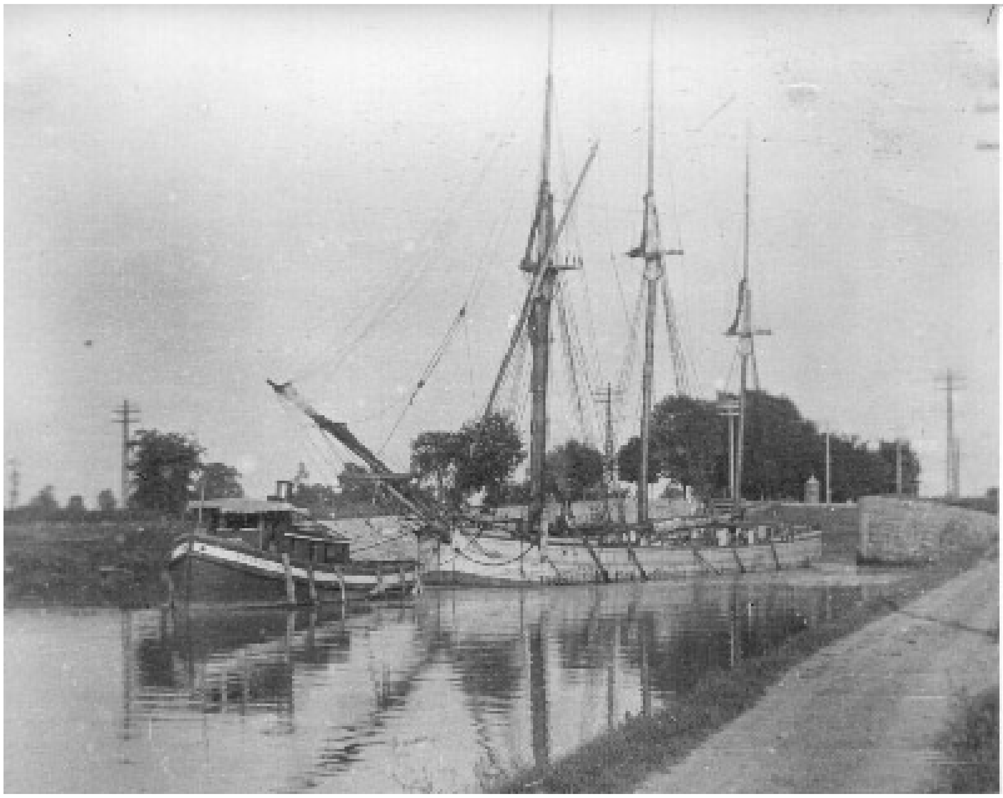
Sailing Canallers:
A Great Lakes Regional Context



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ABSTRACT

Canallers were a vessel type specifically designed to maximize cargo space when traveling through the second Welland Canal, allowing passage into and out of Lake Ontario from Lake Erie and the St. Lawrence River, respectively. Sailing canallers were primarily fore and aft rigged (schooner rig) though a few canallers were also rigged as barks, barkentines, and brigantines. Restricted by lock dimensions, sailing canallers were characterized by straight stems, narrow beams, nearly vertical sides, flat bottoms, folding catheads, folding or pivoting davits, and short, highly canted bowsprits and jibbooms which could be raised while traversing the locks. Canallers also typically had less of a rake to their masts and transoms, and longer gaffs (Wilson 1928; Cuthbertson 1931: 234- 235; Labadie 1989: 21). As a class, their dimensions changed along with the overall dimensions of the locks. The following Regional Context defines common second generation sailing canaller characteristics, attempts to determine their significance within a regional framework, and serves as a detailed guide for canaller site identification and significance assessment.

SECTION ONE
Introduction

Rather than looking at ships merely as vessels for the transportation of goods and people, ships can also be studied as cultural materials themselves, greatly representative of the environments, cultures, and regions in which they were built. The construction techniques and technology of vessels can shed light on the development and economics of maritime communities (Adams 2001). Throughout the history of the Great Lakes region, ships remained the primary method of trade and transport, not only of goods, but of people and information as well. The study of the evolution of specialized shipbuilding techniques and shipboard technology in different regions can create an understanding of unique and remote microcosms of maritime heritage (Adams 2001). This is particularly true of mid to late nineteenth century sailing canaller construction, which reflected and enhanced the economic development of the Great Lakes region.

By the second half of the nineteenth century, the Great Lakes were at the center of rapid technological advancement in shipping and shipbuilding. Industrial and agricultural demands of the era necessitated the development of highly specialized modes of transportation that had high profitability at a relatively low cost of operation. The emergence of purpose-built sailing and steamer vessels to ply the Welland Canal were a unique solution to technological and economic issues facing maritime industries and transportation needs in the mid to late nineteenth century. Technological developments in shipbuilding mechanics and design were established to meet demands of a growing maritime industrial culture. As a relatively simple solution to the needs of bulk cargo transportation, canallers were an important economic and industrial link between the eastern and western United States, helping propel the Midwest, and maritime transportation into the modern era.

As a whole, canallers were vital to the economy of the Midwest, and the region’s transportation infrastructure prior to the development of road and rail networks. Before rail lines connected the Midwest to the population centers of the East coast, these vessels were the lifeline of the Great Lakes region and western frontier, bringing goods and supplies, which spurred their growth and development. This trade between east and west fueled the expansion of major industrial centers in the Great Lakes. Grain and corn, collected from the newly settled farmlands of the Midwest, and later iron ore from mines in Wisconsin and northern Michigan and lumber from the northern shores of the region, were transported from ports on Lakes Michigan, Superior, and Huron to eastern ports on Lakes Erie and Ontario (largely the cities of Buffalo, New York, Oswego, New York and Kingston, Ontario). Vessels returning to Lake Michigan were often loaded with coal, used for heating Midwestern cities and powering factories.

The mid to late nineteenth century demands for trade, and unique geographic characteristics of the Great Lakes created the necessity for specialized vessel designs and unique shipboard technologies not found anywhere else in the world. This progress is reflected in the development and use of canallers, exemplifying the distinctive design of these vessels. Canallers were designed to transit the Welland Canal locks while carrying large amounts of bulk cargo between the markets of the Midwest and the eastern seaboard. These box-shaped vessels were designed to carry the maximum amount of cargo through the Canal locks with only inches to spare. Sail powered canallers had bluff bows, flat bottoms and sterns, short bowsprits, and highly-canted jibbooms. The booms on the vessel’s mainmast (on two-masted vessels) or mizzenmast (on three-masted vessels) were typically shortened so that they would not overhang the stern.

Due to their boxy shape, many claimed that canallers were notoriously poor sailors in heavy weather, an assertion supported by the fact that one particularly violent storm in October 1873 sent six Oswego canallers to the bottom with all hands (Karamanski 2000; Oswego Daily Palladium 1873). Although difficult to sail, canallers were a vital link between the eastern and western Great Lakes, allowing growth and expansion of the American frontier. The following sections of this Context focus on the construction of sailing canallers, their use in Great Lakes trade, and the unique mechanisms employed to create the greatest economic benefit in transporting bulk cargos. This is facilitated by the study and analysis of the archaeological remains of known sailing canallers: *America*, *Christina Nilsson*, *Daniel Lyons*, *Floretta*, *Grace A. Channon*, *Kate Kelly*, *LaSalle*, *Tubal Cain*, *Walter B. Allen*, *Bermuda*, *Cornelia B. Windiate*, *E.B. Allen*, *Kyle Spangler*, *M.F. Merrick*, and *Sligo*. Likewise, the very development and construction of these specialized technologies for trade and transport can help in the overall understanding of maritime industrial commerce in the Great Lakes region.

Though examples of this type of vessel construction are no longer available above the water, the archaeological remains of known canallers in Wisconsin waters, along with the remains of multiple other vessels located on the bottom of the Great Lakes, provide an opportunity to study maritime innovation and the role sailing canallers played in the development of the region's unique maritime industrial context. The well-defined time period in which these vessels sailed allows an in depth study of their varying design and construction features. Each shipbuilder had their own unique designs, but common design features were found on many vessels and remain identifiable in the historical and archaeological record. Additionally, these sites allow for an analysis of evolving unique shipboard mechanisms and technology that would continue to define innovations in Great Lakes shipbuilding well into the modern era.

This Context stands to define common second generation sailing canaller characteristics, determine their significance within a regional framework, and serve as a detailed guide for canaller site identification and significance assessment. The following sections highlight the historical significance of sailing canallers in the Great Lakes, outline common features attributed to the "sailing canaller" hull type, and offer analysis of known sailing canaller wreck sites as examples in determining archaeological site significance. Additionally, a final section offers a discussion of the historical and archaeological significance of sailing canallers, and places the vessel type within its larger regional context.

SECTION TWO
The Welland Canal and Great Lakes Trade

Discussion of Wisconsin's maritime economy, and the maritime economy of the western Great Lakes, requires the inclusion of the eastern Great Lakes of Huron, Erie, and Ontario. Many of Wisconsin's commodities were shipped beyond Lakes Michigan and Superior to eastern Great Lakes ports such as Buffalo, New York, and Kingston, Ontario. Vessels returning from these distant ports carried goods, supplies, and immigrants to the western reaches of the Great Lakes, creating a diverse regional economic universe. Although not the only state in the Great Lakes region to greatly influence and sustain this east-west trade connection, Wisconsin's geographic location made it the endpoint for many people and goods moving westward. Separating Wisconsin from the eastern Great Lakes frequently results in a fragmented understanding of the Great Lakes' maritime heritage.

By the early to mid-19th century, immigrants and people living in the industrial centers of the East began moving westward as the American frontier continued to develop and expand. The large number of immigrants that arrived on Lake Michigan's western shore during first quarter of the 19th century soon began moving from the lakeshore to populate the rich Midwestern prairie lands. The combination of the fertile Midwestern soil and new advancements in farming technology led to a large surplus of grain that made its way to Lake Michigan's port cities for transport to eastern markets via the Great Lakes. The inland lake route greatly facilitated the grain trade's growth by providing cheap and ready transportation.

The brig *John Kenzie* carried the first Lake Michigan grain shipment from Grand River, Michigan, to Buffalo, New York, in 1836. Two years later, in 1888, the city of Chicago sent 39 bags of wheat to Buffalo aboard the *Great Western*. In 1839 the brig *Osceola* carried Chicago's first bulk shipment of wheat, carrying 1,678 bushels from Chicago to Black Rock (Buffalo), New York (Mansfield 1899).

It wasn't until the 1840s that the Great Lake grain trade began in earnest. Chicago grain exports between 1834 and 1840 totaled 13,765 bushels (Mills 1910). In the year 1841 alone, the city saw 40,000 bushels being exported from its port. By 1847, Chicago was shipping more than two million bushels yearly. Milwaukee achieved an equal volume by 1853, and surpassed Chicago in grain exports by 1862 (Karamanski 2000). Due to a lack of adequate harbor facilities and grain elevators elsewhere on Lake Michigan, Milwaukee and Chicago were the dominant grain ports.

Freight rates for grain were subject to supply and demand, dropping during summer months and peaking during the fall harvest time. Freight rates for the 1837-1838 seasons were eight cents a bushel, with an additional two cents per bushel surcharge for elevator service. During the 1850s, rates from Chicago to Buffalo remained steady between 10 and 15 cents per bushel, with steamers earning a fraction of cent more than sailing vessels. During the 1860s, rates dropped to between 4 and 7 cents per bushel. From 1874 onward, rates began a constant decline, reaching 1.53 cents per bushel by 1898 (Cooper 1988; Mansfield 1899; Mills 1910).

The Lake Michigan grain trade consisted of mostly wheat until 1848. After that date, corn began shipping across the Great Lakes in increasing quantities. Oats, barley, and rye were also shipped in small quantities (Cooper 1988). Buffalo and Oswego were early rivals for Lake Michigan grain, with Buffalo capturing a larger share of the trade during the early years. Oswego's disadvantage was that to reach Oswego from Lake Michigan, vessels were required to transit the Welland Canal and were charged a toll of six dollars per thousand bushels, a toll not required to reach Buffalo. By the 1870s, however, canal tolls from Buffalo to Syracuse equaled or exceeded the Welland Canal tolls, and with a shorter route from Oswego to eastern sea ports, Oswego's grain traffic swelled (Oswego Daily Palladium 1897). Vessels returning to Lake Michigan were often loaded with coal from ports on Lakes Erie and Ontario, used for heating Midwestern cities and powering steam-powered factories. Coal tonnage grew with transportation improvements between the mines to eastern lake shipping ports (Mansfield 1899). Grain schooners made the Oswego-Chicago round trip in thirty to thirty-five days, and six to seven trips were completed seasonally (Oswego Daily Palladium 1897).

Regularly scheduled steamship lines connected western Lake Michigan with eastern cities, and multiple steam vessels were under construction at Milwaukee by as early as 1836. This resulted in a decrease in passenger and high-dollar cargo traffic for sailing vessels (Quaife 1944; *Milwaukee Advertiser* 1836). Progress and innovation in transportation only continued to grow throughout the Midwest. On 21 May 1853 the Michigan Central Railway made the first rail connection with Chicago, and in 1855 the first all-rail connection between Buffalo and Chicago was established. Even with the growing popularity of railroads, in many areas around the Great Lakes, waterborne routes remained the only mode of cargo transportation (Quaife 1944; Mills 1910). Over time, however, these railroads began to steal passenger and high-dollar cargo trade from the inland waterways, resulting in even stiffer competition for sailing vessels. Unlike lake vessels, rail lines could provide regularly scheduled shipments that were relatively unaffected by weather, as well as year-round transportation unhindered by ice-covered water. Despite increasing competition, however, lake sail did not succumb to technological advancements of steam and rail. Sail maintained the advantages of lower construction and operation costs, adaptability to many different trades, and had the benefit of centuries of technological development. Sail required less capital investment, its propulsion cost nothing, and the smaller crews were inexpensive relative to steamers and rail lines.

Despite the advantages of sail, one significant obstacle still stood in the way of smooth, efficient cargo transportation between the eastern and western Great Lakes: Niagara Falls. Although the Erie Canal (1925) bypassed the falls and allowed cargo to reach Lake Erie, canal boats were small, which limited the canal's overall capacity for passengers and cargo until its first enlargement was completed in 1862. Moreover, there was no direct water route from Lake Ontario. Discussions about the necessity of direct navigation between Lakes Erie and Ontario date back to shortly after the War of 1812, but it wasn't until almost two decades later that this transportation route became reality (Monk 2003).

The Welland Canal opened on 30 November 1829, ushering in new opportunities for easy and inexpensive methods of moving bulk cargos to and from ports on the western Great Lakes. The first vessel through the canal was the British schooner *Ann and Jane* on a two-day, up-bound transit from Port Dalhousie on Lake Ontario to Port Colburne on Lake Erie. The original Welland Canal (1829-1845) limited vessels to 110 feet in length, 22 feet in beam, and 8 feet in depth, significantly restricting the size and capacity of many vessels. It followed many natural water routes, beginning with Twelve Mile Creek from Port Dalhousie to Merritton, where vessels locked through 40 locks over the Niagara Escarpment. The Canal then followed the

Welland River from Merritton to Port Robinson to avoid the Niagara Falls. As early as 1830, shipbuilders and merchants recognized the need for specialized ships to traverse the canal. By the 1840's, shipbuilders were already designing vessels for the specific function of sailing through the canal locks while carrying ever increasing tons of cargo (Monk 2003; Zant and Thomsen 2016).

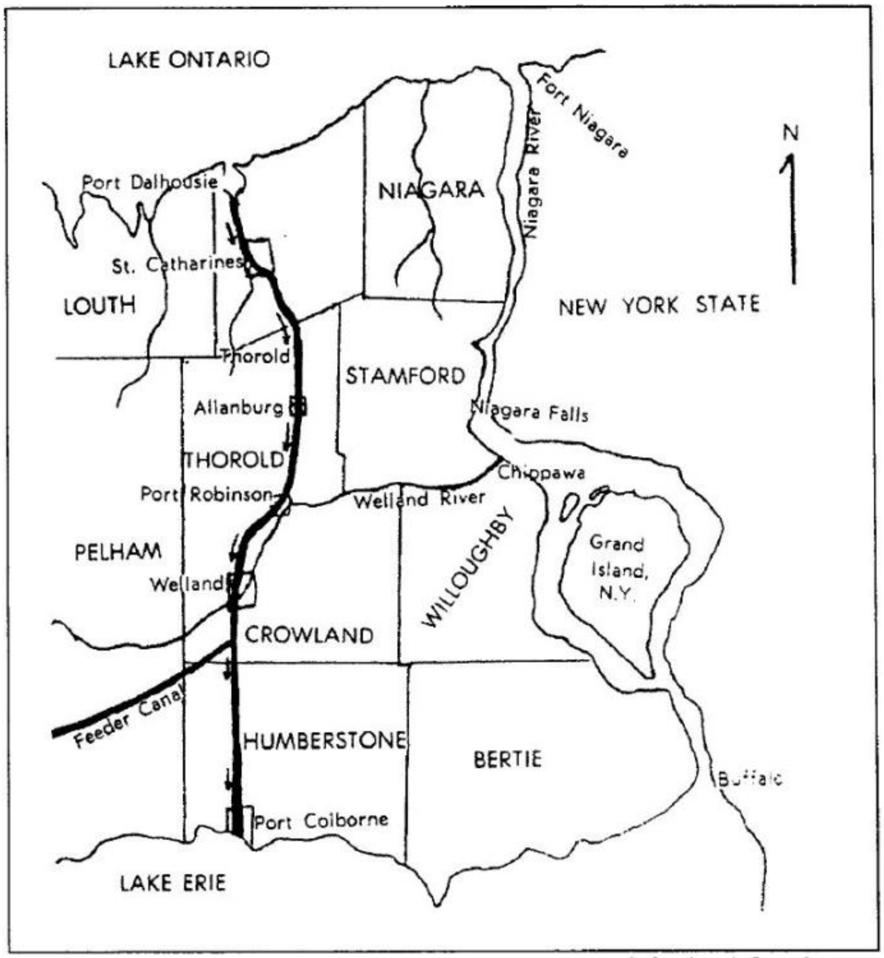

Figure 1. Illustration of the route of the second Welland Canal (Brock University).

Despite these initial attempts at canal vessel design, there was a demand to increase the tonnage capacity of the locks. With the limited depth in the Canal locks, many vessels that fit within the Canal lock dimensions could only carry a fraction of their total carrying capacity. By the early 1840's it was readily apparent that the Welland Canal needed to be enlarged. The Canadian government purchased the Welland Canal Company and expanded the canal in 1846, reducing the number of locks to 27 and cutting a more direct route. The new locks were expanded to accommodate vessels of 150 feet in length, 26.5 feet in beam, and 9 feet in depth. The canal's original wooden locks became control weirs for the new canal, reducing the physical labor of towing ships from lock to lock *(*Aitken 1997; Mansfield 1899; *St*. Lawrence Seaway Management Corporation 2003). With this increase in lock dimensions, the second Welland Canal allowed larger vessel's, carrying more cargo, to ply the canal, increasing the amount of tonnage that could be transported.

It was this second iteration of the Welland Canal that allowed shipbuilders to hone their skills in developing a new hull form, capable of carrying the most cargo through the canal locks, while still allowing the vessel to sail relatively well in the open lakes. Until this point, many Canal going vessels retained construction features typically found on fast sailing vessels that normally plied the lakes. The deep drafts, smooth lines, and clipper bows made these vessels fast and steady in the open lake, but significantly decreased their maximum cargo capacities when traveling through the canal locks (Monk 2003). By the time the updates to the Welland Canal were completed, however, the use of centerboards in sailing vessels had increased exponentially, allowing hulls to be constructed with much shallower drafts, flatter bottoms, and sharper turns of the bilge. Coupled with bluffer, more robust bows, with less sharp cutwaters, the canaller hull was born. Although the mid-1840's marked a turning point in purpose-built canaller construction, there was no single design shipbuilders followed. As the nineteenth century wore on, and demands for cargo changed, different adaptations to hull construction appeared, with almost no two canallers looking the same. As they developed, these sailing canallers became the driving force behind the growth of cities and industry in the Midwest, and feeding the growing cities of the East.

The heyday of the canallers and the grain trade, however, was short lived. By the late 1870s, railroads were gaining ever-larger shares of the Lake Michigan grain trade, and in 1880 rail tonnage finally exceeded lake tonnage (Mansfield 1899). While the increasing development and efficiency of the railroads greatly contributed to the demise of purpose built sailing canallers, the continued development of the Welland Canal brought an abrupt demise to second generation sailing canallers (Monk 2003).

