Honeywell

Honeywell
301 Plainfield Road
Suite 330
Syracuse, NY 13212
www.honeywell.com

May 3, 2017

To: Harry Warner, NYSDEC, Region 7 (1 bound)
Stephanie Webb, NYSDEC, Region 7 (1 PDF)
Holly Sammon, Onondaga County Public Library (1 bound)
Samuel Sage, Atlantic States Legal Foundation (1 bound)
Mary Ann Coogan, Camillus Town Hall (1 bound)
Stephen Weiter, Moon Library (1 bound)
Joseph J. Heath, Esq. (1 bound)
Ann Moore, Solvay Public Library (1 bound)

Re: Letter of Transmittal – Onondaga Lake Repository Addition

The below document has been approved by the New York State Department of Environmental Conservation (NYSDEC) and is enclosed for your document holdings:

- Documentation of Anomaly 13 (A13), Subsite of the Onondaga Lake Superfund Site
  Onondaga County, New York
  November 2016

Sincerely,

John P. McAuliffe

John P. McAuliffe, P.E.
Program Director, Syracuse

Enc.

cc: Timothy Larson, NYSDEC
Chris Fitch, Brown and Sanford (ecopy)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau D
625 Broadway, 12th Floor, Albany, NY 12233-7013
P: (518) 402-9676 I F: (518) 402-9773
www.dec.ny.gov

May 2, 2017

Mr. John McAuliffe, P.E.,
Program Director, Syracuse
Honeywell
301 Plainfield Road, Suite 330
Syracuse, NY 13212

Re: Documentation of Anomaly 13 (A13), Subsite of the Onondaga Lake Superfund Site Onondaga County, New York, Dated November 2016

Dear Mr. McAuliffe:

The New York State Department of Environmental Conservation (Department) has received the above referenced report. The report contains the necessary documentation required for Anomaly 13 (A13). Please see that copies of the report are sent to the document repositories selected for his site. The redevelopment activity described in this document is approved.

As noted in the document, this work is to be performed in accordance with the 1999 Generic Work Plan and corresponding Health and Safety plan for the site.

Sincerely,

Robert Edwards

Robert Edwards
Project Geologist
Remedial Bureau D
Division of Environmental Remediation

Honeywell
301 Plainfield Road
Suite 330
Syracuse, NY 13212
315-552-9700
315-552-9780 Fax

February 18, 2016

Mr. Timothy Larson
Remedial Bureau D
Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway – 12th Floor
Albany, New York 12233-7016

RE: Phase 3 Underwater Archaeological Report for the Onondaga Lake Bottom, Subsite of the Onondaga Lake Superfund Site, Onondaga County, New York September 2014

Dear Mr. Larson:

Enclosed you will find one bound copy and two PDF electronic copies of the Phase 3 Underwater Archaeological Report for the Onondaga Lake Bottom, Subsite of the Onondaga Lake Superfund Site, Onondaga County, New York, dated September 2014.

Please feel free to contact Tom Drachenberg of Parsons at 315-741-3708 or me if you have any questions.

Sincerely,

John P. McAuliffe

John P. McAuliffe, P.E.
Program Director, Syracuse

Enclosure

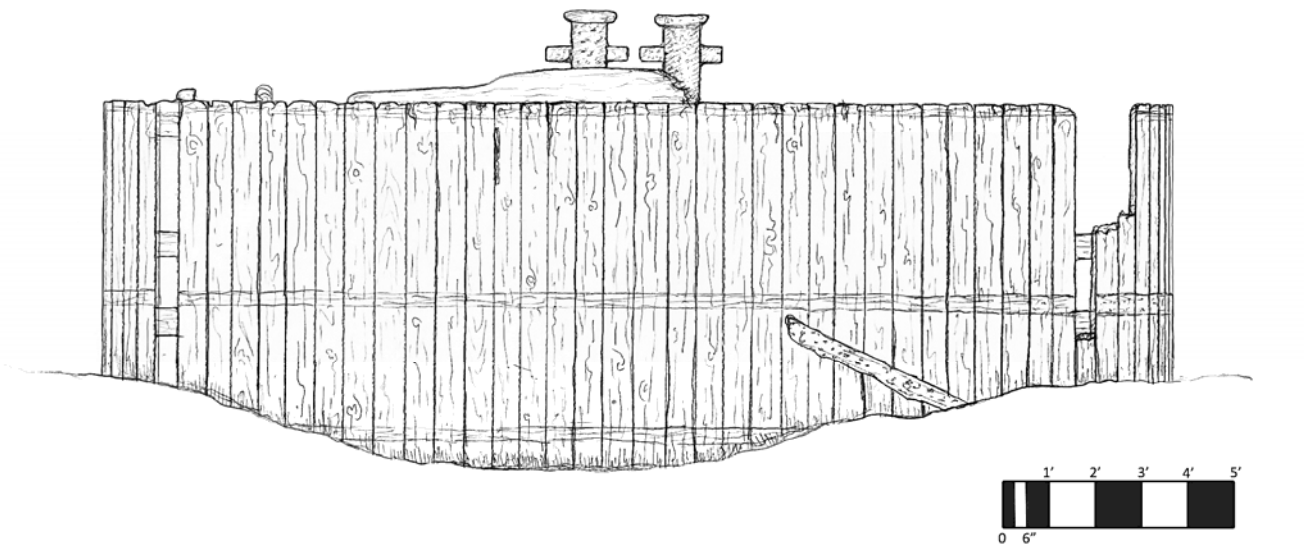
cc: Robert Nunes, USEPA (1 bound, 2 PDF)
Donald Hesler, NYSDEC (Cover Ltr Only)
Tara Blum, NYSDEC (1 bound, 1 PDF)
Harry Warner, NYSDEC, Region 7 (1 PDF)
Jeff Gregg, NYSDEC (1 bound)
Kenneth Lynch, NYSDEC, Region 7 (1 PDF)
Norman Spiegel, Environmental Protection Bureau (Cover Ltr Only)
Andrew Gershon, Environmental Protection Bureau (Cover Ltr Only)
Margaret A. Sheen, Esquire, NYSDEC (Cover Ltr Only)

cc (continued)

Argie Cirillo, Esquire, USEPA (Cover Ltr Only)
Mark Sergott, NYSDOH (1 PDF)
Mike Spera, AECOM (1 PDF)
Joseph Heath, Esquire (ec Cover Ltr Only)
Jeanne Shenandoah, Onondaga Nation (1 bound plus ec Cover Ltr Only)
Tony Gonyea, Onondaga Nation (1 bound)
Thane Joyal, HETF/Onondaga Nation, (1 PDF)
Curtis Waterman, Onondaga Nation (1 PDF)
Heidi Kuhl, Onondaga Nation (1 bound)
Alma Lowry, Onondaga Nation (ec Cover Ltr Only)
William Hague, Honeywell (Cover Ltr Only)
Brian D. Israel, Esquire, Arnold & Porter (1 PDF)
Nancy Herter, NYSHPO (1 bound)
Brian Yates, NYSHPO (1 bound)
Christina Rieth, NYS Museum (1 bound)
Thomas Biel, NYSDEC, Region 7 (1 PDF)
Charles Vandrei, NYSDEC, Division of Lands and Forests (1 bound)
Steve Miller, Parson (1 PDF)
Susan Bupp, Parsons (1 PDF)
Nina Versaggi, Ph.D., Public Archeology Facility (1 PDF)
Adam Kane, Lake Champlain Maritime Museum (ec Cover Ltr Only)

Documentation of Anomaly 13 (A13),

Subsite of the Onondaga Lake Superfund Site,
Onondaga County, New York



Prepared By:

Lake Champlain Maritime Museum

4472 Basin Harbor Road
Vergennes, Vermont 05491

Submitted To:

PARSONS

301 Plainfield Road, Suite 350
Syracuse, New York 13212

Prepared For:

Honeywell

301 Plainfield Road, Suite 350
Syracuse, New York 13212

Phase 3 Underwater Archaeological Documentation of Anomaly 13 (A13),

Subsite of the Onondaga Lake Superfund Site, Onondaga County, New York

Prepared For:

Honeywell

301 Plainfield Road
Suite 330
Syracuse, NY 13212

Submitted To:

PARSONS

301 Plainfield Road
Suite 350
Syracuse, NY 13212

Prepared By:

Christopher R. Sabick
Sarah L. Tichonuk
Cherilyn A. Gilligan

Lake Champlain Maritime Museum

4472 Basin Harbor Road
Vergennes, Vermont 05491

November, 2016

EXECUTIVE SUMMARY

In 2015, Lake Champlain Maritime Museum (LCMM) under subcontract to Parsons and on behalf of Honeywell was tasked to carry out a Phase 3 documentation survey of target A13, a canal boat wreck that lay outside the project's direct Area of Potential Effects (APE) but which has been impacted by dredging and capping procedures.

The documentation of site A13 involved several methods of data recovery including videography and detailed measured drawings. The archaeological activities complied with the NY State Office of Parks, Recreation and Historic Preservation's *Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in NY State* and the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation,* as amended and annotated (48 FR 44716).

This report presents the details of the archaeological documentation and analysis of data recovered and is presented as an addendum to the results of the other Phase 3 archaeological surveys completed in support of the Onondaga Superfund Site Clean-up project. These results were presented in the document: *Phase 3 Underwater Archaeology Report for Onondaga Lake Bottom, Subsite of the Onondaga Lake Superfund Site, Onondaga County, New York* submitted in May 2014.

The detailed documentation of site A13 revealed it to be an early 20th century stave-bowed canal boat that was constructed during the earliest years of the New York State Barge Canal System. This vessel is a well preserved example of another vessel class of the many watercraft types that operated on Onondaga Lake in the late nineteenth and early twentieth centuries. This vessel is now part of a small dataset of freshwater, inland, vernacular craft that played vital roles in the development and maintenance of the commerce throughout western New York and beyond. The documentation of the wreck remains has added a significant amount of valuable data about these under-represented vessel types.

ACKNOWLEDGEMENTS

So many individuals have contributed to the years of research and fieldwork represented in this report that there is not room enough to acknowledge every one individually. Lake Champlain Maritime Museum is particularly grateful for the hard work and dedication of the following individuals and organizations, without whom this study would not have been possible:

Ron Adams
Pierre LaRocque
Adam Kane
Cherilyn Gilligan
Craig Williams
Arthur Cohn
Sarah Tichonuk
Onondaga Historical Association
The Erie Canal Museum
Kelly Miller, Parsons
NY State Museum
Syracuse University Special Collections
University of Vermont Special Collections
The Salt Museum at Onondaga Lake Park
The staff of Candlewood Suites
Honeywell
Parsons
Sevenson

MANAGEMENT SUMMARY

SHPO Project Review Number:

Involved State and Federal Agencies:

NY State Department of Environmental Conservation
NY State Office of Parks Recreation and Historic Preservation
U.S. Environmental Protection Agency

Phase of Survey:

3

Location Information

Location: Onondaga Lake
Minor Civil Division: Towns of Salina and Geddes and City of Syracuse
County: Onondaga

USGS 7.5 Minute Quadrangle Map:

Syracuse West

Archaeological Documentation Overview:

This report presents the results of a Phase 3 underwater archaeological investigation of Target A13 located in Onondaga Lake which had been impacted during remedial activities associated with the Onondaga Lake Superfund site. Four days of archaeological fieldwork were executed in October 2015 by Lake Champlain Maritime Museum (LCMM) on behalf of Honeywell and under subcontract to Parsons, Inc.

Results of Archaeological Documentation:

Site A13 was subjected to a Phase 3 Documentation study. The documentation involved several methods of data recovery including videography, photography, and detailed measured drawings. The results of this documentation include scale drawings of the wreck site which was revealed to be an early 20th century stave-bowed canal boat that dates to the earliest years of the New York Barge Canal System.

Report Authors:

Christopher R. Sabick, Sarah L. Tichonuk, and Cherilyn Gilligan

Date of Report:
November 10, 2016

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

This report presents the results of a Phase 3 underwater archaeological documentation, executed under subcontract to Parsons, Inc. and on behalf of Honeywell, of site A13, a stave bowed canal boat located on the bottom of Onondaga Lake. The work was undertaken by Lake Champlain Maritime Museum (LCMM) to mitigate and document this resource which has been impacted during remedial activities in Onondaga Lake.

This documentation facilitates management and assessment of archaeological resource A13 in Onondaga Lake consistent with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended; the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation*;[1] the NY Archaeological Council's *Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in NY State;*[2] and the NY State Historic Preservation Office's *Phase I Archaeological Report Format Requirements*.[3]

PROJECT LOCATION AND DESCRIPTION

Onondaga Lake is located in Onondaga County, NY and is contained within the City of Syracuse, and the towns of Salina and Geddes (
Figure 1 and 2). The lake has an aerial extent of about 4.5 square miles (11.7km^2), with a drainage basin of approximately 233 square miles (603.5km^2).

The Onondaga Lake Superfund Site comprises the Onondaga Lake bottom, seven tributaries, and upland sources of lake contamination. The remedy for the Onondaga Lake bottom subsite was selected in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA) and documented in a Record of Decision.[4]

Site A13 is located in the southwest section of Onondaga Lake, about 320 yards (292m) from shore in approximately 35-40 feet (10.6-12.2m) of water (Figure 3). The documentation of this site involved several methods of data recovery including videography and detailed measured drawings. Fieldwork was executed by LCMM in October, 2015.

