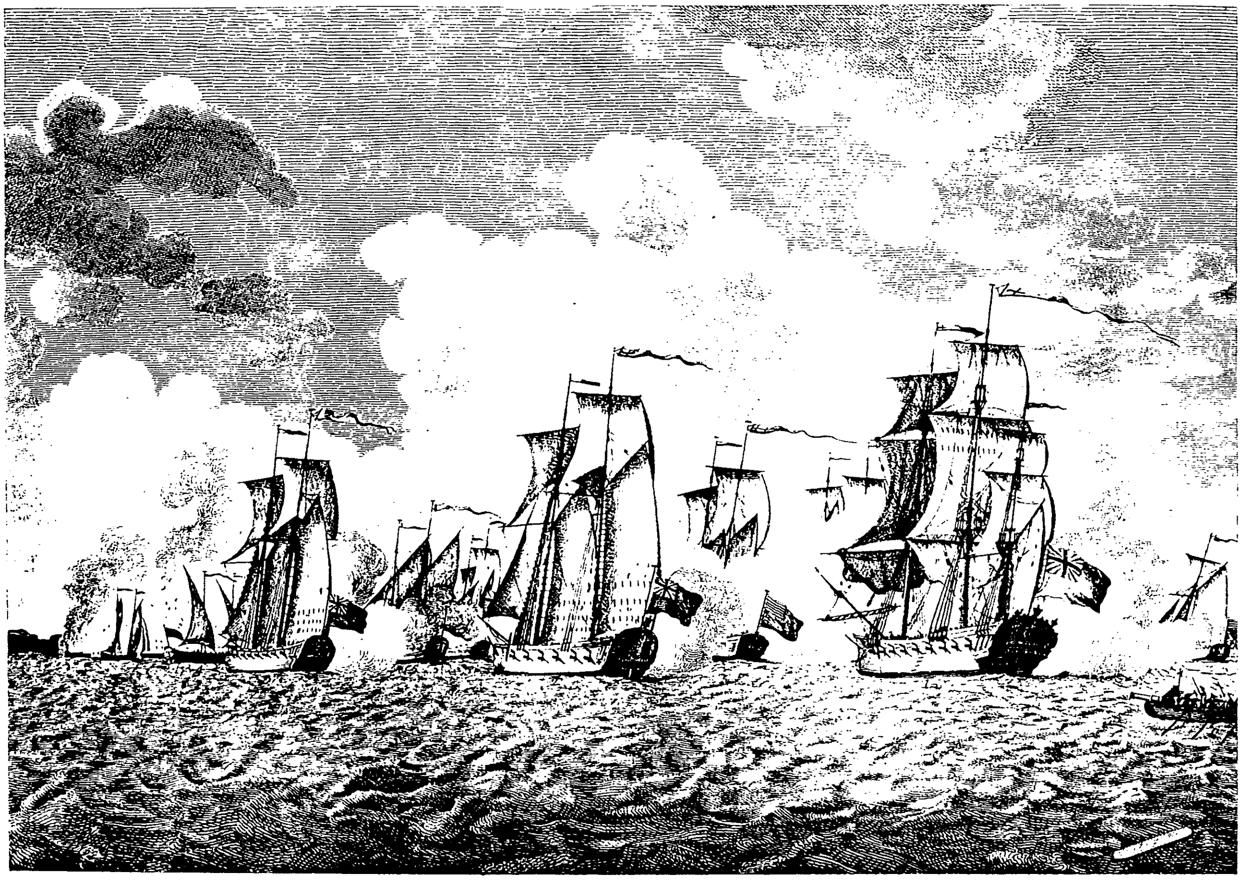

*Figure 22.* Running gun battle between the Americans and the British on Lake Champlain on October 12-13, 1776 (Chambers 1984:xi).

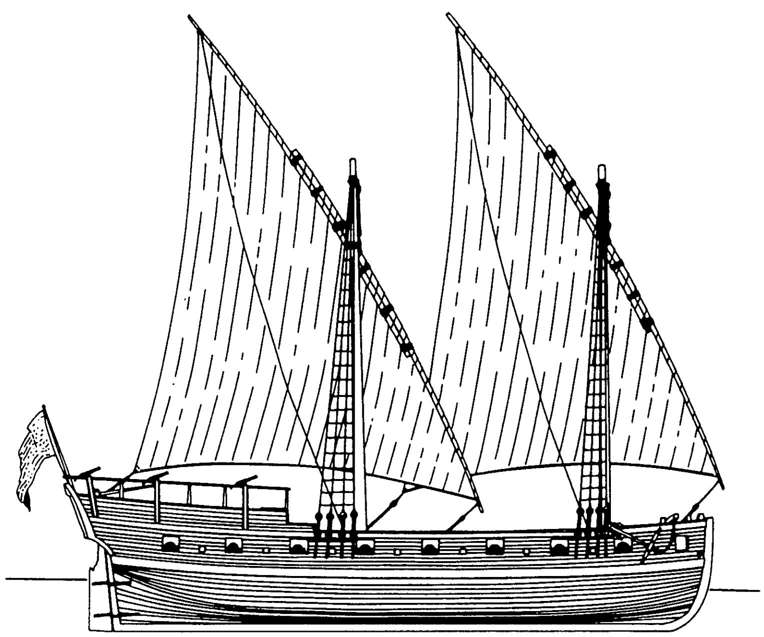

*Figure 23.* Conjectural view of the American galley *Congress* (Lundeberg 1995:17).

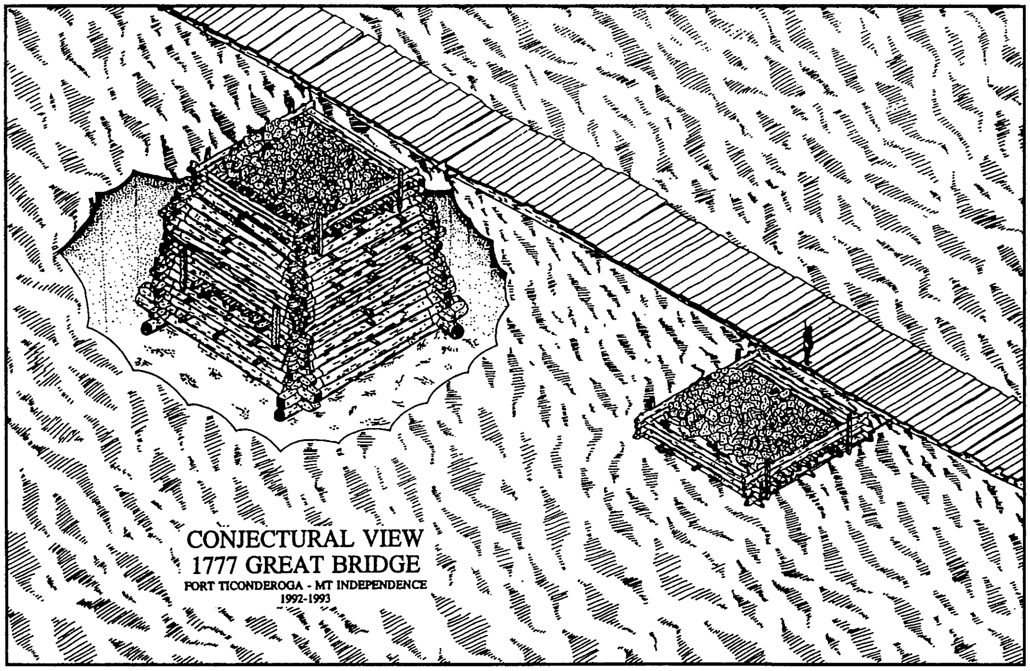


*Figure 24.* Conjectural view of the Great Bridge constructed by American troops between Fort Ticonderoga and Mount Independence in 1777 (Hill 1995:290).

and Mount Independence worked feverishly to increase the strength of their fortifications. Knowing that nearly 12,000 American troops awaited them at Fort Ticonderoga and Mount Independence and winter was soon to come, the British decided to return to Canada to renew their push toward Albany the following year (Bellico 1992:155-162).

After the lake began to freeze, the American force was drastically reduced on Lake Champlain, but construction activities at the fortifications remained constant. During the winter of 1777, the remaining force built a star-shaped fort on Mount Independence, a small fleet of vessels for Lake George, and a floating bridge (VT-AD-0731) between Fort Ticonderoga and Mount Independence (Figure 24). The bridge called for the construction of twenty-two wooden cribs or piers on the lake floor, which anchored a floating walkway that crossed the lake (Bellico 1992:166).

The British strategy for 1777 was quite similar to their aborted plan for 1776. Governor Guy Carleton, the commander of the 1776 invasion force, was replaced in 1777 by the over-confident General John Burgoyne. Planning a three-pronged assault that would cut the colonies into three pieces, Burgoyne wanted to move toward Albany through Lake Champlain, while William Howe moved northward up the Hudson Valley and Lieutenant Colonel Barry St. Leger advanced through Lake Ontario and the Mohawk Valley to rendezvous at Albany. The British force planning to invade through Lake Champlain assembled at St. Jean in June 1777. A new ship, the *Royal George*, and four new provision vessels were added to the existing British fleet to help transport British troops through the Champlain Valley. The British naval force consisted of the ships *Royal George* and *Inflexible*, the schooners *Carleton* and *Maria*, the radeau *Thunderer*, the gondola *Loyal Convert*, and hundreds of bateaux, long boats, and canoes. The British also added to their fleet the captured American row galley *Washington*, gondola *Jersey*, and cutter *Lee*. The American fleet, on the other hand, included only the row galleys *Gates* and *Trumbull*, the schooners *Liberty* and *Revenge*, the sloop *Enterprise*, the gondola *New York*, and a few hundred bateaux and canoes (Bellico 1992:167-168).

The massive British advance quickly overwhelmed the small garrison of fewer than 2500 men at Fort Ticonderoga and Mount Independence. The British put a battery on Sugar Hill, later called Mount Defiance, and the Americans could not realistically hold the forts with British guns overlooking them. The Americans retreated during the evening of July 5/6. All of the American vessels were laden with tents, cannon, provisions, invalids, and women. The next morning the British quickly broke apart the great floating bridge (VT-AD-0731) and boom, which had taken the Americans months of strenuous work to construct. Upon arriving at Skenesborough with the British in pursuit, the Americans destroyed a number of their own vessels, including *Revenge*, *Gates*, *New York,* and *Enterprise*, then fled on foot to Fort Anne. To prevent the British from advancing farther south, the Americans blockaded all possible routes south by destroying the bridges, diverting streams, felling trees into the roads and waterways, and placing other obstructions in the path of Burgoyne's army. The Americans also destroyed anything that could be of value to the British army, such as food, shelter, clothing, draft animals, horses, and hay. American leaders realized that Burgoyne would need to use the road between Skenesborough and the Hudson River to move his troops south and the route to the Hudson Valley via Lake George to carry provisions, ammunition, and other military supplies to his advancing army (Bellico 1992:170-177).

As the first battles were taking place in the Hudson Valley, new engagements occurred on Lake Champlain and Lake George. A three-pronged American raid was organized to attack the now-British holdings at Skenesborough, Fort Ticonderoga, and Mount Independence. The objective of the raids was to release American prisoners, to destroy British provisions, and to cause a menace that would force Burgoyne to send heavy reinforcements from the Hudson Valley back north to protect his supply line. Indeed, the raids successfully took Skenesborough, captured British troops at outposts around Fort Ticonderoga, and destroyed a number of British vessels and structures. The Americans continued to harass the flow of British supplies and communications from Lake Champlain to the Hudson Valley (Bellico 1992:181-183).

With Burgoyne's supply lines stretched thin, his army of 8000 troops struggled against the rapidly growing American force in the Hudson Valley. Beaten back, Burgoyne retreated north to Saratoga, where the American army surrounded his forces, which had diminished in number to 5000, and forced the surrender of the British army on October 17, 1777. Following Burgoyne's defeat, the British decided to abandon the forts in the Champlain Valley, destroying Fort Ticonderoga, Mount Independence, and Fort Crown Point. Most of their supplies were loaded onto British ships and sent to St. Jean, and any supplies not evacuated were destroyed or tossed into Lake Champlain.

The British still maintained control of Lake Champlain, but the threat of an American invasion of Canada was not unforeseeable (Bellico 1992:185-186).

The British continued to demonstrate their presence on Lake Champlain. To ensure that the Americans could not regain control of the lake, the British conducted raids deep into Vermont and New York in 1778, taking prisoners and destroying American vessels, structures, mills, and provisions. Following additional small raids throughout the Champlain Valley in 1779 and early 1780, the British launched their biggest post-1777 expedition in the fall of 1780. On September 28, 1780, a British army of nearly 1000 regulars, Loyalists, and Indians sailed from St. Jean to Isle-aux-Noix. One raiding party of approximately 100 men was sent up the Winooski River to attack White River and Royalton, Vermont. The fleet then landed 100 men at Bulwagga Bay, New York, to meet with a second force arriving from Niagara for an attack on the Mohawk Valley. The remaining 800 men sailed to South Bay, then sent the vessels back to Ticonderoga for a subsequent rendezvous when thirty men carried two bateaux overland to Lake George. The main British force destroyed four forts, six sawmills, a gristmill, thirty-eight houses, thirty-three barns, and 1500 tons of hay, then raised many of the sunken American bateaux on Lake George and Lake Champlain (Bellico 1992:186-188).

In the fall of 1780, Vermont leaders began negotiations with the governor of Canada to become a neutral state. The so-called Haldimand Negotiations were instigated under the guise of a prisoner exchange. The British were intrigued with the possibility that well-rewarded Vermont leaders might assist the British and provide a sympathetic invasion route to the south. These false British hopes prevented a British invasion of Vermont, while Vermont applied pressure to Congress for statehood (Bellico 1992:188-189).

In mid-October 1781, the British, wary of the double-talk of the Vermont delegates, sent a force of 1000 regulars and Loyalists into the Champlain Valley to Ticonderoga. For lack of orders, though, the British troops at Fort Ticonderoga eventually returned to Canada. As negotiations to end the war began in Paris in the spring of 1782, soldiers and land speculators began to recognize the developmental potential of the Champlain Valley. The British, however, remained a presence on Lake Champlain until 1796 at their post at Point au Fer, New York (Bellico 1992:188-189).

***Settlement and Commercialization (1783-1812)***

From 1775 to 1791, Vermont operated as an independent republic on the eastern side of Lake Champlain, while the western side of the lake was under the jurisdiction of New York. New York, Quebec, and Vermont simultaneously claimed the Champlain Islands, however, a problem that did not see resolution until the mid-nineteenth century. The population of the Champlain Valley, only a few hundred in the years following the American Revolution, exploded to approximately 143,000 people by 1810. Business entrepreneurs, land speculators, and individuals yearning for a new start quickly began to move into the valley. The large stands of virgin timber were the easiest and most profitable way to make money, and the dozens of streams and rivers in the valley attracted the development of sawmills. The trees were cut into logs, milled into building materials, burned to make potash, pearlash, and charcoal, or processed to make tar, pitch, and mineral spirits. Towns with manufacturing centers also began to develop along the lakeshore. As the population increased, the commodities heading for Canada diversified to include furs, hides, beef, pork, fish, wheat, cheese, horses, grain, pig iron, tobacco, wool, and paper (Hill 1995:160).

Although some privately built merchant vessels had appeared on the lake before the Revolutionary War, commercial navigation did not begin in earnest until the 1780s, as thousands of settlers, most of them from New England and New York, moved into the Champlain Valley to exploit the region's abundant natural resources. Rafts and small vessels including canoes, barges, scows, sloops, bateaux, whaleboats, and longboats moved much of the material for lack of good roads. Champlain Valley products were exchanged for cash, salt, and manufactured goods at the markets in Quebec (Crisman 1990:3).

After the Revolutionary War, the United States government made a determined effort to stand clear of European conflict while expanding its economic base through peaceful and honest trade without alliances. This approach worked effectively until the renewal of the Napoleonic Wars in 1803, when the fledgling nation became trapped between the two unfriendly superpowers of France and England. For two years, American commerce actually benefited from the conflict, including the Champlain Valley, which continued its exports to Canada. As a neutral party to the Napoleonic Wars, America experienced enormous growth in international trade, becoming the world's largest neutral carrier and the chief supplier of food to Europe. Both Britain and France resented America's neutral trading, however, and a series of confrontations with both belligerent countries soon began. Provoked by the harassment, President Thomas Jefferson called for an embargo in 1807 that essentially forbade all foreign trade. The disastrous effects of the embargo for the U.S. led to the passage of the Non-Intercourse Act of 1809, which permitted trade with all nations except Britain and France. When this legislation expired in 1810, trade was reopened with Britain and France as long as each country withdrew its restrictions on American shipping. France lifted its maritime restrictions, but Britain stalled long enough that America declared war and Lake Champlain once again became a strategic waterway.

Champlain Valley residents depended heavily upon the trade with Canada, so most of the valley residents ignored the embargo acts and traded openly with Canada until the United States government began to rigorously enforce the laws by posting customs agents on the lake. Wharves were purposely built astride the boundary, so that Americans could unload their goods in the United States, and Canadians, out of reach of U.S. Customs, could reload the material on boats docked in Canada. Throughout the embargo and prior to the War of 1812, the Champlain Valley's Canadian trade continued and increased dramatically despite the government's prohibition (Hill 1995:164-170).

***War of 1812 (1812-1815)***

American plans for the War of 1812 included control of Lake Champlain (Figure 25) and the Great Lakes and Lieutenant Thomas Macdonough was charged with the organization of the U.S. naval fleet on Lake Champlain. This fleet already had two vessels; the navy had built two 40-ton row galleys in 1808 to stop smuggling with Canada. As the army and navy began to assemble their forces in the Champlain Valley, the War Department acquired six sloops. The navy acted as a transport for troops and supplies between the army bases in Plattsburgh and Burlington, although the American forces made a single failed attempt to raid a Canadian outpost across the border in 1812. The American fleet was then stationed in Shelburne Bay for the winter, where they made repairs and modifications to the vessels. The first actual engagement between the two opposing navies took place in the channel of the Richelieu River on July 3, 1813. The American sloops *Growler* and *Eagle*, each with 11 guns, mistakenly sailed too far into the river channel and became trapped by three British gunboats and troops along the shore. The American vessels were captured, repaired, and renamed *Broke* and *Shannon* (Bellico 1992:206-209).

In June 1813 Macdonough received permission to purchase the necessary vessels, men, material, and munitions to keep control of the lake. He purchased the *Montgomery* and the 50-ton merchant sloop *Rising Sun*, which was renamed *Preble*. He also rented the sloops *Francis* and *Wasp*. On July 24 Macdonough was promoted to master commandant of the small but growing lake fleet. On July 29, the British departed from Isle-aux-Noix for Plattsburgh with 1000 men, *Broke*, *Shannon*, three gunboats, and more than 40 bateaux. The British raided Plattsburgh, Point au Roche, Swanton, Chazy, and Champlain, burning an arsenal, blockhouses, warehouses, barracks, and a hospital, and looted a number of private homes and captured or burned a number of privately owned vessels (Bellico 1992:209-210).

On December 21, 1813, Macdonough brought his fleet 11.3 km (7 mi) up Otter Creek to Vergennes, Vermont, for winter quarters (Figure 26). Vergennes was chosen in anticipation of a major shipbuilding program scheduled to begin in early 1814, in response to the navy's instructions for Macdonough to increase the size of the fleet. Vergennes was not only surrounded by stands of oak and pine, but it also had a waterfall that powered a host of industries including eight forges, two furnaces, a wire factory, a rolling mill, gristmills, and sawmills. A shipyard was also already in operation below the falls. Vergennes also had one of the most developed iron industries in the region, which processed bog iron ore from Monkton, Vermont. Vergennes not only had secure access to the lake but was also located on a major road through the Champlain Valley (Bellico 1992:211-212).

At Vergennes, New York shipwrights Adam and Noah Brown built for the American fleet six 70-ton row galleys, each with two masts with triangular sails, 40 oars, one 24-pounder cannon, and one 18-pounder cannon. The galleys, completed by late April 1814, were named *Allen*, *Borer*, *Burrows*, *Centipede*, *Nettle*, and *Viper*. During the late spring, the Brown brothers built the 26-gun ship *Saratoga* (Figure 27), which had a length of 43.6 m (143 ft) and width of 11.0 m (36 ft), in an amazing 40 days. They also

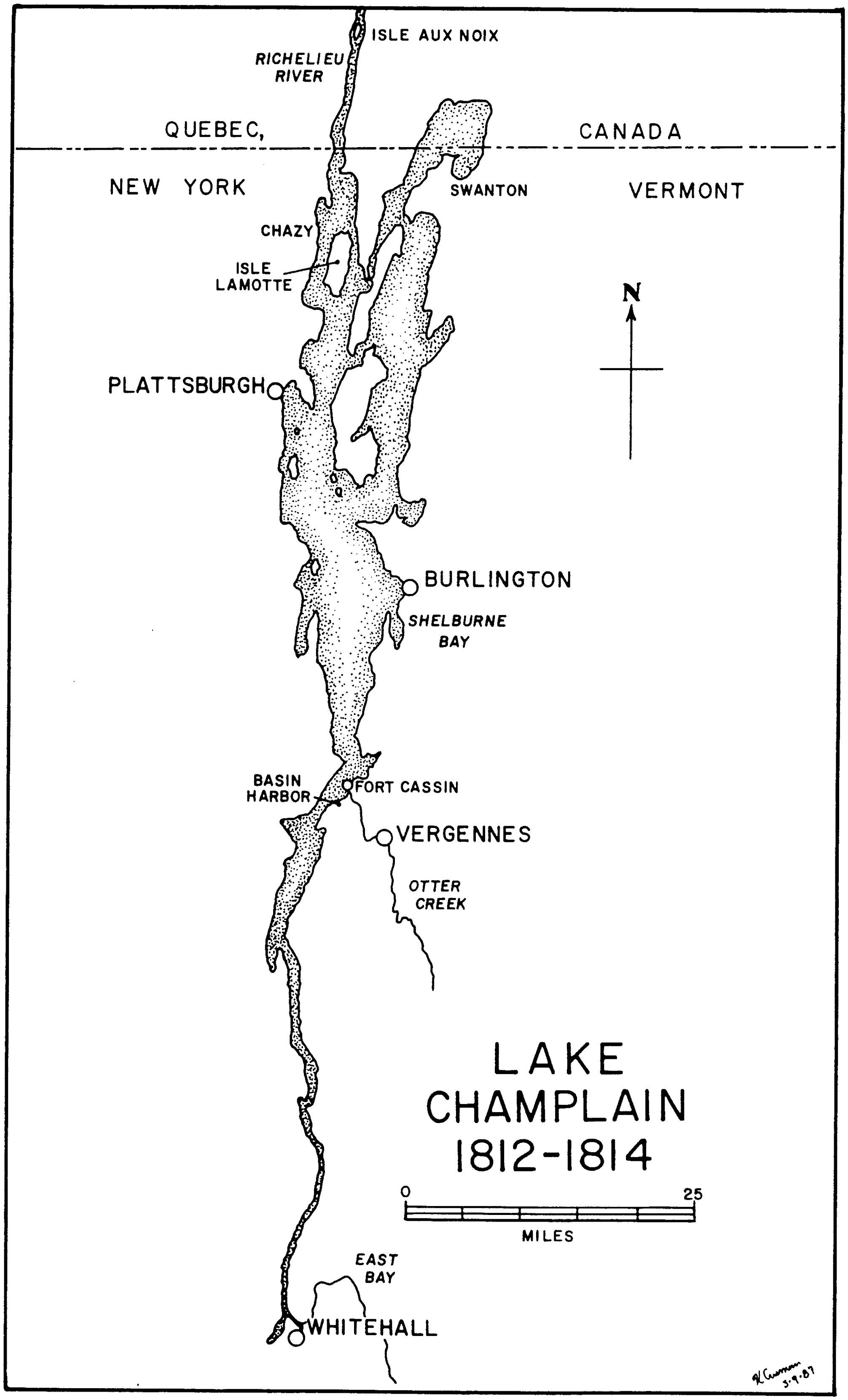


*Figure 25.* Lake Champlain, 1812-1814 (Crisman 1987:4).

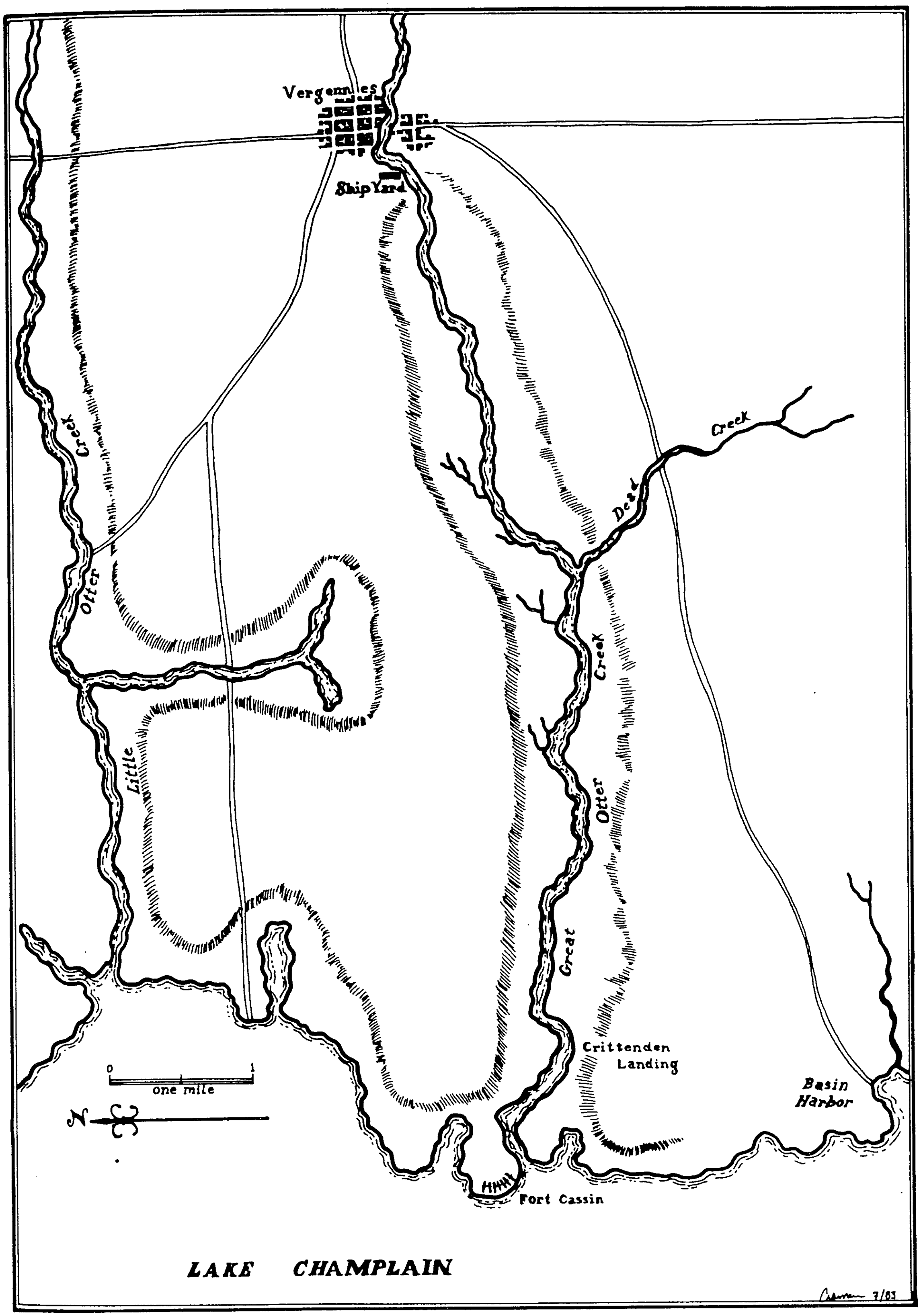


*Figure 26.* Otter Creek and Vergennes (Crisman 1987:17).

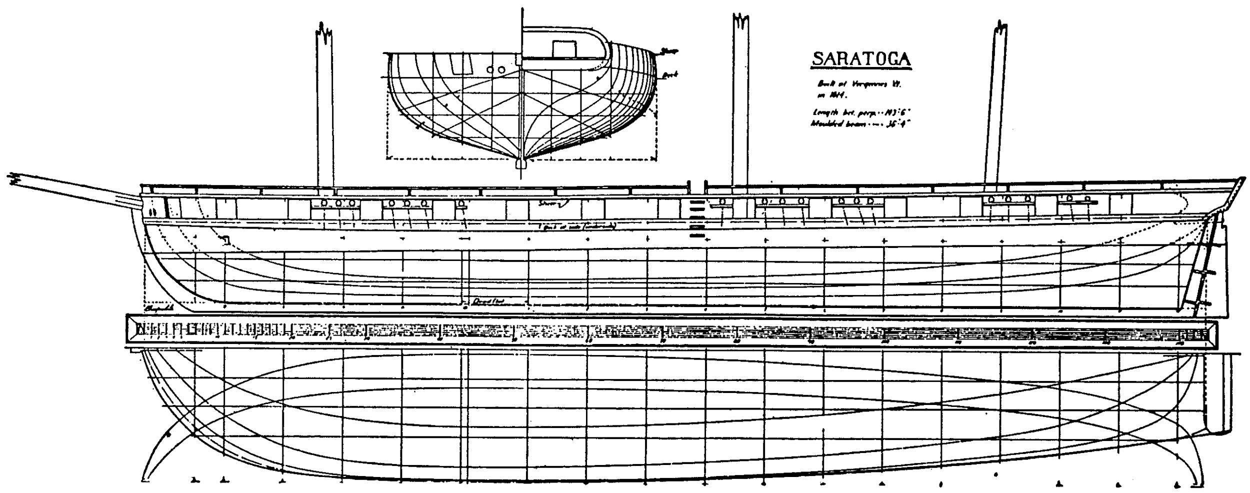


*Figure 27.* Lines of the American sloop of war *Saratoga*, 1814 (Chapelle 1982:113).

converted a steamboat hull partly constructed at Vergennes into the schooner *Ticonderoga*. The 36.6-m (120-ft) vessel with a beam of approximately 7.9 m (26 ft) was mounted with 17 guns taken from the two small sloops *Francis* and *Wasp*. The British were also enlarging their fleet during the spring of 1814, busily constructing the 16-gun, 25.0-m (82-ft) brig *Linnet* (VT-RU-0317) at their shipyard at St. Jean (Bellico 1992:212-216).

On May 9, 1814, the British fleet arrived at the mouth of Otter Creek in hopes of blockading or destroying the American fleet on the river or at least gaining intelligence about the naval fleet and crews. The British were unable to approach the mouth of Otter Creek closely, however, hampered by the presence of Fort Cassin, an earthen fort at the mouth of the river. The fort and the British fleet engaged in a 1 ½-hour battery with few casualities to either side. The American fleet quickly moved down to the mouth of the creek, but the British fleet retreated northward before they arrived. Nevertheless, British naval commander Captain Daniel Pring obtained detailed information from a spy about the American fleet, which led him to begin construction of *Confiance*, a 37-gun frigate and the largest sailing warship that would ever be constructed on Lake Champlain (Bellico 1992:216-217).

The American fleet spent most of the summer patrolling and escorting hundreds of bateaux between Plattsburgh and Burlington with troops and supplies. American Champlain Valley residents transported tons of supplies to the British forts at St. Jean and Isle-aux-Noix, which were crucial in supporting the British army and navy in the Richelieu and Champlain Valleys. On August 11, 1814, the last American vessel, the 36.6 m (120-ft) brig *Eagle* (Figure 28), was launched in a record 19 days. On August 25, the frigate *Confiance* was launched. The 831-ton square-rigged, three-masted ship was 44.5 m (146 ft) long on the gun deck and had a beam of 11.0 m (36 ft) (Bellico 1992:218-219).

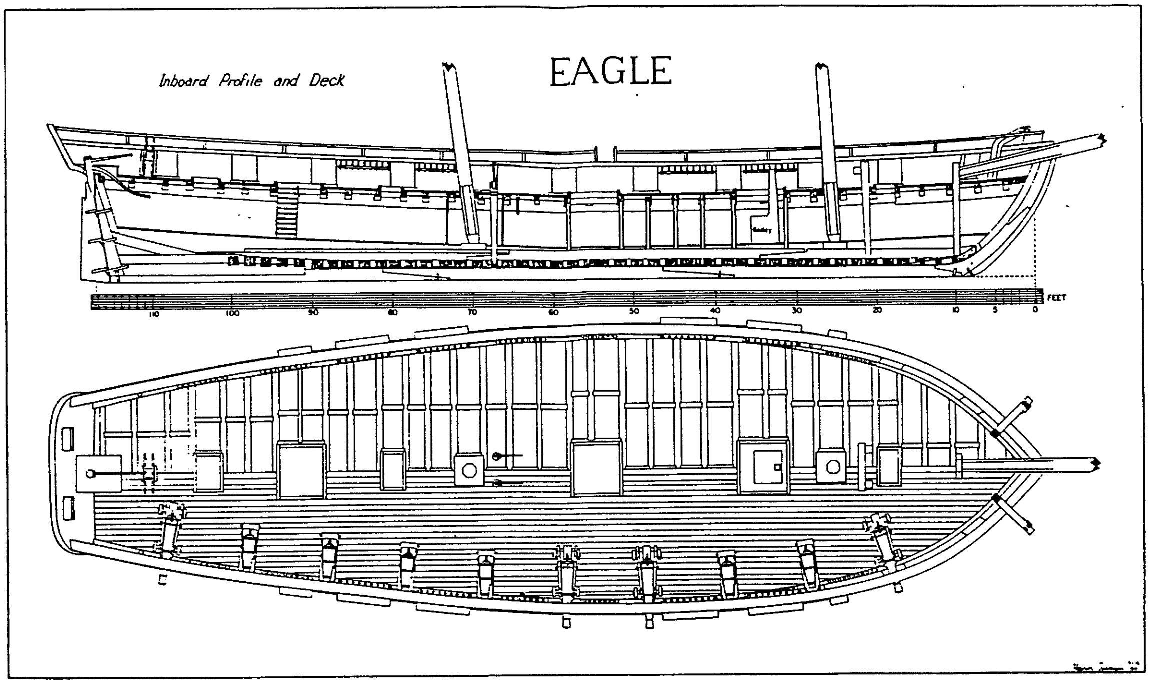


*Figure 28.* Inboard profile and deck plan of the American brig *Eagle*, based upon archaeological investigation (Crisman 1987:inside back cover).

The two fleets finally met in Cumberland Bay on September 11, 1814. Macdonough positioned the American vessels inside the bay to permit the American fleet to use its short-range guns more effectively in the inevitable close battle. Macdonough's strategy for engaging the British was very similar to that used just to the south in Valcour Bay by Benedict Arnold in 1776. Again, the north wind that would carry the British to Plattsburgh would also make it difficult for them to take position in the bay for a close-range battle. Macdonough positioned his fleet in a north-south line inside the bay with an intricate anchoring system rigged with spring lines. This system allowed the American vessels to be turned end-to-end to bring fresh guns on the opposite side of the ship to bear on the enemy should the guns on the original side become disabled.

The two fleets were nearly matched in size and firepower, although the British had greater weight in long-range guns. The British fleet was given to Captain George Downie only days before the battle, leaving him to take command of his new crew in unfamiliar waters. Both fleets had crews consisting of trained seaman and inexperienced land troops; none of the crews, however, were prepared for the devastating battle that was about to begin. The battle raged for two hours and twenty minutes with deafening cannon and musket fire and resulted in a high number of casualities on both sides and holes punched through the hulls of every vessel (Figure 29). The American fleet ultimately defeated the Royal Navy, and the British army withdrew its artillery from the New York shore and returned to Canada (Bellico 1992:221-230).

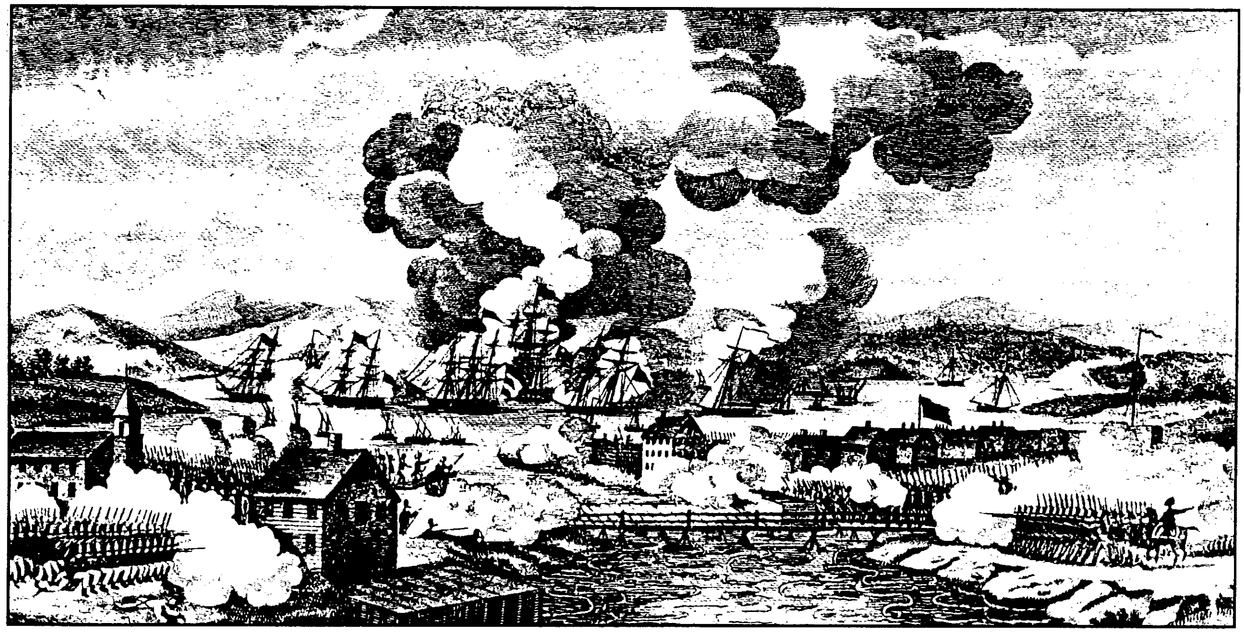

Figure 29. Battle of Plattsburgh Bay, September 11, 1814 (Lewis 1994:27).

None of the vessels sank during the battle, but all needed extensive repair before they could be taken to Whitehall at the southern end of the lake and laid up in ordinary. The vessels were stripped of their masts, guns, sails, and naval stores in early March 1815. After the Treaty of Ghent was signed on Christmas Eve of 1814, there was little need for the naval fleet on Lake Champlain. Most of the vessels were sold for commercial trade on the lake, while the remaining vessels were destroyed or moved up the Poultney River and abandoned (Bellico 1992:232).

After the War of 1812 had ended, the threat of further confrontation on Lake Champlain led to the construction of an American fort near the Canadian border in 1816. Work continued on the fort until it was realized in 1819 that some of the fort was located on Canadian soil. Thereafter, valley residents called the abandoned fortification Fort Blunder (Bellico 1992:234).

***Searching for a New Market (1815-1823)***

The War of 1812 had expanded commercial ties with businessmen in the Hudson Valley, and post-war British tariffs on imports to Canada prevented Canadian markets from once again monopolizing the Champlain Valley's trade. The lack of a navigable waterway, however, continued to impede trade to the south. Stagecoaches and wagon trains connecting the valleys could accommodate people and small amounts of goods, but bulky, heavy cargoes such as timber, potash, iron, and other raw materials were still without an economical means of transportation to the markets of the eastern seaboard. Because of this effective commercial barrier, the population of the Champlain Valley increased only a small amount following the War of 1812 (Crisman 1990:9-10).

The Champlain Valley desperately needed canals to connect itself directly to Canadian or New York markets so that cargoes could easily and cheaply be taken to market. With renewed interest in expanding the Champlain Valley's markets and exports, enthusiasm for building these canals gained momentum. Both canals had been suggested and researched during the Revolutionary War, but at that time such an effort was an insurmountable project for any single, independent company. This transportation barrier was resolved in 1817, when the legislature of New York resolved to build two commercial waterways, the Champlain and Erie Canals, through the interior of upper New York. The Champlain or Northern Canal would extend for 103.0 km (64 mi) between Whitehall and Waterford, New York, which meant that an artificial channel 74.8 km (46.5 mi) long had to be excavated. With tremendous fanfare the Champlain Canal opened in 1823, and its impact on the Champlain Valley's development and history was profound. The trade that had previously occurred predominately with Canada changed directions almost overnight (Bellico 1992:237-238).

### *Golden Era of Waterborne Commerce (1823-1848)*

The opening of the Champlain Canal profoundly affected the economic development of the Champlain Valley. Extractive industries, particularly timber cutting, stone quarrying, and iron mining, experienced a surge of activity as entrepreneurs hastened to take advantage of the new unrestricted domestic market for their products. Agricultural surpluses of apples, potatoes, grain, butter, cheese, and other semi-perishables could quickly and inexpensively be shipped to urban centers along the Eastern Seaboard. The Champlain Canal also provided residents of Vermont and northeastern New York with manufactured goods and raw materials that had previously cost a great deal to ship overland or import from Canada. The year 1823 marked the end of the Champlain Valley's relative isolation from the outside world and its entry into the national economy (Crisman1990:10-11).

The canal presented entrepreneurs with a number of new and lucrative business opportunities. Many lakeside merchants advertised themselves as forwarding agents who could take responsibility for the safe and rapid transportation of freight from one destination to another. As shipping lines developed, the work of forwarding products was simplified since freight could now be under the supervision of one company from its origin to its destination (Crisman 1990:12).

The opening of the canal created a demand not only for canal boats, but also for vessels to transport cargoes between Whitehall and other ports on the lake. Lake sloops and schooners initially met this demand, as cargoes were transferred from standard canal boats to conventional sailing lake craft at each end of the Champlain Canal. The capacity and number of sloops and schooners increased dramatically after the opening of the canal, and small-scale shipbuilding operations were set up at many of the smaller lakeside towns (Crisman 1990:12).

The number and types of vessels that passed over Lake Champlain's waters greatly increased after 1823. The canal's shallow channels, low bridges, and narrow locks were too restrictive for nearly all of the existing lake merchant craft, so large numbers of long, narrow, shallow-draft boats were constructed for canal service. Three types of canal vessels were employed during the early years of the canal: standard canal boats, sailing canal boats, and packets. All of these craft were towed through the canal by teams of mules or horses. By 1833, there were 232 cargo- and passenger-carrying canal boats registered at towns along Lake Champlain and the canal. Shipyards that specialized in the building of standard canal boats and packets appeared in the southern portion of Lake Champlain and at towns along the Champlain Canal. Shipbuilders at the northern end of the lake occasionally constructed sloop- or schooner-rigged canal boats that could sail up to Whitehall, unstep their masts, raise a centerboard or leeboards, and pass through the canal. The sailing canal boats built before 1834 were probably stabilized by leeboards (Crisman 1990:11-12).

The use of the sailing canal boat increased after 1841, when Burlington businessmen Timothy Follett and John Bradley formed the Merchants Lake Boat Line. Recognizing that the transfer of cargoes from lake craft to standard canal boats caused inefficient due to delay, expense, and damage to freight, Follett and Bradley chose to use sailing canal boats in their fleet to avoid unnecessary handling. Their vessels were sloop-rigged canal boats with centerboards, and the profitability of their line soon forced other shippers to switch to similar boats (Crisman 1990:17).

The effect of the sailing canal boat on other types of merchant craft was considerable. The construction of sloops and schooners declined very rapidly after 1842, and those that remained in service were relegated to secondary roles such as transporting bulky cargoes between lake ports. In order to compete with the sailing canal boats, owners of standard canal boat lines also dispensed with unnecessary freight handling by building steam tugboats for canal service and a different style of tugboat for lake service, which towed rafts of standard canal boats. The elimination of trans-shipment at both ends of the Champlain Canal lowered freight rates and increased the profitability of bulk cargoes (Crisman 1990:17).

The opening of the canal also proved beneficial to steam navigation on Lake Champlain. The steamer *Vermont*, completed in 1809, was the world's second commercial steamer and the first steamer on Lake Champlain. The vessel survived the economic and military hazards of the War of 1812, but it sank in the Richelieu River in 1815 when its crankshaft disconnected and punched a hole through the bottom of the hull. This early experiment with steam navigation was, however, still considered a success, and the loss of *Vermont* did not interrupt steamer passenger service for long. A steamboat called *Phoenix* (VT-CH-0587; Figure 30), measuring 44.5 m (146 ft) in length with a 45-hp steam engine, replaced the *Vermont*. *Phoenix* and other steamers that followed operated successful and lucrative services on Lake Champlain. By the 1830s one steamboat company in particular, the Champlain Transportation Company (CTC), began to take the lead over its competitors. The CTC purchased the passenger steamers of other companies or acquired the companies outright. Finally, in January 1835, the CTC acquired a monopoly on Lake Champlain steamboat ferry service, which

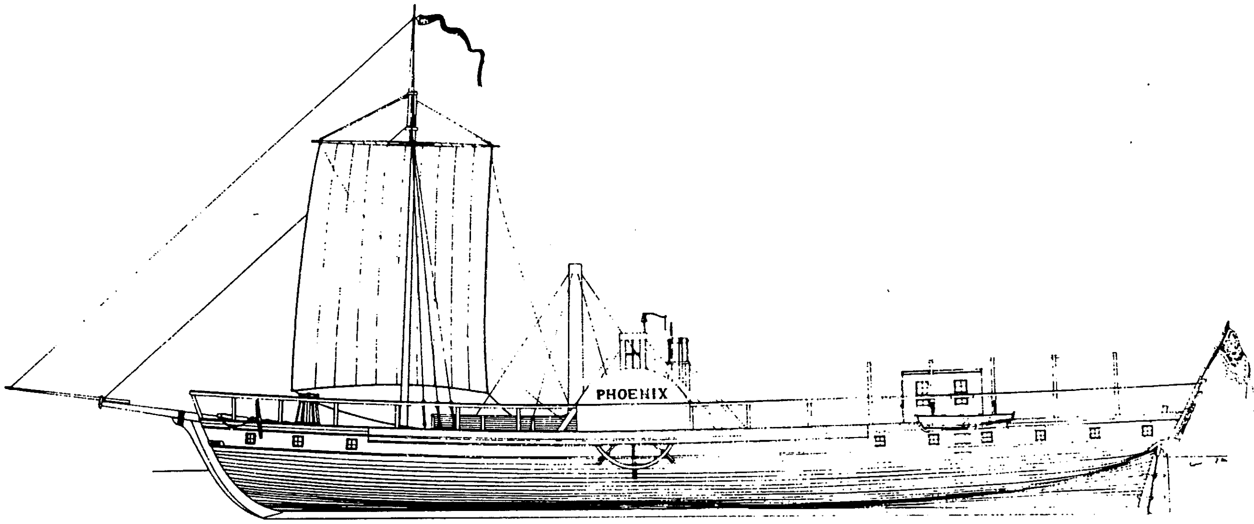


*Figure 30.* Conjectural view of the steamboat *Phoenix* (Cohn 1997:204).

it maintained until the end of the steamer era on the lake despite a few attempts by determined companies and individuals to break into the passenger steamboat business (Crisman 1990:13-15).

Small cross-lake ferryboats were also an important part of Lake Champlain's commercial traffic throughout the nineteenth century. From 1825 onward, steam ferries dominated long-distance crossings, but most of the short-distance crossings continued to be served by sail or sweep-propelled scows. In the late 1820s, a trend of horse-powered ferries swept the lake (Figure 31), and a number of these innovative craft were put into service at medium-distance crossings. By 1848, however, all of these vessels had been replaced with other watercraft types (Crisman 1990:16).