Soon after construction on the second Welland Canal was completed, it was apparent that the dimensions of the canal were still not sufficient enough to meet the demands of the lumber, grain, and coal trades on the Great Lakes. Construction began on the third iteration of the Welland Canal in the mid-1870's, and by 1882, its new, larger locks were opened for ship traffic. The locks of this "new" Welland Canal were built to admit vessels of 270 feet in length, 45 feet in beam, and had an original depth of hold allowance of 12 feet. The depth of the canal locks was deepened to 14 feet only two years later (Monk 2003; Mansfield 393). Although second generation sailing canallers remained in use throughout the Great Lakes, and still traversed the canal locks, the era of specialized sailing canaller construction was effectively over. Shipbuilders continued to build larger vessels, some of which were built to the specifications of the third Welland Canal locks, but the size of the new canal locks adequately satiated the demand for increased cargo capacity for a significant period of time, making many of these specialized techniques of vessel construction obsolete (Monk 2003; Mansfield 393).

The well-defined "era" of second generation sailing canallers allows for a detailed study of their design and construction features. Though each shipbuilder had unique methods of build and design, many general features of sailing canallers were commonly used and remain easily identifiable in the historical and archaeological record. The following section examines these modifications and mechanisms in a detailed typology.

SECTION THREE
Caller Typology

Historically, the term “canaller” was used to reference sailing vessels as well as steamers that traveled through the Welland Canal throughout its various iterations. While this is an accurate term, “canaller” is too broad to use when specifically discussing sailing vessels that traversed the Canal locks. Terminology for each type of vessel has fluctuated throughout various contexts and texts on the subject, but for the purpose of this document “sailing canaller” refers to the purpose-built sailing vessels that plied the Welland Canal, while “propeller canaller” refers to those powered by steam. A discussion of propeller canallers is a worthy subject, but remains beyond the scope of this Context.

Due to the common use of schooner rigs on many of these vessels, they are commonly referred to as “canal schooners” in the Great Lakes region by historians and archaeologists alike. While many “sailing canallers” were outfitted with schooner rigs, the term “canal schooner” does not adequately describe vessels that had purpose built hulls intended to traverse the Welland Canal, but had something other than a schooner rig. While the hull shape of these vessels remained fairly static and consistent throughout the second Welland Canal era, the rigging styles of the vessels varied widely. While many sailing vessels were “canal schooners”, there were also “canal barks”, “canal brigantines”, and “canal barkentines” known to have sailed through the canal, thus, “sailing canaller” remains a more inclusive and clarifying, term.

As sailing canallers developed from their original “moderate” design into “extreme” canallers, several components were added to the vessels enabling them to have a smaller overall breadth and overall length. “Moderate” canallers are those built earlier (1840s to early 1850s), with only slightly squared hulls and few modifications (shortened lengths and narrower beams). “Extreme” canallers are those built to fit exactly within the Welland Canal lock dimensions, and are the focus of this typology (Monk 2003). The terms overall breadth and overall length of the vessel refers to the ship’s width, including its outboard timbers (catheads and channels), and length from the tip of the jibboom to the yawl boat hanging off the stern.

With no surviving historical documentation that details sailing canaller hull lines, only research, investigations, and documentation of archaeological sites and investigations can answer questions specific to sailing canaller construction, design, and use. The research and documentation of these wreck sites offers the potential to answer additional questions about this vessel type as well. Conducting detailed archaeological surveys of the construction features specific to canallers, such as construction of the stem and stern, the turn of the bilge, and hull lines offers significant opportunities to add to our limited knowledge of the vessels. Nineteenth-century wooden vessels were rarely built to drawn plans. Today, little documentation exists that illustrates how wooden sailing vessels in the Great Lakes were constructed and the differences in hull lines and construction techniques between canallers and clipper-type hull models. Several noted features specific to sailing canallers are noted in the following sections.

Hull

The hull shape of most sailing canallers of the second Welland Canal era were simple in design, but allowed the vessels to carry a maximum amount of cargo while forgoing the sleek aesthetics of traditional sailing vessels. Though the hulls of these vessels somewhat resembled other contemporary vessels above the water, below the waterline, sailing canallers more closely resembled modern bulk carriers, which allowed maximum carrying capacity. In order to capitalize on space within the vessel's hold with such tight restrictions on space, the sides of the hull were constructed to be nearly vertical, compared to the elegant, curving hull lines of clipper hull design. Sailing canallers' relatively flat bottoms, harsh turn of the bilge, and almost 90-degree, plumb bow gave them a boxy look, making them look more like schooner-barges that were meant to be towed. It was this boxy shape made these vessels seemingly less hydrodynamic, and gave rise to the idea that sailing canallers were notoriously poor sailers, especially in harsh weather.

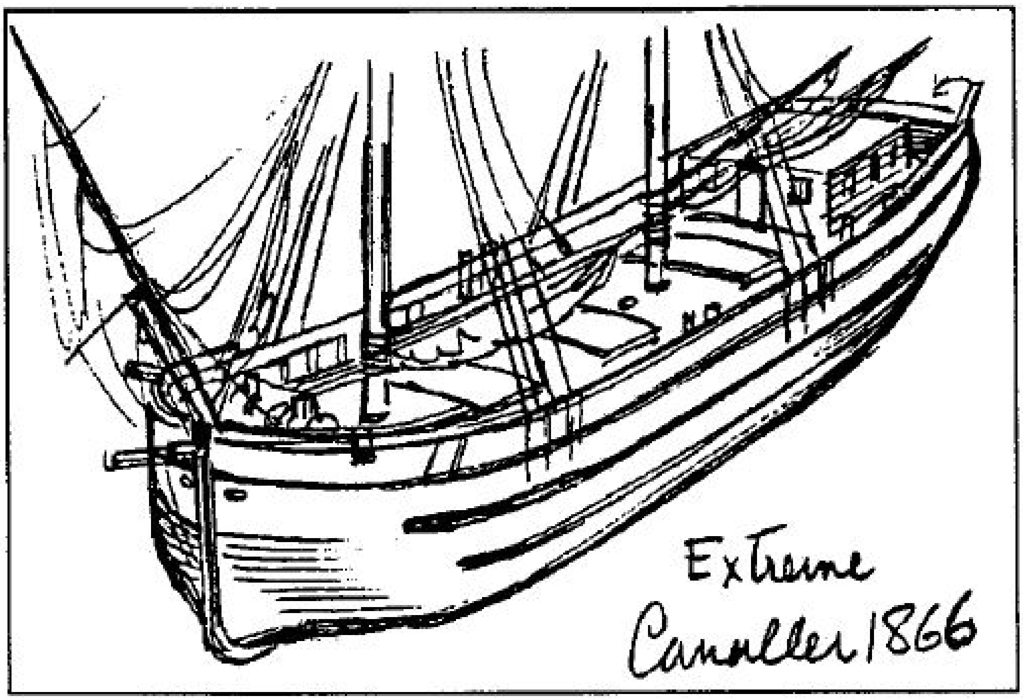

Figure 2. Illustration of an "extreme" sailing canaller (Loudon Wilson).

In addition to plumb bows, sailing canallers were also equipped with square transoms that were less raked than their traditional counterparts. This allowed the vessel's to be built longer, while still fitting within the confines of the Canal locks. With the second generation locks only measuring 150ft long, sailing canallers were built between 135.0 feet and 141.0 feet in length, not including any rigging components. Sailing canallers had very little variance in their breadths as well. Most traditional sailing canallers measured between 26.0 and 26.3 feet in breadth. This was to fit within the 26.6 foot wide canal locks. As sailing canallers developed over time, shipbuilders constructed the vessels wider until they were mere tenths of an inch narrower than the canal's breadth. Numerous accounts exist of vessels getting stuck in locks due to a single line falling between a vessel's hull and the wall of the canal lock.

The depth of the canal locks restricted many vessels with large drafts from sailing through the Canal with a full cargo. As purpose built sailing canallers continued to evolve and become more specialized, their drafts became shallower, allowing the vessels to carry close to full capacity while traversing the locks. Because of these shallow drafts, however, most sailing canallers required centerboards in order to maintain control while sailing in the open lakes.

In order to overcome the lateral motion caused by the wind and sails, vessels needed a way to maintain control and stay on course. Ocean going vessels and many traditional sailing vessels were built with deep drafts to help overcome lateral movement, but this was not possible in many of the shallow water ports of the Great Lakes. Vessels had to be built with a shallower draft in order to frequent many of the unimproved ports on the Lakes, therefore, many Great Lakes sailing vessels made use of centerboards. The centerboard acted as a method of providing lift to counteract the lateral movement of the vessel without having to change the sail plan. It would be dropped when in the open lake or could remain raised while in shallow water. This was especially important when decreasing the draft of many sailing canallers in order to carry more cargo (weight) through the locks (Barkhausen 1990).

Bowsprit and Jibboom

Hull design was not the only modification unique to sailing canallers. With Canal locks measuring only 150 feet in length, shipbuilders developed mechanisms for reducing the overall footprint of vessels, limiting the number of components that traditionally hung outboard on sailing ships. The most prominent of these components were the bowsprit and jibboom, which extended the vessel's overall length by 30 feet or more. With no way to remove the bowsprit and jibboom completely, shipbuilders began to modify them so they could be hoisted upwards while not under sail. Historic photographs and tintypes of sailing canallers being towed through Canal locks depict the vessels with their bowsprits and jibbooms raised at much more of a rake than the vessels would normally operate. A report from a young master of the sailing canaller *Knight Templar*, built in Oswego, New York in 1865, indicates that the bowsprit and jibboom would be lifted to "open [the] bow". Likewise, the report specifies that *Knight Templar* was only equipped with three headsails with forestays connected to the knightheads, which was common on sailing canallers (Wilson 1928). Traditionally sailing vessels included more than three headsails with rigging attached to the knightheads. Having fewer headsails and fewer components attached to the head rigging would have been necessary to easily raise and lower the bowsprit and jibboom. This type of bowsprit and jibboom outfit was sometimes referred to as a cock-billed jibboom (Monk 2003; Wilson 1928).

Archaeological analysis of known sailing canallers has confirmed this mechanism as being commonplace for vessel's that regularly traversed the Welland Canal. The apparatuses for raising the bowsprit and jibboom appear to vary with each shipbuilder, but some common features have been documented in the historical and archaeological record. One feature common to all sailing canallers is a rounded, or concave, back of the mortise cut into the samson post, while the heel of the corresponding tenon on the bowsprit is convex. This feature would allow the bowsprit and jibboom to be raised without having to un-step it at each canal lock. While it is not possible to discern this feature on all sailing canallers represented in the archaeological record, it has been documented on all wreck sites where the bowsprit was either broken, or un-stepped during sinking. Additionally, analysis of historic photographs appear to show a block and tackle system in the head rigging, which would have allowed the bowsprit to be raised in a similar manner to the sails being raised (Monk 2003; Whipple, Green, and Green 2003; Lo 2005; Thomsen and Meverden 2006; Janzen and Scoles 2009; Thunder Bay NMS 2009;

Thomsen et al. 2010; Thunder Bay NMS 2011; UNC Coastal Studies Institute and Thunder Bay NMS 2011; Janzen 2011; Janzen and Scoles 2011; Thomsen and Meverden 2012; Thomsen and Gulseth 2013; Zant and Thomsen 2015; Green 2016; Zant and Thomsen 2016; Thomsen et al. 2016).

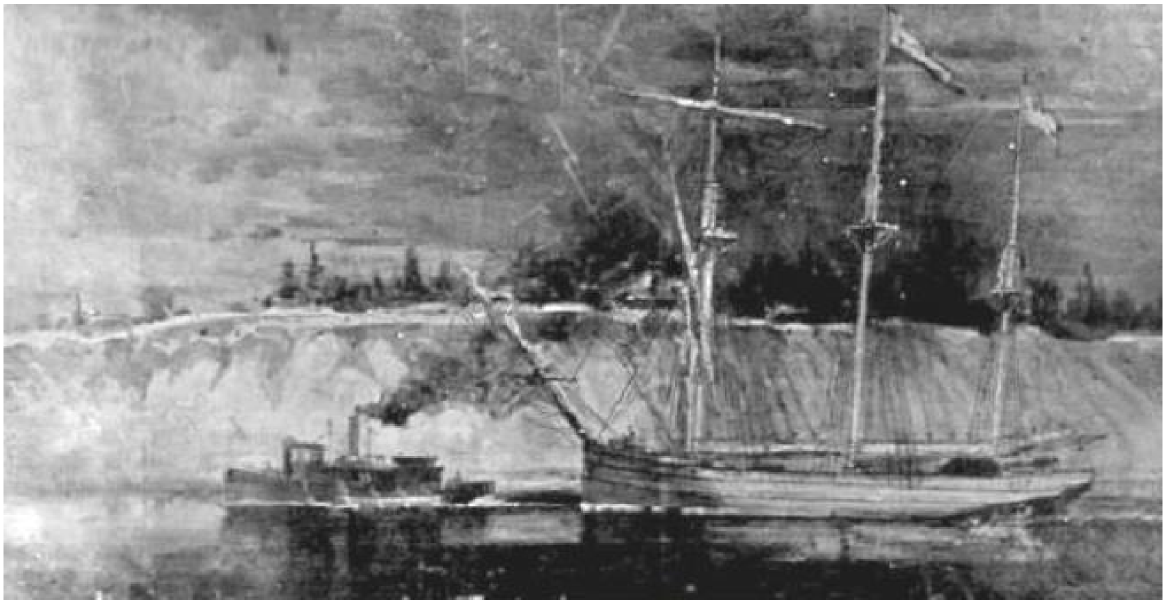

Figure 3. Tintype of a sailing canaller being towed through the Welland Canal with bowsprit raised (Niagara Falls Public Library).

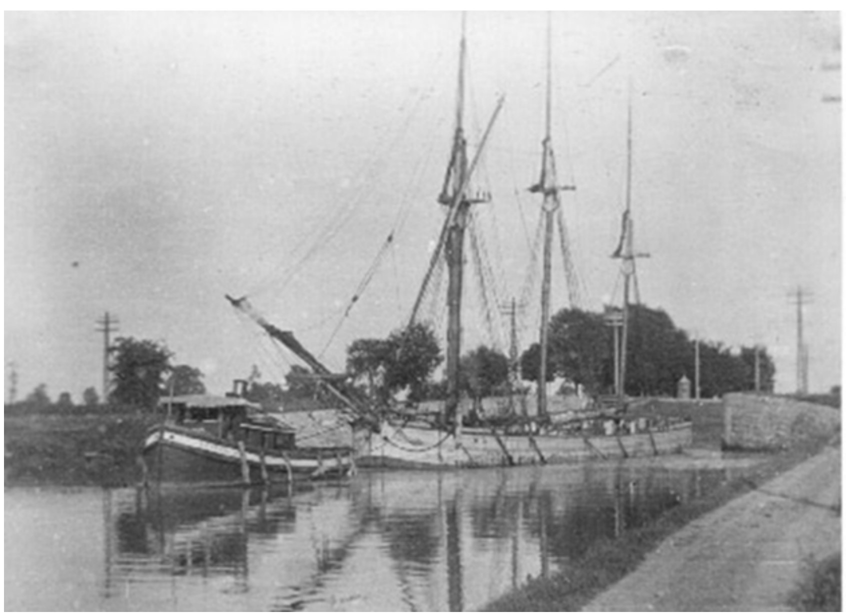

Figure 4. Image of a sailing canaller being towed out of one of the Canal locks. Note the raised bowsprit (C. Patrick Labadie Collection).

A section of the bow railing was also removable, allowing the bowsprit and jibboom to be raised when necessary, and acted as a mechanism to lock the bowsprit in place when underway. As with other sailing canaller components, this apparatus varied with different shipbuilders, but the purpose remained the same. Some sailing canallers featured a narrow section of railing which could be completely removed before raising the bowsprit. The most common mechanism, however, was that the section of bow railing was actually fastened atop the jibboom, rising along with the bowsprit and jibboom (Thomsen and Meverden 2006; Janzen and Scoles 2011; Thomsen and Meverden 2012; Thomsen and Gulseth 2013; Zant and Thomsen 2016).

In order to secure this section of railing, and therefore the bowsprit itself, pins or latches were located on either side of the knightheads. These pin and latch components were either located on the stempost, or on the outer hull on either side of the stempost. The latches would hook to a corresponding metal loop on the interior of the bow bulwark, while the pins would be inserted into metal loops or rings, securing the bow piece in place (Thomsen and Meverden 2006; Thomsen et al. 2010; Thomsen and Meverden 2012). Additional archaeological documentation indicates that some vessels made use of a U-shaped bar that spanned the bowsprit and was inserted into iron eyelets on the exterior of the hull, effectively pinning the bowsprit and bow railing in place (Zant and Thomsen 2016).

Figure 5. Photograph of the iron eyelet at the bow of the *Grace A. Channon* (Wisconsin Historical Society).

Unlike many traditional sailing vessels, sailing canallers either had no forecastle deck or the forecastle deck was not sealed around the bowsprit. If in place, the forecastle deck was supported by athwartship beams, which extended to each side of the bowsprit, and two longitudinal beams along each side of the bowsprit, supported by two small stanchions. This effectively gave canallers two forecastle decks, one port and one starboard, allowing the bowsprit and jibboom to be raised freely, while still allowing for the advantages of a small forecastle deck (Meverden and Thomsen 2008; Thomsen et al. 2010; UNC Coastal Studies Institute and Thunder Bay NMS 2011; Zant and Thomsen 2015; Zant and Thomsen 2016).

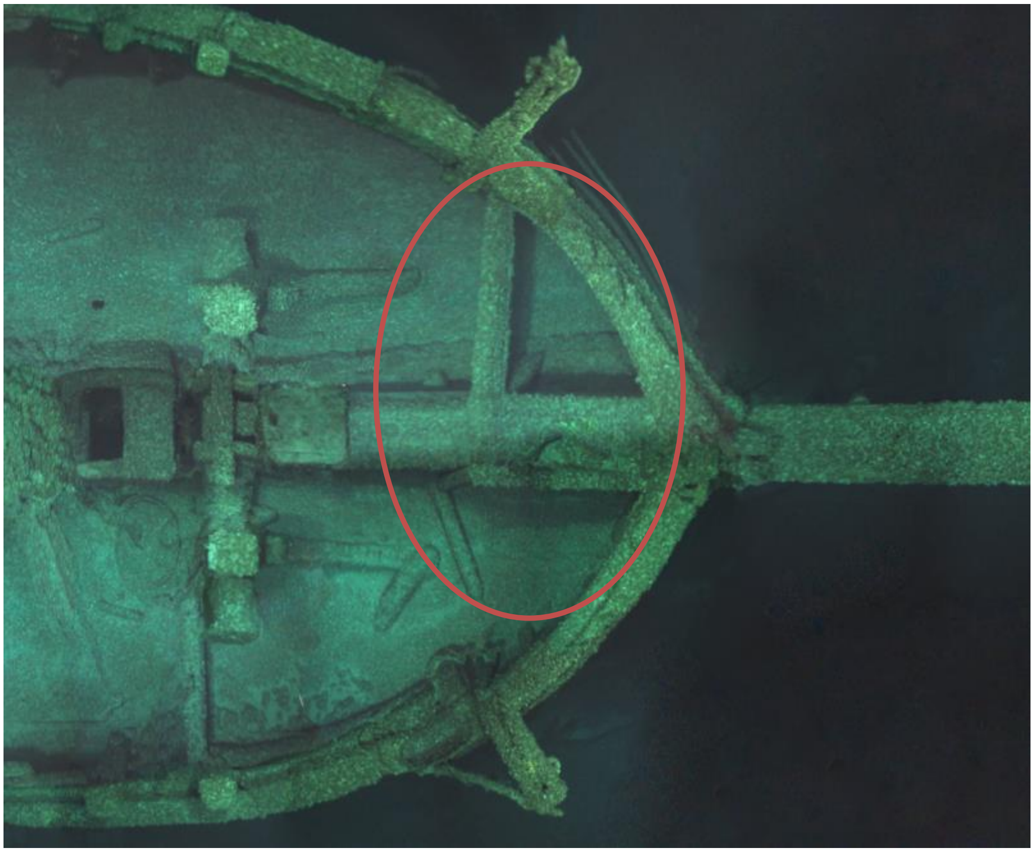
Figure 6. Mosaic of *Walter B. Allen*'s adapted forecastle deck (Wisconsin Historical Society).

Catheads and Anchors

In order to fit as much cargo into the holds of sailing canallers as possible, most sailing canallers were built with 26.0 feet to 26.3 feet beams, but still needed to fit within a canal lock that was only 26.6 feet wide. This meant the vessels could have few components extending past their bulwarks. Catheads were beams used to assist in lowering and raising the anchors, as well as for securing the anchors when not in use, and were located on either side of the bow, overhanging the bulwarks by 2 to 3 feet. This overhang made it difficult, if not impossible, for larger sailing canallers to be lowered in the Canal locks. There was not enough clearance between the Canal lock walls and the exterior of the hull for the catheads, and the anchors they supported, to extend outboard of the bulwarks.