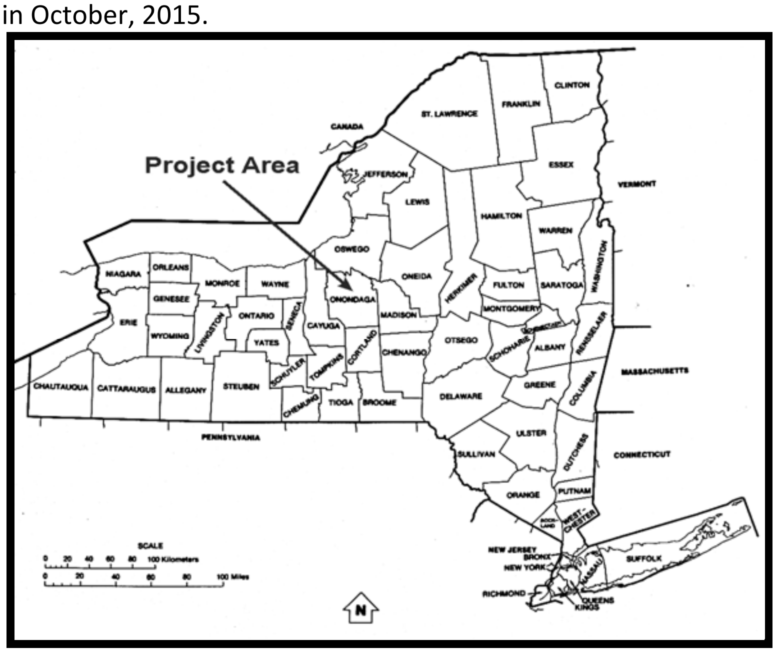


Figure 1: Map of NY State showing the Project Area.

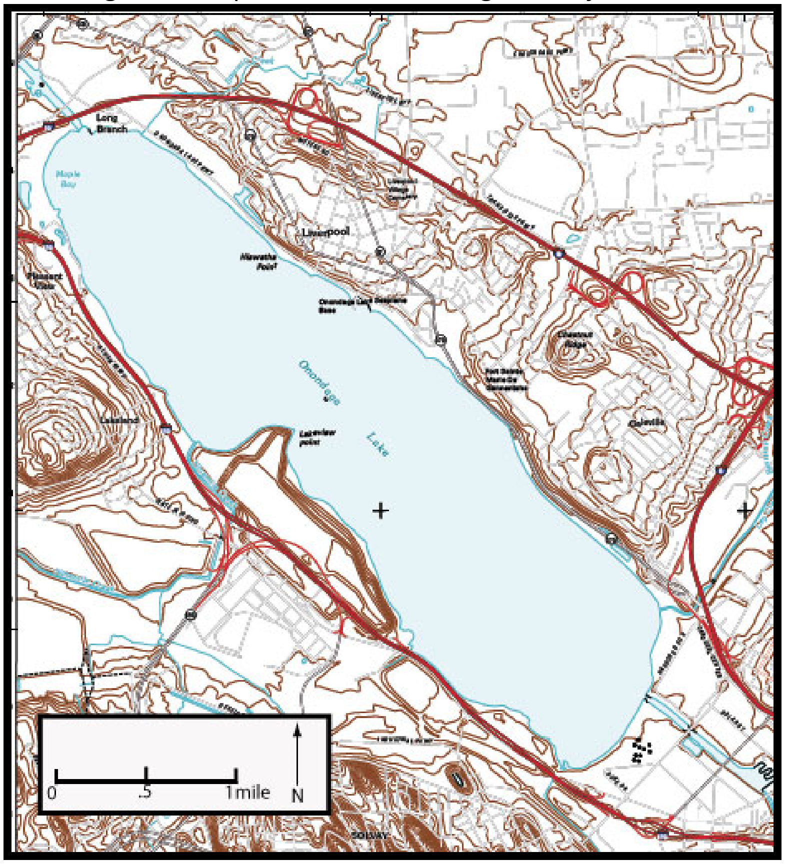


Figure 2: Excerpt from the Syracuse West 7.5 minute Quadrangle showing Onondaga Lake (United States Geological Survey, Syracuse, NY 7.5 Minute Quadrangle, 2010).

Figure 3: Location of Anomaly 13 (A13), in Onondaga Lake (Imagery courtesy of Google Earth Pro)

PREVIOUS ARCHAEOLOGICAL WORK

The basis of this report is found in the previous archaeological and geophysical work undertaken in and around Onondaga Lake. In 2004, the Public Archaeology Facility of SUNY Binghamton carried out a Phase IA cultural resources assessment of the Onondaga Lake Site.[5] This work recommended a Phase IB archaeological survey be executed in Onondaga Lake and along the shoreline due to the high potential that those areas may contain historic cultural resources.[6] In 2005, CR Environmental of Falmouth, Massachusetts, conducted a remote sensing survey of the lake bottom. The effort recorded side scan sonar, magnetometer, bathymetry, and sub-bottom profiler data primarily in support of the remedial design effort. The survey located 755 sonar targets and 1256 magnetic anomalies on the lakebed, including Anomaly 13 (A13) (Figure 4).[7] In 2011, LCMM submitted results from a Phase 1B research which further examined 60 of those anomalies and determined that 20 were recommended as eligible for the National Register of Historic Places (NRHP).[8] While A13 was determined to be eligible for the NRHP it was also determined to be outside of the remediation projects Area of Potential Effects (APE). However, diver examination of the site, related to non-archaeological survey efforts, revealed that the site was being impacted by the dredge spoil pipe that passed over the site from dredging operations happening elsewhere. The revelation of these impacts led to NYS historic preservation officials to recommend that the site be documented archaeologically. The following report is a result of those documentation efforts.

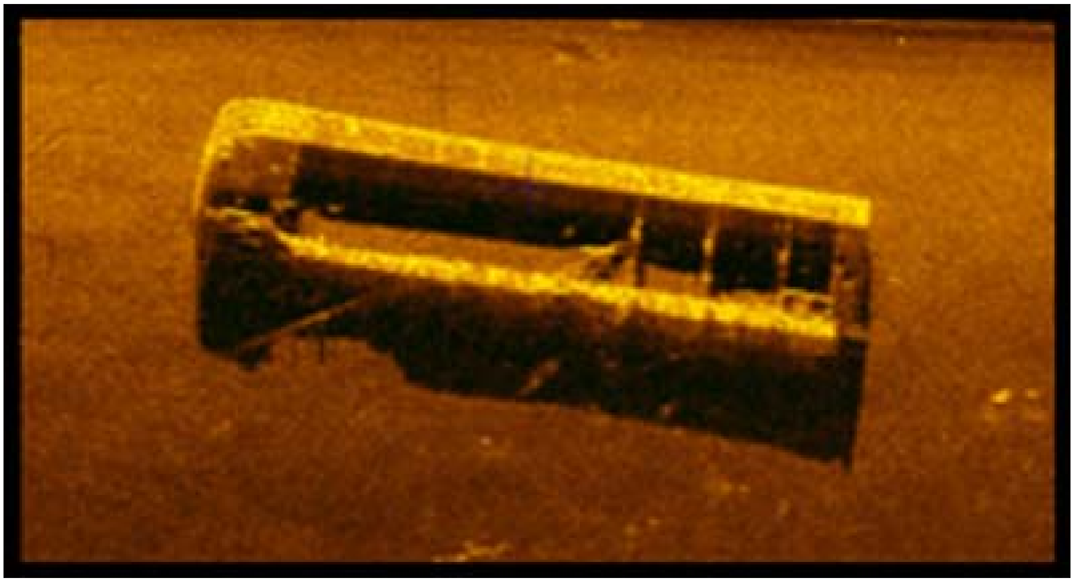


Figure 4: Sonar image from 2005 showing Anomaly 13 (courtesy CRE)

REPORT ORGANIZATION

This report contains five chapters and four appendices. The Introduction contains background material pertinent to the project. Chapter 2 contains the methodological approach used to gather the archaeological data. The historic context for site A13 is presented in Chapter 3, and the Archaeological data is presented in Chapter 4. Chapter 5 contains the summary and the conclusions of the site examination of A13.

Appendix 1 presents the projects Dive logs. A list of Acronyms is presented in Appendix 2 and a Glossary of terms is presented in Appendix 3. The Endnotes are found at the end of the report.

METHODOLOGY

ARCHAEOLOGICAL METHODOLOGY

The methods used in the archaeological examination of A13 are standards in the field, and have been refined by Lake Champlain Maritime Museum (LCMM) staff over the past twenty-five years. The archaeological study was non-destructive and no artifacts were recovered.

The field techniques implemented by LCMM archaeologists were designed to gather the data necessary to accurately reconstruct the vessel's structure. Data was gathered in a logical progression from general to detailed. Documentation initially focused on the site's overall construction or arrangement, with later dives devoted to filling in specific construction details. Because this project had the advantage of continuity of crew, individual team members were given large portions of each site to record in detail. All field measurements were recorded in feet and inches, which was the system of measurement by which the vessels and features were originally constructed.

Measured Documentation

A vessel's hull structure lends itself to use as a reference grid for recording the locations of features. Baselines, consisting of fiberglass reel tapes, were established on the site. Using multiple baselines and off-set measurements, archaeologists recorded where features were located. Small steel rulers were used to map smaller details of the shipwreck. Other recording tools included clipboards with drafting film, staplers, and awls. Recording of curved portions of a structure was aided by the use of a digital goniometer, a digital level set in a 1 foot (30.5 cm) wide waterproof housing. The level allows the curvature of a structural member to be recorded in a series of 1 foot (30.5 cm) increments as the goniometer is "walked" along a baseline. This methodology has been used dozens of times by LCMM archaeologists over the past twenty-five years on Lake Champlain, and has proven effective at accurately capturing the complex curves found in vessel hulls.

Field notes were initially recorded on drafting film with the site name and number, date, area of investigation, the recorder's name, and the field note number. Immediately after the dive, archaeologists recopied their field notes onto graph paper. These recopied notes were also used to record observations too complex to note while working underwater. Recopied note numbers correspond with original field note numbers, and all were inventoried.

Each archaeologist converted his or her field measurements into scale drawings. Definitions of the different drawing types that were produced are below.

- Plan View: A drawing showing the site as if viewed from above looking straight down.
- Cross Section: A drawing showing a transverse section of the vessel or feature.
- End Elevation: A drawing showing the structure as viewed from the end.
- Profile Elevation: A Drawing showing the site as if viewed from off to one side.

Videographic Documentation

Videographic documentation of A13 was gathered using GoPro Hero 3 camera combined with the lighting system from a Light and Motion Blue Fin video housing. Archaeologists made sufficient passes with the video camera to insure thorough coverage of the site. Features of particular interest were documented thoroughly by videoing them from as many angles as possible. The footage captured with this technique was also used to produce still images of particular vessel features when needed.

DIVE METHODOLOGY AND SAFETY PRACTICES

This section provides an outline of procedures which ensured the safety of project divers and facilitated the effective completion of project goals and objectives. The diving operations for this project met all federal requirements for safe diving. All diving activities were in accordance with the strictest provisions of U.S. Army Corps of Engineers and LCMM diving safety manuals and diving guidelines. The safety of project divers was given priority in all decisions and actions undertaken during diving operations. During all diving operations conducted as part of this project, all persons diving and working under the auspices of LCMM abided by this Dive Safety Plan.

Diving Operations

The primary dive platform was securely anchored or moored during all diving operations. All dive operations took place within 100 feet (30.5m) of a dive flag.

Dive teams consisted of four people: one diver, one standby diver, one tender, and one dive supervisor. Each diving member of a team helped the other diving member don, remove, and adjust equipment. The Diving Supervisor checked to ensure that all divers were properly rigged and adjusted immediately before the diver entered the water. No diver entered the water until clearance from the Diving Supervisor had been given. Each diver checked all equipment for proper function immediately upon submerging and upon reaching the bottom before conducting any work.

Schedule and Duration of Diving

Diving took place over four days in October 2015. Dives and divers were restricted to no-decompression limits. In calculating no-decompression limits the next greater time and next greater depth was used on standard U.S. Navy Diving tables. The LCMM dive team carried out a total of 22 dives over four days. Total bottom time for the project amounted to 17.5 hours.

Environmental Conditions

Water depths in the project area did not exceed 40 feet (12.2m), and currents were negligible. Underwater visibility was between 2 and 8 feet (.6-2.4m) (Figure 5). Water temperatures varied between 50 and 65°F (10-18.3°C). Divers donned a range of dry suit undergarments according to that dive's thermal conditions.

Figure 5: Archaeological diver Pierre LaRocque on site A13 (LCMM Collection)

Hazard Analysis

A range of hazardous chemicals are found in Onondaga Lake's bottom sediments. Mercury contamination is found throughout the lake, with the most elevated concentrations detected in sediments in the Ninemile Creek delta and in the sediments and wastes present in the southwestern portion of the lake. Other contaminants present within Onondaga Lake sediments include benzene, toluene, ethylbenzene, and xylenes (BTEX), chlorinated benzenes, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and polychlorinated dioxins and furans (PCDD/PCDFs). The Human Health Risk Assessment for Onondaga Lake found that that contamination in Onondaga Lake presents risks to human health that are above EPA guidelines. In addition, the primary sources of these cancer risks and non-cancer health hazards are due to mercury, PCBs, and PCDD/PCDFs as a result of the consumption of Onondaga Lake fish. However, studies showed that reasonable maximum exposure cancer risks (3.7 × 10-6) for exposure to south basin sediments for construction workers exceeded the low end of the target risk range of 1 × 10-6. All other reasonable maximum exposures (RME) risks for future construction workers were less than the target range.

In general, LCMM divers did not impact the bottom sediments, except for occasional inadvertent contact. The diving equipment and techniques employed prevented any sediments or lake water from touching the diver's and other crew members' skin.

All divers were subject to a decontamination protocol:

1) Upon exiting the water, the diver was washed down with lake water from a high volume hose;
2) The diver was sprayed with a solution of Alconox and water and scrubbed with a brush (Figure 6);
3) The diver was rinsed with clean water;
4) The diver doffed his/her gear;
5) The diver was rinsed with clean water;
6) The dive gear was rinsed with clean water.

Figure 6: During the decontamination procedure, this LCMM diver is sprayed with a solution of Alconox and water (LCMM Collection).

Personnel

The dive team consisted of four individuals: a Diving Safety Officer (DSO), an Assistant Diving Safety Officer (ADSO), and two archaeological divers. Each dive team member met the training and qualification requirements established in USACE Safety and Health Requirements Manual (EM 385-1-1).