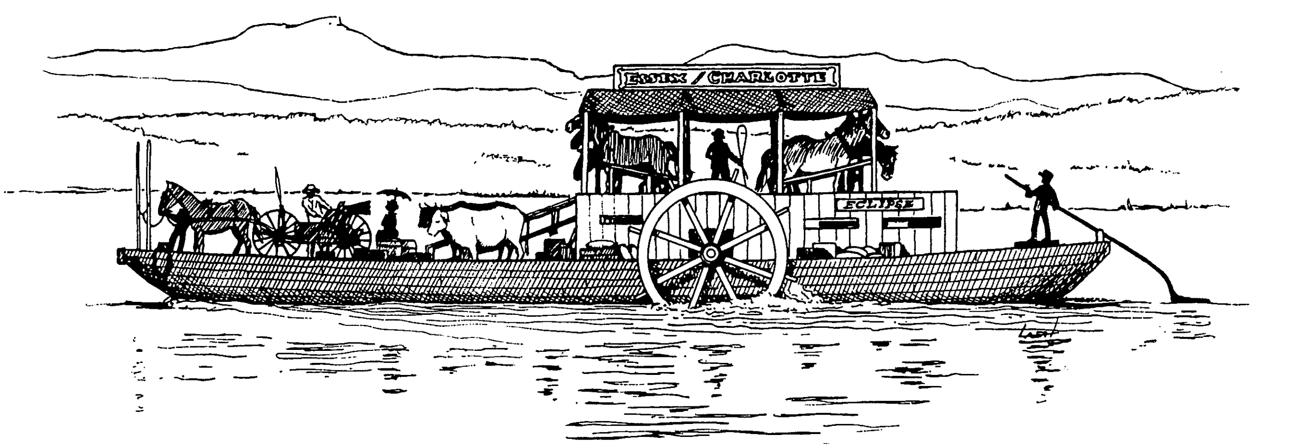


*Figure 31.* Conjectural rendition of the horse-powered ferry *Eclipse* crossing Lake Champlain between Essex, New York, and Charlotte, Vermont (Glenn 1979:22).

The opening of the Chambly Canal around the rapids of the Richelieu River in 1843 also boosted the economy of the Champlain Valley. The new waterway opened a direct passage to interior trade markets and allowed merchants to ship goods between the Great Lakes, the Eastern Seaboard, and the St. Lawrence Valley without transshipment (Crisman 1990:18).

***Railroad Development (1848-1875)***

The idea of connecting Lake Champlain with the Atlantic Ocean by rail was first conceived in the 1830s. In 1848 a railroad was completed that connected the Hudson and Champlain Valleys. This railroad foreshadowed the dramatic effect railways would have on Lake Champlain's shipping and passenger service, as it increased the shipment of perishable products and eliminated the need for packet boats providing passenger service on the canal. The prospect of connecting the Champlain Valley to the Atlantic Ocean became reality in 1849 with the completion of a rail line from Boston to Burlington, Vermont. The railroad industry developed very quickly in the Northeast. The earliest railroads crossed upstate New York and Vermont on their way from Canadian and Great Lakes cities to the warm water ports on the Eastern Seaboard. By 1853, the Champlain Valley was connected by rail to Montreal, Boston, Albany, and New York City. The early railroad years seemed to create more business for the lake vessels, but it soon became clear that they would ultimately appropriate nearly all business. Once railroad spurs were constructed throughout the Champlain Valley and the reliability of trains increased, the price of shipping by rail dropped dramatically and seriously competed with lake commerce. Railroads also offered a year-round transportation alternative, something that Lake Champlain could not provide.

The railroads doomed vessels on Lake Champlain to moving cheap and heavy freight and tourists, although they continued to flourish until the completion of the rail link on the west side of the lake in 1876. Hauling cheap Canadian timber for growing American cities provided a staple for lake shipping for the rest of the nineteenth century, and ferry companies still provided the fastest and easiest service around the Champlain Valley (Figure 32). Steamboats of all sizes and functions were built and operated on the lake during the mid-nineteenth century in attempts to speed transportation on the lake and to make it more economical. These steamboats originally complemented the services of many of the sailing craft but eventually dominated most of the longer ferry crossings throughout the lake.

***Downfall of Lake Commerce (1874-1945)***

One of the most negative effects on Lake Champlain commerce resulted from the construction of a rail line on the western shore of Lake Champlain. Many vessels operating on the lake had depended upon the transport of bulky cargoes of iron ore mined in the Adirondack Mountains. Once railroad tracks ran along the western shoreline, the railroads were able to capture almost all of the iron ore traffic, simply as a matter of economics.

The new rail line also rendered the need for passenger steamers on Lake Champlain unnecessary. Passenger steamers continued to operate on the lake until

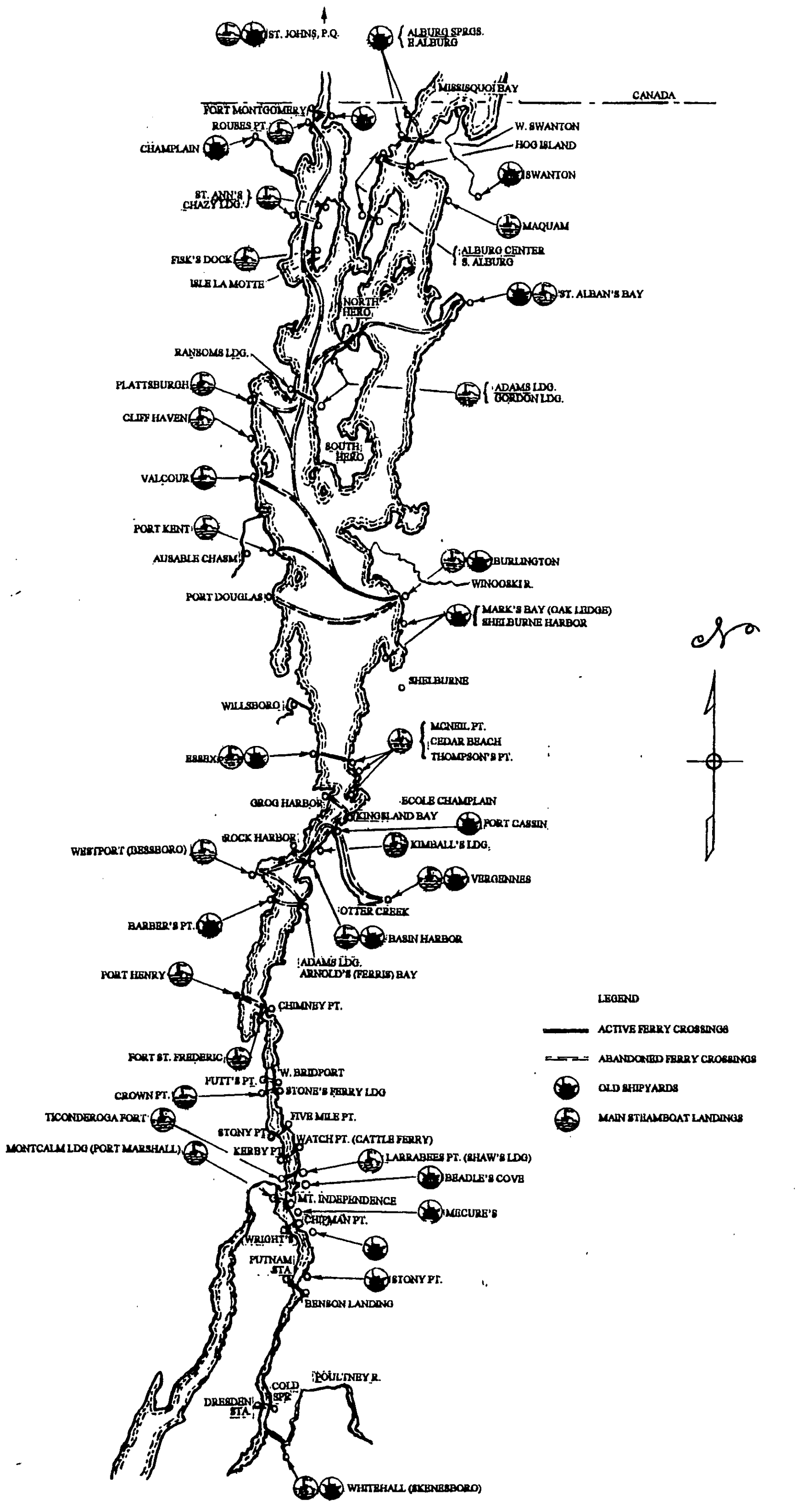


*Figure 32.* Active and abandoned ferry crossings on Lake Champlain (Williams & Hill 1990:16-17).

the middle of the twentieth century (Figure 33), but they were no longer an essential part of the Champlain Valley's transportation network. The 1870s marked a rapid decline in all types of commercial sailing craft on Lake Champlain. With a few exceptions, the production of commercial sailing craft ceased in the 1870s, and a substantial number of the existing canal sloops and schooners were dismasted and converted into standard towed canal boats (Hill 1995:241). An increasing number of steam tugs made towing a faster and more effective means of moving cargo around the lake. The expanding rail system also served a greater number of the northern lake towns, drawing away the freight that had previously supported the sailing craft.

Lake Champlain commerce survived into the middle of the twentieth century by carrying bulky cargoes within the Champlain Valley and bringing fuel oil, kerosene, and gasoline to the largest lake towns and cities. In an effort to stimulate lake commerce and activity on the Champlain Canal, the State of New York decided to enlarge the lock size to accommodate larger vessels by 1916. The state wrongly assumed that enlarging the size of the vessels would reduce the cost of shipment, thus providing an incentive to use water transportation instead of railroads. The new lock dimensions, however, exceeded the practical size for a shallow-draft wooden vessel. Commercial wooden ships had largely become obsolete by the 1920s, when wooden shipbuilding yielded to the construction of iron or steel vessels.

The use of ferries also eventually declined, primarily as a result of bridge construction. In 1927 the Crown Point Bridge, the first permanent highway bridge to span Lake Champlain, was constructed between Crown Point, New York, and Chimney Point, Vermont. The second highway to cross the lake, from Rouses Point, New York, to Swanton, Vermont, was completed in 1938. This causeway required the construction of two bridges, the Rouses Point Bridge and the Missisquoi Bay Bridge. By 1945, bridges connected almost all of the Champlain Islands, and the roads around Lake Champlain had been vastly improved. The automobile, introduced to the region at the turn of the century, eventually replaced the horse and carriage and became the most popular way to transport goods and passengers throughout the Champlain Valley. Even tourists abandoned the lake's excursion vessels and embraced the automobile as the easiest way to explore and move about the area. As the number of automobiles increased, the demand for better roads and bridges took precedence over the lake's commercial fleet.

### *Recreational Period (1945-present)*

Lake Champlain had become a tourist attraction even after the Revolutionary War, but the primary use of the lake did not become recreational until after World War II (1941-1945). At that time the only commercial vessels that remained on the lake were car ferries and a small number of steel barges and diesel tugs. The solid economic footing of many Champlain Valley residents allowed them to purchase small pleasure boats following World War II. The development of reliable outboard motors for these small craft allowed almost anyone to purchase a small runabout for recreational use on Lake Champlain. The number of public beaches also increased, as well as the number of beachgoers.

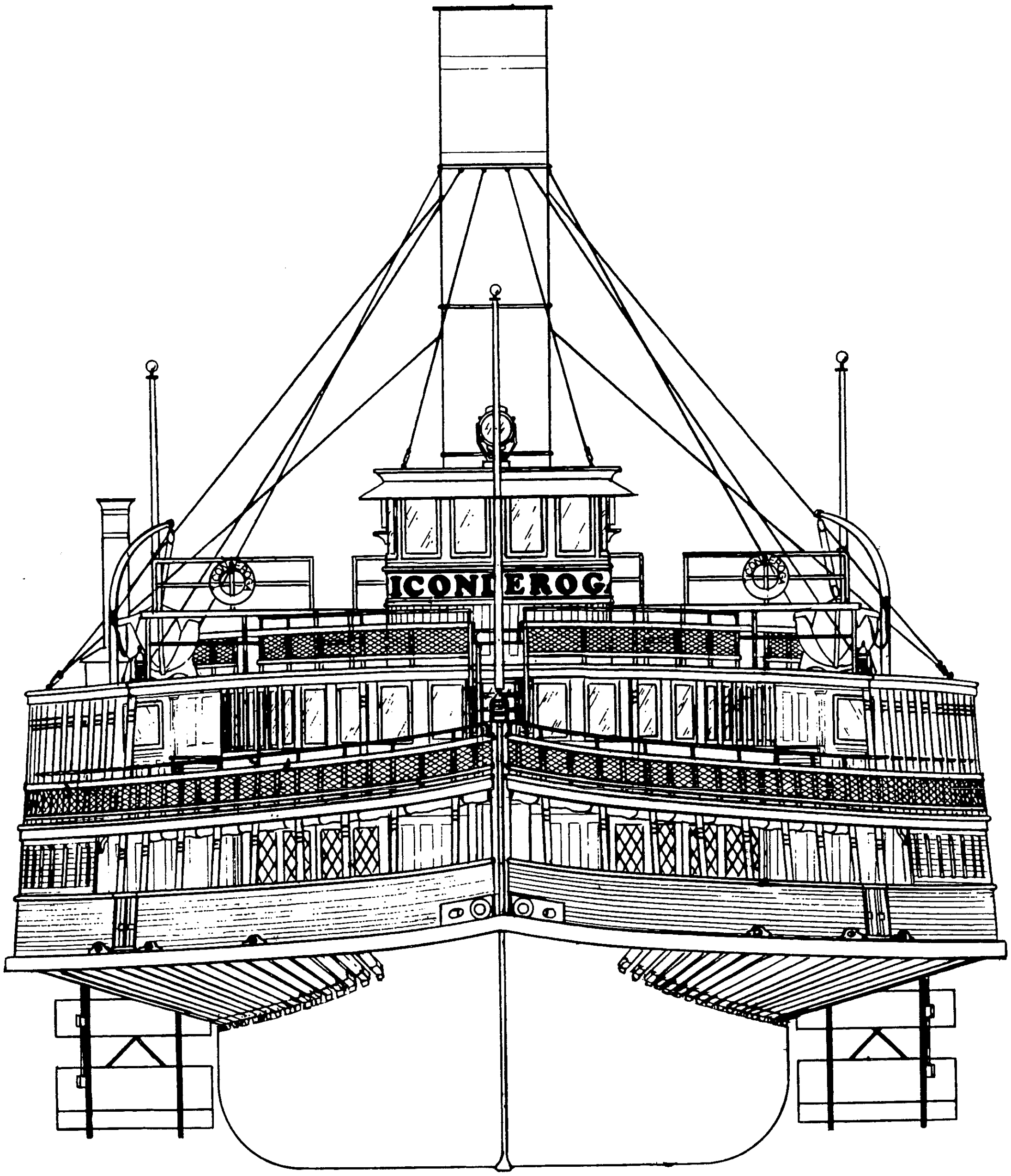


*Figure 33*. Bow of the steamboat *Ticonderoga*, the last steamer on Lake Champlain, which was retired in the middle of the twentieth century (Ticonderoga 1990).

As more lakeshore property was purchased and developed for recreational use, concern for Lake Champlain's water quality and health increased. A number of federal, state, and local ecological organizations were created to monitor and study the lake's environment. Towns and cities conducted studies on how they should develop their waterfronts in an effort to revitalize local economies. Many of these projects never progressed beyond the drawing board, but others have succeeded in recent years.

Appreciation for Lake Champlain's environmental and historical value has dramatically increased over the past decade. Public school programs are beginning to emphasize the Champlain Valley's historic role in regional, national, and international affairs. Citizens are more concerned about the health and preservation of the lake's natural and cultural resources. A number of museums and historic sites dedicated to interpreting Lake Champlain's natural and cultural history have opened in recent years to fulfill the public's desire to learn more about the area's past. Dozens of studies concerning the lake's resources have been undertaken with public support to preserve Lake Champlain.

### *Salvage and Archaeology*

Historians and maritime archaeologists have spent at least the past twenty years exploring Lake Champlain's extraordinary collection of historic shipwrecks. The presence of these archaeological sites provides a direct conduit into the historical record; with proper study, these shipwrecks can potentially provide a better understanding of our past (Cohn 1995:283).

A number of salvage operations and archaeological surveys have been conducted in Lake Champlain over the last century. Over the past twenty years, professional underwater archaeologists, amateur archaeologists, and recreational divers have been surveying the lake bottom and have located dozens of shipwrecks (Figure 34). Underwater archaeological projects in Lake Champlain have documented steamboats, commercial sailing vessels, canal boats, barges, a horse-powered ferry, and French, British, and American warships representing the French and Indian War, the American Revolution, and the War of 1812 (Bellico 1992; Crisman and Cohn 1994). The lake's cold water, limited visibility, and variable depths present a challenging working environment, but they also create a relatively stable environment for these wooden time capsules.

Data from previous archaeological surveys is of great importance to the Lake Survey. This information identifies archaeologically sensitive areas, helps to define the range of the lake's archaeological resources, and describes cultural resources that have already been located, documented, and recovered. It was not the goal of the 1996 Lake Survey to compile and analyze this information; a few generalizations, however, can be made about the results of previous surveys. Numerous researchers have compiled information about Lake Champlain's vessels and maritime history, but the data from previous surveys is incomplete and has never been assembled as a comprehensive report. Compiling a bibliography of Lake Champlain's underwater archaeological investigations should be the first step in this process. Secondly, many previously surveyed areas must be investigated again in order to take advantage of recent advancements in the technology and procedures of underwater archaeology.

According to a preliminary search of the records at LCMM and VDHP, at least forty-six submerged cultural resources are known to be preserved in New York waters. These sites consist of forty shipwrecks, two railroad cars, two battlefield sites, the 1777 Great Floating Bridge piers (VT-AD-0731), and the anchor from the War of 1812 British frigate *Confiance*. Vermont records list 85 submerged cultural resources including seventy-eight shipwrecks, two prehistoric pots, one breakwater, one marine railway, one field of Revolutionary War artifacts, and the 1777 Great Floating Bridge piers (VT-AD-0731) (Appendix R). Dozens of other historic underwater resources are not listed in New York and Vermont state inventories, and New York lacks a formal inventory of the

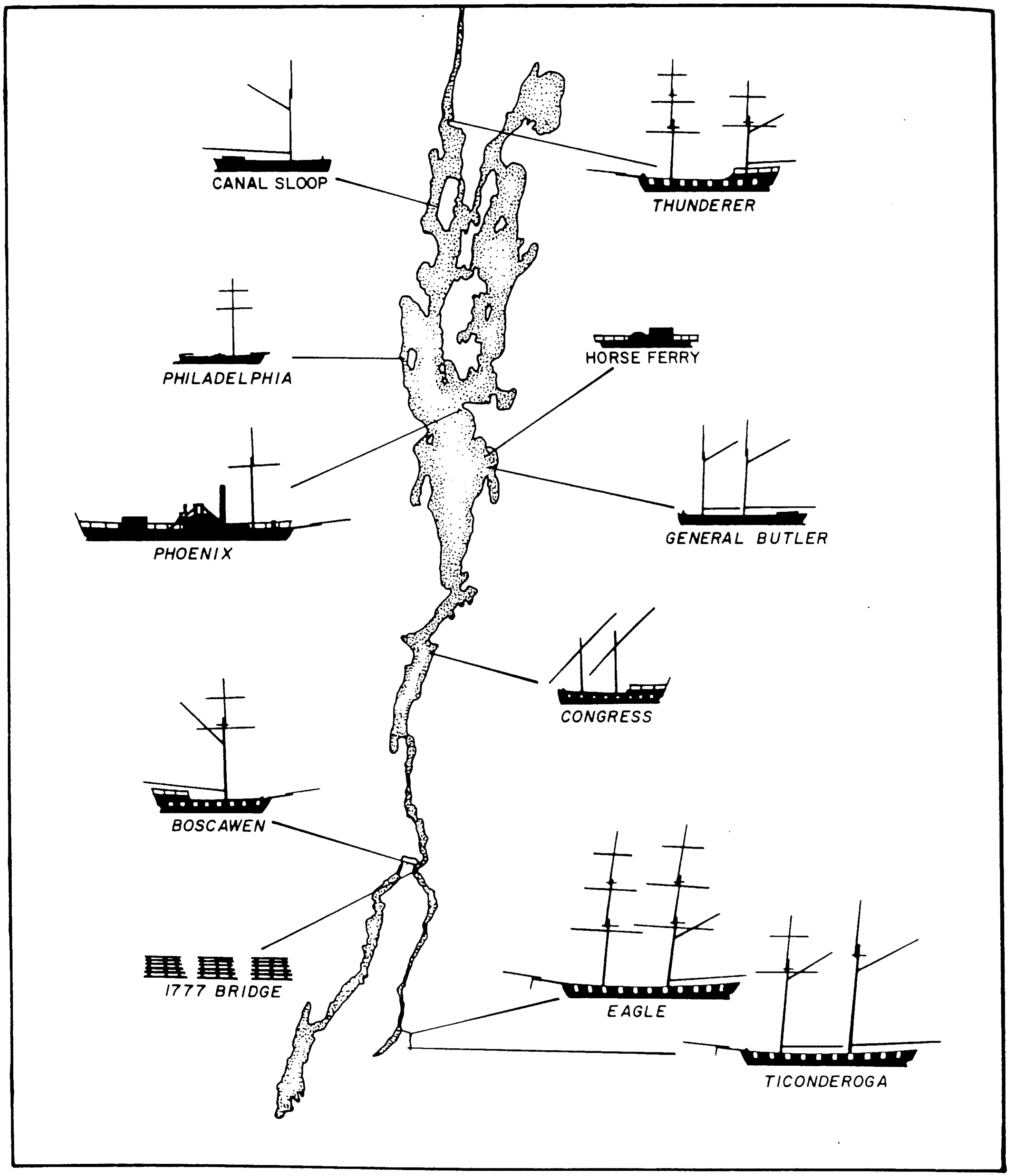


*Figure 34.* Selected shipwrecks and submerged cultural resources in Lake Champlain (Lake Champlain Maritime Museum).

submerged cultural resources in its waters. The completion of inventory forms for known submerged cultural resources must become a priority of the Lake Survey.

In New York the only Lake Champlain underwater cultural resource listed on the National Register of Historic Places is the shipwreck of the sidewheel steamer *Champlain II*, although New York has two National Historic Landmarks (the site of the Battle of Valcour and the site of the Battle of Plattsburgh Bay) listed with the National Park Service. The Revolutionary War fortifications of Fort Ticonderoga in New York and Mount Independence in Orwell, Vermont, along with their underwater resources in Lake Champlain, are both listed as National Historic Landmarks. Vermont has four shipwrecks listed on the National Register of Historic Places, including the sidewheel steamer *Phoenix* (VT-CH-0587), the Burlington Bay Horse Ferry (VT-CH-0591), the sailing canal schooner *O.J. Walker* (VT-CH-0594), and the sailing canal schooner *General Butler* (VT-CH-0590). The number and significance of Lake Champlain's cultural resources, however, indicates that several other Lake Champlain sites could qualify and probably should be added to the National Register.

### *Salvagers and Souvenir Hunters*

Eighteenth-century journals and letters and nineteenth-century newspapers describe several attempts to recover ships and cargo that were either intentionally sunk or accidentally lost in Lake Champlain. These efforts were not always successful, as in the case of two French sloops with ordnance that were scuttled in Cumberland Bay during the French and Indian War. The English recovered much of the material in 1759, but many small objects remained on the lake bottom. In the fall of 1968, some of the French artifacts were found and recovered by three scuba divers. The assemblage of artifacts included two bronze cannon, a swivel gun, muskets, a saber, and anchors. The two bronze cannon, after New York State intervention, are now on public display, one at Crown Point State Historic Site and one at the Clinton County Historical Association (Bellico 1992:112-113).

Many of the more recent salvage operations of early vessels were intended to create tourist attractions or to celebrate historic events that took place on Lake Champlain. During the early 1900s a vessel was recovered from the waters off Fort Crown Point and displayed on the fort's parade grounds until a grass fire destroyed the hulk in the 1940s. The large wooden vessel is today believed to have been the French radeau *Grand Diable*. Other than a few photographs, no documents concerning this vessel have been located (Bellico 1992:109-112).

In 1958, the War of 1812 American schooner *Ticonderoga* was raised from the Poultney River and placed on display in the town of Whitehall, New York, for the 350th anniversary of Samuel de Champlain's exploration of the area. The vessel is now displayed under a shed at the Skenesborough Museum in Whitehall (Bellico 1992:234).

Some of the wrecks and artifacts were recovered from Lake Champlain for personal gain. In 1949 the hull of the War of 1812 British brig *Linnet* (VT-RU-0317) was salvaged from the Poultney River and broken into two pieces. Artifacts and timbers were sold from the vessel. The retrieved bow section of the vessel was eventually carted up to Fort Mount Hope in Ticonderoga and wrongly identified as one of the American gunboats of 1776 (Bellico 1992:233-234). The recovered section is today badly deteriorated, while the rest of *Linnet* (VT-RU-0317) remains in the Poultney River.

Throughout the nineteenth and twentieth centuries local relic hunters and visitors to the Champlain Valley stripped exposed portions from Lake Champlain shipwrecks such as *Royal Savage* near Valcour Island and the other Revolutionary War vessels in Arnold's Bay in Panton, Vermont (Bellico 1992:192). The location of the War of 1812 fleet has always been well known, and in the 1950s and 1960s divers removed hundreds of artifacts from the vessels. Timbers from the hulls were carved into decorative canes, boxes, spoons, and other objects. Other souvenir hunters used magnets or dove down to shipwrecks to collect objects. Hundreds of anchors of various sizes and types, dating from the early eighteenth to the late twentieth century, have been recovered from Lake Champlain. Artifacts recovered from Lake Champlain's shipwrecks are now scattered throughout the United States and Canada, but no attempt has been made to inventory even those objects still located in the Champlain Valley.

Almost all of the vessels recovered from Lake Champlain have been destroyed due to careless handling or a lack of caretaking knowledge, which led to their deterioration. Many of the objects collected by souvenir hunters have also been destroyed or scattered across the country with little or no provenience. Although it would be very time-consuming to inventory documents about past salvage operations in order to research their activities, it could begin to provide information about cultural resources and previous disturbances that can be gained in no other way.

### *Fort Ticonderoga Museum*

For the Tercentenary Celebration of Lake Champlain in January 1909, the Pell Family and residents of Ticonderoga, New York, salvaged the hulk of a vessel that had sunk near the old military dock at Fort Ticonderoga. The vessel was originally misidentified as Benedict Arnold's 1776 schooner *Revenge*. Later correctly identified as the 1759 *Duke of Cumberland*, the wreck was displayed near the shore below Fort Ticonderoga under a shed roof. In 1948 the roof collapsed on the vessel and caused major damage to the hull. The Fort Ticonderoga Museum eventually abandoned the vessel and it rotted along the lakeshore, where it still remains unprotected (Bellico 1992:109-112).

In the 1950s, the Fort Ticonderoga Museum began to investigate two wrecks, believed to date to the Revolutionary War, that lay submerged in the waters adjacent to the fort. One of the vessels, a 22.9-m (75-ft) hulk, was raised in 1954 but burned in 1959. The extent and location of any documentation related to the museum's surveys and the wrecks recovered from the vicinity of the fort, however, is currently unknown (Bellico 1992:109 and 112).

### *Lorenzo F. Haggland*

In the summer of 1932, Lorenzo F. Hagglund, a salvage engineer from New York City, first dived on the Revolutionary War wreck of *Royal Savage* off Valcour Island. Hagglund returned in 1934 and recovered the wreck and the vessel's associated artifacts. He disassembled the extant hull remains, which preserved only a 10.7-m-long (35 ft) and 4.6-m-wide (15 ft) portion of the entire vessel. Today, many of the vessel's timbers and artifacts are scattered throughout New York and Vermont, and most of the surviving hull is in Harrisburg, Pennsylvania (Bellico 1992:192-193).

In 1935 Hagglund returned to Valcour Island with a crew of volunteers and recovered the gunboat *Philadelphia*, which was found to be sitting intact and upright in the middle of the channel between Valcour and the New York shoreline in 17.4 m (57 ft) of water. Hagglund then displayed the vessel throughout the Champlain Valley. In 1961, following Hagglund's death, the Smithsonian Institution acquired the vessel and placed it on permanent display in the Museum of History and Technology in Washington, DC (Bellico 1992:193).

From 1951 to 1953, Hagglund searched unsuccessfully for the American gunboat that sank near Schuyler Island during the American retreat from the Battle of Valcour Island in 1776. In 1952, however, Hagglund recovered an American gunboat from Arnold's Bay. He and a number of prominent Champlain Valley residents organized an investment group called the Lake Champlain Associates, Inc., in the mid 1950s. The group planned to build a huge masonry exhibition hall for the "Museum of Naval History" with an issue of 300,000 shares of common stock. Funds for the museum never materialized, though, and most of the vessels and artifacts raised by Hagglund slowly deteriorated and were lost (Bellico 1992:200-201).

### *Champlain Valley Dive Clubs*

The dive clubs that have existed in the Champlain Valley over the past forty years have proven to be excellent sources of information. Members of these clubs have seen much of the lake bottom within divable depths, have located numerous cultural resources, and have been involved in the recovery of hundreds of historic objects. They are also often aware of previously surveyed regions and sensitive archaeological areas in the lake. Some previous Champlain Valley dive clubs were the Lake Champlain Reef Runners in Burlington, the Lake Champlain Wreck Raiders in Plattsburgh, and the Essex County Dive Club in Willsboro. During the 1960s and 1970s, the Sea Urchins Diving Club of Roxboro, Quebec, and other clubs from the St. Lawrence and Hudson Valleys frequently sponsored trips to Lake Champlain to explore shipwrecks and other finds (Jonathan Eddy, personal communication 1997).

### *Lake Champlain Archaeological Association (1978-1992)*

In 1978 a group of local divers from the Plattsburgh, New York, area founded the Lake Champlain Archaeological Associates (Figure 35), later called the Lake Champlain Archaeological Association. This nonprofit educational organization was organized and directed by William Leege, an avid amateur archaeologist. Leege, a commercial diver who gained his diving experience in the U.S. Navy, had already surveyed and

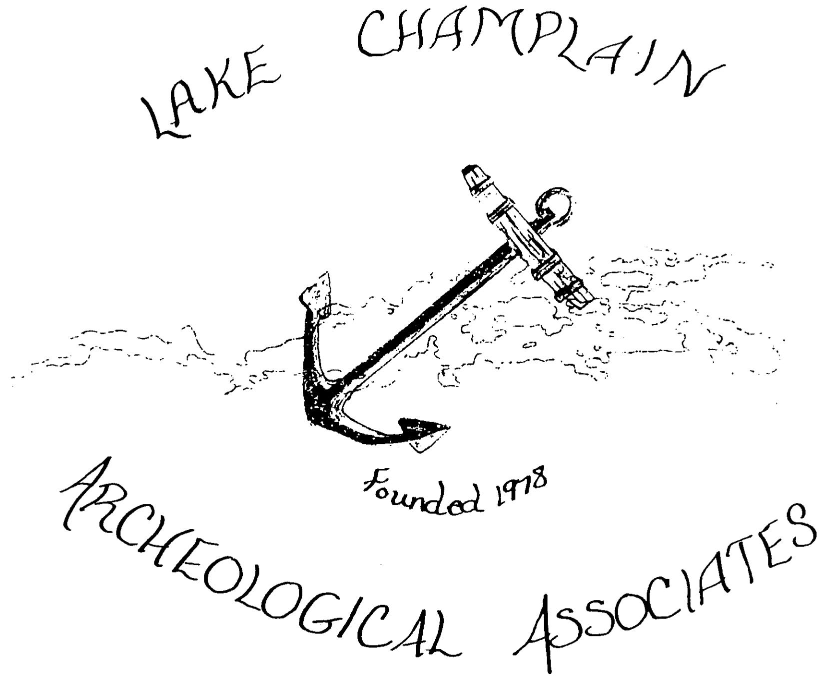


Figure 35. Logo of the Lake Champlain Archaeological Associates (1978-1992), later renamed the Lake Champlain Archaeological Association (Leege, n.d.).

excavated a number of archaeological sites in Lake Champlain, including the 1776 galley *Congress* (VT-AD-0717) in Arnold's Bay, before organizing the LCAA. Members of the organization were not formally trained in underwater archaeological techniques, but they closely followed the development of new techniques and procedures in the field. The LCAA concentrated its efforts on the study of the War of 1812 Battle of Plattsburgh and the Revolutionary War Battle of Valcour Island, conducting documentary research as well as field archaeology. Free-swimming divers surveyed large areas of the lake bottom in Cumberland Bay and Valcour Bay using detailed search patterns. When LCAA divers encountered artifacts, they usually recovered, sketched, cleaned, and catalogued them. The divers also conducted public outreach about their work through local exhibits and presentations. Although the LCAA asked for advice from local museums, many of the objects recovered from Lake Champlain were not conserved completely or stored properly. In 1997 the LCAA's artifact collection was donated to the Lake Champlain Maritime Museum, where it is currently being inventoried, conserved, and researched. This collection preserves an enormous wealth of information about the archaeology of the two battle sites and could lead to the discovery of more small archaeological features in Cumberland Bay and Valcour Bay.

### *Champlain Maritime Society (1980-1988)*

Interest in the study, interpretation, and management of Lake Champlain's shipwrecks led to the formation of the Champlain Maritime Society in 1980, a citizen-based group out of Burlington, Vermont, that focused on the preservation of the lake's historic legacy. The CMS was formed to bring together divers, historians, and

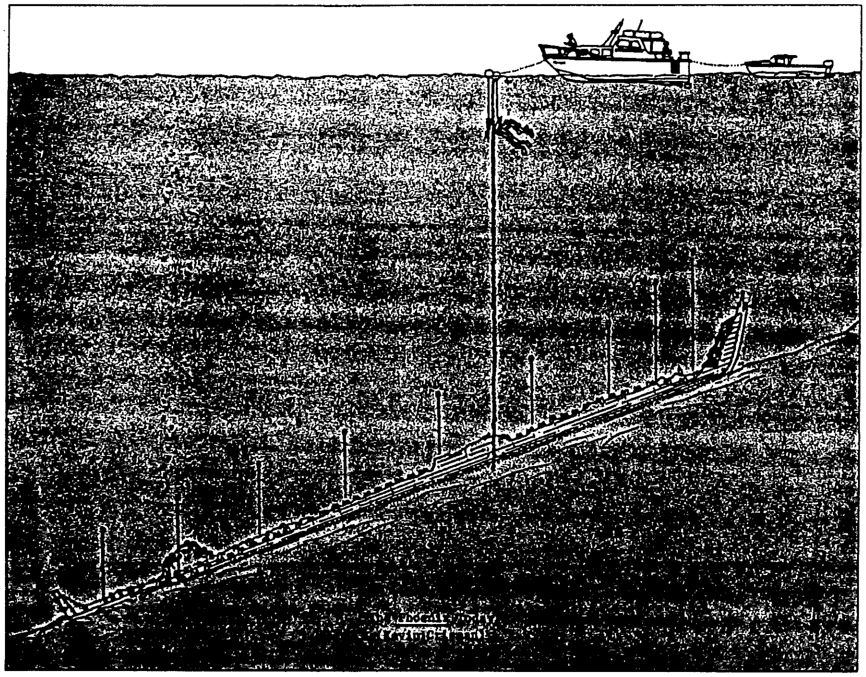

*Figure 36.* Underwater archaeological survey of the steamboat *Phoenix* off Colchester Reef, Colchester, Vermont (Champlain Maritime Society 1985:52).

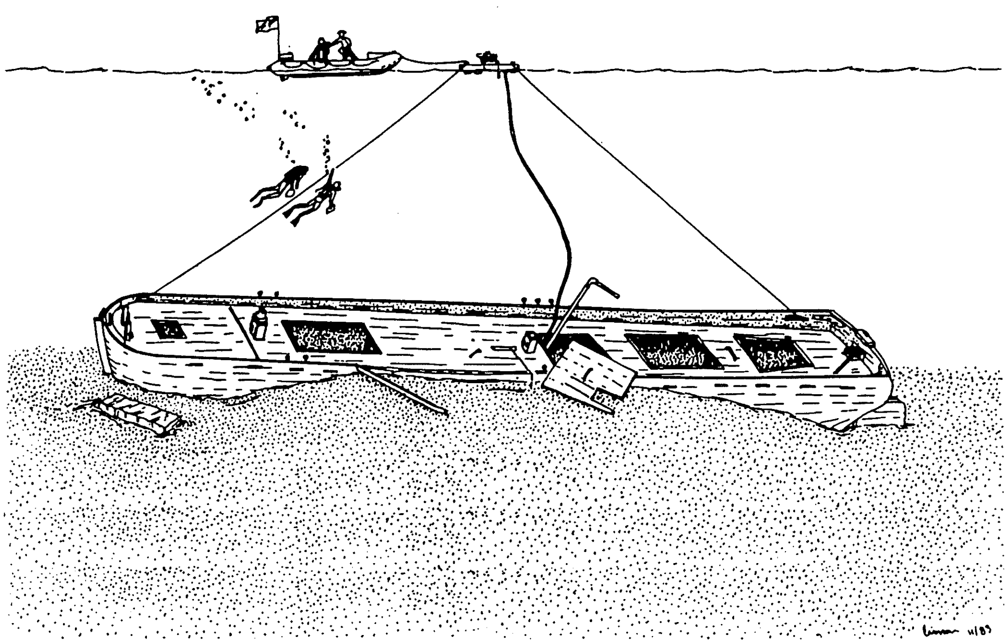

*Figure 37.* Underwater archaeological survey of the sailing canal schooner *General Butler* in Burlington Bay, Burlington, Vermont (Crisman 1986).

archaeologists for organized studies of Lake Champlain's maritime history. The first underwater archaeological projects of the CMS were documentation surveys of the sidewheel steamer *Phoenix* (VT-CH-0587; Figure 36) at Colchester Shoal (Davison 1981a; Davison 1981b; Fischer 1984; Fischer 1985) and the sailing canal schooner *General Butler* (VT-CH-0590; Figure 37) off the Burlington breakwater. These vessels became the focus of a three-year study that eventually resulted in the Vermont Division for Historic Preservation's implementation of the Vermont Underwater Historic Preserve System in 1985. Over a six-year period CMS members conducted detailed documentation surveys of the War of 1812 American brig *Eagle*, American row galley *Allen*, and British brig *Linnet* (VT-RU-0317) in the Poultney River; a sloop at Isle La Motte (VT-GI-0024); a canal boat at Basin Harbor (VT-AD-0718); the Great Bridge of 1777 off Mount Independence (VT-AD-0731); and the British brig *Duke of Cumberland* and British sloop *Boscawen*.

The CMS also conducted surveys to locate new shipwrecks, including an unsuccessful diver survey for the Revolutionary War British radeau *Thunderer* near Isle La Motte and a side scan sonar survey of the South Lake from Whitehall, New York, to Benson Landing at Benson, Vermont. During the three-day survey of the South Lake, the CMS located no fewer than twenty-two targets, the highest concentration being in the old channel approaching the Champlain Canal. Preliminary identification of the targets indicated that all were nineteenth- and early twentieth-century commercial craft. A detailed analysis of these vessels has not yet been undertaken.

In 1982 the CMS examined the badly deteriorated hull of the 1759 brig *Duke of Cumberland* in cooperation with the Fort Ticonderoga Museum. An underwater survey between Fort Ticonderoga and Mount Independence in that year also located three additional wrecks sunk in the mud at the old Fort Ticonderoga dock, including the British sloop *Boscawen*, a French sloop, and a possible French bateau. The CMS and the Fort Ticonderoga Museum undertook a major underwater archaeological survey of *Boscawen* in 1983 and 1984. The goal of the project was to study *Boscawen*'s construction and to recover artifacts from the wreck (Cohn 1985; Crisman 1985a; Crisman 1985b; Krueger 1985; and Miksch 1985).

CMS divers also conducted a small number of archaeology projects for federal and state development review processes, including a Phase I archaeological assessment for a proposed marina in Burlington. The studies conducted by the CMS generated a modest number of archaeological reports, a vast quantity of raw data, and several newspaper, journal, and newsletter articles. The CMS merged with the Basin Harbor Maritime Museum in 1987.

***Lake Champlain Maritime Museum (1986-present)***

By 1986 the success of the Champlain Maritime Society and an increasing realization of the significance of Lake Champlain's underwater resources led to the establishment of the Basin Harbor Maritime Museum at historic Basin Harbor in Ferrisburgh, Vermont, by Arthur B. Cohn and Robert Beach, Jr. In 1989 the museum's name was changed to the Lake Champlain Maritime Museum (LCMM) to better reflect the broad interest and mission of the museum. LCMM is dedicated to preserving the heritage of the Champlain Valley and sharing it with the public. Over the past decade, the museum has seen a remarkable rate of growth, which directly reflects the lake's historical and archaeological significance and the public's interest in this topic.

The Lake Champlain Maritime Museum has conducted most of the professional archaeology in Lake Champlain with the assistance of Kevin J. Crisman, professor in the Nautical Archaeology Program within the Department of Anthropology at Texas A&M University at College Station, Texas. Crisman and LCMM have encouraged many Texas A&M students to utilize Lake Champlain's cultural resources as subjects for theses or dissertations. The archaeology conducted by LCMM has taken many different forms in addition to student research, such as field schools, contract archaeology, and research projects.

Since 1991 LCMM has sponsored field schools in nautical archaeology in conjunction with the University of Vermont in Burlington, Vermont, and Texas A&M University. The field schools documented the Burlington Bay horse-powered ferry (VT-CH-0591; Crisman 1990b; Crisman 1991; Crisman 1992; Crisman & Cohn 1993a), the North Beach sailing canal boat (VT-CH-0606; Cozzi 1992; Cozzi 1993a; Cozzi 1993b), the Great Floating Bridge of 1777 at Mount Independence (VT-AD-0731; Cohn 1995c), the underwater debris field at Mount Independence (VT-AD-0711; Crisman 1995), the sidewheel steamer *Champlain II* (Baldwin et al. 1996), the War of 1812 American row galley *Allen*, and the War of 1812 British brig *Linnet* (VT-RU-0317).

LCMM has conducted most of the contract archaeology in Lake Champlain. These projects have included investigations of *General Butler* (VT-CH-0590; Cohn et al. 1996a), *O.J. Walker* (VT-CH-0594; Cohn et al. 1996b), *Water Witch* (VT-AD-0719; Crisman and Cohn 1993b), the 1777 Great Floating Bridge (VT-AD-0731; Cohn 1995c), and the artifact debris field surrounding Mount Independence (VT-AD-0711; Crisman 1995). The museum's survey team has also investigated the lake bottom in a number of different areas including Missisquoi Bay (McLaughlin 1996), the area near Fort Crown Point (Cohn and Crisman 1990), the area near Fort Ticonderoga and Mount Independence (Cohn 1995b), and the region between Burlington and Keesville, New York. Much of LCMM's archaeological efforts have been conducted as research projects. Other research projects include side scan sonar surveys to document unknown cultural resources in Lake Champlain.

LCMM's archaeological surveys on Lake Champlain's cultural resources have generated a number of archaeological reports, many of which are available at LCMM and the Vermont Division for Historic Preservation (Baldwin et al. 1996; Cohn et al. 1996a; Cohn et al. 1996b; Crisman 1990; Crisman and Cohn 1993; Cozzi 1992). A number of professional journal articles also briefly discuss some of these projects (Baldwin et al. 1996; Cozzi 1992; Cozzi 1996). LCMM has accumulated a large quantity of archaeological data and background research about Lake Champlain's cultural resources. The project archives of field notes, slides, drawings, background research, and draft reports have been maintained at the museum's Nautical Archaeology Center.

### *Vermont Division for Historic Preservation*

The Vermont Division for Historic Preservation (VDHP) took an active role as early as the late 1970s in preserving and studying Lake Champlain's cultural resources. The VDHP has sponsored and initiated many of the projects involving the lake's archaeological resources. Throughout the 1980s, the VDHP sponsored side scan sonar surveys of specific areas within Lake Champlain, including Burlington Bay, Shelburne Bay, and the Mount Independence area.

In 1985, the VDHP developed the State of Vermont's Underwater Historic Preserve System, one of the earliest underwater preserve systems in the nation. This innovative program selected several shipwreck sites and, through the installation of Coast Guard-approved seasonal moorings, provided safe diver access. The underwater preserves are designed to provide divers with a museum-like interpretative experience, fostering an attitude of protection rather than exploitation of Lake Champlain's cultural resources among the diving community.

In addition to locally managed research projects, the VDHP and its development review process have instigated a small number of projects involving Lake Champlain's underwater cultural resources that have been completed by regional archaeology firms. The data from these projects has not yet been fully compiled and analyzed, a task which should be given priority during upcoming years of the Lake Survey. In these cases the individual researchers, who are located throughout the U.S. and Canada, currently maintain most of the archives for these projects.

### *Research-Oriented Underwater Archaeology*

A number of individuals and organizations from outside of the Champlain Valley have completed archaeological research projects in Lake Champlain. Some of these organizations include the Quebec Underwater Archaeological Society, Nautical Archaeological Associates, the National Geographic Society (Shomette 1989), Rochester Engineering Laboratories (Kennard 1984; Kennard et al. 1985), the Committee of Underwater Archaeology and History of Quebec (Théorêt 1978, 1980), and the Maryland Committee for Underwater Archaeology. These organizations have conducted side scan sonar surveys and investigations of specific shipwrecks and other archaeological resources. The Vermont Division for Historic Preservation and the New York Office of Parks, Recreation, and Historic Preservation have information on file concerning the efforts of these organizations. A preliminary review of this data suggests that the documentation could be more fully integrated into a master database. Such data could greatly assist the Lake Survey in identifying specific resources and the locations of cultural resources and unverified targets.

### *Contract Underwater Archaeology*

Federal and state historic preservation laws have initiated a number of archaeological surveys that were conducted in Lake Champlain. The Champlain Maritime Society (Cohn 1984; Thomas et al. 1984, 1989, 1991, 1992) and the Lake Champlain Maritime Museum (Frink et al. 1991) performed most of these projects. A number of projects were, however, completed by other organizations, including John

Milner Associates (Cook and McCarthy 1992; Cox 1992), Vermont Divers (Cohn and Crisman 1986), and Champlain Marine Services (Thomas *et al.* 1982).

## MANAGEMENT OF THE LAKE'S CULTURAL RESOURCES

### *Management Strategy*

The purpose of the Lake Survey is to establish an accurate inventory of Lake Champlain's underwater cultural resources in order to prepare and to establish a comprehensive management plan. This inventory process is estimated to take between five and seven years. The subsequent development of a cultural resources management plan will then require an additional year or more to complete. Many of Lake Champlain's cultural resources are threatened now, however, and any delay in the development of a management plan may lead to partial or total destruction of these threatened resources. It seems appropriate, therefore, that the process of developing management strategies should begin now with the data that is currently available. Management strategies can be discussed well before the management plan is finalized, and extremely threatened resources can be mitigated. Many sections of the management plan can be initiated immediately. The following is a list of actions that can be undertaken now without additional data from the Lake Survey:

- Prepare a *National Register Multiple Property Document* for Lake Champlain.
- Establish signage for Lake Champlain's significant cultural resources.
- Create a brochure discussing the laws protecting the lake's resources.
- Institute a shared Lake Champlain archaeological site survey form.
- Enact guidelines for the management, use, and sharing of archaeological site information agreeable to all state and federal agencies involved.
- Determine how the public can best gain access to the lake's cultural resources.
- Develop a central database for Lake Champlain's submerged cultural resources using an interactive computer database and geographical information systems (GIS) technology.
- Establish a monitoring program for the lake's cultural resources.
- Assess the scientific and historical potential of the lake's resources.
- Develop a cultural/recreational program involving Lake Champlain's submerged cultural resources.
- Assess the current state of the protection of Lake Champlain's underwater resources.
- Obtain input from museums, historians, the diving community, lake town residents, and the general public on the management of the lake's cultural resources.

### *National Register Multiple Property Document*

The National Register of Historic Places, administered by the U.S. National Park Service, is the official list of all of the nation's cultural resources worthy of preservation. Listing Lake Champlain's underwater cultural resources in the National Register would have a number of benefits, including:

- Assistance with the preservation of individual sites by providing recognition of their value to the nation.
- Access to funding and preservation assistance from federal and state agencies.

- Assistance with federal, state, and local cultural resource planning and management.
- Information about the resources would be available to a variety of users in the form of microfilm records, photocopies of the original forms, and an Internet database.

In 1996 LCMM initiated a discussion with the historic preservation offices of New York and Vermont about writing a National Register Multiple Property Document for Lake Champlain. The multiple property document is a National Register listing that includes written statements of historic contexts, property types, and significance for a general region – in this case, Lake Champlain and its navigable tributaries. This document integrates the registration of historic properties and the preservation planning process, providing a flexible and efficient framework for registering Lake Champlain's known significant underwater cultural resources and linking them by common property types or historical context. This type of listing for Lake Champlain would include all historic contexts and property types relevant to the lake, as well as the requirements necessary for listing additional properties. Within this framework, significant related properties could be readily registered as they are identified in the future. This document would be written to allow for amendments and expansion of historical contexts and property types as additional research is accomplished during the Lake Survey. If this document is developed before the Lake Survey is completed, it will expedite the Lake Champlain cultural resource management plan and provide additional guidance in determining which resources require additional research in the immediate future.