To address this issue, shipbuilders designed catheads of sailing canallers with a hinge, located just inboard of the vessel's rail, which allowed them to be flipped back when passing through a Canal lock. The rail was keyed to receive and secure the davit while it was not hoisted inboard. In many contemporary traditional sailing vessels, the cathead would pass directly on top of the upper section of the bulwark, and the main rail was fastened atop the beam. While it is unclear in the historical record how these folding catheads were actually pulled back, documentation revealed that some of the catheads were equipped with a metal eyelet on the top of the beams that could have been attached to a pulley system and hoisted with block and tackle (Thomsen and Meverden 2006; Thomsen and Meverden 2012; Thomsen and Gulseth 2013).

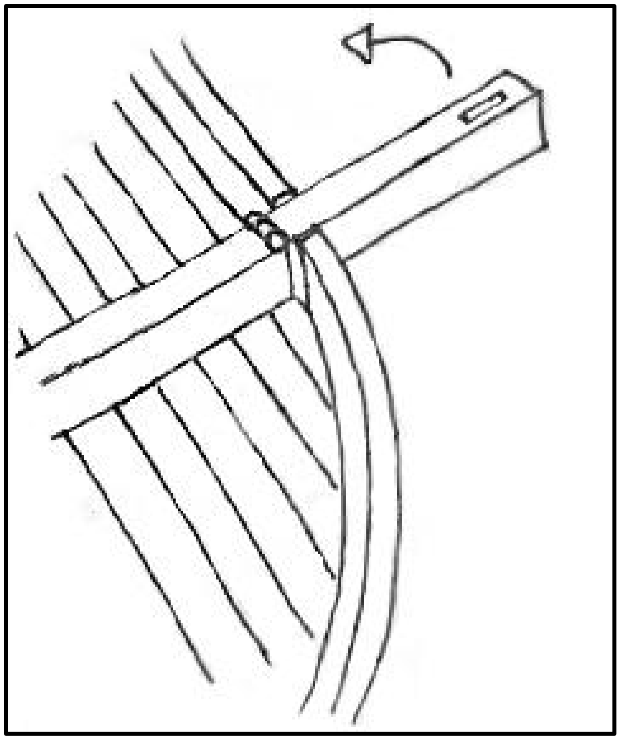

Figure 7. Illustration of a sailing caller's hinged cathead (Wisconsin Historical Society).

Historical photo analysis indicates that this was a widely used mechanism to reduce the overall footprint of second generation Welland Canal vessels. While on many archaeological sites the catheads no longer remain at their original locations or now lie broken due to anchor salvage, evidence of their folding nature has been documented. This is primarily evidenced by the keyed rail, and eyelets affixed to the top of the catheads (Thomsen and Meverden 2006; Thomsen and Meverden 2012; Thomsen and Gulseth 2013).

Stern Davits and Yawl Boat

Almost every sailing vessel in the Great Lakes was equipped with a yawl, or work boat, that was used to ferry crews and equipment to and from shore, and for other maneuvering duties while in harbors and tight quarters (Wilson 1928). Primarily these were attached to the vessel's stern while underway by two davits hanging off the stern. In traditional sailing vessels, these davits were made of wood, and fastened to the vessel as an extension of the main rail, extending 3.0 to 5.0 feet off the stern. Hook-shaped iron davits were also commonly used to fasten the yawl boat. Each davit had a block attached to the end, along with a built in block near its end in wooden davits, which allowed the yawl to be raised and lowered when it needed to be used. As with the bowsprit, jibboom, and catheads, these beams extending off the stern of a vessel increased the vessel's overall footprint. In sailing canallers, these davits were augmented to allow more flexibility in building longer vessels while still being able to fit within the confines of the 150-foot long Welland Canal locks.

Sailing canallers were equipped with folding wooden stern davits, or rotating, iron, hook-shaped davits. Much like catheads of sailing canallers, wooden davits were designed with a hinge on their upper side, which allowed the davit to be folded back completely and the yawl boat brought on deck. The exact look and design of the davits varied from ship to ship (Wilson 1928). It is unclear how the davits were held in place while they were extended and holding the yawl boat, but it is postulated that this was accomplished simply by using gravity and the yawl boat's weight to keep the davits from flipping back while underway in heavy weather. This is evidenced by the fact that on most wreck sites the davits now lie in the flipped back position, as if they were locking though the canal. At most wreck sites, the yawl boat has detached from the davits, either during the sinking or it was used to save crewmembers while the vessel sank. Without the weight of the yawl boat, and with the addition of upwards pressure from the water as the vessel descended, the davits were pushed back into their flipped up position where they now remain. If these were fastened in place, the davits would remain in their engaged positions on the lake bottom.

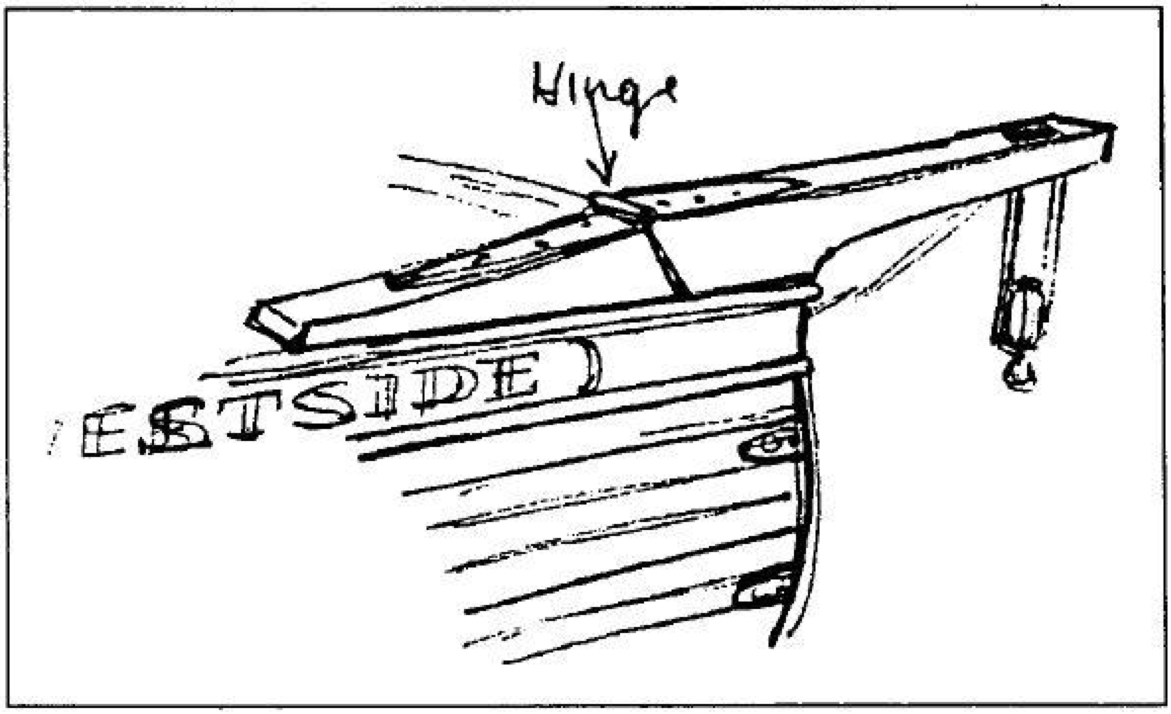

Figure 8. Illustration of a sailing canaller's folding stern davits (Loudon Wilson).

Archaeological and historical analysis has yet to definitively reveal a locking mechanism to reduce vertical movement of the davits when they were engaged, however, various mechanisms for reducing side to side motion of the davits have been identified. Some sailing canallers were equipped with an additional wooden block support atop the stern rail, just inboard of the movable davit arm. The hinge would have been a weak spot on these timber davits, as opposed to traditional wooden davits, which could potentially work free over time. These supports would have given the folding davit arms less room to move, therefore strengthening them (Janzen and Scoles 2011; Green 2016). Other hinged davits had a tongue and groove style attachment when the hinge was open and the davit engaged. The davit arm featured a heel tongue that fit into a corresponding groove cut into the aft end of the railing or davit timber attached to the main rail. This was to prevent the davit from becoming dislodged or swinging during rough weather while in use (Zant and Thomsen 2016).

Figure 9. Photograph of *Grace A. Channon*'s folding stern davits (Wisconsin Historical Society).

Although a feature not unique to sailing canallers, many later built second generation sailing canallers were outfit with rotating iron davits. Much like the folding wooden davits, these could be rotated in such a way as to bring the yawl boat on the stern deck while locking though the canal (Thunder Bay NMS 2009; Thomsen and Gulseth 2013). Many early sailing canallers of the "canaller era" made use of the folding wooden davits, while later built canallers seem to have made use of the iron rotating davits. It is not known if this was a smooth and fluid transition from one type to the other due to technological advances, or if the timing simply aligned with the increasing use of iron on wooden sailing vessels, but it is suggested that iron davits took the place of the heavier wooden folding davits by the 1870's (Wilson 1928).

Booms, Masts, and Rigging

The preference of Great Lakes shipbuilders to employ the use of the fore-and-aft schooner rig on their vessels is well documented. Although square sails were the preferred method of rigging on most ocean going vessels, schooner rigs were easier to maneuver in the Great Lakes, with the reduced strength of the prevailing winds (Monk 2003). This trend remained true for shipwrights who built sailing canallers. The schooner rig was easy to maneuver with fewer people, allowing the vessels to carry a smaller crew. Sails on fore-and-aft schooner rigs were also easily stowed, and booms could be swung out over the side of the vessel to more easily facilitate loading and unloading. It also kept the deck of vessels fairly clear, and allowed the vessels to maintain a smaller footprint across their beams, which was an advantage for the vessels as they locked through the Welland Canal. The schooner rig, however, is not the only documented rig type of sailing canallers. Although it was less common, sailing canallers were rigged as barks, brigantines, barkentines, and topsail schooners. These rig types featured multiple yards on their fore and main masts.

As with traditional sailing vessels, the yards on the masts of these vessels could be tipped to a diagonal position. The yards were attached to the foremast with a hinge and a swivel pin (Wilson 1928). This feature was of great use for sailing canallers as they locked through the canal, making sure that their long yards would not catch the sides of the canal locks as the water was lowered (Wilson 1928; Monk 2003). Though this could be done, the primary rig type for sail powered canallers remained the schooner rig due to the savings in time and costs it offered.

One obvious issue with the schooner rig for sailing canallers was the length of the mizzenmast boom. As with the davits off the stern of the vessel, it was beneficial to have very few spars and timbers hanging off the stern. This became increasingly important as shipbuilders attempted to make vessels longer and longer while still fitting in the canal locks. Thus, the length of the mizzenmast booms, and the cut of canallers' gaff sails differed from other vessels at the time. The gaff sails of sailing canallers had a shorter luff and a low peak, and a boom that did not overhang the transom by more than a few feet, if at all. This also would have necessitated a longer gaff on the mizzenmast. Likewise, the rake of sailing canallers' masts was less than that of traditional sailing vessels. It is thought that, in addition to the square hull, this feature gave sailing canallers their "boxy" appearance, and opposed to the smooth, elegant lines of a traditional schooner (Wilson 1928).

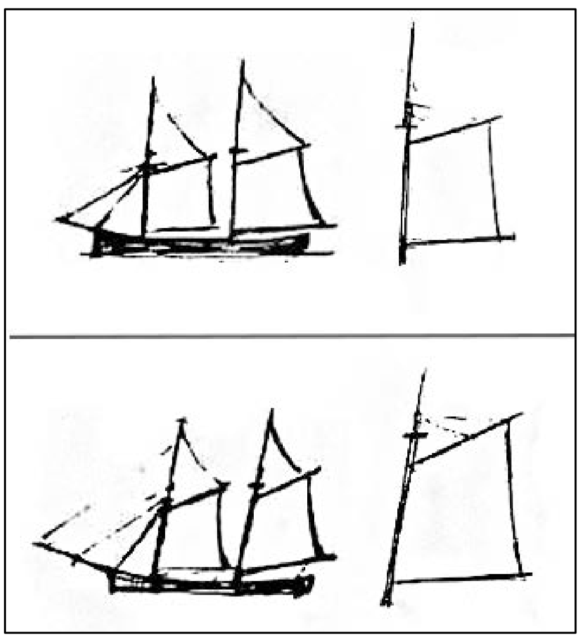

Figure 10. Illustration of a sailing canaller's typical rigging plan compared to that of a traditional contemporary sailing vessel (Loudon Wilson).

SECTION FOUR
Analysis and Comparison of Known Canallers

Many of the wrecks contained in this analysis reside beneath the waters of Lake Michigan and Lake Huron. The following wrecks were chosen for analysis because they represent a range of canaller construction features from throughout the Great Lakes region, and their construction dates span the entirety of the era of the second Welland Canal. Additionally, these vessels have extensive representation in the historical and archaeological record. With no examples of sailing canallers still afloat, the archaeological record is the only tool available with which to understand these vessels. The following analysis is based on data gathered from a compilation of field notes, National Register of Historic Places documentation, archaeological field reports, detailed site plans, research projects, and underwater photographs and video.

Although many different trades made use of canallers, the majority of cargo being transported between the eastern and western Great Lakes in the late nineteenth century came from three industries: lumber, grain, and ore. Each of these trades had specific components necessary for vessel construction, but many sailing canallers were used by different industries and companies throughout their sailing careers. Lumber hookers were used throughout the western Great Lakes, but most of the known sailing canaller archaeological sites in the western Great Lakes consist of vessels used in the grain and ore trade, as Chicago and Milwaukee were major grain ports on Lake Michigan, and remain the primary focus of analysis in this context.

Though sailing canallers were built to certain specifications and contained many of the same modifications to their hull shape, rigging, and other attributes in order to reduce their overall footprint, most sailing canallers were not built to drawn plans. Each canaller has its own unique combination of modifications and variations to allow it to fit within the confines of the Welland Canal locks. The key to identifying them from site to site varies widely. Historical analysis of enrollment records, shipping records, and photographs can reveal common general trends in shipbuilding techniques and design modifications, but a more in depth analysis of how these mechanisms worked in practice requires additional information. Archaeological analysis and comparisons of known sailing canaller wreck sites helps answer questions about the specifics of canaller features and how they differed across the Great Lakes region. This section analyzes multiple archaeological sites individually, highlighting their distinct canaller design and features.

America

The schooner-rigged sailing canaller *America* lies in 120 feet of water 8 miles south southeast of the Kewaunee harbor entrance on Lake Michigan. Lying on a heading of 130 degrees, the deck has collapsed and both the port and starboard sides have broken at the turn of the bilge and fallen to starboard. Despite its broken condition, nearly all of the vessel's hull structure and standing rigging remains scattered around the site.

The broken nature of the hull, as it lies on the bottom of Lake Michigan, is a common feature of canaller wreck sites. At least two other canaller sites in Lake Michigan are similarly broken at the turn of the bilge. Numerous other site formation processes have taken place since the vessel's sinking, but it is clear that the square hull design of sailing canallers made the turn of the bilge an even weaker point than on traditional sailing vessels. It is common for intact wooden wrecks to break at the turn of the bilge over time, however, it is evident that this break occurred as the vessel impacted the lake bottom, and not in a natural process over many years. These vessels were built with such a sharp turn of the bilge that upon impact with the lake bottom, the hull easily broke apart at that point. Undoubtedly, the site has experienced further structural changes since its sinking, but continued monitoring has demonstrated that these changes are slight, and do not account for most of the vessel breakup.

Due to the scattered nature of *America*'s hull, it is possible to locate and analyze distinctive sailing canaller components that would otherwise remain unseen. This is of particular interest near the bow. The vessel's bowsprit has unstepped and has pivoted forward at the top of the stem. The head of the bowsprit now rests on the lakebed at an angle. The tenon on the base of the bowsprit is rounded on its upper edge to allow the bowsprit to be raised vertically while remaining stepped within the samson post. The tenon measures 0.45 feet wide and 1.3 feet long, and fits into the corresponding mortise cut into the samson post of the same measurements. The mortise is rounded out on its interior face to allow the tenon to pivot easily (Thomsen 2012; Thomsen and Meverden 2012; Zant 2016).

Figure 11. Photograph of *America*'s bow (Wisconsin Historical Society).

To allow the raising of the bowsprit, a removable iron clamp held the bowsprit to the top of the stem. The clamp consisted of an iron bar placed over the top of the bowsprit that was secured with an iron bolt on either side of the stem. Each bolt is 2.2 feet in length, and the top of each bar is threaded to accept a square iron nut. The two nuts allowed the clamping bar to be tightened to hold the bowsprit securely in place. To raise the bowsprit for canal lock passage, the bowsprit's standing rigging was disconnected, the stem clamp loosened and removed, and the head of the bowsprit hoisted upward (Thomsen 2012; Thomsen and Meverden 2012).

Aft of the stem clamp, a timber is fastened to the top of the bowsprit that has identical dimensions to the rail and is the same width as the bowsprit. This timber is designed to make the rail continuous when the bowsprit is stepped in place, and allows the bowsprit to be easily removed when needed. This rail timber is fastened atop a wooden block that is attached to the bowsprit measuring 1.3 feet long by 0.5 feet tall. The purpose of this block is to provide an appropriate spacer that raises the rail timber to the appropriate height above the bowsprit.

Figure 12. The rail and clamps on the stempost of *America* (Wisconsin Historical Society).

America's catheads were not located during the original Wisconsin Historical Society survey in 2011 or consequent site visit in 2016. The wreck site has been known for many years and the anchors were removed by salvers in the 1970's, so it is likely that the catheads were dislodged during the salvage and now lie in the debris within the hull near the bow. There is evidence of the catheads original location. The vessel's rail is notched to allow cathead to fold inward. On most traditional schooners, the rail would extend over the top of the cathead, keeping it completely stationary (Thomsen 2012; Thomsen and Meverden 2012; Zant 2016).

The stern of *America* sustained much damage during the wrecking event. The transom remains connected to the fashion timber on the starboard side, but the port side of the transom has separated from the fashion timber and has fallen away from the vessel. Due to this, and the extreme damage to the sides of the hull near the stern, the stern davits were not located during the initial 2011 survey or the 2016 site visit. No rotating iron davits were located on the site, nor were any other components of rotating iron stern davits, leading to the conclusion that the vessel was equipped with folding wooden davits. The folding davits would have been attached atop the port and starboard stern railing and not the transom railing, so specific identification of this feature was not possible. The davits likely remain buried within the large debris field around the stern (Thomsen and Meverden 2012; Zant 2016).

As was common on most traditional Great Lakes sailing vessels and sailing canallers, *America* was equipped with a centerboard. The centerboard remains upright on the site, and begins 47.1 feet aft of the stem, measuring 28.0 feet long, 9.1 feet tall, and 1.6 feet wide. An unusual reinforcing timber is fastened atop the keelson on either end of the trunk. Forward of the trunk, this timber is fastened on the port side of the keelson; aft of the trunk it is fastened to the starboard side of the keelson (Thomsen 2012; Thomsen and Meverden 2012).

Christina Nilsson

Located 0.10 miles southeast of the Baileys Harbor lighthouse, the remains of the *Christina Nilsson* sit upright on the cobble and bedrock lake bottom in approximately 15 feet of water. All that remains on the wreck site is a 26-foot wide by 121-foot long bilge section, consisting of the vessel's lower frames, outer and inner hull planking, centerboard slot, keelson assembly, and an intact mast step. Although not much of the vessel remains, a few sailing canaller features can still be identified on the site. The lower hull and bilge are relatively flat, and the sides of the hull have broken off at the turn of the bilge. These two components are indicative of sailing canaller hull construction. Additionally, the breadth of the vessel, measuring 26.0 feet wide, fits within the measurements of the Welland Canal locks. A section of the vessel's upper hull also remains extant in the harbor, 0.38 miles away from the main wreckage. Frame set measurements and ceiling planking measurements from the initial survey seemed to indicate that this hull section belongs to the main section of the *Christina Nilsson* wreckage, but no additional sailing canaller features could be identified at the time of the 1999 survey (Whipple, Green, and Green 2003).