Dive Platform

Dive operations were staged out of the Lake Operations Center. This site was ideal due to its central location to the project area, ample space for equipment preparation and break-down, and access to restroom facilities. The dive platform utilized was a 30 foot (9.14m) pontoon boat (Figure 77). The dive vessel carried a spare parts kit, tool kit, first aid supplies, and potable water. The dive vessel conformed to U.S. Coast Guard specifications according to class, and had on board all required safety equipment. The vessel was equipped with a safe and secure dive platform/ladder used by divers, aided by their tender, when entering and leaving the water.

Figure 7: Dive platform at Onondaga Lake Park Marina, 2013 (LCMM Collection).

Diving Equipment

The SCUBA equipment was currently certified. A full set of back up equipment was available in the event of equipment malfunction. SCUBA equipment included:

1) Full face mask demand regulators;
2) A primary SCUBA cylinder (either a standard 80 cubic foot aluminum or a steel 95 or 104 cubic foot cylinder);
3) A pony bottle (30 or 18 cubic foot aluminum) with regulator;
4) The regulator attached to the primary cylinder was equipped a submersible pressure gauge;
5) A depth gauge;
6) A bottom timer;
7) A buoyancy compensator device (BCD) capable of floating the diver;
8) A dive knife;
9) A dive light;

10) Drysuits equipped with dry gloves and latex hoods;
11) Surface to diver and diver to diver communications (Wireless OTS Aquacom);
12) An inflatable signal device; and
13) Dive Alert.

Safety Considerations

All diving was performed in accordance with the U.S. Army Corps of Engineers "Safety and Health Requirements Manual" EM385-1-1 dated September 2008 and with the U.S. Navy Diving Manual. Safety was a primary goal of this project, and diver safety was given priority in all decisions and actions undertaken during diving operations. All dive operations were guided by the *Dive Safety Plan* created by LCMM specifically for the work carried out in Onondaga Lake, and by LCMM's *Safe Diving Practices Manual*.[9] Safety oversight was provided by Parsons.

A dive briefing preceded each day of diving. The briefing included an assessment of safety aspects, potential hazards, tasks to be undertaken, emergency procedures, and any necessary modifications to operating procedures. The DSO noted dive briefing attendees and topics discussed on the dive log. All dives were logged throughout the dive, and written comments for the dive log were required of the returning diver immediately upon completion of each dive. Upon completion of a dive and prior to the commencement of the next dive the returning diver informed the dive supervisor about diving conditions observed and specifically about any hazards or potential hazards encountered. Divers remained awake for at least one hour after a dive. Divers waited at least 12 hours before flying after any dive; this was extended to 24 hours following multiple days of diving.

An international diving flag (Alpha flag) and a civilian "diver-down" flag (red with white diagonal stripe) was raised on the diving platform prior to, and lowered following completion of, all diving operations. One crew member was designated as the traffic observer with the task of alerting passing craft of diving operations.

Accurate timepieces were carried by all diving personnel. Fire extinguishers were aboard the dive platform and in each vehicle used. The dive team had a 16 unit first aid kit, a spineboard with flotation, and oxygen on hand during all diving operations. All personnel were familiar with safety procedures and with the locations of safety equipment. There were no accidents or injuries during the fieldwork; if there were, they would have been reported to the diving supervisor immediately, and a report of injury form would have been completed.

Bottom times did not exceed one hour, and divers performed no more than two dives each day. Diving was conducted only on days that weather and conditions permitted safe diving. Diving was not conducted if any of the following conditions prevailed: high winds, thunderstorms, waves exceeding two feet (.61m), low surface visibility conditions (less than 100 feet [30.5m] of visibility), or currents exceeding 1 knot.

Fieldwork was executed by Pierre LaRocque (LCMM Archaeologist, Dive Safety Officer, and Vessel Captain), Christopher Sabick (LCMM Archaeological Director), Sarah Tichonuk (LCMM Archaeologist), and Ronald Adams (LCMM Archaeologist).

HISTORIC CONTEXT

The following chapter provides the historic context necessary to more fully understand the archaeological finding of the documentation of A13. This context is specific to this site. For a more comprehensive historical context of Onondaga Lake please see the *Phase 3 Underwater Archaeological Report for the Onondaga Lake Bottom, Subsite of the Onondaga Lake Superfund Site, Onondaga County, New York,* to which this document is an addendum.

THE ERIE CANAL SYSTEM

The construction of the Erie Canal system began in 1817 and was completed in 1825. It was built by the New York State Commission in order to connect Albany to Buffalo, subsequently connecting the Great Lakes to the Hudson River. This initial system of canals cost $352,000,000 and was paid for entirely by New York State. The canal was 343 miles (552km) long, 4 feet (1.2m) deep, 40 feet (12.2m) wide, and had stone locks measuring 15 feet (4.6m) wide by 90 feet (27.4m) long. Vessels utilizing this waterway were drawn by horses and mules.

In 1822, the salt industry demanded access to Onondaga Lake and the beginning steps toward the construction of the Oswego canal system were set in motion. The Oswego canal opened in 1829, connecting the Erie Canal to Lake Ontario through the city of Syracuse, New York.

In 1835, efforts were taken to enlarge and improve the navigability of the entire canal system due in part to the large amount of traffic along the waterway. By 1862, the Erie Canal was straightened and measured 7 feet (2.1m) deep by 70 feet (21.3m) wide, with locks 18 feet (5.5m) by 110 feet (33.5m). In addition, the Oswego, Seneca, Cayuga, and Champlain canals were deepened.

In order to stay competitive with the railroad industry, the second enlargement of the Erie Canal system began in 1903 (Figure 8). This expansion was referred to as the Barge Canal and the existing system was enlarged to accommodate barges capable of moving up to 1000 tons. When it opened in 1918, the Barge Canal locks measured 350 feet (106.7m) in length and about 45 feet (13.7m) in width. Vessels could not exceed 15 feet (4.6m) above the water line in order to pass under bridges along the canal route and vessels could not have a draft over 9.5 feet (2.9m). This was because sections of the canal remained shallower than others and a boat with a draft greater than 9.5 feet (2.9m) would not be able to traverse the entire canal system.[10]

THE BARGE CANAL

When the Barge Canal opened in 1918, the state of New York had spent about $150,000,000 on improving and modernizing the canal system. Unfortunately, the huge cost of such modernization efforts left the state no funding and limited materials for building the fleet that would be needed for a larger canal.[11] The Superintendent of Public Works in New York published a report on the canals of the State each year, highlighting major issues concerning canal usage, public recommendations for those using the canal, and all data collected on freight moved along canal ways.[12] In the years leading up to the opening of the Barge Canal, pressing issues were raised by Major General William W. Wotherspoon, Superintendent of Public Works from 1915 to 1919. Some of the main issues raised included how the United States federal government could utilize the New York State canals to aid the war (WWI) effort and boost canal industry, and what kinds of new vessels would be most efficient in the new canal system.

Figure 8: Construction of the Barge Canal Prism, Onondaga County, c.1910 (courtesy of Erie Canalway Museum)

The United States' entry into World War I in 1917 severely limited the ability of private investors to manufacture and outfit fleets of barges and other floating equipment for use on the new Barge Canal.[13] This prompted the New York Superintendent to, rather passionately, plead to the US federal government for aid in supplying the new Barge Canal with proper fleets. In 1917, Superintendent Wotherspoon stated that the, "waterways [have] been provided by the State of New York, without the aid from the National government, and that it was lawful and proper in the present national emergency that the Federal government should provide means for making the canals effective."[14] It was Wotherspoon's opinion that only an operating company like that of the railroad would be able to survive on the new Barge Canal and that if the federal government supplied a subsidized service, it would bolster the ability of independent investors to establish and model their businesses after the large scale, federally controlled operation. Superintendent Wotherspoon recommended that the US federal government build at least 100 modern boats for canal use and that the 600 or so canal boats already in use be put to work at full capacity under federal control.[15] It was also recommended that, in conjunction with the building of new canal vessels, "freight should be diverted from the rail routes for transportation by canal" since transportation by water would be more efficient and would alleviate the congestion of the railways.[16]

Meetings between New York State officials were held through the winter months of 1917 in attempts to sway the US federal government to become involved in canal operations. Finally, in April of 1918, representatives of the National Committee on Inland Waterways presented a plan to the New York State Canal Board for US federal control of freight over the state canal systems in the coming year.[17] About 200 'old type' (animal drawn, approximately 240 ton capacity) canal boats, and several tug boats were obtained for use by the federal organization. It was also determined that the federal operation would only utilize the Erie Canal ways. Superintendent Wotherspoon conjectured in the annual Public Works report in 1918 that this was likely due to the fact that the Champlain Canal business was already well organized and that there was greater government interest in commodities moving along the Erie Canal.[18]

No new freight transporting companies entered into business in 1918, and the federal operation remained the only carrier on the Barge Canal in its first year of operation. In response, Superintendent Wotherspoon encouraged independent operators to make use of the Barge Canal in the annual Public Works report stating, “those interested in the formation of such companies may be assured that every facility possible will be offered by the State for the success of the venture.”[19] It was also stated in the 1918 annual report that the government operation would not prevent independent operations from entering the field.

In its first year of operation, the federal organization moved about 30 percent of the total freight carried along the Erie Canal and about 18 percent of the total freight carried along all canal ways.[20] Most of the freight moved by the federal operation was grain and grain products although other commodities such as salt, pig iron, copper and other materials were also carried. In fact, it was reported that the amount of wheat moved in 1918 was more than three times the amount moved in 1917.[21] Overall, the federal operation was credited with an excellent year despite the limited supply of watercraft available.

Superintendent Wotherspoon’s report the following year was much less encouraging of federal operations along the Erie Canal. The report stated that, “the operations of the federal government on the waterways of the State have proven an utter failure and distinctly prejudicial to the best interest of the people of the State.”[22] In 1919, the federal organization acquired 57 new barges but moved less than 16 percent of the total freight carried; this was two percent less than the previous year, while the overall canal traffic increased by seven percent. It was the Superintendent’s opinion that since the circumstances of war warranted the help of the US federal government on the New York State canal ways, once the war was over the government should relinquish its control. In his 1919 report, Superintendent Wotherspoon blamed the US federal government for the lack of new independent operators on the canal stating that, “few, if any, shipping men are willing to compete with a subsidized federal canal service that operates without regard to cost and that assumes no obligation to produce a profit from its operations.”[23] Although limiting statutes were imposed on the federal operations in the year 1919, Wotherspoon believed that independent operations would thrive only if the US federal government would disband their canal operations altogether.[24]

In the 1920s, more transportation companies began operating on the canal, using more modern floating equipment. Although the tonnage of freight moved by canal each year continued to rise, the Barge Canal was still nowhere near its projected capacity. In 1924, the new Superintendent of Public Works, Frederick Stuart Greene reported that the yearly tonnage moved by canal was only 10% of the estimated capacity.[25] Superintendent Greene went on to state that, “either something is radically wrong with the canal, or the day of carrying freight by canal boats is over.”[26] Greene also mentioned in this report that the transportation of lumber, a once common commodity moved by canal, had now switched to transportation by motor truck.

The estimated annual capacity of the Barge Canal was about 20,000,000 tons of cargo, but the closest figure for annual tonnage moved was little more than one quarter of that projection. In 1936, the annual tonnage moved by canal reached 5,015,206 tons, the highest record annually for the Barge Canal.[27] Tonnage continually fell between the 1940s and the 1970s. After the St. Lawrence Seaway opened in 1959, tonnage moved along canal dropped more dramatically and by the 1970s, the Barge Canal moved mostly petroleum products in tank barges pushed by tug boats.[28]

VESSELS ON THE BARGE CANAL

In the years of the old Erie Canal all canal boats were towed through the canals by horse or mule until steam powered tug boats were introduced to the waterway in the 1910s.[29] Once they reached the open waters of standard boats would be tied together in large tows by hawsers, or long, thick ropes that would travel together (Figure 9).

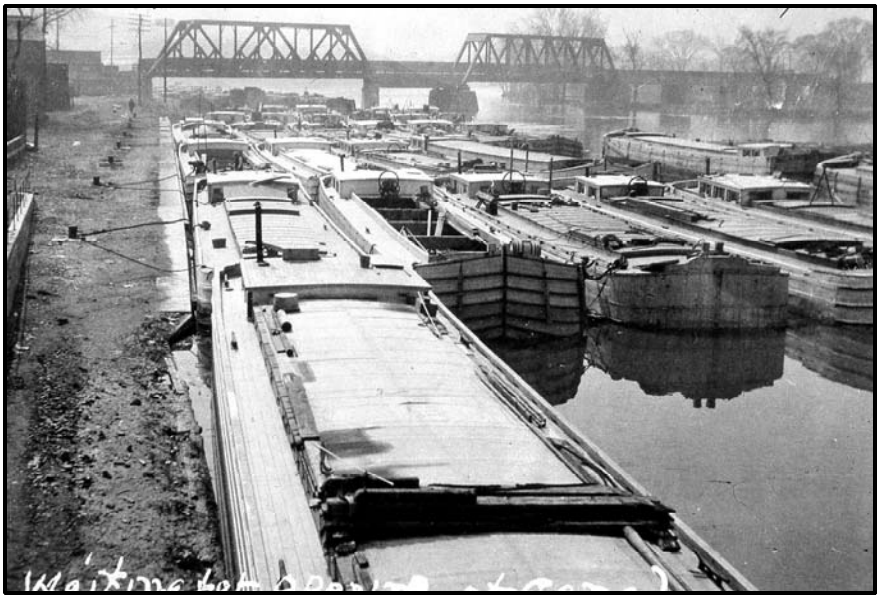


Figure 9: Canal Boats in Whitehall, NY await a tow, note the stave bowed canal boat center right. (LCMM Collection)

The new Barge Canal meant the beginning of the end for the old, animal drawn type of canal boats. The Superintendent of Public Works in New York, Major General William W. Wotherspoon, felt that it also meant the end of single boat owners and the old canal man's way of life. Steam powered tug boats were made available to the 'old type', animal towed canal boats beginning in 1914, as the widening of the canals expanded into and eliminated the old tow paths.[30] This service was made available by New York State, free of charge, though in 1917, Wotherspoon did report that, "the time has come when those using the new system should adapt their boating equipment to the new conditions".[31]