***Protection Strategies***

Lake Champlain's underwater cultural resources require the development and implementation of protection strategies to ensure their survival. Many of these strategies can be linked to environmental and developmental review processes that currently exist. Lake Champlain's cultural resources are directly linked to the lake's environment and can therefore only benefit from the protection of the lake's ecology. Zebra mussels and other aquatic nuisance species have the potential to devastate the region's treasured historic shipwrecks and other submerged cultural resources, which are also directly affected by the water quality of Lake Champlain. Efforts to preserve the lake's natural balance and environmental health will help keep its submerged cultural resources stable.

Construction projects in or adjacent to the lake potentially threaten the lake's cultural resources. Most of these projects should undergo a federal or state review process, but each agency's compliance with the existing laws varies because of differing methods and policies. To solve this problem, each agency involved in such construction projects must be educated about the scientific and historical value of the lake's cultural resources and urged to comply with the existing review process.

Underwater signs are highly recommended for the underwater cultural resources found prior to and as a result of the Lake Survey. Recreational divers approach unmarked underwater sites in a significantly different manner than they approach clearly marked resources. Placing a sign in an obvious location on each resource will define the acceptable behavior for diving on the site. A sign has been designed for both New York and Vermont waters and is currently under review among the appropriate state and federal agencies.

To reinforce the observance of state and federal laws pertaining to Lake Champlain's cultural resources, it is also recommended that a brochure be created outlining these laws. This brochure will also formalize the assumed guidelines that define acceptable diver behavior. Clear, well-publicized guidelines provide the necessary information to create an atmosphere of understanding among all users of the lake's underwater cultural resources. The development of the format and content of the brochure should involve the relevant state and federal agencies and the lake's diving community.

### *Archaeological Site Survey Form*

A submerged site survey form was created in the spring of 1996 in anticipation of the 1996 Lake Survey field season. The form was designed to comply with the needs of the states of Vermont and New York for documenting submerged cultural resources. The survey form was based on the existing forms each state is currently using for archaeological sites found both on land and underwater. The information that was found to be applicable only to terrestrial archaeological sites was eliminated from the form for submerged sites. A draft of the survey form was submitted to the Vermont Division for Historic Preservation and the New York State Office of Parks, Recreation, and Historic Preservation. Each agency has submitted comments, but, as of the printing of this report, the final draft of the survey form is still under review. The acceptance of a form that satisfies all government agencies concerned with the lake's cultural resources will simplify the Lake Survey efforts and standardize the data collected by each agency.

### *Lake Champlain Underwater Historic Preserve System*

The underwater historic preserve programs currently operated by New York and Vermont have proven an effective method of preserving the vessels involved in each program. Other cultural resources in Lake George and Lake Champlain have also benefited as appreciation for the lakes' historic resources increases. Preserve sites provide a mooring, are regularly monitored, and have underwater signs that communicate basic information about diver safety and historic preservation. Providing moorings and information about the preserve sites has produced a high level of diver interest and cooperation in preserving the underwater cultural resources in Lake George and Lake Champlain.

The establishment of underwater preserves in Lake Champlain has dramatically increased the number of annual diver visits to each preserve site, but the total damage these vessels sustain per year has actually decreased. The use of mooring systems has eliminated the need for divers to locate vessels by dragging an anchor, a method which results in an enormous amount of damage to the shipwrecks. The establishment of preserve sites has also impacted the local communities near these sites in a positive way. Increased diver visitation has brought greater economic activity to the local community; area hotels, restaurants, gas stations, dive shops, and marinas have all shared in this modest economic benefit.

The most beneficial program for the preservation of and education about Lake Champlain's cultural resources would be a lake-wide underwater historic preserve program administered jointly by federal and state governments in partnership with non-profit organizations and the public. This type of program seems a logical solution, but it would face a number of complex issues. The most daunting aspect would be to arrange the logistical details of a system operated and funded jointly by federal agencies and the states of both New York and Vermont, dedicating funding and staff toward monitoring the current preserve sites and opening new ones. An assessment of a joint program needs to be accomplished in order to determine the necessity of any time-intensive steps, such as the creation and implementation of new legislation.

### *Assessment of Protection Mechanisms*

A number of federal, state, provincial, and international laws, regulations, and customs protect Lake Champlain's underwater cultural resources. Determining the effectiveness of current protection of the lake's resources depends heavily upon the practical success of the current mechanisms. When successful, the review process should initiate an archaeological survey and, when required, an intensive documentation and excavation of any threatened sites. This process varies, however, from one state or agency to another and cannot always be depended upon to protect a significant archaeological site (Argus Architecture & Preservation et al. 1995).

At the federal level in the United States, Section 106 of the National Historic Preservation Act requires federal agencies to avoid or mitigate the impact of archaeological resources caused by actions under their jurisdiction. At the state level, the State Historic Preservation Acts of New York and Vermont mandate review of impacts created by publicly funded projects. New York's State Environmental Quality Review Act (SEQR) and Vermont's Act 250 are the primary laws governing private development and initiate impact review processes for private projects. In practice, not all federal and state agencies cooperate with those agencies responsible for the review process, and projects are occasionally completed without undergoing a review of potential impact to the region's archaeological resources.

The current protection of Lake Champlain's submerged archaeological sites is largely accomplished by keeping sensitive site locations confidential. Most of the lake's resources are difficult to find because of their size, depth, condition, and environmental setting. This situation is changing, however, as the diving population of the Champlain Valley increases and as new technology makes it easier to locate shipwrecks and other submerged cultural resources. More people are searching for dive destinations, and the technology to locate them is more readily available.

A detailed formal assessment of the protection mechanisms for Lake Champlain's cultural resources has never been completed, but the lake's resources are at an increasingly greater risk as knowledge of their existence grows. The survey team recommends that an examination of all laws related to Lake Champlain's submerged sites be undertaken. The results of the examination will determine if the current laws are adequate and if any additional measures may need to be taken to further protect the lake's resources.

***Site Monitoring***

Documenting the changes in the condition of the lake's known resources will be an important function of the Lake Survey as the project progresses. Each site will be different because of its condition, construction materials, and physical environment, and each must be monitored accordingly. The first step in monitoring Lake Champlain's underwater cultural resources is to establish control data for each site. This information can consist of a compilation of video, photographs, and sketches of the cultural property. Video footage and photographs will allow detailed documentation of specific areas and objects at the site, as well as a general impression of the condition of the site. On some sites a 1-m (3-ft) grid can be placed on two fixed datum nails driven into the structure before the area is videotaped and photographed. This type of grid will establish a reference marker for monitoring such changes as natural deterioration, zebra mussel infestation, and other sources of damage. The ideal situation would be to repeat the video footage and photographs at the site once per year. The initial survey of a site will provide the data necessary to document the site type and to assess any rate of change over time. If any changes are detected, then steps can be taken to remedy the situation.

# Part III
# 1996 Lake Survey

# 1996 LAKE SURVEY

## *Project Planning*

A survey team composed of professionals in the fields of underwater archaeology and remote sensing was organized during the winter of 1995/96 in order to develop the survey strategy and methodology for the 1996 field season, keeping in mind the long-term goals of the lake-wide survey. The survey team determined that the 1996 Lake Survey goal would be to map as much lake bottom as possible and to locate the largest cultural properties that penetrate above the bottom sediments, making them vulnerable to encrustation by zebra and quagga mussels. Once this priority is achieved, the Lake Survey can continue with its primary goal of locating all cultural properties in Lake Champlain, including those that are buried and therefore not threatened by zebra mussels.

The goals and methodology for the 1996 field season were established after considering the Lake Survey's purpose, the size of the survey area, the anticipated range of cultural resources, obtainable funding, accessible equipment, available personnel, the time limit for the Lake Survey, and the time commitment of the 1996 survey team. With the goals for the 1996 season in place, the next step was to determine the survey area. After observing the locations of previous surveys, the survey team decided to concentrate in the central portion of the Main Lake between 73°20.5' N and 73°23.0' N (Figure 38). Extensive archival research indicated that as many as thirty vessels were reportedly lost in the proposed project area. If found, these sites could fill significant gaps in the Lake Champlain vessel typology that would add considerable information to the evolution of wooden shipbuilding in this region. Additionally, a survey of this area of the lake would encompass large areas of the lake floor that have never before been studied.

The survey team also decided to focus some of its efforts close to the lakeshore. Sites located in shallow water are often quickly destroyed by surface waves and lake ice movement or are intentionally broken up as hazards to navigation. As a result, most of Lake Champlain's intact archaeological sites lie at depths below 6.1 m (20 ft). A survey of shoreline areas is also complicated by variations in the ship track, unexpected shallows and snags, suspended sediments, algae, wave action, and aquatic vegetation. These areas are best surveyed with methods that involve either towed divers or divers swimming search patterns.

The primary survey area was divided into four main zones (I-IV), which were subsequently divided into survey areas (A-Z) based upon depth, bottom topography, obstructions, and the possible locations of shipwrecks (Figure 39). All fifty-six ship tracks for the primary survey area were preplanned on a true north-south grid to obtain the most efficient and thorough coverage of the lake bottom. The primary survey area, however, is exposed to strong north and south winds that cause large waves and make the detailed survey work necessary for the project impossible. Consequently, foul weather survey areas were selected in Shelburne Bay, Willsboro Bay, and other sheltered areas.

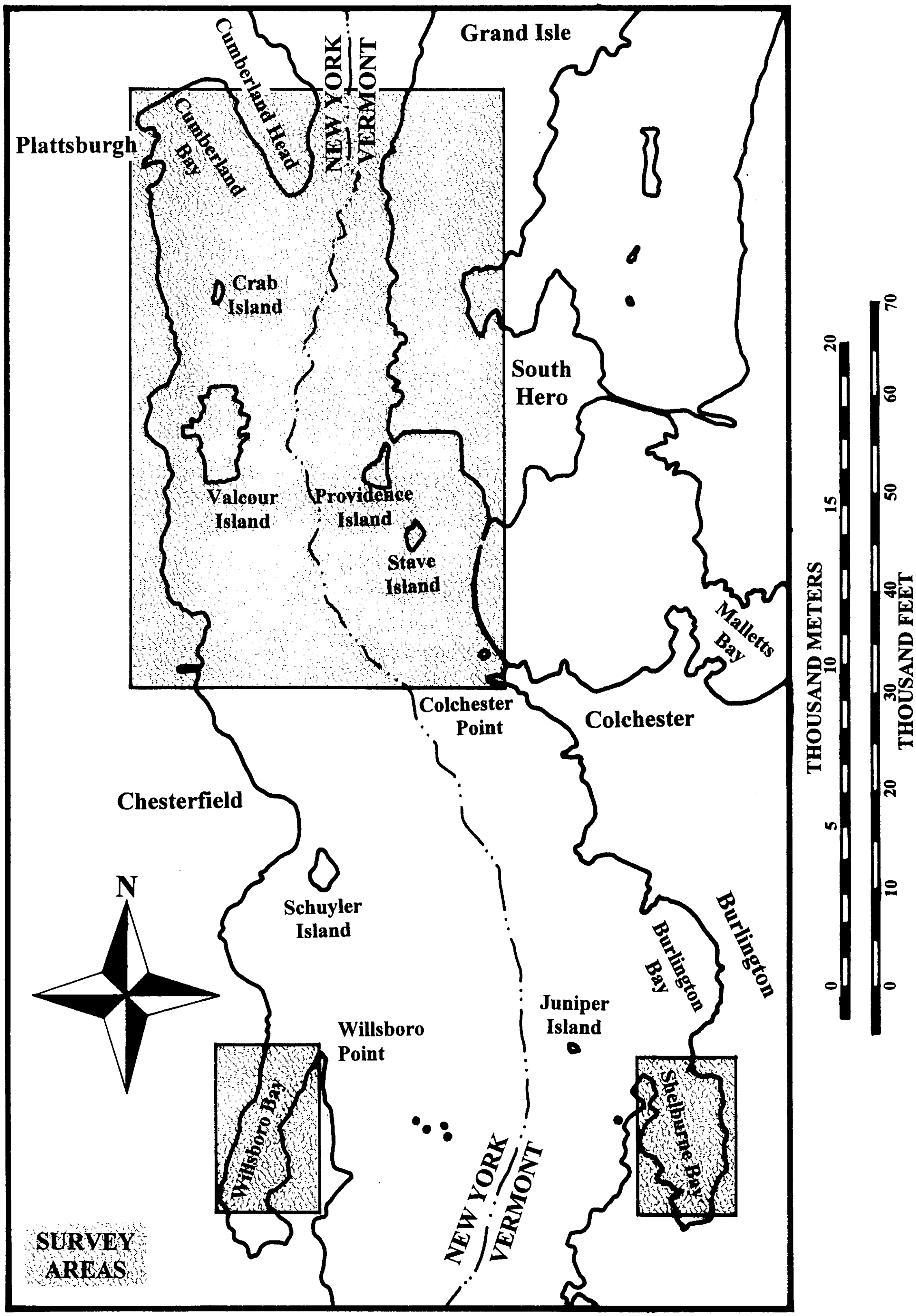


*Figure 38.* The 1996 survey area.

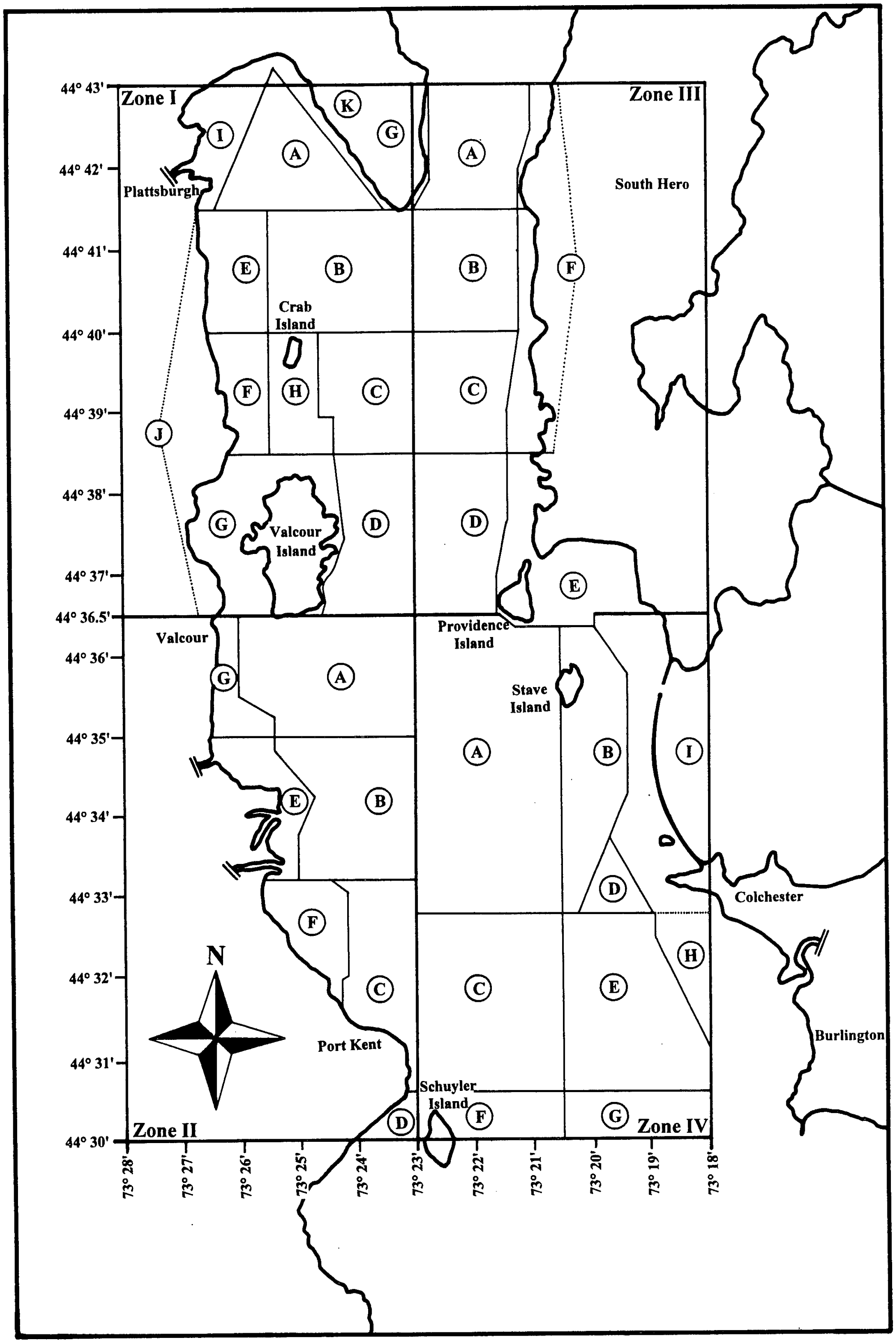


*Figure 39*. Subdivisions of the 1996 primary survey area.

Beginning in early May, the survey team began to organize the electronic equipment and other tools necessary to execute the project. Much of the project's electronic equipment was new to the survey team and had to be retrofitted for the project research vessel, R/V *Neptune*. With a little practice, the new equipment was quickly mastered and proved its worth for the Lake Survey.

| PRIMARY SURVEY AREA | | |
|---|---|---|
| ZONE | SECTION | SURVEY SIZE |
| I | A | 6.5 $km^2$ (2.5 $mi^2$) |
| | B | 10.6 $km^2$ (4.1 $mi^2$) |
| | C | 6.0 $km^2$ (2.3 $mi^2$) |
| | D | 6.0 $km^2$ (2.3 $mi^2$) |
| | E | 3.1 $km^2$ (1.2 $mi^2$) |
| | F | 2.3 $km^2$ (0.9 $mi^2$) |
| | G | 4.7 $km^2$ (1.8 $mi^2$) |
| | H | 2.8 $km^2$ (1.1 $mi^2$) |
| II | A | 9.3 $km^2$ (3.6 $mi^2$) |
| | B | 11.9 $km^2$ (4.6 $mi^2$) |
| | C | 5.4 $km^2$ (2.1 $mi^2$) |
| | D | 0.3 $km^2$ (0.1 $mi^2$) |
| III | A | 3.1 $km^2$ (1.2 $mi^2$) |
| | B | 6.5 $km^2$ (2.5 $mi^2$) |
| | C | 6.0 $km^2$ (2.3 $mi^2$) |
| | D | 6.7 $km^2$ (2.6 $mi^2$) |
| IV | A | 20.7 $km^2$ (8.0 $mi^2$) |
| | B | 7.8 $km^2$ (3.0 $mi^2$) |
| | C | 14.0 $km^2$ (5.4 $mi^2$) |
| | D | 1.6 $km^2$ (0.6 $mi^2$) |
| | E | 12.2 $km^2$ (4.7 $mi^2$) |
| | F | 1.6 $km^2$ (0.6 $mi^2$) |
| | G | 1.8 $km^2$ (0.7 $mi^2$) |

*Table 2.* Primary survey areas of the 1996 Lake Survey in the Main Lake at depths greater than 12 feet.

### ***Project Methods and Logistics***

The field component of the 1996 Lake Survey was divided into two distinct operations: first survey, then target verification. The primary function of the survey was to locate all major cultural properties on the lake floor that penetrate above the bottom sediments and are vulnerable to encrustation by zebra and quagga mussels. It was decided that a non-destructive survey using side scan sonar would be utilized to locate these targets in water depths greater than 6.1 m (20 ft), leaving shallow water areas to be surveyed by divers at a later date. After potential targets were located, free-swimming divers investigated them if the targets were located in depths less than 36.6 m (120 ft). Those targets located in deeper water were to be investigated by a remotely operated vehicle (ROV) near the end of the field season.

The first phase of the 1996 field season of the Lake Survey involved assembling a survey crew, configuring the appropriate survey equipment, and establishing procedures and standards following EPA's quality assurance/quality control standards, so that a scientific and efficient survey could be conducted. The R/V *Neptune* was chosen to be the survey's primary work platform because of its array of electronic survey equipment. The survey team used a Klein 595 side scan sonar unit from Middlebury College in Middlebury, Vermont. Middlebury College also purchased a new 300-m (984-ft) armored cable, which allowed the sonar towfish to be flown at an appropriate height off the lake bottom at any depth encountered during the survey. A hydraulic reel control system was also modified to fit on the R/V *Neptune* to allow constant modifications to the depth of the towfish and to keep it in its ideal range.

Much effort was spent integrating the R/V *Neptune*'s navigational control systems to a new autopilot, a navigation station, and a data-acquiring computer. This network of systems ensured that the vessel's course would follow precise track lines that would overlap adequately and cover the entire lake bottom in the survey area (Figures 40-42). Perhaps the greatest improvement in the 1996 survey in comparison to past surveys of Lake Champlain involved the use of the data acquisition and processing computer ISIS, manufactured by Triton Industries. This tool allowed the survey team to simultaneously record all sonar data along with position by latitude and longitude, depth, and height of the towfish off the bottom. The ISIS system also allowed the survey team to capture information about any target for later analysis.

The side scan sonar operation required the R/V *Neptune* to drag the torpedo-shaped towfish between 5 and 10 m (16.4 and 32.8 ft) above the lake bottom. The towfish was adjusted to transmit a sound signal across the bottom about 100 m (327 ft) to each side. The signal was reflected off the lake floor and traveled up the cable to a recording unit, which translated this data into an image of the bottom. In order to insure complete coverage of the survey area, the survey lines were methodical, using preplanned, overlapping survey routes. This course was entered into the navigational control system utilizing a differential global positioning system (DGPS), which controlled *Neptune*'s autopilot and ensured that the lines were straight and on course. It was not unlike mowing a lawn and making sure that the mower overlaps each preceding track.

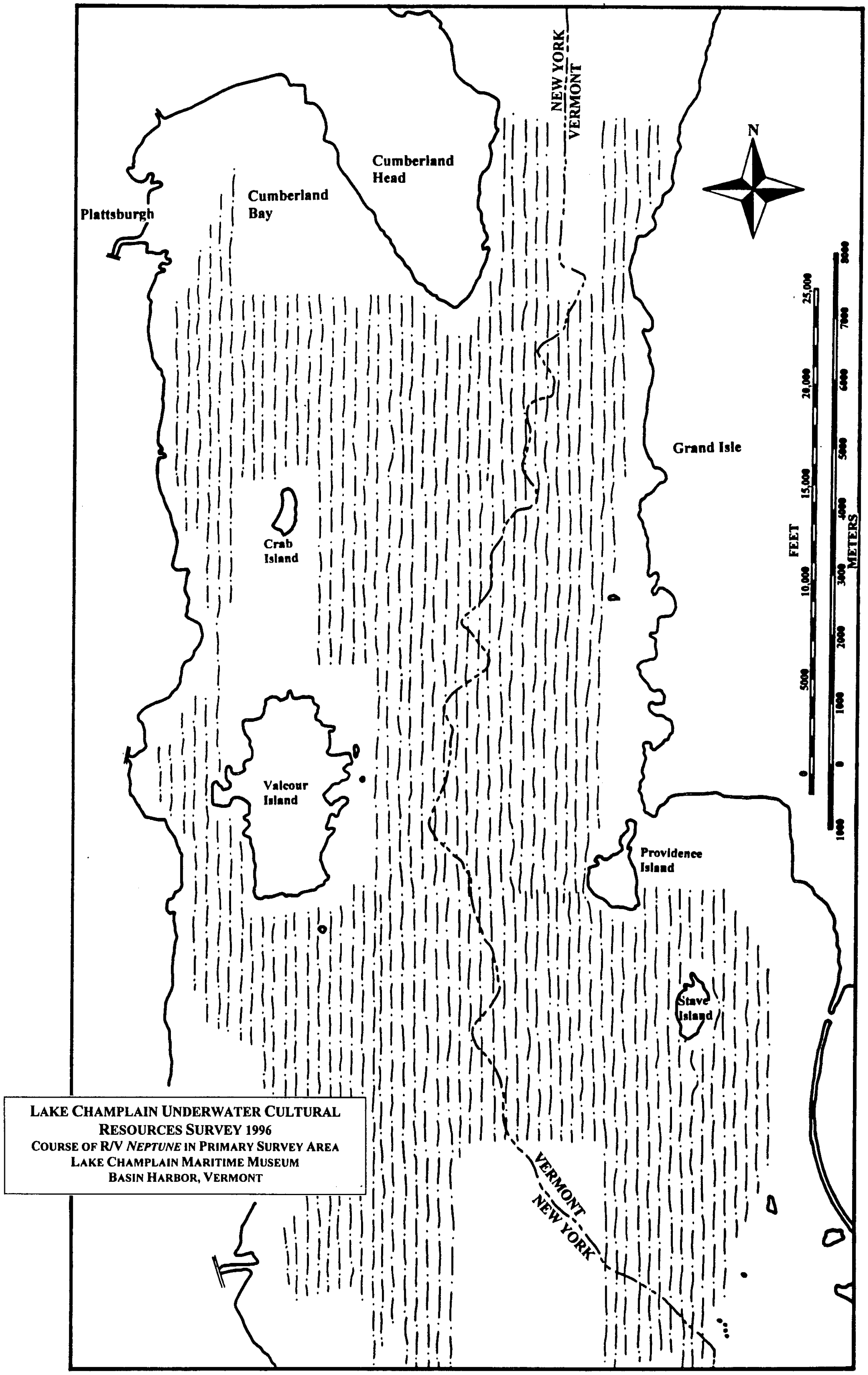


*Figure 40*. Course of R/V *Neptune* in primary survey area.

| AREA SURVEYED | | | |
|---|---|---|---|
| DAY | DATE | AREA SURVEYED | RUNNING TOTAL |
| 1 | 06/13/96 | 3.9 $km^2$ (1.5 $mi^2$) | 3.9 $km^2$ (1.5 $mi^2$) |
| 2 | 06/14/96 | 5.2 $km^2$ (2.0 $mi^2$) | 9.1 $km^2$ (3.5 $mi^2$) |
| 3 | 06/17/96 | 4.7 $km^2$ (1.8 $mi^2$) | 13.7 $km^2$ (5.3 $mi^2$) |
| 4 | 06/18/96 | 7.3 $km^2$ (2.8 $mi^2$) | 21.0 $km^2$ (8.1 $mi^2$) |
| 5 | 06/20/96 | 6.0 $km^2$ (2.3 $mi^2$) | 26.9 $km^2$ (10.4 $mi^2$) |
| 6 | 06/21/96 | 7.8 $km^2$ (3.0 $mi^2$) | 34.7 $km^2$ (13.4 $mi^2$) |
| 7 | 06/22/96 | 3.9 $km^2$ (1.5 $mi^2$) | 38.6 $km^2$ (14.9 $mi^2$) |
| 8 | 06/24/96 | 4.7 $km^2$ (1.8 $mi^2$) | 43.3 $km^2$ (16.7 $mi^2$) |
| 9 | 06/25/96 | 4.7 $km^2$ (1.8 $mi^2$) | 47.9 $km^2$ (18.5 $mi^2$) |
| 10 | 06/27/96 | 5.2 $km^2$ (2.0 $mi^2$) | 53.1 $km^2$ (20.5 $mi^2$) |
| 11 | 06/28/96 | 5.2 $km^2$ (2.0 $mi^2$) | 58.3 $km^2$ (22.5 $mi^2$) |
| 12 | 07/09/96 | 4.1 $km^2$ (1.6 $mi^2$) | 62.4 $km^2$ (24.1 $mi^2$) |
| 13 | 07/10/96 | 4.4 $km^2$ (1.7 $mi^2$) | 66.8 $km^2$ (25.8 $mi^2$) |
| 14 | 07/11/96 | 5.2 $km^2$ (2.0 $mi^2$) | 72.0 $km^2$ (27.8 $mi^2$) |
| 15 | 07/15/96 | 5.4 $km^2$ (2.1 $mi^2$) | 77.4 $km^2$ (29.9 $mi^2$) |
| 16 | 07/17/96 | 5.7 $km^2$ (2.2 $mi^2$) | 83.1 $km^2$ (32.1 $mi^2$) |
| 17 | 07/18/96 | 6.5 $km^2$ (2.5 $mi^2$) | 89.6 $km^2$ (34.6 $mi^2$) |
| 18 | 07/22/96 | 3.9 $km^2$ (1.5 $mi^2$) | 93.5 $km^2$ (36.1 $mi^2$) |
| 19 | 07/23/96 | 3.9 $km^2$ (1.5 $mi^2$) | 97.4 $km^2$ (37.6 $mi^2$) |
| 20 | 07/24/96 | 4.1 $km^2$ (1.6 $mi^2$) | 101.5 $km^2$ (39.2 $mi^2$) |
| 21 | 07/29/96 | 3.4 $km^2$ (1.3 $mi^2$) | 104.9 $km^2$ (40.5 $mi^2$) |
| 22 | 07/31/96 | 5.7 $km^2$ (2.2 $mi^2$) | 110.6 $km^2$ (42.7 $mi^2$) |

*Table 3.* Area surveyed during the 1996 Lake Survey.

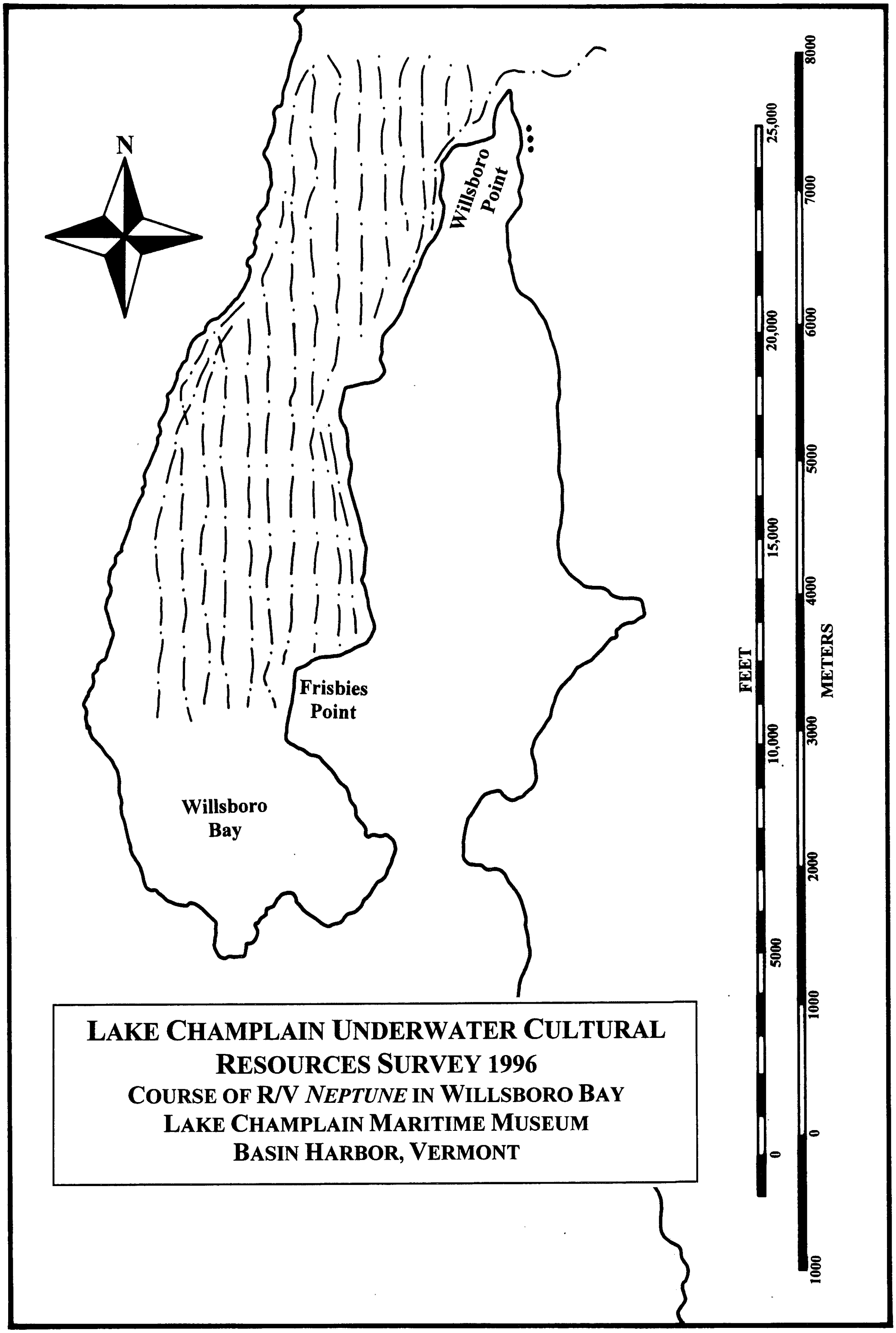


*Figure 41*. Course of R/V *Neptune* in Willsboro Bay, New York.

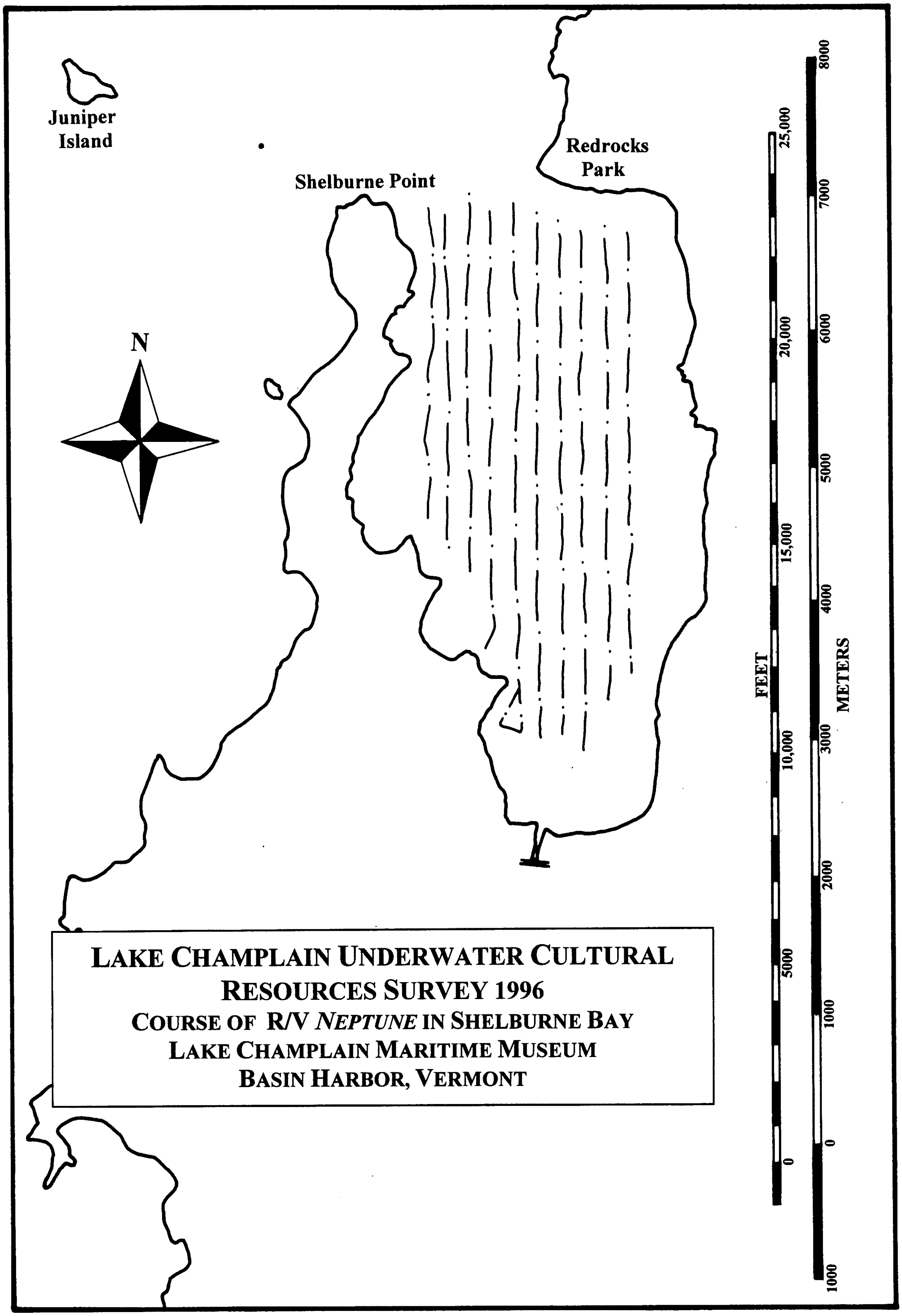


*Figure 42*. Course of R/V *Neptune* in Shelburne Bay, Vermont.

The ISIS data-capturing computer was also an integral part of the survey process. Although a continuous record of the bottom was captured on paper, the computer allowed the survey team to store, print, and analyze bottom and positional data in a more complete, digitized form. The survey team could therefore print out specific targets, create a mosaic of the bottom, enhance the target images, and manage the data in a more efficient way. Although the position of the research vessel was recorded on each transect automatically, the survey team also manually plotted their position every two minutes and recorded it in the project's navigational logbook. Any potential significant cultural or geological feature or observation about survey operations was also recorded in the project log.

Once the search portion of the project was completed, the survey team moved on to the verification stage. This phase involved first relocating the targets of interest and marking them with buoys. A team of divers descended to assess the site, to attempt to identify its origin, use, and clues to its demise, to take its dimensions, and to note safety issues for a second team of divers. After receiving a briefing from the first team, the second team then descended and documented the site on videotape. Verified cultural targets were also documented with sketches, measurements, and notes.

After the field component of the survey, the historians on the survey team researched the newly discovered shipwrecks in order to identify the vessels and the circumstances behind their current location on the lake floor. The geologists on the survey team analyzed the side scan sonar data for potentially significant geological features to be investigated later. The final step was the preparation of this report.

***Project Personnel***

The 1996 survey team consisted of nine individuals supported by a large number of others mentioned in the acknowledgements of this report. The personnel for the survey are all highly trained and came to the project with a wide range of abilities.

David Andrews has an A.S. in electronics from Vermont Technical College in Randolph Center, Vermont. Andrews is a professional diver and scuba instructor and has been involved in underwater archaeological surveys in Lake Champlain since 1984. He served as navigator, verification diver, assistant divemaster, and project videographer.

Arthur B. Cohn, Director of the Lake Champlain Maritime Museum, was the principal investigator and safety officer for the project. Cohn is a professional diver and has been involved in Lake Champlain archaeological projects for the past twenty years. As principal investigator, Cohn organized and supervised much of the survey effort, contributed to the survey's historical research, and directed the production of this report.

A. Peter Barranco, Jr., served as navigation control specialist and historian for the 1996 Lake Survey. Barranco has a B.S. in engineering from Hofstra University in Hempstead, New York, and is a registered Professional Engineer (Civil) in Vermont.

His interests in underwater archaeology began when he worked for the late Lorenzo F. Hagglund in search and salvage operations on a number of wrecks of historical importance in Lake Champlain, Lake George, and the Richelieu River. Since 1953, Barranco has conducted a comprehensive survey and inventory of information related to Lake Champlain vessels. He has provided research support on various underwater archaeological projects conducted in Lake Champlain over the past twenty years (Barranco 1995).

Frederick Fayette served as the captain of the R/V *Neptune* and electronic specialist during the survey. Fred's experience as an aviation electronics technician in the U.S. Navy was essential in the integration and maintenance of the numerous electronic components of the survey. Since 1989, Fayette and the R/V *Neptune* have contributed significantly toward most of the archaeological projects on Lake Champlain (Frink *et al.* 1991).

Seth Haines served as pilot and deckhand during the 1996 Lake Survey. Haines has a B.A. in geology from Middlebury College in Middlebury, Vermont, and has assisted in a number of remote-sensing projects.

Anne W. Lessmann edited and finalized the project report. Lessmann has an A.B. in archaeology from Bryn Mawr College in Bryn Mawr, Pennsylvania, and a M.A. in anthropology with a concentration in nautical archaeology from Texas A&M University in College Station, Texas. She has worked on underwater archaeological projects in the Dominican Republic, Turkey, and the Azore Islands. Lessmann is currently the head conservator and curator at the Lake Champlain Maritime Museum.

Patricia L. Manley and Thomas O. Manley served as the side scan sonar and computer operators during the survey. Both received Ph.D.s in marine geology and geophysics from Columbia University in New York City, New York. Since 1989, they have served as researchers and professors in the Department of Geology at Middlebury College in Middlebury, Vermont. They have worked together on a large number of geological research projects conducted on Lake Champlain and have assisted in the location of cultural resources on a number of previous archaeological projects in Lake Champlain (Frink et al. 1991; Manley et al. 1995). They both brought an enormous amount of technological expertise to the project.

Scott A. McLaughlin served as archaeologist, historian, and report writer for the project. He earned a B.A. in anthropology, geography, and history from the University of Vermont, and he is nearing completion of a M.A. in anthropology with a specialty in underwater archaeology at Texas A&M University in College Station, Texas. McLaughlin has been working in the field of archaeology in the Champlain Valley since 1986 (Baldwin et al. 1996; Cohn et al. 1996a and 1996b; McLaughlin 1996).

***Survey Vessel***

The project's survey vessel was the research vessel (R/V) *Neptune*, owned and operated by Fred Fayette of Milton, Vermont. The R/V *Neptune* is 12 m (40 ft) long with a 3.8-m (12.5-ft) beam and draws 1 m (3.5 ft) of water. This twin-screw steel-hulled vessel is driven by two 225-hp, 5.2-l (318-in$^3$) Chrysler inboard/outboard gasoline engines. Twelve-volt DC power is supplied by batteries charged by the ship's alternators, while 110 and 220 VAC is supplied from a Kohler 75-kW generator.

The superstructure of the R/V *Neptune* consists of a wood cabin approximately 3 m (10 ft) wide, 9 m (30 ft) long, and 2.5 m (8 ft) high with a mast supporting navigation, radio, and radar antennas. The cabin is divided into two separate levels, the upper level being the wheelhouse and the lower containing the operational center of the lake survey, housing the computer, mapping, and logistics areas. This large deckhouse provided ample work, equipment, and living space.

Navigation and positioning aboard the R/V *Neptune* was achieved using a NorthStar 941X Differential Global Positioning System (DGPS) working in conjunction with a Cetrek autopilot system. A Raytheon Loran-C navigation system and an electronic fluxgate compass supported the DGPS. For heavy fog and night-time operations, the R/V *Neptune* was equipped with a Raytheon R40 Raster Scan radar system with a maximum range of 39 km (24 mi). Information from the DGPS, the Loran-C, and the electronic compass systems could be displayed on the radar screen simultaneously with the radar information. An interface between these systems and the R/V *Neptune*'s video plotter and computer further enhanced visual display and storage of navigational information.

In addition, the R/V *Neptune* has a digital color scanning sonar, a Wesmar SS265. This system has a range of 732 m (2400 ft), and its sound beam can be directed a full 360 degrees horizontally and 0 to 90 degrees vertically. The Wesmar system was critical in determining the bottom topography ahead of the vessel to effectively regulate the depth of the towfish and to avoid collisions with the bottom. Other geophysical tools aboard the R/V *Neptune* included tow graphic depth recorders and an underwater video system. The primary depth information was collected using a Furuno FCV667 color video sounder that can be selected to operate at 50 or 200 kHz.

A hydraulic winch placed on top of the deck house permitted the deployment and retrieval of the tow cable for the side scan sonar. The winch could be controlled either from the operations section or from the stern deck outside. To ensure the proper bending radius of the steel tow cable, a 20-cm-diameter (8-in) sheave was hung from a rigid steel frame off the stern. Colored markers on the steel cable indicated the amount of cable deployed.

### *Survey Divers and Diving Safety*

The Lake Champlain Maritime Museum takes a safety-first approach to all of its archaeological projects, an approach that dominates all other objectives for any project. Project personnel are directly responsible for ensuring that project activities enhance this goal. In order to monitor dive safety, Arthur Cohn served as the diving safety officer on the project and performed all dive planning. Assistant divemaster David Andrews and Captain Fred Fayette assisted the diving safety officer.

Survey divers verified and evaluated cultural targets in water depths less than 36.6 m (120 ft). Only professional divers who have been involved in previous archaeological projects on Lake Champlain participated in the verification phase of the project. These divers included David Andrews, Pat Beck, Arthur Cohn, and Jonathan Eddy. All of the divers on the project were certified in first aid, CPR, and oxygen administration.

***Side Scan Sonar***

Sound has proven to be a valuable tool for studying underwater features. Depending upon the size of the feature to be imaged, different acoustical equipment can be employed to acquire the desired data and resolution. For this survey, a Klein 590 short-range side scan sonar unit was used because of its ability to detect lake bottom features even less than 1 m (3 ft) in size.

Side scan sonar records do not typically produce true plan-view maps of the lake bottom, but rather a slightly distorted image called a slant-range view. The image is slanted because the towfish emits sound waves at an angle to the bottom and because the vertical position of the towfish relative to the lake bottom is not considered when the output is printed. Post-processing the original data with relatively simple algorithms can provide slant-range-corrected or plan-view maps. These calculations require knowledge of the towfish's three-dimensional position within the water column and its speed over the bottom. Computer-assisted mapping systems, such as the ISIS System used for this project, have the capability of producing real-time plan-view maps of the bottom on a computer monitor, while at the same time significantly enhancing the original signal. These computer programs make it possible to easily interpret the bottom morphology and locations of cultural features as the towfish gathers data (Figure 43).

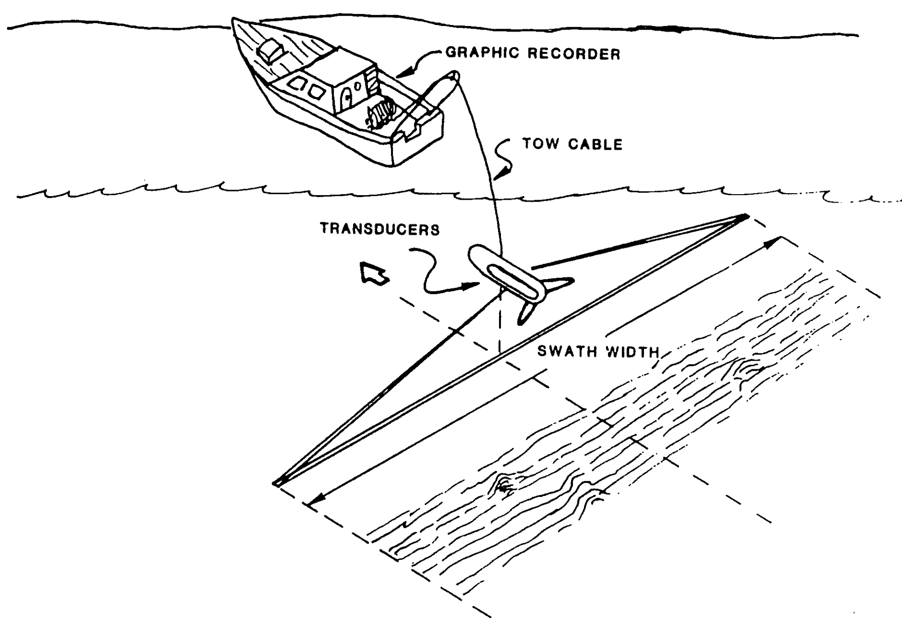


*Figure 43.* Side scan sonar survey (Mazel 1985:1-5).

A dual frequency (100 and 500 kHz) Klein Digital Side Scan Sonar System 595, equipped with a depressor wing, was used during the 1996 survey. The towfish was towed approximately 10 m (33 ft) off the lake bottom at speeds ranging from 3 to 5 knots (3.5 to 5.8 mph). At the beginning of the survey, the survey team had access only to a 100-m (328-ft) Kevlar tow cable that could not be used in water depths greater than 46 m (150 ft), even with the depressor wing attached. For mapping the lake bottom at greater depths, a 300-m (984-ft) steel-armored cable was purchased by Middlebury College in Middlebury, Vermont, along with a transport drum, a deployment drum, and a trailer. This new cable will be essential for much of the mapping of the Main Lake, where water depths are greater than 46 m (150 ft).

The lateral distance mapped by the sonar was set to 100 m (328 ft), thereby generating data for a 200-m (656-ft) swath path along each towfish track. To ensure complete coverage of the lake bottom, the towfish tracks were offset by 175 m (574 ft), so that each consecutive swath would overlap the previous one by 25 m (82 ft). Where conditions prevented the desired line spacing, good navigational control made it possible to return to fill small gaps where necessary. The shallow sections in the survey area where it was not feasible to use the side scan sonar will have to be investigated by diver surveys.

The analog data from the sonar was recorded in several ways to achieve redundancy. The raw data stream was recorded on magnetic tape using a TEAC RT-16 FM recorder and on a 1.2 GB optical platter using ISIS data-acquisition software. A real-time visual display of the side scan sonar data on board the R/V *Neptune* was also crucial for the location and identification of cultural features and for the safety of the sonar unit. These displays consisted of a black and white paper record produced by a Klein thermal chart recorder and an ISIS computer monitor display set up to mimic the thermal printer showing the 100 and 500 kHz signal returns from the towfish.