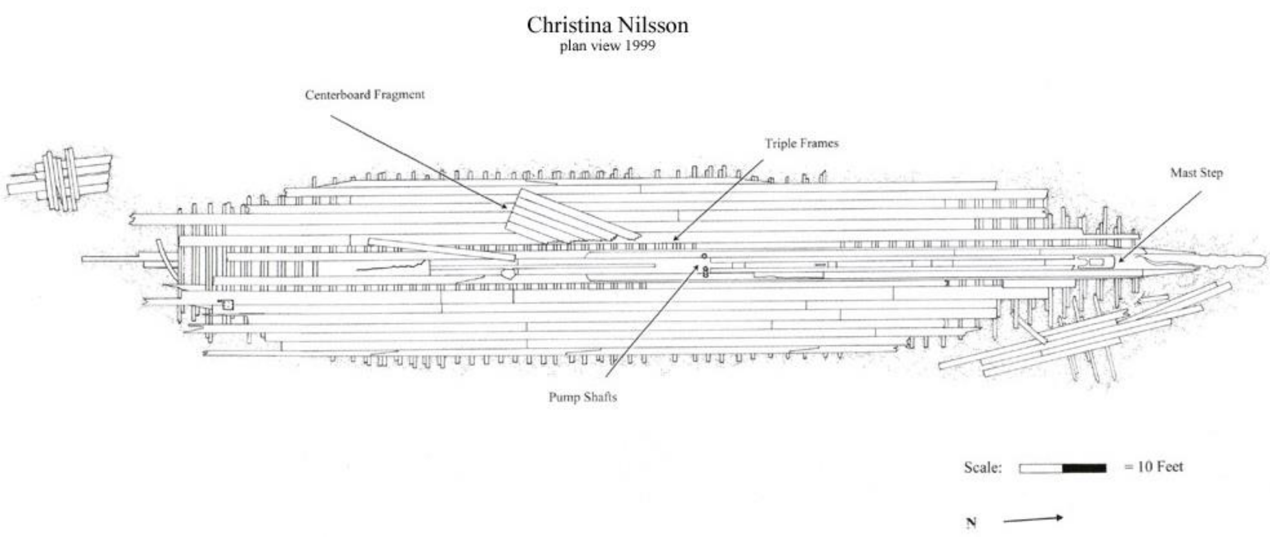

Figure 13. Site plan of *Christina Nilsson* (Wisconsin Historical Society).

In the years since the initial archaeological survey of the site, avocational archaeologists have continued to study the many wrecks within Bailey's Harbor. Since most of the wrecks ran aground and were broken apart by wind and wave action over time, broken hull sections now lie scattered around the bay. These subsequent archaeological investigations have begun to question the identity of the wreckage previously identified as the *Christina Nilsson*. Although it has not been confirmed, avocational archaeologists believe that this wreckage is actually that of the *Joseph Cochrane*, a traditional schooner of an earlier build (pers. Comm. Russ Leitz 2017). While additional archaeological investigations are necessary to confirm or deny these accounts, the width and the flat nature of the bilge section of the remains currently known as the *Christina Nilsson* match those of canaller proportions.

Daniel Lyons

Located 4 miles off Stoney Creek's outlet into Lake Michigan, 9 miles northeast of Algoma, Wisconsin, the schooner-rigged sailing canaller *Daniel Lyons* lies in 110 feet of water, with nearly all hull structure and rigging represented. Similar to *America*, *Daniel Lyons*' hull is broken at turn of the bilge, indicating it was extremely sharp. The sides of the hull are also very flat, with a relatively flat bottom, indicating a box shaped hull, typical of canaller hull construction. A bluff bow is also readily apparent, although the sides of the hull have both fallen to port.

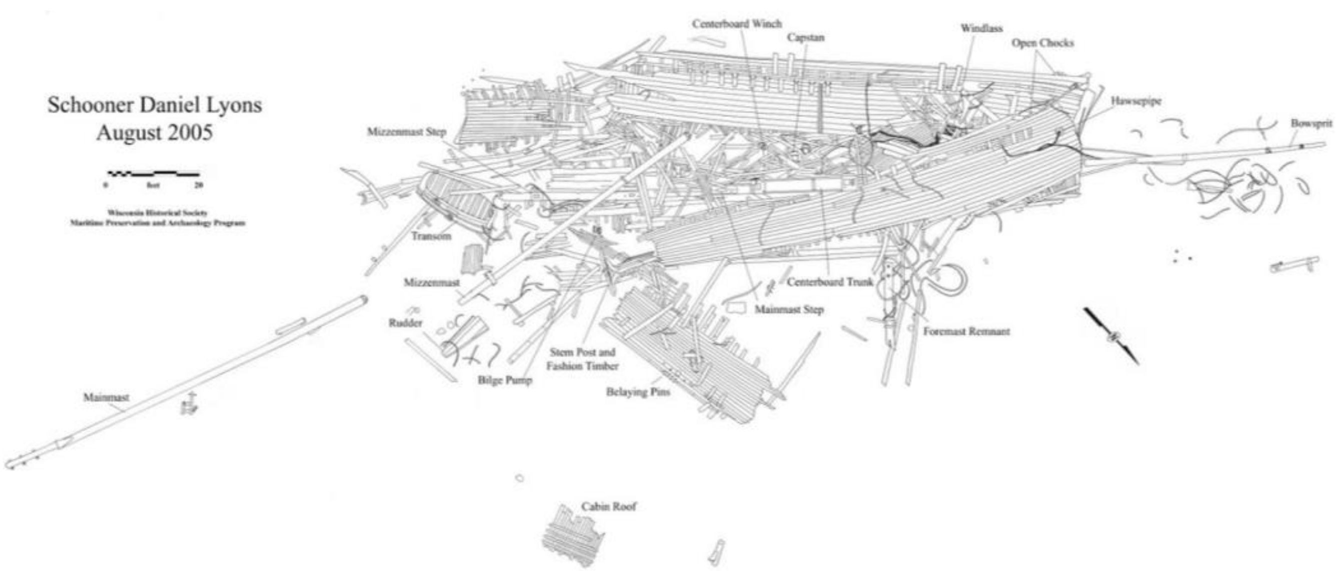

Figure 14. Overall site plan of *Daniel Lyons* (Wisconsin Historical Society).

Many internal structural components can be seen within the *Daniel Lyons'* site due to the broken nature of the hull. The vessel's bow is the site's most visually impressive feature. Before toppling to port, the bowsprit and jib boom dislodged from their location atop the stempost and split the bow in two along the stempost's starboard side, coming to rest atop the keelson. A 0.5 foot tenon protrudes from the base of the jib boom that secured the jib boom to the bowsprit by a mortised wooden block that remains intact atop the bowsprit. The bowsprit continues beneath the starboard side hull, which lays somewhat flattened over the bowsprit, stempost, and deadwood.

Sandwiched between the port and starboard sides, are the remains of the forecastle deck, samson post, windlass, and chain locker. The samson post has fallen towards the port quarter, and the windless now rests atop the forecastle companion way. Although the extent of the bowsprit cannot be seen due to the damage to the bow and its location underneath the fallen hull structure, the corresponding mortise in the samson post is rounded out on its interior face to allow the tenon on the end of the bowsprit to rotate easily when the bowsprit was being raised. This tenon is likely also rounded in a similar manner, and would have fit perfectly into the samson post mortise (Thomsen 2006; Thomsen and Meverden 2006; Zant 2016).

On either side of the bowsprit, no pins were found during the initial survey, but there are two small, metal eyelets on each side of the hull. From an analysis of other, more intact canallers, these correspond to a U-shaped metal bar that extended across the bow to lock bowsprit and corresponding rail piece in place when the vessel was underway. Although the bar was not located during the initial 2005 survey or the subsequent site visit in 2016, it was likely displaced when the hull split at its bow. Likewise, the stern davits could not be located in debris field near the vessel's damaged stern. The transom remains intact, although disarticulated and lying on the sand abaft the keelson. No rotating iron davits were located on the site, meaning the vessel would have been equipped with folding wooden davits, but specific identification of this feature was not possible without locating the bulwark and stern rail in the debris field. The davits likely remain on site, buried within the large debris field around the stern.

The vessel's catheads were also not located during the initial 2005 survey or the site visit in 2016. The bow railing on each side of the hull, however, is keyed to fit the folding catheads, as was found on the *America* site. The anchors of *Daniel Lyons* were also removed by salvers in the 1970's so it is probable they were damaged and disarticulated during that process, and now remain located in the debris of the broken bow (Thomsen and Meverden 2006; Zant 2016).

Figure 15. The remains of *Daniel Lyons*' bow and forward hull sections (Wisconsin Historical Society).

Floretta

Eleven miles south southeast of Manitowoc, Wisconsin, in Lake Michigan, the schooner-rigged sailing canaller *Floretta* lies on the lakebed in 180 feet of water. The hull is somewhat broken, but nearly all of the hull structure and rigging is extant. When *Floretta* hit the bottom of Lake Michigan, the lower portion of her hull, which contained a cargo of iron ore, stayed in place, breaking the vessel at the turn of the bilge. The transom fell aft while the upper portions of its hull, deck structure, masts, and rigging broke away, lifted and pivoted as they fell to the port side. Elements of the vessel's canaller construction can readily be seen on the site, while other components remain hidden within the debris of the bow and hull sections of the vessel.

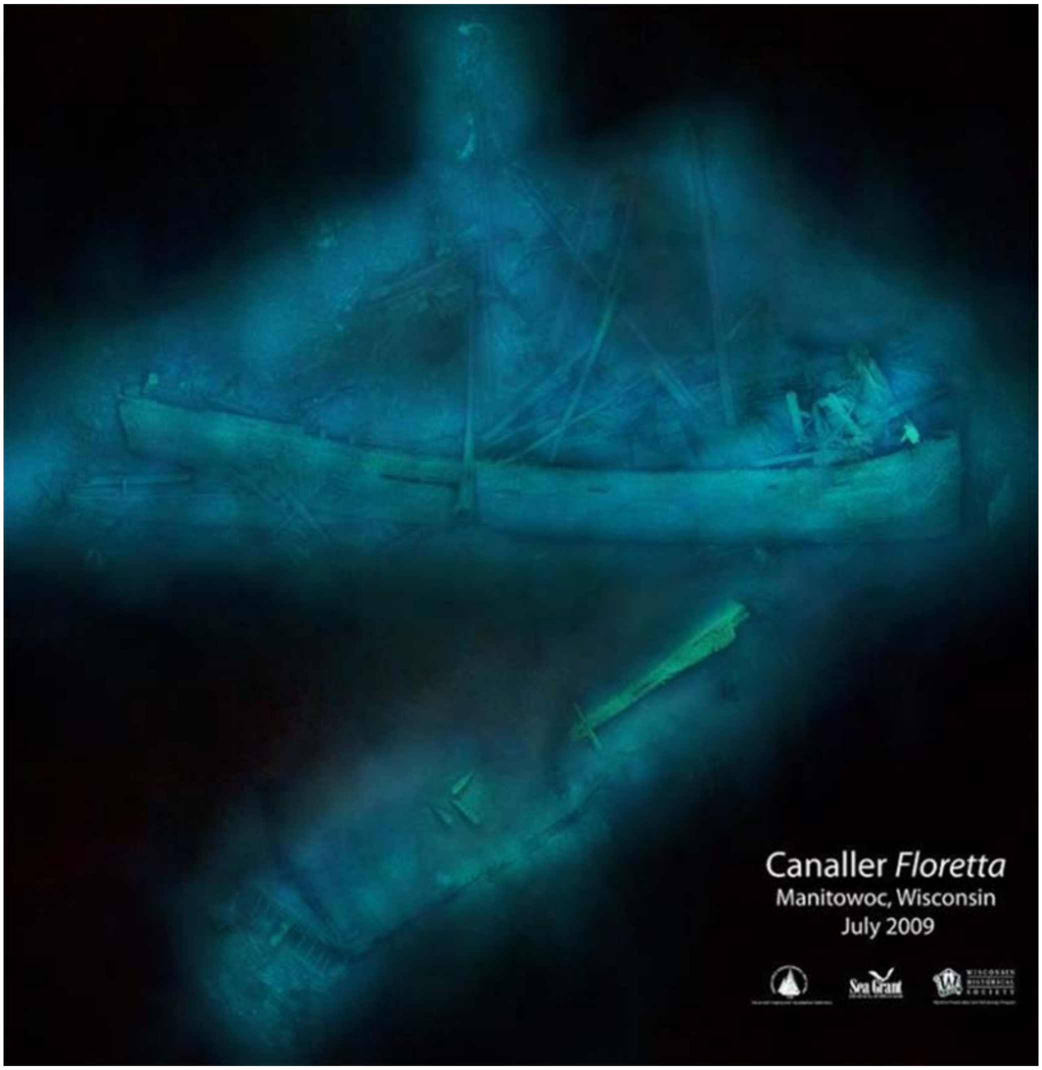

Figure 16. Photomosaic of *Floretta* (Wisconsin Historical Society).

Although broken, the shape of *Floretta*'s hull is very clear; the sides are flat and the stem has very little rake. Although the floors and bilge of the vessel remain largely obscured by the cargo of iron ore still piled against the upright centerboard trunk, it is clear from what can be observed that the bottom of the hull is relatively flat. As with two other canallers located within Wisconsin waters (*America* and *Daniel Lyons*), the hull has broken at the sharp turn of the bilge (Thomsen and Meverden 2006; Thomsen and Meverden 2012; Zant 2016). With the vessel's entire hull located on the site, the vessel's short depth of hold is apparent, along with the lumber ports located along its starboard site, two features very common in canaller construction.

The bow of *Floretta* is significantly broken, with many of its features disarticulated from their original positions. The aft end of the vessel's bowsprit is unstepped and rests on top of the wreckage with its forward end terminating in the sand. Much of the jibboom is still fastened to the top of the bowsprit with two 0.2 foot wide metal bands. The aft end has a beveled tenon that is 1.3 feet tall, which connected the bowsprit into the samson post. The beveled tenon allowed the bowsprit to pivot and be raised when locking through the Welland Canal. Eight feet forward of the tenon is a 1.3 feet wide section of railing. On either side of this rail sections are iron rods, which would have pinned the bowsprit and railing into place on either side of the stempost. On top of the rail piece is a large eye-bolt, to which a line would have been attached to the masthead on the foremast to raise and lower the bowsprit (Thomsen and Gulseth 2013; Zant 2016).

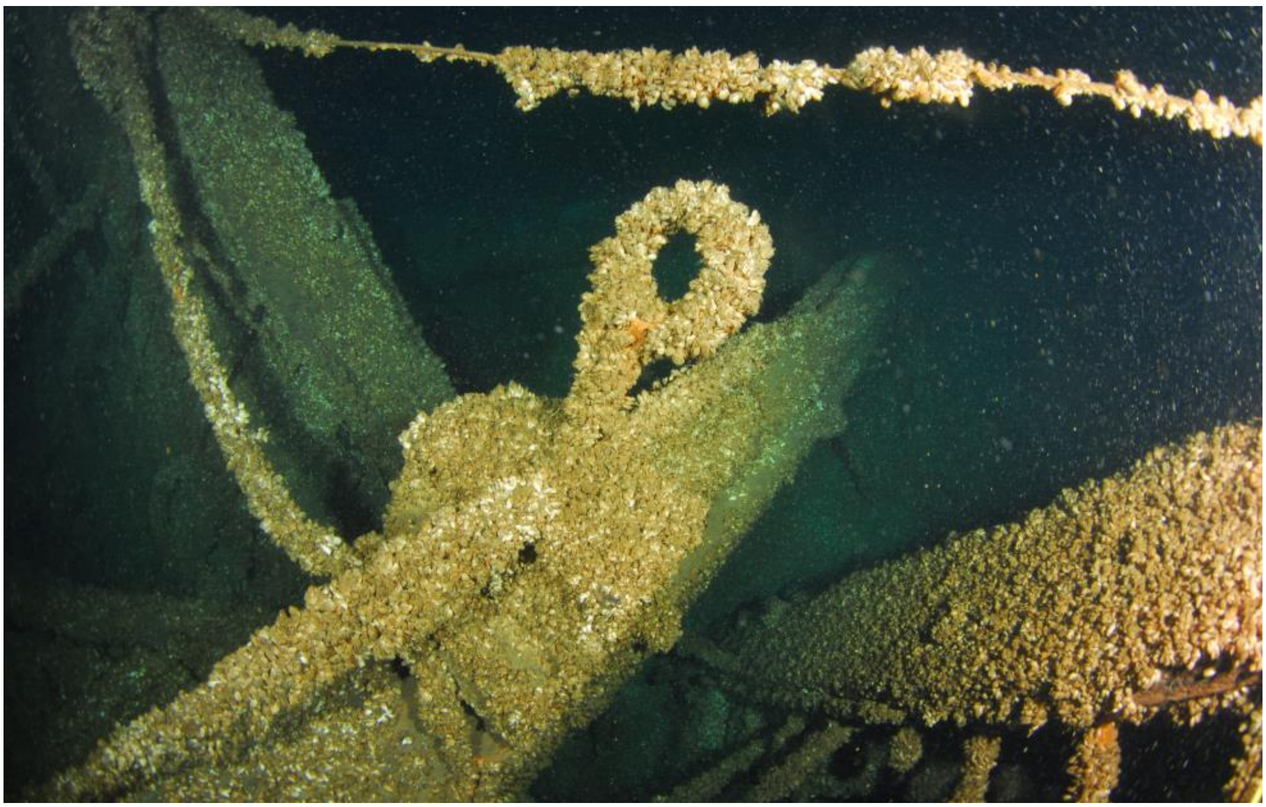

Figure 17. *Floretta*'s bowsprit with attached iron ring (Wisconsin Historical Society).

The samson post has been unstepped from the deck and now lies underneath the starboard hull. It measures 1.3 feet square and has a beveled mortis where the bowsprit would have been stepped. This mortis is 1.3 feet tall, 0.5 feet wide and 0.6 feet deep. The vessel's forecastle deck can also be seen in the wreckage of the bow, though largely broken. It is evident, however, that the forecastle deck was split to allow the bowsprit to be raised and lowered. Instead of maintaining a solid forecastle deck, which was planked over the top of the bowsprit, *Floretta*'s deck was supported by athwartship beams, which extended only to the bowsprit, and two longitudinal beams on either side of the bowsprit. The forecastle deck was only planked to the bowsprit, not over it (Thomsen and Gulseth 2013; Zant 2016).

Further aft, the vessel's catheads have been pulled away from their original location along the hull, and now lie facing inboard. The catheads are located 6.0 feet aft of the bow and are broken, extending into the ship 1.6 feet from the ceiling planking. These would have allowed the timber, and anchor, to be pulled aboard when locking through the Canal. Though the catheads are disarticulated, the railing on both the port and starboard sides are keyed to allow the catheads to fold inward (Thomsen 2013; Zant 2016).

Though the vessel's hull sides are located to the side of the bottom of the hull, *Floretta*'s transom remains just aft of the vessel's bilge, covered in nets. The transom is intact, including a single block and two cleats affixed to the taffrail. Additionally, *Floretta*'s davits extend aft on either side of the transom corners, and measure 2.5 feet above the taffrail. *Floretta* was equipped with iron rotating davits as opposed to the wooden folding timbers found on many other canallers. These davits could be rotated to bring the yawl boat on the stern deck while locking though the canal. It is yet unknown why some sailing canallers made use of folding wooden davits while others, such as *Floretta*, were equipped with rotating metal davits. (Thomsen and Gulseth 2013; Zant 2016).

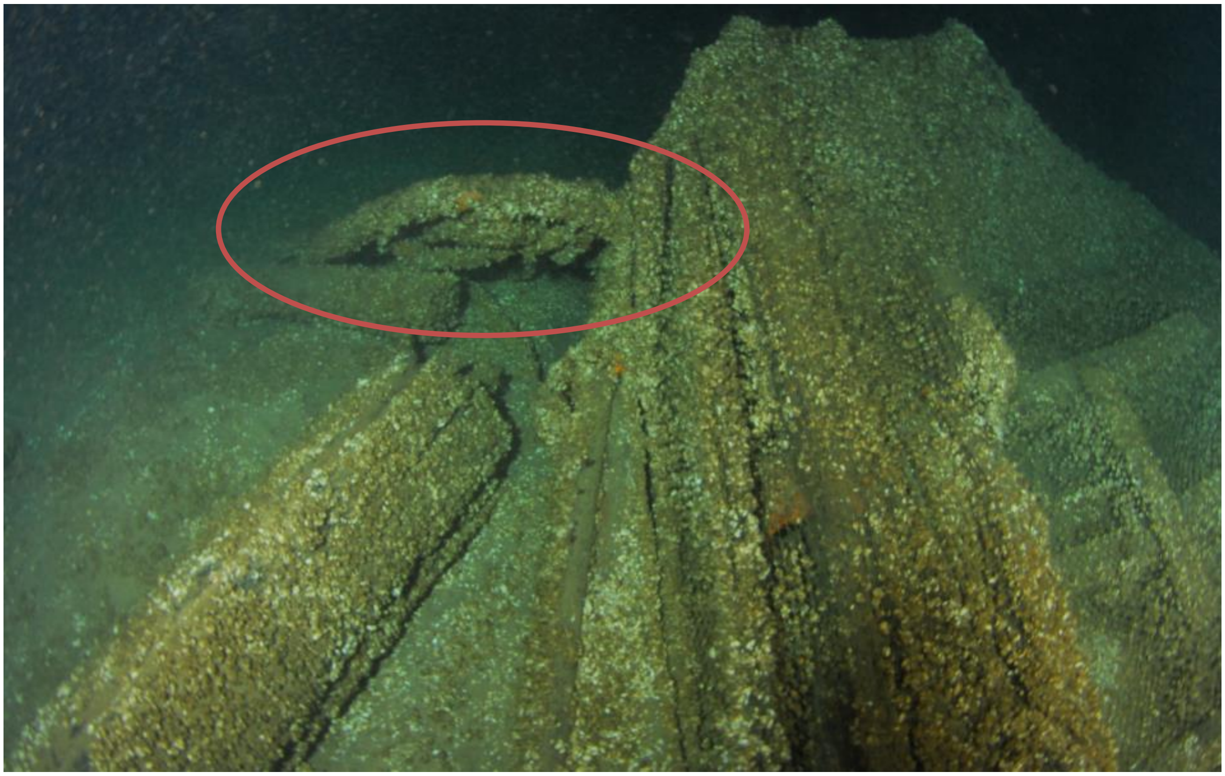

Figure 18. *Floretta*'s transom and port side rotating iron davit (Wisconsin Historical Society).