This free tow service was a huge cost annually to the State of New York. Beginning in 1917, New York State began charging 20 cents per boat per mile for the towing service to alleviate the high cost and act as incentive for boat owners to adapt their vessels for the Barge Canal. This subsidized service would be made available along the entire length of the canal.[32] As a result, the 17 tugs available for tow service were each assigned a section of the canal. This system proved to be inefficient and caused many delays since there were not enough tugs available to service the amount of old type canal boats still in use. Superintendent Wotherspoon stressed again in his 1917 report that the canal cannot be used at maximum capacity until the vessel owners can provide their own motive and not rely on aid from the State.[33]

The new Barge Canal locks measured about 310 feet (94.5m) long and 45 feet (13.7m) wide, therefore the size of vessel that could fit through the locks could be no larger than 300 feet (91.4m) in length and 42 feet (12.8m) in width with a maximum draft of 9.5 feet (2.9m) while in motion along the canal.[34] Beginning in 1916, shipyards began producing new, wider and longer vessels for use in the new canal. It was stated in Wotherspoon's annual Public Works on the Canals of New York State report that it would be impractical to build single boats to fill those dimensions. Instead, a few models were suggested:

> "A barge 250 feet (76.2m) in length, and 35 to 40 feet (10.7-12.2m) in width, with 12 foot (3.7m) sides; another 150 feet (45.7m) in length and 22 feet (6.7m) in width with the intention of passing four such craft through a lock at the same time, one of the four containing the motive power of the fleet…a boat of such dimensions would carry approximately 600 ton of freight."[35]

Vessels carrying 600 tons were considered ideal and said to be easily handled by destination ports.[36] In 1917, these recommendations were modified into three types listed below:

(1) A barge 150' (45.7m) long, 21' 4 1/2" (6.6m) wide, draft 8 1/2 ' to 9' (2.6-2.9m), 600 tons
This type would be operated in fleets of four, which could all pass through locks at once, with one vessel acting as the motive power for the fleet or the fleet could have a separate tug boat.
(2) A barge 207' (63m) long, 38' (11.6m) wide, draft 9 to 9.5' (2.7-2.9m)
This barge would be operated singly with its own motive power on board.
(3) A barge 102' (31.1m) long, 21' (6.4m) wide, draft 6' (1.8m)
These barges would be operated in fleets of five or six with one power barge or with a separate tow boat.

The recommendations recorded in the Public Works reports were a reflection of plans and designs submitted by manufacturers in order to encourage discussion on the matter. The Public Works department was collecting and reporting these data in order to aid boat builders preparing for the opening of the Barge Canal. A 1939 court case demonstrated the staying power of one of the 1917 recommendations. The case involved the damaged "*Nanna C*," a wooden barge canal boat measuring 108 feet (32.9m) long, 22 feet 6 inches (6.9m) wide, and 10 foot (3m) draft. This vessel moved along the canal in a fleet of 6 or 7, passing through locks 3 or 4 at a time.[37]

In addition to these reports, Superintendent Wotherspoon instituted a new boat registration system requiring new data on each vessel in operation beginning with the 1918 season. These data required for operators included, "a statement of ownership of every boat operated under their control, its name and hailing place, dimensions and type, its class, when built and insured value."[38] Each vessel was given a register number, which replaced the old system based on names of vessels. Classes of vessels were broken down into four groups ranging from first class vessels, capable of transporting 'high class freights' to fourth class vessels that were uninsurable, older vessels only able to transport goods of the lowest grade. The reasoning behind the new registration system was based on the, "decline of canal commerce and gradual withdrawal of boats from the canal because of unseaworthiness."[39] It was also a more efficient means of collecting data on the movement of goods and types of successful boats and fleets used along the canal.

Wotherspoon's new boat registration system for the Barge Canal showed that in its first year of operation in 1918, a total of 1,004 vessels were registered. Those vessels registered as 'first class condition' included 322 cargo boats, 20 steam freighters, and 48 tug boats. Vessels in second and third class condition numbered 448 cargo boats, 28 steam freighters, and 33 tug boats. Finally, in fourth class, only five cargo boats were registered for the year 1918.[40] A further breakdown of these new registration data between the years 1920 and 1922 shows the popularity of 'new type' wooden barges with carrying capacities ranging from 100 to 700 tons.

Figure 10 was published in the 1920 Public Works report and shows that in 1920, the majority of vessels in use by individuals, transportation companies, and industries was an 'old type' of wooden barge with a 240 ton carrying capacity, while a 'new type' of wooden barge canal with a 500 ton carrying capacity was the second most popular vessel used by both individuals and transportation companies.[41] Old and new 'types' of vessels refer to the older, animal drawn type of vessel, or the newer vessels built without stables since the barge canal eliminated the tow paths beside the canal. New type vessels relied on tug boats or had their own motive power aboard.

The following statement shows the various types of craft navigating the canals in 1920, likewise the ownership by three groups:

	Individuals	Transportation Companies	Industries
Old type, 240-ton barge, wood.......	709	113	30
Old type, 100-ton barge, wood.......	....	....	28
Old type, 150-ton steamer, wood.....	8	16	2
Old type, 90-ton packet, wood (inactive)	10	....	....
New type, 500-ton barge, wood......	72	23	....
New type, 350-ton steamer, wood....	....	1	....
New type, 650-ton barge, steel.......	....	51	....
New type, 350-ton steamer, steel.....	....	20	....
New type, 500-ton barge, concrete....	....	21	....
New type, 300-ton packet, wood......	....	....	3
New type, 400-ton barge, steel.......	....	8	....
New type, 650-ton tank barge, steel..	....	....	10
	799	253	73

Figure 10: "…Types of craft navigating the canals in 1920"

Figure 11 from the 1922 Public Works report shows a majority of individuals using old type wooden barges with 300 ton carrying capacity while many new type wooden barges appear with varying carrying capacities ranging from 400 to 700 tons, owned and used by both individuals and organizations.[42] Often, old type wooden barges were renovated to eliminate the useless stables and add extra storage capacity.

The statement below shows the various types of cargo vessels in canal operation during 1922 and the ownership as divided into three groups:

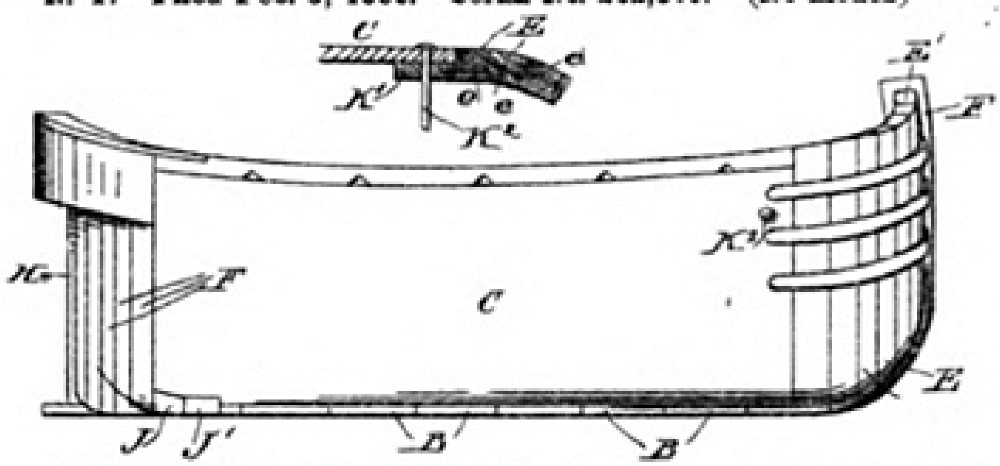
	Carriers		
	Individuals	Organizations	Industries
Old type, 90-ton packet, wood	1	....	....
Old type, 100-ton barge, wood	5	....	22
New type, 100-ton barge, wood (fish boats)	......	....	4
Old type, 185-ton steamer, wood	5	8	7
Old type, 250-ton steamer, packet, wood......	2	....	....
Old type, 300-ton barge, wood	330	73	30
New type, 400-ton barge, wood	......	3	....
New type, 450-ton barge, wood	......	12	....
New type, 450-ton barge, steel	......	30	....
New type, 450-ton steamer, steel	......	15	....
New type, 500-ton barge, wood	75	16	1
New type, 500-ton scow, wood	10	5	....
Old type, 500-ton scow, wood	6	28	....
New type, 600-ton barge, wood	12	....	....
Old type, 600-ton barge, wood	......	1	1
New type, 650-ton barge, wood	1	3	6
New type, 650-ton barge, steel	......	1	....
New type, 650 ton barge, concrete	......	6	....
New type, 700-ton barge, wood	10	....	....
New type, 700-ton motor tank barge, steel....	......	....	4
New type, 700-ton tank barge, steel..........	......	....	10
New type, 750-ton barge, steel	......	51	....
New type, 1500-ton motorship, steel	......	5	....
New type, 2000-ton tank barge, steel........	......	....	4
	457	257	88

Figure 11: "…types of cargo vessels in operation 1922"

STAVE BOW DESIGN

Stave bow ornamentation on canal boats was first developed and patented by Joseph H. Hunt in West Troy, New York. The patent for this boat construction technique was filed in 1888. In the application Hunt described vertical, chamfered timbers around the bow of the boat as seen in Figure 12. This particular bow style can be seen on Pre-Barge Canal style canal boats in Figure 13. The stave bow construction technique was also adapted to the newer, and wider, canal boats developed for Barge Canal use as seen in the construction of site A13.

386,432. BOAT CONSTRUCTION. JOSEPH H. HUNT, West Troy, N. Y. Filed Feb. 3, 1888. Serial No. 262,879. (No model.)



Claim.—1. The herein-described hull of a boat or vessel, consisting of a keelson, stem and stern posts, bottom B, and sides C C, extending forward to the bridge, in combination with the vertical and chamfered timbers E, fitted between the stem-post and the ends of the side C, substantially as described.

2. The herein-described hull of a boat or vessel, consisting of keelson, stem and stern posts, bottom B, and sides C C, extending forward to the bow and stern bilge, in combination with the bow and stern formed of vertical timbers having chamfered edges fitted between the bow and stern-posts and the opposite ends of the sides C C, substantially as described.

Figure 12: Excerpt from Patent application of Joseph H. Hunt for stave bowed canal boat construction (LCMM Collection)

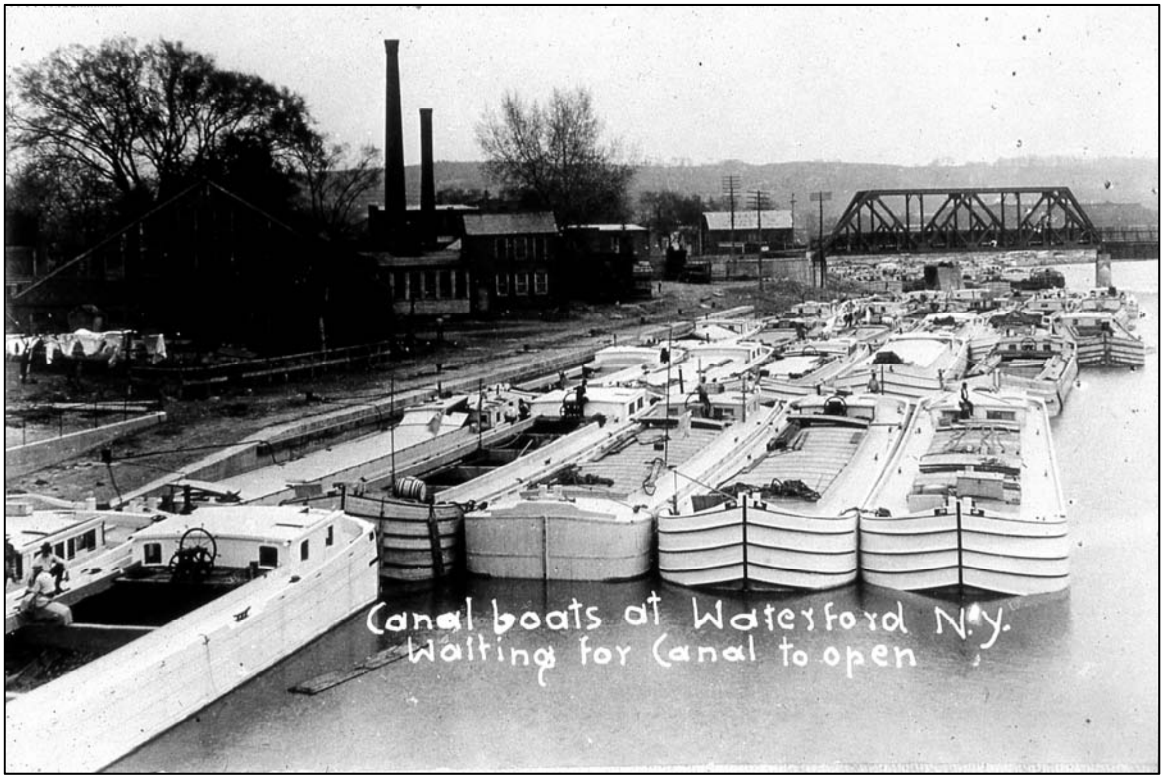


Figure 13: Canal boats in Waterford, NY. Note the stave bowed vessel in the center of the image (courtesy of the Chittenango Landing Canal Boat Museum)

In Richard Garrity's firsthand account of canal boatman, he reported that, "a number of new and slightly different types of wooden barges had been built at Cohoes and other boatyards in that area" during the first few years of the Barge Canal and that they were similar to Erie Canal style boats but, "they had stave bows which were planked straight up and down with rounded corners and, of course, had no bow stables."[43] Garrity explained that these boats were specifically designed for dry grain storage, with special hatch-covered holds and that their dimensions measured 21 to 23 feet wide, 108 feet long, with 12 foot sides and a 600 ton carrying capacity. This specific style of boat was the first generation of the new barge canal boats, some being built with the stave bow. Stave bow boats of these dimensions were still being used and repaired through the late 1930s and into the 1940s as seen by a court case settled in 1939 involving the *Nanna C*.[44] This description also very closely matches the dimensions and arrangement of the vessel at the focus of this study, canal boat A13.