Both imaging systems acted as redundant backups for each other; with respect to primary safety of the sonar, however, the computer display provided output several seconds ahead of the thermal head printer. This faster output from the ISIS computer software provided earlier detection not only of cultural features, but also of sudden bathymetry changes that called for rapid adjustments in the depth of the towfish. After several encounters of undocumented shoals, the Wesmar System aboard the R/V *Neptune* was used to scan ahead of the boat for depth changes and therefore provide an early warning system for the sonar operator.

All findings located by the side scan sonar were logged according to their time, date, and position and labeled sequentially by number. Specific targets that were deemed to be cultural features, labeled sequentially by letter, were often revisited after the completion of each transect for better views from different angles and towfish heights. The best of these views were eventually printed with all pertinent information including their catalog letters or target identification numbers.

***Navigation System***

A number of surveys have been conducted on Lake Champlain, and a great deal of time, effort, and equipment has gone into looking for shipwreck sites. Unfortunately, many past projects were accomplished unsystematically, with little consideration to position-fixing or recording field observations. Archaeological survey work is only beneficial in the long run if subsequent researchers can return to previous discoveries or can continue where the original investigators left off. In order to monitor the position of R/V *Neptune* during the sonar survey, the Lake Survey required an electronic navigation and position-fixing system.

R/V *Neptune* navigated over five hundred north-south transects using a Northstar Differential Global Positioning System (DGPS) receiver. GPS is a satellite-based navigation system that relies on a constellation of satellites distributed around the earth. By relying on the precise orbits of a minimum of three satellites, the GPS receiver can accurately determine the latitude, longitude, and elevation of the antenna it carries aboard the research vessel, based on signal transmission times sent from the satellites.

Unfortunately, the accuracy of the antenna's position depends upon the use of a military or civilian channel. The military channel represents the highest degree of accuracy, with errors of 1 to 2 m (3 to 7 ft). The civilian channel represents the lowest degree of accuracy, with errors of as much as 100 m (328 ft), due to the random manipulation of the satellite's output signals by the military, known as selective availability. Clearly, this degree of accuracy is unsuitable for modern-day mapping programs, and this survey in particular.

Over the past several years, the public sector has created a local system to correct civilian GPS navigation to near-military accuracy by observing the GPS-determined position of an antenna that has an extremely accurate known position. Positional (or differential) errors, determined by comparing the known position of the antenna with that of the GPS fix, are broadcast on a specific radio frequency in real-time mode approximately once per second. GPS receivers equipped with an additional differential antenna can apply these corrections to the satellite-determined position to produce an accurate measurement within 1 to 10 m (3 to 33 ft) of the actual position. These combined systems, GPS and the differential receiver, are known as a Differential Global Positioning System (DGPS) and were for many years two separate systems that needed to be integrated together. Today, however, the newer DGPS have been integrated into a single unit, such as the Northstar 941X DGPS receiver used on R/V *Neptune* for the 1996 Lake Survey.

Two major advantages in using the 941X DGPS are the ease of creating pre-programmed ship tracks or transects and the ease of keeping the ship on course with the DGPS's graphical display. In order to keep the ship's tracks precisely aligned with the pre-defined mapping lines, a Cetrek ProPilot 700 autopilot was used on the R/V *Neptune*. The autopilot, after being installed and interfaced to the 941X DGPS, proved to be an indispensable tool for the daily chore of keeping accurate ship tracks. Although minor corrections to the autopilot were required, the system eliminated hours of tedious work at the ship's helm.

Certain parameters can undermine the accuracy of DGPS. The most important parameter is the distance between the differential beacon, the site that transmits the corrections, and the shipboard DGPS. As the distance between the two systems increases, so does the likelihood that the individual receivers may not be using the same number of satellites or even the same constellation for the determination of position. As a result, corrections determined at the beacon by using one set of satellites may be significantly in error to those needed by a vessel using a different suite of satellites 400 to 500 km (250 to 325 mi) away. For Lake Champlain, the differential beacon is located in St. Jean, Quebec, some 70 km (43.5 mi) north of the 1996 Lake Survey area.

***Precision Depth Recording***

The lake's depth was determined during the survey with the use of a Furuno FCV667 color video sounder precision depth recorder (PDR) that can operate at 50 or 200 kHz. The transducer was hull-mounted on the R/V *Neptune* 41 cm (16 in) below the water line. Since the lake level varies throughout the year, it was recorded daily from the gauge at the King Street Ferry landing in Burlington, Vermont, for post-processing of a digital bathymetry map of the 1996 survey area. Post-processing also assumes a constant sound speed in the water during the survey, although the speed of sound varies with depth, water temperature, and suspended sediments. Recorded depths must be recalculated according to the actual average sound speed of the water column. Previous work completed using the R/V *Baldwin*'s precision depth recorder indicates that these corrections can be accomplished with a simple linear multiplier of the recorded depth.

***Data Collection Systems***

The 1996 Lake Survey utilized a number of powerful computer programs to process and enhance the raw data stream created by the side scan sonar. The Triton ISIS data acquisition and processing system processed, digitized, stored, and displayed the side scan sonar data in a real-time mode. Additionally, the system recorded information such as DGPS position, heading, speed, and water depth. The ISIS system's data storage facility was its internal hard drives and a 1.2 GB optical disk.

The sonar processing and imaging software included several modes of enhancing and displaying the sonar data. No matter which of these display modes was activated, however, the ship's position, course over ground, speed, and water depth were always visible in a separate display window. Of the different display options, the survey team most frequently accessed color enhancements of the slant-range output, slant-range corrected output, image capture of a specific target, dimensional analysis of the target (length, width, and height), and archival storage of the target for later playback, enhancement, and printout. The ISIS system also tracked the altitude of the towfish above the lake floor, since this information is required for both slant-range corrected output and the production of a final merged mosaic plot of the side scan sonar data.

As the survey team's experience with the system increased, it became apparent that the optical drive could not keep up with the continuously large volume of data transmitted from the sonar. As a result, the data was stored on faster hard drives during the survey and later transferred to the optical drive. The ISIS system benefited the survey crew immensely by displaying sonar data on the computer screen several seconds before it appeared on the Klein printer. Target size and shape could be rapidly assessed immediately after the image appeared on the computer screen. All the data was archived by the system so that it could be digitally stored for complete post-processing of specific targets as well as the creation of a mosaic of larger tracts of lake floor.

### *Analysis Tools*

To date, only one section of the 1996 survey area, a portion of Cumberland Bay, has undergone post-processing with computer analysis. The data was analyzed using Vista software from Triton Technologies as part of a senior undergraduate thesis at Middlebury College in Middlebury, Vermont (North 1997). The analysis encountered difficulties with the software package and data format, but a mosaic was produced of previously undocumented areas of pockmarks in Cumberland Bay. The Vista software was found to be a non-user friendly, inflexible program, although Vista software updates will probably respond to the requirements of this project.

## PUBLIC EDUCATION AND OUTREACH

The Lake Champlain Maritime Museum (LCMM) used a number of different strategies in its public education and outreach program for the 1996 Lake Survey. While the project was underway, the staff and an exhibit in the museum's Nautical Archaeology Center interpreted the Lake Survey for the general public. The Lake Survey exhibit space was updated to reflect new information as it was collected in the field. The interpretation of the Lake Survey was also incorporated into the museum's nautical archaeology education and outreach programs involving school groups and visiting organizations. Additionally, LCMM informed the public about the Lake Survey through regional newsletters (LCBP 1997; LCMM 1996, 1997a, and 1997b; MacDevitt 1996). In the spring of 1997, LCMM Director Arthur Cohn produced a video presenting the benefits and results of the 1996 Lake Survey. Funding for the video was provided by the NEIWPCC on behalf of the New York and Vermont Lake Champlain Citizens Advisory Committees under the New York-Vermont Citizens Advisory Committees 1997 Partnership Program (Grant # LC-E096-2-VT-M; 0082-004).

To date, the museum has distributed more than 100 copies of the video free of charge to schools, educators, historians, archaeologists, state and local officials, news media, and individuals who have supported the preservation of Lake Champlain's history. LCMM staff and volunteers have presented the video at more than a dozen conferences and meetings in the Northeast, and local television stations have broadcast segments or the entire video. Museum educators have utilized the new survey video with its footage of newly discovered shipwrecks to bring the history of Lake Champlain to life in classrooms throughout the Champlain Basin. Nearly 40,000 LCMM visitors have learned about the Lake Survey by watching the Lake Survey video, viewing the survey exhibit, or speaking with museum staff about the project.

Press releases about both the 1996 Lake Survey and the recently completed Lake Survey video were distributed to the Champlain Valley media in the spring of 1997. The press releases initiated a positive number of interviews, articles, and broadcasts about the Lake Survey. Public education and outreach efforts for the 1996 Lake Survey have probably reached nearly 100,000 residents of the Northeast. Finally, this report will be distributed to area libraries and repositories and will therefore serve as a long-term outreach effort for the 1996 Lake Survey.

# BACKGROUND HISTORY OF THE 1996 LAKE SURVEY AREA

### *Historical Background Research*

Preliminary historical research was performed both before and after the 1996 field season, focusing on the vicinity of the 1996 Lake Survey area. The towns that border the survey area included Ausable, Chesterfield, Peru, Plattsburgh, and Willsboro on the New York side of the lake and Colchester, Grand Isle, Shelburne, South Burlington, and South Hero in Vermont. The research concentrated particularly on interaction between the town's residents and Lake Champlain.

### *Plattsburgh, New York*

After the French and Indian War had ended, former British soldier Captain Charles de Fredenburg petitioned London for lands along the Saranac River. He received a grant of 30,000 acres of land in 1769, after he had already settled near the river and constructed a dam and mill 4.8 km (3 mi) upriver at a site that is still called Fredenburg Falls today. Fredenburg, however, was loyal to King George III and forfeited his property to the State of New York during the course of the American Revolution. The Cumberland Bay area lay unworked after the Battle of Valcour Island, until Zephaniah Platt of Poughkeepsie, New York, and 32 others obtained a state grant of 30,000 acres that nearly coincided with the old Fredenburg patent. In March 1785, Charles Platt, Zephaniah's brother, and the first group of settlers arrived to build their cabins, a sawmill, and a gristmill near the mouth of the Saranac River. In 1788 the state legislature created Clinton County, which initially included the future Essex and Franklin Counties. The state also designated Plattsburgh as the county seat; in 1815, the legislature created a village at Plattsburgh.

Gristmills and sawmills were built in Plattsburgh in 1785, and the first forge was erected in 1798 using iron ore shipped from Vermont. Manufacturing industries sprang up in Cumberland Bay during the 1830s, and marble works were built in Plattsburgh for sawing marble from Isle La Motte quarries in 1833. Cumberland Head became the landing point for all freight intended for Plattsburgh and the surrounding area. The landing was also connected to Grand Isle by ferry and was the port of entry for the district of Champlain from the 1780s to the 1810s, when a wharf was built at the City of Plattsburgh.

The first settlers of Plattsburgh were farmers who sold the wood from the forests they cleared in the form of logs, boards, potash, or pearlash. Lumber was the chief export of the Saranac Valley, followed by agricultural products. All of these products were exported to Quebec in exchange for necessities not available in the Champlain Valley. The early economy of Plattsburgh, like most towns in the Champlain Valley, depended upon trade with Canada. For lack of roads, Lake Champlain was the chief route for transporting products to market.

In the early nineteenth century Plattsburgh also emerged as an important lakeside community and was noted for its banking and mercantilism. By 1823

Plattsburgh had fifteen retail stores, including all-purpose and specialized shops. Located along the Saranac River, this community also became an industrial center during the early nineteenth century. The Saranac River was the source of power for most of the early industries including sawmills, gristmills, fulling mills, dye-houses, and forges. Eventually, the riverbanks became crowded with industrial buildings. The first forge for smelting iron in Plattsburgh was built in 1798 and processed ore brought by vessels from Monkton, Vermont, and later from Port Henry, New York. Plattsburgh also became a processing center for marble and dolomite from the Champlain Islands. Throughout the nineteenth century, Plattsburgh was the shipping point for forest, mineral, and agricultural products of the Saranac Valley and the distributing center for the northern counties of New York. Plattsburgh was considered to be a major port on Lake Champlain, and it served as the center for transportation and commerce in upstate New York (Everest 1984:44-52).

The use of watercraft was a necessity during Plattsburgh's early years. Settlers made annual trips to Quebec markets during the warm months with small boats and rafts. Prior to 1817, the dock for Plattsburgh was located at Cumberland Head near the existing ferry landing. This dock was also the landing for Daniel Wilcox's ferry, which ran between Grand Isle and Cumberland Head. In 1817 the first wharf was constructed at the mouth of the Saranac River, which soon became the location of numerous docks and a shipyard. Plattsburgh was not noted for its shipbuilding industry, yet several steamers and sailing craft, such as *Lion* (1835), *General Warren* (1826), *Maria* (1827), and *D.A. Smith* (1832), were constructed on Plattsburgh's waterfront. In 1876 Plattsburgh was established as the Northern Terminal for steamers on Lake Champlain. In 1884, 750 steamers and 50 sailing vessels arrived at the port of Plattsburgh, with a total tonnage of 423,295 tons (Porter 1944:33-37).

By the end of the nineteenth century, Plattsburgh, like other lakeside communities, began to utilize Lake Champlain more and more for recreation. In 1925 the City of Plattsburgh acquired land for a public beach, and, with the assistance of the Civilian Conservation Corps, a large swimming beach was created on Cumberland Head in 1930 (Everest 1984:28).

### *Peru, New York*

The first settlers of Peru, then a part of Plattsburgh, built a house opposite Valcour Island in 1772 but moved to Canada at the beginning of the American Revolution. They returned in 1785 and settled slightly south of the Salmon River near the lakeshore. Other settlers moved into the region and developed industries and farmsteads along the Little Ausable and Salmon Rivers. In 1792 the town of Peru, New York, was formed separately from Plattsburgh. Dependent on the lake, the earliest roads led from the lake to the mills upstream on the Little Ausable and Salmon Rivers. Peru had a number of early industries such as sawmills, gristmills, and iron forges, but the community's economy was largely dependent upon agricultural products. Prior to the construction of the railroads, all of Peru's exports were sent to the lakeshore and shipped by vessel from Peru Landing (Port Jackson), later called Valcour. The town of Peru was, however, overshadowed commercially by Plattsburgh throughout its history.

Peru was heavily dependent upon Plattsburgh for most of its economic, social, and commercial necessities (Hurd 1978 [1880]:339-351).

### *Ausable, New York*

In 1839 residents living in the southern half of Peru created their own township, called Ausable. The manufacturing center of Ausable, which had developed at the village of Keesville on the Ausable River, included such industries as cloth factories, gristmills, sawmills, plaster mills, furniture manufacturing, a nail foundry, and a planing mill. All of the exports from Ausable were transported via the lake prior to the construction of railroads in the late nineteenth century. Ausable, like the surrounding towns, survived by exporting agricultural products and relied upon Plattsburgh for the town's necessities (Hurd 1978 [1880]:212).

### *Port Kent, New York*

Port Kent was established in 1823 and grew to be an important commercial port. A ferry service between Port Kent and Burlington, Vermont, was established as early as 1824.

### *Willsboro, New York*

Frisbies Point, located on the west side of Willsboro Point, was the location of a small shipyard that constructed standard canal boats and barges for carrying local stone and other products generated in the local area. The schooner *American* was built here in 1848 by Guy Frisbie. Frisbies stone quarry used these vessels to transport much of the stone it extracted.

### *South Hero Island, Vermont*

South Hero Island was once called *Gawenio*, or the "large or beautiful island," by the Mohawk, and *K'chenamenahan*, or the "principal or large island," by the Western Abenaki (Huden 1962:67 and 75). The prehistoric history of South Hero Island is largely unknown, but the Champlain Islands were used and occupied by prehistoric peoples (Thomas et al. 1989). For prehistoric and historic island inhabitants, it has always been a necessity to have some sort of watercraft for transportation between the islands and the mainland. The earliest vessels were rafts, dugouts, and bark canoes. European settlers later introduced small rowboats and eventually scows propelled by oars and sails, which became the standard ferryboat during the early nineteenth century. In the winter the islanders could cross on the frozen lake, sometimes with disastrous results, unfortunately, if the ice gave way. Many travelers lost belongings or were killed undertaking this hazardous crossing (Stratton 1980:49).

By far the most enduring ferry route on Lake Champlain is the one from Gordon Landing on Grand Isle, Vermont, to Cumberland Head, New York. Shortly after 1790, Benjamin Bell began a ferry service between Gordon Landing, then called Bell's Landing, and Cumberland Head without owning any particular rights for a ferry. A U.S. Customs House was also established at Bell's Landing sometime before 1796 (Stratton 1980:55-60), although details of the history surrounding the ferry landing and the Customs House are currently unknown. The ferry operation at Gordon Landing was likely sporadic throughout the nineteenth century, but it survives to the present as one of the most active ferry crossings on Lake Champlain. Most of the shoreline of South Hero Island has been utilized as farmland up to the present, and many islanders living along the shoreline probably maintained watercraft for fishing and recreational purposes.

### *Shelburne Bay, Vermont*

Shelburne Bay, called Quinneaska Bay by the Western Abenaki (Figure 44), borders the city of South Burlington and the town of Shelburne, Vermont. Most of the Shelburne Bay area was not settled until the early nineteenth century, and little development took place in Shelburne Bay prior to the twentieth century. Most of the land surrounding the bay was utilized as farmland, except for two parcels of land which were commercial shipyards. The shoreline along the entire eastern half of the bay has served as a railroad corridor since the construction of the Rutland and Burlington Railroad line in 1848, which eliminated the town's reliance on lake transportation.

The fighting occurring in the Champlain Valley during the eighteenth century made it difficult to establish permanent settlements along Lake Champlain's shores. In order to encourage settlers to move into the Champlain Valley, King George III authorized Benning Wentworth, Governor of New Hampshire, to grant them land on the eastern side of the lake. One such grant established the town of Shelburne on August 18, 1763. In 1768, the first recorded settlers, John Potter and Thomas Logan, arrived to occupy points of land along the lake shore, areas which are still known by their names. Potter and Logan cut the virgin oak forest in the area and floated the timbers on rafts to Montreal. On a return trip in 1775, however, the commanding officer at Montreal sent three soldiers with the men to guard them and their money. Near the Canadian border, the soldiers murdered the two men and stole their money.

The La Platte River, which discharges into the southern end of Shelburne Bay, is known for an event that occurred there during the Revolutionary War. A band of several hundred Native Americans concealed their canoes under the willows along the shores at the mouth of the river and went into the woods on an expedition for prisoners and plunder. While they were away, settlers found their canoes and riddled them with holes. The settlers than ambushed the returning raiding party, forcing the warriors to take to the river in leaking canoes.

The trade of timber and other materials from Shelburne temporarily stopped during the Revolutionary War. After the war, settlers moved to Shelburne and built a town center along the La Platte River. By 1835 a sawmill, a gristmill, a woolen mill, a tannery shop, a blacksmith shop, and a triphammer shop had been established at Shelburne Falls along the La Platte River. During the early nineteenth century, Shelburne – with its connections to outside markets via the lake and early roads – became a commercially-oriented farming community that produced supplies of wheat, barley, oats, rye, buckwheat, potatoes, hay, maple sugar, and wool (Town of Shelburne 1992:8-10).

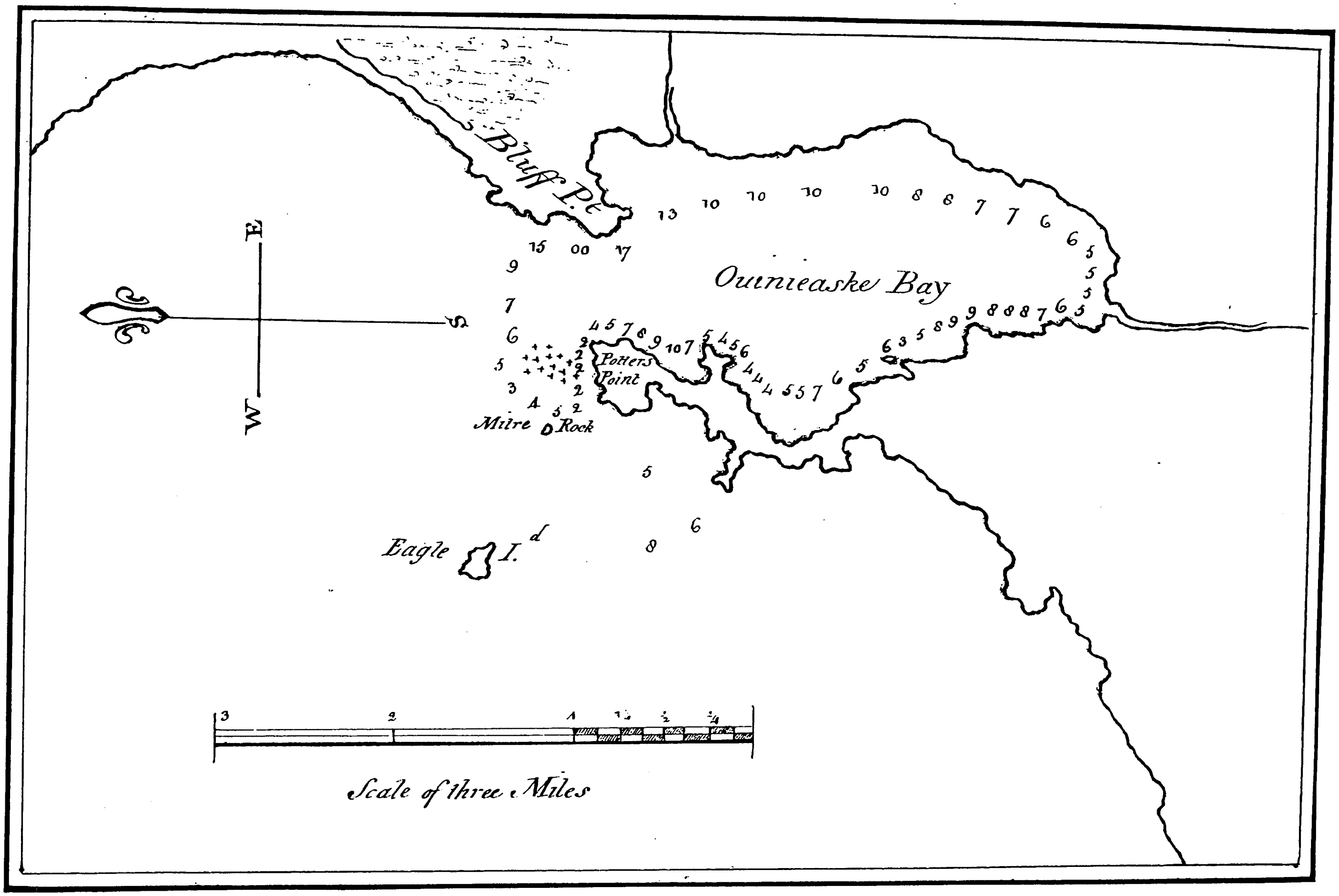


*Figure 44.* Early map of Quinneaska Bay, later called Shelburne Bay (Chambers 1984:56).

Local settlers relied upon vessels leaving Shelburne Bay to transport items such as lumber, wool, potash, apples, wheat, and other goods, although the placement of the harbor installations in Shelburne during the late eighteenth and early nineteenth century is today unknown. The first company to establish a dock on the northern tip of Shelburne Point was the Lake Champlain Steamboat Company (LCSC), who in 1820 moved its winter quarters and the steamers *Congress* (VT-AD-0717) and *Phoenix* (1820 [VT-CH-0587]) to Shelburne Point from Vergennes, Vermont, along Otter Creek. Researchers believe that the LCSC shipyard was located approximately where the Shelburne Shipyard is today.

In 1824 the Vermont Legislature chartered the Champlain Ferry Company to operate between Burlington, Vermont, and Port Kent, New York. The company commissioned master carpenters Philip and Lavater S. White to build a steamer at the Lake Champlain Steamboat Company's yard in Shelburne Bay. In 1825 the steamboat *General Greene* was launched from the Shelburne Shipyard for the Burlington-Port Kent crossing. The following year, the Shelburne Shipyard launched the sloop *Bolivar.* With the shipyard's business expanding, in 1827 the owners constructed a ways for hauling boats out of the water for repairs and a stone building to house the shipyard office, the power plant, the carpenter's shop, and the machine shop.

During the mid-nineteenth century, Captain Napoleon Bonaparte Proctor established another shipyard on the eastern side of the bay at Red Rocks Point, opposite the Shelburne Shipyard. Proctor had a long maritime career as a ship master on Lake Champlain, and he also developed a reputation as a marine architect and inventor. Proctor began his career on Lake Champlain sometime before 1832, by which

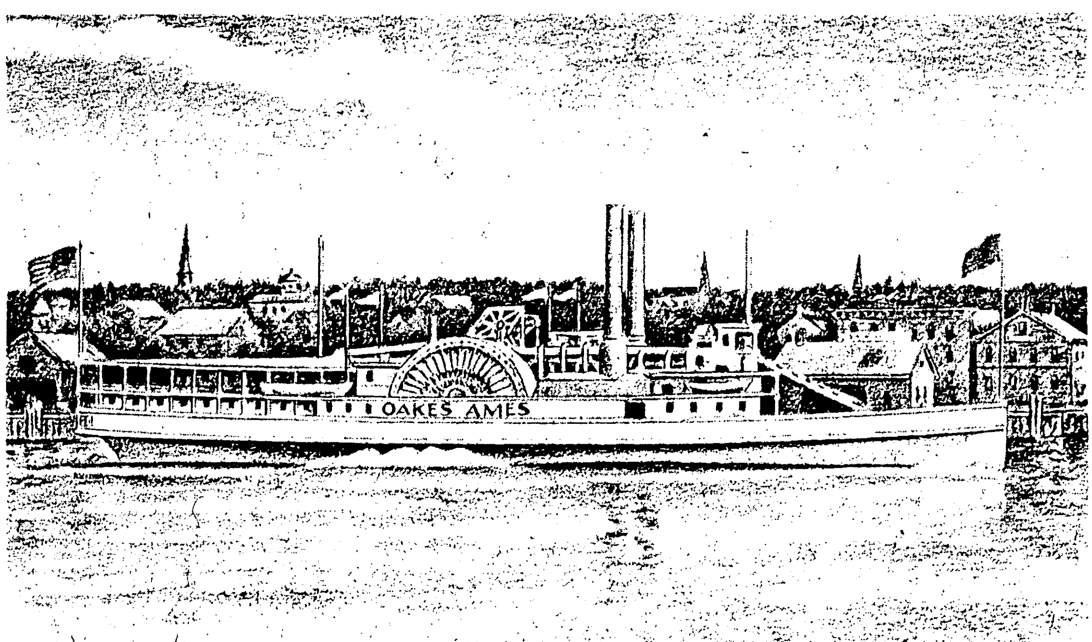


*Figure 45. Oakes Ames* (1868), later renamed *Champlain II*, was the only railroad car ferry on Lake Champlain (Hill 1962:9).

time he was a registered pilot of steam vessels. He became a captain of steam vessels in 1847 and worked in that capacity through 1872 (Canfield 1868:706). *Oakes Ames* (later *Champlain II*) a sidewheel steamer designed to carry railroad cars from Burlington to Plattsburgh, was built in 1868 at Proctor's shipyard (Figure 45). Proctor designed the vessel, and master carpenter Orson Saxton Spear, a well-known Lake Champlain shipbuilder, oversaw the vessel's construction. The detailed history of Proctor's shipyard, including the names of the vessels that were constructed and repaired there, is unfortunately unknown.

Several competing steamboat companies sprang up on Lake Champlain after the War of 1812. Cornelius P. Van Ness, a stockholder in one of these companies, the Lake Champlain Steamboat Company, purchased the shipyard at Shelburne in 1828. In 1832, the Champlain Ferry Company completed the steamboat *Winooski* at the Shelburne Shipyard. The new steamer replaced the aging steamer *General Greene*, which was converted into a sloop in 1833. Also in 1833, Van Ness transferred his ownership of the Shelburne Shipyard to Isaiah Townsend, one of the original directors of the Lake Champlain Steamboat Company, who had purchased the assets of the Champlain Steamboat Company and merged it with the Champlain Transportation Company (CTC) in 1831. It was the Champlain Transportation Company, founded in 1826, that eventually dominated steamboat passenger trade on Lake Champlain throughout the nineteenth century (Figure 46).

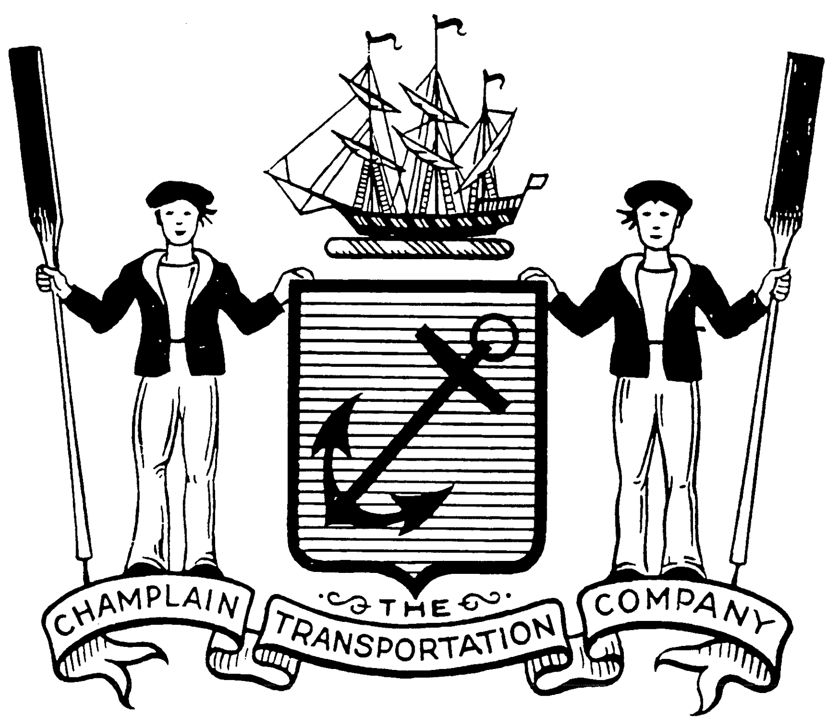


*Figure 46.* Logo of the Champlain Transportation Company (Ross 1997).

As the CTC prospered, the Shelburne Shipyard's facilities grew through a series of land acquisitions, constructing storehouses, dwellings, timber sheds, and other buildings. As competition grew stiff and often ruthless over cargo and passenger trade on Lake Champlain, the CTC became noted for its takeovers of its competitors. With the CTC's near-monopoly on the steam passenger trade on Lake Champlain, the shipyard in Shelburne Bay was extremely active throughout the nineteenth century. At least twelve large sidewheel passenger steamers were built at the Shelburne Shipyard, including *General Greene* (1825), *Winooski* (1832), *Burlington* (1837), *Saranac* (1842), *United States* (1847), *Ethan Allen* (1847), *Boston* (1851), *Adirondack* (1867), *Vermont* (1871), *Chateaugay* (1888), *Vermont* (1903), and *Ticonderoga* (1906) (Webster 1994:128-129).

Vessels were also dismantled at the shipyard; most of the vessels decommissioned at the Shelburne Shipyard were towed out into Shelburne Bay and scuttled. During the twentieth century the Champlain Transportation Company (Lake Champlain Transportation Company [LCTC] after 1948) passed through a number of hands as it responded to new developments in Champlain Valley transportation, eventually finding its niche operating auto ferries at a small number of crossings. The last of the large Lake Champlain steamboats, *Ticonderoga*, was retired to the Shelburne Museum in 1954/55 (Cohn 1997: 185-195). The Shelburne Shipyard continued to build small wooden pleasure craft and vessels for the U.S. Navy until 1971, but it is now primarily used for summer dockage and winter storage of a large number of pleasure craft.

## PREVIOUS ARCHAEOLOGY AND SALVAGE IN THE 1996 LAKE SURVEY AREA

### *Cumberland Bay and Valcour Bay, New York*

Between 1978 and 1990, the Lake Champlain Archaeological Association conducted an extensive diver survey of Cumberland Bay and Valcour Bay to better understand the naval battles that occurred in the area from the French and Indian War to the War of 1812. Unfortunately, the data from their research and information about the artifacts they found were never consolidated into a final report. These artifacts have recently been donated to LCMM, where they are currently in study along with the LCAA's field notes. An analysis of the LCAA's data will be enormously helpful in determining archaeologically sensitive areas in the Cumberland and Valcour Bay area.

### *Gordon Landing, Grand Isle, Vermont*

In 1988 and 1989, the Lake Champlain Maritime Museum conducted a side scan sonar survey near Gordon Landing in Grand Isle, Vermont, prior to the installation of two intake pipes and a fish passage for the proposed Grand Isle Fish Hatchery. The survey was conducted in three phases: a side scan sonar survey in the deep water offshore, free-swimming divers surveyed the shallow water near shore, and the shoreline received an intensive walkover. One shipwreck and a possible geological target were located during the survey (Thomas et al. 1989:32-33).

The diver survey covered the shallow water up to 4.6 m (15 ft) and overlapped the side scan sonar survey. This near-shore survey located no significant finds. The shoreline walkover located approximately 15.2 m (50 ft) of the hull remains of the Champlain Transportation Company auto ferry *Cumberland*. *Cumberland* was a steam screw-driven ferry built in 1919 in Swanton, Vermont, that worked the ferry crossing between Grand Isle and Cumberland Head until its abandonment in the small protected bay at Gordon Landing. The vessel was originally constructed with a length of 19.7 m (64 ft 7 in). Approximately twenty percent of the wooden hull remains along the shore. Through fittings, drift bolts, spikes, and threaded iron rods project from the partly charred timbers of the vessel. According to Captain Merritt Carpenter, a retired Lake Champlain Transportation Company ferry captain, *Cumberland* was a double-ended steam ferry with the engines in the middle and boilers offset to one side. *Cumberland* was an under-powered vessel and was unable to venture out on windy days. Carpenter believes that the vessel was dragged upon the shore at Gordon Landing, where it was dismantled so that the vessel's engines and boilers could be removed and used to improve the ferry piers. When the construction crews were ready to pour the concrete for the pier, *Cumberland*'s machinery was thrown into the pier footings to reinforce the concrete (Thomas et al. 1989:33-34).

In 1994, LCMM conducted a side scan sonar survey west of Gordon Landing. The shipwreck located at Gordon Landing in 1988 was relocated during the 1994 survey and identified as a standard canal boat.

### *Willsboro Bay, New York*

No previous archaeological research has been conducted in Willsboro Bay, although local divers and the Essex County Dive Club have explored much of the area. The survey team was informed that a submerged boxcar that ran off the railroad tracks in 1907 is located in the northwest corner of the bay and that a bow section of a standard canal boat also lies on the bottom of the bay. The remains of a large barge, approximately 27.4 m (90 ft) long, have also been noted in Frisbies Bay along the east side of Willsboro Bay. The Essex County Dive Club removed the rudder of the barge, which is now on display at the Champlain Dive Shop in Willsboro. Close to this submerged barge, near the Frisbies Stone Quarry, is the stern section of a canal boat. Cribbing and granite mooring blocks for floating docks are also reportedly preserved near the quarry. Finally, a canal boat anchor was recovered from Willsboro Bay in 1975 (Jonathan Eddy, personal communication 1997). The 1996 side scan sonar survey, however, located neither these targets nor any additional cultural resources, although many of these targets are located in shallow water inside small bays within Willsboro Bay and may have been out of the area surveyed.

### *Shelburne Bay, Vermont*

In May 1982 a remote-sensing survey was conducted in Shelburne Bay under the direction of James Kennard of Rochester Engineering Laboratories in Fairport, New York. The purpose of this survey effort was to locate fully intact shipwrecks in order to explore and document them and create interpretive slide presentations for the public. One survey run was made with side scan sonar around the periphery of the bay, covering an area approximately 183 m (600 ft) from shore. At that time aquatic plants extended 7.6 to 15.2 m (25 to 50 ft) from shore and limited the survey's capability of locating potential cultural resources close to the shoreline. Two anomalies were noted just beyond Shelburne Bay Marina, but they were not of sufficient interest at the time to warrant further investigation. Another anomaly was found in deeper water between Shelburne Point and Red Rock Point (Kennard 1984:1, 5 and site map 9). None of the targets located during this survey have been relocated or identified as cultural or geological features.

In 1983, the Champlain Maritime Society conducted a survey of the Shelburne Shipyard boat graveyard. The preliminary archaeological survey, called the 1983 Shelburne Bay Steamboat Project, was to inventory and determine the condition of steamboats that had been scuttled there and to provide educational training for amateur divers and historians in the procedures used to document shipwrecks. Using a historic map listing thirteen steamboat wrecks by name, the divers located and documented approximately ten vessels. The survey team measured the length, width, and depth of each vessel and counted the number of frames and longitudinal timbers of the wrecks. A cross-section profile and a plan view were also drawn for most of the vessels. The position of each vessel was also noted along with any distinguishing characteristics. The vessels identified during the project include the sidewheel steamers *Franklin*, *Francis Saltus* or *A. Williams*, *Burlington*, *Whitehall*, *United States*, and *Adirondack* (Chase 1985:54-61).

### *Main Lake*

A large section of the Main Lake was investigated during the 1996 Lake Survey. Previous archaeology in this area has included a small number of side scan sonar surveys and the documentation of the sidewheel steamer *Phoenix* (VT-CH-0587) off Colchester Reef by the Champlain Maritime Society during the early 1980s.

## ARCHAEOLOGICAL FIELD RESULTS

### *Shipwreck Finds*

During the planning stages of the project, the survey team determined that a side scan sonar unit was going to be the primary search tool for the survey project. With side scan sonar, the survey team had access to a large number of positive variables such as bandwidth, frequency, boat speed, and the towfish's distance above the bottom. The greatest effect of changing these variables is on the size of the target that can be located and the amount of area that can be covered at any given time. The survey team chose settings that would allow them to detect only the largely intact cultural features, specifically shipwrecks. This methodology allowed the survey team to image the largest possible area of the lake bottom within the confinements of the 1996 Lake Survey.

The side scan sonar settings, although established to locate large cultural targets, may have also located other, smaller cultural features that were not recognized at the time. Future analysis of the sonar data and continuing diver verifications will locate additional cultural features. The targets that were inventoried and documented during the 1996 Lake Survey were all shipwrecks.

The survey team located thirteen shipwrecks, ten of which were previously unrecorded vessels. Five of these wrecks were located at divable depths and received diver verification in 1996. The other five targets, located beyond safe depth ranges for divers, can only be interpreted through their side scan sonar images until a ROV survey of the sites is accomplished.

### *Wreck A*

While testing the electronic equipment in the afternoon of June 11, the survey team located its first target, Wreck A (Figure 47), in New York waters. This target was first located during a survey in 1988 by LCMM (Thomas et al. 1989) and again in 1994 by LCMM. The side scan sonar images of this vessel suggest that it may be a standard canal boat, although the depth of the target prohibited diver verification.

### *Wreck B*

On June 12, Wreck B (Figure 48) was located in New York waters. This vessel appears from the side scan sonar image to be a standard canal boat, although the depth of the target prohibited diver verification.

### *Wreck C*

On June 14, a clear vessel-shaped target was located in New York waters and designated Wreck C (Figure 49). The preliminary measurements of the vessel were 25.9 m (85 ft) long and 3.8 m (12.5 ft) wide, based on an immediate interpretation of the sonar data by the Triton ISIS System. On June 24, a diver verified that the target was a shipwreck. The wreck, sitting upright on a level sandy bottom, is an early nineteenth

| CULTURAL TARGETS LOCATED DURING THE 1996 LAKE SURVEY | | | |
|---|---|---|---|
| **WRECK** | **STATE** | **VESSEL TYPE** | **STATUS** |
| A[1] | New York | canal boat | side scan sonar image |
| B | New York | canal boat | side scan sonar image |
| C | New York | canal boat | diver-verified |
| D | Vermont (VT-GI-0030) | canal boat | side scan sonar image |
| E | New York | possible sidewheel steamer | side scan sonar image |
| F | Vermont (VT-GI-0031) | sloop-rigged canal boat | diver-verified |
| G | New York | canal boat | diver-verified |
| H[2] | Vermont (VT-CH-0813) | barge | side scan sonar image |
| I | Vermont (VT-CH-0814) | *U.S. La Vallee*, screw driven steam tugboat | diver-verified |
| J | Vermont (VT-CH-0815) | scow barge | diver-verified |
| K[3] | Vermont (VT-CH-0595) | sloop-rigged canal boat | diver-verified |
| L | Vermont (VT-CH-0812) | barge | side scan sonar image |

*Table 4.* Cultural targets located during the 1996 Lake Survey.

[1] Vessel already known from sonar surveys conducted in 1988 and 1994 by LCMM.
[2] Vessel already known from sonar survey conducted in 1983 by the Champlain Maritime Society.
[3] Vessel already known from sonar survey conducted in 1983 by the Champlain Maritime Society.

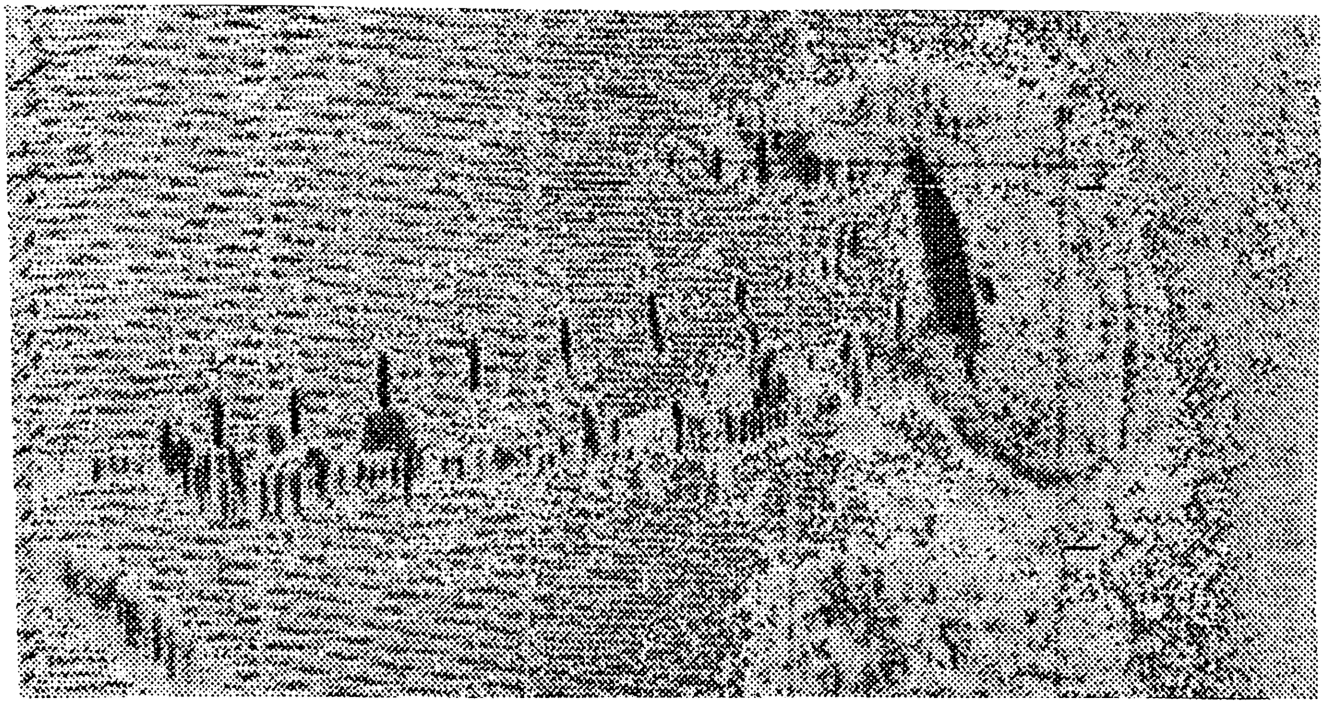

*Figure 47*. Wreck A: Sonar image of a possible standard canal boat (LCMM 1996) located in New York waters.

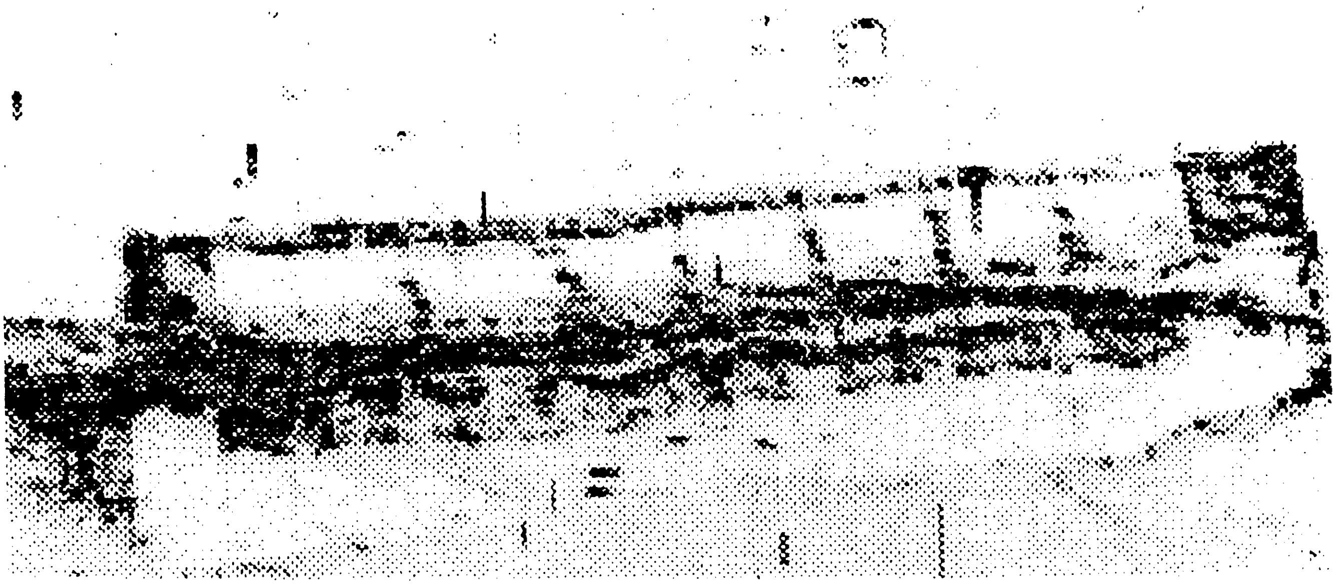

*Figure 48*. Wreck B: Sonar image of a possible standard canal boat (LCMM 1996) located in New York waters.

century sloop-rigged sailing canal boat in poor condition. Only the stem and stern sections of the vessel are intact. The vessel's edge-fastened, strip-planked sides have fallen away and are lying on the bottom. At the curved scow-shaped stern, the intact elements include the rudder, the rudderpost, frames, and the transom. The keel, sister keelsons, and chine log project above the sandy bottom. The vessel apparently sank with no cargo or equipment on board. A single mast tabernacle and evidence of deadeye rings are lying on the bottom.

Iron rods are evident in the area where deck stanchions were once located. An iron rod with an eye was observed near the centerline of the vessel and may have been part of a turnbuckle that was attached to the underside of the deck beams. There was no evidence that the vessel had a centerboard, suggesting that it instead used leeboards to provide stability while sailing. The deck of the vessel is not preserved. A horizontal wooden windlass stands *in situ* at the bow, which is in generally excellent condition. No evidence of zebra mussels was found. The wreck did not appear to have experienced previous diver visits, but the survey team learned while conducting regional interviews that this wreck has apparently been known by local divers for some time and is frequently visited by a select number of divers from the Plattsburgh area (Jonathan Eddy, personal communication 1997).

The survey team returned to Wreck C on the afternoon of August 5. Sketches and video footage of the vessel were taken to record some of the wreck's important features. Two video cameras were used, one with auxiliary lights and one that relied on ambient light. Measurements revealed that the preliminary ship length, based upon sonar data, was incorrect; the actual length of the shipwreck is 18.9 m (62 ft).

***Wreck D***

On June 24, the survey team located the shipwreck target designated Wreck D (VT-GI-0030; Figure 50) in Vermont waters. The side scan sonar images of this vessel suggest that it may be a standard canal boat, although the depth of the target prohibited diver verification.

***Wreck E***

The target designated Wreck E (Figure 51), located in New York waters, seems to be a large vessel. The side scan sonar image suggests a possible wreck of a sidewheel steamer, although the depth of the target prohibited diver verification.