Grace A. Channon

The remains of the schooner-rigged sailing canaller *Grace A. Channon* sit on a heading of 70 degrees, 12.75 miles northeast of the Bender Park boat launch, in Oak Creek, Wisconsin. The vessel rests in 180 feet of water, with all of its deck machinery, spars, rigging, and cabin structure remaining on the site. The hull retains an incredible level of integrity, with many of its original canaller components intact in their original orientations. The hull shape of *Grace A. Channon* is that of a traditional sailing canaller, with straight sides, a sharp turn of the bilge and flat bottom, an upright transom (with only a 30-degree rake), a plumb bow, and a transom with a slight rake. As with other sailing canallers, *Grace A. Channon* is equipped with a centerboard.

Figure 19. *Grace A. Channon*'s starboard side, looking forward. Note the vertical sides of the hull (Wisconsin Historical Society).

The bow of *Grace A. Channon* sits on a 2-degree list to starboard, and remains almost completely intact. The bowsprit remains stepped into the samson post and extends forward of the stempost, where it has broken in two. Since the bowsprit remains stepped inside the samson post, it is difficult to determine the shape of the mortise for the bowsprit's heel tenon. It measures 1.5 feet in height, and 0.5 feet wide, and is likely concave in shape, which corresponds to the same convex curve on the heel tenon of the bowsprit. Like its flat bow, this component is highly indicative of sailing canaller construction.

Grace A. Channon's bow also includes a U-shaped metal bar that extends across the very forward section of the bow railing. The bar extends across the ship's width, and over the railing through two iron eyelets for the bar to be secured. The bar itself is bent inward (away from the bow) slightly starboard of the ship's centerline. This damage likely occurred during the sinking, when the bowsprit broke. The port side of the bar no longer extends through the eyelet, while the starboard side of the bar remains attached. This bar is one of the unique features of sailing canallers. Although this feature has not been found on other sites in Wisconsin waters, the two corresponding iron eyelets were found on either side of *Daniel Lyons*' bow, as previously mentioned. The bar could be lifted, along with a section of railing, so the bowsprit could be hoisted upwards by the rigging when transiting the Welland Canal (Zant and Thomsen 2016).

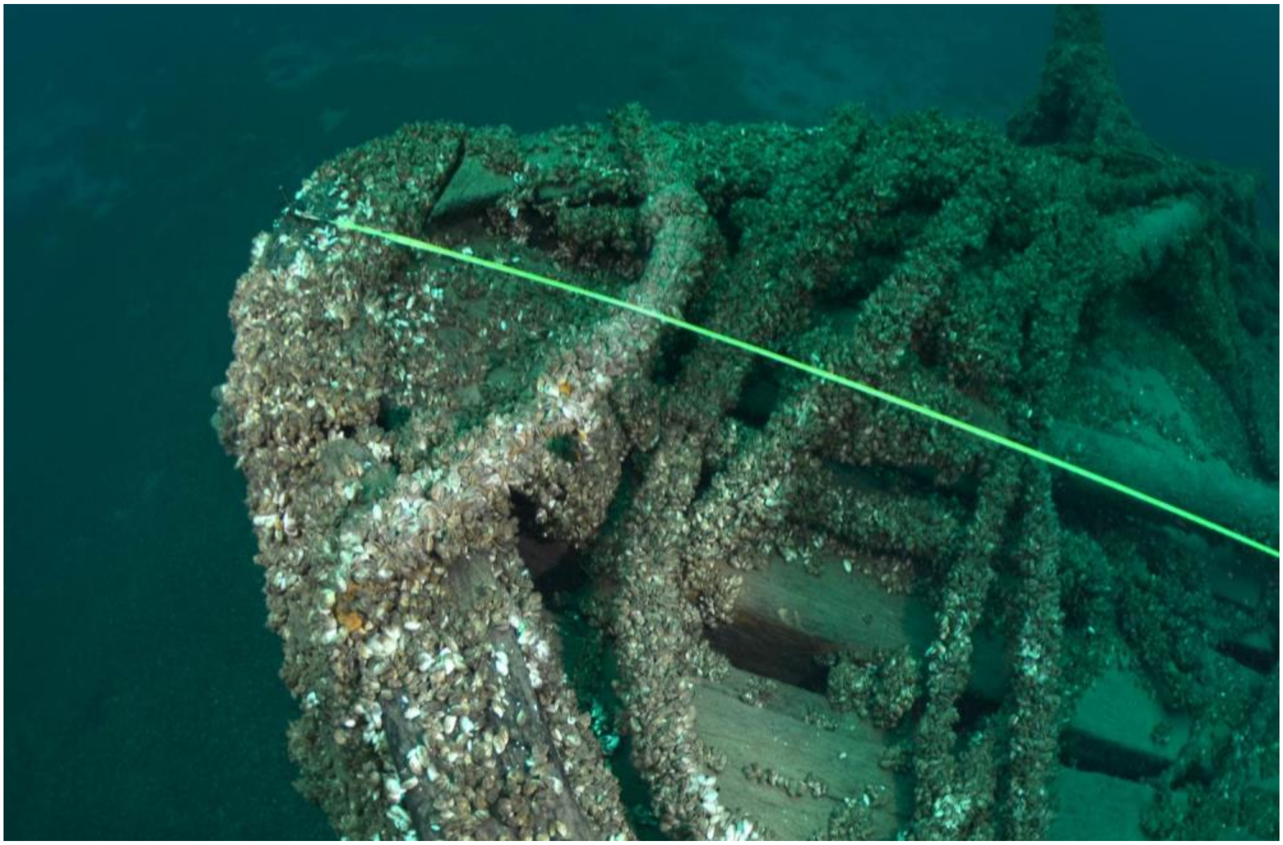

Figure 20. U-shaped iron bar on *Grace A. Channon*'s bow (Wisconsin Historical Society).

Grace A. Channon's forecastle deck is small and remains intact over the forecastle. Unlike many forward forecastle decks, *Grace A. Channon*'s is V-shaped along its aft end, extending from the samson post to the catheads. Similar to the forecastle deck of *Floretta*, *Grace A. Channon*'s forecastle deck was not built as a single deck over the bowsprit. It was supported by athwartship beams, and two longitudinal beams on either side of the bowsprit, leaving an opening above the bowsprit, to allow it to be raised.

Grace A. Channon also features folding catheads that could be flipped inboard of the railing, along with the attached anchors, when traversing the canal locks. The iron hinges measure 0.2 feet in diameter, and they are located on the top of the catheads. The catheads themselves are made of two separate timbers, joined by the hinge. The vessel's railing is notched to accept the cathead when it was not hoisted inboard, opposed to the rail extending over the top of the catheads on traditional sailing vessels. Initially not identified on other canaller vessels, but later identified during 2016 site visits, it is apparent that this was a common feature on sailing canallers, allowing a ship that measured 26.2 feet in beam, to fit through a canal lock that measured 26.5 feet wide (Zant and Thomsen 2016).

Figure 21. *Grace A. Channon*'s port side folding cathead with hinge (Wisconsin Historical Society).

At the stern, *Grace A. Channon*'s two folding davits can be seen. One remains in place on the vessel's stern, folded inward, while the other now lies in the sand off the starboard side of the vessel. As one of the few sailing canaller wrecks in Wisconsin waters with extant examples of wooden folding davits, *Grace A. Channon* offers interesting archaeological insights. The davits are hinged on the top side so they could be lifted up, and stowed along the aft main rail. The hinge measures 0.2 feet in diameter, and is located 0.4 feet inboard of the transom allowing the upper arm of the davit to rest on this section of railing when extended. The davit features a small heel tenon that fits into a corresponding mortise cut into the aft end of the railing to prevent the davit from becoming dislodged or swinging during rough weather while in use. The ends of the davits feature a built in block that would have allowed the yawl boat to be raised and lowered when needed.

Additionally, the taffrail (stern railing) features a 0.15 foot diameter circular mortise that corresponds to a 0.15 diameter peg on the top of each davit. This small feature was likely used to secure the davits in place while storing the yawl on deck or while going through the Welland Canal locks. Just forward of these davits are two wooden posts that rise 2.0 feet above the railing, and measure only 0.1 feet in diameter. At the time of the survey it was not possible to determine what these were used for, but they were potentially associated with securing the davits and yawl boat. This feature has not been identified on other sailing canaller wreck sites (Zant and Thomsen 2016).

Figure 22. *Grace A. Channon*’s port side folding stern davit, folded back (Wisconsin Historical Society).

Kate Kelly

The remains of the canaller *Kate Kelly* lie in 55 feet of water, mostly broken up, on a heading of 315 degrees, 2.0 miles east of Wind Point Lighthouse in Lake Michigan. Although broken up and spread over a large debris field, large sections of its hull remain intact and identifiable, along with its associated gears, machinery, and other artifacts. With some key sections of the vessel missing from the site, however, identifying specific sailing canaller features remains difficult, but a few features can still be recognized (Thomsen et al 2007).

Several large sections of *Kate Kelly* lie scattered over the lakebed. The lower hull is the largest section of the vessel, measuring 112 ft. in length, and has an extremely flat bottom. The vessel’s centerboard and centerboard trunk were identified laying on their sides on the port side of the vessel. The vessel’s plumb bow is also readily identifiable despite the broken nature of the bow section. As the vessel hit the lake bottom, the bow split in two, causing the port side to come to rest facing upward and the starboard side facing downward. The port side bow is intact up to the knighthead, and the stempost remains attached to the starboard side of the hull. The placement of these two sections of the bow does indicate the hull broke apart at the turn of the bilge, similarly to *America*, *Daniel Lyons*, and *Floretta*. No evidence of the bowsprit, jibboom, or samson post were found during the original 2002 and 2003 surveys, so it is not possible to determine if the bowsprit heel tenon was rounded to fit within the corresponding mortise in the samson post. Likewise, the vessel’s catheads and main railing were not located on the site and could not be analyzed (Thomsen et al 2007).

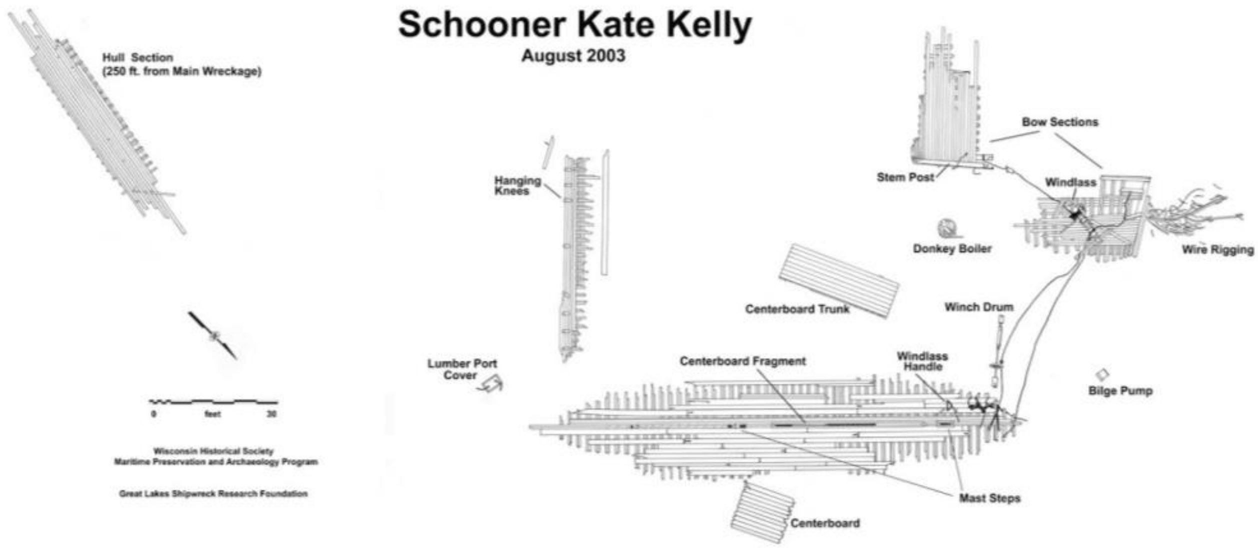

Figure 23. Site plan of *Kate Kelly* (Wisconsin Historical Society).

The vessel's stern is broken and disarticulated, with large sections missing. Due to this, no data of the rake of *Kate Kelly*'s transom, or composition of its stern davits could be collected during the 2002 and 2003 survey or the 2016 site analysis. While it is possible *Kate Kelly* was equipped with rotating iron stern davits, it is far more likely the vessel would have had folding wooden davits (Thomsen et al 2007).

LaSalle

Located 4.15 miles northeast of Two Rivers, Wisconsin off Point Beach State Forest in Lake Michigan, the wreck of the schooner-rigged sailing canaller *LaSalle* lies partially embedded in a bed of quicksand in 11 to 15 feet of water. The vessel retains a remarkable level of integrity for resting in such shallow water. Although *LaSalle*'s main deck does not remain on the site and parts of the vessel are still covered by sand, many sailing canaller features have been successfully identified (Zant and Thomsen 2015).

LaSalle's hull exhibits many features indicative of a sailing canaller. The vessel's bluff bow is apparent with the stem post sitting at 90-degrees to the keel, as are the vessel's flat sides. Likewise, the vessel's length and width, at 141.0 feet and 26.0 feet, fit within the Welland Canal lock dimensions. Although the vessel's bowsprit is not extant, its bed is clearly defined by the hawse timbers and knight heads on the port and starboard sides. These knight heads would have held the bowsprit strongly in place while underway. Two rods, measuring 0.3 feet wide and 1.4 feet long, are located on either side of *LaSalle*'s bowsprit bed, and were used to hold the bowsprit in position. The portside rod is bent outward and appears broken, which was likely caused by the removal of the bowsprit and bowsprit rigging during the original salvage attempts. The starboard side rod remains intact and upright (Thomsen et al. 2010; Zant 2016). These rods could be removed so the bowsprit could be hoisted upwards by the rigging when transiting the canal locks.

Figure 24. *LaSalle*'s plumb bow and bowsprit bed (Wisconsin Historical Society).

LaSalle's bow is unlike most other sailing canallers located in Wisconsin's waters. Instead of having an adapted forecastle deck, *LaSalle* seems to have no forecastle deck. The vessel's bow remained open allowing the bowsprit to be raised and lowered freely. It is possible that the forecastle deck was also removed during salvage, but no debris or associated fasteners for the deck remain on the site. The vessel's main deck remains intact extending from the stempost 15.9 feet aft. The vessel's samson post remains upright, extending through the forecastle deck, and contains a mortise for the bowsprit measures 1.5 feet tall, 0.5 feet wide, 0.5 feet deep, and is concave on the back side, which would have corresponded to the same convex curve on the heel tenon of the bowsprit. Like its flat bow, this component is indicative of a canaller, and would have allowed the bowsprit to pivot upwards easily (Zant and Thomsen 2015).

LaSalle's bulwark is no longer intact in the bow; only the vessel's bulwark stanchions remain in place. Because of this, there are no longer any remains of the vessel's catheads or the notch for them in the rail. The wreck was salvaged shortly after its sinking, and its anchors were removed. This salvage process likely damaged the catheads and much of the upper bulwarks. The salvage attempts also caused the loss of the vessel's main deck, aft of the bow, revealing *LaSalle*'s single centerboard, which extends into the sand now filling the hull.

With much of the stern still covered by sand, the transom was not located during the 2015 survey of the site. Because of this, it was not possible to determine the rake of the transom, or locate any stern davits. Although these have not been identified on the site, combined with the other features attributed to sailing canallers, it is probable that the vessel had an upright transom and folding wooden stern davits (Zant and Thomsen 2015).

Tubal Cain

The wreck site of the barque-rigged sailing canaller *Tubal Cain* is located 1.33 miles northeast of Two Rivers harbor entrance, in 7 to 10 feet of water, lying 300 feet off shore, partially embedded in quicksand. The ship's lower hull remains intact and protected in very fine, gelatinous sand. The visible wreckage is remarkably well-preserved, having recently been exposed. The vessel remains intact up to its gunwales, so its flat sides are readily apparent. Archaeologists were able to identify specific sailing canaller features throughout the site despite the sand covering a large portion of the interior of the hull (Thomsen et al. 2016).

The vessel's bow shows additional indications of sailing canaller construction. Beyond the upright stempost, the vessel's bowsprit bed can clearly be defined by the knightheads on either side. The bowsprit has unstepped from the samson post and now lies resting on the port side of the bow, extending into the sand. Unfortunately, the end of the bowsprit that contains the tenon which would have fit into the samson post is now buried in the sand. Additionally, evidence of the vessel's catheads was not located during the time of the survey because of the damage to the bulwarks at the bow. The main rail, through which the catheads would have extended, no longer remains so it cannot be determined if it was notched to receive the folding catheads (Thomsen et al. 2016).

Tubal Cain's samson post can still be seen above the sand, located eleven feet aft of the stem. It now leans 3.0 feet to the port side which means it is likely unstepped from the keelson. The sand buildup on the site at the time did not allow the mortise in the forward facing side of the samson post to be seen. As with many other sailing canaller wrecks, however, the bowsprit has unstepped not broken, which is a common characteristic of canaller wreck sites. As with other canallers, the vessel also is equipped with a centerboard which remains attached to the keelson (Thomsen et al. 2016).

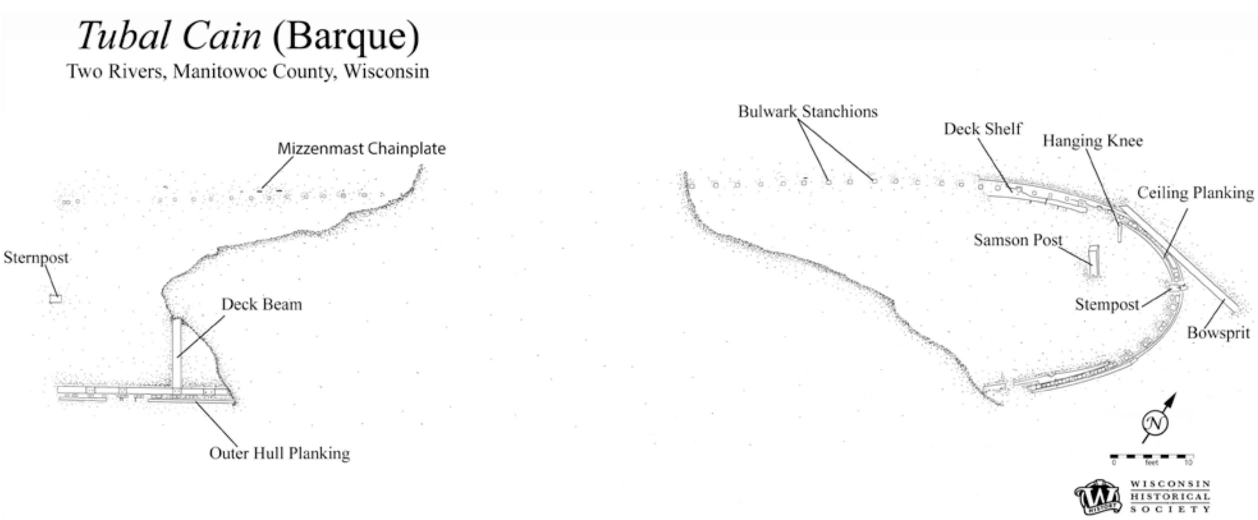

Figure 25. Site plan of *Tubal Cain* (Wisconsin Historical Society).