The new boat registration system instated in 1918 recorded many boats with these exact measurements, hailing from areas in and around Cohoes, Waterford, and Whitehall, New York. Boat builder, Jack Ryan had a shipyard in Whitehall, New York at the turn of the century where he was known for his well-built boats with distinctive 'Jack Ryan sterns,' also known as transom or bustle sterns. Ryan adopted Hunt's stave bow construction later on in his career and continued producing canal boats in Whitehall until 1929.[45] Matton's Shipyard in Waterford, New York also produced canal boats with stave bows, visible in Figure 14.

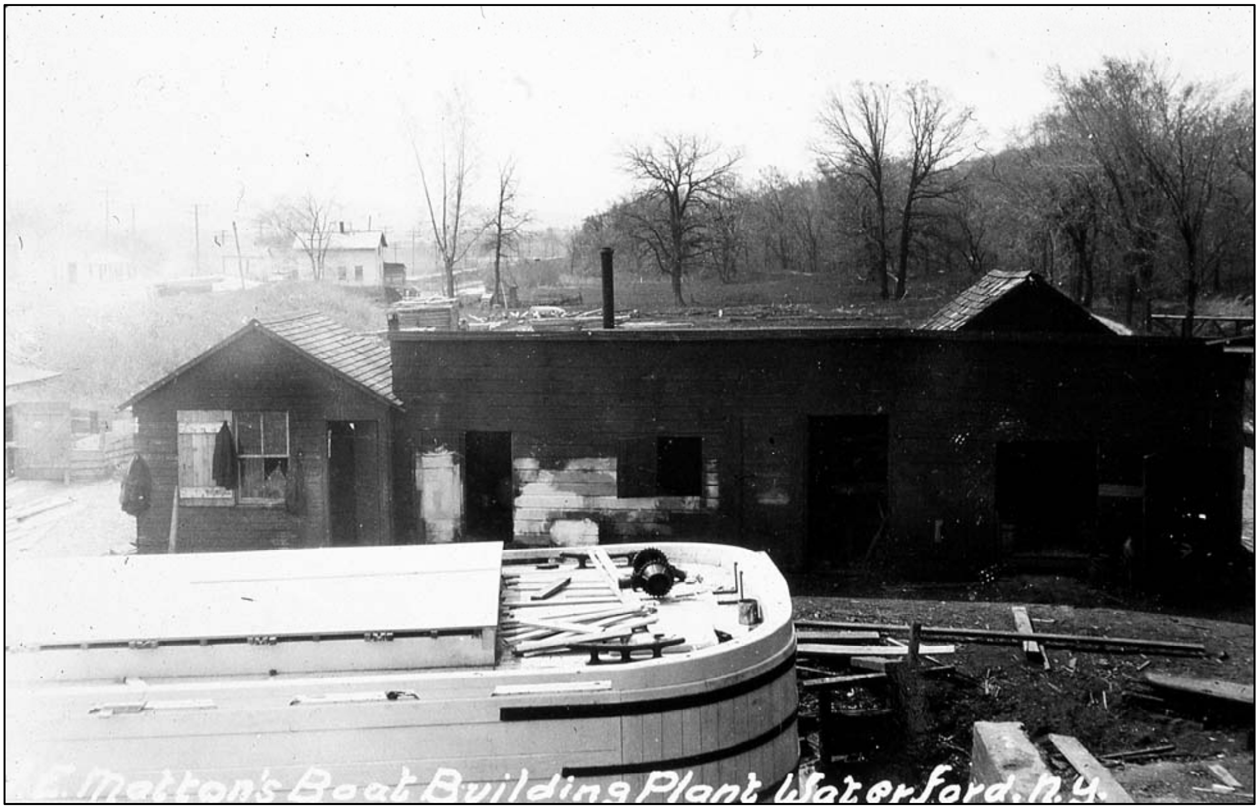


Figure 14: Stave bowed canal boat under construction, Matton shipyard (courtesy of the New York State Museum)

GRAIN BOATS

In its first year of operation in 1918, the subsidized federal transporting company operating in the Barge Canal moved more than three times the amount of wheat than the independent carriers did the previous year. Projections for grain transport for the year 1919 remained at this record high, and the Superintendent of Public Works discussed the need for building grain elevators in New York and the need for more grain boats to be manufactured.[46]

Boatbuilders were still experimenting with new designs for Barge Canal boats between 1918 and 1919, often based on the specifications recommended in the Superintendent of Public Works' annual report. In 1918, a new boat registration system was instated, which documented boat dimensions, type, and class among other data.[47] In addition to the new types of boats being built, including more grain boats, independent carriers were modifying their older canal boats for Barge Canal use, removing obsolete stables and expanding their cargo holds.

Grain boats were often better built than other canal boats and contained an extra lining in the cargo hold to better protect the grain from contact with water. If dry grain in storage came in contact with seepage from the boat, the cargo would swell and could potentially split the hull. These boats were often built with watertight decks and cargo hatches as well as an extra lining in the cargo hold to keep the cargo from coming in contact with the sides and bottom of the boat.[48]

In his memoir, Garrity also explained that a new style of grain boat built in the Cohoes area had stave bows with vertical planks, hatch-covered holds, and very specific dimensions; "The new boats were from

21 to 23 feet wide by 108 feet long with 12-foot sides. They were of 600 ton capacity and carried 20,000 bushels of grain."[49]

The stave bow construction technique and the lining of the cargo hold mentioned above, are both features noted on canal boat A13, suggesting that this vessel had been constructed for the grain trade during the early years of the New York State Barge Canal System.

ARCHAEOLOGICAL RESULTS

SITE DESCRIPTION

Site A13 is the well preserved wreck of an early 20th century stave bowed canal boat built in the early years of the New York Barge Canal System. Evidence in the construction of the hold suggests that this vessel may have been used to haul grain, a common commodity on the early barge canal. The canal boat is 108 feet (32.9m) long, with a 23 foot (7m) beam, and a depth of hold of 10 feet (3m). The construction of the vessel is dominated by the large cargo hatch that runs for approximately 80 feet (24.4m) of the vessels length. No extant cargo is present in the hold which was found to be filled with 5-6 feet (1.5-1.8m) of sediment. One distinguishing feature of this vessel is that the bow is planked with vertically arranged timbers instead of the more traditional horizontal planking. The vertical bow planking is similar in arrangement to the way that barrels are constructed from individual staves, hence the name “stave bowed”.

A13 rests on a level keel on the bottom of Onondaga Lake approximately 320 yards (292m) from shore in 35-40 feet (10.6-12.2m) of water. The area surrounding the site is a featureless mud bottom with no significant aquatic plant growth or fish population. The horizontal surfaces of the site are uniformly covered with a layer of silt from 6-12 inches (15.2-30cm) thick, this does obscure some details of the vessels construction particularly on the foredeck. On the interior of the cargo hold there are at least 5 feet (1.5m) of sediment that obscure the bottom of the vessel and its construction features. Visibility on site typically ranged from 2-6 feet (.6-2.4m) and deteriorated rapidly if the sediment covering the wreck was disturbed.

Site Impacts

Generally speaking, wreck A13 is extremely well preserved. The wood, which makes up the majority of the vessel structure, is still hard and joints between extant timbers are tight. However, the vessel is not completely intact and careful examination of the wreck, and of the various forms of documentation that have been captured of it since it was first discovered in 2005 (video, sides scan sonar, and archaeological documentation were all consulted), demonstrate that the vessel was subjected to both historic impacts and damaged caused by remedial actions that are related to the Superfund cleanup operations.

Historic damage, while significant, is limited to the port side and the above deck structures of the cargo hold and stern. On the forward half of the port side a large section of hull planking is missing or severely damaged. This is also true of the above deck structures like the cargo hatch coaming and the cabin trunk which are also believed to have been damaged historically. These missing structures and the damage to the port side are visible in the side scan sonar image captured in 2005 well before the commencement of remedial actions.

More recent impacts associated with the remediation activities were mostly caused by a dredge spoil pipe sinking to the lake bottom when full and coming to rest on the wreck. This pipe was often maneuvered with powerful tugboats pulling it across the lake bottom. In doing so this pipe appears to have snagged on, and broken free of, the wreck a large number of times causing a significant amount of damage. Along the port side the historic damage, which produced a lot of lose and jagged timbers, was particularly impacted as many of the loose pieces and protruding bolts were torn free or bent over by the pipe impact (Figure 15).

Figure 15: A portion of the rail damage on the port side of A13 (LCMM Collection)

In the bow it appears that the large chock that is positioned forward of the bollards has also been broken and dislocated by this same activity. It has also been noted that several of the vertical bow planks have been disarticulated, possibly at the same time that the bow chock was impacted. Along the starboard side damage to the cap rail and its associated structures was also inflicted upon A13 in recent years. As can be seen on the site plan a portion of the starboard cap rail is missing all together while another section has been pulled up from the deck and is left protruding into the water column.

The remainder of this chapter will consist of detailed discussions of each of the major sections of this sites construction (Figure 16). Descriptions are presented working from the bow to the stern. Additional descriptions of site impacts are presented in the discussions of the sections in which they were found.

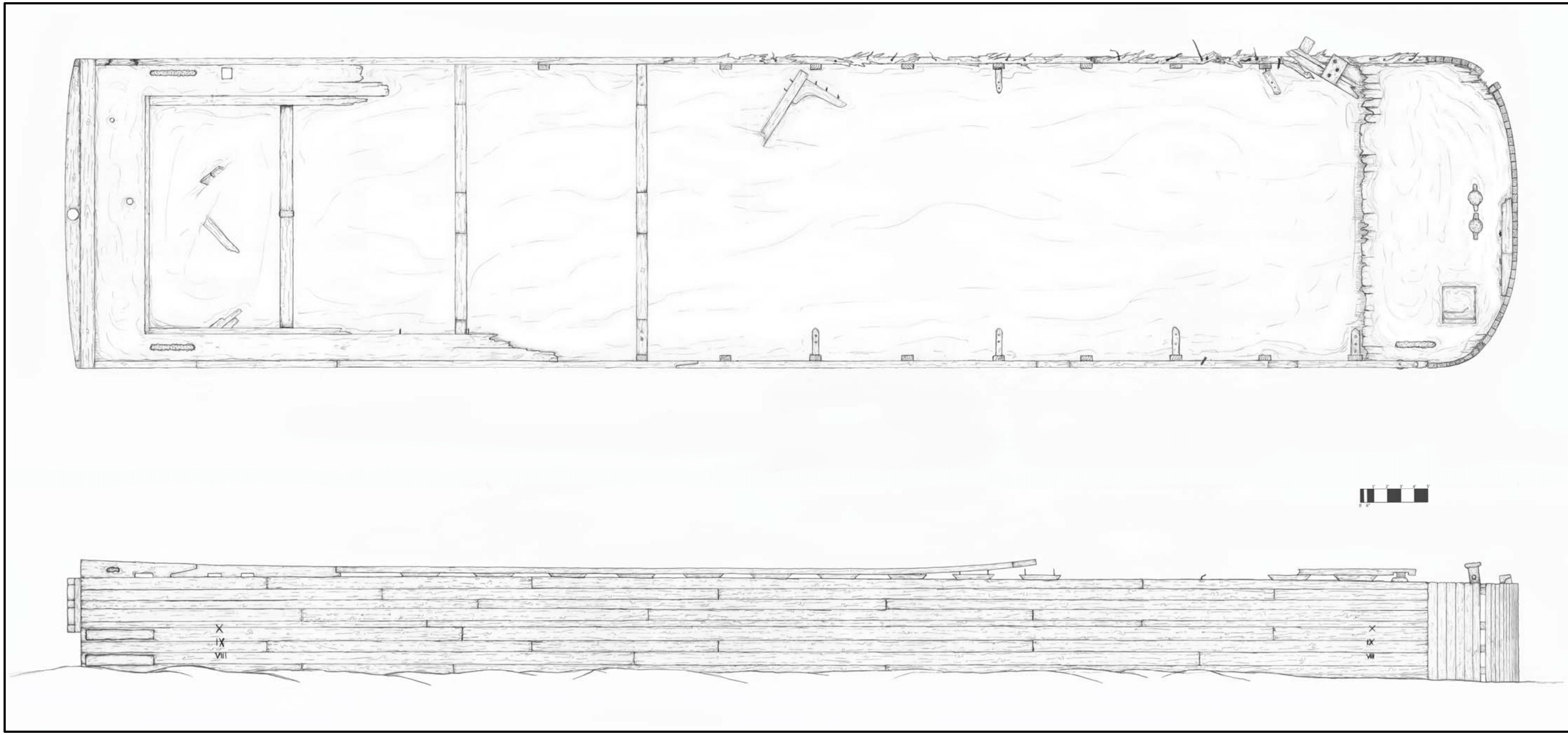


Figure 16: A13 Site plan, Plan and Profile Views (Christopher R. Sabick)

BOW

The bow of A13 is one of its most interesting features. The vertical arrangement of the bow planking on canal boats has been observed in a number of historic photographs and described in some historical sources but it is a feature that has not been documented archaeologically. The bow planking consists of 48 vertical boards that measure 8 inches (20.3cm) wide and 5 inches (12.7m) thick with chamfered edges (Figure 17). This planking begins on either side of the vessel where it is connected to the traditional horizontal planking of the rest of the hull. This juncture occurs 6 ½ feet (2m) aft of the forward most portion of the bow. The "shoulders" of the bow are very bluff leading to a flat on the front of the vessel that is completely perpendicular to the sides. Numerous traces of white paint can be seen on the lower portions of the bow planking.