***Wreck F***

On the morning of June 29, the survey team encountered a clear target in Vermont waters that was designated Wreck F (VT-GI-0031; Figure 52). Diver verification of the wreck was completed on the morning of August 6 and revealed that the vessel is a sailing canal sloop in pristine condition. Wreck F is sitting upright and completely intact on the bottom and almost certainly sank in unplanned and extreme circumstances. All elements that made it a working watercraft are still present. The mast lies *in situ* in the mast tabernacle, the wood and paint are in an excellent state of preservation, the boom is present with its leather-coated jaws, the anchor still hangs off

*Figure 49*. Wreck C: Sonar image of a sailing canal boat (LCMM 1996) located in New York waters.

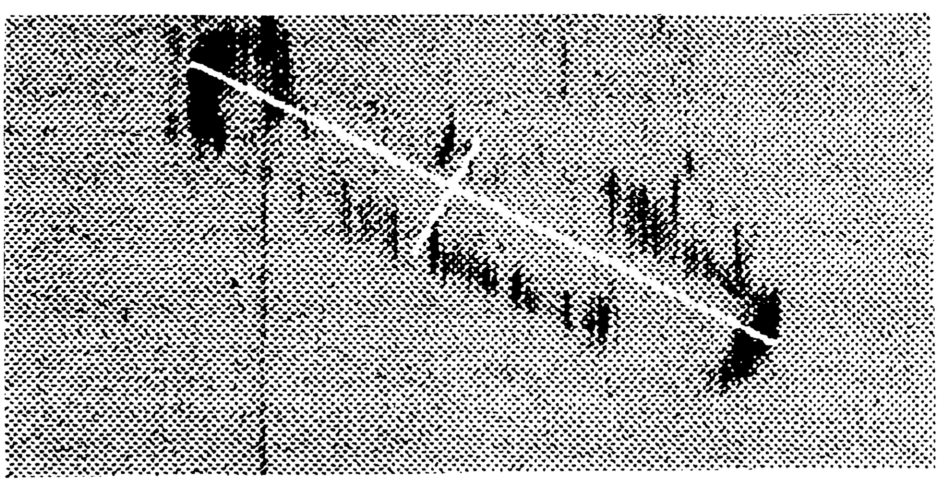

*Figure 50*. Wreck D (VT-GI-0030): Sonar image of a possible standard canal boat (LCMM 1996) located in Vermont waters.

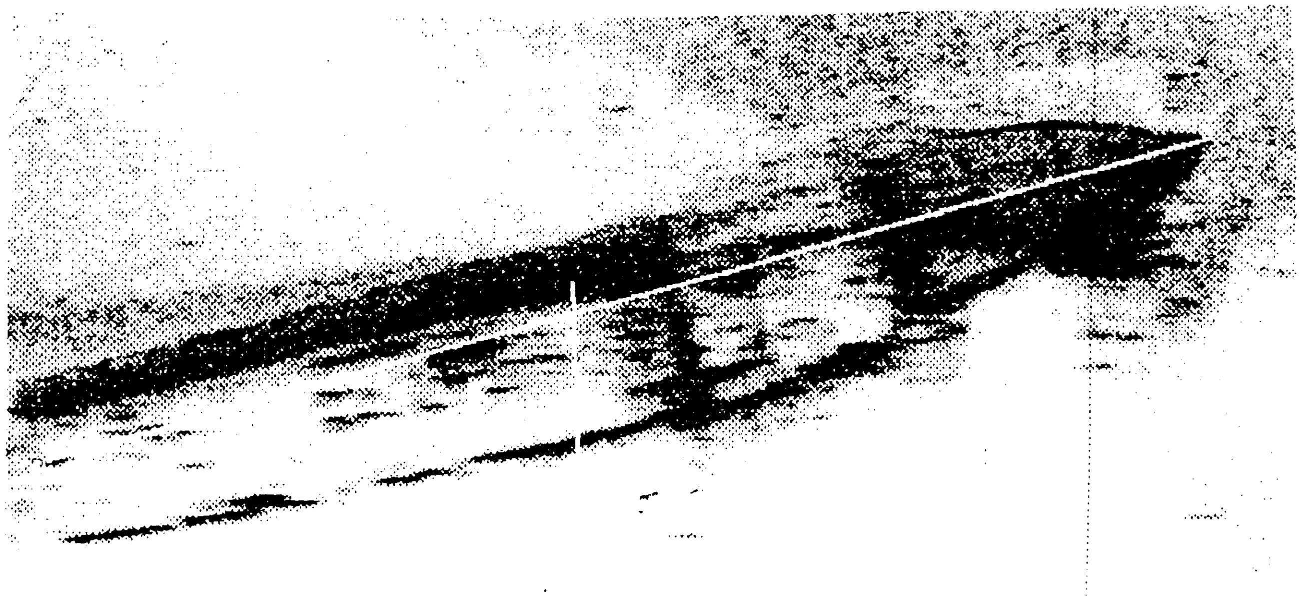

*Figure 51.* Wreck E: Sonar image of a possible sidewheel steamer (LCMM 1996) located in New York waters.

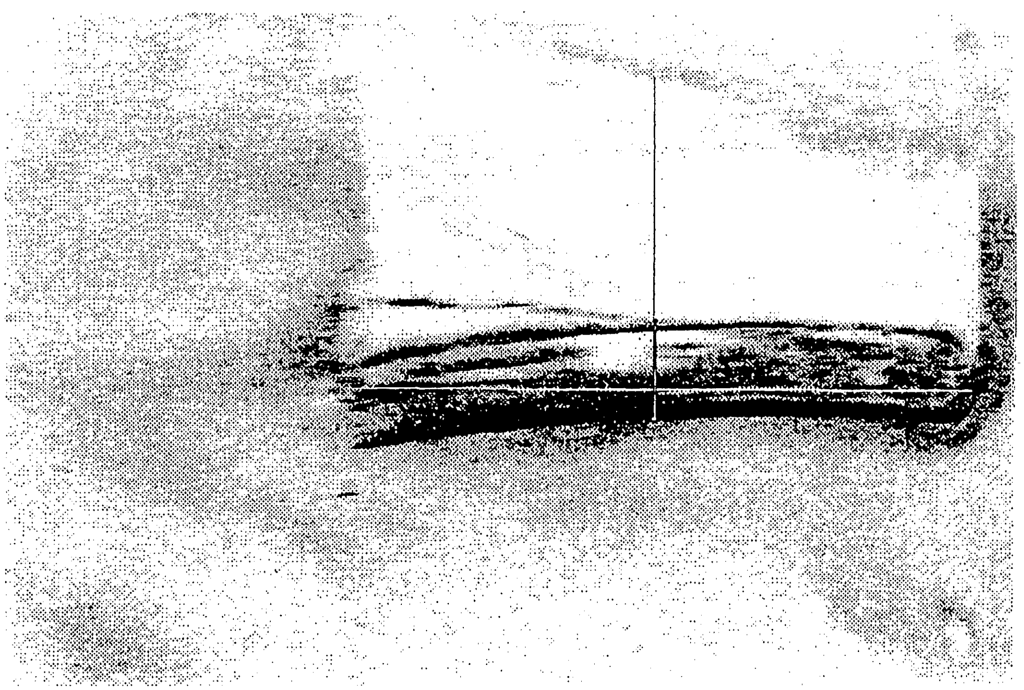

*Figure 52.* Wreck F (VT-GI-0031): Sonar image of a sailing canal boat (LCMM 1996) located in Vermont waters.

the hawse pipe in the bow of the vessel, and the windlass is intact on the bow.

The rear cabin of Wreck F still houses a wood stove, plates, dishes, cups, and water pitchers. The sloop clearly went down in distress, and its archaeological potential is very high. Further research may yet identify the vessel, although those same artifacts that may aid identification efforts are currently exposed and vulnerable to theft and zebra and quagga mussel infestation. An assessment to bury or remove any artifacts from the shipwreck site for conservation was not completed during the survey. These tasks will need to be completed at a later date, as will an assessment of the wreck's eligibility as an underwater preserve site. This vessel is a proverbial time capsule, providing a glimpse into life on Lake Champlain during the mid-nineteenth century.

***Wreck G***

During the afternoon of July 10, the survey team located Wreck G (Figure 53) while working in New York waters. The preliminary measurements of the vessel obtained by the Triton ISIS System, later proved to be slightly inaccurate, were 28.2 m (92.5 ft) in length and 6.4 m (21.0 ft) in beam. On the afternoon of August 6, the survey team returned to Wreck G to verify their finding.

Wreck G is a standard canal boat, an example of what was probably the most populous vessel type to operate on the lake during the nineteenth century. Wreck G's large size indicates that it probably dates to the later nineteenth century. The vessel appears to have been scuttled at the end of its working life, although its generally good condition preserves some interesting construction features. The vessel's big, bluff bow is completely intact. The windlass is present, although it has been dislodged and is off to the port side of the vessel. In the stern, the entire steering mechanism of the vessel is intact, along with many other diagnostic features. The vessel is preserved to a length of 29.6 m (97 ft) and a width of 4.9 m (16 ft). Like Wreck C, this vessel is known to a select number of local divers who visit it frequently (Jonathan Eddy, personal communication 1997).

***Wreck H***

Wreck H (VT-CH-0813; Figure 54) was located during the afternoon of July 11 in Vermont waters. ISIS estimated the vessel's measurements to be 27.2 m (89.2 ft) in length and 8.2 m (26.9 ft) in beam. Wreck H was originally located in a 1983 survey conducted by the Champlain Maritime Society, although its depth has prohibited diver verification. The target's rectangular signature on the side scan sonar image suggests that the vessel may be a construction barge.

*Figure 53.* Wreck G: Sonar image of a standard canal boat (LCMM 1996) located in New York waters.

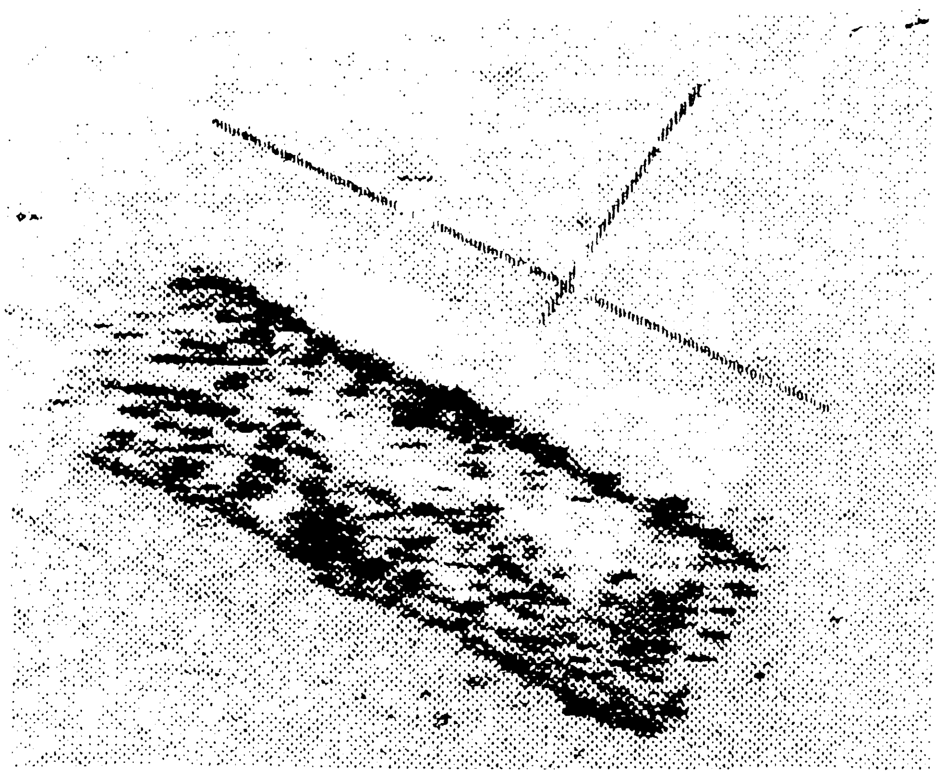

*Figure 54.* Wreck H (VT-CH-0813): Sonar image of a possible construction barge (LCMM 1996) located in Vermont waters.

### *Wreck I*

Wreck I (VT-CH-0814; Figure 55) was located in Vermont waters in Shelburne Bay on July 11. The vessel was estimated to be 13.8 m (45.3 ft) long and 5.3 m (17.4 ft) wide and to stand 2.3 m (7.5 ft) off the lake bottom. On August 7, the diver verification team discovered the target was the wreck of a wooden tugboat with its steam machinery still onboard. Based on its location and description, the vessel was identified as *U.S. La Vallee*, a tugboat that was scuttled in the 1930s after a working life of over fifty years. This sharp-bowed vessel is possibly the only intact steam tug preserved in Lake Champlain. Its towing bits, propeller, ship's wheel, steam stack, and complement of machinery are clearly visible and have been remarkably well-preserved in the cold lake waters.

### *Wreck J*

The survey team located Wreck J (VT-CH-0815; Figure 56) in Vermont waters on July 11, and the diver verification team examined the vessel on August 7. The vessel is 28.7 m (94 ft) long and 9.1 m (30 ft) wide. Wreck J is a heavily-built wooden construction scow or barge, originally designed to carry marine construction equipment around the lake to build the docks and breakwaters that supported the maritime economy of the Champlain Valley. Almost certainly intentionally scuttled, the vessel has been badly burned and is missing its deck, but it remains a very good example of this type of vessel. The extant hull preserves many interesting features, such as naturally shaped knees and extra support timbers designed to hold heavy deck loads. This wooden vessel type, once one of the most common vessels on the lake but now replaced by steel barges, exists today only in the archaeological record.

### *Wreck K*

On July 11 the survey team relocated a sloop-rigged sailing canal boat (VT-CH-0595; Figure 57) originally discovered during a 1983 survey by the Champlain Maritime Society. The 1996 survey crew captured a side scan sonar image of the vessel.

### *Wreck L*

On the morning of July 24, the survey team located Wreck L (VT-CH-0812; Figure 58). The rectangular shape depicted on the side scan sonar image suggests a barge 10.7 m (35 ft) long, although the depth of the target prohibited diver verification.

### *Other Finds*

On the afternoon of July 31, the survey team located in New York waters a canal boat, preserved in pieces, which had been reported by local divers. This wreck is scheduled for further investigation by experienced local divers in 1997.

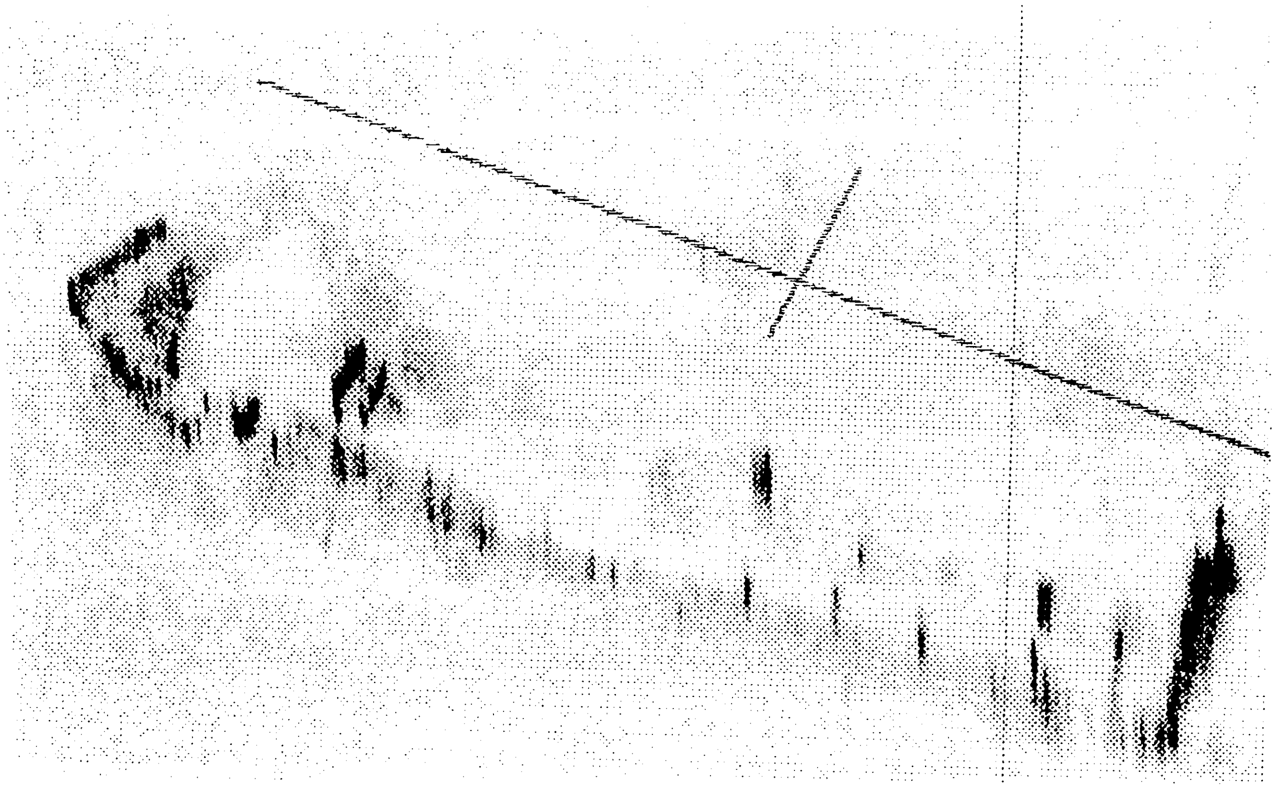

*Figure 55*. Wreck I (VT-CH-0814): Sonar image of the steam tugboat *U.S. La Vallee* (LCMM 1996) located in Vermont waters.

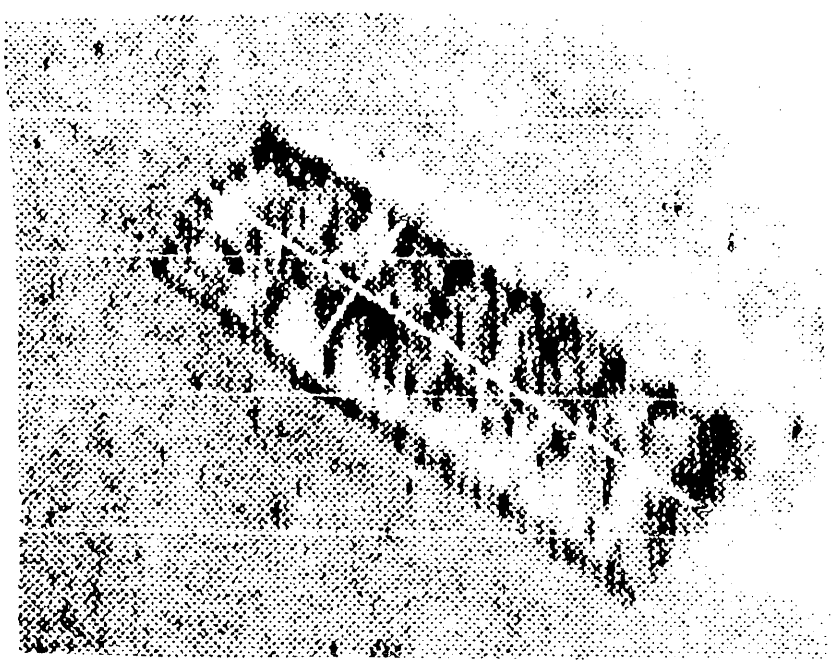

*Figure 56*. Wreck J (VT-CH-0815): Sonar image of a construction scow or barge (LCMM 1996) located in Vermont waters.

*Figure 57*. Wreck K (VT-CH-0595): Sonar image of a sailing canal boat (LCMM 1996) located in Vermont waters.

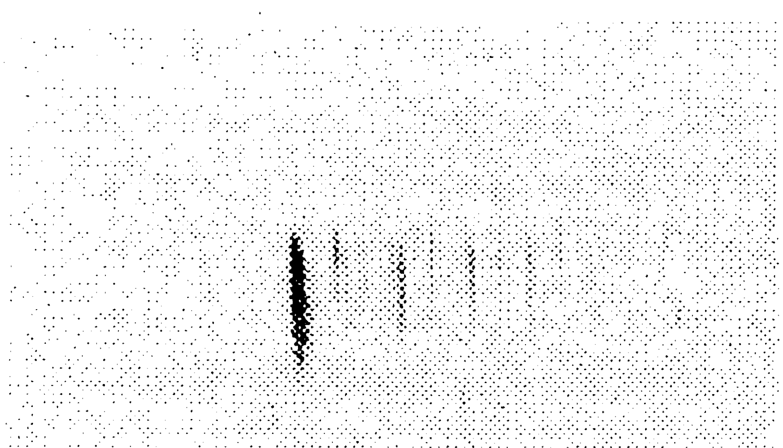

*Figure 58*. Wreck L (VT-CH-0812): Sonar image of a possible barge (LCMM 1996) located in Vermont waters.

# HISTORICAL SURVEY OF *U.S. LA VALLEE*

### *Shipwreck Historical Research*

Lake Champlain's shipwrecks are valuable links to our maritime past. Every shipwreck is capable of telling its own story about ship construction, maritime trade, or life aboard a vessel on Lake Champlain. Unfortunately, the archaeological record lacks a historical context, which can be best provided by contemporary historical records. Historical records about Lake Champlain's maritime history, however, are few; local newspapers are often a good source of maritime information. Each major newspaper printed in the Champlain Valley had at one time a designated section for Lake Champlain's maritime news, and the histories of certain vessels, mostly steamers, can be traced through the newspapers from launching to loss. Another helpful historical source is the registration papers that federal maritime laws required for commercial vessels during the nineteenth century for taxation purposes. These documents contain information about the vessel's dimensions, carrying capacity, construction, and ownership. Finally, customs logs and canal logs also noted all vessels that passed by their stations, recording the vessel's name, type, cargo, dimensions, port of departure, and intended port of entry. Even with all of these sources of information, however, the archaeological record can often answer a number of questions that the historical documents, for lack of data, simply cannot.

Many documents may still exist pertaining to vessels that once operated on Lake Champlain, but they are scattered. If these documents were compiled and catalogued on a database, the identification of the unknown shipwrecks located during the Lake Survey could possibly be simplified. Many shipwrecks have been located in Lake Champlain, but only a small number are known by name. Wreck I (VT-CH-814), located in Shelburne Bay during the course of the 1996 Lake Survey, is one of these few vessels. The historical research for this vessel was easier than most, because the boat was scuttled intentionally within the memories of a few Champlain Valley residents and appears as *U.S. La Vallee* on a comical map of Lake Champlain's shipwrecks (Hazard 1974). Some of the vessel's history has been reconstructed and is presented below as an example of the information that can be gleaned from the historical records about a late nineteenth-century vessel from Lake Champlain.

### *Wreck of* **U.S. La Vallee** *(1880-1931)*

On July 11, 1996, the survey crew covered a total of 7.0 km$^2$ (2.7 mi$^2$) in Shelburne Bay and located three wrecks. One of the wrecks was located in deep water in the area where *U.S. La Vallee* was reportedly sunk in 1931. Later in July, a dive team verified that this shipwreck was indeed that of *U.S. La Vallee*. The vessel was found sitting intact and upright on the bottom in excellent condition (Figure 59). The wheelhouse with its curved windows was found lying in pieces, almost as if it had been blown outward. Trapped air may have torn apart the vessel's wheelhouse in a violent explosion during the vessel's sinking.

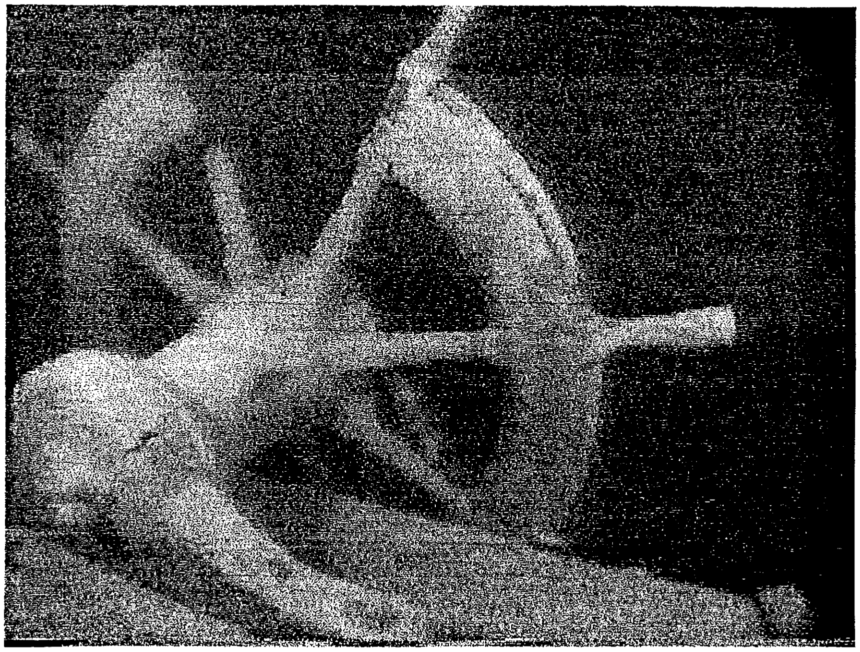

*Figure 59*. Wheel of *U.S. La Vallee*, from underwater video footage (LCMM 1996). Videography by Dave Andrews.

### ***Early Years of Service (1880-1883)***

In 1880 a small wooden tugboat called *Henry Lloyd*, later in its career named *U.S. La Vallee*, was launched at Brooklyn, New York. The vessel's namesake, the name of the shipyard, and the date of the tug's launching are unknown. The vessel was a coal-fired screw steamer not unlike hundreds of other small towing and service craft serving in coastal and inland shipping of its era.

On December 29, 1880, Patrick Hickey applied to the Collector of Customs at New York City for an official registration number for his recently built vessel, the *Henry Lloyd*. The vessel was described as a steam propeller of 13.94 tons burden and 30 hp. On January 5, 1881, C. F. Wager, the Inspector of Customs at New York, issued the tug's official number as 95624. He noted that the number and tonnage of the vessel had been "duly carved or otherwise permanently marked on her main beam." The vessel's name and the hailing port of New York were painted on the tug's stern in white letters, not less than three inches in length on a black background (Wager 1881).

On March 16, 1881, the Collector of Customs at New York issued license #281 for *Henry Lloyd* to participate in coastal trade. The owner and master were listed as Patrick Hickey of Brooklyn, New York. The license also listed the tug's dimensions as 12.35 m (40.5 ft) in length, 3.72 m (12.2 ft) in breadth, and 1.46 m (4.8 ft) in depth of hold. When the license had expired, it was surrendered on August 9, 1882, at Perth Amboy, New Jersey, where Hickey had apparently moved his operation. A new license,

#26, was issued for *Henry Lloyd* at Perth Amboy on August 9, 1882. The new master of the tug was listed as Patrick Burns of South Amboy, New Jersey, who appears to have been an employee of Hickey. *Henry Lloyd*'s tonnage had been recalculated as 13.01 tons, but the tug's dimensions remained unchanged. On March 13, 1883, James Fagan, Jr., replaced Patrick Burns as master. Hickey surrendered the license for *Henry Lloyd* at New York City on November 10, 1883, after he sold the tug.

### *The Georgetown Years (1883-1920)*

A new license, #205, was issued for *Henry Lloyd* on March 13, 1883, at New York City. *Henry Lloyd*'s new owner was the Georgetown Rice Milling Company of Georgetown, South Carolina, and the vessel's new master was W.J.L. Uptegrove. After the tug arrived in Georgetown, the New York City license was surrendered on December 3, and a new license, #3, was issued reflecting *Henry Lloyd*'s new hailing port of Georgetown and master J.R.S. Sian.

The Georgetown Rice Milling Company owned *Henry Lloyd* for the next twenty-three years (1883-1906). A series of annual licenses was issued to the Milling Company for *Henry Lloyd*. Although the tug's dimensions did not change, gross and net tonnage were given respectively as 13 and 7 tons beginning in 1885. In 1896, *Henry Lloyd* was further described as having one deck, no mast, a plain or sharp head, and a round stern. J.R.S. Sian was master of the tug from 1883 to 1905. B.T. Daggett, G.F. Samis, and J.D. Johnson served as masters of the vessel from 1905 to 1906.

On February 26, 1906, *Henry Lloyd* was sold to the Georgetown Chemical Works in Georgetown, South Carolina, with J.D. Johnson as master. J.C. Porter became the vessel's new master on May 7, 1906. On August 21, 1907, *Henry Lloyd*'s license was surrendered because the vessel was rebuilt and lengthened. On August 21, 1907, license #4 was issued to reflect the vessel's new dimensions and tonnage. The license lists the tug's dimensions as 17.11 m (56.1 ft) in length, 3.72 m (12.2 ft) in breadth, 1.46 m (4.8 ft) in depth of hold, 29.43 gross tons, and 19.13 net tons. The tug was still described as built of wood with one deck, no mast, sharp head, and round stern, with J.C. Porter as the tug's master. License #4 was surrendered on August 24, 1908, having expired, and license #2, dated August 24, 1908, was issued to replace it. Renewal licenses were issued over the next six years from 1909 to 1914. The masters of *Henry Lloyd* during this period were J.C. Porter, Robert H. Spencer, W.T. Mills, A.N. Vick, Mort Jones, Edmond Ford, and H.R. Caines. When the Georgetown Chemical Works sold *Henry Lloyd*, license #2 for the tug was surrendered at Georgetown on April 25, 1917.

License #4 was issued to the new owners, C.S. Juell and C.S. Haight of Georgetown, and James A. Loisch was listed as *Henry Lloyd*'s new master. This license was in turn surrendered at New York City on December 14, 1920; the reason for surrender was "dismantled, unfit for use." Seemingly, *Henry Lloyd*'s career was over; a duplicate of license #4, however, shows the original surrender date and port crossed out and replaced with September 21, 1923, and Albany, New York, with the notation, "abandoned: district, hail & property changed, re-documented." It is unknown who purchased *Henry Lloyd* in New York, but the buyer probably intended to strip the vessel and reuse its parts. *Henry Lloyd*, however, was not completely dismantled, although it remained unserviceable for the next three years.

Little is known about the working career of *Henry Lloyd* during its employment in Georgetown, South Carolina, where the tug spent the longest part of its career. The tug probably performed general harbor and coastal towing duties for the tug's owners, the Georgetown Rice Milling Company, the Georgetown Chemical Works, and Juell and Haight. A photograph from the Morgan Collection in the Georgetown County Library, entitled *Sampit River at a Tranquil Time*, shows a stern view of *Henry Lloyd* tied alongside a scow in Georgetown Harbor. This undated harbor scene was probably taken in the early years of the twentieth century and also shows a sidewheel steamer loaded with sacks of perhaps rice, a small steam tug or launch, and several other scows loaded with what appears to be piling and derrick stone. *Henry Lloyd*'s tall stack, typical of these early steamers, was later cut down when the vessel was used on the New York Barge Canal System.

### *The Matton Years (1923-1929)*

Another license #4 was issued to John E. Matton of Waterford, New York, on September 21, 1923, and David G. Roberts was listed as the vessel's master. The vessel was described as a coal burner with a crew of five and used for towing. Although the dimensions were unchanged, the horsepower was given as 75 indicated horsepower (IHP), the first reference to the tug's horsepower since Patrick Hickey applied for an official registration number in 1880 and listed the horsepower as 30. When the original steam engine was changed is unknown; the engine could have been replaced, however, when the vessel was lengthened in 1907 or when Matton acquired the tug.

License #4 was surrendered at Albany, New York, on December 27, 1923, because the tug's name was changed to *U.S. La Vallee*. The tug's second namesake is unknown. License #7 was issued to John E. Matton as owner and master on December 27, and the license was renewed five times between 1923 and 1929. During this period the vessel's masters were David G. Roberts, John E. Matton, Robert Ernest McAuliffe, Clayton H. Godfrey, Henry P. Stewart, and Clarence E. McIntyre.

Captain Fred G. Godfrey, a retired tugboat master with over 40 years of service in the inland waters of the Northeast, recalls that John E. Matton owned a shipyard formerly operated by his father, Jesse Matton. The shipyard, which primarily built canal boats, was located on the old Champlain Canal in Waterford, New York. John Matton took control of the shipyard as early as 1904. After completion of the new Champlain Barge Canal in 1915, Matton moved to an island in the Hudson River at Cohoes, New York, where he operated a shipyard and fleet of tugboats. The new yard built a variety of craft including steel barges and tugs. Matton was a hardworking and successful businessman who was later joined by his son Ralph, and the business became known as John E. Matton and Son, Inc. It was during this later period that the company acquired *Henry Lloyd* and renamed it *U.S. La Vallee*.

Most of the tugs used on the New York canals were old vessels that came up from the New York Harbor area and were cut down for canal use. Most of these *old banners*, as the tugboat men referred to them, were near the end of their useful careers, but had been refitted to squeeze a few more years' service out of them on the canals before being scrapped. *U.S. La Vallee* was an example of this practice; the tug's licenses indicate that it was originally abandoned after forty years of service and partially dismantled in 1920 as unfit for use. Matton purchased the tug, however, then had it re-documented and refitted before returning it to service in 1923. The tug remained in Matton's service for another six years.

Godfrey also recalls *U.S. La Vallee* from his youth, when his uncle, Clayton Godfrey, was the vessel's master (1924-1925), although he does not recall hearing much about the boat's career. The Mattons' tugs had a light brown hull, deck, and wheelhouse. The trim and lettering on their vessels were white, and some, but apparently not *U.S. La Vallee*, had a white sheer strip on their hulls. The vessel's stacks were painted black, and the cabin doors all had a black wooden panel set into them. Typical of the old tugs, *U.S. La Vallee* had a single cylinder, non-condensing steam engine with an atmospheric exhaust (Fred G. Godfrey, personal communication 1997).

According to Godfrey, John E. Matton was not a licensed master and did not operate *U.S. La Vallee*. He was apparently listed as such to fulfill a requirement that each vessel have a master on record. Matton was first listed as master during the winter and spring of 1923/24, when the tug was not operating for the winter season. The second time was for a period of over a year from March 1928 to July 1929, before Matton sold the vessel. The tug was probably out of service for this period and laid up waiting to be repaired or sold (Godfrey 1997).

***The Cashman Years (1929-1931)***

Matton's license #7 for *U.S. La Vallee* was surrendered on July 25, 1929, at Burlington, Vermont, due to a change in ownership and district. On the same day, license #J-2 was issued to James E. Cashman, president of James E. Cashman, Inc., of Burlington. John Fleury was listed as the tug's master. The vessel was described as a coal burner employed in the towing service, with 75 indicated horsepower (IHP) and a crew of three.

James E. Cashman, a contractor from Braintree, Massachusetts, secured contracts from the U.S. Army Corps of Engineers in 1905 and 1906 for repairs to the Burlington breakwater. Cashman subsequently remained in Burlington and was involved in the marine and general contracting business for many years both on land and on Lake Champlain. When Cashman purchased *U.S. La Vallee* from Matton in 1929, the tug was apparently worn out, and much effort was spent to keep the vessel afloat. It is likely that the nearly fifteen-month-long period of apparent inactivity (1928-1929) before Matton sold *U.S. La Vallee* indicated that the tug was by that time of little value. Cashman probably paid very little for *U.S. La Vallee*, hoping only to run the tug a few more years.

A series of photographs in a scrapbook from Special Collections at the University of Vermont, which documents the construction of the marine railway at Shelburne Shipyard in 1929, shows a number of views of *U.S. La Vallee* under repair on the new marine railway (Figure 60). A caption on the back of one of the photographs refers to the tug as the "Useless Valley," a nickname which aptly described the vessel. *U.S. La Vallee*, in addition to several other small craft shown together on the marine railway at the same time, was among the first craft to use the new facility.

Fred Valiquette, Sr., of Burlington, Vermont, a retired construction foreman for both the CTC and its successor the Lake Champlain Transportation Company (LCTC), recalls Cashman abandoning efforts to stop the tug's leaks. Finally, Cashman had the tug towed out into deep water in Shelburne Bay and scuttled (Fred Valiquette, personal communication 1996). Captain Merritt E. Carpenter of Burlington, a retired ferry captain for LCTC, recalls seeing *U.S. La Vallee* moving Cashman's scows and other floating equipment around Burlington Harbor when he was a boy. He was also a witness to the sinking of the tug on June 12, 1931. On that day he was on the dock at Shelburne Shipyard when the old harbor tender *Osceola* towed the tug out into the bay. Carpenter remembers that the tug sank rapidly stern first but briefly popped back up to the surface before sinking to the bottom (Merritt E. Carpenter, personal communication 1997).

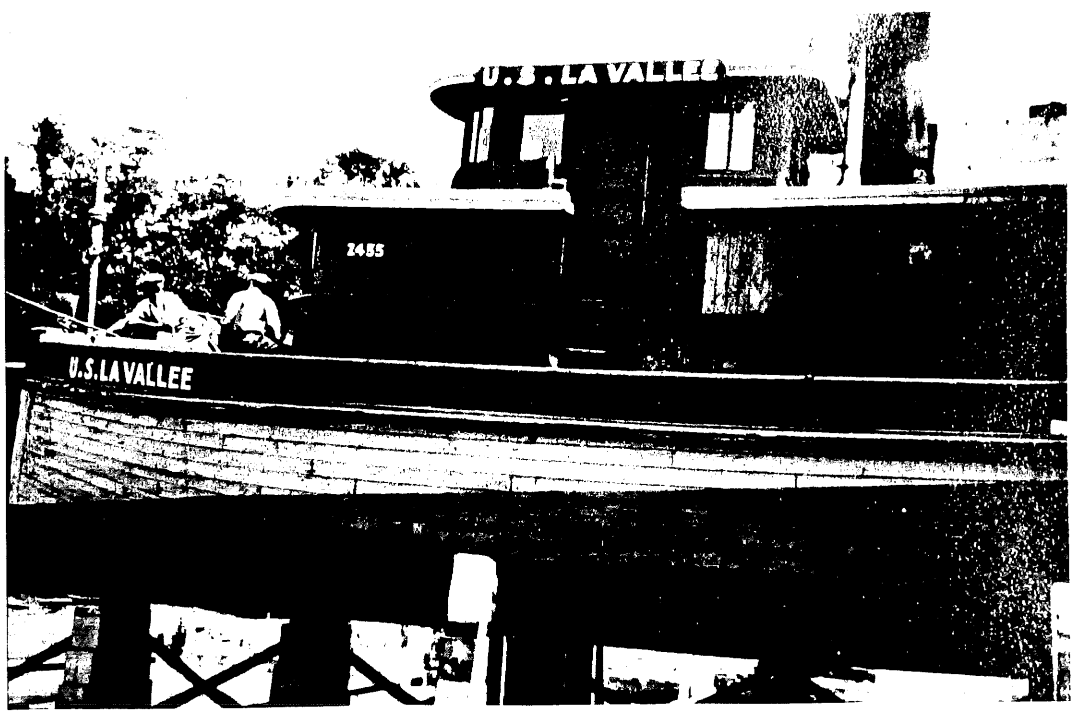


*Figure 60. U.S. La Vallee* on the marine railway at Shelburne Shipyard (courtesy University of Vermont, Bailey-Howe Library, Special Collections).

Cashman's license for *U.S. La Vallee* was surrendered at Burlington on June 16, 1931; the reason was noted as "foundered & sunk, total loss – Shelburne Harbor, Vt. June 12, 1931-0-0." The last two digits, 0-0, indicated that there was no loss of life and that no one was on board at the time the vessel was scuttled. *U.S. La Vallee* was not to be seen again for another sixty-five years.

***Historical Perspective***

Lake Champlain's hardworking commercial vessels rarely received public notice while performing their important but unglamorous duties. This situation was true of *Henry Lloyd/U.S. La Vallee*. The vessel's only public recognition arrives now, when the boat is a submerged wreck, not during the its half-century working career, which ended nearly seventy years ago.

Although no logbooks or other daily records of *U.S. La Vallee*'s career have come to light, a fairly complete record of the tug's service has been preserved in its enrollment papers and licenses. A search of the Champlain Canal lock-keepers' logbooks would probably reveal much about the daily movements of the vessel. A number of photographs have also been located that depict the tug at various times and places during its career. More importantly, we are fortunate to have some personal recollections of the tug by mariners who participated in the twentieth-century maritime history of Lake Champlain.

The importance of this wreck can not be overemphasized. *U.S. La Vallee* is one of very few steamboat wrecks in Lake Champlain that still have an engine and other machinery on board. The tug's excellent condition, except for the wheelhouse, presents a unique opportunity for archaeologists to document the construction and design of the vessel in detail. The site is expected to provide a wealth of information on small latter-nineteenth-century steamboat technology. In a sense, *U.S. La Vallee*'s story is just beginning, as archaeologists and historians start to document and preserve the tug for perhaps the most important chapter of the vessel's history.

| LICENSES ISSUED TO *HENRY LLOYD* | | | | | |
|---|---|---|---|---|---|
| **License Number** | **Date Issued** | **Place Issued** | **Owner** | **Date Surrendered** | **Place of Surrender** |
| 281 | 03-16-1881 | New York, NY | PH | 08-09-1882 | Perth Amboy, NJ |
| 26T | 08-09-1882 | Perth Amboy, NJ | PH | 11-10-1883 | New York, NY |
| 205 | 11-10-1882 | New York, NY | GRMC | 12-03-1883 | Georgetown, SC |
| 3 | 12-03-1883 | Georgetown, SC | GRMC | 12-12-1884 | Georgetown, SC |
| 1P | 12-12-1884 | Georgetown, SC | GRMC | 12-15-1885 | Georgetown, SC |
| 5P | 12-15-1885 | Georgetown, SC | GRMC | 12-17-1886 | Georgetown, SC |
| 5 | 12-17-1886 | Georgetown, SC | GRMC | 12-20-1887 | Georgetown, SC |
| 5 | 12-20-1887 | Georgetown, SC | GRMC | 12-20-1888 | Georgetown, SC |
| 9 | 12-20-1888 | Georgetown, SC | GRMC | 12-20-1889 | Georgetown, SC |
| 4P | 12-20-1889 | Georgetown, SC | GRMC | 12-24-1890 | Georgetown, SC |
| 7 | 12-24-1890 | Georgetown, SC | GRMC | 12-29-1891 | Georgetown, SC |
| 5 | 12-29-1891 | Georgetown, SC | GRMC | 12-30-1892 | Georgetown, SC |
| 5 | 12-30-1892 | Georgetown, SC | GRMC | 12-30-1893 | Georgetown, SC |
| 6 | 12-30-1893 | Georgetown, SC | GRMC | 08-13-1895 | Georgetown, SC |
| 1 | 08-13-1895 | Georgetown, SC | GRMC | 08-13-1896 | Georgetown, SC |
| 1 | 08-13-1896 | Georgetown, SC | GRMC | 01-12-1898 | Georgetown, SC |
| 4 | 01-12-1898 | Georgetown, SC | GRMC | 02-07-1899 | Georgetown, SC |
| 7P | 02-08-1899 | Georgetown, SC | GRMC | 03-27-1900 | Georgetown, SC |
| 10P | 03-27-1900 | Georgetown, SC | GRMC | 03-27-1901 | Georgetown, SC |
| 8P | 03-27-1901 | Georgetown, SC | GRMC | 04-11-1902 | Georgetown, SC |
| 12P | 04-11-1902 | Georgetown, SC | GRMC | 07-28-1903 | Georgetown, SC |
| 2P | 07-28-1903 | Georgetown, SC | GRMC | 07-28-1904 | Georgetown, SC |
| 3P | 07-31-1905 | Georgetown, SC | GRMC | 02-26-1906 | Georgetown, SC |
| 12P | 02-26-1906 | Georgetown, SC | GCW | 08-21-1907 | Georgetown, SC |
| 4P | 08-21-1907 | Georgetown, SC | GCW | 08-24-1908 | Georgetown, SC |
| 2P | 08-24-1908 | Georgetown, SC | GCW | 04-25-1917 | Georgetown, SC |
| 2P 1R | 08-03-1909 | Georgetown, SC | GCW | 04-25-1917 | Georgetown, SC |
| 2R | 09-05-1910 | Georgetown, SC | GCW | 04-25-1917 | Georgetown, SC |
| 3R | 09-11-1911 | Georgetown, SC | GCW | 04-25-1917 | Georgetown, SC |
| 4R | 01-06-1913 | Georgetown, SC | GCW | 04-25-1917 | Georgetown, SC |
| 4P | 04-25-1917 | Georgetown, SC | J&H | 12-14-1920 | New York, NY |
| 4P | 04-25-1917 | Georgetown, SC | J&H | 09-23-1923 | Albany, NY |
| 4P | 09-23-1923 | Albany, NY | JEM | 12-27-1923 | Albany, NY |

License #: P= Permanent license; R= Renewal license; T = Temporary license

Owner:
PH = Patrick Hickey, Brooklyn, New York
GRMC = Georgetown Rice Milling Company, Georgetown, South Carolina
GCW = Georgetown Chemical Works, Georgetown, South Carolina
J&H = C.S. Juell and C.S. Haight, Georgetown, South Carolina
JEM = John E. Matton, Waterford, New York

*Table 5.* Licenses issued to the steam tugboat *Henry Lloyd* (1880-1923).

| LICENSES ISSUED TO *U.S. LA VALLEE* | | | | | |
|---|---|---|---|---|---|
| **License Number** | **Date Issued** | **Place Issued** | **Owner** | **Date Surrendered** | **Place of Surrender** |
| 7P | 12-27-1923 | Albany, NY | JEM | 07-25-1929 | Albany, NY |
| J2 P | 07-25-1929 | Burlington, VT | JEC | 06-16-1931 | Burlington, VT |

License #: P = Permanent license

Owner: JEC = James E. Cashman, Inc., Burlington, Vermont
JEM = John E. Matton, Waterford, New York

*Table 6.* Licenses issued to *U.S. La Vallee* (1923-1931).

| MASTERS OF *U.S. LA VALLEE* | | |
|---|---|---|
| **NAME** | **BEGINNING DATE** | **END DATE** |
| David G. Roberts | 9-21-1923 | 12-27-1923 |
| John E. Matton | 12-27-1923 | 05-14-1924 |
| Robert Ernest McAuliffe | 05-14-1924 | 05-29-1924 |
| Clayton H. Godfrey | 05-29-1924 | 12-16-1925 |
| Henry P. Stewart | 12-16-1925 | 06-28-1927 |
| Clarence E. McIntyre | 06-28-1927 | 03-30-1928 |
| John E. Matton | 03-30-1928 | 07-25-1929 |
| John Fleury | 07-25-1929 | 06-16-1931 |

*Table 7.* Masters of the steam tugboat *U.S. La Vallee* (1923-1931).

# GEOLOGICAL FIELD RESULTS

### *Geological Findings*

The 1996 Lake Survey obtained side scan sonar images of approximately 110.6 $km^2$ (42.7 $mi^2$) of Lake Champlain's bottom, including a vast quantity of information concerning the geology and hydrology of Lake Champlain. The results of the geological data are very preliminary at this time, since many of the features cannot be fully interpreted without further research and the production of a mosaic of the sonar data. This effort will involve a number of detailed studies conducted by dozens of researchers.

Following the conclusion of the 1996 field season, the survey team began to analyze all of the accumulated data. At Middlebury College, researchers are selectively processing some of the geological information and creating a mosaic of the lake floor in Cumberland Bay, adding new information about the lake's dynamics in the Plattsburgh area.

Six lake bottom sediment types were identified during the 1996 side scan sonar survey, namely tailings, lineations, furrows, pockmarks, sediment waves, rock outcrops, and rock ridges. Each of these structures generated a distinctive image on the side scan sonar records. Sedimentary bedforms are created when there is a change in the transport rate of sediment carried by the bottom current. This change is normally caused by lake bottom irregularities already present in the geology or by submerged cultural features. Varying the speed or the type of the sediment carried by the bottom current forms different types of sedimentary features. Each of the geological features located during the survey is briefly discussed below.

### *Tailings*

Sediment tailings exist in the mud-dominated sections of Lake Champlain. Aligned with the direction of the water currents, they form down current behind obstacles that protrude above the bottom. As the water flow is directed around the obstacle, a low flow region is generated in the wake of the obstacle, allowing sediment to be deposited. Thus, sections containing tailings are regions of deposition and indicate bottom current directions.

### *Lineations*

The bottom currents form lineations as they remove fine-grained sediments and align the coarse-grained sediments in strips parallel with the bottom current. These features appear on side scan sonar images as parallel black and white linear streaks.