The vessel's length of 137.4 feet and breadth of 26.3 feet fit within the specifications of the Welland Canal locks. Additionally, Tubal Cain's stem post and gripe sit upright and nearly vertical. The stern post can also be seen sticking up from the sand, with a 0.2 feet deep groove on the aft edge to receive the rudder post. Evidence of Tubal Cain’s transom was not visible at the time of the 2016 survey, so the rake of the transom could not be identified. Given the nature of the shifting sand on the site, it is likely to be nearby, covered by sand. Because the transom and much of the stern rail was not located at the time of the survey, identification of the folding stern davits was not achieved. The taffrail at the stern, which is where the davits would have been attached, no longer remains attached to the bulwarks, and the davits were not located, though it is likely they lie nearby, covered by sand (Thomsen et al. 2016).

Walter B. Allen

Seven miles northeast of Sheboygan, Wisconsin, in Lake Michigan, the wreck of the sailing canaller *Walter B. Allen* sits upright and intact in 170 feet of water. The vessel remains in remarkable condition with most of its components intact. Due to the high degree of preservation, the vessel’s canaller construction features are readily apparent. Aside from having flat sides, an upright stem that is at an almost 90-degree angle from the keelson, a transom with only a slight rake, and a flat bottom with a sharp turn of the bilge, *Walter B. Allen* measures 142.0 feet in length and 25.0 feet in beam, which would have allowed it to tightly fit within the Welland Canal locks. The vessel is also equipped with a centerboard, which would have made sailing with such a flat bottom and square shaped hull easier (Thomsen et al 2010).

There are many sailing canaller components visible on the vessel’s bow. The bowsprit remains in place, stepped into the samson post at an angle of 14 degrees and is round with a flat top and bottom. The bowsprit extends 16.4 feet forward of the rail and 8.2 feet inside the rail to the point where it is stepped into the samson post. The samson post’s forward edge is located 11.2 feet from the peak of the bow, and the mortise for the bowsprit is visible on the forward surface. There are rods that remain on either side of the bowsprit that hold the bowsprit into position. These rods were attached on the inboard side of the bulwarks by a metal latch on a hinge, which could be clasped together to secure the rods, or be unlatched to easily remove the rods, and raise the bowsprit. An upper rail section sits atop the bowsprit, which would be lifted along with the bowsprit. (Thomsen et al. 2010; WHS field notes).

Figure 26. *Walter B. Allen*’s bowsprit pins (Wisconsin Historical Society).

The vessel is also equipped with a unique version of folding catheads. Although *Walter B. Allen*'s anchors no longer remain on the site, its two catheads still remain intact, extending 2.6 feet out from the inside of the top rail. The catheads on *Walter B. Allen* are unique in that they are attached to the inboard side of a bulwark stanchion, instead of the forecastle deck. This gives the catheads a shape that is more similar to hooked davits as opposed to traditional catheads with long, flat timbers.

The catheads themselves are made up of two timbers, attached by an iron hinge that measures 0.2 feet in diameter and rests on top of the cathead. These hinges are unique in that they are also attached to a thin iron band that runs along the top of the cathead. Although it is still unclear, this is possibly an additional support feature necessary due to the shape of these particular catheads. It is not known if this style of cathead was commonplace or if it was a design feature attributed to one single builder. Evidence points to the latter, as another sailing canaller, *E.B. Allen*, built by the same shipwright as *Walter B. Allen*, also features these unique catheads.

Figure 27. L-shaped catheads at *Walter B. Allen*'s bow (Wisconsin Historical Society).

Walter B. Allen also features a small, split forecastle deck. Although the deck planks are no longer extant, the athwartship deck beams and deck stanchions remain on both sides of the bowsprit. Like in many other canallers, this division of the port and starboard forecastle decks made it possible for *Walter B. Allen*'s bowsprit to be hoisted upwards while in the locks. While most vessels' forecastle decks extend from the stem post back to the samson post, *Walter B. Allen*'s only extends halfway from the stem post to the samson post. It is not clear as to why this deck was built so small, but it is possible the shipbuilder wanted the bow to remain more open to allow easier access to the bowsprit, samson post, and bowsprit lifting components (Thomsen 2010; Thomsen et al. 2010; Zant 2016).

At the vessel's stern, the starboard side davit lies in the sand, while the port side davit remains attached to the vessel and is folded inboard along the taffrail. It is attached to the rail with a large iron hinge, measuring 0.25 feet in diameter. The taffrail is notched at its stern facing end to receive the davit when it is folded outboard and fully engaged. The davit itself tapers from a thickness of 0.9 feet near the hinge, to 0.5 feet at its extent. A block is built into the end of the davit, which would have allowed the yawl boat to be raised and lowered. No securing mechanism for the davit was located. The vessel's transom remains intact as well, with a rake of only 25-degrees.

Figure 28. *Walter B. Allen*'s stern folding davits (Wisconsin Historical Society).

At the time of the survey the foremast was still standing while the mainmast had unstepped during the sinking and lies over the port side railing. An analysis of the standing mast revealed that the foremast had little to no rake. As one of the few sailing canallers in Wisconsin with a standing mast, this suggests that sailing canallers did not have raked masts like most other traditional sailing schooners. As of the 2016 site visit, both masts had fallen (Thomsen et al. 2010).

Bermuda

Located approximately 3.7 miles from Munising, MI, in Murray Bay off Grand Island in Lake Superior, are the remains of the sailing canaller *Bermuda*. The site lies within the Pictured Rocks National Lakeshore in approximately 30 feet of water, in a protected bay, which has kept the vessel from experiencing damage and degradation due to natural factors. Shortly after *Bermuda* wrecked, its masts, bowsprit, rigging, and deck machinery were removed, but much of the vessel remains intact and in good condition, and many sailing canaller features remain visible on the site.

The vessel measures 136.0 feet in length and 26.0 feet in breadth, matching the dimensions of the Welland Canal locks. Additionally, the hull is box shaped, with a plumb bow, flat transom with a very slight rake, straight sides, a flat bottom, and a sharp turn of the bilge. The vessel's centerboard can also still be seen standing upright along *Bermuda*'s centerline. The bowsprit has been removed, but the bowsprit bed remains in place between two knightheads, clearly indicating its position. This also allows for a detailed look at the rounded mortise cut into the forward face of the samson post. This would have corresponded to a rounded tenon on the end of the bowsprit, which would have allowed it to be raised into the rigging while in the Canal locks. Just forward of the samson post are additional timbers, which seem to be an addition to the original samson post face. It is not known why these were in place, but it is possibly a repair, or some other addition later in the vessel's career (Janzen 2011).

The bulwarks are missing from the bow, along with the bow railing, leaving only the bulwark stanchions in place. Because of this, it was not possible to determine the type of catheads *Bermuda* had on board or see the notch cut into the railing for the catheads to pass through. From the breadth of the vessel, however, it is possible to determine that *Bermuda* would have had to be equipped with folding catheads. With catheads reaching out an additional 1.5 to 2.0 feet past its 26.0 foot breadth, they would have needed to be able to fold inward to fit within the 26.6 foot wide canal locks. As with *LaSalle*, there is no evidence of a small forecastle deck at the vessel's bow. This would have left the bow open, allowing the bowsprit to be raised and lowered freely.

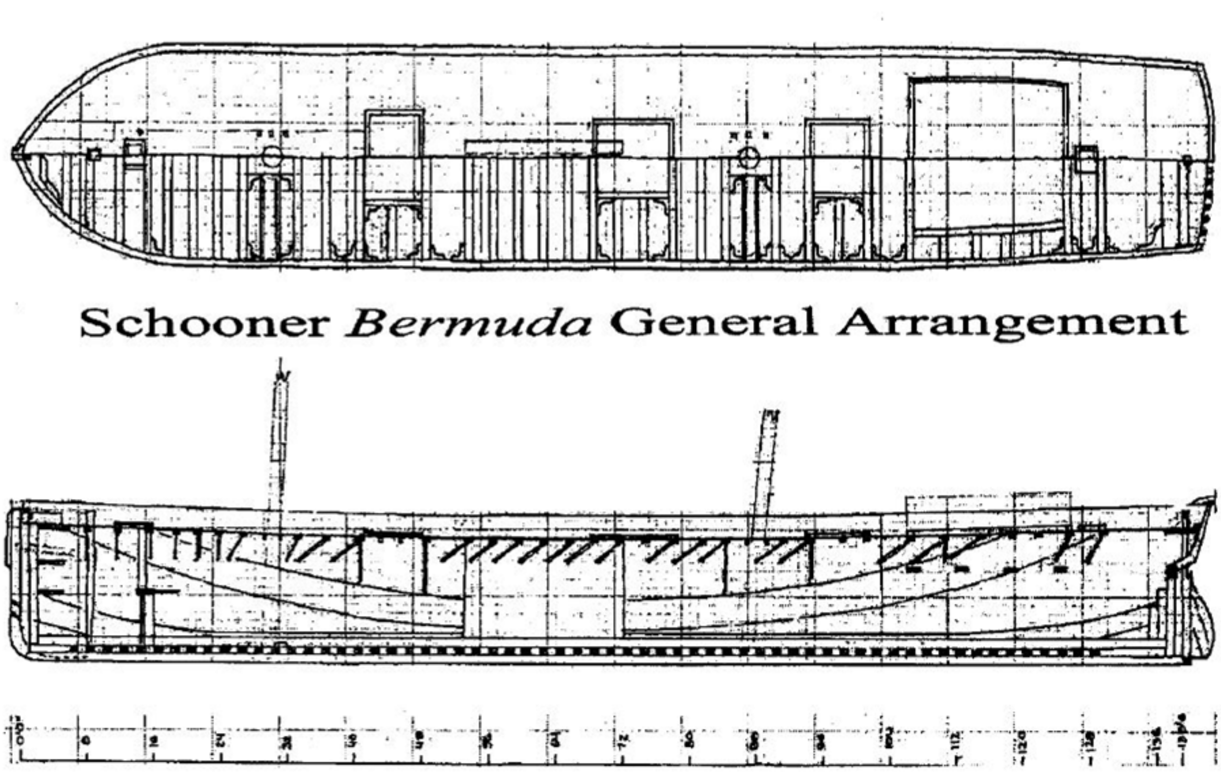

Figure 29. Hull lines of *Bermuda* (C. Patrick Labadie Collection).

Similarly, at the stern, most of the taffrail and some of the stern rail are now missing, making identification of the type of stern davits on *Bermuda* difficult. The davits themselves were not located during photograph and video analysis. The transom remains intact at the stern, and is raked at less than 30-degrees, adding to the boxy shape of the vessel. It is possible that the folding stern davits remain close by the main wreckage in the vessel's small debris field (Janzen 2011).

Cornelia B. Windiate

The wreck of the sailing canaller *Cornelia B. Windiate* lies just less than 10 miles off the coast of Presque Isle, Michigan in 180 feet of water in Lake Huron. The vessel remains completely intact, with its three masts still standing. With such extensive preservation, the sailing canaller characteristics of this vessel are easily identified. The vessel is 138.0 feet long and has a 26.0 foot beam, indicative of a second generation Welland Canal sailing vessel. Along with its size, the shape of the vessel's hull is very boxy, with flat sides, a plumb bow, sharp turn of the bilge and flat bottom. Likewise, the vessel is equipped with a centerboard which would have allowed the crew better control while sailing the flat bottomed vessel in rough weather (Labadie 2005).

The vessel's bowsprit remains intact, stepped into the samson post and extending through the bow railing. A small section of railing that is affixed directly atop the bowsprit could be raised along with the bowsprit when the vessel was locking through the Canal. Although the bowsprit remains stepped into the samson post, it is probable that the bowsprit has a rounded tenon on its end that fits within the corresponding mortise cut into the forward face of the samson post, however, this cannot be confirmed. This would allow the bowsprit, and a small section of bow railing, to pivot upward. On either side of the bowsprit, on the outside of the hull, are iron rods that extend through the rub rail and above the bow railing. These are similar to rods seen on other canallers that acted as pins to hold the bowsprit and railing in place. It is also possible, however, that these were used to secure the vessel's double forestay. Without closer investigation, it is not possible to tell (Thunder Bay NMS 2009).

Further aft are *Cornelia B. Windiate*'s catheads. Like many other sailing canallers, these are made up of two timbers fastened together by an iron hinge located just inboard of the main rail. The rail itself is notched to receive the cathead as opposed to being fastened to it directly. This allowed the end of the cathead to be hinged upward to lay inboard of the bulwarks, effectively lifting the anchor as well. This allowed the 26.0 foot wide vessel to fit within the confines of the 26.6 foot wide locks. The inboard section of the cathead extends from the bulwarks to the samson post at a 45-degree angle. The vessel also has an adapted forecastle deck that does not extend over the top of the bowsprit. It is supported by two deck beams and two deck stanchions, each on either side of the bowsprit. This allowed the bowsprit to be raised and lowered freely, without having to remove a section of the forecastle deck as well.

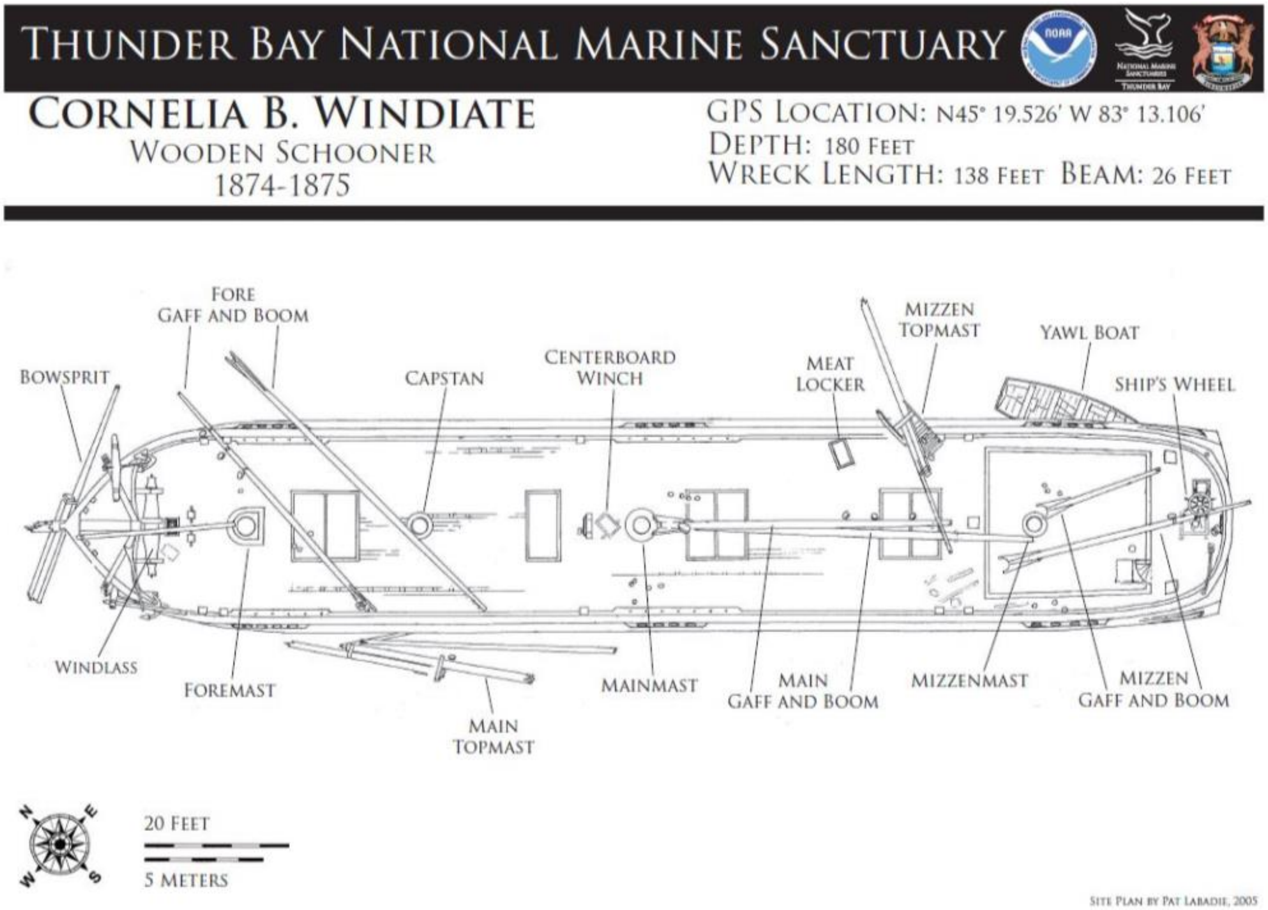

Figure 30. Site plan of *Cornelia B. Windiate* (C. Patrick Labadie and Thunder Bay NMS).

Booms and gaffs now lie littered across the deck of the vessel. Near the mizzenmast, atop the cabin roof, lies the mizzenmast gaff and boom. The boom is clearly much shorter than the main and foremast booms. For a sailing canaller to fit within the Welland Canal locks, it was necessary to shorten the mizzenmast boom so it did not hang outboard of the taffrail more than a few feet. As one of the few sailing canallers with intact standing masts, it is also possible to discern the rake of the masts. As with the *Walter B. Allen*, *Cornelia B. Windiate*'s masts have a very slight rake. This was a common feature found on sailing canallers, adding to their boxy appearance (Thunder Bay NMS 2009; Thomsen et al. 2010).

Unlike many other canallers, *Cornelia B. Windiate* has a slightly rounded taffrail, although the transom itself is flat and has a rake of less than 35-degrees. The vessel is also equipped with rotating iron davits similar to *Floretta*, as opposed to the flat, folding wooden davits found on many other sailing canallers. The port side davit remains in place with a block attached to its end, while the starboard side davit has detached from the taffrail and no longer remains in place. These davits could be rotated to bring the yawl boat on the stern deck while locking though the canal. With only two current examples of sailing canallers with iron rotating davits, it has yet to be determined if there is any correlation between this feature and the shipbuilders or the year of build (Labadie 2005).

E.B. Allen

The wreck of the *E.B Allen* lies 4.5 miles east of the north shore of Thunder Bay in Lake Huron in 100 feet of water. The hull of the vessel remains completely intact, save for a hole in its port side where it was rammed by the bark *Newsboy* in 1871 (Thunder Bay NMS 2017). The vessel's main deck, cabin, transom, and masts no longer remain on the site, but the vessel remains a great deal of integrity, and many of its sailing canaller features are still identifiable. With a length of 134.0 feet and 26.0 foot beam, the vessel was slightly smaller in length than others which traversed the Welland Canal locks, but it maintained many of the same features as larger vessels built to sail the canal: a plumb bow, folding catheads, straight sides, a sharp turn of the bilge, a flat bottom, and a bowsprit that could be lifted. As with many other canallers, *E.B. Allen* was equipped with a single centerboard along its centerline (Labadie 2009).