Figure 17: Top of Bow staves, starboard bow quarter (LCMM Collection)

Unfortunately due to the collapsed nature of the foredeck, and the thick coating of silt on the interior of the vessel, it is impossible to conclusively determine how these planks are supported internally. However in two locations in the bow, damaged stave planking allows for a glimpse of the internal structure and it suggests that a series of breasthooks are spaced vertically throughout the bow (Figure 18). The first of these breasthooks is located 24 inches (61cm) below the bottom of the deck planking and is 6 inches (15.2cm) thick. The second visible breasthook is located 13 inches (33cm) below the first and it is also 6 inches (15.2cm) thick. Externally, the stave bow planking was supported, and protected, by a number of 3 inch (7.6cm) wide iron bands that ran horizontally around the bow and crossed on to the horizontal side planking at either end. Several of these iron bands have been pulled off of the bow and have dropped to the bottom though their original arrangement is clearly visible in the "ghost" (iron staining) left behind on the stave timbers. The top most iron band was located at the very top edge of the stave bow planking, another is located 23 inches (58.4cm) above the mud line and a third 44 inches (1.1m) from the lake bottom.

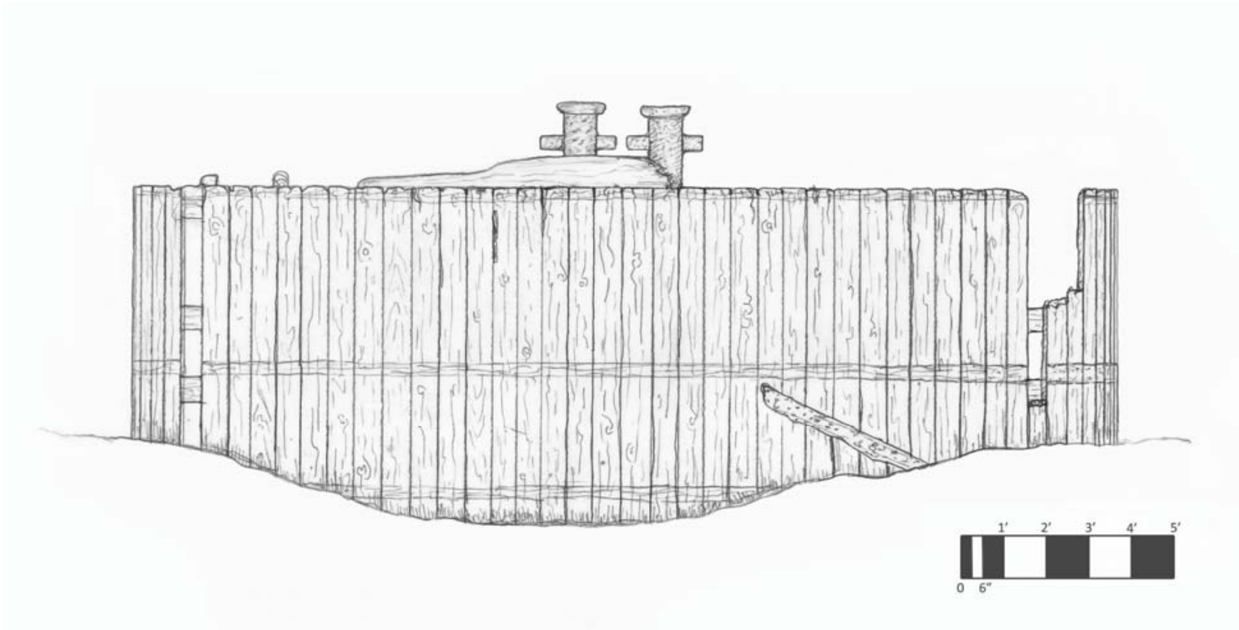


Figure 18: A13 Bow profile drawing displaying stave planking (Christopher R. Sabick)

On the port bow quarter three of the stave planks are broken off about halfway to the mud line. There is also one missing plank on the starboard "corner" of the bow. It is through these spaces left by these damaged planks, which are broken down close to the mudline, that the few observations of the internal bow structure were made.

The foredeck is also extant on A13 though its after edge has pulled free from the sides, and its supporting deck beam, and slumped into the cargo hold. Despite the thick layer of silt that covers the entire foredeck, there are a number of features worthy of note in this area. The ends of foredeck timbers are exposed in a few locations and suggest that the foredeck is made up of timbers 5 ½ inches (14cm) wide and 3 inches (7.6cm) thick. In the extreme bow is a large chock that is 8 ½ inches (21.6cm) sided and rises 8 ½ inches (21.6cm) from the deck amidships and tapers down gradually to the starboard side. The port side of this timber has been broken off and is dislocated onto the foredeck. Video footage from 2012 depicts this timber as intact so its damage is from recent impacts. Originally, the timber stretched for a total length of 12 feet (3.7m). The aft face of this timber held at least four iron ring bolts with large iron rings attached to them. These were most likely used as fairleads in handling the tow cables of the vessel.

Directly aft of the chock are two large cast iron bollards. These are arranged so that the horizontal bars practically touch amidships. The drum for each bollard is 11 ½ inches (29cm) in diameter at the top though the main body of the bollard is 9 inches (22.9cm) in diameter. The horizontal arms of the bollards are each 6 inches (15.2cm) long and 3 ½ inches (8.9cm) in diameter. These bollards would have been used in handling tow cables and mooring lines. Both bollards show recent, extensive, abrasion damage where the old rust and concretion have been worn away (Figure 19). In addition to the bollards there is also a large iron cleat (38 inches [.96m] long) located on the starboard side of the bow near the juncture with the sides. There may have been a similar cleat on the port side but would have been located in one of the areas with significant historic damage and is no longer present.

Figure 19: Comparison of bollard condition in 2012 vs. 2015 (LCMM Collection)

Three feet (.91m) aft of the bow, and located on the starboard side of the foredeck, is a small hatch leading to the forecastle of this canal boat. The opening is 30 inches (76.2cm) by 30 inches (76.2cm) square with a 2x2 inch (5x5cm) coaming that is still extant on one side. Inside this hatchway it was noted that the forecastle was also filled with a thick layer of silt and only a single piece of iron debris was visible above the mud. No attempt to enter this area was made due to risk of entanglement and entrapment.

It appears that the after edge of the foredeck was somehow wrenched forward, and off, of the deckbeam and knees that supported it. Without these supports the aft edge of the foredeck has slumped down into the cargo hold. In doing so it dislocated a number of timbers including the deckbeam and stanchion that supported it. These disarticulated timbers now obscure most of the details of the forecastle. However, careful documentation with video shows that there was a separation between the hold and forecastle in the form of bulkhead made of approximately 6 inch (15.2cm) wide tongue and groove boards. Beyond this fact it is difficult to determine any additional features of the interior bow.

SIDES AND HOLD

The cargo hold, which is the largest feature of this vessel, begins immediately aft of the collapsed foredeck and runs aft for at least 80 feet (24.4m). It is presumed that during its working life there were walk ways along either side of the cargo hatch but these are no longer present. There is evidence of at least seven deck beams that once spanned the hold and connected the two sides of the vessel. However, most of these deckbeams are missing or have collapsed into the hold and their locations are only known by the remains of supporting structures attached to the sides of the vessel like hanging knees.

Other than these features the cargo hold fills the entire inside of the vessel. Measurements with a metal probe at several locations demonstrated that there are 5 to 6 feet (1.5-1.8m) of sediment in the hold. Though it was impossible to access and document the construction features of the vessels bottom, these measurements were able to confirm that the canal boat’s depth of hold is 10 feet (3m) from the underside of the deck beams to the ceiling planking.

Careful examination of the interior sides of the hold revealed that it is entirely lined with a very tight fitting of 10 inch (25.4cm) wide ship-lapped boards. This cargo hold “lining” is loosely fastened to battens underneath which keep the ship-lap boards from touching the outer hull planking. This construction technique creates a double hull arrangement in the cargo hold, any water that may seep through the outer hull planking will run down behind the ship-lapped lining and into the bilge without wetting the cargo. Construction of this type suggests that keeping the bulk cargo carried by this canal boat dry was of primary importance. Many vessels of this type were used to carry bulk cargos of grain, which can cause damage to a vessel through expansion if it gets wet, and this is further evidence of the importance that the operators placed on keeping the cargo dry.

The sides of the canal boat are constructed of 6 inch (12.2cm) thick planks that are joined together with edge fastening. With this style of construction thick planking is joined together by iron rods that are driven vertically through the edges of the planks combing all of the planks into a single structural element (see Figure 20). This type of construction is common on canal boats and barges after the mid nineteenth century. The individual hull strakes are composed of a number of planks varying in length. They are typically joined together with butt scarfs to form complete strakes. In numerous locations caulking can be seen protruding from planking seems.

The upper edge of the hull planking was reinforced by a heavy Wale strake that runs the entire length of the vessel’s sides. This substantial timber is 8 inches (20.2cm) molded and 10 inches sided. The addition of this significant structural timber at the top of each side provided considerable strength to the sides and provided an ample platform for the attachment of the walkways, knees and deckbeams.

On their very aft end of the vessel, where the side planking meets the transverse stern planking, the strakes are protected by the addition of at least two frogs per side (a third may be buried in the silt). Frogs are additional wedge shaped pieces of timber that would act as bumpers to protect the seam between sides and transom from being directly impacted by normal operating collisions with other vessels and the lock walls. Each frog is 5 feet (1.5m) long, 8 inches (20.3cm) wide and 3 inches (7.6cm) thick on its aft edge, moving forward this timber thins to 1 inch (2.5cm) on its forward edge.

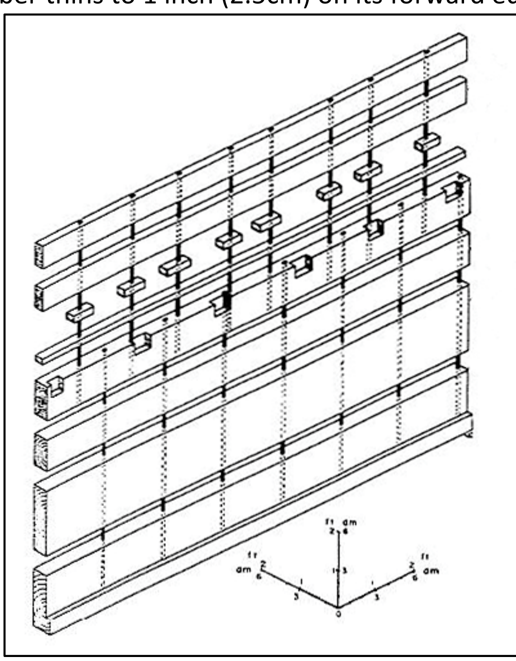


Figure 20: Drawing demonstrating the edge-fastening technique of vessel construction (Cozzi)

Above decks the edge of the vessel is defined with a cap rail that runs the length of the sides and ends on the foredeck. This cap rail consists of a 4 inch (10.1cm) wide and 5 inch (12.7cm) thick timber that rests on series of trapezoidal chalks. These chalks are 36 inches (91cm) long and 3 inches (7.6cm) tall and spaced 3 feet (91cm) apart. The spaces between them act as scuppers giving any water that makes its way on deck an easy way to escape.

This cap rail is damaged in a number of places particularly in the forward half of the vessel on the port side. Significant damage is also present on the starboard side though the underlying structures are still present, which is not the case in portions of the port side. On the forward end of the starboard side coaming there is a sheave built into the timber directly outboard of the large iron cleat that is found on the foredeck (Figure 21). This 8 inch (20.3cm) diameter sheave would have been used to in line handling. It was probably mirrored on the port side, though the extensive damage in that portion of the hull has destroyed any evidence of a second sheave.

Figure 21: Sheave at the forward end of the starboard cap rail (LCMM Collection)

The sides of the canal boat A13 were connected by a series of deckbeams that stretched across the hold at regular intervals along its length (Figure 22). Only a three of these decks beams are entirely extant but they give us a good indication of how these structures were arranged. The deck beams themselves are composed of two horizontal timbers stacked vertically. They are supported on either end by substantial hanging knees and amidships by a sturdy stanchion. In most cases this stanchion was attached to the deckbeam by an iron strap that ran up and over the top of the deck beam timbers and back down to the reverse side of the stanchion. The horizontal deck beam timbers are 10 inches (25.4cm) sided by 10 inches (25.4cm) molded and 10 inches (25.4cm) sided by 8 inches (20.3cm) molded. The stanchion measures 10 inches (25.4cm) molded and 10 inches (25.4cm) sided. The metal strap that binds the deckbeams and stanchions together is 3 inches (7.6cm) wide, ½ inch (1.3cm) thick, and extends along the stanchion for 18 inches (45.7cm) (Figure 23). The knees that supported deck beams at either end have an upper arm that is 24 inches (61cm) long and a lower arm that is 44 inches (1.1m) long. The timbers range from 4-14 inches (10.1-35.6cm) molded and are 6 inches (15.2cm) sided. The knees were fastened to the deckbeams, wale and side planking by a number of large iron bolts.