### *Furrows*

Sediment furrows are long, narrow, trough-shaped depressions that form parallel to the mean current direction. These features differ from lineations in that they have sharp, well-defined trough walls. An extensive field of furrows was located and mapped to the east of Valcour Island. Tuning fork patterns show that bottom water flow direction is predominately from the southeast to the northwest in this area.

### *Pockmarks*

Pockmarks are conical depressions found in the lake bottom. Though nesting fish create many of the smallest pockmarks, large pockmarks greater than 1 m (3 ft) are believed to be formed as a result of gas or fluid moving upward through the lake's bottom sediments. This upward flow causes sediment re-suspension and effectively removes the fine-grained sediments, leaving only medium and coarse-grained sediments behind. The entire process effectively condenses the central region, causing the depression or pockmark. Pockmarks appear on side scan sonar images as a circular or oblong shape with a semicircular band of black closest to the sonar fish, indicating that no acoustic energy is being returned. This image is located next to a semicircular band of white farther from the towfish, noting that acoustic energy is returned from the farthest wall of the depression.

Many of the surveyed areas contained pockmarks; the Cumberland Bay region, however, had areas of very large pockmarks, some having diameters as large as 40 m (130 ft). This region is experiencing some upward migration of groundwater along what appeared to be faults in the bedrock underlying the sediment.

### *Sediment Waves*

Sediment waves are regular undulations found on the lake bottom where bottom currents are strong enough to remobilize the bottom sediments. The crests and troughs of sediment waves align themselves perpendicular to the direction of the bottom currents and can thus be used as directional indicators. Images of sediment waves appear as alternating dark and white parallel bands on a side scan sonar image.

Most sediment waves are often associated with projections above the lake bottom, such as rock outcrops or cultural features. Objects protruding from the lake floor obstruct the normal bottom current and generate a flow that can create these bedforms. Sediment waves are generally classified into distinct groups by size, orientation, and symmetry.

### *Bedrock Outcrops and Ridges*

An unexpected find of the survey were high standing bedrock outcrops and ridges not previously mapped. These rock ridges caused local depths to decrease by as much as 50 m (165 ft) in a matter of 100 to 200 m (325 to 650 ft) in distance. The ridges are clearly part of the underlying bedrock of the lake, and mapping them will be beneficial for Lake Champlain fisheries and future research operations. The geology of these features is currently unknown.

### *Valcour Island, New York*

The survey located large sedimentary furrows to the east of Valcour Island. These longitudinal lake bottom features are regularly spaced grooves, oriented parallel to the dominant bottom current direction. Formed in fine-grained cohesive sediments, furrows are generally 2 to 3 km (1 to 2 mi) in length and have spacing ranging from 10 to 350 m (30 to 1150 ft) and widths ranging from 1 to 150 m (3 to 500 ft). Previous studies on furrow formations have shown that large secondary circulation cells in the bottom boundary layer of the water column initiate furrows and preferentially concentrate coarser materials in long linear depressions.

The lake's bottom currents transport sediments in several different ways, depending on their size and the speed and turbulence of the bottom currents. Fine-grained sediments such as clay and silt are transported in suspension within the water column. These particles move great distances without settling due to the turbulence of the bottom currents. Sand-size particles, too heavy for suspended transport, are moved by a process known as saltation, in which the sand-sized grains bounce or hop along the bottom of the lake in the direction of the bottom currents. The energy needed for a sediment particle to leave the lake bottom is supplied by hydraulic lift or by already saltating sand grains striking stationary sand grains. Saltating grains remain close to the lake bottom. The process of saltation is unable to move heavier particles of very coarse sand and gravel, which slide or roll down current by a process known as traction.

As the finer-grained sediments are picked up by the bottom currents and transported away, the heavier coarse-grained sediments settle, and the reduced volume of sediment created by the missing fine sediments generates a trough. These troughs continue to grow during intervals of strong abrasive current flows or abate and fill in during weaker current flows. Once established, however, furrow troughs can reinforce the position of a secondary circulation as well as continue to widen and deepen as the coarse-grained material is effectively trapped on the furrow floor (Flood 1981 and 1983).

Previous side scan data near Valcour Island has shown that the longest furrow was 828.1 m (2715 ft) and the shortest, 23.4 m (76.7 ft). The average furrow length was 227.2 m (745 ft), while the average width was 3.2 m (10.5 ft), and depth, 1.7 m (5.6 ft). These furrows possess a northwest-southeast alignment and were related to the dominant bottom currents. High-speed bottom current events have been documented using an Acoustic Current Doppler system and can be directly correlated to periods of erosion within the furrow field (Luecke 1996, Manley et al. 1996). Thus, these features are actively forming on the lake bottom.

### *Cumberland Bay, New York*

Pockmarks were found throughout the Cumberland Bay area. With depths of up to 30 m (100 ft), pockmarks generally range in size from 1 to 200 m (3 to 650 ft) in diameter. Various processes are thought to create pockmarks, such as interference from a foreign body, differential rates of sediment compaction, change of composition of the sediments, and human interference. The most likely and widely accepted explanation for pockmark formation is the seepage of pore fluid, consisting of ground water or liquid rock, from the underlying sediment and bedrock. The pore fluid that is released from the bottom sediments to create pockmarks is generally of four types, including thermogenic gas, biogenic gas, hydrothermal gas, and ground water (Hovland and Judd 1988).

Regardless of the source of the seepage, the mechanism by which pockmarks form is thought to be consistent. First, an impermeable layer in the sediment stops pore fluid migration from below. In time, increased pressure from the captured gases or water creates a dome in the bottom sediments. The dome eventually loses its holding strength and erupts, and the column of gas or water escaping from the dome fluidizes the overlying sediment. As the sediment begins to settle out, the coarse-grained sediments are redeposited and the bottom currents carry away the fine-grained sediments.

An analysis of the pockmarks found within Cumberland Bay was undertaken in two locations. The first area located was 0.75 $km^2$ (0.29 $mi^2$) in aerial distribution, while the second area was 1.75 $km^2$ (0.68 $mi^2$). The pockmarks in the study areas averaged 20 m (65 ft) in diameter and 2 m (6 ft) in depth and were arranged along a linear trend that ran southeast to northwest. This orientation matches the tectonic fabric of the region's bedrock geology.

Three cores 7.6 cm (3 in) in diameter and ranging in length from 167 to 204 cm (65 to 80 in) were taken in the smaller pockmarked study area to investigate the formation of these pockmarks. Core 1 was positioned to obtain samples close to the edge of a pockmark; Core 2, within the intervening pockmark-free area; and Core 3, directly inside a pockmark. Core B, a comparison core with a length of 209 cm (82 in), was taken in Town Farm Bay in Charlotte, Vermont, an area without pockmarks, and used as a control reference.

Physical properties, magnetic susceptibility, conductivity, pore water chemistry, and grain size of the cores were measured. The core taken inside the pockmark (Core 3) showed distinctly different results than those taken outside the pockmark. Cores 1 and 2 exhibited different ranges than Core 3 for all of the measurements. As was suspected, the comparison core, Core B, was distinctly dissimilar to all three of the cores taken in Cumberland Bay. Core 3 had higher porosity and lower density than Cores 1 and 2. Cores 1 and 2 had very similar patterns of distribution, while Core 3 had a different distribution of depth dependent values. Magnetic susceptibility for Core 3 was much lower, almost half that of the values for Cores 1 and 2.

Conductivity and anisotropy were different in all three cores. Core 1 was consistently anisotropic and was more conductive in the transverse direction. Core 2 was similar to Core 1 in that it was anisotropic in the transverse direction but not as strongly so. Core 3 displayed a section of anisotropy that was comparable in strength to Core 1.

The pore water profiles were all quite similar between cores. Sodium and potassium depth profiles behaved in the expected advection-diffusion manner. Silicon exhibited a random scatter interpreted as being caused by the saturation point being reached. The magnesium and calcium depth profiles showed a systematic removal of the calcium and magnesium ions from the pore water.

When considering the linear distribution of the pockmarks, their alignment with tectonic faults, and the characteristics of the pore water, the current hypothesis regarding their origin is that these pockmarks were created by groundwater migrating upward through the lake bottom sediments. Further investigation will be necessary to determine if these features are presently active.

# PROJECT SUMMARY

### *General Conclusions*

Lake Champlain has one of the best-preserved collections of underwater cultural resources in North America. Sites already found in the lake reflect nearly every era of human history in the Champlain Valley, from the Paleo-Indian period to the present. Both natural factors and human actions, however, seriously threaten these irreplaceable prehistoric and historic resources. Effective management requires the accumulation of information about the location, number, type, and significance of these underwater sites in order to maximize their public benefits and to address the issues that are facing them. These issues include insufficient protective legislation and enforcement, natural physical processes, degraded water quality, looting, vandalism, recreational conflicts, overuse, and aquatic nuisance species.

At this time the most immediate threat to the underwater cultural resources of Lake Champlain are zebra and quagga mussels, non-native species inadvertently introduced to the Great Lakes in 1987 through the ballast water of a transatlantic ship. Zebra mussels have been present in Lake Champlain since 1993, and quagga mussels have been observed in the Erie Canal system, where they are spreading eastward. It is only a matter of time before they reach and infest Lake Champlain. These species of mussels threaten the lake's resources by obscuring them, by making their documentation and survey virtually impossible, and by physically degrading the resources through a mussel colony's weight and corrosive action.

Measures to halt this inevitability are currently being sought; but no effective means to protect underwater historic resources from the impact of these mussels has yet been found. An estimated fifty percent of Lake Champlain's historic shipwrecks lie within the mussel's prime habitat in 35 m (100 ft) of water or less and are therefore at risk of zebra mussel colonization. The remaining 50 percent, at depths greater than 35 m (100 ft), will be at risk of quagga mussel degradation. The primary goals of the 1996 Lake Survey were to locate archaeologically sensitive areas and large cultural features at least fifty years of age, to identify as many of these sites as possible, and to document them at some level before the opportunity is lost.

The first step in protecting Lake Champlain's submerged cultural resources is to know exactly what types of artifacts and sites are preserved on the lake floor. In order to prepare an effective, comprehensive management plan for these resources, we must first be aware of the types of sites that might be encountered. The Lake Survey has been designed to expand the inventory of Lake Champlain's underwater sites with this long-range purpose in mind. In addition to locating previously unknown submerged archaeological sites, the goal of Lake Survey planners is to generate a list of all vessel types that have appeared on Lake Champlain, as well as a computerized catalogue of all currently known sites. A list of large ocean and lake vessels has been generated for New York State (Brouwer 1990), but a more detailed compilation of New York and Vermont vessels on Lake Champlain in particular is currently underway.

Recruiting the assistance of the local recreational diving community is another logical step towards locating, identifying, and protecting Lake Champlain's cultural resources. Local divers spend thousands of hours each year scanning the lake bottom for interesting dive sites, and they often locate cultural resources. In many cases, however, these sites are not always reported to the appropriate state authorities, their information is not processed or studied, and they contribute nothing toward the advancement of current knowledge of the lake's history. Involving the dive community in the survey program and other related programs would not only lead more divers to report their archaeological discoveries, but would also foster a sense of community that would engender the protection, preservation, and study of the lake's irreplaceable cultural resources.

The recent formation of the Lake Champlain Basin Program has introduced a new era of cooperation between the states of Vermont and New York and private organizations where efforts to research and document the lake's resources are concerned. Vermont, New York, and, in some cases, the federal government have jurisdiction over sites in Lake Champlain. Funding and support, therefore, must be obtained from both federal and state governments as well as public and private organizations. The management plan for the lake's cultural resources must be developed as a joint document between these parties in order to make the study and preservation of the lake's cultural resources a cooperative endeavor.

The field component of the 1996 Lake Survey was divided into three stages: side scan sonar survey, diver survey, and ROV survey. The search phase of the project continued from June 3 to July 31, encompassing 22 days of scanning the lake floor for cultural resources. During this portion of the survey, the team scanned approximately 110.6 $km^2$ (42.7 $mi^2$) of the lake bottom and located over 300 geological and cultural targets, thirteen of which were shipwreck sites. The identification phase of the survey project determined that nine of these sites were previously unrecorded shipwrecks (Wrecks B-G, I-J, and L) and four were known shipwreck sites that have not yet been studied (Wrecks A, H, and K, plus one site reported by New York divers). Scuba divers completed preliminary investigations of five of these shipwrecks (Wrecks C, F, G, I, J), but the other sites (Wrecks A, B, D, E, H, K, L) lie beyond safe diving limits and await ROV investigation. The ROV survey could not be completed in 1996 but will be conducted as a part of the 1997 Lake Survey.

***Underwater Preserves***

Whatever the cause of a shipwreck, namely war, weather, navigational error, or intentional scuttling, shipwrecks offer the public a chance to explore Lake Champlain's history in an unparalleled and exciting way. Hundreds of divers visit the Vermont Underwater Historic Preserves each year, taking advantage of the opportunity to witness the lake's history firsthand. Visitation of the lake's shipwrecks already contributes toward Champlain Valley tourism; the impact of the Underwater Preserves on the region's economy will undoubtedly grow in the years ahead. Some of the wrecks located during the 1996 Lake Survey and other shipwreck sites throughout the lake would be excellent candidates for future inclusion in an underwater historic preserve system.

Out of the sites located in the 1996 Lake Survey, Wrecks C and G have previously been visited by a select number of divers from the Plattsburgh Bay area. Experience with Lake Champlain shipwrecks has demonstrated that diver visitation to known shipwrecks tends to increase significantly over time, as the divers who currently know the wrecks discuss their experiences and encourage other divers to visit the sites. If Wrecks C and G are left unmarked and untended, this predictable increase in diver activity each season may lead to serious damage to the sites as divers drop anchors onto the wreck or drag anchors across the lake bottom to find it. This type of damage will be far more devastating to the sites than the unintentional wear-and-tear that would occur if these sites and others are opened as underwater historic preserves. Well-intentioned diver traffic may eventually have some impact on each vessel's condition, but it will not be as destructive as the practice of dragging an anchor to locate a shipwreck site.

Before any shipwrecks can be opened to the public, however, a formal preserve feasibility study must be conducted for each site. Also, a long-term bi-state management plan between the appropriate agencies and institutions in New York and Vermont must be developed regarding the issues of cooperatively managing underwater preserve sites. The dive community has expressed an interest in assisting with the management of the lake's underwater historic preserves, so it is advised that the states involve them in any development of new preserve sites and management plans.

***Potential Contributions to the Region's Geological History***

Despite Lake Champlain's size, only limited studies have been completed on the lake's bottom morphology over the past thirty years. The 1996 survey documented significant sedimentary lake bottom features that had in some cases been identified during earlier surveys, but this new data will generate a better understanding of the bottom currents and pore fluid movement in localized regions around the lake. The features identified during the survey are important because they indicate interaction between lake sediments and bottom currents, as well as the significance of groundwater seepage into Lake Champlain in the survey area.

Side scan sonar also revealed several different geological features on the lake floor, namely sediment tailings, sediment waves, sediment furrows, pockmarks, bedrock outcrops, and bedrock ridges. Sedimentary features, both depositional and erosional, are created by current action on the lake bottom as sediment is redistributed along the lake floor. These features can thus provide information on bottom currents or even such issues as possible contaminant redistribution. The distribution and types of sedimentary features revealed during the side scan sonar survey indicate that portions of Lake Champlain have been or are being modified by bottom currents, making them important areas for possible re-suspension of bottom sediments.

Processes of erosion and deposition are clearly quite active in Lake Champlain. The presence of furrows, sediment waves, and pockmarks provides conclusive evidence of current redistribution of bottom lake sediments. These features, which indicate the re-suspension of sediments for the various bed forms, have been found in particular regions of Lake Champlain that are known to contain harmful toxins. The data acquired during the 1996 Lake Survey can be used to study the movement of groundwater entering Lake Champlain, the internal movements of the water and sediments in the lake, the lake's bathymetry, and the identification of bottom sediment types. These studies can potentially provide information about Lake Champlain that is available from no other source, especially with regard to pollution prevention and control and ecological preservation and restoration.

Selected side scan sonar records have been and are presently being digitally enhanced to better display both the cultural and geological features imaged by the sonar. This post-processing of the sonar data will be completed with the Vista software developed by Triton Industries. A mosaic of the pockmarks of Cumberland Bay was recently completed with this software as part of an undergraduate senior thesis at Middlebury College (North 1997). The results of North's work were presented at the spring student symposium sponsored by the Lake Champlain Research Consortium and at the Vermont Geological Society meetings in April 1997. Work on the furrow field east of Valcour Island will commence in the near future, and an updated bottom bathymetry map of the entire region surveyed in 1996 will also be generated.

### *1996 Lake Survey Archives and Repository*

The 1996 Lake Survey archives consist of field notes, the dive log, the navigation log, the project log, maps, printouts, video cassettes, photographs, photocopies and computer disks. These archives are currently being stored at LCMM's Nautical Archaeology Center (NAC). The NAC, which contains an archaeology/conservation laboratory, a research library, and a curation facility, meets the federal regulations for curation of federally-owned and administered archaeological collections (NPS 1991).

### *Conclusion*

The cultural resources of Lake Champlain provide a concrete link to the region's rich and diverse past. In addition, these submerged resources are playing an increasing role in contemporary society, demonstrating an economic, recreational, educational, and aesthetic value to the community. The lake's underwater resources complement the Champlain Valley's more accessible and recognizable resources, such as the region's historic structures and settlements, cultural landscape resources, archaeological resources on land, and traditional cultural properties. By mandate of federal and state laws, the public owns these historic treasures, and the public should take pride in preserving and managing them for future generations.

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# Appendices

# APPENDIX A: GLOSSARY

**Aft** Near or at the stern of a vessel.

**Barge** A large, unpowered, generally flat-bottomed boat towed by other craft and used as a freight-hauler or work platform.
**Bateau** (plural **bateaux**) A lightly-built, flat-bottomed, double-ended boat.
**Beam** A dimension measured from side to side of a vessel.
**Bilge** The lowest point of a vessel's interior hull.
**Boat** An open vessel, usually small and without decks, intended for use in sheltered water.
**Bow** The forward end of a vessel.
**Breakwater** A structure, usually made of stone or concrete, built to create a harbor or improve an existing one.

**Cabin** The living quarters of a vessel.
**Canal** A manmade waterway or artificially improved river used for navigation.
**Canal boat** A boxy vessel designed to travel in a canal system. This type of vessel has no means of propulsion and must be towed or pushed by another vessel.
**Ceiling** The internal planking of a vessel.
**Centerboard** A board or metal plate that moves vertically or pivots up and down in a slot in the keel; limits a vessel's lateral motion by increasing the surface area of the keel or keel plank.
**Chine log** A longitudinal timber at the angular junction of the side and bottom of a flat-bottomed vessel.
**Cultural resource** A nonrenewable historical resource such as archaeological sites, artifacts, and standing structures.
**Cutter** A single-masted fore-and-aft rigged sailing vessel with a running bowsprit, mainsail, and two or more headsails.

**Deadeye** A round or pear-shaped block pierced by several holes, used mainly to secure the standing rigging of a vessel.
**Deck** A platform extending horizontally from one side of a ship to the other.
**Deck beam** A timber mounted across a vessel from side to side to support the vessel's deck and provide lateral strength.
**Draft** The depth of a vessel's keel below the waterline when the vessel is loaded.
**Drift bolt** A cylindrical iron rod used to fasten ship timbers together; usually headed on one end and slightly larger in diameter than the hole into which it is driven.

**Edge-fastened** A shipbuilding technique used to attach the hull planks of a vessel together. The planks are set edge to edge and a hole drilled through them. Large iron bolts are driven then driven through the planks to hold them together.

**Floor timber** A frame timber that crosses the keel and spans the bottom of a vessel.
**Fore** Located toward the front of a vessel.
**Fore-and-aft** From stem to stern or from front to back; oriented parallel to the keel.

**Frame** A transverse timber or group of timbers that creates the skeleton of a vessel and to which the hull planking and ceiling are fastened.

**Galley** A shallow-draft vessel that is propelled by sails or oars.
**Gondola** A large, flat-bottomed, double-ended vessel propelled by oars or sails.
**Gunboat** see Gondola.

**Harbor** A safe anchorage, protected from most storms; may be natural or manmade; a place for docking and loading.
**Historic** The period after the appearance of written records for a given region. For the Champlain Valley this date is AD 1609.
**Hold** The lower interior part of a ship, where the cargo is stored.
**Hull** The structural body of a vessel, not including the superstructure, masts, or rigging.
**Hull plank** A thick board used to create the outer shell of a hull.

**Inboard** Toward the center of a vessel.

**Keel** The main longitudinal timber upon which the framework or skeleton of a hull is mounted; the backbone of a hull.
**Keel plank** A thick, central hull plank used in place of a keel.
**Keelson** An internal longitudinal timber, fastened on top of the frames above the keel for additional strength.
**Knee** An L-shaped timber used to strengthen the junction of two surfaces on different planes.

**Leeboard** One of a part of movable boards or plates attached to each side of a vessel to prevent slippage downwind.
**Longitudinal timber** A long timber that runs parallel to the length of a vessel.

**Mast** A large wooden pole that supports the sails of a vessel.
**Mast tabernacle** A timber assembly or housing that supports the mast at deck level. This feature was commonly used to support a hinged mast, like those used on sailing canal boats.
**Mooring** A permanent placement of an anchor, anchor chain, shackles, and buoy, necessary to anchor a vessel.
**Mud line** The intersection of a shipwreck's hull with the bottom's surface.

**Outboard** Outside or away from the center of a vessel's hull.

**Plank** A thick board used as sheathing on a vessel.

**Radeau** (plural **radeaux**) A flat-bottomed barge partially enclosed by inward sloping sides, propelled by both sails and oars, and carrying heavy guns.
**Reconnaissance survey** An initial inspection of an area for cultural resources.
**Rigging** Hardware and equipment that support and control the spars and sails of a vessel.

**Rudderpost** A vertical timber to which the rudder is attached.

**Sailing canal boat** A boxy vessel with one or two fore-and-aft rigged masts that could be lowered when the vessel entered a canal system.
**Schooner** A fore-and-aft-rigged sailing vessel with two or more masts.
**Sheer** The curvature of the deck from fore to aft, as seen from the side of the vessel.
**Sloop** A single-masted, fore-and-aft-rigged sail boat.
**Sloop-rigged canal boat** A boxy vessel with one fore-and-aft-rigged mast that could be lowered when the vessel entered a canal system.
**Spike** A large nail.
**Stanchion** An upright supporting post.
**Steamboat** A vessel propelled by a steam engine.
**Steamer** A vessel propelled by a steam engine.
**Stem** An upward curving timber or assembly of timbers attached to the forward end of the keel.
**Stern** The after end of a vessel.

**Tabernacle** A timber assembly or housing that supports the mast at deck level. This feature was commonly used to support a hinged mast, like those used on sailing canal boats.
**Tiller** A handle attached to the rudderpost to steer a vessel.
**Timber** In a general context, all wooden hull members, especially those that form the framework or skeleton of the hull.
**Towfish** The torpedo-shaped unit that houses the transmitter and receiver of a side scan sonar and is usually towed behind a vessel.
**Transom** The transverse part of the stern of a vessel.

**Underwater archaeology** The archaeological study of submerged cultural resources.
**Underwater cultural resource** A nonrenewable historical resource that partially or entirely lies below water, such as submerged prehistoric archaeological sites, artifacts, bridges, piers, wharves, and shipwrecks.

**Vessel** A watercraft, larger than a rowboat, designed to navigate on open water.

**Waterline** The intersection of the vessel's hull and the water's surface.
**Whaleboat** A double-ended, lightly-built boat that could be rigged with one or two masts but was primarily rowed.
**Wharf** A structure, parallel to the shore, for docking vessels.
**Windlass** A horizontal drum winch mounted on the bow of a vessel and supported by bitts or brackets; used for tasks such as hauling anchors, stepping masts, and moving cargo.

# APPENDIX B: ABBREVIATIONS

**AD**: *Anno Domini* (in the year of the Lord)
**AM**: *ante meridiem* (before noon)
**A&M**: Agriculture and Mechanics
**A.B.**: *Artium Baccalaureus* (Bachelor of Arts)
**A.S.**: Associates of Science

**B.A.**: *Baccalaureus Artium* (Bachelor of Arts)
**BC**: before Christ
**BFP**: *Burlington Free Press*
**BFPT**: *Burlington Free Press and Times*
**BP**: before present (1950)
**Bros.**: Brothers
**B.S.**: Bachelor of Science

**°C**: Celsius
©: copyright
**CA**: cooperative agreement
**c.**: circa
**CAA**: Clean Air Act
**CAC**: Citizens Advisory Committee
**cc**: carbon copy
**CFR**: Code of Federal Regulations
**cm**: centimeter
**CMS**: Champlain Maritime Society
**c/o**: care of
**CPR**: cardiopulmonary resuscitation
**CRWG**: Cultural Resources Working Group
**CTC**: Champlain Transportation Company
**Cult.**: cultural
**CWA**: Clean Water Act

**DC**: District of Columbia
**DGPS**: Differential Global Positioning System

**ed.**: edition
**e.g.**: *exempli gratia* (for example)
**EPA**: Environmental Protection Agency
**et al.**: *et alii* (and others)

**°F**: Fahrenheit
**ft**: feet
**FY**: fiscal year

**GIS**: Geographic Information Systems

**GPS**: Global Positioning System

**hp**: horsepower

**i.e.**: *id est* (that is [to say])
**in**: inch
**Inc.**: incorporated
**Inv.**: inventory

**kHz**: kilohertz
**km**: kilometer
**km$^2$**: square kilometers
**kmph**: kilometers per hour
**kW**: kilowatt

**LCBP**: Lake Champlain Basin Program
**LCMC**: Lake Champlain Management Conference
**LCMM**: Lake Champlain Maritime Museum
**LCT**: Lake Champlain Transportation
**LCTC**: Lake Champlain Transportation Company

**m**: meter
**MA**: Massachusetts
**M.A.**: *Magister Artium* (Master of Arts)
**mi**: mile
**mi$^2$**: square miles
**mph**: miles per hour
**Ms.**: manuscript

**NAUI**: National Association of Underwater Instructors
**n.d.**: no date
**NEIWPCC**: New England Interstate Water Pollution Control Commission
**No. or no.**: number
**NOAA**: National Oceanic and Atmospheric Administration
**NPS**: National Park Service
**NY**: New York
**NYDEC**: New York Department of Environmental Conservation
**NYED**: New York Department of Education
**NYOPRHP**: New York Office of Parks, Recreation, and Historic Preservation
**NYS**: New York State
**NYSM**: New York State Museum

**p.**: page
**PDR**: precision depth sounder
**Ph.D.**: *Philosophiae Doctor* (Doctor of Philosophy)
**pp.**: pages

**PM**: *post meridiem* (after noon)
**PO**: Post Office

**QA/QC**: quality assurance/quality control

**Re**: regarding
**Res.**: resources
**RFP**: request for proposal
**ROV**: remote-operated vehicle
**RR**: rural route
**RV**: research vessel

**SBRAs**: small businesses in rural areas
**SHPO**: State Historic Preservation Office

**TAC**: Technical Advisory Committee
**Tel**: telephone number
**TWA**: TransWorld Airlines

**U.S.**: United States of America
**USC**: United States Congress
**USGS**: United States Geological Survey
**USA**: United States of America
**UTM**: Universal Transverse Mercator

**VDEC**: Vermont Department of Environmental Conservation
**VDFPR**: Vermont Department of Forests, Parks, and Recreation
**VDHP**: Vermont Division for Historic Preservation
**VHF**: very high frequency
**Vol. or vol.**: volume
**VT**: Vermont

**WBE**: Women's business enterprise

# APPENDIX C: MEASUREMENT CONVERSION TABLE

| MEASUREMENT CONVERSION TABLE† | | |
|---|---|---|
| **Moving right multiply** | | **Moving left divide** |
| inch (in) | 2.540 | centimeter (cm) |
| inch (in) | 1/12 | foot (ft) |
| inch (in) | 1/36 | yard (yd) |
| foot (ft) | 30.480 | centimeter (cm) |
| foot (ft) | 0.305 | meter (m) |
| foot (ft) | 1/3 | yard (yd) |
| yard (yd) | 0.914 | meter (m) |
| mile (mi) | 1.609 | kilometer (km) |
| square mile ($mi^2$) | 2.590 | square kilometer ($km^2$) |
| acres | 0.404 | hectares |
| miles per hour (mph) | 1.609 | kilometers per hour (kmph) |
| Celsius temperature (°C) | multiply by 9/5 then add 32 | Fahrenheit temperature (°F) |
| Fahrenheit temperature (°F) | subtract 32 then multiply by 5/9 | Celsius temperature (°C) |

† Multiply when converting measurements from the left side of the chart to the right side of the chart. Divide when moving from the right to the left side of the chart, except in the case of temperature conversions. In this situation only move from the left to the right side following the directions presented. Most of these conversions are approximations of the true value (Morris 1982).

# APPENDIX D: TIME SCALES

## *Geologic Time Scale*

| GEOLOGIC TIME SCALE | | | | |
|---|---|---|---|---|
| **EON** | **ERA** | **PERIOD** | **EPOCH** | **BEGINNING DATE (BP)** |
| PHANEROZOIC | Cenozoic | Quaternary | Holocene | 11,000 |
| | | | Pleistocene | 1.6 million |
| | | Tertiary | Pliocene | 5 million |
| | | | Miocene | 24 million |
| | | | Oligocene | 37 million |
| | | | Eocene | 57 million |
| | | | Paleocene | 66 million |
| | Mesozoic | Cretaceous | Late | 97 million |
| | | | Early | 144 million |
| | | Jurassic | Late | 163 million |
| | | | Middle | 187 million |
| | | | Early | 190 million |
| | | Triassic | Late | 230 million |
| | | | Middle | 240 million |
| | | | Early | 245 million |
| | Paleozoic | Permian | Late | 256 million |
| | | | Early | 286 million |
| | | Pennsylvanian | | 320 million |
| | | Mississippian | | 360 million |
| | | Devonian | Late | 374 million |
| | | | Middle | 387 million |
| | | | Early | 408 million |
| | | Silurian | Late | 421 million |
| | | | Early | 438 million |
| | | Ordovician | Late | 458 million |
| | | | Middle | 478 million |
| | | | Early | 505 million |
| | | Cambrian | Late | 525 million |
| | | | Middle | 530 million |
| | | | Early | 540 million |
| PRECAMBRIAN | Proterozoic | Keweenawan | | 1 billion |
| | | Huronian | | 2.5 billion |
| | Archeozoic | Timiskaming | | 3.35 billion |
| | | Keewatin | | 4.6 billion |

***Basin Stage Time Scale***

| BASIN STAGE TIME SCALE | | |
|---|---|---|
| **EPOCH** | **LAKE STAGE** | **BEGINNING DATE (BP)** |
| LAKE CHAMPLAIN | Modern | 2000 |
| | Hypsithermal | 8000 |
| | Early | 10,200 |
| CHAMPLAIN SEA | Port Henry | |
| | Burlington | 10,800 |
| | Port Kent | 11,800 |
| | Pre-Port Kent | 12,000 |
| LAKE VERMONT | Fort Anne | |
| | Coveville | |
| LAKE ALBANY | | 13,000 |

***Prehistoric Native American Time Scale***

| PREHISTORIC NATIVE AMERICAN TIME SCALE | | | |
|---|---|---|---|
| **TIME PERIOD** | **SUBDIVISION** | **BEGINNING DATE (BP)** | **BEGINNING DATE** |
| CONTACT | | 400 | AD 1609 |
| WOODLAND | Late | 950 | AD 1050 |
| | Middle | 2100 | 100 BC |
| | Early | 2900 | 900 BC |
| ARCHAIC | Late | 6000 | 4000 BC |
| | Middle | 7500 | 5500 BC |
| | Early | 9000 | 7000 BC |
| PALEOINDIAN | | 11,300 | 9500 BC |

*Euro-American History Time Scale*

| EURO-AMERICAN HISTORY TIME SCALE | | |
|---|---|---|
| **TIME PERIOD** | **SUBDIVISION** | **BEGINNING DATE (AD)** |
| RECREATIONAL LAKE | Lake Champlain Management | 1990 |
| | Redevelopment of Lake Champlain's Shoreline | 1945 |
| COMMERCIAL | Downfall of Lake Commerce | 1875 |
| | Expansion of Railroads | 1849 |
| | Golden Era of Waterborne Commerce | 1823 |
| | Searching for a New Market | 1815 |
| POLITICAL INSTABILITY | War of 1812 | 1812 |
| | Settlement and Commercialization | 1781 |
| | Revolutionary War | 1775 |
| | Early Settlement | 1763 |
| | French and British Military Conflict | 1666 |
| | Exploration/ Contact | 1609 |

# APPENDIX E: REQUEST FOR PROPOSAL

**August 2, 1995**
**Lake Champlain Basin Program Underwater Cultural Resources Survey**
**Request For Proposals**

**PURPOSE:**

The Lake Champlain Management Conference (LCMC), in conjunction with its Technical Advisory Committee (TAC) and the Cultural Resources Working Group (CRWG), is soliciting proposals for an underwater cultural resources survey in Lake Champlain.

**BACKGROUND:**

Lake Champlain is considered by many to be the most historic body of fresh water in the Northern Hemisphere. Of singular importance are the lake's historic shipwrecks, believed to be the largest and most intact collection in North America. The extraordinary array of underwater archeological resources is the physical evidence of a long and varied history spanning more than 10,000 years.

Lake Champlain's underwater cultural resources are seriously threatened by the recent introduction of zebra mussels, a non-native nuisance species. Zebra mussels threaten submerged cultural resources not only by obscuring them, making inventory and survey impossible, but also by physically destroying the resources, which can collapse under the zebra mussel colony's weight and corrosive action. Mitigation measures are currently being sought; nevertheless, as of this writing, an effective means to protect underwater historic resources from the impact of zebra mussels has not been found. An estimated 50% of Lake Champlain's historic shipwrecks are at risk of zebra mussel colonization because they lie within the mussels' prime habitat.

The Lake Champlain Basin Program (LCBP) was established to coordinate the activities envisioned by the Lake Champlain Special Designation Act of 1990. The program is guided by a 31-member Management Conference, which is responsible for developing a pollution prevention, control, and restoration plan for the Lake Champlain basin. A statement of Legislative Intent, issued by Senators Leahy, Moynihan, Jeffords, and D'Amato, charges the Management Conference to "examine the impact of water quality degradation, as well as mitigation efforts, on cultural resources that are an important part of the region's history." The Statement continues, encouraging the Secretary of the Interior, acting through the National Parks Service, to "consult with the Management Conference in carrying out historic preservation and natural landmark programs with the basin. Of special interest is the survey and inventory of lakeshore and underwater historical and archeological resources."

A draft of the pollution prevention, control, and restoration plan, commonly known as The Plan, was released in October 1994. One action addressed in the

Cultural Resources chapter is to "develop and implement a [bi-state] management strategy for Lake Champlain's underwater historic resources." The Plan was released in October 1994. One action addressed in the Cultural Resources chapter is to "develop and implement a [bi-state] management strategy for Lake Champlain's underwater historic resources." The first phase of this action is to identify and inventory resources. In its FY '95 budget, the Lake Champlain Management Conference allocated $30,000.00 of EPA funding to survey underwater cultural resources.

**PROJECT AREA:**

Lake Champlain

**PROJECT GOALS:**

Design a bi-state underwater cultural resource survey form to assure consistent documentation and evaluation of resources.

Field survey and inventory previously undocumented underwater cultural resources in New York and Vermont waters.

Prepare a survey report that maps all areas surveyed and includes recommendations for protecting and managing these resources, including, but not limited to, additional inventory; additional research and documentation; National Register nomination; development of Underwater Historic Preserves; development of other public access, interpretation, and education programs; recovery, conservation, and public exhibition of particular artifacts; reburial of artifacts; site monitoring programs; zebra mussel mitigation measures, as they become known. Site locations are confidential and will not be included in publicly distributed reports.

Accurately map all recorded resources both on USGS topographical maps and lake charts following New York and Vermont SHPOs QA/QC procedures. These maps will be provided to the VDHP, NYOPRHP, NYDEC, and NYS Museums. Site locations will also be recorded in digital form.

**PERFORMANCE EXPECTATIONS:**

All work will meet the *Guidelines for Conducting Archeological Studies in Vermont*, *New York Archeological Council Standards*, and the *Secretary of the Interior's Standards and Guidelines for Archeology*. A principal investigator must be 36 CFR 61 qualified.

**PRODUCTS:**

1) A Methodology and Project Schedule

The project will be planned and implemented in conjunction with a Project Advisory Team that includes one or more representatives from the Vermont Division for Historic Preservation (VDHP); the New York State Office of Parks, Recreation, and Historic Preservation (NYOPRHP); the New York Department of Environmental Conservation (NYDEC); the New York State Education Department; the Vermont Department of Environmental Conservation (VDEC); and the LCBP Technical Advisory Committee (TAC).

2) Quarterly Progress Reports submitted to the Project Advisory Team

3) Survey Reports

A draft survey report that includes a summary of results and recommendations as outlined above will be submitted to a Project Advisory Team for review and comment. The Advisory Team will have 30 days for this review. The comments of the Advisory Team will be incorporated into a final report, to be completed by 30 days following return of the draft report to the contractor. Fifty (50) copies of an Executive Summary will be prepared for broad distribution.

4) Site Survey Forms

Site survey forms will be completed for all confirmed underwater historic sites. Appropriate VT or NY State Site Survey forms will be completed as per relevant site locations, and will be submitted to VDHP, NYOPRHP, NYDEC, and NYS Museums, accordingly.

5) Presentation of Findings

The consultant will present project findings and recommendations to the Lake Champlain Management Conference, the Technical Advisory Committee, and the Cultural Resources Working Group.

6) Article

The consultant will submit an article to the Lake Champlain Basin Program Public Education/Outreach Coordinator for publication in the official newsletter.

7) Press Release

The consultant will submit a press release about the project goals and results to the LCBP Public Education/Outreach Coordinator for distribution to newspapers in New York and Vermont.

**PROJECT DURATION:**

12 months

**PROJECT SCHEDULE:**

Proposals Due - At the Lake Champlain Basin Cultural Heritage Office in Crown Point, NY by 4:00 PM, twenty-six (26) calendar days from the date of this release.

Notification of Successful Applicant - The Management Conference's Technical Advisory Committee expects to make its recommendation to the Management Conference on or about September 7, 1995.

Draft Survey Report - Due July 1, 1996

Final Report - Due August 31, 1996

**BUDGET:**

The project is to be accomplished with a federal budget not to exceed $30,000.00.

**MATCHING CONTRIBUTIONS:**

A matching contribution of 25% is required by the Special Designation Act. It may be in either funds or in-kind services. Budget proposals should clearly document the intended use(s) and source(s) of such contributions. Federal funds may not be used as a source of matching funds.

Use the following formula to calculate the match:
(Federal $ @ 75%) - Federal $ = Match
For example, if the Federal amount is $30,000, the match amount would be $10,000. $30,000 @ 75% = $40,000 $40,000 - $30,000 = $10,000

**CRITERIA FOR SELECTION OF PROPOSAL:**

Proposals will be evaluated according to the following criteria (roughly in order of importance):

- Clarity and conciseness of proposal. Relevance of the proposal to the project goals
- Documented past performance, including demonstrated ability of project personnel to perform underwater archeological surveys and complete survey documentation in a timely fashion
- Quality of prior contributions to issues relevant to the tasks
- Knowledge of Lake Champlain Maritime history
- Knowledge of zebra mussel impact issues
- Discussion of how survey area will be prioritized and selected
- Public education element(s)
- Cost, relative to alternatives, for the task
- Discussion of types of ancillary data (i.e. bathymetry, bottom type, etc.) that may be obtained as part of this project without additional cost to the project.
- Utilization of businesses owned by women or minority groups is encouraged
- Institutional support, including ability to provide matching funds
- Ability to complete project within stated time frame

**REQUIREMENTS FOR PROPOSAL SUBMISSION:**

Original plus (10) copies of all proposals must be received by the Lake Champlain Basin Program Cultural Heritage Office no later than 4:00 PM, 26 calendar days from the date of this release. Proposals, excluding all supporting materials, must not exceed (5) PAGES IN LENGTH. Proposals should include the following: (1) a narrative statement directly addressing the scope of the work plan and elaborating the study design and methods to be employed, and the anticipated results and (2) a budget proposal describing the proposed use of federal funds and matching contributions. Recent resumes of principal team investigators, showing qualifications relevant to the proposed study must be appended to the proposal.

**Please send proposal and direct all questions to:**

**Ann Cousins**
**Lake Champlain Basin Cultural Heritage Office**
**RR 1 Box 220, Bridge Road**
**Crown Point, New York 12928**
**Tel: 518-597-4212**

**PROPOSAL SELECTION PROCESS:**

The Management Conference will select proposals for funding based on the recommendations of the Proposal Selection Committee. All reviews will be consistent with EPA policy regarding conflict of interest found at 40 CFR 30.613. Reviewers will not be associated with an institution submitting a proposal.

**OTHER IMPORTANT INFORMATION AND REQUIREMENTS:**

Reporting Requirements: Investigator will be required to report in writing to the Project Advisory Team on a quarterly basis and verbally as required. The

Underwater Cultural Resources Survey Report must meet the procedural requirements of the VDHP and NYOPRHP.

Public Participation: Education and outreach are an important part of the Lake Champlain Basin Program. There should be one or more public education element(s) in the proposal, with a minimum requirement of press releases, which will be developed with the Basin Program Office. These will explain the goals and the findings of the work. Additional ideas for public education and outreach will be looked upon favorably.

Preparation of Contract: After the Management Conference selects a proposal for award, the investigator will work with NEIWPCC to complete a contract. The investigator may be required to submit additional details or modify technical and budgetary aspects of the proposal.

# APPENDIX F: PROPOSAL

August 28, 1995

**Underwater Cultural Resources Survey**

This proposal is submitted in response to the RFP authorized by the Lake Champlain Management Conference, in conjunction with its Technical Advisory Committee and the Cultural Resources Working Group, for an underwater cultural resources survey in Lake Champlain. It is the desire of the Lake Champlain Maritime Museum at Basin Harbor, Vermont, to bring together a team of experienced researchers to implement the goals outlined in the RFP. The Lake Champlain Maritime Museum possesses the technical and archaeological expertise to locate, survey, and develop a comprehensive management plan for the resources yet to be discovered. A systematic lake-wide survey has been a long-term goal of the Maritime Museum. We intend to use this underwater cultural resources survey as a major step in fulfilling that goal.

In the past twenty years, historians and maritime archaeologists have discovered that Lake Champlain holds North America's most extraordinary collection of historic shipwrecks. The presence of this vast number of archaeological sites provides a new conduit into the historical record and, with proper study, potential for better understanding out past.

The study, interpretation, and management of this lake bottom preserve gave rise, in 1980, to the Champlain Maritime Society, a bi-state, citizen-based effort focused on the preservation of this special legacy. By 1986, the success of the Champlain Maritime Society and increasing realization of just how significant and unexplored this underwater collection was led to the establishment of the Lake Champlain Maritime Museum at historic Basin Harbor. The museum is dedicated to preserving the heritage of the Champlain Valley and sharing it with the public. Over the past decade the museum has seen a remarkable rate of growth, a direct reflection of the lake's historical and archaeological significance and the public's interest in this topic.

Over the past twenty years, the team at the Lake Champlain Maritime Museum has been surveying the lake bottom and has located dozens of shipwrecks. The underwater projects have documented Native American dugout canoes, French and British naval ships (c. 1758-59), American and British naval vessels, canal boats, and even a horse-powered ferry (c. 1825). While the lake's cold water and variable depths and visibility present a challenging working environment, they also create a relatively stable world for these wooden time capsules. For this reason, the lake turns out to be one of the best possible laboratories for training in archaeological documentation. The Maritime Museum currently sponsors an annual nautical archaeology field school training program in conjunction with the University of Vermont and Texas A&M University. Thus far we have examined only a small percentage of the lake's bottomland.

During the last decade the technology used to survey the lake has made quantum leaps. Recent improvements in sonar techniques and navigational control systems give us the capability to systematically examine and image the entire lake bottom and determine the number and variety of shipwrecks and other cultural sites located there. The proposed field survey will be an intensive remote sensing examination of a portion of the lake's bottom. Museum historians, utilizing archival records, have identified several sites, which have not yet been located. The survey will target these sites, concentrating on the shallow waters due to the greater incidence of zebra mussels. State-of-the-art side scan sonar will be utilized to examine the lake bottom and identify potential targets of cultural origin. This survey will also utilize a Differential Global Positioning System (DGPS) for navigation and site plotting. This is a major new advance over the earlier and less accurate Loran C System. All cultural resources located during the survey will be precisely mapped on both USGS topographical maps and lake charts following New York and Vermont SHPO's QA/QC procedures. These maps will be provided to the VDHP, NYOPRHP, NYDEC, and NYS museums.

For the field survey phase of the project we plan to utilize two surface support vessels, the 40-foot R/V *Neptune* and a 17-foot inflatable dive boat. The larger vessel will be used as the platform for the remote sensing survey.

A Klein 595 side scan unit, with 100 kHz and 500 kHz capability, will be one of the primary investigative tools. In addition to the paper record generated by the side scan sonar, the data will be recorded continuously on magnetic tape, which can be duplicated and archived in a number of locations. During the post-project data processing, portions of the record (the archaeological targets) can be digitized and computer enhanced, and sonar mosaics of selected areas can be produced.

A specific target verification component will work along with the electronic survey. Priority targets identified by sonar will be located and examined by experienced divers. In relatively shallow waters (0-100'), experienced divers will provide preliminary evaluation of the targets' origin, condition, and significance using National and State Register criteria. In deeper waters (over 100'), targets will be examined by a remote-operated vehicle (ROV) that will provide the preliminary evaluation. The Lake Champlain Maritime Museum, in conjunction with the VDHP and the NYOPRHP, will collaborate on the design of a bi-state cultural resource survey form to assure consistent documentation and evaluation of resources. The survey form will meet the procedural requirement of both agencies.

All work performed will meet the *Guidelines for Conducting Archaeological Studies in Vermont*, the *New York Archaeological Council Standards*, and the *Secretary of the Interior's Standards and Guidelines for Archaeology*. The principal investigator, Arthur Cohn, is 36 CFR 61 qualified.

The presence of a collection of shipwrecks scattered along the bottom of Lake Champlain gives us the potential to add greatly to the historical and archaeological record of the lake, while raising the important issue of resource management. In 1985

Maritime Museum Director Art Cohn assisted the Vermont Division of Historic Preservation in developing its Underwater Historic Preserve System. This innovative program selected several shipwreck sites and, through the installation of Coast Guard-approved seasonal moorings, provided safe diver access. The underwater preserves are designed to provide divers with a museum-like interpretive experience; fostering among the diving community a protective rather than exploitative approach. Since 1985, Art has been the coordinator of the Underwater Historic Preserve Program for the Vermont Division of Historic Preservation and, in that capacity, oversees the opening, closing, and monitoring of the sites. Each underwater cultural resource site presents a different set of conditions, and each must be considered for inclusion into a Preserve program on its own merit. Recommendations will be based on archaeological fragility and sensitivity, depth, bottom conditions, boat traffic, and accessibility.

A new and profoundly disruptive phenomenon has recently occurred in Lake Champlain, the zebra mussel. The presence of this non-native invader makes developing an accelerated lake survey and documentation program much more urgent. In February 1995, the Lake Champlain Maritime Museum was selected to identify the effects of zebra mussels on underwater historic shipwrecks, and compare available methods for protecting and treating these resources. The Maritime Museum sent delegates to the 5th annual Zebra Mussel Conference in Toronto, Canada. The delegates were charged with producing a comprehensive report that would present an overview of all known information about the potential impact of zebra mussels on historic shipwrecks, and known protection and treatment options, and make recommendations about the implications of zebra mussels to the lake's historic shipwrecks.

The Maritime Museum is currently working with the joint New York/Vermont Department of Environmental Conservation Zebra Mussel Monitoring program. Through the museum's influence, two shipwreck sites have been included in the monitoring program. The additional sites significantly expand the database that the States of Vermont and New York are compiling (with LCBP funding) about veliger (zebra mussel juveniles) distribution and density. The museum has established a water analysis laboratory to test for the presence and density of the microscopic zebra mussel veligers. The facility is staffed by a lab technician/educator (funded by LCBP) who performs the dual role of analyzing the water samples as well as interpreting for the public the issues surrounding zebra mussels and what can be done to slow their spread to other Vermont Lakes. Museum visitors are oriented to basic water quality testing and are helped to make the connection between zebra mussels, historic shipwrecks, and the Lake's ecosystem.