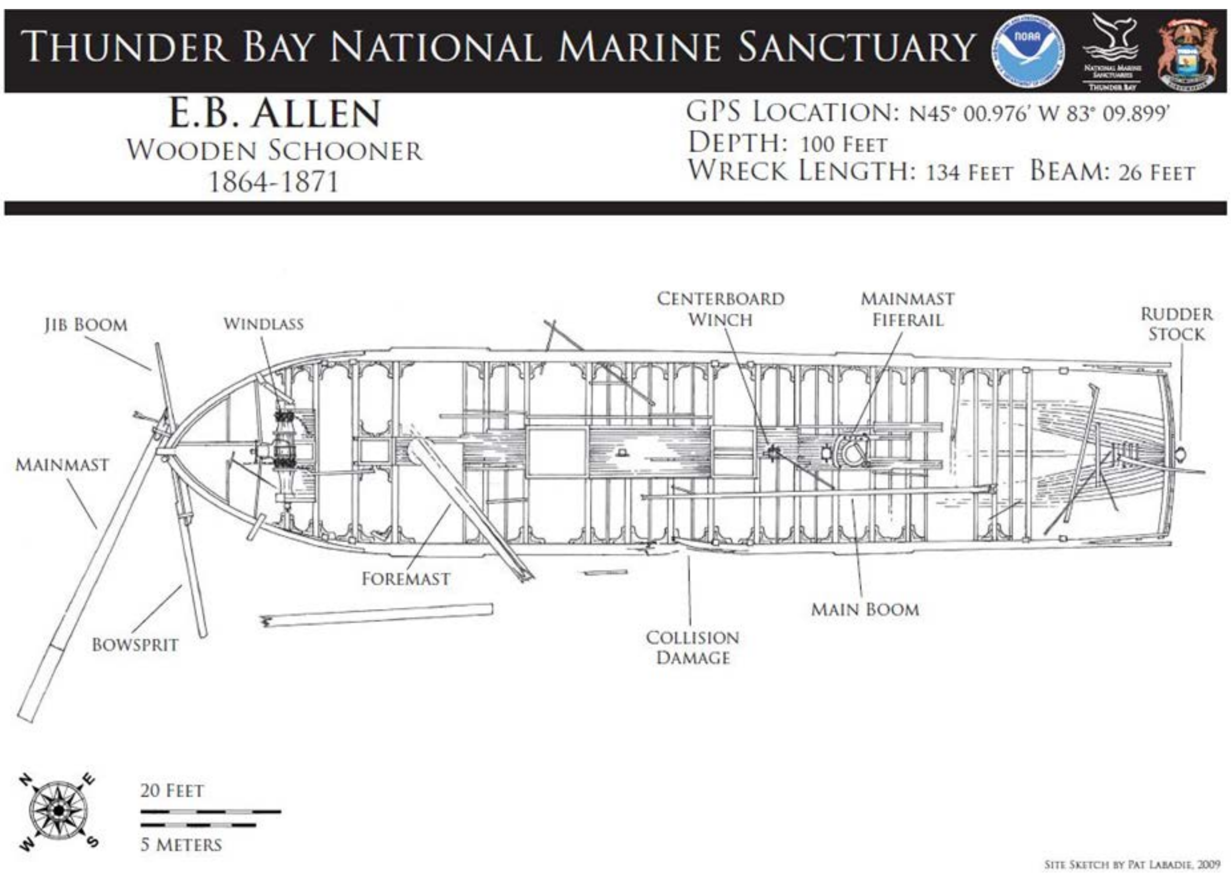

Figure 31. Site plan of *E.B. Allen* (C. Patrick Labadie and Thunder Bay NMS).

The bowsprit of the *E.B. Allen* has unstepped and now lies in the sand at the vessel's bow. A common occurrence during the sinking of sailing canallers, this allows the rounded tenon on the end of the bowsprit, as well as the rounded mortise cut into the vessel's samson post are clearly visable. This shape allowed the bowsprit to lift smoothly out of its bed when necessary to lock through the Welland Canal. Additionally, on either side of the bowsprit bed are two metal rods that were used to hold the bowsprit, and a section of bow railing, in place while under sail. With the bowsprit unstepped, these rods are no longer latched, but originally they were attached on the inboard side of the bulwarks by a metal clasp on a hinge, which could be latched together to secure the rods, or be unlatched to raise the bowsprit. This system is very similar to that seen on the *Walter B. Allen*. *E.B. Allen* (1864) and *Walter B. Allen* (1866) were both built by the same shipwright, H.C. Pierson, only two years apart. *E.B. Allen*, the earlier of the two vessels, is shorter, and much less boxy than *Walter B. Allen*. Like other builders of sailing canallers, in the intervening years between the two vessels' launches, H.C. Pierson's building techniques had evolved to design a vessel that was more efficient at carrying more cargo through the canal locks. *E.B. Allen* could be considered a prototype for the specialized canaller components needed to maximize the ship's carrying capacity, which H.C. Pierson later used in building the *Walter B. Allen* (Thomsen et al. 2010; UNC Coastal Studies Institute and Thunder Bay NMS 2011; Zant 2016).

Likewise, the unique design of *E.B. Allen*'s catheads matches the design of *Walter B. Allen*'s catheads. The catheads are unique in that they are attached to the inboard side of a bulwark stanchion, instead of the forecastle deck, giving them an "L" shape as opposed to traditional catheads with long, flat timbers. The catheads are made up of two timbers, attached by an iron hinge that measures 0.2 feet in diameter and rests on top of the cathead. The hinges are also attached to a thin iron band that runs along the top of the cathead as a possible extra support feature. Both catheads remain extant on the vessel's bow. The starboard cathead has broken at the hinge and now rests on the vessel's deck. The port cathead remains attached, but flipped inward and now resets on the portside carrick bit cheek supporting the windlass (Labadie 2009; Thomsen et al. 2010; UNC Coastal Studies Institute and Thunder Bay NMS 2011; WHS Field Notes 2016).

Although most of the vessel's main deck planking no longer remains, the vessel's structure and deck beams remain intact, including the forecastle deck beams and deck stanchions. As with many other canallers, *E.B. Allen*'s forecastle deck was split to allow the bowsprit freedom of movement. This division of the port and starboard forecastle decks made it possible for the bowsprit to be hoisted upwards while traversing the Welland Canal locks.

Unfortunately the stern of *E.B. Allen* suffered damage during the sinking. The aft cabin no longer remains on the site, along with the aft deck, taffrail, and transom. Without these features, identifying and folding davits at the stern or rake of the transom is not possible. Likewise, the vessel's masts no longer remain to determine their rake or the length of the mizzenmast boom. It can be assumed, however, that *E.B. Allen* featured many of the same components as *Walter B. Allen*, but this cannot be confirmed, and comparison of any design evolution of these features could not be conducted (Labadie 2009; UNC Coastal Studies Institute and Thunder Bay NMS 2011).

Kyle Spangler

The wreck of the sailing canaller *Kyle Spangler* is located 3.3 miles northeast of Presque Isle, in Lake Huron in 185 feet of water. The vessel measures 130.0 feet in length and 26.0 feet in beam, fitting within the dimensions of the second Welland Canal locks. The wreck remains intact on the lake bottom with its two masts still upright. Due to the remarkable integrity of the wreck site, many of the unique sailing canaller features remain in place on the vessel and allow great insight into how these features were implemented. The vessel's shape is the first indication it is a sailing canaller. *Kyle Spangler* has flat sides, a flat bottom, sharp turn of the bilge, a centerboard, slight rake to the transom, and a plumb bow, although it now is split open (Green 2016).

During the sinking, the vessel's bowsprit unstepped from the samson post and now lies in the sand near *Kyle Spangler*'s bow. The bowsprit has a rounded tenon on its end that fit into a corresponding rounded mortise cut into the samson post. This can still be seen on the wreck, despite the damage to the vessel's bow (Thunder Bay NMS et al. 2008; Janzen and Scoles 2009).

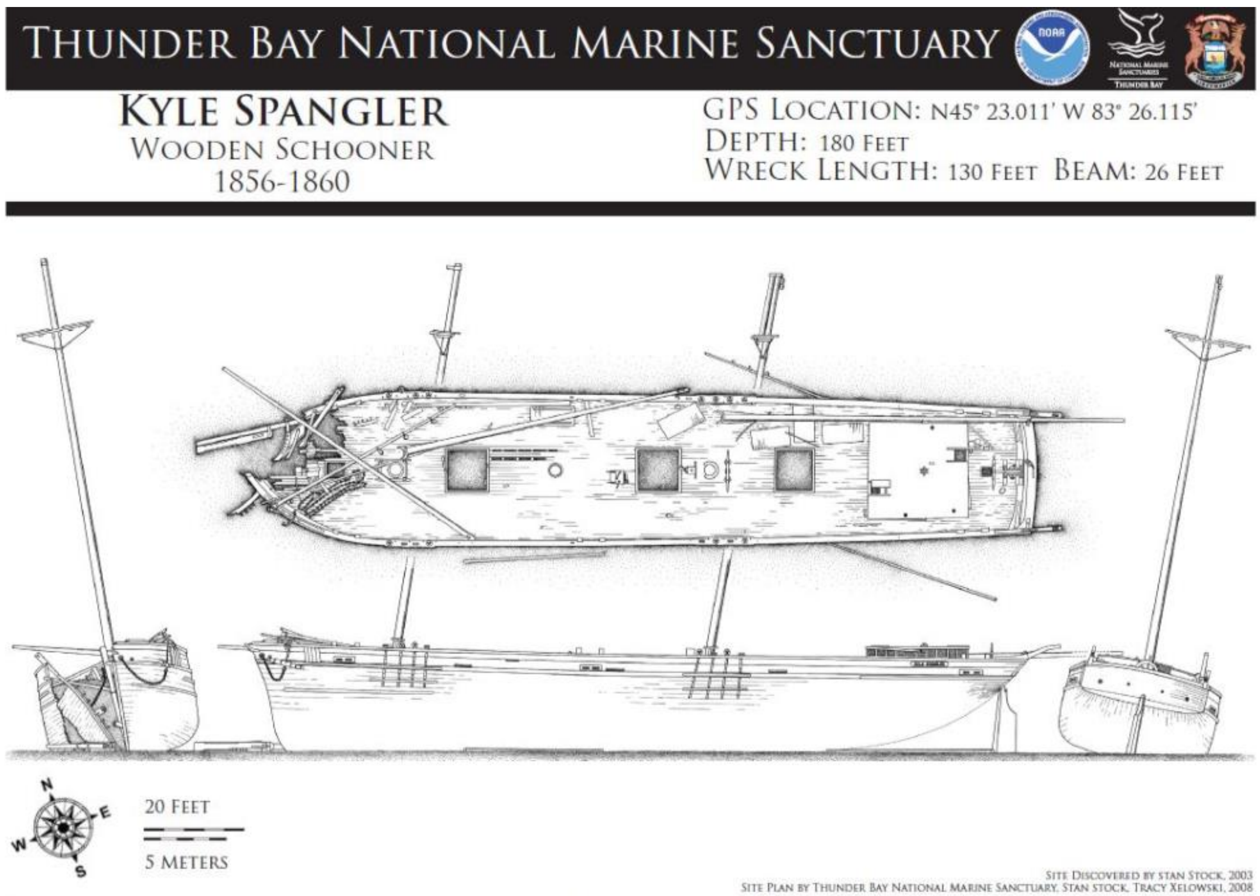

Figure 32. Site plan of *Kyle Spangler*'s (Thunder Bay NMS, Stan Stock, Tracy Xelowski).

The split in the vessel's bow section makes identifying other canaller features difficult, but there are two iron eyelets on either side of the stempost, which may indicate that *Kyle Spangler* made use of a U-shaped metal bar that extended across the very forward section of the bow railing, as found on *Grace A. Channon* and *Daniel Lyons*. This bar would have locked the removable piece of bow railing and the bowsprit into place when the vessel was underway. *Kyle Spangler* did not have an adapted forecastle deck like many other canallers, it had no forecastle deck at all, similar to *LaSalle* located in Lake Michigan. The vessel's catheads have been lost within the debris of the bow section, but it is possible to determine where they would have passed through the railing. The rail on both the starboard and port sides of the vessel is notched to allow the catheads to be folded inward when passing though the locks (Zant and Thomsen 2015; Green 2016; Zant and Thomsen 2016).

The vessel's folding stern davits are readily apparent along the aft railing. Both davits remain engaged, extending past the transom. These davits are of particular interest because it allows a look at the hinges from a downward view. Most sunken canallers have had their davits folded back from the lack of weight pulling them down and the force of water pushing them upwards during sinking. *Kyle Spangler*'s, however, have remained in place. The hinges are connected to an iron plate on each of the two timbers which would have allowed the davits more support, and strengthened the hinge itself, so it was less likely to break due to use (Janzen and Scoles 2009).

Another interesting component on *Kyle Spangler,* is the existence of an additional wooden support for the davits located on the taffrail. An additional small timber is affixed to the taffrail on both the port and starboard sides, just inboard of the davits. These appear to be a part of a locking mechanism to keep the davits in place and to help support them. Without further investigation, however, it is impossible to gain a complete understanding of this mechanism. The vessel's transom itself has a very slight rake, and does not extend past the aft extent of the rudder, allowing maximum clearance when in the canal locks. Likewise, the rake of the vessel's two masts is very small at only 10-degrees, another feature common to sailing canallers (Thunder Bay NMS et al. 2008; Janzen and Scoles 2009; Green 2016).

M.F. Merrick

The wreckage of *M.F. Merrick* lies in 310 feet of water off the coast of Presque Isle, in Lake Huron. At 137 feet in length and 26.0 feet in beam, *M.F. Merrick* was built to fit exactly within the confines of the Welland Canal locks. The wreck remains in remarkable condition, with only its masts fallen and a large hole in its port side where *R.P. Ranney* collided with the sailing canaller in a heavy fog. With this level of preservation, it is easy to identify sailing canaller features executed in the vessel's design. The hull is a boxy shape, with flat sides, a sharp turn of the bilge, flat bottom, an upright transom, and a plumb bow. A single centerboard was also located along the vessel's centerline (Thunder Bay NMS 2011; Janzen and Scoles 2011).

The bowsprit has unstepped from the samson post and now lies on the main deck with its forward end facing aft. This allows the heel tenon on the bowsprit to be identified easily in an analysis of photo and video imaging. The heel tenon is rounded and matches the shape and size of a corresponding mortise cut into the samson post. The rounded shape of this mortise and tenon allowed the bowsprit and jibboom raised with relative ease. A small section of the bow railing also remains attached atop the bowsprit as well as a large wooden cleat. Pins were not identified during photo and video analysis, so it was not possible to determine how the bowsprit and section of bow railing were secured in place while the vessel was underway (Janzen and Scoles 2011).

An additional interesting feature was identified on the bowsprit, slightly visible beneath the layer of quagga mussels now covering the wreck. A narrow band of white paint can be seen on all four sides of the bowsprit. This is the first time a paint band such as this has been located on a wreck site. While it is not known what this was for, it seems to be a marking to indicate where the bowsprit would pass through the bow railing, used as a marker for sailors to confirm that the bowsprit was secured correctly when it was lowered back into the bowsprit bed after traveling through the locks (Janzen and Scoles 2011). Due to quagga mussel infestations on many other sailing canaller wreck sites, and a lack of paint residue on these sites overall, it has not been possible to identify this feature on any other sailing canaller wreck site.

Figure 33. *M.F. Merrick*'s bowsprit with white paint still visible and section of bow railing attached (John Scoles).

M.F. Merrick was also equipped with folding catheads, which can still be seen on the site. The port side cathead is folded up, and now almost rests on the carrick bit cheek supporting the windlass. The starboard side cathead is broken at the hinge, and the outboard timber now lies on the deck, near the unstepped bowsprit. Additionally, the railing is notched on both sides of the vessel, indicating where the catheads would have originally passed through when engaged. Like *Walter B. Allen* and *E.B. Allen*, *M.F. Merrick*'s catheads are attached to the inboard side of a bulwark stanchion, instead of the forecastle deck, giving the catheads an "L" shape instead of long, flat timbers extending back to the samson post (Thomsen et al. 2010; UNC Coastal Studies Institute and Thunder Bay NMS 2011; Janzen and Scoles 2011). While similar in design, *M.F. Merrick* was not built or designed by the same shipbuilder as *Walter B. Allen* and *E.B. Allen*, but was built by John Oades in Clayton, New York.

Like many other sailing canallers, *M.F. Merrick* features an adapted forecastle deck, extending from the stempost to the samson post. The deck does not extend over the top of the bowsprit, but only extends to its sides instead. The forecastle deck planks are no longer extant, but the deck beams and stanchions remain on both sides of the bowsprit, which allowed space for the bowsprit to be hoisted upwards.

The transom of *M.F. Merrick* has a very small rake, which added to the vessel's boxy shape, but allowed the vessel to be built longer and still fit within the Canal locks. Additionally, the vessel's folding davits can still be seen, folded back along the stern rail. The starboard side davit remains in place along the rail, while the port side davit is hanging precariously off the side of the rail. The davits are equipped with hinges approximately 0.2 feet in diameter, allowing them to be folded back when traveling through the locks, and folded out to hold the yawl boat while sailing (Janzen and Scoles 2011).

While it is unclear how the davits were secured in place while locking through the Welland Canal, small wooden supports can be seen atop the taffrail, just inboard of the folding davits on both sides of the vessel, similar to those found on *Kyle Spangler*. Though it is not confirmed, these were likely used to secure the davits while they were engaged, and helped to keep them from shifting laterally in rough weather. As is evidenced by the current precarious position of the port side davit, the hinges were points of potential weakness, so having an additional support would have helped keep them from as much stress and wear (Janzen and Scoles 2009; Thunder Bay NMS 2011; Janzen and Scoles 2011; Green 2016).

Sligo

The wreck of *Sligo* rests 1.2 miles southwest of Toronto, Ontario, in Humber Bay, in 65 feet of water. All components of the vessel remain on site, though the hull is broken in multiple locations. This is the result of the rapid shifting of its limestone cargo during the sinking, and the fact that the site sits within the anchor field for large modern bulk carriers waiting to enter Toronto Harbor. Although broken with a large debris field, multiple sailing canaller features can still be identified on the site. Measuring 135.0 feet in length and 26.0 feet in beam, *Sligo* fits within the Welland Canal lock specifications (Monk 2003; Lo 2005).

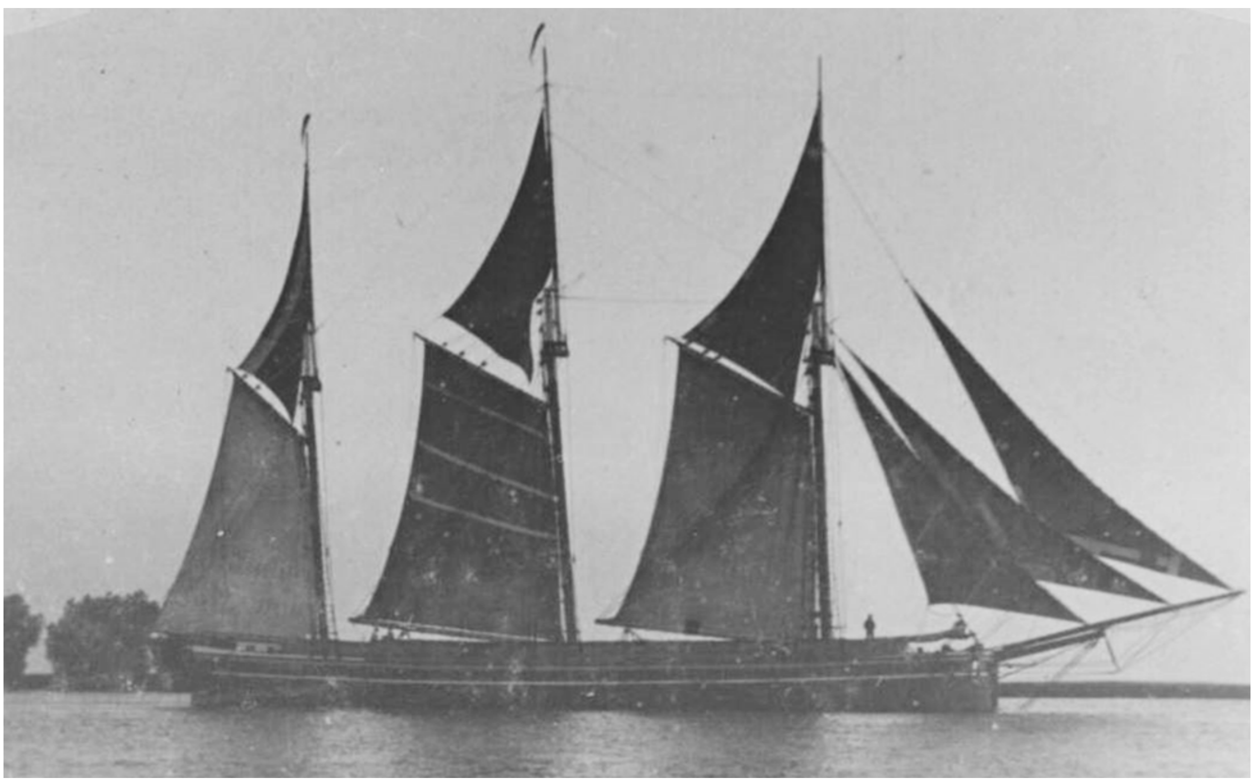

Figure 34. Historic image of *Sligo* (C. Patrick Labadie Collection).

The lower hull of *Sligo* remains nearly intact, and it maintains its boxy shape, with flat sides, upright stern, a centerboard, a flat bottom, and sharp turn of the bilge. The vessel's plumb bow is still upright, broken off about 12 feet above the sand. The vessel's main deck has collapsed, so the samson post sits at an angle, making identification of the rounded mortise cut into its forward facing side impossible. The bowsprit has, however, unstepped, and no longer remains near its original location. The bulwarks around much of the vessel have fallen outward and now lie disarticulated in the sand, making identification of the notches in the railing for the catheads impossible. One timber from the port side folding cathead remains near *Sligo*'s windlass. It no longer is attached to the main deck, but is propped on the port side carrick bit which supported the windlass. The quagga muscle encrusted iron hinge measures approximately 0.2 feet in diameter (Monk 2003; Lo 2005).