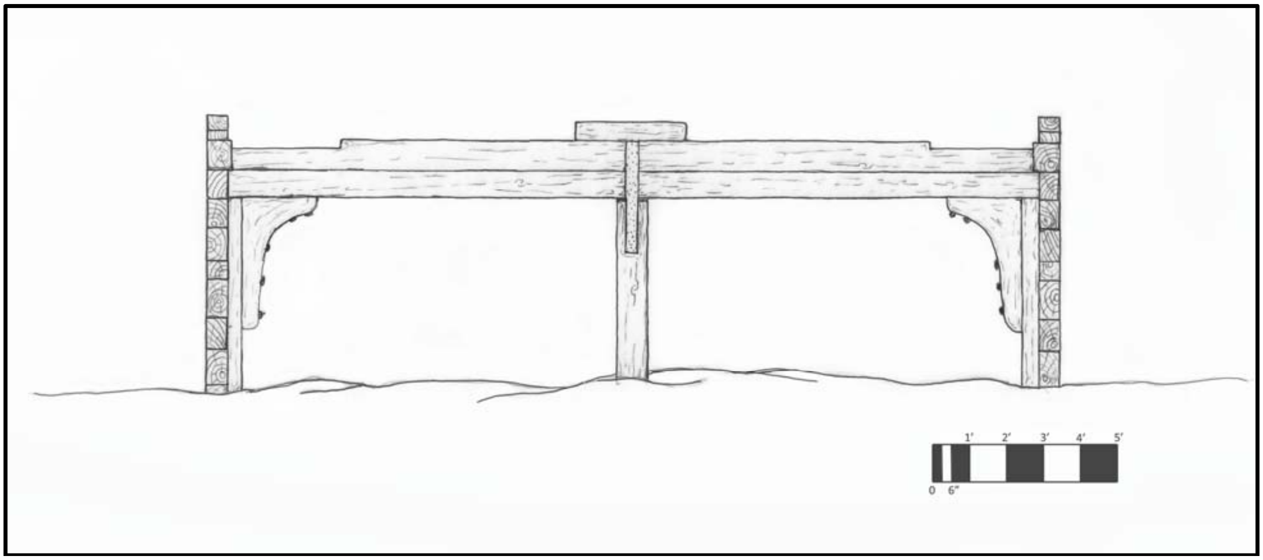


Figure 22: A13 Cross Section taken at 42 feet on the main baseline (Christopher R. Sabick)

Figure 23: Iron strap attaching the stanchion to the deck beam (LCMM Collection)

The two extant deckbeams found in the cargo hold have an additional block of wood affixed to their upper surfaces. This block of wood is 3 feet (91.4cm) long, 6 inches (15.2cm) thick and 10 inches (25.4cm) wide. The specific purpose of this piece of wood is unclear. However, it may have been used as a central support for a hatch cover that protected the cargo from the elements. As the deckbeams themselves are not crowned the additional amidships height that this block provided to any hatch cover would have helped it shed water efficiently.

The vertical sides of the canal boat were also supported between deck beams by futtock timbers. These timbers are 10 inches (25.4cm) wide and 4 inches (10.2cm) thick. They are fastened to the side planking with a series of bolts and large spikes.

An unexpected discovery that was made during the documentation of A13 was the identification of draught marks on the outer hull planking (Figure 24). The Roman numerals VIII, IX, and X were found carved into the wood on the forward and aft end of the horizontal planking on both sides of the vessel. The presence of these draught marks on each "corner" of the canal boat would have allowed the operators to insure that the vessel was evenly loaded and to know how much water the vessel was drawing with a simple observation.

Figure 24: Draught mark, A13 (LCMM Collection)

STERN

The stern of A13 contains the remains of the walkways that once stretched along the length of the cargo hold. This was also the location of the, now missing, stern cabin. Across the transom of the vessel are a number of large horizontal buttress timbers that were used to support the stern longitudinally as well as to support the rudder and rudderpost, both of which are absent.

The walkways on either side of the vessel are 28 inches (71.1cm) wide and composed of deck planking that is between 8 and 12 inches (20.3-30.5cm) wide and 2 inches (5.1cm) thick. On the port side this walkway extends for 22 feet 9 inches (6.9m) where it terminates in splinters and broken planks. This is also true of the walkway on the starboard side that extends for 35 feet 4 inches (10.8m). There is a 6 inch (15.2cm) square opening in the port side deck planking just forward of the iron cleat. This believed to have formerly held a pump housing that is no longer extant.

As previously mentioned it is assumed that the walkways originally extended the full length of the cargo hold to their juncture with the foredeck. Evidence of these missing walkway sections can be seen on the few in situ deckbeams. Each of these timbers is notched on it upper surface to seat the, now missing, walkway planking. These notches inform us that the walkway was a maximum of 36 inches (91.4cm) wide, though this notch may have also seated the cargo hatch coaming which is estimated (as there are no fragments of it in situ) to be 8 inches (20.3cm) wide like the cabin coaming in the stern. If this is true the walk way would have been 28 inches (71.1 cm) wide along it entire length.

The remaining evidence of the cabin trunk suggests that it was 16 feet (4.9m) wide by 10 feet (3m) fore and aft. Sadly, little remains of the structure of the cabin above decks and all that is visible in the space that the cabin once occupied is a few jumbled timbers sticking out of a thick blanket of silt. Aft of the cabin is a transverse walkway that is 5 feet (1.5m) wide fore and aft.

The top transom timber is 12 inches (30.5cm) wide and 11 inches (28cm) thick. Across the transom are three horizontal bustle timbers that are curved in shape and supported the rudderpost and rudder. The first of these timbers is located 16 inches (40.6cm) below the top of the transom (Figure 25). The others are spaced 16 inches (40.6cm) apart below the first. On their outboard edges these timbers are 4 inches (10.2cm) wide, this swells to 13 inches (33cm) wide amidships before diminishing gradually again on the opposite side. These bustle timbers are 5 inches (12.7cm) thick. The outboard corners of the bustle timbers are protected by a vertical timber that is 4 feet (1.2m) long and 6 inches (15.2cm) wide. The top two transom timbers are pierced by a 9 inch (22.9cm) diameter hole amidships that would have once housed the rudder post (Figure 26). The central portion of the lower transom timber is broken out amidships but presumably also contained this hole for the rudder post when it was intact. No evidence of the rudder or rudder post have been located on site.

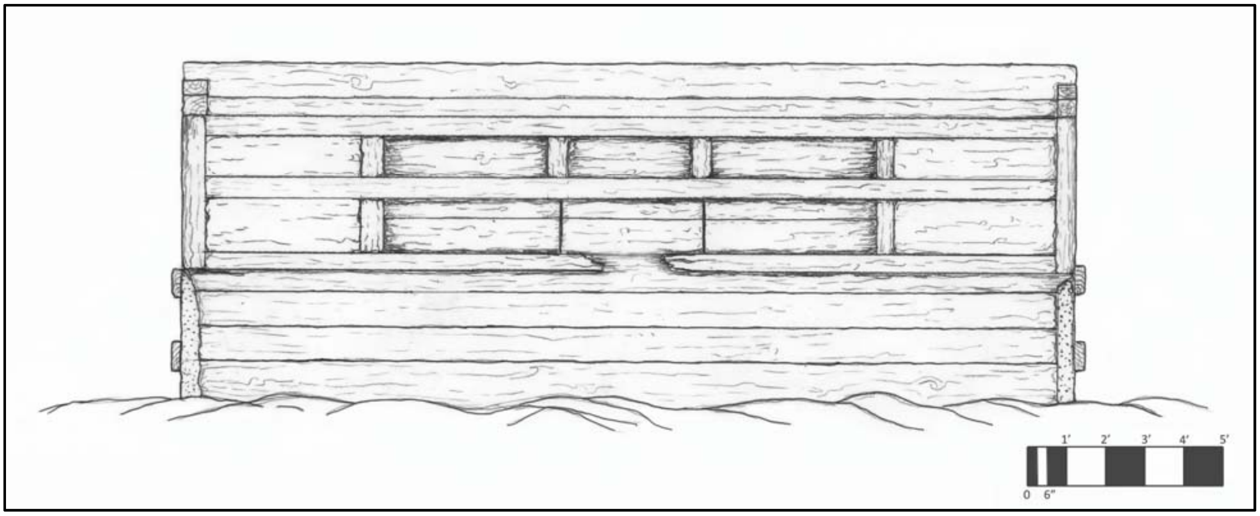


Figure 25: A13 Stern Profile (Christopher R. Sabick)

Figure 26: Hole through the top stern buttress timber for the (absent) rudderpost (LCMM Collection)

Between the bustle timbers are a two upright supports on either side of the centerline. The uprights are made of timbers 5 inches (12.7cm) wide and 16 inches (40.6cm) tall. Outboard of the first upright, on either side, the space between the transom timbers is filled with large wooden chalks that are curved in shape like the buttress timbers that they help to reinforce. Canal boats with similar stern arrangements have been noted in historic photographs (Figure 27)

Below the transom timber buttresses (and presumably behind them) the stern is planked horizontally with timbers that are 11 inches (28cm) wide. While no exposed edge was visible to measure the thickness of these planks it can be assumed that they are similar in thickness to the side hull planking which is 6 inches (15.2cm) thick.

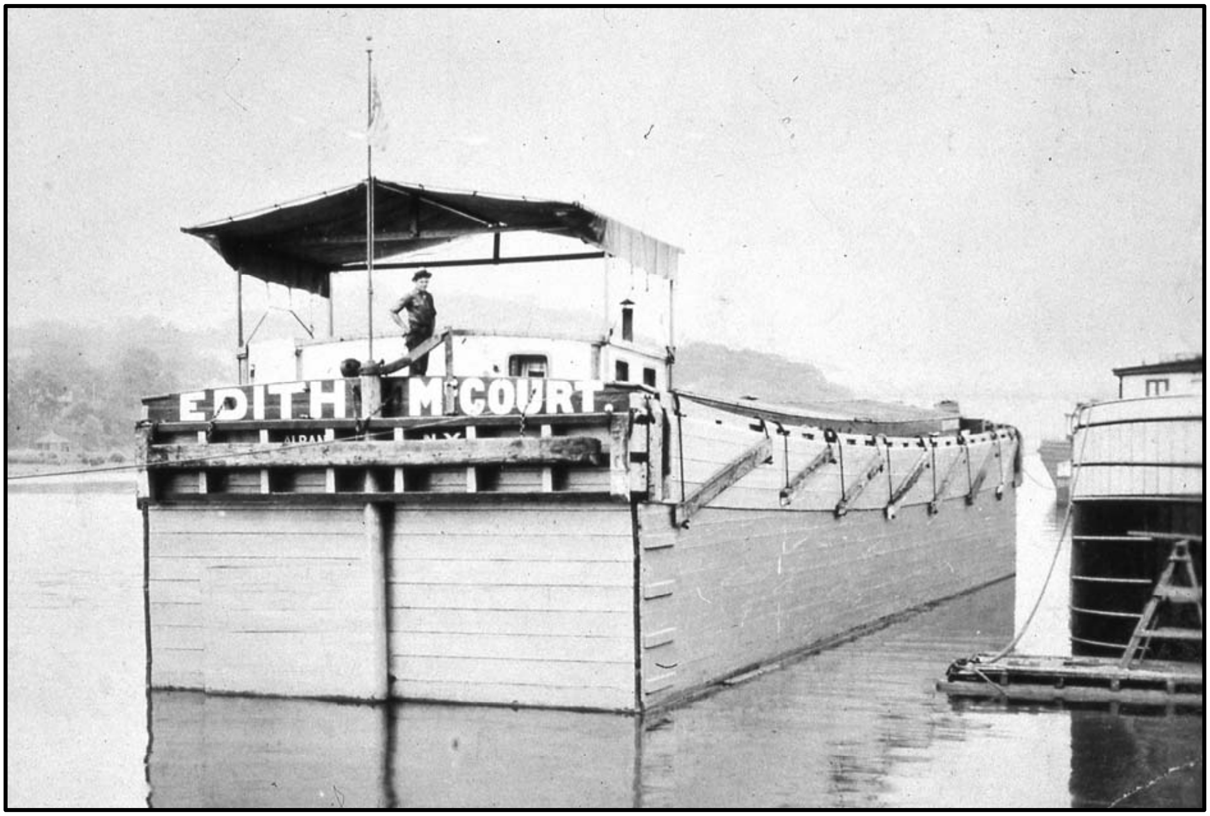


Figure 27: Canal boat *Edith McCourt*. Note the bustle style stern, and frogs protecting the stern quarter (courtesy of the New York State Museum)

CONCLUSIONS

The archaeological documentation of site A13 has revealed a tremendous amount of information about a vessel type that was previously only known from historic references and photographs but that had not been documented in detail. Site A13 has been identified as an early New York State Barge Canal boat. Based on its size and design it has been determined this boat was built in the first quarter of the 20th century when shipbuilders were still experimenting with vessel designs to exploit the new expanded barge canal and lock system. A13 measures 108 feet in length, it has a 23 foot beam with a depth of hold of 10 feet.

Canal boat A13 is a stave bowed canal boat, a construction technique that employs vertical planking at the front of the vessel. This unusual technique for bow planking was developed in the late 19th century and initially used on some vessels built for the smaller Erie Canal System. However, as demonstrated by site A13, this technique was adapted to the longer and wider boats of the early Barge Canal Era as well.

Evidence gathered from of the interior of A13 shows that it was built with a double hull arrangement in the cargo hold. This construction style was commonly employed on vessels that were designed to haul grain. The double hull arrangement in the cargo hold protected the cargo from moisture. This was particularly important for vessels carrying grain as it was known to swell tremendously if it got wet leading to potential vessel damage.

Despite that fact that this vessel has been impacted (both recently and historically) and dates the early 20th century, the documentation of its unusual design and characteristics make it a valuable addition to the incomplete understanding of the inland vernacular watercraft that work on America's canal systems. The slowly growing database of knowledge about these vessel types continues to enlighten readers about the watercraft and people that owned, operated and often lived on these boats and the canal system itself.