The Lake Champlain Maritime Museum is dedicated to sharing information about the lake's history, the process of nautical archaeology, and historic preservation with the widest possible audience. We have existing relationships with Vermont and New York divisions of historic preservation, local historical societies, museums, universities, colleges, and grade schools, and feel confident we would be able to design an effective method of sharing this program with a broad audience. We anticipate a number of volunteers from both Vermont and New York working directly with the project.

We recognize and applaud the Lake Champlain Management Conference's high priority on public education efforts regarding lake issues. Referring to the guidelines presented in "Incorporating a Public Education Component into Lake Champlain Management Conference Research and Demonstration Grants," we intend to implement all five methods/means of informing and involving the public. The museum staff anticipates working with the Vermont Division for Historic Preservation, the New York Bureau of Historic Sites, and Lake Champlain Management Conference staff to insure that the public information, education, and outreach program is an effective one.

A final technical project report will be prepared that meets the *Secretary of the Interior's Standards and Guidelines for Archaeology* and the *Guidelines for Conducting Archaeological Studies in Vermont* and the *New York Archaeological Council Standards*. A draft project report will be submitted to the Project Advisory Team for review and comment. A list of all targets as well as charts which show their locations will be produced. Issues related to site/target sensitivity will dictate how much of this information is included in the final report.

The report, as specified in the RFP, will contain a series of recommendations, which address issues relating to the management and protection of any submerged resources located during the survey. Issues relating to the recovery, conservation, and public exhibition of specific underwater properties will be discussed; recommendations relating to underwater signage and monitoring of archaeologically sensitive areas; the need for any additional National Register or National Landmark designation to specifically include the underwater areas; issues of public access as it relates to the Federal Abandoned Shipwreck Act of 1987; a discussion of issues relating to the establishment of additional underwater historic preserve sites; suggestions about the need for additional inventory, research or documentation of specific underwater properties and future sources of funding for any additional recommended work, protection, or interpretation.

# APPENDIX G: QUALITY ASSURANCE PLAN

## Quality Assurance Project Plan
## for Underwater Cultural Resource Survey

**Prepared for:**

United States Environmental Protection Agency
Region 1, John F. Kennedy Federal Building
Boston, Massachusetts

**Prepared by:**

Lake Champlain Maritime Museum
RR#3, Box 4092 Basin Harbor Road
Vergennes, Vermont 05491

**Project Title:**

Lake Champlain Basin Program Underwater Cultural Resources Survey

**Background:**

Lake Champlain is considered by many to be the most historic body of fresh water in the Northern Hemisphere. Of singular importance are the lake's historic shipwrecks, believed to be the largest and most intact collection in North America. This extraordinary array of underwater archaeological resources is the physical evidence of a long and varied history spanning more than 10,000 years.

Lake Champlain's underwater cultural resources are seriously threatened by the recent introduction of zebra mussels, a non-native nuisance species. Zebra mussels threaten submerged cultural resources not only by obscuring them, making inventory and survey impossible, but also by physically destroying the resources, which can collapse under the zebra mussel colony's weight and corrosive action. Mitigation measures are currently being sought; nevertheless, as of this writing, an effective means to protect underwater historic resources from the impact of zebra mussels has not been found. An estimated 50% of Lake Champlain's historic shipwrecks are at risk of zebra mussel colonization because they lie within the mussel's prime habitat.

The Lake Champlain Basin Program (LCBP) was established to coordinate the activities envisioned by the Lake Champlain Special Designation Act of 1990. The program is guided by a 31-member Management Conference, which is responsible for developing a pollution prevention control and restoration plan for the Lake Champlain basin. A Statement of Legislative Intent, issued by Senators Leahy, Moynihan, Jeffords, and D'Amato, charges the Management Conference to "examine the impact of water quality degradation, as well as mitigation efforts, on cultural resources that are an important part of the region's history." The Statement continues, encouraging the Secretary of the Interior, acting through the National Parks Service, to "consult with the Management Conference in carrying out historic preservation and natural landmark programs with the basin. Of special interest is the survey and inventory of lake shore and underwater historical and archaeological resources."

A draft of the pollution prevention, control and restoration plan, commonly known as The Plan, was released in October 1994. One action addressed in the Cultural Resources chapter is to "develop and implement a [bi-state] management strategy for Lake Chaplain's underwater historic resources." The first phase of this action is to identify and inventory resources. In its FY '95 budget, the Lake Champlain Management Conference allocated $30,000.00 of EPA funding to survey underwater cultural resources.

**Project Description:**
The Lake Champlain Maritime Museum has been asked to organize a side scan sonar survey in Lake Champlain. We have chosen an area in the greater Valcour Island, New York/Grand Isle, Vermont region, because of its significant historic associations. In response to the Lake Champlain Basin Program's project goals, we intend to survey as much of the lake bottom as possible, while still maintaining good quality control procedures. Our primary function is to survey and inventory previously undocumented underwater cultural resources in New York and Vermont waters. We will also be developing a new bi-state underwater cultural resources survey form to assure consistent documentation and evaluation of resources. The results of our survey will be presented in a survey report that indicates all areas surveyed and includes recommendations for protecting and managing these underwater resources. It will include recommendations regarding additional research and documentation; potential for nominating specific sites to the National Register; the feasibility of including any of these sites in an underwater historic preserve program; the potential of other types of public access; the development of interpretive and education programs; the feasibility and cost benefit value of recovery, conservation and public exhibition of particular artifacts; the potential need for site monitoring programs; and a review of current zebra mussel mitigation measures as they currently exist.

**Schedule of Operations:**

| | |
|---|---|
| Mobilization date: | June 3, 1996 |
| Location: | Burlington, Vermont |
| Planned survey duration: | Approximately 15 days |
| Verification of target phase: | June 21 through 25, 1996 |
| Demobilization date: | June 25, 1996 |
| Draft survey report form: | October 31, 1996 |
| Final report: | December 31, 1996 |

On Monday, June 3, at approximately 0900 hours, the R/V *Neptune* will depart Burlington, Vermont, with the principal investigators and crew for this survey. We expect to arrive in our survey area later that morning and will immediately begin operations. Operations will continue for the next 18 days with the plan to work with the weather and wind conditions so as to maximize the amount of area surveyed.

**Survey Methodology and Equipment**
Our experienced crew will be utilizing as our primary survey tool a Klein Model 595 dual frequency side scan sonar system mounted aboard the R/V *Neptune*. The side scan data for both the 100 kHz and 500 kHz channels will be stored on a Triton ISIS data recorder. A printed hard copy will also be developed from the Klein thermal-printing unit. Our plan is to operate on a range setting of 100 meters per side (or examination of a 200 meter swath), with each survey transect overlapping our previous survey transect. We will be stepping over 150 meters and overlapping a total of 50 meters, thereby assuring complete coverage of our survey area. Boat speed will be approximately 4 knots. Confidence in coverage is generated when we add the navigational control system to our survey, which in this case will be a North Star 941X differential GPS (Global Positioning System). This primary system is backed up with a Raytheon Loran-C navigation system and an electronic Fluxgate compass. It has been our experience that with this type of navigational control and continuously visible track lines, our movement off the pre-planned survey transect is very modest. Should any gaps appear in the survey lines, these will be re-done. In addition the R/V *Neptune* is equipped with a Raytheon R40 Raster Scan radar system. This system has a 24-mile range and is designed to interface with the GPS, Loran-C, and electronic compass systems. Navigational information from these systems can be displayed on the radar screen simultaneously with the radar information. These systems are further enhanced by their interface with the R/V *Neptune*'s video plotter and computer for visual display and storage of navigational information. As the survey progresses, all targets will be logged and inventoried for future examination. We will determine cable length and layback based on the changing depth within our survey area. The Project Director, in conjunction with the captain and sonar operators, will make all final decisions regarding number, location of transects to be surveyed and the appropriate overlaps based on current conditions.

Our data storage system is the Triton ISIS, a full-functioned system that acquires, stores, and processes side scan sonar signals. The system digitizes the signals and combines the sonar imagery with navigation inputs. The result of this capability is the geocode of all sonar images that are displayed and the additional ability to enhance the digital images for better image interpretation. The actual side scan sonar operation is improved with the ISIS system as the system allows the operator of the sonar to manipulate the time varied gain thresholding and to adjust speed and correct for slant range to improve image quality. The ISIS system also stores the sonar data for post survey processing of the sonar information. The ISIS also automatically stores a database of target information in real time with all the navigational information on targets for post survey analysis.

**Verification Phase**
At the conclusion of the sonar survey portion of this project, a priority list of potential cultural resource targets will be developed and a verification process will be undertaken. The verification of targets will be done both by experienced archaeological divers working in shallow water (100 ft or less) or by a Benthos Open Frame ROV (Remote Operated Vehicle) operated by experienced Benthos personnel. Targets will be located

and identified and, based on their significance, recorded. The information about each site will be transferred to a newly developed bi-state cultural resources inventory form as well as analyzed in the final report. Archaeological procedures will meet the *Guidelines for Conducting Archaeological Studies in Vermont*, the *New York Archaeological Council Standards*, and the *Secretary of the Interior's Standards and Guidelines for Archaeology*.

**Scientific Party**

Arthur B. Cohn - Project Director, Principal Investigator, Lake Champlain Maritime Museum

Frederick Fayette - Captain, R/V *Neptune*; Co-Principal Investigator, Lake Champlain Maritime Museum

Peter Barranco - Navigation Specialist, Co-Principal Investigator, Lake Champlain Maritime Museum

Dr. Patricia Manley - Sonar Operator, Co-Principal Investigator, Middlebury College

Dr. Thomas Manley - Sonar Operator, Co-Principal Investigator, Middlebury College

Seth Haines - Technician, Middlebury College

**Other Equipment on Board**

The R/V *Neptune* is also equipped with an EG&G side scan sonar system and a hydraulic reel and A-frame system for deployment and depth control of the side scan sonar system. In addition the R/V *Neptune* has a digital color scanning sonar, a Wesmar SS265. This system has a range of 2400 feet and can be directed a full 360 degrees horizontal and 0 to 90 degrees vertical. The R/V *Neptune* also has two graphic depth recorders and its own underwater video system. The R/V *Neptune* has the standard VHF communications capabilities.

**Deliverables**

1) The Principal Investigators will coordinate their activities with a special Project Advisory Team made up of personnel from the Vermont Division for Historic Preservation; the New York State Office of Parks, Recreation, and Historic Preservation; the New York Department of Environmental Conservation; the New York State Education Department; the Vermont Department of Environmental Conservation; and the Lake Champlain Basin Program Technical Advisory Committee. The team will be coordinated by Ann Cousins, Cultural Resources Coordinator for the Lake Champlain Basin Program.

2) The Principal Investigator will submit quarterly progress reports to the Project Advisory Team. A draft of the survey report will be submitted upon the schedule previously mentioned, and upon final approval a total of 50 copies will be prepared for distribution. Fifty copies of an Executive Summary will also be prepared for distribution. The site survey forms will be developed and utilized for all confirmed underwater historic sites.

3) The Principal Investigator will present project findings and recommendations to the Lake Champlain Management Conference Technical Advisory Committee and the

Cultural Resources Working Group. The Principal Investigator will submit an article to the Lake Champlain Basin Program Public Education Outreach Coordinator for publication in the Newsletter.

# APPENDIX H: CONTRACT BETWEEN NEIWPCC AND LCMM

***Contract***
LC-X001840-05
LC-DP95-4-VTRFP; 0080-026
Inv. of Underwater Cult. Res.

**CONTRACT BETWEEN**
**NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION**
**AND**
**LAKE CHAMPLAIN MARITIME MUSEUM**

This contract is entered into on **May 1, 1996**, by the New England Interstate Water Pollution Control Commission (the "Commission"), represented by the Commission's Executive Director as the Contracting Officer, and having its usual place of business at 255 Ballardvale Street, Wilmington, MA 01887 (Tel: 508-658-0500; Fax: 508-658-5509), and Lake Champlain Maritime Museum (the "Contractor"), RR#3, Box 4092, Vergennes, VT 05491, Contact: Arthur Cohn, (Tel: 802-475-2022; Fax: 802-475-2953)

WHEREAS, the "**Lake Champlain Underwater Cultural Resources Survey**" is a project approved by the Lake Champlain Management Conference and US EPA Region I, and

WHEREAS, the accomplishment of the following described work and services is authorized by an agreement between the Commission and the Contractor, and

WHEREAS, it is in the best interest of the Commission to obtain the assistance of the Contractor in connection with said work and services, and

WHEREAS, the Contractor is qualified to perform said work and services,

NOW THEREFORE, the parties mutually agree as follows:

## ARTICLE I. SERVICES BY AND RESPONSIBILITIES OF THE CONTRACTOR

A. Work Products

(1) The Contractor is responsible for conducting all the work for and preparing the final reports for the project. The work and services to be performed are more fully described in (1) the proposal dated August 28, 1995; (2) the additional information dated September 1, 1995; (3) the letter, dated February 19, 1996, to Wendy Cohen, EPA from Arthur Cohn, Lake Champlain Maritime Museum, and (4) the letter, dated April 19, 1996, to Lee Steppacher, EPA, from Arthur Cohn, Lake Champlain Maritime Museum, all attached hereto and made a part hereof.

(2) The contractor is responsible for satisfying the following reporting requirements:

(a) Brief (1-2 page) quarterly written reports shall be submitted by the 15th day after the end of each calendar quarter (March, June, September, December) to the oversight project officer designated in Article II. The quarterly reports shall describe progress to date, list completed outputs, list problems encountered and anticipated, and state the means of responding to those problems.

(b) A draft final report is due November 30, 1996, and the final report is due by December 31,1996.

(c) The Contractor agrees to use recycled paper for all reports which are prepared as a part of this agreement and delivered to the Commission, U.S. EPA, or the person with oversight responsibility named in Article II.

(d) Ten (10) copies of all drafts of the final report for review purposes shall be provided to the oversight project officer designated in Article II. One camera-ready final report shall be submitted to the LCBP Office, 54 West Shore Road, Grand Isle, Vermont 05458.

(e) The Contractor shall work with the LCBP to ensure that published reports produced under this contract conform to the LCBP report format. Part of this format includes acknowledgments and disclaimer statements regarding the federal funding involved in the support of this project. Contact: Elizabeth Soper, LCBP (802) 372-3213.

(f) The Contractor shall be available to present results of their work to the Technical Advisory Committee and/or the Lake Champlain Management Conference, as requested.

(3) If any environmental data are collected under this agreement, the Contractor is responsible for preparing for approval by EPA a QA/QC Project Plan that will outline in detail the manner in which this project will be implemented and completed and provide assurance that the project shall adhere to established EPA QA/QC requirements. This Project Plan shall follow US EPA guidelines for the preparation of QA/QC Project Plans (40 CFR Part 31.45; 40 CFR Part 30.200 and 30.503).

(4) The Contractor is responsible for the following data collection and presentation requirements:

(a) All data collected under this agreement shall follow the guidelines in the Draft Lake Champlain Program Information Management policy which provides guidance on ensuring that data collected will be standardized, accessible and usable to interested parties within the Basin, as well as beyond it. Contact: Greg Charest, US EPA Region 1, (617) 565-4528.

(b) All data presented on maps for the Lake Champlain Basin in any report shall use base map information, either in digital or paper form, provided by the LCBP. Contact: Lisa Borre, LCBP, (802) 372-3213.

(c) Development of any GIS maps shall be coordinated with the LCBP Data Coordinator and shall adhere to mapping standards as presented in *Handbook of GIS Standards and Procedures for the LCBP*. Contact: Bob Gabliuso, VT Center for Geographic Information, (802) 656-8840.

(d) Unless otherwise advised, the Contractor shall work with the Lake Champlain Basin Program Office to write two press releases, one at the commencement of the project and one when results are available. Contact: Elizabeth Soper, LCBP (802) 372-3213.

(5) The Commission's or EPA's approval of work products, reports, and incidental work or material furnished hereunder shall not in any way relieve the Contractor of responsibility for the technical adequacy of his work. Neither the Commission's nor EPA's review, approval, acceptance, or payment for any of the services shall be construed as a waiver of any rights under this contract.

(6) The Contractor shall, without additional compensation, correct or revise any errors, omissions or other deficiencies in his/her work products, reports, and other services.

B. Responsibilities and Requirements

(1) Final Invoicing. The final report must be approved before final payment is issued. (The approval process may include peer review.) The final invoice for payment shall be labeled as "final invoice" by the Contractor and shall be received by the oversight project officer designated in Article II within 15 days of the end date of this contract. If additional time is needed for project completion and the approval process, the Contractor shall request, in writing, a no-cost extension contract amendment. The amendment request shall be sent as per Article II.

(2) Matching Funds. The Contractor shall provide a minimum of Ten Thousand Dollars ($10,000) in non-federal matching funds or in-kind services and resources. The Contractor shall meet all federal requirements for matching funds (40 CFR 31.24), including ensuring that these non-federal funds are expended concurrently with the expenditure of federal funds from the EPA/NEIWPCC grant or cooperative agreement and within the approved project period of that cooperative agreement. The Contractor shall document the use of matching funds on a form provided by the Commission. All match documentation shall be routed for approval as per Article II. The Contractor shall resolve any and all disputes with EPA over the qualification of funds submitted as match.

(3) Affirmative Action. The Contractor agrees and is required to use the following affirmative steps to assure that minority firms, women's business enterprises, labor surplus area firms, and small businesses in rural areas (SBRAs) are used when possible. The Contractor must ensure to the fullest extent possible that at least 8 percent of federal funds for supplies, construction, equipment, or services are made available to organizations owned or controlled by socially and economically disadvantaged individuals, women, and historically black colleges and universities.

(a) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

(b) Assuring that small and minority businesses and women's business enterprises are solicited whenever they are potential sources;

(c) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;

(d) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises;

(e) Using the services and assistance of the Small Business Administration, and the Minority Business Development Agency of the Department of Commerce. The Contractor shall report to the Commission on any applicable invoices the following information: name, address and type (MBE or WBE) of businesses used and amount of funds to each MBE or WBE business included in the period of services submitted for payment.

4) Administrative Regulatory Compliance. The Contractor agrees that it will comply with all applicable federal laws and regulations, including but not limited to **40 CFR Part 31** (Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local Governments), in effect on the date of execution of the assistance agreement for this project. Requirements covered include, but are not limited to: prohibition of contracting with a suspended or debarred party, requirements for subcontractors.

(5) Performance. The Contractor shall be, and shall remain, liable in accordance with applicable law for all damages to the Commission or EPA caused by the Contractor's negligent performance of any of the services furnished under this contract, except for errors, omissions, or other deficiencies to the extent attributable to the Commission, Commission-furnished data, or any third party. The Contractor shall not be responsible for any time delays in the project caused by circumstances beyond the Contractor's control.

(6) Access to and Retention of Records for Audit Purposes. The Contractor shall maintain books and records in accordance with generally accepted accounting principles and practices consistently applied. The Contractor shall allow access by the Commission, the federal grantor agency, the Comptroller General of the United States, or any of their duly authorized representatives to any books, documents, papers, and records of the Contractor which are directly pertinent to this specific contract for the purpose of making audit, examination, excerpts, and transcriptions. Retention of all such items is required for three years after the Commission makes final payment and all other pending matters are closed. If any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of the 3-year period, the records must be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular 3-year period, whichever is later.

(7) Equal Employment Opportunity. In connection with the execution of this contract, the Contractor shall not discriminate against any employee or applicant for employment because of age, race, religion, color, sex, or nation of origin.

(8) Indemnification. The Contractor agrees that it will indemnify and hold harmless the Commission, its members, officers, and employees from and against all losses from claims, demands, payments, suits, actions, recoveries, and judgements of every nature and description brought or recovered against it by reason of any omission or act of the Contractor, its agents, employees, or subcontractors in the performance of this contract. The Commission may retain such monies from the amount due the Contractor as may be necessary to satisfy any claim for damages, costs, and the like, which is asserted against the Commission.

(9) Workers' Compensation. This contract shall be void and of no force and effect unless the Contractor shall provide and maintain coverage during the life of this contract for the benefit of such employees as are required to be covered by the provisions of the Workers' Compensation Law.

(10) Environmental Regulatory Compliance. For any contracts and subcontracts in excess of $100,000, the Contractor agrees to comply with all applicable standards, orders, or requirements issued under section 306 of the Clean Air Act (CAA) (42 USC 1857 (h), section 508 of the Clean Water Act (CWA)(33 USC 1368), Executive Order 11738, and Environmental Protection Agency regulations (40 CFR Part 15). These sections prohibit contracting with any person or facility who has been convicted of environmental violations of the CWA or CAA.

C. Subcontracts

(1) Administrative Regulatory Compliance. The Contractor Further Agrees to insert in any subcontract hereunder, provisions which shall conform substantially to the language of this clause, including this paragraph. Article I, B, (3) and (4).

(2) Access to and Retention of Records. The Contractor agrees to make Article I, paragraph B (6) applicable to all sub agreements.

## ARTICLE II. OVERSIGHT

A. Technical and administrative oversight of all work performed under this contract shall be provided by the following individual in cooperation with the LCBP Technical Advisory Committee. The Contractor shall receive direction from and shall submit all invoices, reports, data, or other deliverables for work performed to:

Ann Cousins
RR#1, Box 220
Bridge Road
Crown Point, New York 12928
Tel: 518-597-4212

B. The final invoice for payment shall be received by the Commission within 30 days of the end date of this contract. If additional time is needed for project completion and the approval process, the oversight officer shall process the Contractor's request for a no-cost extension contract amendment.

## ARTICLE III. CHANGES TO THE CONTRACT

A. The Commission may at any time, by mutually agreeable written amendments, make changes within the general scope of this contract in the services or work to be performed, changes in the work plan, and/or budget. If such changes cause an increase or decrease in the Contractor's cost or time required to perform any services under this contract, whether or not changed by any order, the Commission shall make an equitable adjustment and modify this contract in writing. The Contractor must assert any claim for adjustment under this clause in writing within 30 days from the date it receives the Commission's notification of change, unless the Commission grants additional time before the date of final payment.

B. No services for which the Contractor will charge an additional compensation shall be furnished without the written authorization of the Commission.

## ARTICLE IV. DURATION OF THE CONTRACT

The Contractor shall complete all work and services required under this contract by **March 1, 1997**.

## ARTICLE V. COMPENSATION TO THE CONTRACTOR

A. The Commission's obligation under this contract is for a total amount not to exceed Thirty Thousand Dollars ($30,000) within the contract period for the services of the Contractor. Payment is contingent upon the Commission's receipt of federal funding.

B. Payments for work performed shall be made from original monthly invoices, pending receipt of one W-9 Form completed by the Contractor if appropriate. Invoices are to be submitted by the Contractor as per Article II, for approval prior to forwarding to the Commission for payment according to the following schedule. Invoices shall provide itemized documentation of costs related to work performed, shall indicate the time period of work invoiced, and shall be accompanied by a brief written progress report.

| | |
|---|---|
| $27,000 | on a reimbursement basis upon receipt of approved original invoices; |
| $ 3,000 | upon completion and approval of all work products and documentation of all match. |
| $30,000 | Total |

C. Payments shall be made within 45 days of the Commission's receipt of an approved invoice.

D. Upon satisfactory completion of the work performed under this Contractor, the contractor shall label the final payment request as "final invoice," and, in so doing, shall deliver to the Commission a release of all claims against the Commission. Final payment under this contract shall not constitute a waiver of the Commission's claims against the Contractor under this contract.

E. The final invoice for payment shall be received by the oversight office as per Article II within 15 days of the end date of this contract; the final invoice shall be approved, forwarded to, and received by the Commission within 30 days of the end date of this contract.

## ARTICLE VI. TITLE TO PROPERTY AND DATA; COPYRIGHTS AND PATENTS

A. During the term of this contract, the title to any and all equipment and accessories purchased by or charged to funds provided by the contract, shall be in the name of the Commission. Upon termination of this contract, the title to and possession of all rights to such equipment and accessories shall be conveyed to the Commission.

B. This contract is supported with federal funding awarded to the Commission. The federal government has an unrestricted right to use any data or information generated using assistance funds or specified to be delivered to EPA in the Commission's assistance agreement.

C. The federal awarding agency reserves a royalty-free, non-exclusive, and irrevocable license to reproduce, publish, or otherwise use, and to authorize others to use, for federal government purposes:

(1) The copyright or patent in any work developed under this contract which is supported by federal funds; and

(2) Any rights of copyright or patent to which the Contractor purchases ownership with funds from this contract.

D. The Commission reserves the right to copyright or patent any work, discovery, or invention which arises or is developed in the course of or under this contract. The Commission shall, as required, report such activity to the Federal awarding agency.

## ARTICLE VII. TERMINATION OF CONTRACT

A. The Commission may terminate this contract or any part by giving written notice to the Contractor and specifying the effective date, such date to be at least fourteen (14) calendar days from the date of notice.

B. Upon receipt of a termination notice, the Contractor shall (1) promptly discontinue all affected work (unless the notice directs otherwise), and (2) deliver or otherwise make available to the Commission all data, drawings, specifications, reports, estimates, summaries, and such other information and materials as may have been accumulated by the Contractor in performing this contract whether completed or in process.

C. In the event of termination, the Contractor shall be paid for services rendered and expenses incurred up to the date of termination, presuming charges are reasonable and customary. In the event of termination due to Contractor's default, payment due to the Contractor at the time of termination may be adjusted to cover any additional costs to the Commission because of the Contractor's default.

## ARTICLE VIII. REMEDIES

Unless otherwise provided in this contract, all claims, counter-claims, disputes, and other matters in question between the Commission and the Contractor arising out of, or relating to, this contract or the breach of it will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the state in which the Commission is located.

**IN WITNESS WHEREOF**, the parties hereto have executed this contract as of the day and year first written above.

| | |
|---|---|
| NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION | LAKE CHAMPLAIN MARITIME MUSEUM |
| __________________________ | __________________________ |
| Ronald F. Poltak<br>Executive Director | Arthur B. Cohn<br>Director |

***Amendment #1***

LC-X 001840-01
LC-DP59-4-VTRFP Underwater Cultural Resources
(0080-026)

**CONTRACT BETWEEN**
**NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION**
**AND**
**LAKE CHAMPLAIN MARITIME MUSEUM**

**Amendment #1**

This serves as an amendment of your May 1, 1996 contract between NEIWPCC and Lake Champlain Maritime Museum. This amendment is necessary to extend the ending date of the contract.

The specific changes in the contract are as follows (in bold):

Article 4. PERIOD OF SERVICES

The Contractor shall complete all work and services required under this contract by **September 30, 1997**.

All other sections and subsections of this contract remain the same.

______________________________
Ronald Poltak
Executive Director, NEIWPCC

______________________________
Arthur B. Cohn
Lake Champlain Maritime Museum

***Amendment #2***

LC-X001840-01
LC-DP95-4-VTRFP Underwater Cultural Resources
(0080-026)

**CONTRACT BETWEEN**
**NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION**
**AND**
**LAKE CHAMPLAIN MARITIME MUSEUM**

**Amendment #2**

This serves as an amendment of your May 1, 1996 contract between NEIWPCC and Lake Champlain Maritime Museum. This amendment is necessary to extend the ending date of the contract.

The specific changes in the contract are as follows (in bold):

Article 4. PERIOD OF SERVICES

The Contractor shall complete all work and services required under this contract by **December 31, 1997**.

All other sections and subsection of this contract remain the same.

---

Ronald Poltak
Executive Director, NEIWPCC

---

Arthur B. Cohn
Lake Champlain Maritime Museum

*Amendment #3*

LC-X001840-01
LC-DP95-4-VTRFP Underwater Cultural Resources
(0080-126)

**CONTRACT BETWEEN**
**NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION**
**AND**
**LAKE CHAMPLAIN MARITIME MUSEUM**

**Amendment #3**

This serves as an amendment of the May 1, 1996 contract between NEIWPCC and Lake Champlain Maritime Museum. This amendment is necessary to extend the ending date of the contract.

The specific changes in the contract are as follows (in bold):

Article 4: PERIOD OF SERVICES

The Contractor shall complete all work and services required under this contract by **May 31, 1998**.

All other sections and subsections of this contract remain the same.

______________________________
Ronald Poltak
Executive Director, NEIWPCC

______________________________
Arthur B. Cohn
Lake Champlain Maritime Museum

# APPENDIX I: CONTRACT BETWEEN VDFPR AND LCMM

***Contract***

**COOPERATIVE GRANT AGREEMENT**
**BETWEEN**

**THE STATE OF VERMONT, DEPARTMENT OF FOREST, PARKS, AND RECREATION,**
**AND**
**THE LAKE CHAMPLAIN MARITIME MUSEUM, VERGENNES, VT**

## ARTICLE I - BACKGROUND AND OBJECTIVES

WHEREAS, Lake Champlain contains what many consider to be the best collection of underwater cultural heritage resources in North America; and

WHEREAS, Lake Champlain's underwater cultural heritage resources provide a tangible record of nearly 500 years of human history, and that provide important educational, recreational, and economic development opportunities; and

WHEREAS, the States of Vermont and New York have specific state and federal authorities for preserving and managing the underwater cultural heritage resources in Lake Champlain; and

WHEREAS, both Vermont and New York have identified the importance of Lake Champlain as a cultural and recreational resource; and

WHEREAS, on November 15, 1990, the Lake Champlain Special Designation Act was signed into law and established a Lake Champlain Management Conference to develop a comprehensive plan for the preservation of the Lake's resources; and

WHEREAS, the 1996 Lake Champlain Underwater Cultural Resources Survey is a project approved by Lake Champlain Management conference with partial funding provided by the Environmental Protection Agency (EPA) through New England Interstate Water Pollution Control Commission (NEIWPCC) and partial funding provided by the National Park Service (NPS); and

WHEREAS, the Lake Champlain Maritime Museum (hereafter LCMM) was awarded a contract to do the 1996 Lake Champlain Underwater Cultural Resources Survey through a competitive bid process prior to distribution of the EPA funds; and

WHEREAS, the State of Vermont, Department of Forests, Parks, and Recreation (VDFPR) has entered into a Cooperative Agreement with the NPS to develop a recreation management plan and cultural resources program including development of a "Management Strategy for Underwater Historic Resources" through a multi-year, systematic survey of the lake bottom and historic shipwrecks (CA 1600-1-9007, Amendment 7); and

WHEREAS, the VDFPR and NPS Cooperative Agreement provides $46,000 for the 1996 Lake Champlain Underwater Cultural Resources Survey;

NOW THEREFORE, the VDFPR and the LCMM enter into a Cooperative Grant Agreement in order to continue the 1996 Lake Champlain Underwater Cultural Resources Survey and to meet the requirement of the VDFPR Cooperative Agreement with the NPS.

**ARTICLE II - STATEMENT OF WORK**

A. VDFPR agrees to:

1. Act as recipient of moneys from the NPS, act as the grantor of moneys to LCMM, and prepare quarterly financial report and billings for the 1996 Lake Champlain Underwater Cultural Resources Survey grant moneys from the National Park Service.

B. The Lake Champlain Basin Program (LCBP) Cultural Heritage Office agrees to:

1. Prepare Cooperative Grant Agreements;
2. Provide technical and administrative project oversight of all work performed under this contract, and after review of all products and invoices, submit invoices to VDFPR for payment to LCMM.

C. LCMM agrees to:

1. Receive direction from and submit all invoices, reports, data or other deliverables for work performed to:

Ann Cousins, Project Oversight Officer
Lake Champlain Basin Program
RR 1, Box 220, Bridge Road
Crown Point, New York 12928
Tel: 518-597-4212

Work Products

1. As part of the multi-year systematic lake-bottom mapping project, the LCMM will expand southward the survey area as described in the attached August 28, 1995, and April 19, 1996, LCMM correspondence. The LCMM will utilize side scan sonar technology to examine a large portion of the lake bottom in Vermont and New York, locate cultural resource targets within the area of examination, and upon prioritization, execute a verification and documentation of suspected shipwrecks utilizing divers in shallow water and remote operating vehicles (ROV) in deeper water. The project will follow the *Guidelines for Conducting Archaeological Studies in Vermont*, *the New York*

*Archaeological Council Standards*, and the *Secretary of the Interior's Standards and Guidelines for Archaeology.*

2. All reports of the 1996 Lake Champlain Underwater Cultural Resources Survey will treat the summer survey project as a single project, cooperatively funded by EPA, NPS, LCMM, and private donors. The LCMM is responsible for the following reporting requirements:

a) Brief (1-2 page) quarterly written reports shall be submitted by the15th day after the end of each calendar quarter (March, June, September, December) to the project oversight officer:

b) A draft final report is due **November 30, 1996** and the final report is due **March 1, 1997**.

c) Ten (10) copies of all drafts of the final report for review purposes and twenty (20) copies of the final report shall be provided to the oversight project officer.

d) Presentation of findings to the Cultural Resources Working Group and the Technical Advisory Committee and/or the Lake Champlain Management Conference or its Successor Organization.

3. Environmental data collected must meet the EPA QA/QC requirements (40 CFR 31.45, 40 CFR 30.200 and 30.503).

4. The LCMM is responsible for the following data collection and presentation requirements:

a) All data collected under this agreement shall follow the guidelines in the Draft *Lake Champlain Program Information Management Policy*.

b) All data presented on maps for the Lake Champlain Basin shall use base map information provided by the LCBP.

c) Development of any GIS maps shall be coordinated with the LCBP Data Coordinator and shall adhere to mapping standards as presented in *Handbook of GIS Standards and Procedures for the LCBP.*

d) The LCMM shall work with the LCBP Office to write at least two press releases.

5. The LCBP Cultural Heritage Office's approval of work products, reports, and incidental work or materials furnished hereunder shall not in any way relieve the LCMM of responsibility for the technical adequacy of its work.

6. The Contractor shall, without additional compensation, correct or revise any errors, omissions, or other deficiencies in work products, reports, and other services.

Responsibilities:

7. Final Invoicing. The final report must be approved before final payment is issued. The final invoice for payment shall be received by the oversight project officer within 30 days of the end date of this contract. If additional time is needed for project completion and the approval process, the Contractor shall request, in writing, a no-cost extension contract amendment.

8. Performance. The Contractor shall be, and shall remain, liable in accordance with applicable law for all damages to the VDFPR caused by the Contractor's negligent performance of any of the services furnished under this agreement.

9. Retention of Records. The Contractor shall maintain books and records in accordance with generally accepted accounting principles. Those records shall be made available to the state and federal grantors, or any of their duly authorized representatives for the purpose of making audit, examination, excerpts, and transcripts. Retention of all records is required for three years after VDFPR makes final payment and all other pending matters are closed.

10. Equal Employment Opportunity. In connection with the execution of this contract, the Contractor shall not discriminate against any employee or application for employment because of race, color, religion, sex, national origin, age, disability, sexual preference, or other non-merit factors.

11. The LCMM shall complete all work and services required under this contract by **March 1, 1997**.

## ARTICLE IV - COMPENSATION TO THE CONTRACTOR

A. The VDFPR's obligation under this agreement is for a total amount not to exceed forty-six thousand dollars ($46,000). Payment is contingent upon VDFPR receipt of federal funding.

B. Monthly invoices are to be sent to project oversight officer identified in ARTICLE II C1 for approval prior to being forwarded to the VDFPR Business Manager. Invoices shall provide approval prior to being forwarded to the VDFPR Business Manager. Invoices shall provide itemized documentation of costs related to work performed and shall be accompanied by a brief written progress report.

$43,000 on a reimbursement basis upon receipt of approved original invoices; and $3,000 upon completion of final report and approval of all work products.

C. VDFPR shall initiate payment procedures upon receipt of approved invoice.

## ARTICLE V - TERMS OF AGREEMENT

A. This Agreement shall be effective when signed by all parties and shall remain in effect for one (1) year from that date, subject to the right of any party to terminate in accordance with Article VII hereof. No changes, modifications, or amendments in the terms and condition of this Agreement shall be effective unless reduced to writing, numbered and signed by the duly authorized representatives of the VDFPR and LCMM. The commitment of additional funds in furtherance of this Cooperative Agreement shall be authorized by individual addenda.

## ARTICLE VI - KEY OFFICALS

VDFPR
Maja Smith
Lake Champlain Recreation Coordinator

Susan Bulmer
State Recreation Planner

Peter Strobridge
Business Manager

LCBP
Ann Cousins
Cultural Heritage Coordinator

LCMM
Art Cohn

## ARTICLE VII - TERMINATION

This Agreement may be terminated by any party by giving written notice at least thirty (30) days in advance to the other parties.

In WITNESS WHEREOF, each party hereto has caused this Cooperative Grant Agreement to be executed by an authorized official on the day and year set forth opposite their signatures:

STATE OF VERMONT, DEPARTMENT OF FORESTS, PARKS, AND RECREATION

______________________________ ____________________
Conrad Motyka Date
Commissioner

LAKE CHAMPLAIN MARITIME MUSEUM

______________________________ ____________________
Art Cohn Date
Director

*Amendment #1*

**ERATIVE GRANT AGREEMENT BETWEEN VERMONT DEPARTMENT OF FORESTS, PARKS, AND RECREATION, AND LAKE CHAMPLAIN MARITIME MUSEUM**

**Amendment #1**

This serves as an amendment to the August 29, 1996, cooperative Grant Agreement between the State of Vermont Department of Forests, Parks, and Recreation, and Lake Champlain Maritime Museum.

The specific changes in the contract are as follows (in bold):

Article II Work Products [page 3] 2 (b) A draft final report is due **September 30, 1997**, and the final report is due **November 30, 1997**.

[page 4] 11. The LCMM shall complete all work and services required under this contract by **November 30, 1997**.

All other sections and subsections of this contract remain the same.

Conrad Motyka, Commissioner — Date
State of Vermont Department of Forests, Parks, and Recreation

Arthur B. Cohn, Director — Date
Lake Champlain Maritime Museum

***Amendment #2***

Grant # R-PLN/LCM-96-018
Change # 2

**STATE OF VERMONT**
**AMENDMENT TO GRANT AGREEMENT**

It is agreed by and between the State of Vermont, Department of Forests, Parks, and Recreation (hereinafter called "the State") and the Lake Champlain Maritime Museum, (hereinafter called "the Grantee") that the Grant Agreement dated September 27, 1996, be amended as follows:

Page 3, Article II, No. 2b: Statement of Work
Delete "November 30, 1996", and
"March 1, 1997"
Insert: "January 31, 1998", and
"May 31, 1998"

Page 4, Article II, No. 11: Statement of Work
Delete: "March 1, 1997"
Insert: "May 31, 1998"

Except as modified by the above amendment, all other provisions of the original Grant Agreement dated September 27, 1996, shall remain in full force and effect.

| The State of Vermont<br>Department of Forests, Parks, and Recreation | Lake Champlain Maritime Museum |
|---|---|
| By: ______________ | By: ______________ |
| Title: Commissioner | Title: ______________ |
| Date: ______________ | Date: ______________ |

## APPENDIX J: LETTER OF AGREEMENT BETWEEN LCPP AND LCMM

**NEW YORK - VERMONT**
**CITIZENS ADVISORY COMMITTEES**
**ON LAKE CHAMPLAIN**

Vermont Lake Champlain CAC
Lake Champlain Basin Program
54 West Shore Road
Grand Isle, Vermont 05458
Tel: (802) 372-3213

New York Lake Champlain CAC
c/o Dept. of Environmental Conservation
Route 86 - PO Box 296
Ray Brook, New York 12977
Tel: (518) 897-1216

May 2, 1997

Subject: Letter of Agreement
Lake Champlain Partnership Program (LC-E096-2-VT-M)
0082-004

Arthur Cohn
Lake Champlain Maritime Museum
RR 3 Box 4092 Basin Harbor Road
Vergennes, Vermont 05491

Dear Mr. Cohn:

This is a letter of agreement between the New England Interstate Water Pollution Control Commission (NEIWPCC), on behalf of the Citizens Advisory Committees, and under the Lake Champlain Partnership Program. The Attached scope of work includes a description of the project, reporting schedule, and payment schedule for "public Interpretation of Lake Survey."

**Name of organization receiving support**: Lake Champlain Maritime Museum

**Project Contact**: Arthur Cohn

**Address:** RR#3 Box 4092 Basin Harbor Road
Vergennes, Vermont 05491

**Phone Number**: (802) 475-2022

**Total amount of Partnership Program award**: $5,000.00

**Total amount of recipient matching fund commitment**: Recipients are asked to document the use of nonfederal matching funds, including in-kind and volunteer services, to help the Citizens Advisory Committee meet matching requirements of federal funds used for the Partnership Program. Match must be documented by recipient on "NEIWPCC Match Certification Form" enclosed.

**Time frame for the project**: June 1, 1997 to May 31, 1998.

**Lake Champlain Partnership Program**
**Scope of Work**
**"Public Interpretation of Lake Survey"**

**Project Description**: During 1996, the LCMM surveyed 40 square miles of lake bottom, capturing new geological data and discovering 10 new shipwrecks. By creating and distributing a short video on the findings, the public can become informed about the countless wooden shipwrecks, representing multiple forms of historic transportation, that lie hidden beneath the waters of Lake Champlain. The film will demonstrate the urgency for locating, identifying, and doing what is possible to protect these priceless artifacts before they are obscured by layers of colonizing zebra mussels. The LCMM hopes to continue scanning the entire bottom of Lake Champlain, estimated to take the next 5-7 years.

**Reporting Schedule**

| | |
|---|---|
| September 30, 1997 | Submit progress report on the status of the project. |
| May 31, 1998 | Submit final report, including a description of the work completed and a financial report detailing how grant funds where spent. |

**Budget**

| | |
|---|---|
| Film production | $4,000 |
| Materials | $ 750 |
| Printing | $ 250 |
| **Total** | **$5,000** |

**Payment Schedule:** Two payments shall be made to according to the following schedule, process and provisions:

| | |
|---|---|
| $4,500 | Upon signing of letter of agreement and submittal of an invoice. |
| $ 500 | Following completion of the project and a final written report, approval of an invoice documenting the full grant amount, and submittal of matching fund documentation. |
| $5,000 | TOTAL |

**Publicity:** Awardees agrees to publicize their project and will include mention of support from the New York-Vermont Citizens Advisory Committees 1997 Partnership Program in their publicity.

**Invoices, match documentation, and reports should be sent to:**

Colleen Hickey
Lake Champlain Basin Program
54 West Shore Road
Grand Isle, Vermont 05458
(802) 372-3213 or 1-800-468-5227

for review and approval prior to forwarding to NEIWPCC. NEIWPCC will pay the approved invoices within 45 days of receipt. Compensation paid under this agreement shall be subject to all federal and state tax regulations.

Sincerely,

Roland F. Poltak
Executive Director
NEIWPCC

Arthur Cohn
Lake Champlain Maritime Museum

Enclosures: Invoice
Match Certification Form

# APPENDIX K: QUARTERLY REPORTS

***August 1996 Quarterly Report***

**MEMORANDUM**

Date: August 9, 1996
To: Ann Cousins, LCBP Cultural Heritage Office
From: Art Cohn, Director, Lake Champlain Maritime Museum
Re: 1996 Underwater Mapping/Interim Report

Thank you for your memo of August 6th. It was a pleasure having you out on the survey and giving you a chance to see the operation we put together. You did manage to schedule into one of the rare nice days, so the experience was not exactly typical of the 1996 "weather from hell" season!

I appreciate getting an update on the status of the NPS contract and will look forward to seeing a draft at your convenience. I have thought about this quite a bit and I do believe that trying to incorporate EPA and NPS work plans and reports into one large survey operation and report makes the most sense for everybody involved. I have been working on a bi-state survey form, in fact it is almost completed. This form can be used interchangeably for any type of survey or site documentation, whether by diver or ROV. It simply fills in as many of the blanks as can be identified based on observations.

The survey continues to go well. The first phase of this season's mapping program involved assembling a survey crew and configuring the appropriate survey equipment as per the EPA's QA/QC so that we could implement a thoughtful and efficient survey. Working with Captain Fred Fayette of the R/V *Neptune*, which was our primary survey platform, we mounted a Middlebury College Klein 595 side scan sonar unit and were able to convince Middlebury College to purchase a new 300 meter armored cable, which allowed us to very efficiently fly the towfish at the appropriate height off the bottom throughout our survey area. Hooking this cable up to a hydraulic reel control system allowed us to make constant modifications to the height of the fish and keep it in its ideal range. Other core survey persons were Pat and Tom Manley of Middlebury College, Peter Barranco of Montpelier, and Dave Andrews. In addition we were able to involve a number of volunteers in the survey process.

Navigation was controlled through our DGPS (differential global positioning system), which automatically sent positioning data to our autopilot, to our staffed navigation station, and to our data acquisition computer. This allowed us to run extremely precise track lines, ensuring that the planned overlap was adequate.

Perhaps the greatest improvement in this year's survey involved the use of the data acquisition and processing computer manufactured by Triton Industries and known as ISIS. This tool allowed us to simultaneously record all the sonar data, our position by latitude and longitude, the depth of the water, and the height of the fish off the bottom.

It also allowed us to capture out any target of interest in a very efficient manner. This means that any cultural anomaly, or other interesting feature, could simply be frozen and later printed for our examination.

Once the survey portion of our project is completed, we will be moving into a verification stage. This verification will involve first re-locating the targets of interest and buoying them in such a way that divers can locate and identify what these targets are. We are also working out the logistics for bringing up an ROV system for several deep-water targets.

As per your suggestions, I am submitting an invoice for the bulk of the EPA funds. I will contact you shortly with the results of our initial verification work.

Thank you again for your support. Please feel free to call with any questions.

*December 1996 Quarterly Report*

## The Lake Champlain Maritime Museum's Report of the First Season (1996) of Its Lake Champlain Survey

Funding for the LCMM Lake Survey has been generously provided by the Lake Champlain Basin Program, the Environmental Protection Agency, the Lintilhac Foundation, the National Park Service, and a private foundation who wishes to remain anonymous.

Lake Champlain has the legitimate claim of being the most historic body of water in North America. The precise number of wooden shipwrecks at the lake's bottom is unknown, but, based on the 300+ ships that LCMM scientists and others have identified over the past twenty years, it is predicted that there are dozens of undiscovered shipwrecks representing multiple forms of watercraft. It is highly anticipated that the lake-wide survey will reveal new information, which will greatly benefit scientists and scholars, as well as students and the public, through publications, exhibits, and the opening and maintenance of new underwater preserves for public access. The broadest public benefit resulting from the survey will be the development of a comprehensive management plan to preserve and protect all archaeological sites and allow for further studies. The survey has taken on new urgency due to the rapid spread of zebra mussels in Lake Champlain. Zebra mussels have already encrusted many archaeological sites, obliterating all exposed surfaces, and it is estimated that within the next few years, they will have attached themselves to a majority of the lake's shipwrecks.

We are pleased to report that we have successfully completed our first research season. The initial year of our project consisted of three distinct components – planning, data survey, and verification. Planning began during the winter of 1995-1996 and culminated in three weeks of intense strategy development and equipment preparation immediately prior to the start of data collection. Data collection began in June and continued through the end of the season. Verification followed.

The survey was carried out on the primary research platform, R/V *Neptune*, which carried its own data package of electronic sensing equipment including side scan sonar, DGPS navigational control system, and data-capturing hardware. Travelling in straight lines, the vessel towed a transducer-equipped "fish" lowered close to the lake bottom to examine an approximately 600-foot-wide swath with each transects. Each subsequent transect overlapped the previous one, insuring complete and methodical coverage of the bottom. In forty days, we were able to examine over 40 square miles of never before imaged Lake Champlain bottom (approximately 10% of the lake's total bottom area). We identified over three hundred cultural and geological targets – ten of which, we have confidence, are newly discovered shipwrecks. Five are in deep water over 180' and will be examined by a special ROV operation. Five other historic shipwrecks that we located are in what are arguably diveable waters – the deepest in 110 feet of water, the shallowest in about 60 feet.

We verified the five shallow water targets by diving on them. Each site was assessed to determine its nature – type, dimensions, date of origin, use, and clues to its sinking – and then documented on video tape.

In addition to archaeological data, analysis of the sonar data gathered also shows interesting geological features of the lake bottom and contradictions to previously documented depth contours. Post-processing analysis of these geological data have begun at Middlebury College under the direction of Geology Professors Patricia Manley and Thomas Manley. It is anticipated that these analyses will lead to new research in this field.

**Underwater Historic Preserve Potential**

Going hand-in-hand with the archaeological potential of underwater sites located during the survey will be their significant recreational potential. In 1985, the Vermont Division for Historic Preservation established one of the first underwater historic preserve programs in the United States. This nationally recognized program has grown to include five underwater sites, which each year are visited by hundreds of local and visiting divers. I have been the coordinator of this program for the state since its inception. LCMM is currently in discussions with the State of Vermont regarding LCMM's being officially designated as the agent of the state to manage the historic underwater preserves. The 1996 lake-wide survey has provided five new potential sites to add to the underwater preserve system, which, with enhanced management, could give both New York and Vermont the potential to become one of the country's most dynamic historic diving destinations.