Much of the vessel's main deck remains on site, but it has collapsed within the sides of the hull, and now lies on top of the remaining cargo of limestone. The stern of the vessel remains broken and scattered. It is speculated that *Sligo* sank stern first, causing that section of the ship to sustain the greatest amount of damage upon impact with the lake floor. The transom no longer remains intact, and lies somewhere within the large debris field, as do the stern railings and taffrail. Without being able to locate these specific components, identifying the type of stern davits *Sligo* was equipped with is not possible. Historical images, however, seem to indicate that *Sligo* was outfit with wooden folding davits, like many of its contemporary sailing canallers built in Canada (Monk 2003; Lo 2005).

SECTION FIVE
Discussion

The unique geographic characteristics of the Great Lakes, paired with growing demands for grain, corn, lumber, and iron ore shipped from the Midwest created a demand for highly specialized vessels and technologies not found anywhere else in the world. This is reflected in the unique design of sailing canallers. The distinct shape of these vessels allowed them to fit tightly through the Welland Canal locks, and separates them from other sailing vessels of the same era. While most sailing canallers contained the same basic characteristics, each had its own unique adaptations based on its construction date, shipbuilder, and use. Analyzing each known wreck site individually allows the small nuances and idiosyncrasies of each shipbuilder to be identified and studied, formulating an in depth typology of sailing canaller design. It is the broader exploration of the coal, wheat, and iron ore industries, however, which offers an understanding of the larger economic trends and evolving maritime industrial growth in the Great Lakes region. By examining the role sailing canallers played in the development and evolution of maritime industrial commerce on a regional level, a broader understanding of maritime innovation can be achieved (Raistrick 1972; Palmer and Neaverson 1998; Palmer et al. 2012).

Analyzing maritime technological innovations, such as the development of specialized sailing canallers on a regional scale in relation to the fluctuation of economic trends, reveals a systematic cycle of development. This cycle reflects patters of economic growth and development from the eastern seaboard to the western reaches of Lake Superior and Lake Michigan, the origins of the second Welland Canal sailing canaller construction techniques, and helps determine how they differed from first generation canallers. This approach can also offer economic explanations for the eventual demise of this class of sailing ships by the early 1880's and the building of the third Welland Canal, and adds insight into the economic development of the Great Lakes region at the end of the 19th century.

The development and design of modified sailing vessels to fit within the exact confines of the Welland Canal locks highlights adaptations in maritime commerce as the commercial demands for bulk materials changed. Prior to the opening of the Welland Canal, transportation of grain and ore to the industrial centers of the East was a difficult task. Likewise, transporting coal from eastern mines to fuel industrialization in the Midwest was equally challenging. While rail networks thrived throughout the eastern section of the country, many areas of the Midwest were primarily accessible only by water. Due to public opinion and multiple economic depressions, railroads did not become commonplace in many parts of the Midwest until the mid-1840's (Young 2005). Even after railroads began to dominate the Midwestern landscape, and stretch ever further westward, the fastest and most inexpensive mode of transportation for bulk cargo remained waterborne.

The distinctive geography of the Great Lakes, and the barrier they posed to railroads, triggered ambitious plans to connect rail lines on opposite shores of the lake. By the late 1840's, railroads allowed farmers to get their goods from the vast agricultural regions of the Midwest to cities such as Chicago and Milwaukee much faster, but transporting goods quickly eastward remained an obstacle. Located at the southern extent of the Great Lakes system, Chicago was naturally situated to become the terminus for all railroads crossing the country, but overland transportation of bulk cargo over long distances remained expensive and slow. Likewise, despite its sprawling railroad yards, the sheer volume of traffic into and out of Chicago caused long delays in shipping times. In the era of accelerating technological advancement and rapid expansion of industry and commerce, the goal was to create a shorter, faster connection between the growing, resource-rich settlements of the "new" Northwest Territories (Minnesota, the Dakotas, Montana, and Idaho) and the commercial and industrial centers of the Atlantic Seaboard (Zant et al. 2014).

This increase in demand for faster transportation of goods between the East and West came in tandem with the beginning of the Great Lakes grain trade in the mid 1840's. While not a perfect correlation, the development of rail lines between Midwestern farmland and cities, and the influx of bulk grain cargos moving eastward, necessitated large-scale technological advancements in maritime industrial power. With its opening in 1829, the first Welland Canal was an early attempt at alleviating slow overland transportation by increasing transportation times. By the time the Great Lakes grain trade was in full operation (mid-1840's), and the corn trade began in earnest (1848), it was apparent that the original canal locks were too small to handle the large enough amounts of cargo passing through in a reasonable period of time. This combination of factors led to the enlargement the Welland Canal locks.

The expansion of the Welland Canal locks did not immediately lead to faster rates of cargo passing between lakes Erie and Ontario. Although the second Welland Canal significantly reduced the number of locks through which vessels had to traverse (from forty to twenty-seven), this did not significantly decrease the time it took to pass through the canal. Typically a vessel took up to 48-hours to transition through the Canal at a cost of \$12 to \$30, plus freight rates. To earn decent profits, canallers averaged five to eight round trips (grain or corn to eastern ports, and coal back to the Midwestern ports) per season (Monk 2003).

It was not until vessel size began to increase that significant changes in the amount of cargo tonnage moving through the canal began to occur. With the increase in lock dimensions, larger vessels carrying more cargo could fit through the locks, therefore increasing the amount of cargo that could be transported through the canal. In the first few years of operation, vessels that traversed the second Welland Canal remained relatively small. It was not until 1845 that building specialized sailing canallers began in earnest. That year, a significant increase in tonnage passing though the canal was evident. Shipbuilders and ship owners knew that they must construct and maintain vessels that could navigate the canal locks while transporting as much cargo as possible with each trip (Mansfield 1899; Monk 2003).

Over time, as industrial markets continue to grow, adaptations to transportation systems are required to meet a growing demand for products and raw materials; the ability to handle higher volumes of cargo at a cheaper rate becomes the highest priority (Palmer et al. 2012). As industry changes, technological innovations also change to reflect these improvements. It is these patterns of development that reflect larger patterns of economic growth and development in a region, which in turn, spur new industrial changes. By analyzing sailing canallers as specialized industrial tools, crafted specifically as a mechanism of economic development, it is possible to understand the evolving nature of Great Lakes regional trade and industrial expansion at the end of the 19th century. Thus, allowing the design and construction of sailing canallers to be placed within a larger regional context. Vessel size, shape, design, and construction, were all influenced by the necessity to transport more cargo at a faster rate to increase profit.

The bluff plumb bows and upright transoms of sailing canallers developed out of a need to fit more cargo into a restricted amount of space. Likewise, the flat bottom, sharp turn of the bilge and shallow draft of sailing canallers were intended to allow vessels to carry more tons of bulk goods and still fit into the canal locks shallow 9.0 foot depth. Many early vessels that traversed the Welland Canal could carry a larger capacity of goods, but the weight of the cargo would set the vessel too low in the water, leading to potential grounding in the locks. Thus, vessels were only partially loaded. With the adaptation of flatter hull bottoms, the overall displacement of the vessel allowed it to sit higher in the water when filled with more cargo, maintaining a shallower draft. The use of centerboards in sailing canaller construction developed out of this boxy hull design. As hulls became even more boxy and shallower in draft, they became less easy to maneuver in open water. The addition of the centerboard insured sailing canallers had more control, even with a cross wind, and allowed them to maintain course.

Similarly, the adjustable components featured on sailing canallers allowed for hulls to be built longer and wider, increasing a vessel's carrying capacity. Folding davits, catheads, and lifting bowsprit/jibboom outfits allowed most of the overhanging equipment, which commonly would hang outboard of the main rail, to be brought aboard, saving precious space in the Canal locks. The yawl boat, anchors, and bowsprit and martingale were all essential for the operation of the vessel once it passed through the canal and into open water, so adaptations had to be made to accommodate them while designing the vessels to be more economically viable as a method of transport. These adaptations in sailing canaller shipbuilding met the growing need for increased bulk cargo transportation between the Eastern and Western reaches of the Great Lakes. In turn, the coal, iron, lumber, corn, and grain industries across the Great Lakes region became more profitable for a time due to the increase in tonnage passing between ports. With an increase in profitability, and the ability to transport more goods, consumers could purchase higher tonnages of cargo at a lower cost, which further increased demand. This cycle helps shed light on the growing industrialization of the Midwest and the growth of cities such as Chicago and Milwaukee, and demonstrates how technological innovation fluctuates with economic demands.

The very patterns of economic development reflected in the evolution of the Welland Canal, from its first iteration to its second, and the development of the specialized sailing canaller ship design, spurred new industrial changes in demand. Eventually demand outgrows the tools developed to meet that demand, necessitating change. Once the effectiveness of technology is felt, not only is the demand for transportation of materials met, but demand for more materials grows. Over time the effectiveness of early technology begins to dwindle because profitability and performance needs to be increased, thus leading to the development of new, more cost effective technology (Palmer and Neaverson 1998; Palmer et al. 2012). Almost as soon as the second Welland Canal began operation, the growth rate of the grain, corn, iron ore, and coal industries necessitated the development of new tools and technologies to cope with the increase in transportation demands (Monk 2003).

By the mid-1850's it was apparent the second Welland Canal locks were not large enough to meet the needs of Great Lakes shipping. Between the costs of towing through the canal and freight rates being charged for passage, the profitability of transporting cargo via second generation sailing canallers was low. Coupled with the ever growing demand to move more tonnage through the canal faster, shipping companies were strained to make ends meet. Ship and company owners began calling for enlargements in the canal by the mid to late 1850's, and in the mid 1870's, construction of the third Welland Canal began in earnest (Monk 2003). This new canal, which opened in 1882, decreased the number of locks from 27 to 26, and increased the lock size to 270 feet in length and 45 feet in width, with a depth of 12 feet and later 14 feet. With this increase in lock size, the necessity of specially built "sailing canallers" diminished. Though some shipbuilders continued to build vessels to fit within the specifications of the new Welland Canal locks, most did not, and the ingenuity and the usefulness of second generation sailing canallers as the only economically viable method of moving cargo around the Niagara Escarpment decreased (Monk 2003).

Though no longer necessary to traverse the Canal system, second generation sailing canal schooners did not completely disappear with the opening of the third Welland Canal. These vessels continued to make the trip from Lake Ontario to lakes Michigan and Huron well into the 1880's and early 1890's. With the increase in lock size, tugs and tow steamers could now fit into locks with the sailing vessels, eliminating costs of towing operations on the shore. Likewise, with the increase in the depth of the canal locks, canallers could now be filled to capacity to further increase profits.

A combination of economic downturns in the 1870's ushered in an era of economic uncertainty in the Great Lakes, and throughout the United States, which led to an unusually light demand for the movement of bulk materials. In addition to the gradual decline of sailing canaller profitability in the 1870's, the Panic of 1873 thwarted certain maritime industries, and left many sailing canallers idle. This forced many ship owners to attempt to conscript their vessels for ocean service and direct trade with European ports to keep their vessels profitable. While not uncommon for Great Lakes vessels to work in ocean service during slow shipping seasons, the second Welland Canal helped facilitate this European trade, helping it to expand further westward to ports such as Milwaukee, Detroit, and Chicago (Monk 2003). Designed to fit easily through the canal locks and sail on inland waterways, sailing canallers had to be overhauled for ocean travel. Spars were shortened, bulwarks raised, the hulls strengthened, and the rigs changed to barkentine, which was better suited to open ocean travel (Thomsen and Gulseth 2013).

While many sailing canallers did eventually make the shift into ocean service, many of the vessels which primarily sailed on the western Great Lakes were never conscripted, and were able to remain in service on the Lakes after only short periods of inactivity. Much is still unknown about the use of sailing canallers in ocean service, and why so many vessels were slated to travel abroad, but never made any voyages. An in depth analysis of direct European trade and Great Lakes vessels goes beyond the scope of this study, but understanding the fluctuations in demand for bulk cargo transport on the Great Lakes allow light to be shed on this trend and the broader international context into which sailing canallers fit.

Second generation sailing canallers continued to impact Great Lakes maritime industries in many ways, long after they had outlived their usefulness in their original forms. By the late 1890's and early 1900's, sailing canallers transitioned from their original function of transporting cargo through the Welland Canal, to operating in intra-lake trade in low-value bulk cargo industries on the western Great Lakes. To increase their profitability, most sailing canallers were cut down to barges and towed in consort with other similar vessels (Monk 2003). In addition to requiring fewer crewmembers to operate, allowing these aging vessels to operate in the consort system prolonged their usefulness, and increased overall cargo carrying capacities for ship owners.

The expansion of railroads in the 1870's and 1880's also had a major impact on the profitability and use of sailing canallers in the later decades of the 19th century. The heyday of sailing canallers filled a transportation gap that was created between two phases of the railroad boom in the United States. An increase in cargo transportation needs developed in the 1840's and 1850's due to the ease with which the early railroads allowed Midwestern farmers to get their product to the markets and docks of Chicago and Milwaukee. In order to handle increased output, shipping companies had to devise a way to quickly and cost-effectively transport bulk goods from the Midwest to eastern markets; thus, second generation sailing canallers were developed. Although beneficial to local farmers, cross country rail lines remained slow, unreliable, and expensive in comparison to waterborne trade. By the end of the 1870's, however, transportation of bulk cargo via railroads was becoming much more reliable, faster, and affordable. Though many smaller markets and hinterland communities still relied on waterborne transportation well into the 20th century, large industrial markets in the Midwest and on the eastern seaboard were connected by a wide reaching web of rail lines, and the effectiveness of specialized sailing canallers, and the ingenuity of their shipbuilders, no longer remained relevant. By the 1880's, the era of sailing canallers was effectively over (Mansfield 1899; Young 2005).

Although the usefulness and profitability of sailing canallers had dwindled by the end of the 19th century, their influence in design and construction can be found throughout the Great Lakes region. The basic, boxy hull shape was innovative and transformative for Great Lakes bulk cargo transportation well into the modern era. Builders of schooner-barges took many design techniques from sailing canallers, such as flat, upright sides, flat bottoms, a sharp turn of bilge, and a plumb bow because it was an effective way to carry large amounts of cargo in a wooden vessel. Schooner-barges, however, were not bound in size by the dimensions of a canal lock, and could therefore be much larger and more efficient. James Davidson, a prominent builder of schooner-barges and large wooden steamers, built sailing canallers in the 1870's for Bidwell and Banta in Buffalo, and the Bailey Brothers in Ohio, before moving on to Bay City, Michigan where he established his own shipyard, building large wooden vessels long after his contemporaries had switched to iron and steel (Jensen 1994). Although it is not known how much influence Davidson's time building canallers in Ohio had on his later hull designs, his influential wooden vessels bear remarkably similar hull lines to sailing canallers.

Sailing canallers only plied the Welland Canal and waters of the Great Lakes for a short period of the late 19th century, but their effects and influence on trade and waterborne transportation throughout the Great Lakes region were widespread. Second generation sailing canallers developed and adapted out of an economic necessity for speed and high capacity while fitting within the confines of the second Welland Canal locks. Filling a transportation gap between increasing trade demands for grain, corn, iron ore, and coal and the development of reliable methods of bulk cargo transportation via rail, sailing canallers effectively helped usher the Great Lakes region into a modern era of transportation. The technological mechanisms developed on canallers to maximize their carrying capacity and profitability were created to meet demands of a growing maritime industrial economy that tied the prosperous cities of the eastern seaboard to the Midwest, and helped facilitate continued westward expansion into the country's interior.

As alternative transportation methods for bulk cargoes developed, the effectiveness of specialized sailing canallers began to wane. The same demand for cargo transportation that led to the rise of the sailing canaller effectively led to its downfall as well. As the transportation needs for the grain, corn, iron ore, and coal industries were met, they began to become more profitable. Once these industries became more profitable and cost efficient, and Midwestern cities began to grow and develop, demand increased for even more for goods being shipped across the Lakes, which created a necessity for faster, more economical shipping technology. This in turn led to the building of the third Welland Canal, and marking the end of the specialized sailing canaller in lieu of larger, more economical vessels which could now traverse the canal locks. Paired with the expansion of the railroad network in the 1870's and 1880's, second generation sailing canallers began to be used in other capacities, allowing for modern maritime technological advancements to develop. This advancement demonstrates a cycle of innovation, which paved the way for the evolution of the Great Lakes maritime industrial commerce and the region's entry into the modern era.

SECTION SIX
Conclusions and Recommendations

Sailing canallers were a unique vessel type that operated during a crucial period in Great Lakes shipping and the expansion of the United States. For a short number of years following the opening of the first Welland Canal, growth of the Midwest, spurred by early success in the corn, grain, and iron ore trades, outpaced contemporary methods of transportation throughout the Great Lakes region. Railroads were only beginning to reach the Midwest, and remained an expensive and slow method of transportation for large amounts of bulk cargo. The opening of the first Welland Canal eased transportation between Midwestern farms and eastern markets, but as the economic and industrial landscape of the Great Lakes region rapidly evolved modifications were needed. The second Welland Canal, and the specialized vessels built to fit within the exact confines of the canal locks, connected the Midwest to the cities of the eastern seaboard, and through them, the world. It was a transitionary period of maritime innovation which facilitated the growing needs of the burgeoning interior of the United States and helped fuel expansion westward. In addition to the cargo these vessels carried, the second Welland Canal allowed an unprecedented number of immigrants to reach the country's interior, and helped usher the Great Lakes region into the modern era.

The mid to late nineteenth century emergence of purpose-built sailing vessels to ply the Welland Canal was a relatively simple solution to meet the diverse demands of bulk cargo transportation in the Great Lakes. As such, sailing canallers were a critical economic connection between the eastern and western United States, linking the economic and industrial landscapes of the Midwest with eastern markets, and fueling the expansion of major Great Lakes industrial centers. By analyzing the construction of sailing canallers, their use in Great Lakes trade, and the unique mechanisms employed to create the greatest economic benefit in transporting bulk cargos, this analysis allows for an understanding of sailing canallers and their place within the larger historic context of the Great Lakes region and the evolution of maritime industrial commerce.

Sailing canallers were designed to transit the canal locks while carrying the largest possible amount of cargo. These box-shaped vessels, with their bluff bows, flat bottoms and sterns, short bowsprits, and highly-canted jibbooms, were vital to the economy of the Midwest, and transportation infrastructure prior to the development of road and rail networks. Through expert craftsmanship of Great Lakes shipbuilders, sailing canallers offered an important link in the development of the Midwest, connecting the region's economy and industrial advancement with eastern markets, fueling the expansion of major Great Lakes industrial centers. With little to no drawn plans, and no contemporary examples of sailing canallers available, information gathered through historical and archaeological investigations of known canallers located on the bottom of the Great Lakes provides the only remaining opportunity to study the construction techniques of these unique vessels, their adaptations, and the role they played in the development of the region's unique maritime industrial context.

While an in depth regional analysis of sailing canallers has allowed for a greater understanding of the vessel type as a whole, and an understanding of the economic and industrial contexts into which sailing canallers fit, there is still much more to be learned from these wreck sites and their histories. This study has relied heavily upon documents, data, and research from wrecks in the Wisconsin waters of Lake Michigan and the Michigan waters of Lake Huron. While additional video and photographic data has been used to expand the analysis, further research into other known sailing canallers lost in the Great Lakes can significantly add to the breadth of this study. Although sailing canallers had generalized characteristics and modifications that aided in allowing the vessel to reduce its overall footprint, the features on no two sailing canallers were the same. Adaptations to sailing canaller modifications demonstrate that the evolution of these shipboard mechanisms was not a blanket development. The design and mechanics of sailing canaller components remained similar, but could be adapted for different industries in different areas and environments. When possible, sailing canallers were modified to carry even more cargo, maintaining a delicate balance between seaworthiness and maximizing cargo space.

Broad economic trends in the United States have had an effect on the development of maritime technology over time, and this study has touched on many of these factors, which pertain to the Great Lakes region. Additional research into the specific trends of economic booms and declines in the late 19th century and Welland Canal tonnage amounts and rates per year would add significantly to the understanding of the catalysts for maritime industrial development. This would open an additional discussion on the symbiosis of developing terrestrial and water based transportation throughout the Great Lakes region in the late 19th and into the 20th century.

Although only a contributing factor to the larger trends of industrial and economic development in the Great Lakes, the importance of second generation sailing canallers and the architectural modifications developed onboard cannot be overlooked. The designs and implementation of this hull type paved the way for the effective trade between the eastern seaboard and the Midwest, and served as a prototype for the construction of later schooner-barge and bulk carrier hull designs. By formulating an understanding of the catalysts of maritime innovation and design, a more comprehensive understanding of the nuances of maritime industrial heritage and culture in the late 19th century can begin to develop, revealing the broader regional context of sailing canallers.

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