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APPENDIX 1: DIVE LOGS

Dive Log • Lake Champlain Maritime Museum • 4472 Basin Harbor Road • Vergennes • VT • 05491

Date: 10/1/15	DSO: Pierre LaRocque		ADSO: Ron Adams		Log No.:
Dive Site: Onondaga Lake					
Reason for Dive: A13 Documentation					
Weather: 5-10mph (N) wind, cloudy	Depth Range: 45'		Water: °F	Air: °F	UW Vis.:

		DIVE 1							DIVE 2						
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
1	Chris Sabick	32%	2500	903	951	500	45'	/							/
								/							/
Dive Notes: Orientation dive.															
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
2	Ron Adams	32%	3000	1028	1110	900	45'	/							/
								/							/
Dive Notes:															
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
3	Sarah Tichonuk	32%	2800	1123	1200	1800	45'	/							/
								/							/
Dive Notes: Stern documentation															
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
4	Pierre LaRocque	32%	3259	1213	1244	2200		/							/
								/							/
Dive Notes: (steel hp 120ft² tank															

Dive Log • Lake Champlain Maritime Museum • 4472 Basin Harbor Road • Vergennes • VT • 05491

Date: 10/2/15	**DSO:** Pierre LaRocque		**ADSO:** Ron Adams		**Log No.:**
Dive Site: Onondaga Lake					
Reason for Dive: A13 Documentation					
Weather: cloudy, windy	**Depth Range:** 45'	**Water:** 56 °F	**Air:** 40-55 °F	**UW Vis.:** 2-4'	

Team No.	Name	DIVE 1 Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	DIVE 2 Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
1	Pierre LaRocque	32%	2100	0933	1021	300		/	32%	2987	1217	1316	900		/
								/							/
Dive Notes:															
2	Chris Sabick	32%	2200	0957	1041	800		/	32%	2200	1240	1328	700		/
								/							/
Dive Notes:															
3	Sarah Tichonuk	32%	2800	1043	1142	400		/	32%	2850	1400	1502	400		/
								/							/
Dive Notes:	Document stern profile.								Document stern plan view.						
4	Ron Adams	32%	2900	1102	1145	500		/	32%	2000	1338	1429	500		/
								/							/
Dive Notes:															

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Date: 10/3/15	DSO: Pierre LaRocque	ADSO: Ron Adams	Log No.:
Dive Site: Onondaga Lake, A13			
Reason for Dive: Documentation			
Weather:	Depth Range:	Water: °F	Air: °F UW Vis.:

		DIVE 1							DIVE 2						
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
1	Pierre LaRocque	32%	2400	9:43	10:24	1401		/		1345	1202	1241	100		/
								/							/
Dive Notes:															
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
2	Chris Sabick	32%	2400	9:57	10.51	700		/	32%	2200	1221	1308	400		/
								/							/
Dive Notes:															
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
3	Ron Adams	32%	2600	1034	1119	400		/							/
								/							/
Dive Notes:															
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
4	Sarah Tichonuk	32%	2800	1050	1142	700		/							/
								/							/
Dive Notes:															

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Date: 10/4/15	DSO: Pierre LaRocque	ADSO: Ron Adams	Log No.:
Dive Site: Onondaga Lake A13			
Reason for Dive: Documentation			
Weather:	Depth Range:	Water: °F Air: °F	UW Vis.:

		DIVE 1							DIVE 2						
Team No.	Name	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In	Dive Gas	Tank PSI	Time In	Time Out	Tank PSI	Max. Depth	Rep. Group Out/In
1	Pierre LaRocque	32%	3042	954	1054	500		/							/
								/							/
Dive Notes:															
2	Chris Sabick	32%	2400	1104	1153	700		/							/
								/							/
Dive Notes:															
3	Ron Adams	32%	2975	1205	1247	537		/							/
								/							/
Dive Notes:															
4	Sarah Tichonuk	32%	3000	1217	1306	1000		/							/
								/							/
Dive Notes:															

APPENDIX 2: LIST OF ACRONYMS

A.B.: *Artium Baccalaureus* (Bachelor of Arts)
ADSO: Assistant Dive Safety Officer
APE: Area of Potential Effects
A.S.: Associates of Science
ASL: Above Sea Level
B.A.: *Baccalaureus Artium* (Bachelor of Arts)
BCD: Buoyancy Compensator Device
B.L.: Base Line
BP: Before Present
Bros.: Brothers
B.S.: Bachelor of Science
BTEX: benzene, toluene, ethylbenzene, and xylene
°C: Celsius
CA: cooperative agreement
c.: circa
CAC: Citizens Advisory Committee
CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR: Code of Federal Regulations
cm: centimeter
c/o: care of
CPR: cardiopulmonary resuscitation
CRE: CR Environmental, Inc.
CWA: Clean Water Act
DAN: Divers Alert Network
DC: District of Columbia
DGPS: Differential Global Positioning System
DSO: Diving Safety Officer
ed.: edition
EPA: Environmental Protection Agency
ESRI: Environmental Systems Research Institute
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
km²: square kilometers
kmph: kilometers per hour

kW: kilowatt
LCMM: Lake Champlain Maritime Museum
m: meter
M.A.: *Magister Artium* (Master of Arts)
mi: mile
mi²: square miles
mph: miles per hour
Ms.: manuscript
NAGPRA: Native American Graves Protection and Repatriation Act
NAUI: National Association of Underwater Instructors
n.d.: no date
NHPA: National Historic Preservation Act
No. or no.: number
NOAA: National Oceanic and Atmospheric Administration
NPS: National Park Service
NRHP: National Register of Historic Places
NY: New York
NYDEC: NY Department of Environmental Conservation
NYED: NY Department of Education
NYOGS: NY Office of General Services
NYOPRHP: NY Office of Parks, Recreation, and Historic Preservation
NYS: NY State
NYSM: NY State Museum
p.: page
PAHs: polycyclic aromatic hydrocarbons
PCBs: Polychlorinated biphenyls
PCDD: Polychlorinated dioxins
PCSF: Polychlorinated furans
Ph.D.: *Philosophiae Doctor* (Doctor of Philosophy)
pp.: pages
PM: *post meridiem* (after noon)
PO: Post Office
Re: regarding
Res.: resources
RFP: request for proposal
ROV: remote-operated vehicle
RV: research vessel
SCUBA: Self Contained Underwater Breathing Apparatus
SHPO: State Historic Preservation Office
SPC: Solvay Process Company
SUNY: State University of New York
Tel: telephone number
US: United States of America
USACE: United States Army Corps of Engineers
USC: United States Congress
USEPA: United States Environmental Protection Agency
USGS: United States Geological Survey
USA: United States of America

UTM: Universal Transverse Mercator
VHF: very high frequency
Vol. or vol.: volume

APPENDIX 3: GLOSSARY

Aft Near or at the stern of a vessel.

Amidships The middle of a vessel.

Archaeological Site Locations where signs of human activity are found.

Archaeology A sub-discipline of anthropology involving the study of the human past through its material remains.

Artifact Any object used or manufactured by humans.

Athwartships From one side of a ship to the other.

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.

Bathymetry The measurement of the depth of bodies of water.

Beam A dimension measured from side to side of a vessel.

Bedrock A mining term for the unweathered rock below the soil.

Bilge The lowest point of a vessel's interior hull.

Bilge Stringer A fore and aft timber located in the bottom of the hull that lends longitudinal strength to the hull and keeps the frames in line.

Bitts Strong wooden or metal uprights used for securing heavy ropes such as anchor cables.

Boat An open vessel, usually small and without decks, intended for use in sheltered water.

Bollard Short thick post of wood or iron (often mounted in pairs) used for securing mooring ropes, springs, or hawsers.

Bolt A fastener consisting of a threaded rod with a head at one end, designed to be inserted through a hole in assembled parts and secured by a mated nut that is tightened by a wrench.

Boom Spar used to stretch out the foot of a sail.

Bottom Planking In an edge-fastened vessel the planking that covers the flat bottom of the vessel, normally oriented transversely.

Bow The forward end of a vessel.

Bowsprit A spar projecting forward from the bow.

Breadth The measurement of a ship's width.

Breakwater A structure, usually made of stone or concrete, built to create a harbor or improve an existing one.

Breast Hook A large, horizontal knee fixed to the sides and stem to reinforce and hold them together.

Bulwark The side of a vessel above its upper deck.

Bulkhead Vertical partition between two decks of a ship, running either lengthwise or across, forming and separating different compartments.

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. The vessel has no means of propulsion and must be towed or pushed by another vessel or animal.

Caprail A timber attached to the top of a vessel's frame.

Cargo hatch A deck opening providing access to stow cargo below.

Causeway A raised roadway across water or marshland.

Ceiling The internal planks of a vessel.

Chine log A longitudinal timber at the angular junction of the side and bottom of a flat-bottomed vessel.

Chock Wooden wedge used to prevent other structural members from moving.

Clamp A thick ceiling strake used to provide longitudinal support.

Cleat A T-shaped rigging fitting to which a vessel's lines are attached.

Coaming The raised lip with which openings in the deck such as hatchways are framed to prevent water on deck from running into the hold.

Cocked Hat Triangular wooden block used to brace the floors and futtocks where the bottom of the hull meets the sides.

Cultural Resource A nonrenewable prehistoric or historical resource such as archaeological sites, artifacts, and standing structures.

Deck A platform extending horizontally from one side of a ship to the other.

Decking The individual timbers that form the floor of the deck.

Deck beam A timber mounted across a vessel from side to side to support the vessel's deck and provide lateral strength.

Derrick Form of crane used to hoist cargo or their weights. It consists of a swinging boom supported by a topping lift and controlled sideways by guys.

Diagonal Bracing Angled bracing in the hull of a vessel used to resist fore-and-aft or athwarships distortion.

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 through the planks to hold them together.

Fairlead A deck fixture used to lead a rope in a required direction.

Fender Timber designed to absorb the force from impacts with vessels or wharfs.

Floor Timber A frame timber that crosses the keel and spans the bottom of a vessel.

Fore Located at the front of a vessel.

Fore-and-Aft From stem to stern, 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.

Futtock A frame timber that continues where the floor timber leaves off and continues up the side of a vessel.

Gudgeon Device used to attach the rudder to the boat so that it can swing freely.

Gunwale The timber above the sheer strake.

Hanging knee A vertical L-shaped timber attached to the underside of a beam and the side of a vessel; used to connect and reinforce the junction of a deck beam with the side of the vessel.

Harbor A safe anchorage, protected from most storms; may be natural or manmade; a place for docking and loading.

Hatch A deck opening in a vessel providing access to the space below.

Historic The period after the appearance of written records for a given region.

Hold The lower interior part of a ship in which 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 the vessel.

Keel The main longitudinal timber upon which the framework or skeleton of a hull is mounted; the backbone of a hull.

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.

Lighter A type of barge used to carry goods and equipment.

Longitudinal timber A long timber that runs parallel with the length of a vessel.

Magnetometer A scientific instrument used to measure the strength and/or direction of the magnetic field in the vicinity of the instrument. In archaeology this is used to identify metal objects.

Mast A large wooden pole that supports the sails of a vessel.

Mooring A permanent placement of an anchor, anchor chain, shackles and buoy necessary to anchor a vessel.

Mortise A cavity cut into a timber to receive a tenon.

Moulded Dimension The measurement of depth of a timber as seen in a cross-section view of a vessel.

Mud line The intersection of a shipwreck's hull with the bottom's surface.

Naphtha Launch: A small vessel that ran on the naphtha engine which did not use steam, but instead forms of gasoline and vapor.

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

Plank A thick board used as sheathing on a vessel.

Plank-on-Frame A shipbuilding technique, also commonly known as carvel built. Vessels of this type have planking running fore and aft with the planking laid edge to edge.

Port The left side of a vessel when facing forward.

Primary Source An artifact, document, or individual that provides information based on personal observations. A firsthand account.

Provenience The original location of an object, in reference to artifacts it is the exact location in which they were found.

Rabbet A concavity in the keel or chine log into which the planking is fit.

Rake The projection of a ship, at stem or stern, beyond the ends of the keel.

Rake timber Timber that acts as framing for the raked end of a scow.

Rider Interior frame mounted inside a ship's hold and bolted to other structural elements to strengthen the ship's structure.

Rigging The hardware and equipment that support and control the spars and sails of a vessel.

Rigging block A wooden pulley used to operate a vessel's spars and sails.

Room and Space The distance between the moulding edges of two adjoining frames.

Rub Plate A metal band placed on the forward end of the stem and bottom of the keelson to protect the underlying wood.

Rubwale See Rub Strake.

Rub Strake: A rail on the outside of the hull of a boat to protect the hull from rubbing against piles, docks and other objects

Rudderpost A vertical timber in the stern of the vessel to which the rudder is attached.

Scarf An overlapping joint to connect two timbers or planks without increasing their dimensions.

Schooner A fore-and-aft-rigged sailing vessel with two or more masts.

Scow Flat bottomed watercraft, normally rectangular in cross-section with outward sloping ends.

Secondary source An individual's description and interpretation of a historical event recorded at a different time and place. A secondhand account.

Sheer strake The top strake, or plank, of a wooden vessel next below the gunwale.

Sided dimension The measurement of width of a timber as seen in a plan view of a vessel.

Sloop A single-masted, fore-and-aft-rigged sail boat.

Spar A pole used to help support the sail of a vessel.

Spike A large nail.

Spud: Posts found on some barges which are lowered from the barge and pushed into the waterway floor to anchor the vessel in place.

Stanchion An upright supporting post.

Standing Knee A vertical L-shaped timber attached to the top of a deck beam, or decking; used to connect and reinforce the junction of a deck beam with the side of the vessel.

Starboard The right side of a vessel when facing forward.

Steamboat A vessel propelled by a steam engine.

Steamer A vessel propelled by a steam engine.

Stern The after end of a vessel.

Strake A continuous line of planks, running bow to stern.

Stringer A longitudinal timber fixed to the inside surface of the frames of a vessel to provide it with greater strength fore-and-aft.

Tenon a projection on a timber which fits into a mortise.

Tiller A handle attached to the rudderpost to steer a vessel.

Timber In a general context, all wooden hull members; specially those that form the framework or skeleton of the hull.

Top Log Longitudinally oriented timber which runs on top of the futtocks.

Towfish The torpedo-shaped unit that houses the transmitter and receiver of a side scan sonar and is usually towed behind a vessel.

Transverse Describes a component of a ship that runs side to side, not fore and aft.

Underwater archaeology The archaeological study of underwater cultural resources.

Underwater cultural resource A nonrenewable resource that partially or entirely lies below water, such as submerged prehistoric archaeological sites, artifacts, bridges, piers, wharfs and shipwrecks.

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

Wale A thick strake of planking located along the side of a vessel for the purpose of stiffening the outer hull.

Waterline The intersection of the vessel's hull and the water's surface.

Wharf A structure, parallel to the shore, for docking vessels.

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[15] New York State, *Annual Report 1917*, Pgs 10-13.
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[17] New York State, *Annual Report of the Superintendent of Public Works on the Canals of the State For the Year Ended June 30, 1918*, Pgs 14-15.
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[21] New York State, *Annual Report 1918*, Pg 25.
[22] New York State, *Annual Report of the Superintendent of Public Works on the Canals of the State For the Year Ended June 30, 1919*, Pg 15.
[23] New York State, *Annual Report 1919*, Pg 15.
[24] New York State, *Annual Report 1919*, Pg 22.
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