All five shallow sites – three in Vermont and two in New York – have underwater preserve potential. I would estimate that, should these sites be chosen for inclusion in an underwater preserve-type program, each site would require approximately two weeks of archaeological documentation prior to the installation of a mooring system. A rough estimate of costs for a survey of each site would be approximately $15,000.

The three Vermont sites will be addressed through discussions with state officials. Of the two potential underwater historic preserve sites on the New York side of the lake, one rests outside Plattsburgh Harbor and appears to be a circa 1840s vintage sailing canal boat. The boat appears to have been intentionally abandoned in this area after a long working life. The bow and stern are erect, the deck is gone, with the sides lying on the bottom. The hull form may also prove to be a new transitional type of construction. The site is interesting archaeologically in that it contains a wooden windlass and an interesting stern window construction. At first glance it has minimal safety issues, as there is no penetration possible, and minimal archaeological sensitivity in that the boat appears to have been stripped prior to its sinking.

The second New York vessel is located off Port Kent. It is a large, intact, late-nineteenth-century standard canal boat, which also appears to have been intentionally scuttled. Its archaeological sensitivity is minimal, and no artifacts were seen which would require removal. There are some safety issues relating to the depth of the site, yet arguably the site is within depth limitations of the regional underwater preserve system.

**ROV Verification**
In our initial proposal we had indicated that during the 1996 survey we planned to utilize ROV technology to document sites located beyond safe diving limits. We had made formal arrangements for verification with Benthos, one of the leading manufacturers of ROVs whom we have worked with in the past. We intended to utilize a larger and more sophisticated system than we had in the past and this created some logistical issues. The power requirements of the large machine and its weight were not easily accommodated in the support vessels we had available. While working out an alternative shipboard process, Benthos was tapped to join the TWA disaster search team and then it was fall. The weather on the lake was deteriorating to the point where I was concerned about bringing up this expensive technology only to be held in port. All of the sites we needed to examine were in the broad lake in open water. Deep-water sites are not subject to early zebra mussel attachment and, because of the on-going nature of the survey, we would lose very little by postponing the ROV operation. It could be argued, in fact, that it would be more economical to amass a large number of targets before the ROV operation is launched.

We do intend to stage the ROV verification of at least five targets located in deep water in 1996 as part of the 1997 documentation component. Based on this analysis, decisions regarding more comprehensive documentation site studies will be made.

**Partnerships**
LCMM has formed a number of vital partnerships this year with state and local government bodies and academic institutions, which greatly contributed to the survey's success to date and which will help ensure the project's continued success over the next 5-7 years. LCMM has the important collaborative support of:

- The Vermont Division of Historic Preservation: Townsend Anderson, State Historic Preservation Officer; Giovanna Peebles, State Archaeologist
- The New York State Office of Parks, Recreation, and Historic Preservation: Larry Golbrecht, Mark Peckham
- The New York State Department of Education/State Museum: Phil Lord, Director
- Middlebury College: Dr. Patricia Manley, Professor of Geology and Department Chair; Dr. Thomas Manley, Professor of Geology
- The University of Vermont: Thomas Salmon, President; Dr. Alan McIntosh, Water Quality Specialist and Professor of Natural Resources; Dr. Mary Watzin
- The Institute of Nautical Archaeology at Texas A&M. University: Dr. Kevin Crisman, Professor of Nautical Archaeology
- The National Park Service: Kevin Foster, Chief Maritime Historian

- The Environmental Protection Agency
- Vermont Senators Patrick Leahy and James Jeffords
- The Lake Champlain Basin Program: Lisa Borre, Vermont Coordinator; Ann Cousins, Cultural Heritage Coordinator
- The Naval Historical Center, Washington, DC: Dr. Robert Neyland

**Final Report**

I have begun to work on a draft of the 1996 final survey report and would hope to complete the draft by March 1997. A number of pieces being written by other project contributors are all underway.

**Bi-State Survey Form**

I have circulated a draft of the survey form to both New York and Vermont authorities and, to date, have received no feedback, so I do believe that this form is acceptable and simply needs to be refined for each state's purposes.

**Plans for 1997 Season**

We anticipate no major changes or new directions in the near future, though, by design, the scope and intensity of our research will increase and intensify during the next 2-3 years. In 1996, survey data collection comprised 80% of our effort, verification 10%, and public interpretation 10%. In 1997 that balance will shift to 50% data collection, 40% verification/documentation, and 10% public interpretation. Next season, we hope to field two separate teams – one for data surveying and one for verification/documentation who will work concurrently throughout a sixty-day research season under the direction of a Project Manager. I will continue to serve as the overall Project Director.

The Lake Champlain Maritime Museum's Lake Survey is integral to the Museum's overall efforts and long-range plans. Ongoing Museum objectives which are tightly interconnected with the survey's goals include the professional conservation of artifacts and responsible management of Lake Champlain's underwater cultural resources.

Since 1992, to accommodate and further encourage the public's interest in a number of LCMM-led archaeological field studies (including recovery and conservation of artifacts from the waters at Mount Independence and Fort Ticonderoga), a small portion of LCMM's exhibit space has been designated as a seasonal conservation laboratory. Artifacts recovered during field excavations have been conserved in full view of the public and have turned what is normally a "behind the scenes" activity into an exciting venue for visitor interaction with real objects and processes. LCMM's success with this space convinced LCMM's Board of Trustees of the need for a permanent year-round conservation laboratory. I am delighted to report that the Museum has recently received a grant of $243,000 for this new facility which will importantly serve as headquarters for the Lake Survey and the dissemination of information about it to the public. Of prime concern to the Museum is sharing the findings of the survey with the widest possible audience. Toward that end, we are in the process of producing a video to report on the first year of the Lake Survey and to share what we are learning with the public. This video will become the focal point of a new exhibit at the Museum about the Lake Survey. I have also recently completed the first in a series of public lectures to report our findings to students at Middlebury College, the University of Vermont, St. Michael's College, and Johnson State College.

The shipwrecks we are locating are public resources on public bottomland; these cultural treasures belong to all of us and we are committed to bringing the public new information, as we discover it.

Respectfully submitted,

Arthur B. Cohn
Director

***March 1997 Quarterly Report***

| | |
|---|---|
| To: | Ann Cousins |
| From: | Arthur B. Cohn, Project Director |
| Re: | Quarterly Report: Lake Survey |
| Date: | March 13, 1997 |

I am pleased to report that there has been significant progress on the Lake Survey, both in analysis of 1996 data and planning for 1997. I would, however, like to request an extension of time for producing the final report as the post-processing of the geological data has taken longer than expected. Let me begin this report with a brief discussion about that.

Because of the way we were able to collect the sonar data using an ISIS computer, we gave ourselves the opportunity to post-process and analyze the data in a more comprehensive manner. This winter we have been working with this new technology process. Fred Fayette, our technical specialist, working with Tom and Pat Manley at Middlebury College, arranged for rental of special software to be utilized in conjunction with a computer we purchased specifically for this process. A Middlebury College student was brought into the project as well. We did experience some difficulties in translating data we collected into these mosaic images and have been working with the computer company in California on a very intense basis to try to work out the bugs on our end as well as on their end. I must emphasize again that this type of processing is really state-of-the-art, and we are experiencing what I would consider to be normal problems in developing a protocol. We did feel, however, that it was critically important to the way we get organized to recover data in 1997 to go through the exercise of attempting off-season post-processing. This way any glitches or mechanical changes, which would aid in this process for the future could be worked out, and I think we are gaining a much better understanding of the variables.

I have also been working with Peter Barranco to research some of the archaeological targets located last season and plan out our survey strategy for 1997. I am pleased to report that the wreck we identified as a steam tugboat, has been further identified as the tugboat *U.S. LaVallee*. Furthermore we have been able to find at least two historic photographs of this boat: one while working on the Hudson River and one while working on Lake Champlain. Research into the identification of the other vessels continues. We have also begun to outline a video script for the possible fabrication of a survey presentation for the public. We have applied to the Lake Champlain Basin Partnership Program for financial support for that project.

Finally, much work has gone into planning for the continuation of the Survey in 1997. As of this writing we hope to continue the sonar portion of the survey during the months of June and July. I am attempting to simultaneously field a documentation team to quickly map, photograph, and video document the previously located sites and, to that end, believe we have secured some additional funding through the Lake Champlain

Basin Program Cultural Resources Working Group. We have also tentatively scheduled and made arrangements with Benthos of Falmouth, Massachusetts, for staging an ROV (remote-operated vehicle) survey in August. This would permit us to prioritize the five deep-water sites, which were located in 1996 with any new deep-water sites located in 1997.

There is still much detailing, logistical scheduling, and recruitment which needs to be done to get ready for 1997. We are in fact hard at work on pulling together the report for 1996. I will keep you posted on our progress and I look forward to answering any questions you may have.

## *June 1997 Quarterly Report*

| | |
|---|---|
| Memo to: | Ann Cousins, Lake Champlain Basin Program |
| From: | Arthur B. Cohn, Project Director |
| Re: | Quarterly Report, Lake Champlain Survey Project |
| Date: | June 12, 1997 |

Since our last quarterly report, a tremendous amount of activity has taken place on the Lake Survey front. Significant effort has gone into drafting the 1996 Lake Survey report and, although it is taking a little longer than I had hoped, I am quite pleased with how the document is shaping up. I would hope to have a draft in your hands by the end of June. Since the last report, a 1996 Lake Survey video, which in effect reports on the result of the 1996 survey, has been finalized and released to the public. It has drawn a number of news stories, it has been incorporated into our educational program, it has been distributed widely to researchers, cultural resource managers, and educators. Specifically a number of teaching archaeologists have requested copies and have incorporated it into their teaching programs. Perhaps the most important development since the last report is that we have actually started the 1997 Lake Survey. As of this writing we have completed an additional ten square miles of lake bottom and have located a number of interesting new targets. We have scheduled for a firm date the ROV survey for August, and I have also begun planning and making commitments with personnel to specifically engage in a feasibility-documentation survey on two shipwrecks located in New York waters which were found during the 1996 survey. This operation should begin shortly after the 4th of July holiday.

I hope this outline has provided you with the information you require, and please feel free to contact me if you need any additional clarification.

***November 1997 Quarterly Report***

To: 71160.1100@compuserve.com
From: Lake Champlain Maritime Museum <1cmm@sover.net>
cc:

Dear Ann,

I apologize for the delay in sending you this quarterly report; but, since our last report, we have been working at a great pace to try to finalize the 1996 survey report. It is coming along very well, and I would hope to be able to forward a draft to you by December 1. In the meantime, we have been working on a number of fronts to enhance results of the survey. We completed a deep-water ROV project in August and have been working with the ROV contractor to produce the best image results possible. A number of public education forums about the survey have been held, both at the grade school and university levels as well as in forums for the general public. A good deal of analysis of last year's work is going on as a component of drawing together all the information which will make up that final report. I do hope to get you that draft soon.

Please feel free to have me clarify any of the above.

Sincerely,

Art

# APPENDIX L: 1996 LAKE SURVEY RESULTS VIDEO SCRIPT

**Lake Champlain Maritime Museum**
**Basin Harbor, Vermont**

**Presents:**

**THE LAKE CHAMPLAIN SURVEY: 1996 RESULTS**

***Fran Stoddard:***

Defining the border of northeastern New York and Vermont and flowing into Canada, Lake Champlain is one of the most historically significant lakes in North America. The 120-mile-long strategic waterway has been the scene of important battles by French, British, and American armies and navies during the colonial wars, the American Revolution, and the War of 1812. For a century and a half, the lake also served as a vital commercial highway for sail, steam, and canal vessels moving raw materials that fueled the growth of the region and the United States.

In the course of this heavy military and commercial use, a large number of vessels have come to rest on the lake bottom. In the past, some shipwrecks located in shallow water have been removed, usually to their destruction. More recently, vessels like the *Phoenix* (VT-CH-0587), the *General Butler* (VT-CH-0590), and the Horse Ferry (VT-CH-0591) have been found and studied in place, preserved by the lake's cold, fresh water. To date, only ten percent of the bottom of the lake has been explored, but hundreds of shipwrecks have been located, dozens have been documented, and five have been opened for public use.

For centuries, most of the lake's legacy of wooden ships has lain undisturbed and stable on the lake bottom. A few dedicated explorers have begun the task of surveying the lake in a careful, systematic, and scientific way, to identify wreck sites and learn as much as possible from these rich archaeological time capsules. It is a project that was envisioned as taking generations to complete.

Zebra mussels have changed all of that. This non-native invader was introduced into the Great Lakes from Europe in the mid-1980s, and has been present in Lake Champlain since 1993. The Maritime Museum was commissioned to study the impact of the zebra mussels on shipwrecks and make predictions and recommendations. Using the Great Lakes as a real-life window, we predict that zebra mussels and a related deeper water mussel, the quagga, will encrust most of the lake's shipwrecks in the next five to seven years. These encrusted shipwrecks will be virtually impossible to study or analyze. We also fear the shipwreck's stability will be radically altered. The resulting archaeological and informational loss is beyond calculation.

What to do? As we began to put the situation into perspective, one very positive option began to emerge. Using state-of-the-art sonar technology, we have the capability to accelerate the survey in the 90 percent of the lake which has never been seen. With this technology, we have the ability to image large tracts of lake bottom, locate cultural targets, verify their origin and characteristics with divers in shallow water, and, in deeper water, utilize ROV technology to examine the target. In this way we can capture information and prioritize further archaeological documentation before the zebra mussels take hold.

The race was on. Once we had reached these conclusions, the challenge became one of logistics and funding. With time of the essence, our goal was to gear up as rapidly as possible to take advantage of our relatively short field season. Planning began during the winter of 1996, and by spring we were ready to begin this monumental task.

Working on the research platform R/V *Neptune*, we selected the area of the lake between Grand Isle, Vermont, and Plattsburgh, New York, to begin the work. Our primary survey search tool was a side scan sonar. Its operation requires you to drag a torpedo-shaped transducer behind the survey boat and close to the lake bottom. The towfish sends out a sound signal across the bottom, in our case about 300 feet out on each side. The signal is returned and transmitted up a cable to a recording unit, which translates this data into an image of the bottom.

In order to ensure complete coverage of the bottom, the survey lines must be methodical, so our navigator uses latitude and longitude to preplan an overlapping survey route. This information is entered into our navigational control system, DGPS, which was attached to an autopilot to insure the lines run were straight and on course. It is not unlike mowing your lawn and making sure you overlap each preceding line.

Another important piece of equipment we incorporated into this survey was a data-capturing computer. Although we have a continuous record of the bottom captured on paper, the computer allows us to store, print, and analyze bottom and positional data in a more complete and digitized form. This permits us to print out specific targets, create a mosaic of the bottom, enhance the target images, and manage the data in a more efficient way.

Although our position on each transect is automatically recorded, we also manually plot our position every two minutes and record it in the project logbook. Any potential significant cultural or geological feature or observation about survey operations gets recorded in the project log.

We divided the 1996 survey into two distinct functions, first survey, then target verification. During our survey effort, we were able to examine over 40 square miles of never-before-imaged lake bottom. We identified over 300 cultural and geological targets, ten of which, we have confidence, are newly discovered shipwrecks. With the survey operation concluded, we began the next phase: verification.

Of the ten new cultural targets located, five are in deep water and five are in diveable depths. Our goal this season was to locate the five targets in 120 feet of water or less and dive on them. The first diver is sent down to assess the site, attempt to determine what it is, what are its dimensions, the date of its origin and use, clues to its sinking, and safety issues for the next team. Upon surfacing and briefing the next team, divers then go down and document the site on video tape.

***Fred Fayette:***
"So, Arthur, was there a shipwreck down there?"

***Arthur Cohn:***
"One of the nicest dives I have ever done in my life, absolutely fantastic. I mean, it is a pristine sailing canal boat – the nicest condition of any boat we have seen, as far as I can tell, like it went down yesterday."

Of course, none of these boats went down yesterday. All five of the vessels we dove on turned out to be vessels that were built in the nineteenth century, and many of them went down to the bottom in the nineteenth century. And it is only the lake's preserving water that gives us the great opportunity to look at these five sites for the archaeological and recreational potential they possess.

The first boat I would like to talk about is a scow, a construction scow, a very heavily-built barge that was designed to carry marine construction equipment around the lake to build the docks and the breakwaters that supported the maritime economy of that period. It has been burned. It is on the bottom, and yet it is a clearly very good example of that type of construction, with a lot of interesting features like naturally grown knees and support timbers that were designed to hold a heavy weight.

Another vessel we looked at turned out to be a standard canal boat, probably the most populous vessel that ever operated on the lake during the nineteenth century. The example that we found is a late-nineteenth-century canal boat, which we conclude because of its size. It is really a large vessel. It is in very, very good condition; even though it appears to have been taken out and scuttled at the end of its working life; but it really contains some wonderful features. The bow section is completely intact. It is a big, bluff, bullheaded-type of a bow. The windlass is there, although it has been dislodged and is off to the side of the vessel. In the stern, we get a wonderful example of an intact tiller bar, rudderpost, and rudder, the whole steering mechanism of the vessel, and there are many other diagnostic features on this boat.

Another boat that we looked at and really a very special vessel turns out to be a steam-powered tugboat, which we know to be the vessel *U.S. La Vallee*, which we think went to the bottom sometime in the 1930s after a long working life of over fifty years. It is intact, remarkably intact, with a very sharp bow. Its towing bits are still present. Its propeller is still present, and the ship's wheel is still present, along with the steam stack and all the machinery that made this boat an operating tugboat.

The fourth vessel we examined is a sailing canal sloop, which dates it to about circa 1840. This is a vessel that clearly had a long and perhaps hardworking life on

Lake Champlain, and, when it went to the bottom, it went to the bottom in rough shape. The deck is gone. The sides have collapsed, but what we have is a relatively intact bow with a wonderful feature on it, which is a wooden windlass – only the second windlass of this type that we have seen on any boat on Lake Champlain. And also, in the stern of the vessel, which is also intact and rising off the bottom, we get a lot of the construction features of that, including the rudderpost and the rudder of the vessel. And even more interesting, because we have not seen it before, inside of the four stern cabin windows on the inside transom piece, we see some V-shaped grooves cut into that transom. And that is something we have not seen before, and we are not really sure of the reason that is present.

But the last vessel that we see, which is in fact another sailing canal sloop, by contrast to the vessel we have just seen, is a pristine watercraft. It is completely intact and almost certainly went to the bottom in unplanned and extreme circumstances, because here it is, looking like it was on its maiden voyage, sitting on the bottom with all the elements that make it a working watercraft. The mast is present with its heel still stuck in the mast tabernacle. When you look at this vessel, look at the state of preservation of the wood and the paint. The boom is present with its leather-coated jaws. The anchor is still hanging off the hawse pipe in the bow of the vessel. The windlass is there. All the elements that made this boat a working boat – the tiller bar, the rudder – all of these things are there. Then, when we get to the rear cabin, where all the life of a vessel took place, we still have the wood stove. And, when we looked inside, plates, dishes, cups, water pitchers, all the elements, all the things that the people who lived onboard this vessel used to support their daily life. It is the proverbial time capsule for life in the mid-nineteenth century on Lake Champlain.

***Fred Fayette***

"Did it look like it went down in duress?"

***Arthur Cohn***

"It went down in duress. Every piece of working gear – personal gear, plates, dishes, pitchers, blocks, masts, boom, anchors – it is all there."

***Fran Stoddard***

Since the conclusion of the 1996 field season, the survey team has been hard at work analyzing all the accumulated data. At Middlebury College, researchers are selectively processing the geological information, creating mosaic views of the lake floor, and adding to our understanding of the lake's dynamics.

At the same time, historians at the Lake Champlain Maritime Museum are researching the newly discovered shipwrecks in order to identify them and to learn how the ships ended up on the bottom of the lake. The research team is also planning the continuation of the sonar survey. We still face the daunting challenge of racing against the zebra mussel population explosion in order to investigate the vast area of the lake bottom which has never been seen before, not unlike the surface of some distant planet.

Also this season, we will field an archaeological documentation team, which will work throughout the season to examine the shipwrecks located in 1996 and any new sites discovered in 1997. The final component of the 1997 strategy will be to study all of the deep-water targets, which will be examined by remote-operated vehicle. Perhaps the most exciting target located to date is the deep-water target designated Wreck E. We have confidence that this intriguing vessel will be identified!

***Arthur Cohn***

Lake Champlain is a public treasure, and these sites belong to all the people of the respective states. We hope this short film has given you a sense of what we are doing and why we are doing it, and we look forward to bringing you results of the next season's survey.

**SURVEY PERSONNEL:**

Art Cohn
Director, divemaster

Fred Fayette
Boat captain and engineer

Peter Barranco
Navigator and historian

Pat Manley
Geologist, sonar operator

Tom Manley
Geologist, sonar operator

**CREW:**

Seth Haines
Dave Andrews
Kathy Baumann
Mark Manley
Jonathan Eddy
Pat Beck

**FUNDING AND INSTITUTIONAL SUPPORT:**

Lake Champlain Basin Program
Environmental Protection Agency
National Park Service
Lintilhac Foundation
Freeman Foundation
Lake Champlain Partnership Program

and the
New York-Vermont Citizens Advisory Committees on Lake Champlain
Senator Patrick Leahy
Lake Champlain Maritime Museum
Lake Champlain Transportation Company
Middlebury College
New York Bureau of Historic Sites
Vermont Division for Historic Preservation
University of Vermont
Institute of Nautical Archaeology at Texas A&M University
Triton Technology, Inc.

**VIDEO PRODUCTION:**
Dave Andrews
Videographer

Fran Stoddard
Narrator

Future Images
Computer animation

Benthos
ROV footage

University of Vermont Special Collections

New York State Sea Grant
Great Lakes footage

New York State Archives

Aske Collection
Lake Champlain Maritime Museum

Advantage Video
Post-production editing

Art Cohn
Director

## APPENDIX M: SUBMERGED SITE TYPES

The following is a list of the submerged site types that are expected to be located during the lake survey.

BRIDGE
- Abutment
- Pier
- Piling
- Crib

CANAL

DOCK AND HARBOR INSTALLATION
- Berth
- Breakwater
    - Floating Breakwater
    - Earthen Breakwater
- Crib
- Dock
    - Double Dock
    - Draw Dock
    - Dry Dock
    - Floating Dock
    - Wet Dock
- Dolphin
- Floating Crane
- Floating Dry Dock
- Harbor
- Jetty
- Landing House
- Marina
- Pier
- Piling
- Quay
- Slip
- Wharf

HISTORIC DUMPSITES

SUBMERGED PREHISTORIC SITES
- Base camp
- Cache
- Cemetery
- Extractive camp

- Find spot
- Fish weir
- Individual burial site
- Kill site
- Small residential camp
- Sweat lodge

WATERCRAFT

- Commercial Craft
  - Standard Canal Boat
  - Sailing Canal Boat
    - Schooner-Rigged
    - Sloop-Rigged
  - Steam-Powered Canal Boat
  - Ferry
    - Cable Ferry
      - Hand-Powered
      - Steam-Powered
      - Diesel-Powered
      - Gas-Powered
    - Horse-Powered
      - Treadmill
      - Turntable
    - Sloop-Rigged
  - Schooner
  - Scow
    - Sloop-Rigged
    - Unpowered
  - Sidewheel Steamer
  - Sloop
  - Tugboat
    - Diesel Powered Tug
    - Steam Powered Tug
- Experimental Craft
- Fishing Vessel
- Houseboat
- Leisure Craft
  - Canoe
    - Birchbark
    - Cedar-Canvas
    - Aluminum
- Safety Craft
- Channel Dredger
- Small Craft
- Warship

## APPENDIX N: CULTURAL RESOURCE SURVEY FORM

### *Instructions for Survey Form*

**Instructions for the Completion of the**
**Lake Champlain Archaeological Site Survey Form**

- If this form is being completed as part of an update, check the box in the upper right corner of the form.

1. If the site is located in the State of New York, place a check on the line.
2. If the site is located in the State of Vermont, place a check on the line.
3. If the site is located in the province of Quebec, place a check on the line.
4. Enter the name of the site if known, otherwise create a name for the site.
5. Enter the appropriate state or province inventory number.
6. Enter the town in which the site is located.
7. Enter the county in which the site is located.
8. Enter the nearest geographic feature from the site (e.g. Burlington breakwater, Crown Point Bridge, or West Swanton boat access).
9. Enter the title of the USGS quad where the site is located.
10. Enter the date the USGS quad was printed.
11. Enter the name of the NOAA chart where the site is located.
12. Enter the date the NOAA chart was printed.
13. Enter the latitude at which the site is located.
14. Enter the longitude at which the site is located.
15. Enter the method used to arrive at the latitude and longitude at which the site is located (e.g. Loran, GPS, or DGPS).
16. Enter the date on which the location of the site was determined.
17. Enter the UTM zone in which the site is located.
18. Enter the UTM Easting at which the site is located.
19. Enter the UTM Northing at which the site is located.
20. If the site dates to the prehistoric period (10,000 BC–AD 1609) place a check on the line.
21. If the site dates to the historic period (AD 1609–present) place a check on the line.
22. If the site is a vessel, place a check on the line.
23. If the site is not a vessel, place a check on the line.
24. Enter the appropriate temporal affiliation:

    **Prehistoric**
    Paleo-Indian (9300–7000 BC)
    Early Archaic (7000–5500 BC)
    Middle Archaic (5500–4000 BC)
    Late Archaic (4000–900 BC)
    Early Woodland (900–100 BC)
    Middle Woodland (100 BC–AD 1050)

Late Woodland (1050–AD 1609)
**Historic**
Exploration/Contact (1609–1666)
French & British Military Conflict (1666–1763)
Early Settlement (1763–1775)
Revolutionary War (1775–1783)
Settlement and Commercialization (1791–1812)
War of 1812 (1812–1815)
Search for New Markets (1815–1823)
Golden Era of Waterborne Commerce (1823–1848)
Railroad Development (1848–1875)
Downfall of Lake Commerce (1875–1945)
Recreational Period (1945–Present)

25. Enter the appropriate historical context:

| | |
|---|---|
| Agriculture | Industry |
| Commerce | Tourism |
| Exploration | Transportation |
| Government | War |
| Recreation | Other (specify) |

26. Enter the name of the project during which the site was found if applicable.
27. Enter the name of the project director if applicable.
28. Enter the organization with which the project director is affiliated.
29. Enter the appropriate project type.

| | |
|---|---|
| Archival | Oral history |
| Field investigation | Other (specify) |

30. Enter the method used in locating the site (e.g. side scan sonar, proton magnetometer, personal communication, newspapers, or scuba diver survey).
31. Enter the name of the individual submitting the site survey form.
32. Enter the date the form was completed (month/day/year).
33. Enter the address of the individual submitting the site survey form (street, town, state and postal code).
34. Enter the phone number of the individual completing the form.
35. Enter the name of the individual who located the site.
36. Enter the date the site was located.
37. Enter the address of the individual who located the site.
38. Enter the phone number of the individual who located the site.
39. Enter the name of the owner of the site.
40. Enter the date that the owner acquired the site.
41. Enter the address of the owner of the site (street, town, state, and postal code).
42. Enter the phone number of the owner of the site.
43. Enter the appropriate vessel type:

| | |
|---|---|
| Barge | Raft |
| Brig | Row boat |
| Cabin boat | Sailing scow |
| Canal boat | Schooner |
| Canoe | Schooner-rigged sailing canal boat |

| | |
|---|---|
| Cutter | Scow barge |
| Dingy | Screw steamer |
| Dugout canoe | Sidewheel steamer |
| Ketch | Sloop-rigged sailing canal boat |
| Motor boat | Yacht |
| Motor Yacht | Other (specify) |

44. Enter the function of the vessel (e.g. coal carrier, ferry, or excursions).
45. Enter the name last used for the vessel.
46. Enter the last homeport of the vessel.
47. Enter the last official registration number of the vessel.
48. Enter the last owner of the vessel.
49. Enter the original designer of the vessel.
50. Enter the name of the master shipwright who constructed the vessel.
51. Enter the place at which the vessel was originally constructed.
52. Enter the date upon which the vessel was originally completed.
53. Enter the length of the vessel.
54. Enter the breadth of the vessel.
55. Enter the depth of hold of the vessel.
56. Enter the draft of the vessel.
57. Enter the tonnage of the vessel.
58. Enter the appropriate mode of propulsion for the vessel.

| | |
|---|---|
| Diesel engine | Sail |
| Gas engine | Steam engine |
| Horse-powered | Other (specify) |

59. Enter the name of the last master of the vessel.
60. Enter the names of the last crewmembers of the vessel.
61. Enter the type of cargo aboard the vessel at the time it was lost.
62. Enter the appropriate cause of the vessel's loss:

| | |
|---|---|
| Abandonment | Storm |
| Fire | Other (specify) |
| Negligence | |

63. Enter the date of the vessel's loss.
64. Enter the appropriate site type for non-vessels:

| | |
|---|---|
| Artifact scatter | Dolphin |
| Bascule bridge | Drawbridge |
| Boat access | Jetty |
| Breakwater | Lighthouse |
| Bridge | Navigational aid |
| Cable ferry | Pier |
| Canal | Submerged prehistoric site |
| Causeway | Swing Bridge |
| Crib | Wharf |
| Dock | Other (specify) |

65. Enter the function of the site.

66. Enter the name of the site if known, otherwise create a name for the site based on its description and geographic location.
67. Enter the name of the last owner of the site.
68. Enter the name of the individual who constructed the site.
69. Enter the place were the site was originally constructed.
70. Enter the date the site was constructed or deposited.
71. Enter a short list of the construction materials from which the site was built.
72. Enter the cause of the site's loss.
73. Enter the date of the site's loss.
74. Enter a brief description of the site.
75. Enter the size of the site in square meters.
76. Enter a description of the soil conditions at the site.
77. Enter the appropriate average water clarity conditions at the site on a scale from 1 to 3, with 3 being the worst.
78. Enter the appropriate description of the bottom conditions at the site:

| | |
|---|---|
| Clay | Ledge |
| Cobbles | Mussels |
| Grass | Sand |
| Gravel | Soft |
| Hard | Other (specify) |

79. Enter the nearest geomorphic feature from the site (e.g. Savage Island, King Bay, Schuyler Reef, or Five Mile Point).
80. Enter the water depth at which the site is located.
81. Enter the elevation at which the site is located.
82. Enter the slope at which the site is located.
83. Enter a percentage representing the amount of the original site that is currently intact.
84. Enter a percentage representing the amount of the site that is submerged.
85. List the types of features that are present at the site.
86. Enter the appropriate response to the site's integrity:

| | |
|---|---|
| Decayed | Intact |
| Disturbed | Slightly disturbed |
| Eroded | Vandalized |
| Heavily disturbed | Other (specify) |

87. List the appropriate current threats to the site:

| | |
|---|---|
| Agriculture | Natural decay |
| Development | Vandalism |
| Erosion | Zebra Mussels |
| Ice | Other (specify) |

88. Enter the appropriate estimate for the determination of the site as an Underwater Historic Preserve Site:

| | | |
|---|---|---|
| Eligible | Ineligible | Unknown |

89. List the factors affecting the site's eligibility for inclusion in the Underwater Historic Preserves.
90. Enter the appropriate estimate for the determination of the site for inclusion in the State Register for Historic Sites:

| Eligible | Ineligible | Unknown |
|---|---|---|

91. List the factors affecting the site's eligibility for inclusion in the State Register for Historic Sites.
92. Enter the appropriate estimate for the determination of the site for inclusion in the National Register of Historic Sites:

| Eligible | Ineligible | Unknown |
|---|---|---|

93. List the factors affecting the site's eligibility for inclusion in the National Register of Historic Sites.
94. If the site is included in the Underwater Preserve System, enter a description of the site's management status.
95. Briefly describe the historical significance of the site.
96. Describe what is contained in the site archive (e.g. photographs, documents, letters, artifacts, videotape, audiotape, and drawings).
97. State the repository that is currently housing the site archive.
98. Briefly list the previous work that has been done on the site.
99. List the references that pertain to the site.
100. List any significant additional data that is not contained in the standard form.

*Survey Form*

**Lake Champlain Maritime Archaeological Site Survey Form**

**Update ☐**

**SITE LOCATION:** New York 1 Vermont 2 Quebec 3
Site Name: 4 Site Number: 5
Town: 6 County: 7
Nearest Geographic Feature: 8
USGS quad: 9 Date: 10
NOAA: 11 Date: 12
Latitude: 13 Longitude: 14
Location Method: 15 Date: 16
UTM: Zone: 17 Easting: 18 Northing: 19

**SITE TYPE:** Prehistoric 20 Historic 21 Vessel 22 Non-vessel 23
Temporal Affiliation: 24 Historic Context: 25

**PROJECT NAME:** 26
Project Director: 27
Organization Affiliation: 28 Project Type: 29
Survey Method: 30

**FORM SUBMITTED BY:** 31 Date: 32
Address: 33
Phone Number: 34

**LOCATED BY:** 35 Date: 36
Address: 37
Phone Number: 38

**OWNED BY:** 39 Date: 40
Address: 41
Phone Number: 42

**VESSEL DATA:** Type: 43 Function: 44
Name: 45 Home Port: 46
Official Number: 47 Owned by: 48
Designed by: 49 Built by: 50
Place Built: 51 Date: 52
Length: 53 Breadth: 54 Depth of Hold: 55
Draft: 56 Tonnage: 57 Propulsion: 58
Mastered by: 59
Crewed by: 60
Cargo: 61
Cause of Loss: 62 Date: 63

**NON-VESSEL DATA:** Type: 64 Function: 65
Name: 66
Owned by: 67 Built by: 68
Place Built: 69 Date: 70
Construction Materials: 71
Cause of Loss: 72 Date: 73

**SITE DESCRIPTION:** 74

Site Size: 75

**ENVIRONMENTAL SETTING:** Soil: 76

Water Clarity: 77 Bottom Conditions: 78

Nearest Geomorphic Feature: 79

Depth: 80 Elevation: 81 Slope: 82

**SITE CONDITIONS:** Percent Intact: 83 % Submerged: 84

Features Present: 85

Site Integrity: 86

Threats to Site: 87

**SITE MANAGEMENT:**

Underwater Historic Preserve Eligibility: 88

Factors Affecting Eligibility: 89

State Register Eligibility: 90

Factors Affecting Eligibility: 91

National Register Eligibility: 92

Factors Affecting Eligibility: 93

Site Management Status: 94

**HISTORICAL SIGNIFICANCE:** 95

**SITE ARCHIVE:** 96

Repository: 97

**PREVIOUS WORK:** 98

**REFERENCES:** 99

**ADDITIONAL DOCUMENTATION:**

100

# APPENDIX O: SIGNAGE FOR ARCHAEOLOGICAL SITES

***New York Signage***

**ARCHAEOLOGICAL RESEARCH AREA**

This area is currently undergoing active archaeological research by the New York State Office of Parks, Recreation, and Historic Preservation. The (NEW YORK LAW) prohibits the excavation, removal, displacement, or destruction of archaeological material on or under state-owned land without a permit. State-owned land includes all property on the bottom of natural waters within the State of Vermont's boundaries.

**Please** cooperate with this research project by avoiding disturbance of this area.

If you have any questions, please contact one of the following organizations:

| | |
|---|---|
| **NEW YORK STATE<br>OFFICE OF PARKS, RECREATION, AND HISTORIC PRESERVATION**<br>Historic Preservation Field Services Bureau<br>Peebles Island, PO Box 189<br>Waterford, New York 12188-0189<br>(518) 237-8643 | **LAKE CHAMPLAIN MARITIME MUSEUM**<br>4472 Basin Harbor Road<br>Vergennes, Vermont 05491<br>(802) 475-2022 |

*Vertical Signage*

### ARCHAEOLOGICAL RESEARCH AREA

This area is currently undergoing active archaeological research by the Vermont Division for Historic Preservation. The Vermont Historic Preservation Act (Title 22 Vermont Statutes Annotated Chapter 14) prohibits the excavation, removal, displacement, or destruction of archaeological material on or under state-owned land without a permit. State-owned land includes all property on the bottom of natural waters within the State of Vermont's boundaries.

**Please** cooperate with this research project by avoiding disturbance of this area.

If you have any questions please contact one of the following organizations:

| | |
|---|---|
| **STATE OF VERMONT DIVISION FOR HISTORIC PRESERVATION**<br>135 State Street, Drawer 33<br>Montpelier, Vermont 05602-9821<br>(802) 828-3226 | **LAKE CHAMPLAIN MARITIME MUSEUM**<br>4472 Basin Harbor Road<br>Vergennes, Vermont 05491<br>(802) 475-2022 |

# APPENDIX P: PRESS RELEASE

## FOR IMMEDIATE RELEASE - May 15, 1997

From: Lake Champlain Maritime Museum
Contact Person: Art Cohn, Director
Phone: 802-475-2022

**Results of the 1996 Lake Champlain Survey Released**

During the summer of 1996, the Lake Champlain Maritime Museum (LCMM) initiated an ambitious new project to systematically examine the entire floor of Lake Champlain. Fueled by the recent infestation of zebra mussels, the survey, which was envisioned as taking decades to complete, has been radically accelerated. The intention of the survey is to locate and document shipwrecks and other submerged archaeological sites before they are covered and damaged by zebra mussels. In addition, the data being collected will also be utilized to add to our understanding of the geology and physical dynamics of Lake Champlain.

During the summer of 1996, the survey team systematically examined forty square miles of lake floor which has never been seen or imaged before. LCMM, in conjunction with its survey partners, is pleased to announce that during the course of the survey ten (10) previously unknown shipwrecks were discovered. During the 1996 survey five of the targets in divable depths were examined and filmed by the dive team. In addition, computers were used to capture a vast amount of geological data and a selective post-processing project at Middlebury College has begun.

Of the ten newly discovered shipwrecks, the five which have been investigated, represent a wide range of nineteenth-century commercial watercraft. A large wooden scow barge, which was used to carry marine construction equipment around the lake to build the docks and breakwaters, is one of the five sites identified. The second vessel is what we have defined as a "standard canal boat." These were long, narrow commercial carriers whose hull design was dictated by the size of the canal locks. These canal boats made up the largest class of vessel ever to operate on Lake Champlain and had no independent means of propulsion. They were towed by either horses or mules on the canal, and by steam tugboats on the lake. A very well-preserved steam tugboat was another vessel located during the survey and was found sitting upright on the bottom. This working tug has been identified as the *U.S. LaVallee*. It was built in 1880, and all of its steam machinery and component parts are still present.

Two other vessels located are what we call "sailing canal sloops." These vessels were designed to sail upon the lake but upon reaching the canal, were able to take on the function of a standard canal boat by raising their centerboards and lowering their masts. We speculate that both these vessels may have been built during the decade of the 1840s and their careers appear to have been radically different. One looks as though it had a long, hard-working life, perhaps even being converted during its career from a sailing to a standard canal boat. Although its bow and stern are relatively intact, the sides have collapsed and the deck is gone. In contrast the other vessel is a perfectly preserved watercraft of the period. It appears to have gone down in a storm and, lying on the bottom today, contains every maritime element and personal object that a boat of this type would have contained. It is a proverbial time capsule of the mid-nineteenth century on Lake Champlain.

Results of the 1996 survey have recently been released in a 15-minute documentary which details why the museum launched this aggressive survey, the techniques that have been employed to survey and document these vessels, and underwater footage and discussion of the five new vessels already verified. This film is being shown at the Nautical Archaeology Center at LCMM as part of its interpretation of the lake survey. It is also being shared with school programs and historical societies. The film details plans for the 1997 continuation of the survey scheduled to begin in early June. This season, in addition to the sonar survey component, a second diver documentation component will be in operation. Finally, at the end of the season, a remote-operated vehicle survey will be launched to examine all the deep-water targets.

Funding for the survey has come from the Lake Champlain Basin Program, the Environmental Protection Agency, the National Park Service, the Lintilhac Foundation, and an anonymous Vermont foundation. Partnerships with Middlebury College, the University of Vermont, the Institute of Nautical Archaeology at Texas A&M, and the Vermont and New York Divisions for Historic Preservation, are indicative of the broad collaboration being utilized to complete this landmark survey.

-30-

# APPENDIX Q: PAST SALVAGE AND ARCHAEOLOGY PROJECTS

**1909** Crown Point, New York, residents recovered what is believed to have been the French radeau *Grand Diable* off Fort Crown Point.

**1909** Ticonderoga, New York, residents recovered British schooner *Duke of Cumberland* (1759) off Fort Ticonderoga.

**1934** Lorenzo F. Hagglund recovered American schooner *Royal Savage* (1775) near Valcour Island, New York.

**1935** Lorenzo F. Hagglund recovered American gunboat *Philadelphia* (1775) near Valcour Island, New York.

**1949** Gallick family of West Haven, Vermont, recovered part of the British brig *Linnet* (1814 [VT-RU-0317]) from the Poultney River.

**1951** Lorenzo F. Hagglund conducted a survey to locate the lost American gunboat (1776) near Schuyler Island.

**1952** Lorenzo F. Hagglund conducted a survey to locate the lost American gunboat (1776) near Schuyler Island and raised a Revolutionary War American gunboat from Arnold's Bay, Panton, Vermont.

**1953** Lorenzo F. Hagglund conducted a survey to locate the lost American gunboat (1776) near Schuyler Island.

**1958** Whitehall, New York residents recovered the War of 1812 American schooner *Ticonderoga* (1814).

**1960** William Leege excavated the hulk of the American galley *Congress* (1776 [VT-AD-0717]) in Arnold's Bay, Panton, Vermont.

**1961** William Leege excavated the hulk of the American galley *Congress* (1776 [VT-AD-0717]) in Arnold's Bay, Panton, Vermont.

**1967** Smithsonian Institution, Washington, DC, conducted a survey to locate the lost American gunboat (1776) near Schuyler Island.

**1968** Smithsonian Institution, Washington, DC, conducted a survey to locate the lost American gunboat (1776) near Schuyler Island.

**1972** A. Peter Barranco, Jr., of Montpelier, Vermont, conducted a survey to locate the British radeau *Thunderer* (1776).

**1977** Rochester Engineering Laboratories conducted a survey around the southern tip of Isle La Motte, Vermont.

**1978** Committee of Underwater Archaeology and History of Quebec, Laval-des-Rapides, Quebec, conducted a survey for a War of 1812 sloop near Isle La Motte.
Rochester Engineering Laboratories conducted a documentation survey of *Water Witch* (1832 [VT-AD-0719]) and a side scan sonar survey around Diamond Island, Ferrisburgh, Vermont.

**1979** Rochester Engineering Laboratories conducted a documentation survey of the sidewheel steamer *Phoenix* (1815 [VT-CH-0587]) and conducted a side scan sonar survey from Cannon Point to Split Rock, Essex, New York, along the New York shoreline.

**1980** Champlain Maritime Society documented the sidewheel steamer *Phoenix* (1815 [VT-CH-0587]) and the sailing canal schooner *General Butler* (1862 [VT-CH-0590]).
Rochester Engineering Laboratories conducted a side scan sonar survey between Button Bay, Ferrisburgh, Vermont, and Rock Island, Panton, Vermont, along the Vermont shoreline.

**1981** Champlain Maritime Society documented the War of 1812 fleet in the Poultney River, the sailing canal schooner *General Butler* (1862 [VT-CH-0590]), and the Isle La Motte sailing canal sloop (c. 1840s [VT-GI-0024]).
Rochester Engineering Laboratories conducted a side scan sonar survey from Westport, New York, to Split Rock, Essex, New York, along the New York shoreline. The survey team also conducted a documentation survey of *Champlain II* (1868).

**1982** Champlain Maritime Society conducted a survey to locate the British radeau *Thunderer* (1776) near Isle La Motte; conducted the South Lake Side Scan Sonar Project; and documented the sailing canal schooner *General Butler* (1862 [VT-CH-0590]), the Isle La Motte sailing canal sloop (c. 1840s [VT-GI-0024]), the Basin Harbor shipwreck (VT-AD-0718), and the War of 1812 fleet in the Poultney River.
Rochester Engineering Laboratories conducted a side scan sonar survey partly in conjunction with the Champlain Maritime Society. The survey area included the waters between Basin Harbor and Button Bay, Ferrisburgh, Vermont; Whitehall, New York, and Benson Landing, Benson, Vermont; Shelburne Bay; Crown Point, New York, and Rock Island, Panton, Vermont, (along the Vermont shoreline); and Buoy 39 in Orwell, Vermont, and Fort Ticonderoga, New York.

**1983** Champlain Maritime Society documented the American Brig *Eagle* (1814), the sailing canal schooner *General Butler* (1862 [VT-CH-0590]), the Isle La Motte

sailing canal sloop (c. 1840s [VT-GI-0024]), the sidewheel steamer *Phoenix* (1815 [VT-CH-0587]), and the 1777 Great Bridge (VT-AD-0731); conducted a diver survey of the Fort Ticonderoga/Mount Independence area and Shelburne Bay; and developed a background history for Arnold's Bay, Panton, Vermont.
Rochester Engineering Laboratories conducted a side scan sonar survey of Burlington Bay, Vermont, and the area from Sloop Island to Picket Island, Charlotte, Vermont, along the Vermont shoreline.

**1984** Champlain Maritime Society documented the American galley *Congress* (1776 [VT-AD-0717]) and the British sloop *Boscawen* (1759) and conducted surveys of Burlington Bay and Kingsland Bay.
Rochester Engineering Laboratories conducted a side scan sonar survey of Burlington Bay and documented the Burlington Bay Horse Ferry (c. 1825 [VT-CH-0591]).

**1985** Champlain Maritime Society documented the American galley *Congress* (VT-AD-0717) and the British sloop *Boscawen*.

**1986** Champlain Maritime Society documented the American galley *Congress* (1776 [VT-AD-0717]) and conducted the Phase I Archaeological Assessment for Proposed Marina by Northshore Development Inc., Burlington, Vermont.

**1987** Joseph Zarzynski conducted a survey to locate the lost American gunboat (1776) near Schuyler Island.
Lake Champlain Maritime Museum conducted a survey near the Missisquoi Bay Bridge.

**1988** Lake Champlain Maritime Museum conducted a survey near the Grand Isle Fish Hatchery, the Missisquoi Bay Bridge, and Schuyler Island; and documented the sailing canal schooner *O.J. Walker* (1862 [VT-CH-0594]).
National Geographic Society conducted a survey to locate the lost American gunboat (1776) near Schuyler Island and documented the Burlington Bay Horse Ferry (c. 1825 [VT-CH-0591]).

**1989** Lake Champlain Maritime Museum conducted a survey to locate the lost American gunboat (1776) near Schuyler Island and documented the Burlington Bay Horse Ferry (c. 1825 [VT-CH-0591]) and schooner-rigged sailing canal boat *O.J. Walker* (1862 [VT-CH-0594]).

**1990** Lake Champlain Maritime Museum documented the Burlington Bay Horse Ferry (c. 1825 [VT-CH-0591]) and *Water Witch* (1832 [VT-AD-0719]); conducted a survey near Fort Crown Point; and conducted a survey from Burlington, Vermont, to Keesville, New York, for a proposed AT&T Fiber Optic Cable.

**1991** John Milner Associates conducted a survey at the U.S. Coast Guard Station at Burlington, Vermont.
Lake Champlain Maritime Museum documented the Burlington Bay Horse Ferry (c. 1825 [VT-CH-0591]) and the North Beach Sailing Canal Boat (VT-CH-0606).

**1992** Lake Champlain Maritime Museum documented the Burlington Bay Horse Ferry (c. 1825 [VT-CH-0591]) and conducted a survey in the Fort Ticonderoga/Mount Independence area.

**1993** Lake Champlain Maritime Museum documented the sailing canal schooner *General Butler* (1862 [VT-CH-0590]), the sidewheel steamer *Champlain II* (1868), the schooner *Water Witch* (1832 [VT-AD-0719]), and Revolutionary War artifact features in the Fort Ticonderoga/Mount Independence area (1777).

**1994** Lake Champlain Maritime Museum conducted a remote-sensing survey in the Main Lake and documented the sidewheel steamer *Champlain II* (1868) and sailing canal schooner *General Butler* (1862 [VT-CH-0590]).

**1995** Lake Champlain Maritime Museum documented the British brig *Linnet* (1814 [VT-RU-0317]), the American row galley *Allen* (1814), the sailing canal schooner *General Butler* (1862 [VT-CH-0590]), and the sailing canal schooner *O.J. Walker* (1862 [VT-CH-0594]), then conducted a survey near the Missisquoi Bay Bridge and evaluated the impact of zebra mussels on shipwrecks in Lake Champlain.